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مركز المنظومات الإلكترونية والبرمجيات
ELECTRONIC Systems AND programming center

Journal of Electronic Systems and Programming

Issue N0:6 December 2022

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Electronic Systems and Programming Center

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Issue No: 6 - 2022

Editorial:
6th Issue – Journal of Electronic Systems and Programming

We are delighted to announce the publication of the 6th issue of the Journal of Electronic Systems and Programming (JESP).

The contributions in this issue come from deferent areas of study. It is extremely important to publish scientific research carried out in the most diverse research environments, in order to collaborate with the advances of science and the society.

Numerous number of original submissions has received, all of which have gone through a rigorous review process. The accepted articles have been published in 6th issue.

Finally, we thank our reviewers and authors for their fundamental contribution to the 6th release of the Journal. We still hope authors could consider JESP to be a place where to publish their work.

Editorial Board

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Educational Data Mining During the COVID-19 Pandemic

Educational Data Mining During the COVID-19 Pandemic

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Abstract

Educational data mining studies have employed various techniques and tools in supporting decision-making based on students' online presence, academic performances, and personal profiling. However, the unexpected advent of COVID-19 and imposed containment measures around the world necessitate academic institutions to haphazardly transfer academic activities to the eLearning environments. This rapid transfer might have posed peculiar challenges to the usual decision-making approaches. Fortunately, data mining techniques have proven their merit in supporting quick and complex decision-making. Accordingly, in the present study we assessed eLearning studies that employed data mining techniques in making educational decisions in the period of COVID-19 pandemic. Based on the common research approaches, data mining solutions employed in addressing the peculiar educational challenges were explored and analyzed to inform future decisions. The study findings revealed that several studies have utilized data mining in ascertaining

the effectiveness of various eLearning modalities including social media in teaching and learning during the pandemic. Moreover, studies have utilized both machine learning and statistical data mining approaches in supporting educational decisions during the pandemic. However, none of the current studies reported the application of the popular educational data mining platforms during the pandemic. Thus, future studies require to employ the expertise in educational data mining techniques toward demonstrating the efficacy of the common educational data mining platforms in supporting various academic activities and academic decision-making processes. However, this current study's purpose is to analyze eLearning studies that utilized data mining approaches in endowing educational activities or in making educational decisions during the period of COVID-19 pandemic.

Keywords: *Educational Data Mining, COVID-19, Data Mining, Education, eLearning*

1. Introduction

The advent of COVID-19 and linked containment measures adopted by governments over the world has consequently influenced the education sector in its variety. Thus, students, parents, educators and other stakeholders at primary, secondary and higher education levels of the education sector have been influenced contrastively by COVID-19 [1][2][3][4][5][6][7][8]. In an endeavor to curtail and reduced the spread of the novel corona virus, governments imposed a total lockdown policy, thereby making the stay at home necessary. The lockdown implies the closure of markets, bakeries, coffee shops, and any other gathering places like schools, which makes the conventional educational approach at all levels to stop completely. However, there is urgent need for statistics on the possible effect of the rapid transfer to eLearning platforms on learning activities and student's performance during the pandemic [9][10][11][12]. Furthermore,

eLearning platforms and tools (like zoom) as a proposed solution to the aforementioned problem might prove to be abortive. Because, with all the capabilities of eLearning tools and platforms, there is urgent need for taking informed decisions based on teacher's/students' technology readiness as well as continues data monitoring among others.

Educational data-mining measures seek to develop, explore and execute basic induction approaches that encourage the extraction of meaningful data and knowledge from unstructured educational data. Educational data mining extracts patterns, changes, relationships, and anomalies from large academic datasets. Some of the exemplary use cases include analysis and visualization of educational data, predicting students' profiling and performance [13][14][15], managing students' enrolment and grouping [16][17][18], organizing syllabus and learning contents, academic planning and scheduling [19], [20], and monitoring online examination [21][22][23].

However, this present study aim is to explore eLearning studies that employed data mining techniques in supporting educational activities or in making educational decisions during the period of COVID-19 pandemic. Based on the common research approaches, data mining solutions employed in addressing the peculiar educational challenges were analyzed for the benefit of educationists and researchers to inform decisions in the future instances and related crises.

2. Methodology

To address the key research question "how educational data mining techniques helped in the fight against the negative effect of COVID-19 on educational activities?" a systematic literature review process was utilized based on the PRISMA framework (Moher, Liberati, Tetzlaff, Altman, & Group, 2009). The methodology followed in accessing the most relevant articles for the present study involved internet searches from three popular scientific databases, namely:

Scopus and Science Direct. I utilized the following keywords in making the searches; “Educational data mining”, COVID-19, “data mining”, and education as operands in the search boxes and the two logical operators AND with OR were appropriately used in synthesizing the volume of the records accessed. Furthermore, no limit was imposed on the year of publication for the records to be included. As such, the search spanned over the period from the inception of the databases to 2021. Consequently, hundreds of records were gathered at the initial search stage. However, the articles included in the present study are those that are full-text, downloadable and published in English language. The inclusion and inclusion criteria was summarized with the help of Table 1.

As shown in Figure 1, the systematic literature review procedure was explained with the assistant of the PRISMA follow diagram of the study. Specifically, two hundred and thirty-one records were carefully screened for inclusion/exclusion in the study. At the first stage of screening, eighty-seven duplicated records were eliminated. The remaining one hundred and forty-four records were assessed for eligibility. Ninety-four studies out of the 144 records were rejected, due to the following causes: articles not written in English language (n=3), editorial and related non-research materials (n=11), and conference papers (n=80). The remaining fifty studies were further assessed; twenty-three records were eliminated because they are not relevant to the research aim (n=10) and included a vague research aim (n=13). Consequently, twenty-seven full-text articles were recovered, read, and qualitatively estimated. Nonetheless, additional reports were eliminated because the studies were on educational data mining but not during COVID-19 pandemic (n=23). Finally, four studies satisfied the implication criteria. As stated earlier, the PRISMA flow diagram (Figure 1) summarized the abovementioned systematic literature review procedure.

Table 1: Inclusion and Exclusion Table

Inclusion criteria
Any study that has the key terms “Educational data mining”, COVID-19, “data mining”, and education in either its title, keywords or abstract.
No limit on the publication year.
Articles full-text.
Articles that are publicly downloadable.
Exclusion criteria
Documents that are not available on the internet
Articles whose full-texts are not available.
Articles that are not accessibly downloadable.
Articles published in other non-English languages.

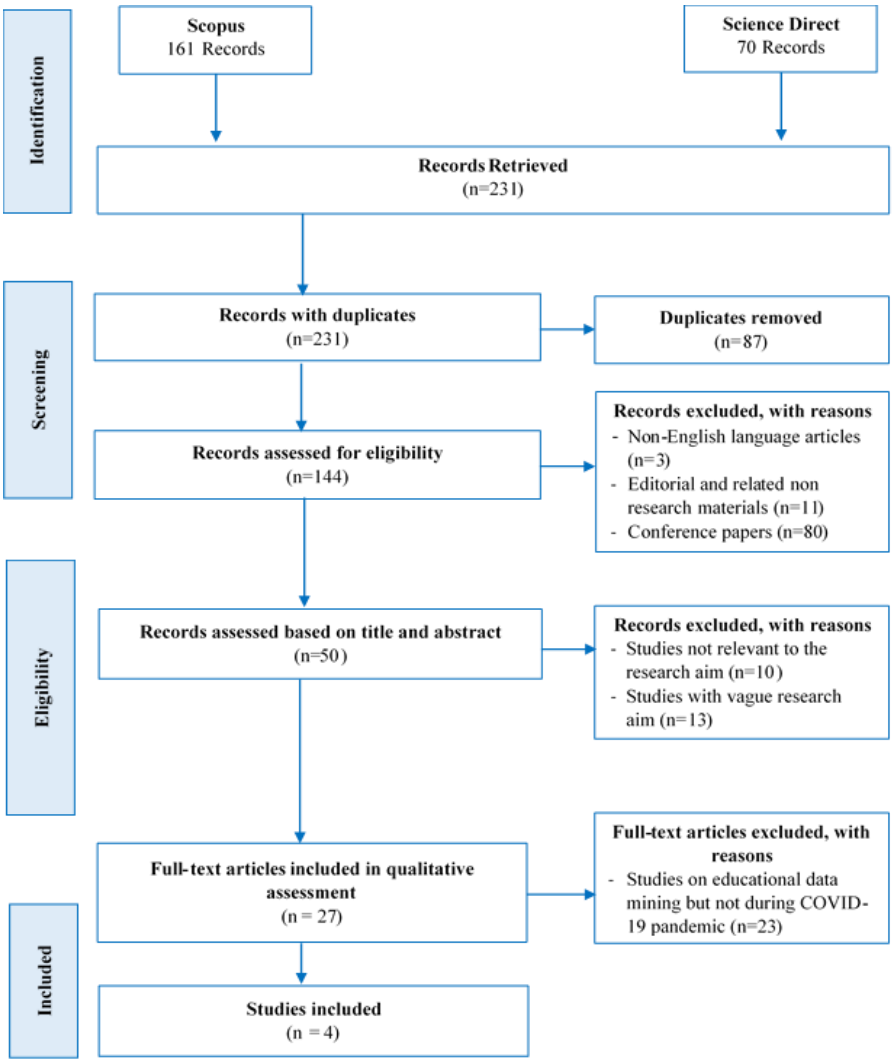

Figure 1: PRISMA Flow Diagram of the Study

3. Results

Exemplary platforms specifically designed for educational data mining purposed include Questa [https://www.novatia.com/home-questa], Kidaptive [https://www.kidaptive.com/], and Cognii [https://www.cognii.com/]. Other relevant platforms include Knewton [https://www.knewton.com/] that supports in determining gaps in a student's wisdom and assigns proper coursework; Querium [http://querium.com/], which provides customization tutorials and exercises, Volley [https://volley.com/], and Century Tech [https://www.century.tech/] that reduces instructors' workload by providing intelligent personalization of learning plans based on cognitive neuroscience and data analytics. However, key strategies for utilizing these platforms involve extensive application of various data mining techniques. Therefore, with expertise in educational data mining techniques the vital capabilities of these platforms could be utilized in supporting various academic activities and academic decision-making processes.

With the advent of COVID-19, numerous open-source data-mining platforms were made available for academic and non-academic institutions to utilize in making informed decisions. In accelerating responses to the COVID-19 pandemic, various institutions utilized data integration platforms such as Palantir Foundry [https://www.palantir.com/palantir-foundry/], graph analytics platform such as TigerGraph [https://www.tigergraph.com/] and location intelligence platforms such as CARTO [https://carto.com/location-intelligence/] among others.

3.1 Trends and Status of Studies on Educational Data-Mining

Figures 2-5 highlighted the trends in the studies on educational data mining during and before the advent of COVID-19. Meanwhile,

several studies showed utilized data mining in ascertaining the effectiveness of various eLearning modalities including social media in teaching and learning during the pandemic [29]. However, with the dynamics of the pandemic, there is need for exploring the best practices in educational data mining especially against future pandemics and other related crises.

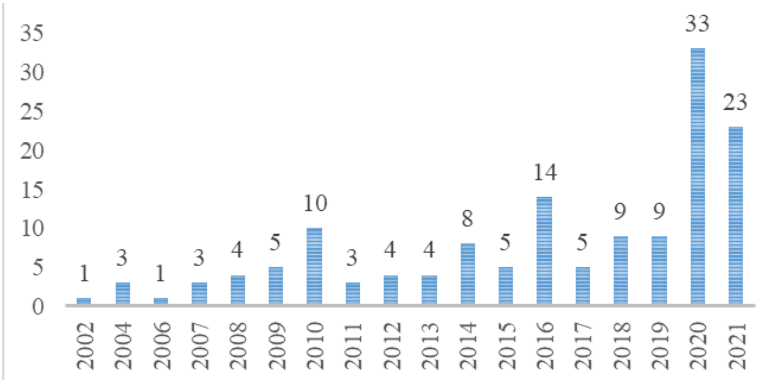

Figure 2: Records across Years

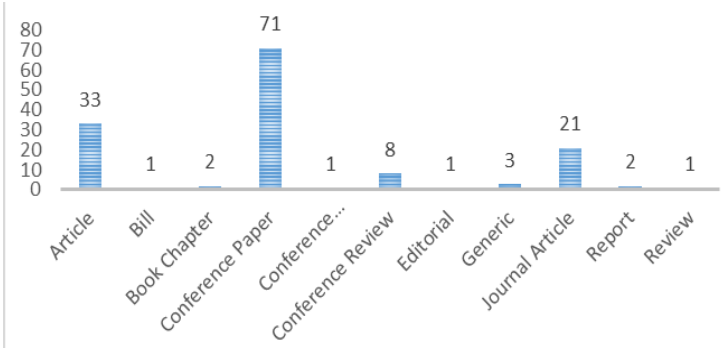

Figure 3: Frequency of Document Types

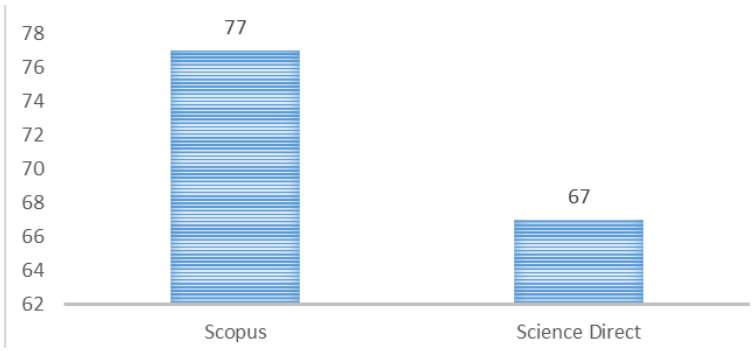

Figure 4: Frequency of Records across the Databases

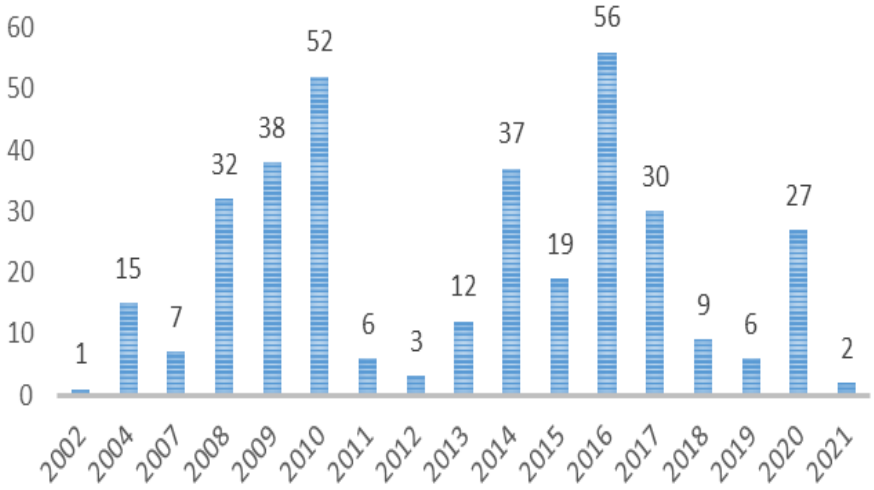

Figure 5: Trend of Citations across Years

3.2 Approaches to Educational Data-Mining during COVID-19

3.2.1 Machine Learning Approaches

Su and Wu [24] explored user behaviors by analyzing clickstreams of multimedia video monitoring patterns in combined IT domains using k-means clustering technique. The experimental finding revealed three distinct behavioral patterns in terms of actively engaged users, long engaged users, and watching engaged users. Statistically considerable difference was discovered between the three categories of users' watching behaviors.

Duru et al. [25] extended the commonly used clickstream and learners' demographic features in MOOC studies with 420,000 comments to predict learners' future performance, engagement and learning success. The study categorized learners based on estimated English language proficiency and the content of their respective comment texts. The study findings revealed the predictive weakness of comments alone.

Williamson and Eynon [26] explored the efficacy of AI-powered virtual teaching assistant (TAs) for automating and reliving teachers from the burden of verbal question answering and routine interactions. The study demonstrated the application of the virtual TA during COVID-19 online classes by responding to questions with appropriate learning materials and contents from a repository. The experimental study further analyzed student posts and implemented a classifier based on the posts to decide the appropriateness of responding to questions.

3.2.2 Statistical Approaches

Ariawan et al. [27] conducted a quasi-experiment with sixty students from Malang State Vocational High School to investigate the comparative impact of virtual and traditional discussion sessions on

student's motivations during the COVID-19 pandemic. The study employed the statistical technique of paired sample t-test, the obtained result indicated a statistically consequential difference in the two discussion approaches, and virtual discussion positively influenced the students' motivation.

Pal and Patra [28] proposed and integrated theoretical model based on proposed based on Task Technology Fit (TTF) and Technology Acceptance Model (TAM) to investigate the adoption factors of video-based learning during the COVID-19 pandemic. The study administered the data collection tool on 232 students that enrolled in a full-semester video-based learning course during the COVID-19 pandemic. Accordingly, possible moderating effects of digital inequality as well as gender disparity were considered and the findings based Partial Least Squares method indicated 64.6% variance on how the video-based learning method positively aligns with the student's learning habit and actual use of the learning contents.

Nkomo and Daniel [18] explore the students' learning experience with lecture recordings during remote learning sessions in the era of the COVID-19 pandemic. The authors administered a questionnaire to 660 undergraduate and postgraduate participants from a public university in New Zealand. The study findings showed an enhanced learning experience from the students that accessed supplementary learning resources in terms of fostered flexibility and inclusive learning environment for students with learning disabilities.

4. Discussion

The reviewed literature revealed the value of educational data mining in formulating, analyzing and implementing powerful data analytics in extracting vital information from both structured and unstructured educational data. Various techniques based on statistical tools as well as machine learning algorithms were utilized in extracting useful patterns for backing crucial decisions, policies and academic

activities. Despites various educational data mining platforms and open source platforms that could have aided educational decisions during the COVID-19 pandemic, none of the reviewed studies utilized the highlighted platforms in the academic decision processes. However, the reviewed studies have utilized both machine learning and statistical approaches in supporting educational activities and decisions. The studies that adopted machine-learning techniques utilized ubiquitous clickstream data, demographic information and discussion comments learning in revealing crucial online behaviors of students during the pandemic. Furthermore, other related studies employed the machine learning techniques in implementing intelligent systems that could handle the ubiquitous enquiries from students in the era of COVID-19 and similar situations. On the other hand, the statistical educational data mining approaches utilized during the pandemic analyzed self-reported behavioral data in assessing students' satisfaction and learning experiences. The statistical approaches have proved their value in supporting decisions pertaining to the association between students learning style, and experiences with the learning contents as well as the virtual academic environments adopted due to the pandemic. The statistical approaches relied mainly on data from standard behavioral scales such as the popular TAM and other non-standard questionnaires.

5. Conclusion

The reviewed literature revealed the value of educational data mining in formulating, analyzing and implementing powerful data analytics in extracting vital information educational data. The extracted patterns and associations have been the vital driver for informed educational decisions and policies. The present study highlighted instances on how educational data mining techniques were utilized in analyzing students' academic performance, monitoring and planning among others during the COVID-19 pandemic. The extracted data patterns

and associations have been the vital driver for informed educational decisions and policies through ascertaining the effectiveness of various eLearning modalities including social media in teaching and learning during the pandemic. For instance, [29] systematically highlighted some of the vital studies that employed education data mining in identifying the value and feasibility of social media user-generated as well as system-generated data in addressing eLearning challenges during the COVID-19 pandemic. Furthermore, some of the exemplary use cases of educational data mining that can be utilized during COVID-19 and similar disasters include analysis and visualization of educational data, predicting students' profiling and performance, managing students' enrolment and grouping, organizing syllabus and learning contents, academic planning and scheduling, and monitoring online examination. For instance, [13] highlighted the efficacy of educational data mining in supporting the complex process of improving managerial decision-making in higher learning institutions based historical and operational data. Thus, the techniques highlighted could be transferred to the period of COVID-19. Another instance can be seen from [18] in which students' engagements with lecture recordings was explored for flexible, remote and distance learning during the Covid-19 pandemic. However, the present study was limited by the search criteria followed. The search criteria were tailored to the popular scientific databases. The articles accessed in the present study are those that are full-text, downloadable and published in English language based on the two search terms "educational data mining", and "COVID-19". Expanding these search criteria might yield additional studies for more comparative findings. The authors hope that the present findings will help researchers, educationists and relevant stakeholders on the application of educational data mining during COVID-19 pandemic and similar instances.

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2

An Experimental Study of the Influence of the Teflon and Cotton Material on the Helmholtz Resonator

An Experimental Study of the Influence of the Teflon and Cotton Material on the Helmholtz Resonator

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Abstract

This paper aims to enhance knowledge of acoustic dynamics in the Acoustical duct with Helmholtz Resonator (HR). The study investigates two different materials of the under most wall of the cavity using (Teflon and cotton) and their effect on HR via experimental work. In the present study, Helmholtz resonators are designed and implemented to investigate comprehensive practical measures of acoustic pressure using two microphone system approaches to estimate the net acoustic power transmission in the duct downstream of the HR to obtain an optimum performance over a range of exciting frequencies. In addition, precise acoustic measures in a tube with an HR-induced loudspeaker at various frequencies are taken via experimental work. LabVIEW software is employed to examine the signals, with a sample rate of 44100 s/sec and several samples of 20000. This study creates a clear power spectrum of two acoustic channels in the tube with and without HR. The most promising results are recorded by utilizing Piston from Teflon. The

average noise reduction has reached 49%, and that value is the highest reduction in all experimenting results.

Keywords: *Helmholtz resonator (HR), noise signals, acoustic pressure, power spectrum, noise reduction, dynamic response*

1. Introduction

Noise is one of the most common and annoying environmental pollutants in large cities and factories, often emitted in their neighbourhood. The audible sound may be successfully reduced by modifications at the source of its generation. Manufacturing, together with our modern organization's requirements for different human convenience apparatuses, fast travel, and devices for routine jobs in homes and offices, increased noise pollution levels almost everywhere. Disclosure of increased noise levels can generate hearing loss. Therefore, the exposure times are kept within standards or recommended practices adopted.

Helmholtz resonators have been employed for adjusting acoustic techniques such as industrial operations, ICE exhaust, and engine manifold designs and are also utilized as apparatuses to regulate the powerful sound fields developed within jet devices. The position proposed here assumes a system that changes the acoustic response of acoustic dynamics in the auditory tube with HR; the system consists of a static HR, and active control of an audio speaker delivers a varying acoustic frequency. The acoustic wave signals travel in the tube as a plane wave, and a signal generator system causes these waves with a known wave (sine wave). The acoustic pressure fluctuation is counted by two microphones system; the first microphone is close to the speaker, the other is at the end of the device, and the Helmholtz resonator is positioned close to the

loudspeaker. Table 1 shows the total permissible exposure times in 24 hours for different sound pressure levels. In addition, the two-microphone technique has been used to measure the net acoustic power transmission downstream of HR and the net acoustic power transmission in the duct without the HR. The acoustic wave signals cross in the duct as a plane wave, and a signal generator system generates these waves with a known wave (sine wave). One of the microphones is encountered before the neck–duct interface, and the other microphone is behind the HR in the tube.

Table 1: Safe Noise Levels Exposure Time

Noise duration Per day in	Sound pressure level in
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 (or less)	115

The issue of low-frequency tonal noise is ingrained in initiatives utilizing interior combustion (IC) engines, compressors, fans, blowers, power transformers, gearboxes, etc. The dynamic nature of tonal noise disturbances workers within the enterprise and the surrounding society. Leaning upon the class of application, existing design, cost controls, and tonal noise messages can be controlled in multiple methods by establishing reactive silencers, walls, side branch elements, and active or passive noise control instruments. The outcome represented here involves attenuating tonal noise transmission in channels utilizing side unit resonators. One method of attenuating tonal noise reproducing in ducts is to employ one or more

side unit resonators, each mainly developed for optimal implementation at a unique frequency.

The optimal performance of the Helmholtz resonator is designed to achieve at one frequency best, valid over a highly narrow frequency band. Studying and analysing many sound waves of noise sources is essential to know the behaviour of wave noise and dominated frequency, which causes environmental noise. Analysis of noise signals contains signal processing. For example, auto-correlation, cross-correlation analysis, power spectrum, data acquisition system, root mean square (RMS), and the correlation methods applicable to complex data have been derived from Fourier series and transforms. Where autocorrelation function provides a powerful means of identifying hidden periodicities in random noise utilizing the fundamental distinction in the shape of the auto-correlogram for periodic and random data, and cross-correlation may therefore be regarded as a filtering procedure where the characteristics of the referenced wave-form define the frequency features of the filter relative to the signal being analysed. The autocorrelation function defines the correlation of signal values at two moments of time, which is represented in its most prevalent form [1]. The HR focus is an old and straightforward concept. It consists of an air-filled gap with a relatively small opening. It has been researched for over 100 years, numerous notably by Von Helmholtz, Lord Rayleigh, and Ingard in 1953 [1]. The Helmholtz resonators have been operated for different classes of applications. They are helpful in passive control of the sound of single resonant peaks by working instantly on the field. The HR has benefits over other noise control techniques in that it does not need energy to perform, is simple, demands no power, and may be involved in high-frequency noise. Helmholtz resonators are developed to accomplish optimal execution at one frequency only and are good over a narrow frequency band (actions as a gap filter). Any slight difference in the frequency or difference in temperature, which alters

the speed of sound and, therefore, noise wavelength, will reduce the effectiveness of the resonator. HR has multiple applications, such as in mufflers of ICE engines [2]. There is primarily work on the process of HRs, computing resonant frequencies, and the influences of resonator shape on its features [3, 4, and 5]. In passive control, many earlier studies reported successfully executing the adaptive HR to attenuate the noise transmission in ducts. Lamancusa et al. [6] presented the benefit of a magnitude variable HR for attenuating the release frequency noise of an IC engine. Matsuhisa et al. [7, 8] performed investigations with two classes of resonators, first, in which the hole volume was varied, and second, in which the neck cross-sectional area was various. Tuning of the resonator was reduced utilizing an algorithm established on the phase contrast between the pressure in the cavity of the resonator and the pressure in the tube. Also, Bedout et al. [9] designed an adaptive HR toned by employing the signal from a microphone located in the pipe downstream of the resonator. Radcliff et al. [10] reported on making a semi-active HR for which tuning was performed by encountering pressure sensors, first, in the hole of the resonator and second, in the vent downstream of the resonator. Este've et al. [11] investigated the recent growth of an adaptive HR for decreasing broadband noise information in a missile payload fairing. In addition, they showed that the optimal tuning of HRs has been performed utilizing the data from one or more pressure sensors located in the tube downstream of the resonator. However, in many cases, particularly in industrial exhaust stacks, where the stacks act as a path for the exhaust gases to be made out to the atmosphere, it is neither desirable nor useful to scale microphones in a device. Rong et al. [12] studied the acoustic attenuation of the HR, including an extended neck and sound-absorbing materials. A two-dimensional analytical method based on the mode-matching technique was designed to select the transmission failure (TL) of the piston-driven model of the HR. Our previous work investigated four types of necks (cylindrical perforated and non-perforated channels with different

lengths). The results show that a longer perforated neck achieves the most substantial noise decrease. The development of the neck classes on HR was studied in detail by Al-Taleb et al. [13].

This paper has designed and implemented the passive noise control device (HR). The study and analysis of noise signals have been investigated using different materials such as Teflon and cotton. There is a need for more work to study better the possible influence of using Helmholtz resonators as passive control devices. This study investigates the acoustic characteristics of Helmholtz resonators experimentally using Teflon and Cotton.

2. Experimental Setup and Theory

A Helmholtz resonator comprises a volume of air (V) and a neck (opening) that combines the air with the surroundings. The structure of the experimental apparatus is shown in Figure 1. The rig consists of a cylindrical tube (duct), a Helmholtz resonator, a signal-generating system, a microphone system, a data acquisition system, and different types of necks. The Helmholtz resonator is a cylindrical steel tube with a length of 0.16m, and an inner diameter of 0.131m was cut from a standard steel tube with a median wall thickness of 0.4cm. The dimensions are 8.8cm long physical neck with an inside diameter of 5.2cm; the Helmholtz resonator is positioned at 60 cm from the loudspeaker. Figure 2 illustrates the dimensions of the Helmholtz resonator used in the present study.

The duct is an open-open end horizontal cylindrical tube made of carbon steel material with a thickness of 4 mm. The apparatus sizes are 1.50 m in length and 22.5 cm in internal diameter; it is supported by two fused flanges at both ends of the vent, as shown in Figure 3. The right-hand side end of the tube is open to the atmosphere, and the other is mounted on the loudspeaker. The signal-generating system includes a signal generator (type Peak Tech) and a loudspeaker

(Clarion SE-510 model) with a maximum power of 15W, and its frequency ranges from 20 Hz to 3500 Hz. Its effective diaphragm radius and area are 0.0625m and 0.02454, respectively. The acoustic pressure oscillation is calculated by two microphones design, the first microphone is found near the speaker, and the other is located at the end of the tube.

The air in the neck can be estimated as a lumped mass moving. This air motion in the neck generates small oscillations in the natural pressure. Thus, the air volume inside the resonator can be assumed to act like a spring. Regarding a potential flow of air via the opening, a uniform pressure inside the hole, and ignoring radiation failures. These two together form a single degree of freedom system, including one resonant frequency. When the HR is disclosed to external sound pressure, the harmonic signal of the air in the neck is created. The frequency response of this motion relies on the resonator features, such as the neck's sizes, the resonator's volume, and the type of materials, such as Teflon and cotton. Also, the system has considerable damping, mainly due to the air moving in the channel and the eddies around the neck edges.

In theory, the air in the neck makes a sound pressure that cancels the happening sound pressure at the resonant frequency of a resonator. Therefore, the HR response at the end is close to its natural frequency and is the primary standard for its performance. This single degree of freedom feature of HR creates them functional in targeting peaks in the noise spectrum of the system to be controlled. Thus, other resonators can be assigned to different acoustic modes to gain maximum control performance.

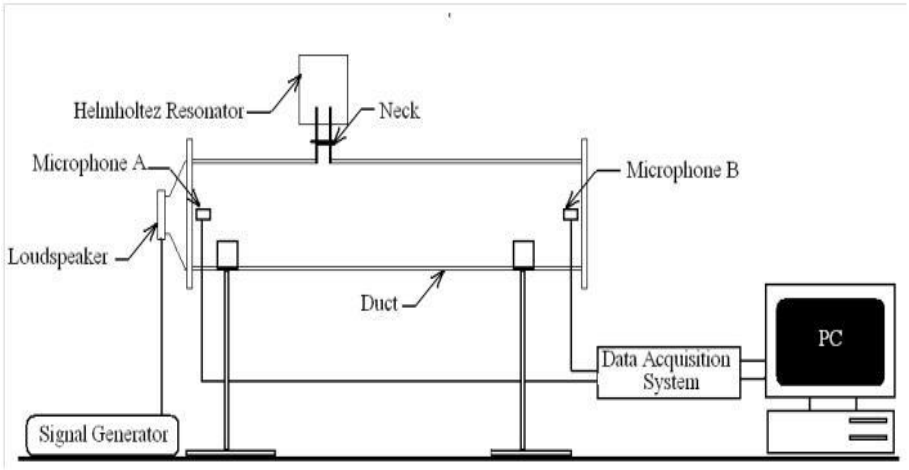

Figure 1: Experimental setup [13]

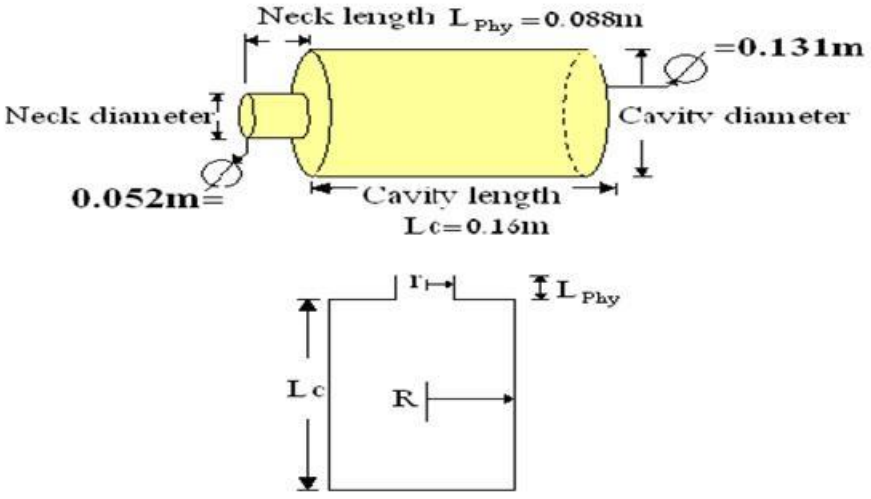

Figure 2: Schematic of a Helmholtz Resonator

In addition, the overview of the experimental setup of this test rig is shown in Figure 3. It consists of a signal generator, a data acquisition system, and a sound pressure level meter. In this study, two test rigs have been used to analyze the acoustic dynamics. The first test rig was used to measure the resonance frequencies of the HR model Figure 4; the second test rig was used to investigate the influence of the geometry of HR on the noise attenuation performance of the resonator. Further, a Data acquisition card mounted on a PC was used to acquire the acoustic pressure signal. The software used is known as LabVIEW by National Instruments. The data acquisition card is a NI(PCI-MIO-16E-1) with eight input differential channels. The data acquisition sampling rate was 44100 samples per second, and the duration of each sampling was 0.45 seconds (the number of samples is 20000).

Figure 3: Experimental setup of the test rig

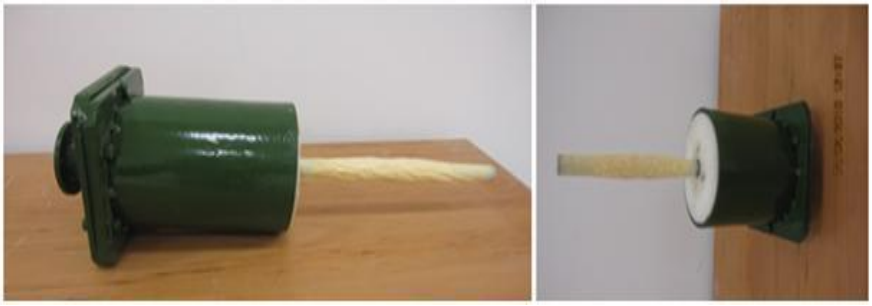

Figure 4: Experimental setup of the HR.

2.1. Spectra LAB software

Spectra LAB software is a powerful dual-channel spectrum analyzer. Figure 5 shows a window of Spectra LAB with two channels. The program interfaces with most Windows-compatible sound cards to deliver real-time spectral estimation, recording, playback, and post-processing abilities. In this study, the sampling rate for the samples recorded using Spectra Lab software was 44100 (samples/second), and some 20000 samples were extracted from the recorded signal. Lab VIEW software has been used to analyze the pre-recorded indicative and provide the results in a tabulated form. The microphones were connected to the sound card and received the signals from the signal generator (Peak Tech) via a loudspeaker; the signals were recorded using spectra lab software. The signals obtained by the spectra lab were converted into reader files and analyzed by lab VIEW software. The experimental setup for calibration is shown in Figure 3. After processing a back diagram of lab VIEW software, the results have been graphically displayed using Excel software. The results needed for calibration are the power spectra, the cross-correlation, and the waveforms of the known input signals.

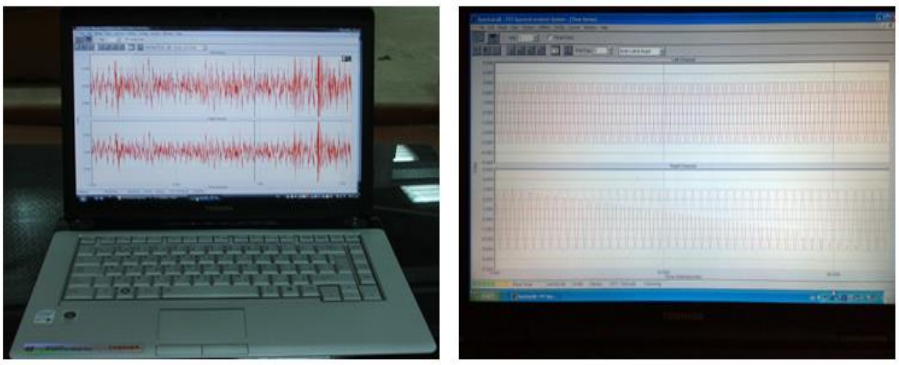

Figure 5: A window of Spectra LAB with two channels.

2.2. Cases of the piston

Figure 6 illustrates various conditions for the HR system and the change of the piston surface by using Teflon, as shown in Fig 6a and Cotton Fig 6b. In the present study, the first surface used was Teflon material at 2 cm height, and the effect of the reflected waves on this surface has been studied. The second surface used was cotton at 2 cm height and its effects on the HR efficiency.

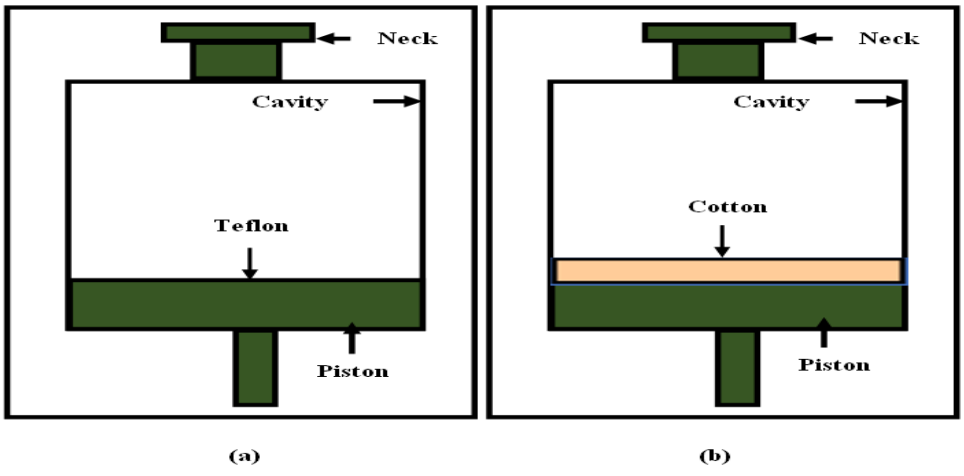

Figure 6: Various cases of the piston surface. Teflon (a), and Cotton (b).

3. Results and Discussion

This section explains the most important results that have been obtained practically. All the results have been taken under the same circumstances by accepting readings from 12 pm to 7 am to avoid any external noise effect. The study describes the analysis of noise signals and the reduction of noise using one of the recent technology methods. In this study, signals treatment techniques include (power spectrum, root mean square, and cross-correlation). The first results from the study have been taken by duct without HR. Then, the tube has taken the second results with HR by using different cases of materials inside HR such as Teflon and Cotton. These results have been repeated many times to make sure they were corrected, and their effect on HR efficiency reduces the noise. In addition, the surface of the piston Teflon was designed to fit with the cavity's diameter; the surface was changed with the cotton under the exact dimensions and conditions.

In this test rig, two acoustic signals were measured simultaneously in an exciting duct with a Helmholtz resonator. The measured signals contain Channel 1 from microphone A, located close to the loudspeaker, and the other from microphone B at the open end of the duct, as shown in Figure (1). The microphones pick up signals and are connected to the data acquisition system through the analog-to-digital (A/D) channel. This section studies the influence of the surface of the piston within the cavity using Teflon and Cotton and their impact on the efficiency of HR to study the effect of a duct with and without HR.

Figures 7,8 and 9 illustrate the simultaneously gauged acoustic signal fluctuations plotted against time and the power spectra; the signals are picked up by two channels, A and B, in the tube without HR and with HR using Teflon and Cotton materials; at an excitation frequency of 200 Hz. Figure 7 illustrates that the output signal (CH2) is similar to the input signal (CH1) before inserting the HR system. Also, the time response has been analyzed sequentially using HR, as shown in

Figures 8 and 9. It may be concluded that the amplitude signals CH2 for two cases of Teflon, as shown in Fig 8, and cotton, as shown in Fig 9, dropped significantly when HR was employed. So, the lower curve can represent the best HR efficiency, and the less efficient HR could be obtained from the highest curve.

Figure 10 shows the duct's root mean square (RMS) acoustic pressure signals vs frequencies without the HR system. This figure also depicts that the peak frequency of the acoustic signal picked up by the channel has the same frequency as the acoustic excitation unit (loudspeaker), with a power spectrum free of any sub-harmonic, which indicates that the signals are pure signals of sine waves. It may be noted from the figure that there is no change in output signals due to the absence of HR in the system. Once the piston surface uses within the cavity from Teflon, the output RMS curve represents the emerging signal when the duct is with HR, as shown in Figure 11. It may be noted from the figure there is a reduction in the signal emerging, especially when the frequencies are between (200-240Hz), due to the efficiency of HR. The lower curve can represent the best efficiency of HR. Further, the surface of the piston Teflon has been designed to fit with the diameter of the cavity, where the character was changed to the cotton material under the exact dimensions and conditions. Figure 12 illustrates the output RMS curve when the piston surface uses within the cavity from Cotton when the duct is with HR. It may be noted there is a clear reduction in the output signals compared with Figure 10 when the duct is without HR. It could be argued that through the results and analysis of these two cases. It can be concluded there is a reduction in the signal emerging, especially when the frequency is 200HZ, due to the efficiency of HR. The best case was obtained and helped to give the best efficiency of Helmholtz when the piston surface was made of Teflon. The character can help speed the reflection waves colliding, leading to speed colliding entering the microwave cavity. Also, this increases the speed of destructive interference within the cavity and

gets the best reduction and efficiency. Furthermore, the results and analysis of the surface of the cotton led to the reflection of the waves colliding in, but less rapidly than the reflection waves from the surface of Teflon, and thus the smaller collision microwaves involved and say the destructive interference between the waves. However, a large part of the waves that collide with the piston's surface is absorbed when the surface of the piston changes to cotton.

This absorption of the waves resulted in the delay part of the waves reflected from the surface waves within their collision, leading to delays in the process of destructive interference within the cavity between the waves, which gave less efficient Helmholtz compared to the previous case. Also, through the results which have been collected, it is possible to control the efficiency of Helmholtz. This can be done by changing the cavity's dimensions and shape.

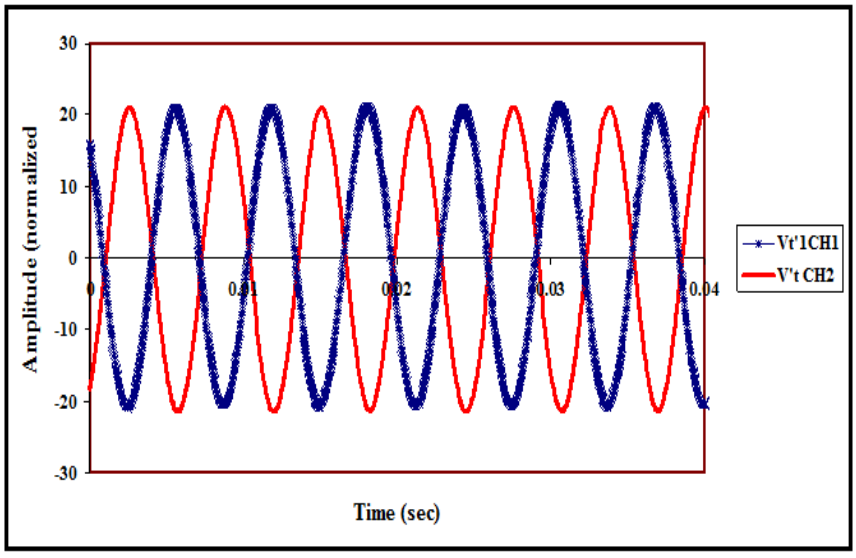

Figure 7: Instantaneous signals at duct without HR (applied frequency 200Hz).

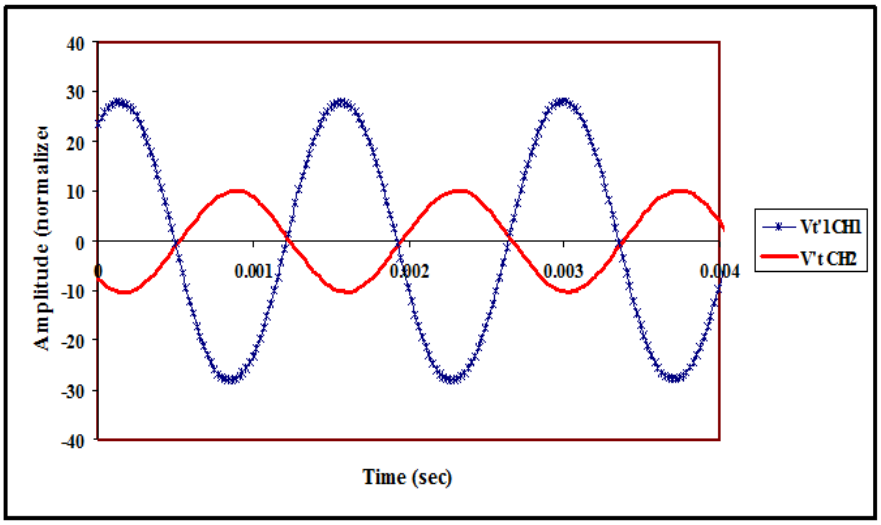

Figure 8: Instantaneous signals at duct with HR (Piston from Teflon), (applied frequency 200Hz)

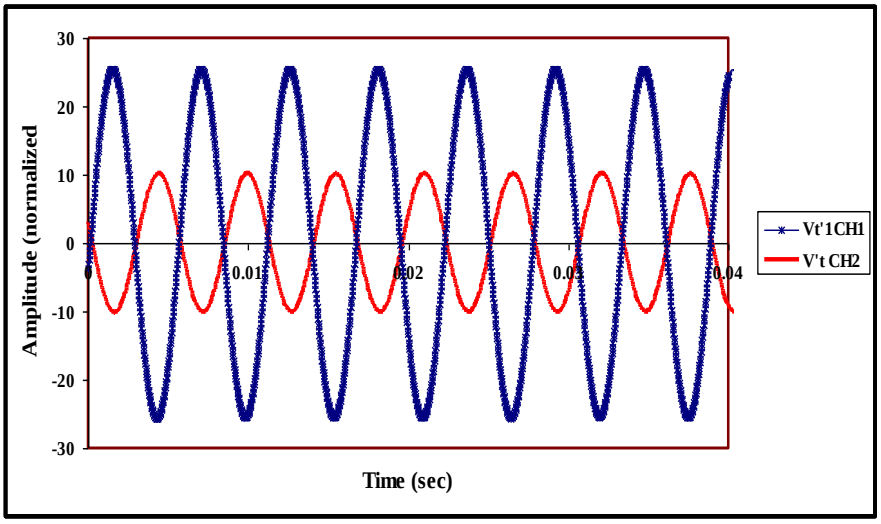

Figure 9: Instantaneous signals at duct with HR (Piston from Cotton), (applied frequency 200Hz)

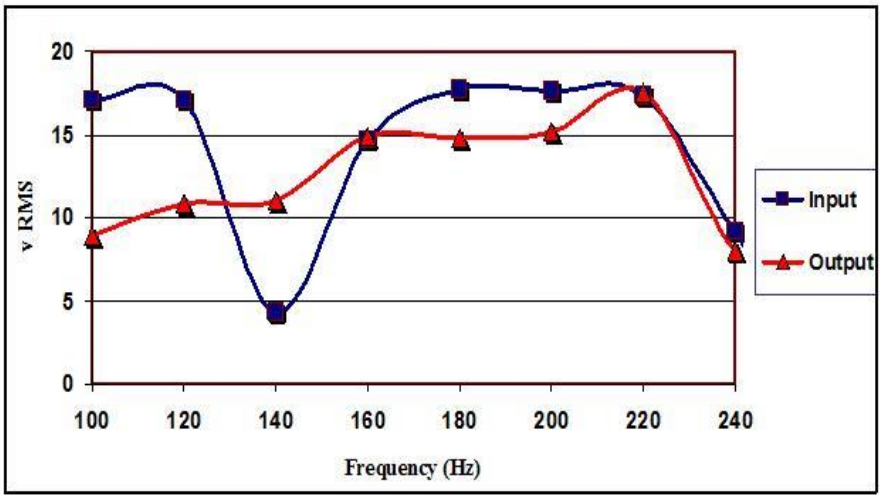

Figure 10: Comparison between input & output RMS on duct without HR, (100-240Hz).

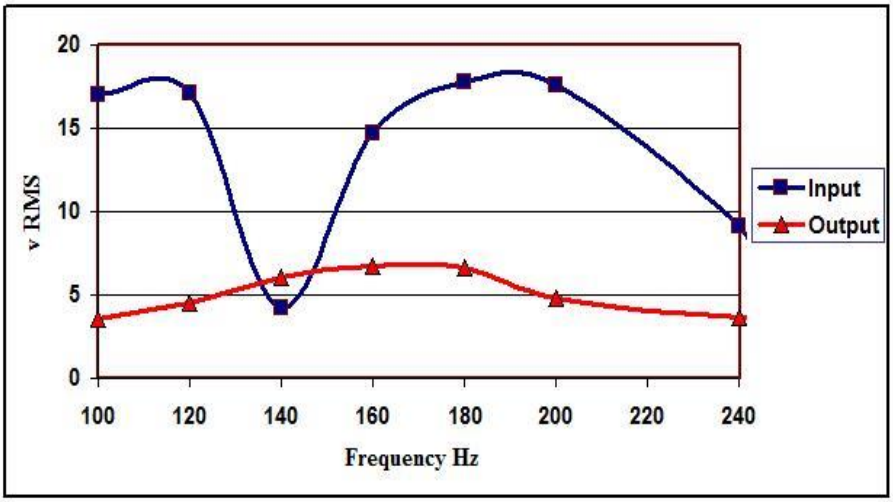

Figure 11: Comparison between input & output RMS on duct with HR, (piston from Teflon)), (100-240Hz)

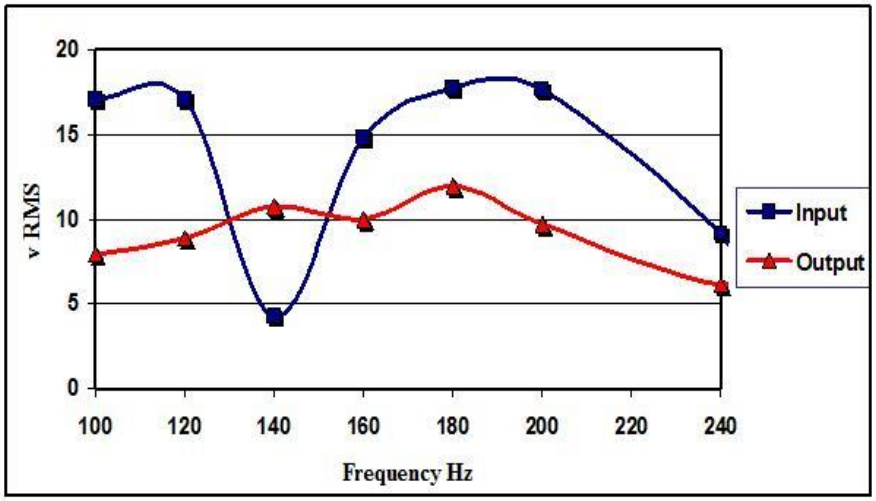

Figure 12: Comparison between input & output RMS on duct with HR, (piston from cotton), (100-240Hz)

4. Conclusion

The Helmholtz resonator is a passive control device that reduces low-frequency noise at a narrow band of frequencies. Acoustic dynamics response in the audio duct with HR by using two different materials of the bottom wall of the cavity (Teflon and cotton) have been investigated via experimental work. The predicted resonance frequencies of HR depend on the model used, and the importance of selecting the model depends on HR's dimension and wavelength of the acoustic signal. The experimentally spectral results were obtained for an exciting duct with and without a Helmholtz resonator open to the atmosphere using the two microphones technique; the results demonstrate that materials such as Teflon and cotton play a significant role in the reduction of noise. The changes in the materials, such as Teflon and Cotton, as well as the physical length of the neck, affect resonance frequency and noise performance attenuation of the HR. In

this study, the best percentage of reduction for the noise was at frequencies between 200-240 Hz with an average of 49 % when the piston was from Teflon. The results show that Teflon material achieves the most substantial reduction of noise.

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The Impact of Seasonal Variations on Assessment of Photovoltaic Efficiency in Tripoli-Libya

The Impact of Seasonal Variations on Assessment of Photovoltaic Efficiency in Tripoli-Libya

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Abstract

The limitation of understanding the mechanism and magnitude of the solar PV systems variability is still under investigation in terms of actual operating conditions. The Solar PV system was employed to identify the effect of seasonal variations on the productivity of electricity. The 5 kW Solar Photovoltaic system was set up. On a flat area in one of the areas of Tripoli-Libya. The main objective of setting up this PV system was to discuss the 5 KW PV system productivity fixed in Tripoli, during summer and winter, with studying the effect of

seasonal conditions on the electrical efficiency. This work focuses on the evaluation of the performance of PV systems using the estimation of power and ampere in winter and summer. It's found that the PV system performance is clearly affected between winter and summer due to the significant change of seasonal variations. The values of power calculated by 5 KW PV system in January are 4.2 KWh, meanwhile in June are 9.8 KWh. On other hand, the values of the ampere generated in January are 45% smaller than the values of the ampere calculated in June. The standard deviation obtained on January showed about 2.5, while in June, the value was around 6.0.

Keywords*: Solar PV system – seasonal – variations - system performance*

1. Introduction

Photovoltaic systems (PV) are commonly used in the last decades due to their universality and sustainability [1]. One of the most important issues for all the developing countries is the generation of the electricity. The consumption of the electricity is increased yearly by increasing of the world population [2]. The increase of the demand of the electrical power leads to utilize a variety of energy sources. The current world energy consumption relies mostly on fossil fuels with a percentage of Oil 35%, Coal 29% and Gas 24%, whilst Nuclear and Hydro power represent a 5.5% and 6.5% respectively from the total energy consumption across the world according to British Petroleum (BP) [3]. The usage of the alternative or renewable energies becomes a very important issue for all the countries due to many factors such as the depletion of fossil resources, the disasters of nuclear power plants like Fukushima/Japan, and the impact of greenhouse gases on the environmental [4]. The exploitation of renewable energy sources increases annually and the development of renewable energy technologies such as photovoltaic (PV), hydroelectric energy, tidal

energy, wind power and ocean wave power technologies has gained a full attention in the last decades. The availability of solar energy everywhere on the surface of the world encourages the expansion of the solar power technologies worldwide with a huge investment for developing the proper techniques [5]. The distribution of solar power worldwide [KW/m^2] is illustrated in Fig. 1.

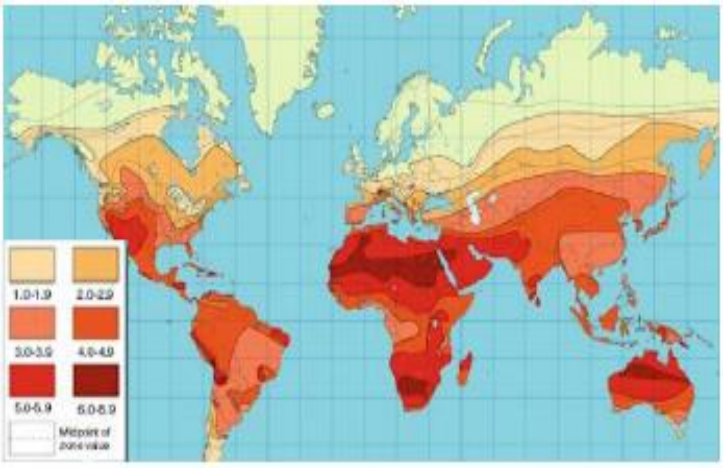

Figure 1: Distribution of solar energy [KW/m^2] [5]

The distribution of solar energy on the surface of the earth is a non-uniform with high intensity of solar radiation in the southern part of the world in comparison with low intensity of solar radiation in the northern part. The solar energy distribution around the world must be considered to design the suitable solar power system [6]. The generation of electricity from solar power can be mainly obtained by different two ways, the first way uses the photovoltaic cells (PV) as shown in Fig. 2, and the second way uses the solar collectors as illustrated in Fig.4, and receivers to obtain thermal heating to generate a steam in order to rotate the turbines and generators [5]. Solar PV systems represent a potential solution instead of the conventional power plants operated by fossil fuels in order to avoid the

environment-associated issues such as toxic gas emissions and global warming [7-11].

Figure 2: Photovoltaic cells assembly [11]

Figure 3: Solar collectors for concentrated solar power plants [5]

The influence of seasons on PV performance is very important due to the seasonal variations [12]. The meteorological conditions such as the solar radiation intensity and its spectral content, angle of incidence, ambient temperature, and wind speed, have great effects on the PV system performance [12, 13]. It's reported that the PV system performance is mainly affected by the solar spectrum distribution and the increase of temperature, which leads to significant differences in the electrical efficiency between summer and winter [14, 15]. The other important factor is the impact of sky clearness that leads to the fluctuations in PV system power production at short timescales [16]. So, the energy yield from the PV array is the most crucial parameter to assess the viability of any installation.

Tripoli has a climate same as coastal cities compared to many other cities. Such a study will be useful to quantify the spectrum related parameter to estimate its effect on the performance of the PV array.

This paper will discuss the 5 KW PV system productivity fixed in Tripoli, during summer and winter, and the effect of seasonal conditions on the electrical efficiency.

2. PV System Description

Five KW PV system was used to investigate the effect of seasonal changes in summer and winter. The solar PV system used in this research is illustrated in Fig. 4a, Fig. 4b. The PV system was installed using 8 mono-crystal panels 390w each, connected with Inverter (solax power, 5KW), and then connected with Lithium-Ion Battery (Master with BMS, 50Ah/116V, 5.8 KW). Full PV system specifications are summarized in Table 1.

Table 1: shows the PV system specifications

Section	Type	Capacity	Size
Solar panel	Q mono-crystal cells	P_{mpp}390w	1.84mm x1030mm x 32mm
Inverter	Solax Power	5.0 Kw	420mm x 339mm x 143mm
Lithium-Ion Battery	Triple Power T-BAT H5.8	50Ah/116V, 5.8 Kw	708mm x 474mm x 193mm
Battery Pack	Triple Power HVI 1550	50Ah/116V, 5.8 Kw	647 mm x474 mm x 193 mm

Figure 4a: Solar PV system.

Figure 4b: Solar PV system.

3. PV System Performance Analysis

The calculations of power and ampere was performed in winter and summer, and the real data was collected in January and June respectively, in order to examine the effect of both factors on the productivity of PV system during different seasons, where the changes are mostly expected to occur each year. The average power and average ampere were calculated using **Q1** and **Q2** respectively. The total average power (**W**) in winter and summer are calculated with equation (1):

The average power

$$\boldsymbol{W_{av}}) = \frac{\sum \textbf{average power } /\boldsymbol{month}}{\sum \boldsymbol{day/month}} \quad (1)$$

Where, **W** is average power (**Watts**). While the Average ampere (**I**) in winter and summer were calculated with equation (2):

$$\boldsymbol{I_{av}} = \boldsymbol{W_{av}/V} \quad (2)$$

Where, **I** is average ampere, **W** is average of watts, **V** is volts (constant)

4. Results and Discussion

The measured monthly received power calculated in January and June, are given in (Figs. 5, 6) respectively. Based on the values presented in Fig. 7, it can be showed that the measured values of power received by 5 KW PV system in January are, on average, by 4.7 KWh. While in June are 10.3KWh.It was found that the measured values of the energy generated by the solar panel in June are on average by 45% higher than the values of the energy calculated in June. The biggest difference in data observed during January was (83%) and June was (42.3%).

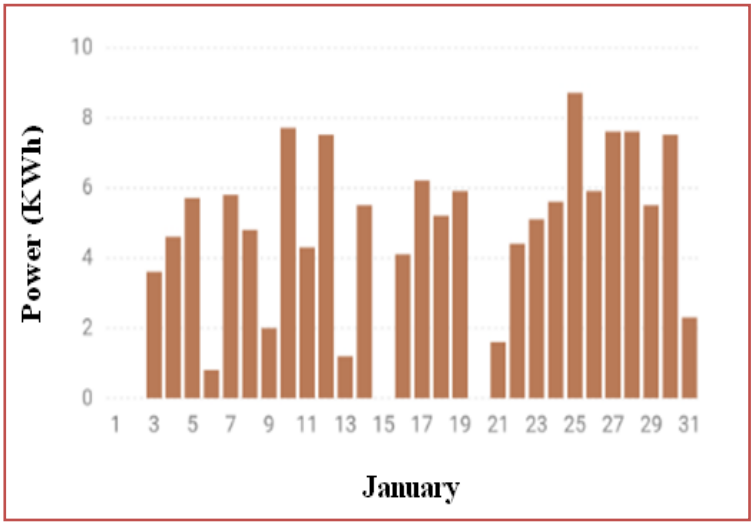

Figure 5: The measured monthly received power collected in January

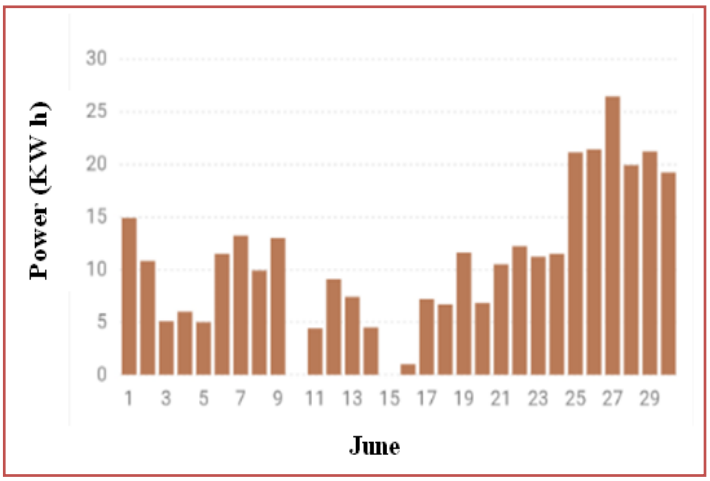

Figure 6: The measured monthly received power collected in January.

The measured average monthly estimated amber (A) in January and June, are given in Fig. 8. The measured values of the productivity amber generated in January are on average by 45% smaller than the values of the amber calculated in June.

The standard deviation of the results obtained during January was calculated, and the value of the deviation showed about 2.5, which means that it is low and that the data are gathered around the mean. While in June, the value was around 6.1 which indicate that the data spread more around the mean value. All previous results during the two months of measurements related to the power and current were made are influenced by factors such as total radiation, its spectral content, angle of incidence, ambient temperature, wind speed and is characterized by a distinct annual seasonal pattern, with slight variations due to meteorological events. Naturally, this affects the different results. In addition, the coefficient of losses factor should be taken into account, which many references refer to. In many

references, it reaches to around 0.75, which includes shadows, defects in connections, dust and losses in the inverter.

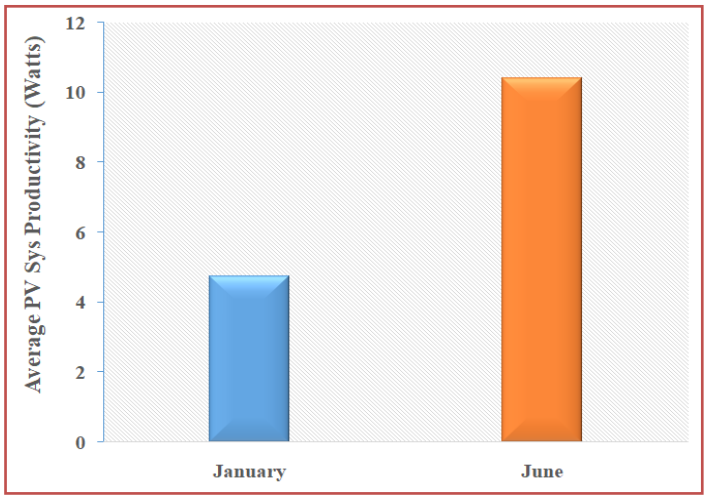

Figure 7: Average PV system (W).

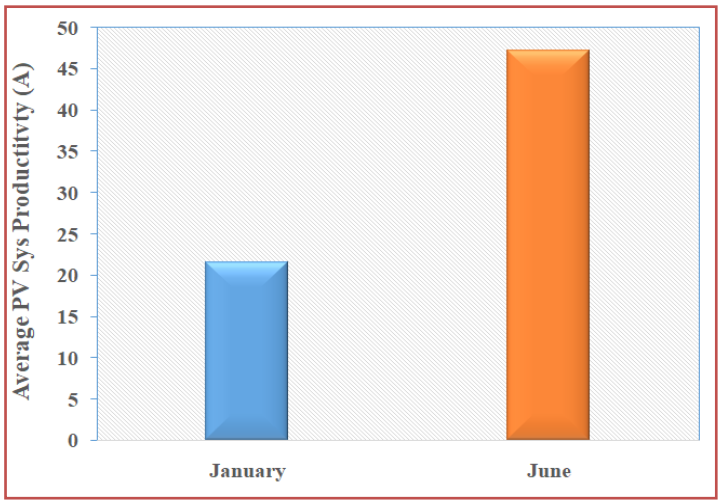

Figure 8: Average PV system (A).

5. Conclusion

1. The research was conducted on 5 KW solar PV system by collecting data in winter and summer. The productivity of solar PV system in terms of power (W) and amber (A) changes between winter and summer season respectively, due to the seasonal variations.
2. Experimentally obtained values of power received by 5 KW PV system in January are on average by 4.2 kWh. While in June are 9.8 kWh.
3. The values of the amber generated in January are 45% smaller than the values of the amber calculated in June.
4. The seasonal variations such as the solar radiation intensity and its spectral content, angle of incidence, ambient temperature, and wind speed, have great effects on the PV system performance in terms of power and ampere.

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Role of IoT in Sustainable Development of the Health Field in the Libyan State

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Role of IoT in Sustainable Development of the Health Field in the Libyan State

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Abstract

Internet of things technology (IoT) has a major and an effective role in all areas of life, as this technology depends in its work on sensors and actuators connected through computer networks, and it monitors and manages things electronically. This technology is used in all fields, whether health, economic, social or educational. Today, the IoT has become a heterogeneous and highly distributed architecture that can respond to the daily needs of different individuals and organizations. With the rapid development of IT-based technologies such as the IoT and cloud computing, low-cost health services, effective supervision of centralized management, and public health monitoring can be achieved and supported. Therefore, there has been a growing interest

in the integration of IoT and healthcare in both the academic world and the business world.
This paper focuses on the role of the IoT in supporting sustainable development programs in the field of health care in Libya, so that Libya can achieve the sustainable development program according to the United Nations Development Program for the year 2030.

Keywords: *IoT, sustainable development, health care*

1. Introduction

The Internet of Things, as defined [1], is the ability of things to connect to the Internet and send and receive data, for example, cameras connected to the Internet, which allow monitoring over the Internet, and it is also defined [2] as things that can be linked through a unique address. The IoT has several uses in different areas of life such as health care, life sciences, smart housing, industry, agriculture, education, and other fields.
Many researchers have discussed the great role that the IoT plays in our daily lives, and the study [3] touched on the role of this technology in the field of smart agriculture, where researchers developed a system for monitoring sheep when they are grazing so that they are controlled so as not to cause damage to agricultural lands near the grazing area. This process is done by placing sensors in the neck of the sheep, which send signals to a computer, which allows the process of monitoring and controlling the field of sheep grazing.
One of the important roles of this technology is also to combat climate changes, especially the phenomenon of desertification that many countries, including Libya, suffer from, by monitoring changes in temperature, humidity and carbon dioxide rate [4] using microcontrollers via wireless communication with temperature, humidity and carbon dioxide sensors in agricultural lands, and also as

shown in [5], this technique can be used to control irrigation so that microcontrollers and sensors are used to monitor and control the amount of irrigation water in an effective way to reduce this water during the irrigation process by measuring soil moisture, air humidity and temperatures .

Perhaps one of the areas that touches daily human life is electrical power systems. The IoT plays an important and effective role in the field of monitoring of electrical power systems. [6] Explained the energy consumption monitoring system through the use of the IoT, so that the waste of electrical energy was reduced. This system can be used for a small house or a large building. This system consists of a group of transducer sensors connected to control panels. These sensors have the ability to communicate with three phases at the same time and read each phase separately. These readings are collected and sent to a data processor and this process is done by wireless communication.

One of the areas of importance that needs the most attention is health care, where the IoT provides many benefits in this area, including improving diagnosis and treatment, the possibility of remote monitoring, and reducing the costs of care [7]. Among the applications that this technology effectively contributes to in the field of health care are tomography, monitoring of glucose level as well as blood pressure in addition to hearing devices.

One of the solutions to which this technology contributes is the role it plays in controlling and monitoring home appliances such as air conditioners, electric lamps, water heaters and other household equipment and appliances, which helps to control electrical energy consumption and reduce costs [8].

The purpose of this research paper is to touch upon the extent to which the IoT technology is utilized in implementing sustainable development programs in Libya, especially in the health field, because of its great importance to the life of the citizens and that is by trying to answer the following questions:

1. What is the role of the IoT in the implementation of the United Nations Development Program in Libya?
2. What are the areas in which this technology can contribute to the implementation of sustainable development programs?
3. What role can this technology play in the health field in Libya?

The aims of this research are to:

1. Reveal the importance of the IoT technology.
2. Shed light on this technique and the extent to which it is used.
3. Identify some of the solutions that some countries have taken to exploit this technology in implementing sustainable development programs.
4. The possibility of benefiting from this technology in the field of health care in Libya.

The rest of the paper is organized as follows: section II outlines the United Nations program for sustainable development. The role of IoT in the implementation of the United Nations Development Program in Libya is explained in section III. Some sustainable development programs in Libya using IoT technology are outlined in section IV. Conclusions and recommendations are explained in sections V and VI respectively.

2. United Nations program for sustainable development

In 2015 [9] the member states of the United Nations agreed on a sustainable development plan consisting of 17 main goals and 169 sub-targets as well as 231 indicators, to be implemented by the year 2030. The main objectives of this plan have been divided into the following elements:

1. Persons: This component includes the following main objectives:
   A. Quality of education.
   B. Good health
   C. The eradication of hunger.
   D. The eradication of poverty.
   E. Equality.
2. Participation: It includes the participatory component.
3. Peace: includes justice and the force of law.
4. Recovery: includes decent work, economic growth, infrastructure and industrial development.
5. Planet: includes clean energy, responsible consumption, life on land and under water, the atmosphere, clean water and wastewater, and sustainable cities and communities.

According to [10], Information and Communication Technology (ICT) can accelerate the development of the human race and bridge the digital divide. The United Nations International Telecommunication Union has devoted a tremendous effort to show the important role of ICT in achieving the sustainable development goals.

In 2002, at the World Summit on Sustainable Development, three critical dimensions of sustainable development were clarified: economic, social and environmental development. Several conferences were held at the global level regarding sustainable development until 17 sustainable development goals were agreed upon in 2015. After that, a report was issued by the United Nations clarifying the vision after 2015, where this vision contained in this report is based on three basic values, namely human rights, equality and sustainability, and four basic dimensions: (1) comprehensive economic development, (2) comprehensive social development, (3) tangible environmental sustainability, (4) peace and security.

With regard to economic development, it includes poverty reduction, food supply, health care, economic growth, sustainable industrialization and the promotion of innovation within the framework of the economic dimension. Reducing poverty using information and communication technology by giving opportunity for the poor class to expand their assets to access markets, as well as helps state institutions to provide aid, especially for the homeless. An important factor is improving security to ensure that the poor are able to deal with risks such as financial and health risks. From the researcher's point of view, perhaps the most effective solution to the problem of poverty is to adopt the Islamic system of Zakat, which is the best solution to reduce poverty in any society. Technology can be exploited in this regard by collecting information about the poor by exploiting information networks.

With regard to the issue of food supplies, it is represented in the existence of sustainable agriculture by employing technology in irrigation and rationalizing energy consumption. As the exploitation of technology will provide the necessary information and knowledge through IoT networks using sensors to monitor the irrigation process and reduce the use of pesticides [11].

In terms of health care, information technology has made an effective contributor to this field by exploiting this technology through smart phones to provide health care to patients and exploiting IoT technology in this vital service field [12].

Enhancing Teaching and Learning opportunities offered by ICT technologies nowadays and in recent years, ubiquitous learning environments have been proposed for the widespread adoption of mobile devices in the education sphere. Thus, the science of technological and social forecasting has been integrated into the context of education. This trend has also created additional challenges and burdens for teachers when they participate in such a complex educational system that is equipped with technological opportunities.

Sustainable economic growth, productive employment and decent work: In the twenty-first century, with a widespread sense of environmental and social responsibility, it becomes an inevitable choice for industrial enterprises to adopt the concepts of systematic economic, social and environmental development. Thus, industrial enterprises not only have to pay attention to productivity and investment efficiency, but also have to take into account the issues of sustainable development.

To achieve the sustainable development of the industry, one of the great challenges is to use the limited land resources in a reasonable and planned manner. To this end, using GIS-based spatial decision support system techniques, to help achieve the appropriate location of the newly planned industries. The proposed software tool is very useful for developing countries, where sustainable industrialization is still in its early stages considering environmental developments.

As for social development, one of the elements that has been focused on is the issue of gender equality in terms of job opportunities as well as social activities, in which social media platforms have played an effective role. Emphasis was also placed on reducing the differences between the classes of one society. One of the important things is what is known as sustainable cities, and the focus is in this context for two reasons, the first is that 70% of the world's population will be in cities by 2030, and these cities will be the main source of greenhouse gas emissions, with an estimated 70% at the global level [13]. The IoT has been widely regarded as a future essential platform for achieving smart sustainable cities. Obstacles are identified on the way to reaching the goal. For example, the irregularity of connected things creates barriers to dealing with a variety of data generated by IoT devices. It also unveiled a promising avenue for realizing smart cities, that is, the development of the IoT with self-reconfigurable functions [14].

The concept of sustainable consumption and production was proposed in 1992 by the Earth Summit in Rio de Janeiro, Brazil. In this

framework, a prototype of the sustainable factory of solar cells has been implemented, which guarantees productivity, high quality and guarantee. To find a balance between the three dimensions of sustainability in Japan [15]. Also, a model was proposed to remove the waste phase and use the recycling phase for sustainable consumption. Some studies focused on the manufacturing scenario and the proposed mechanisms for providing energy. Recently, the structure of energy consumed by production has been analysed, with the aim of discovering the real reason behind the low energy efficiency of modern manufacturing facilities. A methodological framework that coordinates the production and transportation system was also proposed [16]. Thanks to technological progress and the progress made by the information and knowledge society, e-justice is emerging as new tools that provide people with more convenient access to justice compared to the traditional method. Establishing an e-government that provides the community with great opportunities to receive informational justice services. Recently, electronic justice has emerged as a necessary sector for electronic administration, especially as it contributes significantly to the formation of the modern justice management system and openness in public services [17]. Some studies have shown an innovative vision of e-justice based on the concept of citizen axis in the development of information and communication technology in legal cases [18].

There is still a lot that needs to be looked at. How to mitigate inequality with a rapidly increasing urban population, we need to reconsider the emerging issue of how to create a modern city with less stressful and more creative environments. Livability and quality of life are key factors when designing long-term energy, water, pollution and waste management systems. It is expected that new approaches will be proposed by taking these objectives into consideration. Moreover, it is widely accepted that bottom-up designs should be adopted to achieve ICT-based future sustainable cities [19].

Since many important practices in the context of social sustainability are global issues, such as urbanization in a global setting, implementation of smart cities, and sustainable energy production and consumption. In addition, collective intelligence can be used to pursue the improvement of an overall society based on the collective efforts contributed by individuals. Therefore, many global partnerships for collective awareness are essential to the sustainable development of human society in the future [20].

As for the sustainable environment, it is in this framework that the preservation of environmental resources is considered because the sustainable management of water and sanitation, as mentioned in [21], many of the world's population face difficulties in accessing very basic services for humans. For example, some people still hardly have access to safe drinking water or sanitation facilities. This is likely to increase political instability and exacerbate the cycle of poverty. The drinking water crisis has been rated the number one global risk by the World Economic Forum, 2015. 82% whom facing this problem, are from rural areas.

Access to modern, reliable, sustainable and affordable energy is one of the goals to achieve the sustainable development of society (the main problem in Libya), one of the most important factors is the provision of energy resources that must be fully sustainable [22].

[23] Explains the key points in achieving sustainable energy supplies with restricted CO_2 emissions. Then, [24] studied the basics of smart grid technology in ICT-based sustainable energy services. A general framework for a social and ecological energy system is proposed. Later. [25] Presentation of the development of Li-ion batteries based on electronic vehicle (EV) technologies. Electric vehicle technologies are still in their early stages. A lot of designs and products are in great demand across original equipment manufacturers (OEMs), electric vehicle industries, and research institutions. Therefore, this new battery product can provide the basis for the electric vehicle industries.

3. The role of IoT in the implementation of the United Nations Development Program in Libya

Libya is a third world country and therefore it needs a lot of effort to keep pace with what is happening in the world of exploiting modern technology and harnessing it for the purpose of sustainable development, especially in light of the lean years it is going through at the present time.

The IoT can make an effective contribution to the implementation of some of the sustainable development goals of the United Nations Program for the year 2030 despite the passage of time, if there is seriousness on the part of state officials, although the apparent does not reflect this seriousness. Exploiting this technology for the purpose of development needs to harness many possibilities, whether material or technical, and also requires a great effort from specialists in the field to conduct studies and research in particular to reach how this technology contributes to the application of sustainable development programs, even if partially.

Among the areas in which this technology can contribute are the missing areas of health care, environmental protection, rationalization of energy consumption, and transportation.

Using the IoT for sustainable community development aims to develop engineering systems that enable sustainability by protecting natural and ecological systems [26]. Through the interdependence of systems, sensing and communication technologies, IoT for Sustainability aims to provide a model that balances society's need to provide environmental protection and maintains a secure economic community.

The strong relationship between the IoT and sustainability need not be emphasized. For example, monitoring floods, sewage and storm flows

[27]. A sensing and communications-based IoT solution supports sustainable communities (Goal 11) by reducing water-related disasters and economic losses. IoT for smart grid situational maintenance supporting infrastructure (Goal 9). The Internet of Things supports smart city-wide lighting and improvements in energy efficiency (Goal 7). The next generation of wireless IoT has the potential to advance on multiple fronts to accommodate the ever-increasing demands of commercial applications, scientific infrastructures and government agencies; for better and broader connectivity (Goal 9). In the field of human health (Goal 3), rather than a single major technological breakthrough, society can count on the culmination of several major IoT-enabled technologies. IoT technologies can provide the timely collection of wireless data on crop and soil moisture, supporting effective water management decision-making (Goals 2 and 12). In digital forest management, an early warning system for drought stress can help initiate and prioritize actions (Goal 13). Detection of soil moisture in forests can aid forest restoration decisions. These examples clearly show that sustainable community development is the main benefit of the IoT.

Through many projects linking IoT to sustainable development, and in the study [28], the relationship between IoT and sustainability was explored. In particular, 640 different IoT projects were compared with 17 SDGs in order to analyse the relationship between sustainability and IoT. It was proven that 84% of the analysed IoT projects showed stronger potential to achieve these goals. The five sustainable development goals (health (3), clean energy (7), stimulating industry and infrastructure (9), sustainable cities and communities (11) and responsible consumption and production (12)) were emphasized by 75% of the projects.

There are many IoT projects related to sustainable development, whether in developed or developing countries.

The following are some of these projects, which can be benefited from in the Libyan state, as in some developing countries:

- Sustainable Development Goals 7, 9 and 11: IoT is used to detect fires and smoke with alarms in high-density urban areas in Kenya and South Africa
- In East Africa and India, low-income households are being supplied by IoT with small, off-grid solar energy.
- Minibuses connected to public transport IoT is used in Kenya to monitor acceleration, speed and brakes to control risky driving
- Sustainable Development Goals 12, 13, 14 and 15: In East Timor, cloud-based IoT supports monitoring illegal fishing activity
- Air Pollution Monitoring IoT to sense outdoor air pollution in Benin
- Sustainable Development Goal 4. In South Africa, the IoT has connected students and faculty to an automated attendance system using biometric features.
- SDGs 1, 2 and 8: In Kenya, support the IoT to monitor accurate weather forecasting
- In India, pumps are connected to each other using IoT for irrigation for mobile irrigation management
- IoT for herds in Namibia, Senegal and Botswana for animal tracking, health record keeping and anti-theft.
- Sustainable Development Goals 3 and 6: In Rwanda and Kenya, SMS water pumps and sensors to support villagers.
- The cellular cold chain connected to the IoT is used for the safe delivery of vaccines
- In West Africa, IoT supports pulse, oxygen and temperature monitoring.

The following are also some of the uses of IoT technology in developed countries, including what was mentioned in the reference [29]:

- Use of the IoT in the healthcare services industry. The IoT offers new opportunities to improve healthcare. In healthcare systems, all objects (people, equipment, medicines, etc.) can be tracked and constantly monitored. Thanks to its global connectivity, all healthcare-related information (logistics, diagnosis, treatment, recovery, medication, management, financing and even daily activity) can be efficiently collected, managed and shared.
- Using the IoT in the food supply chain. Today's food supply chain is very complex. It has a large geographic and temporal scale, complex operating processes, and a large number of stakeholders. Complexity has caused many problems in quality management, operational efficiency and general food safety. IoT technologies offer promising capabilities to address tracking, visibility, and control challenges. It can cover the food supply chain in what is called a farm-to-sheet manner, from precision farming to food production, processing, storage, distribution and consumption. In the future, the food supply chain is expected to be safer, more efficient and sustainable.
- Use of the IoT in transportation and logistics. The IoT will play an increasingly important role in the transportation and logistics industries. As more and more physical objects are equipped with barcodes, RFID tags or sensors, carriers and logistics companies can perform real-time monitoring of the movement of physical objects from source to destination across the entire supply chain including manufacturing and shipping distribution and so on. Moreover, the IoT is expected to offer promising solutions for transforming transportation systems and automotive services. As vehicles have increasingly powerful sensing, communication, and

data processing capabilities, IoT technologies can be used to enhance these capabilities and share untapped resources between vehicles in parking spaces or on the road.

- Using the IoT in firefighting. The IoT has been used in the field of firefighting security to detect potential fires and provide early warning of potential fire disasters. In China, RFID tags and/or barcodes are attached to firefighting products to develop nationwide firefighting product information management databases and systems. By utilizing RFID tags, portable RFID readers, smart video cameras, sensor networks, and wireless communication networks, firefighting authority or related organizations can perform automatic diagnosis to achieve real-time environmental monitoring, fire early warning, and emergency rescue as per requirement. Researchers in China are also using IoT technologies to build automatic fire alarm systems in order to raise the level of the country's firefighting and emergency management to a better level.
- Underground IoT (IOUT). IOUT is the stand-alone devices that collect any relevant information about the land and are interconnected with communication and networking solutions that facilitate the transmission of information from fields to farmers and decision-making devices. It is conceivable that IOUT not only provides on-site monitoring capabilities (eg, soil moisture, salinity, temperature), but when interconnected with existing field machinery (irrigation systems, combines, and seeds) allows complete field autonomy and paves the way for improved solutions food production. In IOUT, communications can be made through soil and plants from underground devices, and information obtained from the field can be sent to cloud computing via the Internet for real-time decision making. Due to the unique requirements of IOUT applications; i.e. information from the soil, work in distant crop fields, radio communications

through plants and soil, exposure to the elements; Current wireless over-the-air solutions face significant challenges because they are not designed for these conditions. As such, the IoT has also given rise to a new type of wireless communication: underground wireless communications, where radios are buried in the soil and wireless communications are conducted partly through the soil. The integration of UG communications with IOUT will help conserve water resources and improve crop yields. Moreover, advances in IOUT will benefit other applications including landslide monitoring, pipeline assessment, underground mining and border patrol [30].

- In today's world of progress, the embedded system plays a major role in the real-time system. The intelligent connected IOT solution provides secure two-way communication between devices. This system creates a real-time bus stop automation system using Radio Frequency Identification (RFID) by deploying the appropriate devices at each possible stop between the source and destination. The device is able to track every bus registered in the transit area at the stations, which has an RFID tag. Bus information is taken care of using RFID and current location being tracked using GPS. The hardware system, if installed, can record the time of arrival and departure of buses in real time. The system can reduce the efforts of the conductor that is assigned to a particular bus. The data is to split and distribute the different bus stops on alternate routes to get a good result from them. This system provides accurate and correct entries for buses. With the development of regular public transportation, this prototype enables a more efficient and time-saving system.[31]
- Perhaps one of the most important roles in which the IoT is used is waste management, especially household waste, as the use of the smart container, which is a solar-powered waste compression box. The sensor monitors the amount of waste accumulated and

automatically compresses the waste so that it can hold up to 10 times as much as normal bins. It also transmits fill level information wirelessly to the controller. It can be used with all types of containers such as mobile containers, large waste containers and even underground bins. It senses how much waste is inside the bin and transmits fill level information wirelessly to the controller. Administrators and drivers can log into server networks to access data analytics and monitor smart box filling levels in real time. Server networks notify administrators on transferring denials when groups are needed and create optimized paths for each group. So, instead of blindly collecting waste using fixed routes and schedules, drivers can learn about smart waste collection routes and schedules based on where collection is actually required. This smart solution helps administrators need fewer trucks, less fuel and less time for their batches, reducing operational costs by up to 80%. It is the smart solution designed to save money and keep streets clean [32].

- The use of the IoT in managing energy consumption is one of the most important modern applications in what is known as smart cities, where the energy management system consists of smart buildings, which contain sensors to collect information about energy consumption, temperature, humidity and others. Initial treatment was carried out and then referred to the control units, which In turn, it processes and manages the data received from the various sensors. Usually in smart buildings, there are several systems that work in coordination with each other, such as gas control systems, heating, cooling and others, so that the result is control and management of energy consumption in an optimal way in the building. The smart energy grid is a key component of strategies towards a sustainable energy future. Driven by the use of the IoT, they can not only facilitate the integration of renewable energy sources and electrification of transportation,

but also provide new value-added services related to energy. In particular, the shift in energy management will be driven by the design and deployment of smart grids. Smart power grids have the potential to extend their capabilities through intelligence and data flow. With the help of the IoT, energy management in smart power grids can reach every corner of the city and will stimulate smart grid infrastructure. Smart Energy plus Internet is a new development of energy management systems with a deep integration of the Internet, energy production, transmission, storage, consumption and marketing [33].

- Perhaps one of the important applications of the IoT, especially in crowded cities, is the management of parking stations. Smart parking systems are categorized into different categories that each have a different purpose and use different technologies in vehicle detection. Drivers and operators benefit from smart parking systems. Drivers use the system to find the nearest parking space and parking operators can take advantage of the system and the information collected to agree on better parking patterns and a better pricing strategy. For example, since parking lot demand is unstable, using a dynamic pricing approach, which takes into account the time and type of customers, can help operators increase their revenue. Smart parking enables many attractive services such as smart payment/reservation, which can greatly enhance the experience of both drivers and operators. Moreover, the smart parking system helps prevent unauthorized use of vehicles, as it increases security measures in parking lots. Moreover, smart parking can play an important role in providing a clean and green environment by minimizing vehicle emissions through decreasing delays in finding vacant parking space [34].

4. Some sustainable development programs in Libya using IoT technology

Libya is a country that suffers from many problems in all fields and needs tremendous efforts in all areas of sustainable development. Therefore, exploiting the technology of the IoT to implement some sustainable development programs needs to prioritize these programs so that the focus is on the most important before the important, although all programs are important and interrelated in one way or another.

From the researcher's point of view, the programs that touch the daily life of the citizen have priority over the rest of the programs. Therefore, the areas of health, education and services are among the most important areas that must be focused on and the search for optimal ways to implement them by exploiting the technology of the IoT and benefiting from the experiences of other countries in this field. This will be addressed in this Research for the field of health care, as a result of its great importance in people's lives and the deterioration of health services in Libya.

4.1 Healthcare field

Many countries have exploited the technology of the IoT in the field of health care, due to the critical importance of this field in people's lives. The following is some clarification of some of the services in which this technology is exploited in this field:

An Adverse Drug Reaction (ARD) is an injury caused by taking a drug [35]. This may occur after a single dose of the drug, prolonged administration, or a combination of two or more drugs. Since the ADR is generic in nature, i.e. not specific to drugs for a specific disease, there is a need to separately design some common technical problems and their solutions (called ADR services). An IoT-based adverse drug interaction has been suggested in [36]. Here the patient terminal

identifies the drug via barcode/NFC-enabled devices. With the help of an intelligent pharmacy information system, this information is then coordinated to sense whether the drug is compatible with the sensitivity and electronic health record system.

Community health care monitoring comes with the concept of creating a network that covers an area around the community. This could be an IoT-based network around a municipal hospital, a residential area, or a rural community.

The sequencing of many of these networks can be realized as a collaborative network structure. In this regard, a specialized service called community health care is inevitable to meet the collective technical requirements as a single package. The community medical network structure can be viewed as a 'virtual hospital'. The approved health information service system was considered based on a functional framework of a four-tier structure, a method for sharing data between medical facilities and a service platform for obtaining health records and obtaining remote medical advice.

Raising awareness about children's health and educating the general public as well as children themselves about the needs of children with behavioral or psychological problems and their family members is critical. This has motivated researchers to develop a specialized IoT service called Children's Health Information to meet this need in an efficient manner. In this regard, an interactive code has been proposed which has been placed in the children's ward that provides children's health information services aimed at educating, entertaining and empowering children in hospitals, and a mobile health service based on the IoT that can encourage children to develop good eating habits with the help of their teachers and parents.

The use of semantics and ontology to share large amounts of medical information and knowledge has been widely considered. The broad potential of medical semantics and ontology has received close attention from designers of healthcare applications based on the IoT. Putting medical semantics and ontologies at the top of the IoT requires

a separate service called Semantic Medical Access (SMA). A semantic medical monitoring system based on IoT sensors has been proposed IoT healthcare applications drive medical bases to analyze massive amounts of sensor data stored in the cloud. A ubiquitous data-access method has been proposed that can collect, integrate, and interoperate IoT data for emergency medical services.

There are many emergencies that significantly involve healthcare problems, including adverse weather conditions, transportation accidents (flights, ships, trains, and vehicles), collapse of earthen sites, and fires, among others. In this context, a dedicated service called Indirect Emergency Health Care (IEH) can offer a range of solutions such as information availability, change notification, post-incident actions, and record keeping.

An Embedded Gateway Configuration Service (EGC) is an architectural service that connects network nodes (to which patients connect directly), Internet (to which requested servers and clients connect directly), and other medical equipment. From a service perspective, although a gateway may appear with different characteristics, this requires some common integration features depending on the specific purpose of the published gateway. In this regard, the concept of an EGC service becomes relevant. As part of the ubiquitous healthcare system, there is a good example of EGC where the service allows automated and intelligent monitoring. A personal mobile gateway is used for an IoT-based medical sensor network, and the question of how to implement an IoT gateway using mobile computing devices is discussed [35].

There are many applications that depend on the IoT in the field of health care, including:

1. Glucose Sensor

Diabetes is a group of metabolic diseases in which glucose (sugar) levels in the blood rise over a long period. Blood glucose monitoring

detects individual patterns of blood glucose changes and helps plan meals, activities, and when to take medications. A method is proposed to configure mobile IoT for non-invasive glucose sensing on real-time basis. In this method, sensors from patients are connected through IPv6 connection to respective healthcare providers. There is what is known as the utility model, which is a transmitter to transmit collected physical data about blood glucose based on IoT networks. This device includes a blood glucose collector, a mobile phone or computer, and a back processor. In addition, an IoT-based general medical acquisition detector that can be used to monitor glucose level has been proposed [35].

2. ECG monitoring

Electrocardiogram (ECG) monitoring, that is, the electrical activity of the heart recorded by electrocardiogram, includes measurement of simple heart rate and determination of the base rhythm as well as the diagnosis of multifaceted arrhythmias and insufficient blood supply to the myocardium. The IoT application for ECG monitoring has the potential to give maximum information and can be used to the fullest. A number of studies have explicitly discussed IoT-based ECG monitoring. One innovation in this field is an IoT (IoT)-based ECG monitoring system consisting of a portable wireless transmitter and a wireless receiver processor. The system integrates a self-research method to detect abnormal data such as the ability to determine heart function on a real-time basis. A comprehensive detection algorithm for ECG signals is located in the application layer of the IoT (IoT) network to monitor the ECG [35].

3. Blood pressure monitoring

The question of how to combine a sphygmomanometer and a mobile phone with proximity technology is addressed as part of IoT-based blood pressure monitoring. A stimulus scenario in which blood

pressure must be systematically controlled remotely is presented by showing the structure of communications between a health center and the main health center [35].

4. Body temperature monitoring

Monitoring body temperature is an essential part of health care services because body temperature is a critical vital sign in maintaining homeostasis. The mobile IoT (IoT) technology was used using a body temperature sensor, where a typical sample of the achieved body temperature changes is presented, which shows the successful operation of the IoT system by the developed mobile phone. A temperature measurement system has been proposed based on a home gateway through the IoT where the main gateway transmits the user's body temperature with the help of infrared detection. Another IoT-based temperature monitoring system has been proposed. The main system components responsible for temperature recording and transmission are the RFID module and the body temperature monitoring module [35].

5. Oxygen saturation control

Pulse oximetry is suitable for indirect and continuous monitoring of blood oxygen saturation. The integration of IoT with pulse oximetry is useful for technology-driven medical healthcare applications. A survey of healthcare services based on Constrained Application Protocol (CoAP) discusses the potential of IoT-based pulse oximetry. Pulse Oximeter Function Wearable Wrist Pulse Oximeter This device comes with a Bluetooth health device pro based connection, and the sensor connects directly to the Monere platform. An IoT-enhanced low-power/low-cost pulse oximeter has been proposed for remote patient monitoring as this device can be used for continuous monitoring of patient health via an IoT network. Wearable pulse

oximetry can be adapted for health monitoring using a wireless sensor network with the IoT [35].

6. Rehabilitation system

Since physical medicine and rehabilitation can enhance and restore the functional ability and quality of life of those with some physical impairment or disability in general, they are a vital branch of medicine. The IoT has the potential to enhance rehabilitation systems in terms of alleviating problems associated with an aging population and a shortage of health experts. This design successfully demonstrates that the IoT can be an effective platform for connecting all the resources needed to deliver real-time information interactions. IoT-based technologies can constitute a worthwhile infrastructure to support effective remote consultation in comprehensive rehabilitation. There are many IoT-based rehabilitation systems such as Integrated Application System for Prisons, Rehabilitation Training for Hemiplegic Patients, Smart City Medical Rehabilitation System, and Language Training System for Childhood Autism [35].

7. Wheelchair management

Several researchers have worked to develop fully self-propelled smart chairs for people with disabilities. The IoT has the potential to accelerate the pace of work. A health care system for wheelchair users based on IoT technology has been proposed. The design comes with Peribody Wireless Networking integrated with different sensors whose functionality is tailored to IoT requirements. A medical support system has been implemented that takes into account Peer-to-Peer (P2P) and IoT (IoT) technology. This system provides chair vibration control and can detect the condition of the wheelchair user. Another worthy example of note for the development of the IoT-based wheelchair is the connected wheelchair designed by Intel's IoT division. This development ultimately demonstrates that standard

'things' can evolve into connected, data-driven machines. This device can monitor the vitals of the individual seated in the chair and collect data about the user's perimeter, allowing to classify the accessibility of the site [35].

8. Medication management

The problem of drug non-compliance poses a serious threat to public health and causes huge financial waste around the world. To address this issue, the IoT offers some promising solutions. A smart medicine box packaging method has been proposed for IoT-based drug management. This method entails a prototype system and validation of the system by field trials. This packaging method comes with airtight sealing based on dismantling materials controlled by radio communications. An e-health service architecture based on RFID tags for a drug control system is being delivered via the IoT. Here the implementation of the prototype is shown, and the ubiquitous drug control system has been specifically designed to provide ocean-based living solutions [35].

In the pharmaceutical industry, counterfeit drugs cause a costly and potentially fatal problem. Infrared and radio frequency identification (RFID) technologies are a way to address some of the similar problems that can track and monitor drugs without direct contact. In addition, RFID can manage drug-related processes to quickly update inventories, and has a very low response time. By using RFID technology, as well as electronic product code standards and linking them to the Internet, it is possible to obtain a drug control system, as well as obtaining a lot of information related to the doctor, nurse, medication, patient, hospital and pharmacy [36].
Fluctuations and deviations in temperature are a result of limited techniques, inaccurate temperature monitors, and human error. Accordingly, solutions that support the IoT have been proposed to reduce the risk of wasting pharmaceuticals due to temperature

fluctuations. Proposals for the implementation of the IoT have been developed and the impact of each of the challenges mentioned has been specifically identified. The proposed framework is based on the IoT and three main themes (pharmaceutical industry, cold chain and IoT). When compiling data for this proposal, human error, technology, temperature control, infrastructure, and business challenges were identified. This study concluded that companies can attach IoT devices to the secondary packet and upload data on temperature, GPS, humidity, shock, etc. instantly via the mobile network anywhere and anytime. Finally, the study demonstrated that IoT-enabled solutions are useful for better mitigating temperature anomalies. Thus, they concluded that new IoT technologies will improve cold chain management in terms of data collection, data sharing and decision making [36].

Due to the large size and variety of drugs makes the process of administration more complex due to the variety of their types and functions. To improve drug inventory management, introduce the use of the IoT to form a theoretical framework for intelligent inventory. This framework relies on Arduino boards, sensors, and Near Field Communication (NFC) to improve the performance of drug inventory management. The IoT architecture includes communications, accounts, and peripherals. To exchange data, the NFC reader connects to the host and simultaneously sends the data to the database. After reading the database, the parameter indicating the correct location will be sent to the personal computer (PC). After completing this process the overall process can be categorized into three main scenarios, drug storage, pickup and inventory. The results showed that the proposed framework is effective and can improve drug stock management [36].

Therefore, using IoT technology, we can improve the efficiency of pharmaceutical care, reduce medical errors, control medical costs, save time, and develop more innovative ideas to help and provide services to patients and improve the patient's medical experience. In

addition, the IoT provides great opportunities to support decisions related to medicine and training.

One of the areas in which IoT technology can be exploited is the continuous monitoring of patients' health. An increasing number of devices, tools, and applications are being used by IoT-based wearable sensors for various monitoring applications to avoid preventable deaths due to hospital errors or other related errors. IoT-enabled healthcare monitoring may transform the healthcare industry in terms of improving access to patient information and providing qualified patient care through continuous monitoring from anywhere, anytime. Via the IoT, clinicians can access and store patient information and analyze stored data to monitor and track patients.

9. Mobile health services

Given the wide spread of mobile phones and the largest percentage of the population owning mobile phones, the focus on exploiting this technology to provide better health services to citizens, especially in remote and rural areas, is one of the most important factors that help create a sustainable health care program. This is known as mobile health. Some studies [37] have confirmed that there are social benefits to investments in IoT health technologies. For example, a study conducted in developing countries on the benefits of e-health in 11 public and private healthcare delivery institutions of various sizes and settings (rural/urban) revealed that investing in e-health can contribute 50-80% to reducing medication error rates, Increased use of prescription and generic medications by 30% and patient screening and preventive health care procedures by 40%.

The feasibility of using IoT technologies to support health systems in remote areas also depends on smart partnerships. Digital health is an emerging field for operators. It requires a mixed set of ICT and health skills and resources and a partnership-based model. If IoT health technology opportunities are fully exploited, related organizations will

have to proactively build strategic partnerships and create sustainable and collaborative health models. These approaches can offer a range of different strengths and capabilities that facilitate the delivery of smart healthcare in remote areas. Training and awareness are equally important components to facilitate the acceptance and use of the new systems among health workers. Health professionals who have difficulties understanding and using digital health technologies may have negative perceptions about their usefulness and will be less likely to accept these interventions. Providing training can ultimately contribute to shaping their digital literacy, reduce anxiety about making mistakes, and encourage the use of digital systems and devices. Training should be reinforced in the basic processes of inventory management, control, contact tracing, prescribing, and distributing inventory. It is important to note that one of the ideal IoT health solutions for rural healthcare is working with mobile phones through text or voice messages. However, to ensure that the messages are well read and understood, the solution must be adaptable to the cultural and linguistic features of the rural population. There are health and wellness apps that are widely available as of now, and many of them currently lack multilingual functionality. The development of health applications with features that are adaptable to rural culture provides a great opportunity to accelerate their adoption. Most importantly, these solutions must be cost-effective.

5. Conclusions

This study was exposed to the role of the IoT in implementing sustainable development programs in general. It also addressed the effective role that this technology can play in some vital areas of sustainable development that directly and permanently touch people's requirements, namely, the areas of health, education, transportation and services. The role of this technology in helping to implement some sustainable development programs in Libya was discussed, and

the importance of this role, given the current situation in Libya and the neglect and shortcomings it suffers from. The focus has been on the health field, as health services in Libya are very poor, and all citizens suffer from deteriorating health services. The study touched on some applications and services that can be provided by IoT technology to raise the level of services and health care, especially for chronic diseases such as blood pressure and diabetes, which are widely spread in Libya. This study also touched on the experiences of some countries that can be benefited from, whether at the regional or international level.

Through this study, we can conclude the following:

1. The use of technology to provide services has become a necessity.
2. Exploiting IoT technology helps to provide better services in a faster time and at a lower cost.
3. Using the IoT to help implement sustainable development programs covers many shortcomings of the responsible authorities.
4. The IoT provides a lot of important services, especially in the field of health care, to monitor chronic diseases such as blood pressure and diabetes, as well as to exploit smart phones in these operations.
5. The IoT has an effective role in managing medicines in order to save effort and money and this enhances the efficiency of pharmaceutical care.

6. Recommendations

1. The responsible authorities represented in the Presidency of the Government and the Ministry of Health must develop programs and plans to ensure the exploitation of this technology in the health field as well as other fields.

2. As a result of the effective role played by IoT technology in accelerating the completion of sustainable development programs, the responsible authorities must allocate sufficient budgets to introduce this technology in sustainable development programs, especially since Libya is one of the countries behind in implementing these programs.
3. Real training and qualification for the optimal use of this technology in implementing everything related to sustainable development programs in the health field because of its paramount importance on the life of the citizens, as well as working on the rest of the sustainable development programs in other fields.

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5

Occupational Noise Level of Semolina Purifier Machines

Occupational Noise Level of Semolina Purifier Machines

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Abstract

Small and medium factories in the field of grain grinding emit high levels of noise, which have harmful effects on workers, so this noise must be measured, and analysed to understand and control noise levels, and reduce its impact on workers, and also its impact on the decrease in production rates in the factory and reduce the life of grinding machines due to high vibrations. This paper provides an analytical study of the signals recorded by the microphone system connected to a high-speed data collection system, the power spectrum of the noise emitted for the number of seven wheat grain mills for the production of semolina (couscous), located in the city of Tripoli, Libya, was calculated. The study also included the assessment and measurement of the noise sound pressure level [dB] in this semolina factory. The results showed that, the noise levels were measured for all milling machines ranging from 92 to 96 dB at a distance of one meter away from the grinding machine, these values were higher than the permissible safety limit of 85 dB for 8 hours per shift. The results also show through power spectrum that the dominant frequency emitted by the machine does not exceed 10 Hz. This meant that the powerful and main source of the grinding machines was emitted by a sieve that moved at a slow speed.

Keywords: *Noise, power spectrum, milling machine, sound pressure level.*

1. Introduction

Environmental pollution can generally be defined as the presence of a pollutant in the environment that is likely to harm the environment or human health. As such, pollutants take many forms. They include not only chemicals and gases emitted by fossil fuel combustion or radiation, but also noise at different levels, especially noise from machinery in small, medium and large factories. The number of potential pollutants is therefore innumerable. The link between pollution and health is both a complex and an emergency process, in order for pollutants to have an impact on health, individuals exposed to pollution must receive noise on special care to minimize its danger to them. Noise also has other negative aspects on the production machines themselves from high vibrations which are the reason for the occurrence of this high level of noise, which reduces the production process and also reduces the life of the machine. The number as well as the power of noise and vibration sources has been increases as a result of the development of industry in the last decades. Thusly, the grade of pollution for many work places and even for some large adjacent areas [1, 2].

The media of generating noise is Industrial machinery and processes. The sources of their noise include; rotors, stators, fans, vibrating panels, turbulent fluid flow, impact processes, electrical machines, internal combustion engines and so on [3,4]. Noise and vibration that are beyond certain limits that adversely affect the safety in industrial activities and reduce the products' quality has been scientifically investigated. In industrial environment, noise the human body has been highly influenced by noise emissions. They affect the ability to work with technical, economical, medical, social implications [5]. The Australian Environment Council, 1988 [6] stated that not only the

noise pollution can damage hearing but also it can evoke other psychological, physiological, and possibly pathological reactions.

The intensity of noise and duration of exposure correlates proportionally with the range of damage on human's health due to the occupational noise. In industrial workplaces, the noise remains a common environmental pollutant and has been considered a constant issue since the Industrial Revolution [7]. Consideration of noise pollution and human health is taken in the account by some organizations. They have established level limits of noise intensity beyond which isn't permitted to stay in the dangerous pollutant spaces. This includes but not limited to the Department of Licensing and Regulatory Affairs [8], and Occupational Safety and Health Administration (OSHA) [9]. As shown in Table 1, the maximum exposure time is set to 8 hours a day by USA at a continuous sound pressure set of 90dB. Based on OSHA regulations, any incremental increase of 5 dB in noise level correlates with a cut in half of the allowable exposure time. (Olishifski and Standard, 1988)[9]. The World Health Organization WHO (2001) [10] has set a recommended standard for noise intensity level at working spaces.

Table 1: dB noise level by the time authorized hours per day [8]

Duration/day (hours)	Sound level dB(A) (Slow response)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25	115

At a working area consisting of eight hours shifts exposed to an excess of 85 dB (A) can predisposes workers to the NIHL [11]. Noise-Induced Hearing Loss is considered a defect in hearing aid due to excessive loud noise exposure. About 30 million USA workers are actively encountering an extreme noise level at their worksite [7]. This exposure to high levels of noise will lead to significant loss in hearing which results into financial crisis of losing hundreds of million dollars annually (NIOSH, 1998)[12]. Additionally, the World Health Organization concludes 4 million US dollars of daily damage [13].Statistics conclude that 12-15% of Germany's working population are exposed to hazardous noise level that is above WHO (2001)[10]. Higher percentages are seen in Egypt, where 70% of employees are continuously in an hazardous noise level environment [14]; and Kenya with big percentage of 75.8 [15].

Many field studies were conducted for different kinds of factories regarding this issue. The results of the Olishifski et al [9] study revealed that with a number of sampling located at 50 cm, the noise level above OSHA permissible noise exposure limit. Thus the workers may face temporary hearing loss and the prolonged to these noise levels can lead to permanent hearing loss and other non-auditory effects. Also as respect to 65 flour mill workers surveyed during the study, 70.76% reported a hearing problem, 23.07% headache at work as well as 7.69% workers headache remains after completion of work [7].

Research work has been done in India. Prasanna et al (2008) [16] have been study the main occupational hazards of noise for the workers in rice mills during the operation of various machines. Workroom noise survey had been carried out in eight famous rice mills in the North East region of India which were built during the period between 1980 and 1985. The region's rice mills. The results showed that the sound-pressure level (SPL) in the workrooms of the rice mill varied from 78 to 92 dBA. Of 26% of the total workers were exposed to noise

exceeding 85 dB. Thus about 26% of all workers felt that noise interfered with their work as well as about 49% of workers mention that noise interfered with their conversation. Their study concluded that loud noises in rice mills which workers are exposed to will highly lead to a detrimental effect on their health. Even though proper measures of noise control has been taken, preventive maintenance of machines should be done to every rice mill.

Noise pollutant emission issues did not limited to large machine factories but also expanded to small and medium Enterprises (SMEs).For instance, Maize milling SMEs produce high levels of noise that can have adverse effects on human's thus requiring control. They reported that the noise measurements in 41 SMEs were recorded from 89-103 dB_A in DSM and 92-103 dB_A close to the milling machines. Thus these values consider to be higher than the safe level of 85 dB_A for 8 hours working shift. Moreover, the measurement revealed high noise level in the immediate neighbourhood of the milling plants. Therefore, it is important to implement the suggested administrative and technical solutions to minimise this problem [17].

Lastly, In other study performed by Bies and Hansen, (2009) [18] illustrated that inside the factory, The reduction of the sound pressure level can be effectively achieved by decreasing the sound power emitted by the sound source and/or acting on sound absorption and insulation .However, changing the sound source is not advisable in most cases because this improvement may adversely affect the machine and its operation. Thus leading to low efficiency, longer processing time and consequently to low productivity. The principle objectives of this research are to investigate the noise emissions signals in terms of power spectrum, and also measuring the sound pressure levels (SPL) in dB of seven semolina purifier machines in milling factory in Tripoli – Libya.

2. Experimental setup

The overview of the experimental set up of this test rig is shown in Figure 1. It consists of a seven semolina purifier machines in milling factory in Tripoli, a microphone system and data collection system, and a sound level meter.

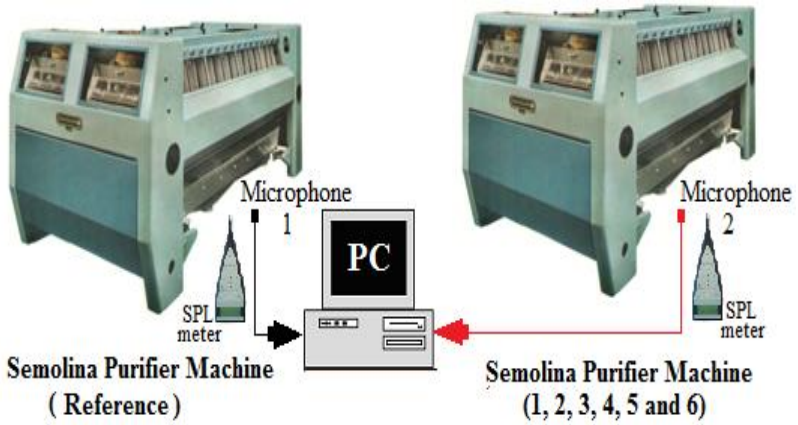

Figure 1: Overall experimental setup of the semolina purifier machines and microphones system

The purifier model "MQRE 5D" is a machine used to separate the particles of bran from semolina coming from plan sifters of breaking, Figure 2 show the semolina purifier machine. This machine is used to clean and grading the finished products such as semolina and middle wheat from durum and sizing and medium wheat from hard and soft wheat. It is also used in the production of low ash flour and special granular flour, etc.

Figure 2: Semolina purifier machine.

To find out the lowest noise emission of the semolina Purifier machine selected in this study, the noise was measured for seven semolina Purifier machines of the same manufacturer, using a sound pressure level device in decibels, Figure 3 shows the sound pressure meter used in this study. As for the rest of the machines, they are numbered with Arabic numerals 1, 2,3,4,5 and 6. In this research, the lowest noise level was 92.5 dB, which unfortunately is considered above the permissible level of noise in factories, which is 85 dB. This machine is only to be a reference semolina Purifier machine for comparing the analysis of the noise signals emitted between the reference machine and other machines using microphones, where one of the microphones is installed on the reference machine at a distance of one meter and the other on the machine to be compared at a distance of one meter, and the comparison is in the same way for the rest of the machines.

Figure 3: Sound pressure level meter.

3. Results and Discussions

Cereals are produced from a very large family of flowering plants referred to as herbs. Cereals include corn, wheat, rice, oats, barley and corn, all commonly referred to as cereals. Soybeans, lentils, cotton seeds and alfalfa are not cereals, but, nevertheless, they are classified under the category of oilseeds or animal feed. In this paper, a factory was chosen to grind wheat grains to produce semolina use for couscous meal, which is one of the main food and traditional food in North Africa, especially in Libya, for the purpose of analysing the noise from these mills. The study was focused on spectral analysis of the acoustic signal emitted by seven machines, where the machine with the lowest noise level in this plant was selected, and considered as the reference for comparison with other machines.

The noise was recorded using the microphone system connected to the computer through a high speed sample rate data acquisition system technology, then analysed using a LabView computer software. The results are represented in the power spectrum of each mill, and its comparison with the reference mill, in order to clarify the difference in the level of sound intensity and frequency of each machine. Mechanical noise is a phenomenon common in most of the factories,

which require careful analysis when considering the impact on workers and working environment.

The experiment was conducted on seven machines in the factory using a sound pressure level meter (dB). In order to find out the level of noise generated by the machines, in this study the lowest noise level was selected from them, and referred to as the reference machine, which had a noise level of 92.5 dB. The rest of the machines were compared to the reference machine. Two microphones were installed, one in the reference machine and the other on the rest of the machines, where comparison is made between the reference machine and other machines.

Figure 4 shows power spectrum of recorded acoustic signals where the first microphone was installed on the reference machine and the second microphones was installed on machine 1, 2, 3, 4, 5 and 6 located one meter away from machine. In the same time the sound pressure level meter was placed closed to the microphone to measure SPL of each machine in dB. Form the Figures; the dominant frequency are market on each machine in the sub-figures and its power spectrum amplitude in [Vrms] Table 2 show the dominant frequency, and sound pressure level for all machines and compared with the reference machine.

Table 2: dominant frequency, and sound pressure level for all machines and ref. machine.

	Mach. 1	Ref.	Mach 2	Ref.	Mach 3	Ref.	Mach 4	Ref.	Mach 5	Ref.	Mach 5	Ref.
Dominant frequency [Hz]	5.6	5.6	5.41	5.41	5.42	5.42	5.41	5.41	5.41	5.41	5.41	5.41
SPL [dB]	93.4	92.5	93.1	92.7	94	92.7	95.4	92.9	93.8	92.7	93.6	92.6
Vrms [Volt]	1.19	0.247	0.62	0.13	1.9	0.337	2.86	0.51	1.92	0.229	1.47	0.27

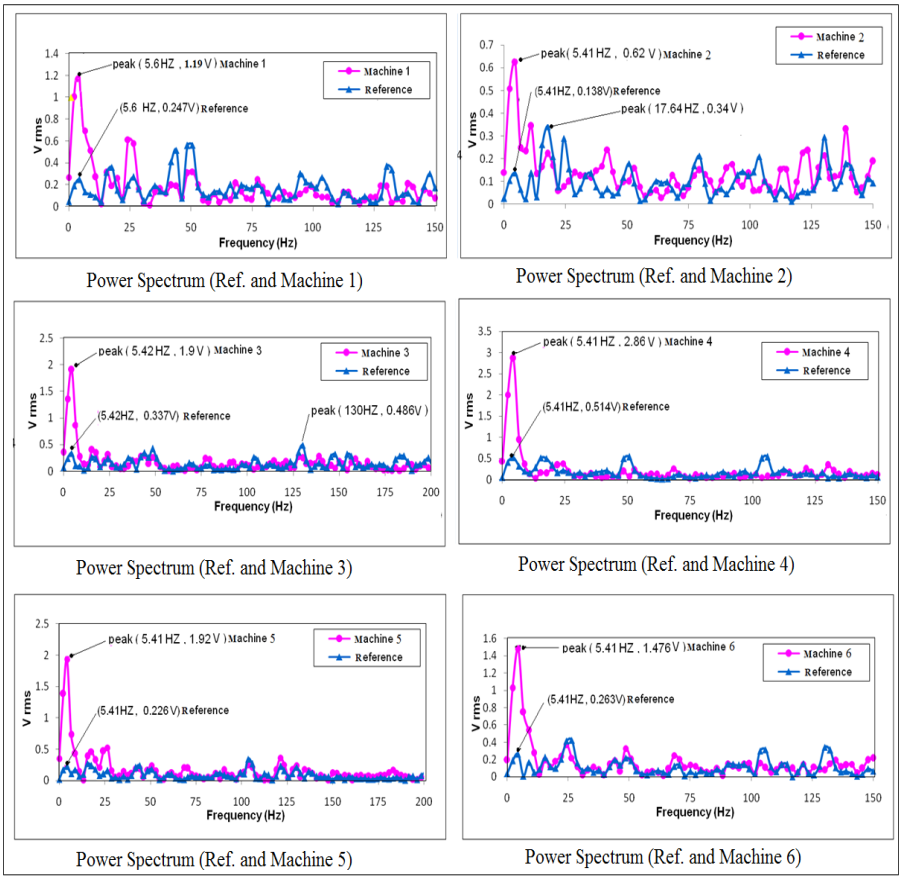

Figure 4: power spectrum analysis for all machines and ref. machine.

Finally, the grain milling machines were compared to the reference machine in terms of noise level and power spectrum analysis. It shows that there is a large discrepancy between the machines, some of them are close to the noise level of the reference machine and some of them are higher. This is due to the bad condition of the machines and their lack of maintenance, which emits a high noise level. Which in turn will cause a decrease in production and also a decrease in the life of the machine. It also causes noise pollution to the factory, causing dangers to the auditory system of factory workers. Figure 5 shows the

sound pressure levels in dB for all machines and compared to the reference machine.

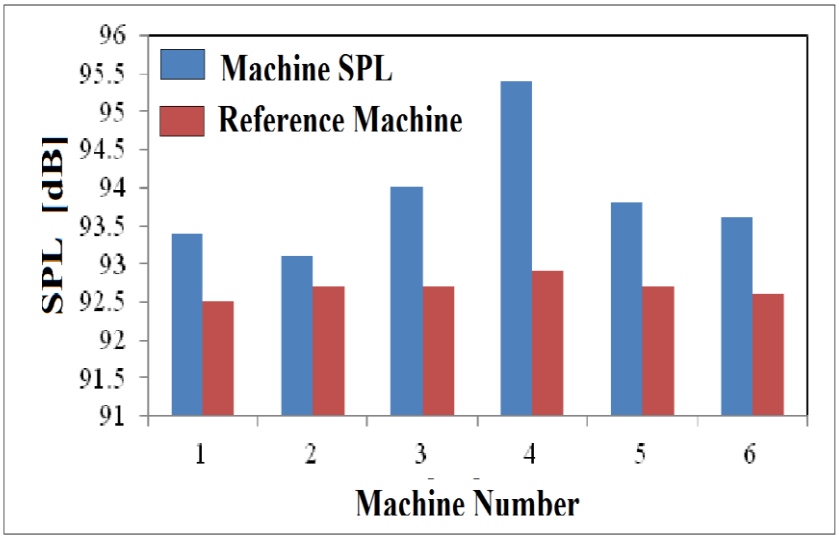

Figure 5: Sound pressure level (SPL) for all machines and ref. machine.

4. Conclusions

The noise survey revealed the seven cereals mills selected at one of the main milling plants in Tripoli, Libya, to produce semolina used in one of the main foods in North African countries couscous. This paper was concerned with one of the acoustics pollutants (noise) in semolina milling factories emitting from the machines, because of its direct impact on the workers and also on the efficiency of machines as a result of high vibrations due to the lack of the periodic maintenance of machines, which contributes to reducing production and reducing

the life of machines. After analysing the results of this study, some conclusions were summarized as follows:

- From the study, it became clear to us that there is a difference in noise levels in all machines, and all of them are above the internationally permissible level, that is, higher than the maximum permissible 85dB, although these machines have the same (model and age), the reasons may be the period of operation and periodic maintenance that is not cared for. Therefore, it requires addressing, controlling or reducing this level of noise.
- From the analysis of the acoustic signals emitted from machines using the microphones systems, for which the power spectrum of the acoustic signal was calculated, it became clear to us that the dominant frequency for all the emitted noise was at low frequencies, not exceeding 10Hz, It is often sourced from grain sifts after the grinding process.

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6

A Novel CPKM-DLNN Based Deepfake Detection Using EP-SURF and PSKF Techniques

A Novel CPKM-DLNN Based Deepfake Detection Using EP-SURF and PSKF Techniques

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Abstract

Nowadays, due to the improvements in technology, the editing of videos and images by the present generation is more accessible than earlier. Because of their overwhelming impact on the world, distinguishing between real and deepfake videos has become an ultimate issue. Hence, a new CPKM-DLNN-based deepfake detection method is proposed in this work. At first, the input video undergoes synchronous error determination. After that, the input video is converted into frames and audio signals using FFT. Now the contrast enhancement of the frames (image) takes place by Interpolated Double Plateau Histogram Equalization (IDPHE). After that, the facial points are extracted via Edge Preserved-SURF (EP-SURF). At the same time, the contrast-enhanced image is segmented using the VJA algorithm, and the features are extracted. Meanwhile, noise present in the audio signal is removed by the Polynomial Structured Kalman Filter (PSKF) technique. Now, the crucial features extracted from the noise-removed audio signal, segmented frames along with the facial points extracted are further given to the Correlated Probability with Kernel MISH-based DLNN (CPKM-DLNN) classifier for detecting

the deepfake video. The experimental outcomes indicated that the proposed approach obtains the highest accuracy and efficiently identifies the deepfake video without misprediction.

Keywords: *Deepfake, Fast Fourier Transform (FFT), Viola Jones Algorithm (VJA), Extraction, Segmentation, Deep Learning Neural Network (DLNN).*

1. Introduction

Advancement in technology has made significant changes in the field of image and video deep fake manipulation. Deepfake is the combination of Deep Learning (DL) methodology and fake. It means the creation of fake videos using DL via the analysis of any photo-realistic audiovisual content [1]. Lack of lip-syncing, unnatural facial and lip appearance or movements, and irregularity among facial regions like the left and right eyes are the crucial ways of characterizing Deepfakes [2]. Some of the areas where these deep fakes are more popularly used are the creation of fake news content, false pornography, hoaxes, and also imitation in financial and economic matters [3]. Deepfake is generally created by scrutinizing a particular face in plenty of photos or videos. Consequently, Artificial Intelligence (AI) approach is trained with that particular face for its manipulation and after that, the trained face is mapped to that particular person in an image or video using the same AI approach [4]. The creation of deepfakes not only affects the right and reputation of an individual but also highly distresses the privacy of information or image on the internet [5]. Also, because of the increase in the quality and quantity of fake videos, it is quite difficult to distinguish real videos or images from fake ones without comparison [6]. Hence, it is essential to develop deepfake detection techniques for the effective detection and authentication of videos or images.

Deepfake detection involves fake image detection and fake video detection. Face swapping is the most popular image deepfake employed by cyber attackers to gain illegitimate access. Further, the visual artifacts within the video frames and their varying temporal characteristics made the deepfake detection process quite challenging [7], [8]. Hence, various techniques are utilized for the effective detection of Deepfakes. Earlier, handcrafted feature-based methods are utilized. In handcrafted feature-based methodology, a large number of clues and artifacts are detected using various detection algorithms [9]. Since the existing methodologies detect the deepfake on the basis of certain artifacts or inconsistencies in an image or video, they failed to concentrate on the forgery regions in the detection process [10]. Hence, deep learning techniques are utilized in the effective deepfake detection process. In the deep learning approach, distinctive features are extracted from the corresponding video or image and classified as real or fake using numerous neural network structures. Hence, novel CPKM-DLNN-based deepfake detection is proposed in this paper.

1.1 Problem Definition

Even though the existing research methodologies provide efficient detection of Deepfakes in image or video clips, there exist certain shortcomings that are enlisted further down.

- Most of the existing methodologies perform deepfake detection only based on the movement of the mouth and not based on the expressions.
- Increased Synchronization errors in existing methodologies result in the error output.
- Variations in the expressions might result in varying geometrical values and produce erroneous detection.

To overcome the afore-said issues, novel CPKM-DLNN-based deepfake detection is proposed in this work.

The outline of the paper is condensed into the following sections; section 2 surveys some of the relevant related works, section 3 describes the details and fundamental concepts of the proposed methodology, and section 4 determines the efficiency of the proposed work compared to some of the existing methods, and section 5 concludes the paper.

2. Literature Survey

[11] introduced an efficient XcepTemporal-based Convolutional Recurrent Neural Network (XT-CRNN) technique for the detection of deepfake videos and audio. Here, an XceptionNet Convolution Neural Network (CNN) was used for the representation of the facial features in video frames. These feature representations from both audio and video were then fed into bidirectional recurrent layers for inconsistency detection. Experimental results proved the efficacy of the presented method. However, this system has the limitation that it may be vulnerable to some types of unforeseen attacks.

[12] propounded an Optical Flow-based CNN (OF-CNN) for the detection of deepfake videos. Initially, the Optical Flow (OF) fields were estimated and cropped into a bounding box by processing the video frames. The cropped OF fields were then given as input to CNN for the classification of video frames into tampered or original. Thus, the presented technique exploited the temporal inconsistency problem. But, the system was highly affected by the cross-forgery scenario.

[13] presented Expectation-Maximization (EM) methodology for deepfake detection. Primarily, fingerprints representing the Convolutional Traces (CT) obtained during the generation of the deepfake image were extracted. The extracted features were then fed

into the Random Forest (RF) classifier for effective classification. Thus, authentication and security of the image were well preserved by this approach. On contrary, the presented approach was prone to overfitting problems.

[14] established Spatial Rich Model (SRM) based deepfake detection. In the presented methodology, the incoming video was divided into numerous segments. Then, the selected frames from each segment were combined into two streams. After that, the noises were extracted using SRM filters. Further, segmental and stream fusion was adapted to obtain the data from both segments and streams. Hence, the problem of semantic inconsistency was avoided using this approach. But, presented SRM filters-based deepfake detection was not suitable for detecting low-quality images.

[15] suggested a machine learning-based deepfake detection framework. The presented approach was made of Xception network, Global Average Pooling (GAP) layer followed by CNN. Here, CNN was used to perform feature extraction. The extracted features were then given to the classifier for effective classification. Thus, the utilization of key video frames in deepfake detection reduced the computation time drastically. Nevertheless, the presented approach had memory limitation problems.

[16] employed the Tensor Decomposition-based Deep Neural Network (TD-DNN) method for the fake news detection process. Primarily, the tensor was made by mingling the news with the user, and community information. After that, the news representation was obtained using matrix-tensor factorization. The factors thus obtained were used as features for news classification. Hence, a better classification accuracy of about 86% was obtained. But, the presented approach was not suitable for real-time classification.

[17] ejected a Frame-Temporality stream-based CNN (FT-CNN) for the detection of deepfake videos. Firstly, the frames were extracted from the incoming video and fed into MesoNet. Through MesoNet, the mesoscopic properties were extracted from images. Meanwhile, time dependant residual features were extracted from the temporality-level stream and given into Resnet for effective classification. The experimental results justified the superiority of the presented methodology. However, the scheme still had fundamental compression artifacts .

[18] developed a 3- Dimensional (3D) CNN (3D-CNN) model. Here, Spatio-temporal features were extracted from an adjacent frame sequence in a video. Further, the 3D kernel was multiplied with the cube of stacked successive video frames to obtain information in both spatial and temporal dimensions. The experiment results demonstrated that the presented approach not only addressed the issues of data authenticity and storage but also provided high reliability for deepfake detection architecture. On the other side, the different types of facial re-enactment were not detected .

[19] projected a 3-layered frequency CNN (fCNN) for detecting forged facial images. In this methodology, faces were firstly extracted using a Viola-Jones detector and converted into the frequency domain using (2-Dimensional) 2D Global Discrete Cosine Transform (2D-GDCT). Then, the extracted frames were fed into fCNN for effective classification. The experimental results proved that the presented method was more secure and demonstrated its efficiency by evaluating its performance using various datasets. But, the scheme failed to ensure the reliability of classification.

[20] investigated the Fundamental Feature Extraction Network (FFE-Net) and the Representative lip feature extraction and Classification Network (RC-Net) based deepfake detection. The fundamental information for speaker authentication was provided by FFE-Net,

whereas high-level lip features that discriminate against human imposters were extracted using RC-Net. Further, the Adam algorithm was used to perform the optimization function. Thus, the presented approach was more robust and could be applied to defend against different kinds of DeepFake attacks. However, the scheme had not supported the high dynamic deployment scenarios.

3. Proposed Deepfake Detection Methodology

In recent times, numerous hyper-realistic fake images and videos are created and distributed on these social networks which in turn affected the privacy and peace of the corresponding entity. Hence, a novel CPKM-DLNN-based deepfake detection method is proposed using EP-SURF and PSKF techniques. The structural design of the proposed methodology is displayed in Figure 1.

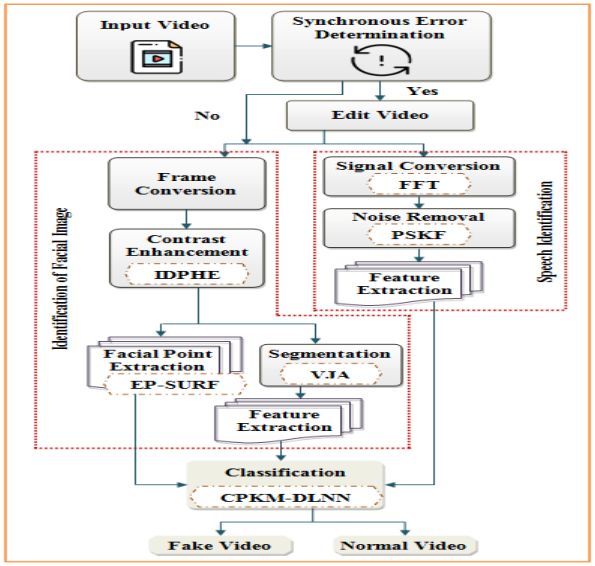

Figure 1: Structural design of the proposed deepfake detection system.

3.1 Synchronization Error Determination

At first, the incoming video is checked for synchronization errors. If the time duration of the video signal (V_{T_s}) is equal to the length of the audio signal(A_{T_s}), then the video is edited to obtain zero synchronization error otherwise, the video undergoes a fake video detection process. The mathematical formulation for the synchronization error determination process is given in (1).

$$\begin{cases} V_{T_s} == A_{T_s}, editvideo \\ V_{T_s} \neq\neq A_{T_s}, fakevideo\ det\ e\ ctionprocess \end{cases} \quad (1)$$

3.2 Identification of Facial image

Firstly, facial images and speech signals are identified from the incoming video. Here, facial image identification involves the following processes.

3.2.1 Frame Conversion

Now, the obtained error-free videos are converted into multiple frames for effective detection. The frames thus obtained are converted into images which in turn undergo a contrast enhancement process. The output obtained at the end of the frame conversion process is specified asV^f.

3.2.2 Contrast Enhancement using IDPHE

The quality of the image thus obtained in the frame conversion step is enhanced in this step. Contrast enhancement is the process of altering the minimum pixel intensity of the image to the maximum. For increasing the contrast of the image, IDPHE is proposed. Normally, in Double Plateau Histogram Equalization (DPHE), contrast

enhancement is mainly based on the upper and lower threshold limits. During the contrast enhancement, the histogram may suffer from the over-enhancement problem. So, to solve this, the methodology uses an interpolation approach for the intensity levels. The process involved in IDPHE is given as follows.

- Primarily clip limit (th^m) for the corresponding two plateaus of the input image histogram $\left(\hbar(V^f)\right)$ is defined using IDPHE. In IDPHE, two points $(p1, q1), (p2, q2)$ are set on the plateau for an effective enhancement process. After that, the local maximum and a local minimum of the peak points are obtained using the following expression.

$$th^m = q1 + (p - p1)\frac{(q2-q1)}{(p2-p1)} \tag{2}$$

Here, $p$specifies independent variable, $p1, q1$ is the value at one point and $p2, q2$ is the value at another point.

- (th^m) is provided with upper clip limit (th^u) and lower clip limit (th^d) values. Among the two clip limits, the upper clip limit (th^u) is utilized for analyzing the local maxima of the histogram of peak points whereas the local minima of the histogram of peak points are achieved via the lower clip limit (th^d) and are written in (3).

$$H(V^f) = \begin{cases} th^u, \hbar(V^f) \geq th^u \\ \hbar(V^f), th^d < \hbar(V^f) < th^u \\ th^d, 0 < \hbar(V^f) \leq th^d \\ 0, \hbar(V^f) = 0 \end{cases} \tag{3}$$

Where, $H(V^f)$ is the histogram obtained using two clip limit.

- The Cumulative histogram equalization of the contrast-enhanced image $\left(C(V^f)\right)$ is given as follows

$$C(V^f) = \sum_{i=0}^{K} H(V^f), 0 \leq V^f \leq m \quad (4)$$

- The contrast-enhanced image obtained using IDPHE $\left(E^{im}\right)$ is detailed in the upcoming expression

$$E^{im} = \left[\frac{A \cdot C(V^f)}{C(m)}\right] \quad (5)$$

In the above expression, A refers to the maximum number of gray levels in an image, and m indicates the total number of gray levels. Thus, the proposed IDPHE avoids the over-enhancement or the under-enhancement of the image and provides the optimal enhancement in the image contrast.

3.2.3 Facial Point Extraction using EP-SURF

After the contrast enhancement stage, facial points are extracted from$\left(E^{im}\right)$. Facial point extraction is mainly used to characterize and localize crucial regions of the face like eyes, nose, mouth, etc. For facial point extraction, the proposed work uses EP-SURF methodology. Speed up Robust Features (SURF) technique is a scale and rotation invariant face point detector. SURF undergoes Interest point detection, local neighbourhood description, and matching phase. However, the utilization of the Gaussian filters in the interest point detection phase results in the loss of crucial information. Hence, the Edge Preserving (EP) methodology is adapted in the proposed work. This integration of EP in general SURF is the so-called EP-SURF. The EP-SURF procedure is described below,

- Initially, interesting point detection takes place. For the detection of an interesting point in$\left(E^{im}\right)$, the Hessian matrix is used. Let

$W(u, v)$ be the point in the contrast-enhanced image. Hence, the Hessian matrix $\left(\Im(W, \alpha)\right)$ is expressed below.

$$\Im(W, \mu) = \begin{bmatrix} S_{WW}(W, \alpha) & S_{WW}(W, \alpha) \\ S_{WW}(W, \alpha) & S_{WW}(W, \alpha) \end{bmatrix} \quad (6)$$

In the above expression, $S_{WW}(W, \alpha)$ indicates the convolution of the laplacian second-order derivative (∇^2) used for preserving the edge of the image and is written as follows.

$$\chi = \Re \cdot \nabla^2 E^{im} \quad (7)$$

Here, χrepresents the detected interesting facial point, and $\Re$stands for constant.

- After the detection of an interesting point, the intensity of the pixels within the neighbourhood of the detected interesting points is described. Then, the description provided regarding the intensity of the neighbourhood pixel is matched with the corresponding pairs. Thus, the facial points extracted are subjected to the CPKM-DLNN classifier for classification.

3.2.4 Segmentation using VJA

Meanwhile, the contrast-enhanced image obtained in section 3.2.1 is segmented using Viola Jones Algorithm (VJA). Due to the efficiency of VJA to work in real-time, VJA is used in the proposed work for segmentation. VJA adapts the following three techniques to perform segmentation. It is explained further down.

Step: 1 to begin with the segmentation process, VJA uses Haar features to divide the contrast-enhanced image $\left(E^{im}\right)$ into rectangular regions of sizes $\times t$. The Haar-like features can easily be computed by

the formation of an integral image $\left(G(i,j)\right)$ at the location (i,j) and are formulated below.

$$G(i,j) = \sum_{s=1}^{i} \sum_{t=1}^{j} E^{im}(s,t), 1 \leq i \leq s, 1 \leq j \leq t \quad (8)$$

Here, $E^{im}(s,t)$ represents the original contrast-enhanced image.

Step: 2 since a large number of haar features are evaluated for each window, the Adaboost algorithm is utilized to reduce the redundancy that might arise between the features. Adaboost approach acts as a classifier in this methodology and it selects only the most relevant features for an effective detection process.

Step: 3 after the selection of the most relevant features, the positive window is determined after passing the initially segmented images through a large number of cascaded stages. In each stage, the regions that are wrongly segmented are detected and hence the false positives are effectively reduced. Hence, the segmented images are modeled asY^{im}.

3.2.5 Feature Extraction

Here, certain important features are extracted from the segmented imageY^{im}. In the proposed methodology, features such as Local Binary Pattern (LBP), Area of the triangle (AOT), Inscribed Circle Circumference (ICC), and Inscribed Circle Area of the triangle (ICAT) are extracted. Thus, the $G-$ number of image features extracted (ν^g) is represented as

$$\nu^g = \nu^1, \nu^2, \ldots, \nu^G \quad (9)$$

3.3 Speech Identification

In this stage, the audio (speech) signal from the incoming video is effectively processed through the following sub-phases.

3.3.1 Signal Conversion via FFT

The audio file in the incoming video is signal-converted using FFT in this step. Fast Fourier Transform is mainly utilized for converting the audio signal $(\hat{A}^z)$ into a certain number of spectral components. Hence, frequency information regarding the audio signal is obtained. The mathematical formulation of the audio signal is given in (10).

$$\hat{A}^z = \sum_{c=-\infty}^{\infty} f(c) e^{ic2\pi\hat{A}^z} \tag{10}$$

In the above expression, $f(c)$ denotes the co-efficient of the Fourier transform, and z represents the time period, and is given in (11).

$$z_1 = \frac{1}{\hat{A}^1} \tag{11}$$

Thus, the Fourier coefficient is defined as follows.

$$f(c) = \frac{1}{\hat{A}^1} \int_{-z/2}^{z/2} \hat{A}^z \, e^{-ic2\pi\hat{A}^z} \tag{12}$$

Hence, the audio file converted into an audio signal using FFT is specified as $\beta(I)$.

3.3.2 Noise Removal by PSKF

After the signal conversion process, noise removal takes place. Here, the noises are removed by smoothing the entire signal. Here, the noises are removed by using the Polynomial Structured Kalman Filter (PSKF). The Kalman filter smoothen the images only based on the specific iteration levels of the filter. It results in an erroneous noise removal process and hence the signals cannot be obtained clearly. In order to balance that, the PSKF function is used. Thus, the noise removed using PSKF $(\beta^*(I))$ can be expressed as

$$\beta^*(I) = \varphi^N(I) \cdot \beta^N(I) + \varphi^{N-1}(I)\beta^{N-1}(I) + \ldots + \varphi^2(I)\beta^2(I) + \varphi^1\beta(I) + \varphi^0 \quad (13)$$

Where, $\varphi^N(I)$ indicates the correlation function.

3.3.3 Feature Extraction

In order to detect the deepfake in the audio signal, it is necessary to detect certain important features from the noise-removed audio signal. Some of the features extracted from $\left(\beta^*(I)\right)$ are Mel Frequency Cepstral Coefficients (MFCC), Linear Predictive Coding (LPC) analysis, and perceptually based Linear Predictive (PLP) analysis. Hence, the $H-$ number of features extracted from the audio signal is written as

$$\upsilon^h = \upsilon^1, \upsilon^2, \ldots, \upsilon^H \quad (14)$$

3.4 Classification via CPKM-DLNN

In this section, deep fakes are effectively classified using the features extracted from the segmented image and the noise-removed audio signal along with the extracted facial points. Deep Learning Neural Network (DLNN) is made of an input layer, a hidden layer, and an output layer. In DLNN, the weight values are randomly initialized. This random weight initialization causes the classifier to produce a false detection. To overcome such failure, initially, the correlation between the neurons is calculated and the probability of the one with the strongest correlation to the total number of neurons is determined for the weight initialization, and also the activation function used in DLNN undergoes a gradient vanishing problem. Hence, the kernel MISH activation function is utilized in the deepfake detection system. This merger of correlation probability in weight initialization and Kernel Mish activation function in the general DLNN is named CPKM-DLNN and is shown in Figure 2.

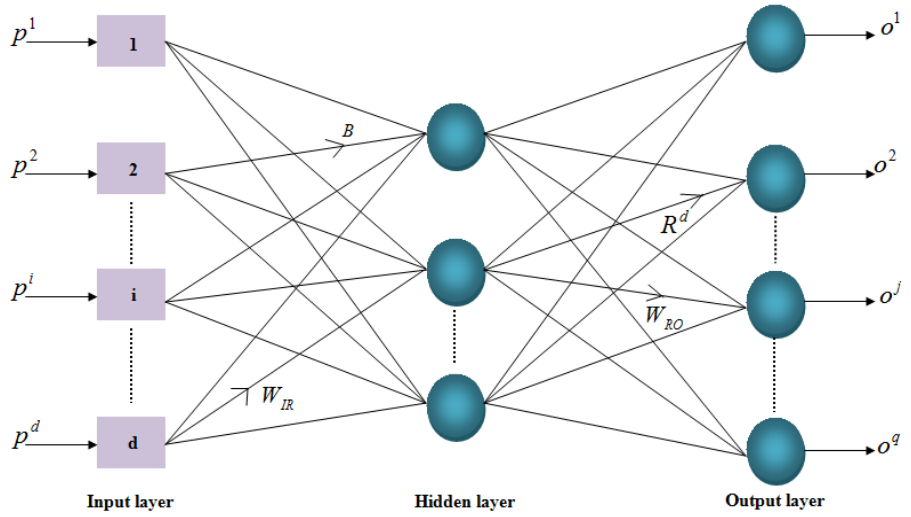

Figure 2: Structure of proposed CPKM-DLNN

Step 1: DLNN is made of the input layer(P^{in}), the output layer(O^{out}), and the number of the hidden layer between$0 < d < D$. The features extracted are given as input to the input layer where the input signal is multiplied by the weight function and the product is summed up with the bias value to get the output. Thus, at each node, the input(X_c), is multiplied by the input-hidden weights. The hidden layer output (R^{hid}) is given by,

$$R^{hid} = \eta\ [\sum_{d=0}^{D+1}\ B^d + \sum_{c=1}^{L} X_c w_{IR}] \tag{15}$$

$$X_c = \{\chi, v^g, v^h\} \tag{16}$$

In equation (15), B^d specifies the bias value, w_{IR} means input-hidden weight value, and $\eta[R^d]$ is the Kernel mish activation function and is illustrated in equation (17),

$$\eta(R^d) = R^d \cdot tanh[ln(1 + exp[-\gamma\|R^d - \xi\|^2])] \quad (17)$$

In the above equation, γ represents the constant parameter, and ξ is the center vector for the neuron.

Step 2: The weight initialization of the DLNN by determining the correlation between the successive neurons and thereby finding the strongest correlation between them. Here, the strongest correlation thus determined is used for weight initialization and is described as

$$w = \frac{\rho}{\zeta} \quad (18)$$

In the above expression, ρ signifies the strongest relation between neurons, and ζ indicates the total number of neurons.

Step 3: The output layer of the CPKM-DLNN (O^{OUT}) is calculated as follows,

$$O^{OUT} = \sum_{q=0}^{Q}\left(B^D + w_{RO} \cdot \eta(R^d)\right) \quad (19)$$

Where, B^D is the bias value of the output layer and w_{RO} characterizes the hidden-output layer weight values.

Step 4: After calculating the output, the error values(e), are measured using the below equation (20),

$$e = \frac{1}{2m}\sqrt{(E^{tar} - E^D)^2} \quad (20)$$

In equation (20), (m), indicates the number of training parameters and E^{tar} signifies the target value, and E^D is the predicted value. Finally, the classifier classifies the video as normal $(\tilde{O})$ or fake$(\overline{O})$. The pseudocode for the proposed CPKM-DLNN is given below.

Pseudocode for Proposed CPKM-DLNN

Input: Features extracted X_c

Output: Classified data $\tilde{O}, \overline{O}$

Begin

Initialize the input layer $\left(P^{in}\right)$, the output layer $\left(O^{out}\right)$, and the hidden layer $\left(R^{hid}\right)$

Initialize $0 < d < D$

Input X_c

For each d

Obtain w

Determine $\eta\left(R^d\right) = R^d \cdot \tanh\left[\ln\left(1+\exp\left[-\gamma\left\|R^d - \xi\right\|^2\right]\right)\right]$

Calculate $\left(R^{hid}\right)$

Compute $O^{OUT} = \sum_{q=0}^{Q}\left(B^D + w_{RO} \cdot \eta\left(R^d\right)\right)$

End for

Evaluate error value (e)

Obtain $\tilde{O}, \overline{O}$

End

4. Results and Discussion

In this section, the performance of the proposed deepfake detection system is compared with other conventional techniques to show the effectiveness of the proposed model with that of state-of-arts. The proposed methodology is implemented in the working platform of MATLAB.

4.1 Database Description

DeepFake-TIMIT (DF-TIMIT) database is utilized in the proposed work. The dataset is trained with low-quality and high-quality videos. It is provided with videos in which the faces were swapped using a Generative Adversarial Network (GAN) and is recreated using the AutoEncoder-based DF (AE-DF) approach.

4.2 Performance Measurement for PSKF

Here, the performance of the proposed method is evaluated based on Peak Signal to Noise Ratio (PSNR) and is compared with other existing techniques such as Kalman Filter (KF), Wiener Filter (WF), and Gaussian Filter (GF).

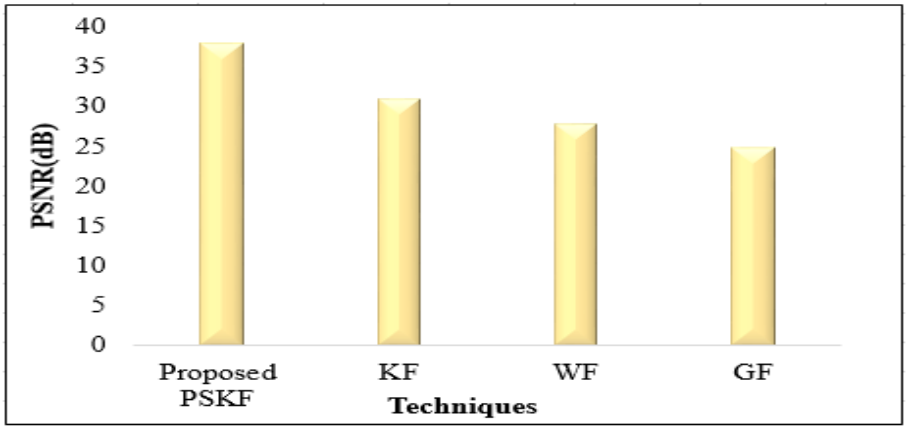

Figure 3: Performance evaluations in terms of PSNR

From the Figure 3, it is appropriate that the proposed PSKF technique attains a higher PSNR of 38dB. Conversely, the existing noise removal methods obtain lower values that are, KF (31dB), WF (28dB), and GF (25dB). Hence, the proposed system achieves more accurate results than the existing methods.

4.3 Performance Assessment of CPKM-DLNN

In this section, the superiority of the proposed CPKM-DLNN classification is evaluated by means of the performance metrics and then, compared the results with the existing classification techniques like Deep Learning Neural Networks (DLNN), Artificial Neural Networks (ANN), and Recurrent Neural Networks (RNN).

Table 1: Comparative Analysis of proposed CPKM-DLNN

Techniques	Accuracy (%)	Precision (%)
Proposed CPKM-DLNN	97.8	97.2
DLNN	94.5	94.3
ANN	90	89.9
RNN	88.7	88.5

Table 1 unveils the performance of the proposed CPKM-DLNN classification techniques by means of precision and accuracy. Here, the proposed CPKM-DLNN classifier accomplishes a spike in its accuracy (97.8%); whereas, the existing RNN classifier shows the accuracy (88.7%), which is moderately low. Similarly, the other classifiers also exhibit lower accuracy than the proposed system. In addition, the precision of the existing classifiers is also inferior to the proposed system. The precision of the existing techniques is DLNN (94.3%), ANN (89.9%), and RNN (88.5%) but the proposed CPKM-DLNN has 97.2%. Therefore, the proposed method exactly detects Deepfakes thereby the confidentiality of the network is improved.

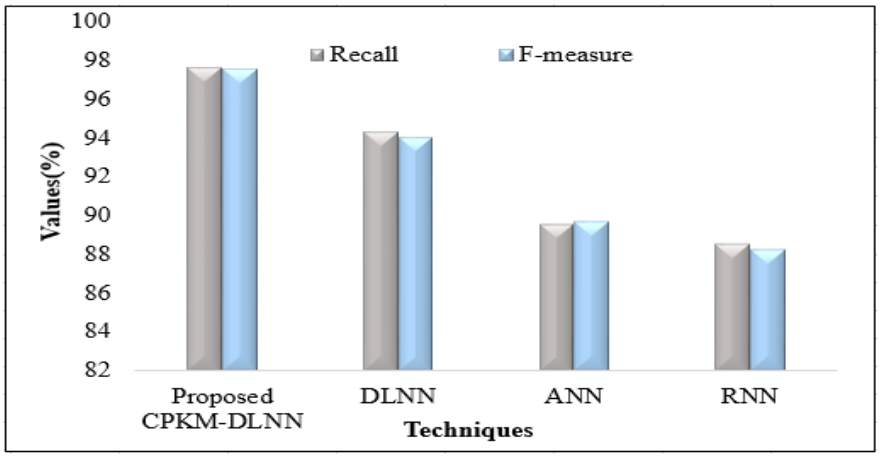

Figure 4: Performance measure of the proposed system in terms of recall and F-measure

Figure 4 conveys the performance of the proposed CPKM-DLNN method with respect to its recall and f-measure. It is transparent that the recall and f-measure of the other conventional classifiers have recall and f-measure, such as DLNN (94.25%, 93.96%), ANN (89.5%, 89.7%), and RNN (88.5%, 88.2%). On the other hand, the proposed system has 97.6% recall and 97.5% f-measure accordingly. So, from the discussion, the performance of the proposed model is superior to the other conventional techniques.

5. Conclusion

The work has proposed a novel CPKM-DLNN-based deepfake detection model for fighting against various uncertainties. The approach includes several operations, in which face recognition on the input video is performed through contrast enhancement, facial point extraction, and segmentation. Thereafter, speech identification is performed using the PSKF technique. Then, the experimentation analysis is done to validate the effectiveness of the proposed algorithm. The publically available datasets are used for the analysis,

in which the proposed withstands with the highest metrics rate of 97.8% of accuracy, 97.2% of precision, 97.6% recall, and 97.5% of f-measure. Likewise, the result of the filtering technique reveals that it significantly enhances the quality and contrast of the image without any noise and distortion with 38dB PSNR. Overall, the proposed deepfake detection method outperforms the existing state-of-art methods and remains to be more reliable and robust. But, the proposed methodology analyses the synchronous error only by the time variation of the video, which may not provide better results all time. So, in the future, the proposed methodology can be enhanced by considering the advanced methodology for synchronous error detection and trending algorithms for deepfake detection.

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7

The Comparison between the approximate calculations of the total losses by heat transfer with measured power losses in Induction Motor

The Comparison between the approximate calculations of the total losses by heat transfer with measured power losses in Induction Motor

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Abstract

It is important to know how to determine and calculate the power losses of the Induction Motor (IM) during his work. There are many different ways to arrive this goal. As an example: Lumped Circuit Method and Thermal Analysis by Finite Element Method. In this study we were tried to calculate the total losses of a small squirrel cage induction motor (SCIM) 0.3kw based on the analytical calculation for the heat transfer methods using Excel program. Then the analytical results gained by the already mentioned method had compared with the real measured results given by the HISTZ laboratory. The comparison appears an agreement with the measured

ones, but with some differences at the end of the curve of the total loss.

Keywords: *Heat transfer, Induction motors, heat losses, measurement, calculation*

1 INTRODUCTION

The three phase induction machine is one of the most popular rotating electrical machines used in industrial driven equipment. [1] Therefore when the electrical machine operates it generates heat, this heat transmits in the machine through conduction, convection and radiation. To describe the power losses and the temperature distribution over the cross section of an induction motor thermal analysis will assist the motor designers to get information and to improve machine performance. Many research works have been done to study the thermal analysis of three phase induction motor. As an example, Mahdi Atig et al (2018) presented the results of an experimental investigation to see the impact of the open phase faults on the thermal behavior in the 2.2 kW three phase squirrel cage induction motor and to display the stator current with healthy and faulty conditions under different loads [1]. Also Mr. Andrew Strandt et al (2014) presented the effect of PWM waveforms on motor losses and demonstrates that the use of a small three phase line reactor between the drive and the motor dramatically reduces the motor losses under low PWM switching frequencies [2]. Maheen Gul et al (2021): investigating induction motor thermal performance analysis [3]. . Many authors [6-10] have made numerous attempts with thermal modeling and analysis of the induction motor. The finite element method (FEM) has also used by many authors [10, 16] to determine the temperature rise in electrical systems. In this study we were tried to calculate the total losses of a small squirrel cage induction motor (SCIM) 0.3kw based on the analytical calculation for the heat transfer

methods using Excel program. Then the analytical results gained by the already mentioned methods had compared with the real measured results given by the HISTZ laboratory. The comparison appears an agreement with the measured results, but with some differences at the end of the curve of the total loss.

2 HEAT LOSSES OF INDUCTION MOTOR

The squirrel cage motor is a device that converts electrical energy into mechanical energy. When the motor is loaded, three phase stator currents produce a magnetic field that rotates the rotor. Consequently, heat losses are generates inside motor. The induction motor power losses comprise of central aspects can be divided into five parts; stator copper losses (P_{SCL}) = $3I_1^2R_1$, rotor copper losses (P_{RCL}) = $3I_2^2R_2$, iron losses, friction and stray losses. The losses make heat sources inside the induction motor, the scattering and the dissipation process of heat losses toward outside that follows the heat transfer methods (radiation, convection and heat conduction). Figure1. Show the equivalent circuit of the induction motor.

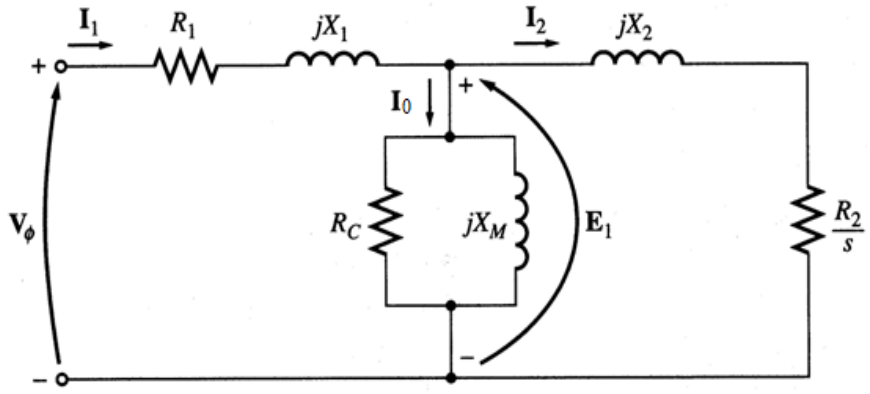


Figure1: Shows the Equivalent Circuit of the induction motor [2]

3 MATHEMATICAL FOUNDATION

3.1 Heat Transfer

Heat transfer is the process of transferring heat by temperature difference. So that, the heat transfer of motor structure is from rotor winding and goes to the airgap then it goes directly to stator winding, frame, then to the out of the motor. The Mathematical equations which are used to define induction motor, thermal behavior are generally derived from basic energy balance equations, three mechanisms (radiation, convection, conduction) in the general dissipate heat energy which results in induction motor losses**. In Conduction heat transfers**, heat flux Q calculated from equation $Q_{th} = KA\frac{\Delta T}{\Delta x}$ with the introduction of Rth thermal resistance due to conduction $R_{th} = \frac{\Delta T}{Q_{th}} = \frac{\Delta x}{KA}$. Heat transfer is modeled analogous to Ohm's law. **In convection heat transfer** always from high temperature to low i.e., solid to gas or liquid with the surface layer, this power dissipated because of convection is represented as $Q = hA(T_s - T_\infty)$. Where A represents to the area, T_s represents to the temperature and h is convection heat transfer coefficient. Thermal resistance value which defines the convection heat transfer is calculated as $R_{th,conv} = \frac{1}{Ah}$. **In radiation**, Heat flux dissipated due to radiation is represented with the help of Stefan-Boltzmann's equation: $Q_{th} = \in \sigma_{SB} (T_1^4 - T_2^4)$ [3]

3.2 Airgap heat transfer

In order to account the heat transfer across airgaps in electrical machines, it may use the dimensionless convection correlation developed from testing on concentric rotating cylinders as the Reynolds number, Nusselet number and Prandtl number. To determine the appropriate convection correlation for computing h (coefficient of convection heat transfer), over an isothermal flat plate The Reynolds

number must first be determined $Re_L = \frac{\rho u L}{\mu}$, Also the Prandtl number maybe calculate from equation $Pr = \frac{u c_p}{k}$, so If $Re_L < 5 * 10^5$ then the flow is laminar over the entire plate, and the appropriate correlation is given by $Nu_L = 0.664\ Re_L^{\frac{1}{2}}\ Pr^{\frac{1}{3}}$. So that the convection coefficient is $h = \frac{Nu_L k}{L}$. While, if $Re_L > 5 * 10^5$ then the flow is Turbulent as in figure 2. In that case the Nusselet number will be $Nu_L = 0.036\ Re_L^{0.8}\ Pr^{\frac{1}{3}}$. And the convection coefficient is equals to the equation $h = \frac{k}{L}\ (0.036\ Re_L^{0.8}\ Pr^{\frac{1}{3}})$. On the other hand, The Reynolds number for flow in a circular tube is defined as $Re_D = \frac{\rho u D}{\mu}$. Where u is the mean fluid velocity and D is the tube diameter. Therefore, if Re_D <2300 the flow is laminar and the Nusselet number will be $Nu_D = 4.364$. Then the convection coefficient is $h = \frac{48k}{11D}$ and if Re_D >2300 the flow is Turbulent and the Nusselet number will be $Nu_D = 0.023\ {Re_D}^{0.8}\ Pr^{\frac{1}{3}}$ the convection coefficient is $h = \frac{k}{D}\ (0.023\ {Re_D}^{0.8}\ Pr^{\frac{1}{3}})$ [4]

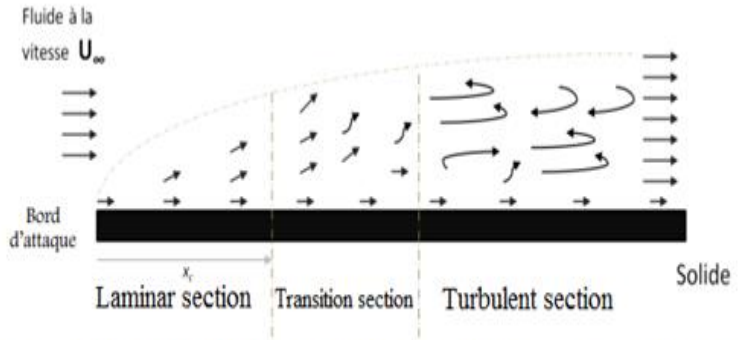


Figure 2 The External Forced Convection , Laminar flow and Turbulent flow [5]

4 EXPERIMENTAL

In order to measure the motor's electric and thermal parameters, the tests were carried out at the HISTZ laboratory Of Zawia, a bench has been realized as a control panel with AC/DC power supply 0~260V/5A (E M-3310-1D) as shown in Figure3. The experimental test is composed of a small four–pole three phase squirrel cage induction motor so that the specification of the test motor is shown in Table1. The induction motor is mechanically coupled with a magnetic powder brake unit (E M-3320-A) with the brake controller (E M-3320-1N) to control the loading processes. The load on the machine can be varied step by step by the magnetic brake unit. The temperature measurements are obtained using the thermocouples (ST10un/S57/023 thermometer) were located as illustrated in Figure4 (1: frame, 2: stator core -frame, 3: stator winding, 4: airgap and 5: ambient temperature). Furthermore, during the tests the motor temperature is measured at a different load in different days, different intervals from 10 minutes into 15 minutes along 45 minutes.

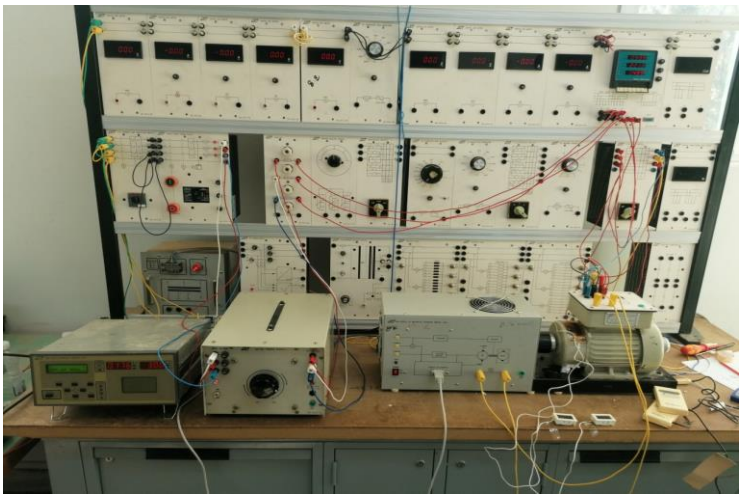


Figure3. Shows the setup of the experimental test motor

Table1. Specification of the test motor

Parameters	Values
Ph	3Φ
voltage	220 V
Rated current	1.4 A
HZ	50/60Hz
Rated speed	1420/1670 rpm
P	0.3kw
Type	EM-3330-3c
S/N	050612
Connection	**Y**

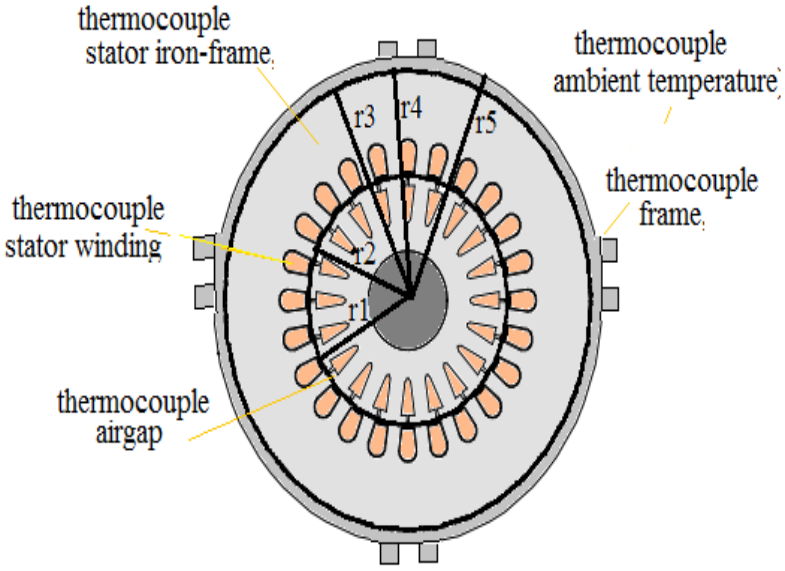


Figure4.The location of the thermocouples and the radiuses of inside components of motor

4.1 Measurements of the cooling air velocity around the fan

The air speed has been measured during the axial direction using software program on a mobile phone (Zephyrus wind meter program) and it was put it at the beginning, middle, and at the end of all the axial fin channels. Then the average values of the air speed were calculated, and it was 3m/s.

5 RESULTS AND DISCUSSIONS

5.1 Measurement of the total power losses

The measurement data is directly read from the measurement instrument without any additional conversions. The electrical input power (P_{in}(w)), electrical current and the power factor (p.f.) were measured with digital power analysis meter (DM2436A) also the speed of motor (r.p.m(m/s)) was measured with the brake controller, Table2 gives details of the experimental results. When motor is brought into play, the total power losses of the motor can be expressed as $P_{total\ loss}$ = stator copper $_{loss}$ + rotor copper $_{loss}$ + Iron $_{loss}$. Because, friction and stray losses are small, then, it may be neglected. As an expected in Fig. 5, the electrical input power increased when the load is increased. Consequently, the total power losses increased as shown in Fig. 6. So it can be noted that at 70% load, the value measured of the total power losses was reached to 80w and this value is different compared to the analytically calculated.

Table2: Experimental parameters of the system with fixed voltage.

Load (%)	V(v)	I(A)	(p.f.)	P_{in}(w)	r.p.m(m/s)
No load	220	0.879	0.216	72.262	1485
30%	220	0.924	0.48	168.8	1469
60%	220	1.028	0.653	255.49	1432
70%	220	1.101	0.716	300.03	1411

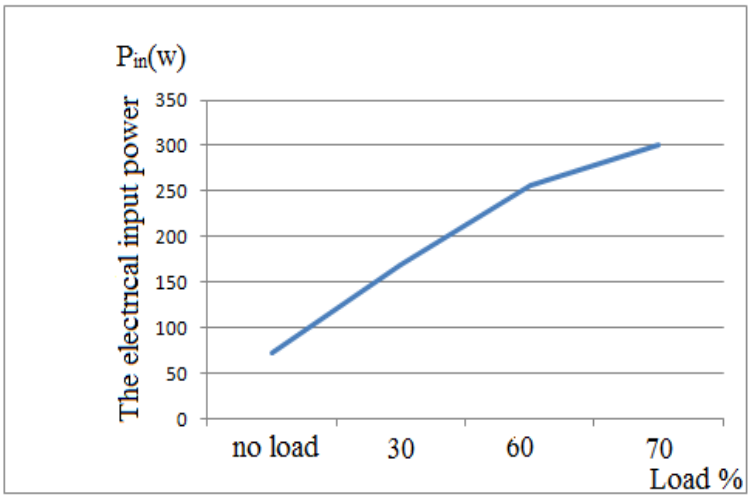


Figure 5. the electrical input power increase when the load increases

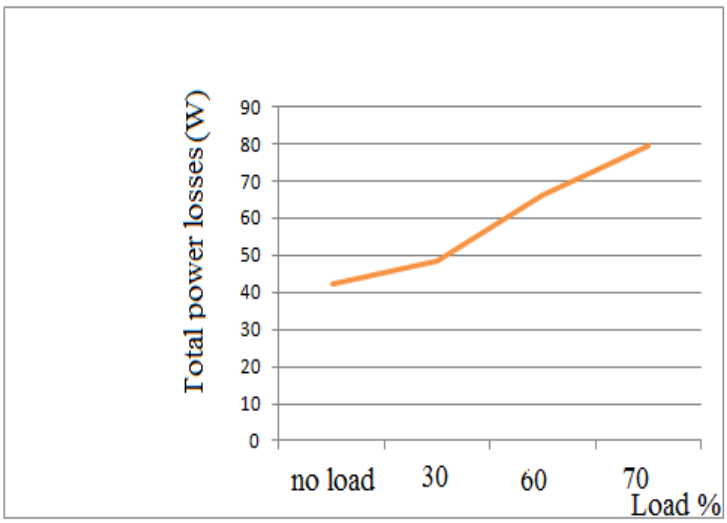


Figure 6. the total power losses measured based on the load variation

5.2 HEAT TRANSFER CALCULATION

According to Figure (7-a), the heat transfer calculations of the radial and axial conductivities are very complex. So that, only the calculation of the conductivity along radial direction will consider, and the axial thermal conductivity must neglected. As a result, the series of thermal resistances will be as shown in Figure (7-b). Table3. Gives details the results of the analytically calculated heat losses Q(w) . Figure (8) illustrates the heat losses calculated after the operation of the induction motor. In this figure we can see that, at the starting point the heat losses are very small, but after few operating minutes the heat losses rise gradually. When steady state is reached and at 70% load, it is noticed that the heat losses arrived approach to (3.6 w) this result is different compared to the first one as shown in Figure 6.

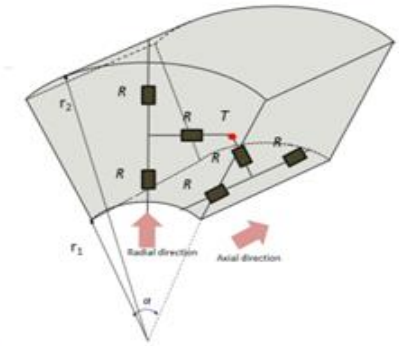
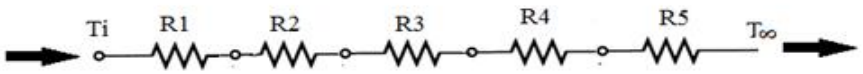


Figure 7 ,a the radial and axial heat transfer direction in cylindrical co-ordinate[5]



b Equivalent thermal Circuit for a series composite cylindrical wall

Table 3: The total calculations of Thermal resistances and the total calculations of power losses in the test Motor

R_T	Ti	T∞	Q
5.634452	28.2	16.6	2.058763
5.634452	28.4	14.3	2.502462
5.634452	35.4	17.3	3.21238
5.634452	37.9	17.2	3.673827

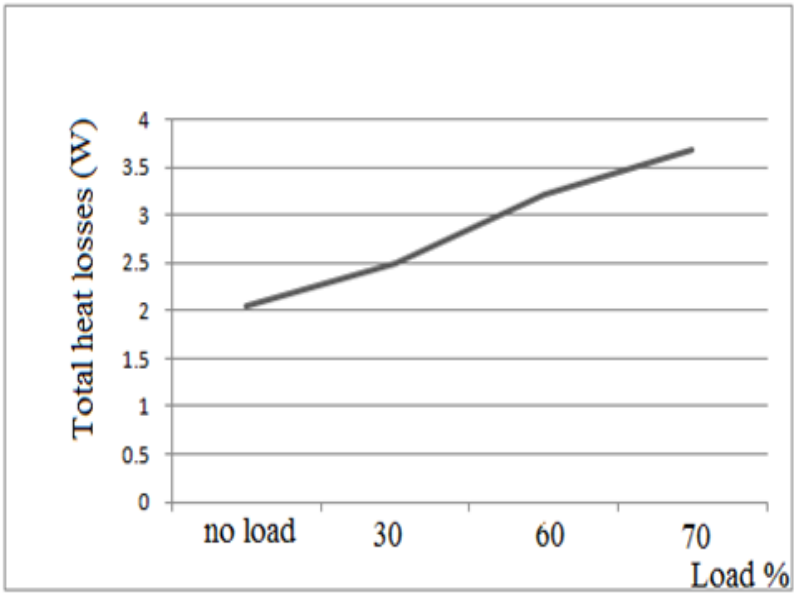


Figure 8 the heat losses calculated analytically based on the heat transfer methods at the steady-state

6 CONCLUSION

The measured and calculated losses are compared in Figure 6 and Figure 8. In Figure 8 slightly lower losses can be observed in the calculation of the transfer method at no load and with the 30% load. But with the higher loads, calculation losses are few different

compared to the measured ones. These different results probably due to two essential assumptions, so that, the first one are the calculations of heat flow were along the radial direction of the cylindrical, with no axial flow of heat, i.e. the temperature gradient in the axial direction is zero, so that, in this case the thermal resistances should be corrected in Fig.(7-b) . The second one, were by neglecting the mechanical and additional losses, therefore, the mistake in the main equation of the total power losses also should be corrected. Also because the location of thermocouples and geometrical dimensions of the machine all these make errors between calculated and measured values. On the other hand, these errors in the two above Figures are within acceptable range for practical experiments.

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APPENIDX

1- Calculation of the Equivalent Circuit parameters of induction motor

In case of Y Connection

No load test

From Table 2:

Electrical current (A) $I_1 = I_0$

$V_{ph} = V_L/\sqrt{3} = 220/\sqrt{3} = 127v$

The electrical input power (w) $P_{in} = \sqrt{3} V_L I_L \cos\theta = 3V_{ph} I_{ph} \cos\theta$

Output power (w) $P_{out} = \tau_{load}\, \omega_m$

Torque (Nm) $\tau_{load} = P_{out}/\omega_m$

The power factor (p.f.) $\cos\theta = 0.216$

$\Theta = \cos^{-1}(0.216) = 77.52^0$

$R_c = V_{ph}/I_c = V_{ph}/I_0 \cos\theta = 127v/(0.879 \times 0.216)A = 668.89\ \Omega$

$X_m = V_{ph}/I_m = V_{ph}/I_0 \sin\theta = 127/(0.879 \sin 77.52^0) = 147.989\ \Omega$

DC test: Average $R_{dc} = 36\ \Omega$

2 - Machine Parameters and geometric dimension

Radius of rotor r_1 (m)	Inner radius of stator r_2 (m)
Outer radius of stator r_3 (m)	Inner radius of frame r_4 (m)
Outer radius of frame r_5 (m)	Height of fin (H) 0.60cm
Length of frame (L) 12.7 cm	Number of fin (n_f) 21
Thickness of fin 0.55cm	

Table 4 the radiuses of Components inside test Motor (m)

r_1(m)	r_2(m)	r_3(m)	r_4(m)	r_5(m)
0.01775	0.0296	0.0436	0.0536	0.0636

$h_i = \frac{KNu}{D}$ is Inner convection heat transfer coefficient **(**w/m^2 c^0**)**

$h_o = \frac{KNu}{L}$ is Outer convection heat transfer coefficient **(**w/m^2 c^0**)**

k: Thermal conductivity (cupper, iron and cast)

T_i , T_∞ Inner and Outer temperature C^0

Table 5 Thermal Parameters of inside Components of test Motor (Calculation results)

Ti	T∞	h_i	K_{st}	K_{ir}	K_{cast}	L	h_o
28.2	16.6	15.36	260	80	50	0.12	16.89
28.4	14.3	15.36	260	80	50	0.12	16.89
35.4	17.3	15.36	260	80	50	0.12	16.89
37.9	17.2	15.36	260	80	50	0.12	16.89

$R = \left(\frac{lnr1/r2}{2\pi kl}\right)$ Thermal resistances for cupper iron and cast R_2, R_3, R_4

$R = \frac{L}{hA}$ Thermal resistances for air R_1, R_5

$A = 2\pi r_5 L + 2HLn_f$ Area for out surface with fin:

Outer surface A_o = 0.078169 m^2

Table 6 the Thermal resistances calculations of Components of test Motor				
R_1	R_2	R_3	R_4	R_5
4.867092	0.001976578	0.003425092	0.00454	0.757419

Total Thermal resistances $R_T = R_1 + R_2 + R_3 + R_4 + R_5$

Total heat losses $Q = \Delta T / R_T$

From calculations

At Inner Airgap

Re_L Reynolds number = 11324.59

Nu_L Nusselet number =35.052

At Outer the frame

Re_L Reynolds number = 188743

Nu_L Nusselet number =257

Pr Prandtl number.

Table7 Thermophysical Properties of gases (Air) at Atmospheric Pressure Reference [4]							
T (K)	ρ (kg/m^3)	c_p (kJ/kg.K)	$\mu.10^{-7}$ ($N.s/m^2$)	$\nu.10^{-6}$ (m^2/s)	$k.10^{-3}$ (W/m.K)	$\alpha.10^{-6}$ (m^2/s)	P_r
300	1.1614	1.007	184.6	15.89	26.3	22.5	0.707

8

Enhanced Array Patch Antenna Parameters for 5G Applications

Enhanced Array Patch Antenna Parameters for 5G Applications

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ABSTRACT

This paper presents a design and simulation of a microstrip array patch antenna operating at 28 GHz for 5G communication with a maximum reflection coefficient of -17 dB, a very wide bandwidth of 1.5 GHz and a high gain of 6.84 dB A Roger RT5880, which has a dielectric constant of 2.2 and a height of 0.2 mm has been used as a transmission line with an inset feed. Antenna dimensions were calculated and simulated results have been performed and analyzed using CST Microwave Studio Package. Moreover, linear array with 3x1 and 5x1, to provide better gain to reach 13 dB and reducing the mutual effect, was developed using decoupling simple slab techniques.

1. INTRODUCTION

The fifth Generation Mobile Network or simply 5G is the forthcoming revolution of mobile technology. The features and usability are much beyond the expectation of a normal human being. With its ultra-high speed, it is potential enough to change the meaning of cell phone usability. With a huge array of innovative features, now the smart phone would be more parallel to a laptop. A broadband internet connection can be used; other significant features that fascinate people are more gaming options, wider multimedia options, connectivity everywhere, zero latency, faster response time, and high-quality sound and HD video can be transferred on other cell phone without compromising with the quality of audio and video, The topic covered in this work will be the design of a microstrip antenna for 5G networks [2].

This paper aims at designing mm-wave microstrip antenna deployed in 5G mobile communications. This is achieved through the following approach:

- Simulation of proposed antenna fed by 50 Ω coax-microstrip lines. Modifications are made to get better results either by changing the physical dimensions or substrate material.
- Design a linear phased array with 3×1 and 5×1 for the proposed antenna.
- A simple decoupling slab structure is used to overcome the MC problem that is resulted from the antenna array [5].
- Performance metrics such as measurements of return loss, gain, radiation efficiency, bandwidth, VSWR and full antenna radiation patterns will be evaluated in each case. All results are carried out using CST microwave studio.
- The rest of paper is organized so that section II provides the methodology and the design of proposed antenna. Array antenna with different elements is also developed using CST

Microwave Studio. Section III deals with the results obtained as well as discussing these results. The concluding remarks are in section IV.

2. Designed Antenna Parameters

There are three essential parameters for designing any antenna, which are the fundamental frequency, dielectric permittivity and thickness of substrate. In this work, a single microstrip patch antenna is proposed for 5G communication. The proposed antenna is designed to resonate at 28 GHz and has a low-profile structure with dimensions of 4.46 mm × 5.6 mm × 0.2 mm.

The dielectric permittivity of the substrate (εr =2.2 in this design) is an essential parameter for evaluating the antenna performance, as it is desirable to have low dielectric constant. This provides a better efficiency, large bandwidth and better radiation. Shifting the frequency to higher values requires the length of patch to be reduced [8].

TABLE 1: The parameters of proposed antenna [9].

Parameters	Value
Dielectric Constant (εr)	2.2
Dielectric Substrate	Roger RT5880
Thickness Substrate	0.2mm
Loss Tangent (tanδ)	0.0009
$\boldsymbol{Z_0}$	50Ω
Resonant frequency	28GHz
Feeding method	Microstrip Line Feeder
Copper thickness	$\boldsymbol{35\mu m}$

2.1 Analysis and design procedures

Based on given frequency 28GHz, all parameters, as well as the other physical dimensions of the proposed antenna were calculated using the rectangular patch design equations [1] such as length, width of patch, and substrate. Final design of the antennas is simulated based on the dimensions shown in table 2.

TABLE 2: The dimensions of the proposed antenna [4].

Parameters	Dimension (mm)
The length of patch (Lp)	3.43
Width of patch (Wp)	4.4
Length of the substrate (Ls)	4.64
Width of the substrate (Ws)	5.6
Thickness of Substrate (h)	0.2
Width of Feeder (Wf)	0.6
Length of Feeder (Lf)	0.7
Length of gap (Lg)	0.4
Width of Gap (Wg)	1.156

The performance predictions and simplified analysis was based on a proposed rectangular shaped microstrip patch antenna operating at desired frequency and application as shown in the figure (1)

FIGURE 1: A rectangular shaped microstrip patch antenna

3. Results and Discussion

The proposed design was simulated using CST package and the results cannot be properly attained as the mathematical equations are used, so it was important to go for the parametric study, which is based on changing one of the physical dimensions to get the desired resonant frequency.

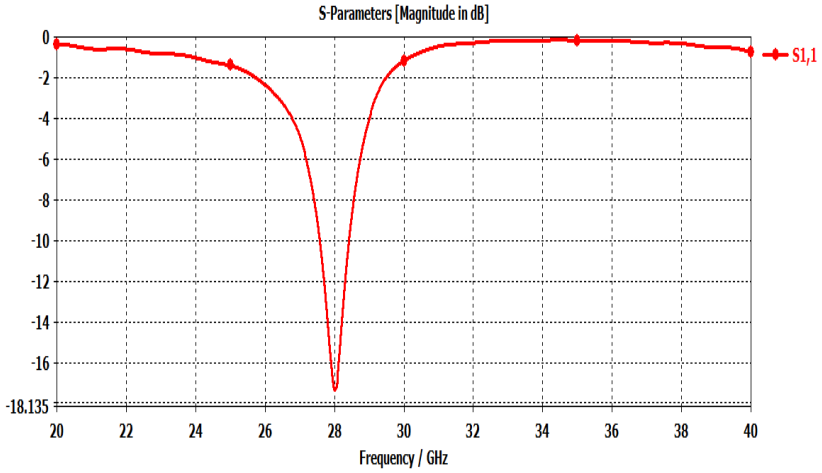

FIGURE 2: The return loss resonating at 28GHz

The standard reference of the return loss is to have power that is less than -10dB to practically transfer more than 90% of the transmitted power in the desired direction figure (2). About -17dB is presented at 28GHz with operating bandwidth of about 1.5GHz laying between 27.2 and 28.7GHz. At this design, it is important to evaluate VSWR which should be between 1 and 2. In this design a suitable result is achieved at the desired frequency giving that VSWR = 1.3129, in this case as the result is closer to 1 meaning that the reflection coefficient tends to zero, meaning lesser power is lost figure (3)[7].

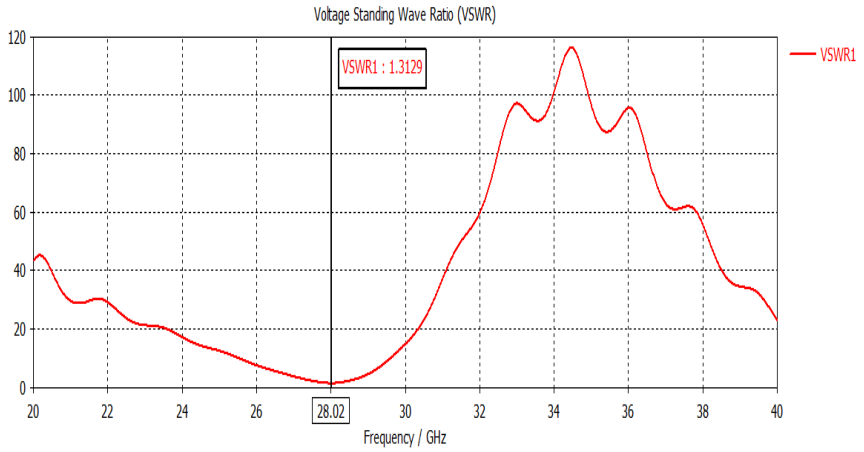

FIGURE 3: The VSWR graph.

As shown in figure (4), the performance of the system reaches 89% of the total efficiency.

Figure (5), presents the radiation pattern, which taking circular polarization geometry with gain of 6.84 dB, as the axial ratio value at 900 is less than -3dBi as in figure (6), then the proposed antenna is circularly polarized, which is one of the main requirements to provide 5G services.

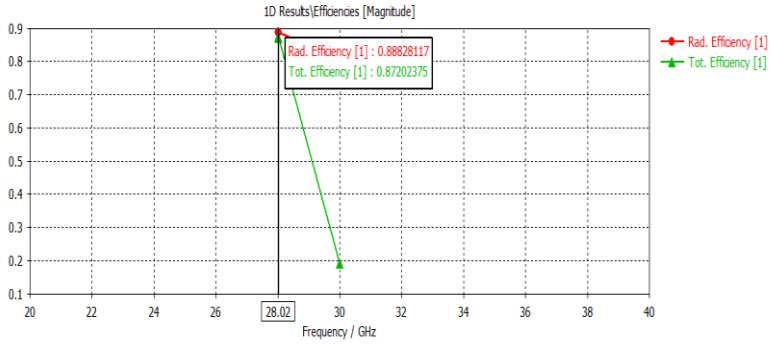

FIGURE 4: Proposed design efficiency

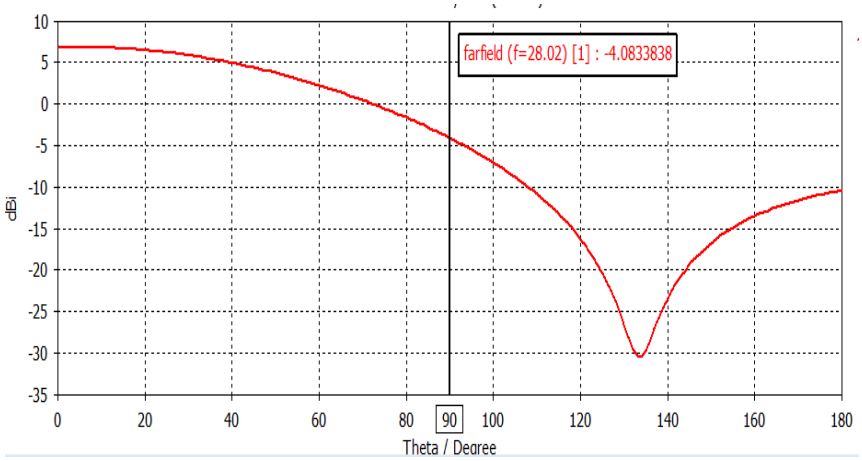

FIGURE 5: Radiation pattern of proposed design.

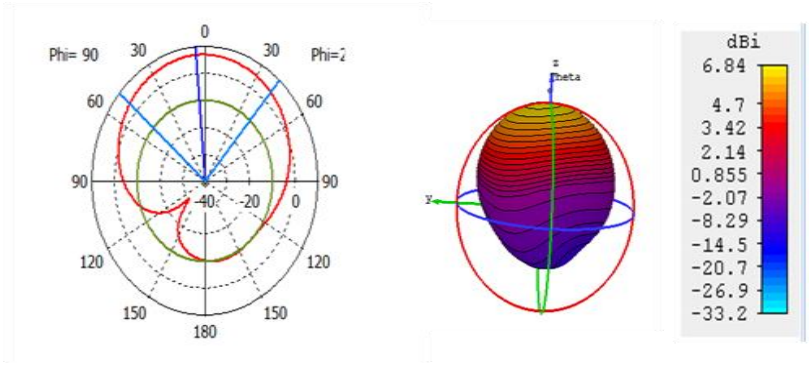

FIGURE 6: The axial ratio.

Figure (7) represents the surface current distribution with different colors. The current should be densely distributed at the edges of the slot placed on the substrate; this reflects that the edges are responsible for dominating the antenna performance [6].

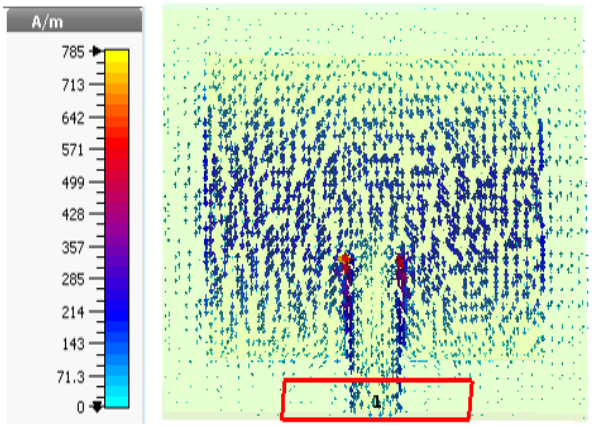

FIGURE 7: Current distributions.

To improve the design performance of the proposed antenna an array was constructed. An array of a group of single elements that is used to improve the directionality of the antenna beam and therefore achieving better efficiency. There are different types of the array configurations such as, a linear phased shape, planar and phased array [10]. The main reason for applying array scheme is to generate tiny beam and avoid pattern of side lobes. In this work, 3x1 and 5x1 identical linear array elements is designed with d= $\lambda/4$ mm of spacing in between elements.

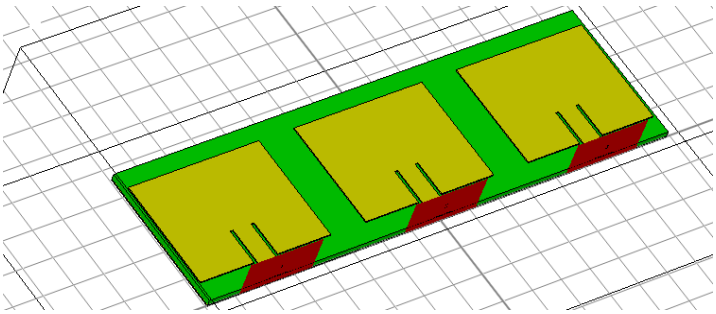

FIGURE 8: Antenna Array

Figure (9) represents the mutual return loss array of the with mutual coupling of -19 dB for S21.

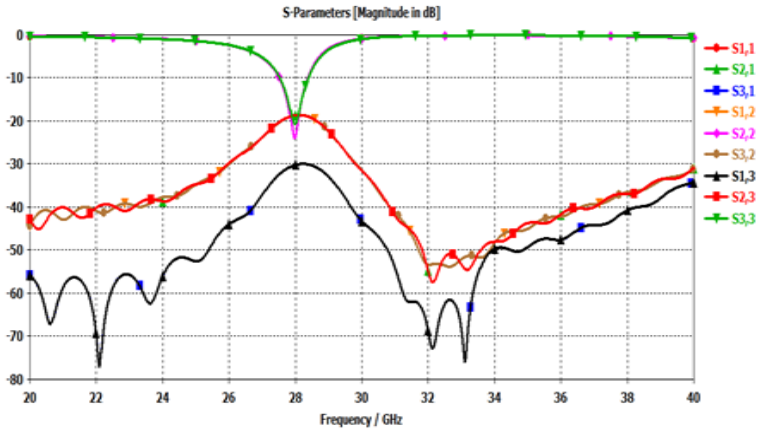

FIGURE 9: The mutual return loss array with mutual coupling of -19 dB for S21.

Figure (10) represents the VSWR for all elements in the array, which exhibits the desirable results at the resonant frequency of interest.

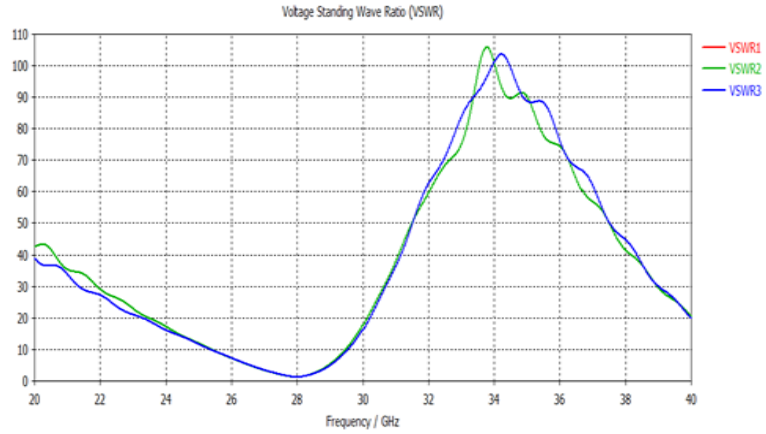

FIGURE 10: The VSWR for all elements in the array

Figure (11) represents the radiation pattern of the array and demonstrates improvement in the gain by 4 dB compared with the single element. This is due to adding the decoupling slab between elements to reduce the mutual effect.

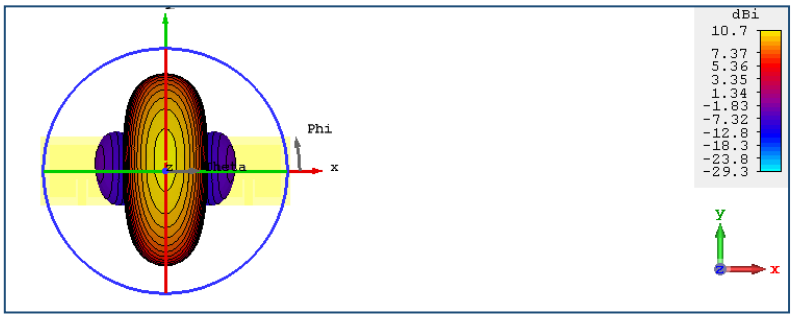

FIGURE 11: The radiation pattern.

Whenever, the number of elements is increased, the overall gain increases as well as the return loss reduces to provide more beam as shown in figures (12), (13) and (14).

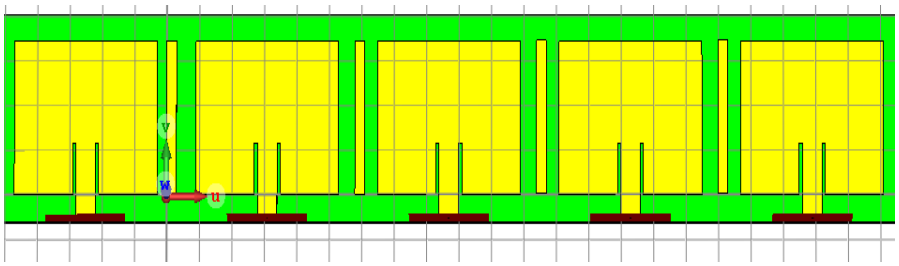

FIGURE 12: 5x1 linear antenna array.

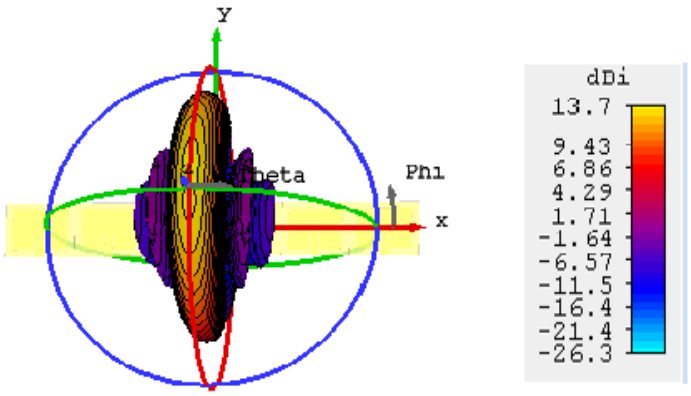

FIGURE 13: 5x1 linear antenna radiation pattern and gain.

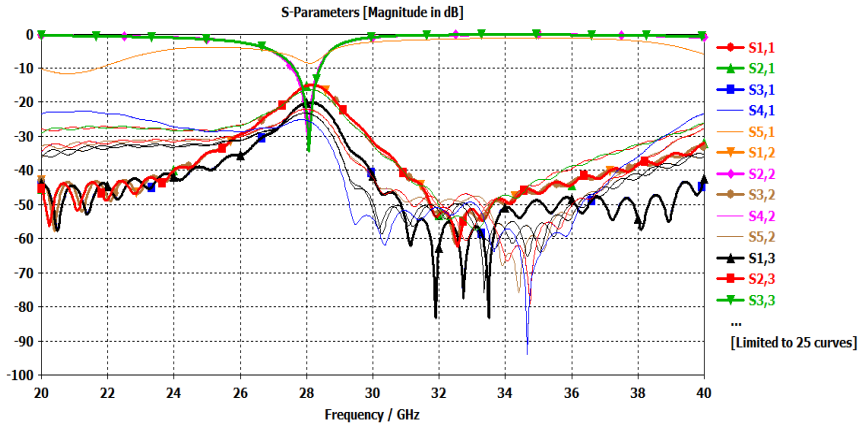

FIGURE 14: Return loss and mutual coupling effect of antenna array with 5x1

4. Conclusions

According to the design and observed results, the proposed antenna characteristics can meet the requirements of 5G and wideband communication applications. Initially the parametric study was conducted on the design to have an antenna working or resonating at 28GHz, which is a target frequency for 5G applications. Then, an array structure was designed to improve the antenna performance; where gain has been improved from 6,10 and 13 dB for single, 3x1 and 5x1 arrays respectively.

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