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Analysis of Total Dissolved Solids and Electrical Conductivity in Different Water Supply Schemes of Taluka Chachro, District Tharparkar

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Abstract

The present work aims at investigating groundwater quality parameters, particularly total dissolved solids (TDS) and electrical conductivity (EC) of Taluka Chachro District Tharparkar in Sindh province of Pakistan. The sampling was performed at twenty six different locations for the assessment of water quality and the results were compared with World Health Organization (WHO) standards. Water samples were stored in sterilized plastic containers of 500 ml immediately after collection from the site. pH and water temperature of the samples were checked at the time of sampling, whereas, TDS and EC were examined in the laboratory. The pH measurement was made with calibrated Hanna 3910 pH meter, electrical conductivity with Hanna 2210 EC meter and total dissolved solids (TDS) with Hanna 103 TDS meter. The results revealed that the amount of both TDS and EC in all examined water samples was more than WHO standards. It was concluded from the study that the examined groundwater samples are unsafe for human as well as livestock consumption.

Keywords—Fuzzy logic controller, flexible alternating current transmission, PI controller, unified power flow controller.

1 Introduction

All living creatures living on the earth require water for their existence and evolution. Its acceptable quality as well as appropriate quantity is very important for their survival. Water has distinctive structure, as it has the capability to disperse, dissolve, and captivate a number of compounds that deteriorate the quality of drinking water. It dissolves contaminants from the surroundings through human and animals activities [1]. The water quality refers to the physical, chemical, biological parameters and other practices that may change the characteristics of water. Indeed, water quality could be affected in any step of the hydrological cycle. It might be influenced from the evaporation process in the atmosphere up to the end of its cycle when it is taken out from a well or spring. Groundwater contribution for drinking purpose in rural areas is about 88% where there is scattered population [2].

In Asia alone, around one billion people are directly dependent on the groundwater aquifers [3]. The drinkable water in Sindh province is mostly based on the surface water of the river Indus and groundwater from different aquifers. Tharparkar district covers an area of about 22,000 square kilometers with an estimated population of 1.2 million. Out of that, ninety five percent live in nearly two thousand scattered villages, especially adjoining any source of water. The arrangements required for the treatment and supply of surface water do not exist. Therefore, ground water is the only source of drinking water in rural communities which is being acquired from the dug wells at the average depth of 10 to 100 m. Furthermore, the quantity of groundwater is not enough to serve the people, thus they compel to use saline water. In fact, the groundwater of the area contains extremely high level of various salts and minerals and therefore it is not safe for the consumption of human as well as livestock population. It has been reported that the level of total soluble salts in the groundwater of Tharparkar is between 636 ppm to 9543 ppm. Although, different governmental and non-governmental organizations installed various tube wells, hand pumps through use of solar and wind energy systems, but these schemes have not been completely successful due to lack of technical expertise

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and maintenance issues. On average, the villagers take about four to six hours to get five pots (50 to 60 liters) of water from dug-wells using traditional tactics. Such practices not only take too much time but also require much labor and efforts.

It is reported that about 81 % population of the area relies only on rain-fed agriculture for their source of revenue as well as on farm animals. The total domestic water requirement of the Tharparkar district is about 0.25 % of the received rainfall. However, rain water harvesting capacity in the area is only 0.6 % of the total water requirement. Both rainwater harvesting and groundwater recharging are the most useful alternatives to tackle the water issue faced by the people. It has been observed that mega projects and overwhelming water schemes could not solve the water issues of the area and therefore it is recommended to support local practice sustained by renewable energy based community-managed water projects with proper maintenance to provide safe water to the people [1-3].

Among all water quality parameters, concentration of hydrogen ion (pH), temperature, total dissolved solids (TDS) and electrical conductivity (EC) are the focused parameters for every researcher. The pH of normal drinking water should be between 6.5 and 8.5 as given by World Health Organization (WHO). Acidic water can lead to corrosion of metal pipes and plumping system. On the other hand, alkaline water is generally considered to be safe; however, it could produce side effects in body at high alkanity [4]. Temperature influences the biological activity and growth of the organism in the water. It controls the types of organisms that can live in different water bodies. As temperatures vary from their desired range, the number of species decreases and finally they disappear at high temperature. Generally, the rate of chemical reactions increases as water temperature increases and vice versa. Groundwater have tendency to dissolves more minerals from the rocks at higher temperatures and thus acquires higher electrical conductivity. The situation could be opposite in view of the oxygen, dissolved in the water. When the water is warm, it holds less dissolved oxygen as compared to cold water. Thus, the survival of aquatic life is more problematic when there is less dissolved oxygen [4][5].

1.1 Measurement Techniques of Total Dissolved Solids (TDS)

TDS refer to any mineral salts and metals such as Ca, Mg, Fe, NaCl and sulfates dissolved in water that can pass through a 2.0 μm or smaller pore size filter. It is useful in describing chemical density of water. Direct measurements for TDS include gravimetric, and flow densitometry, which are considered as expensive and time consuming [6]. Total dissolved solids have widely been adopted as a quantifiable measurement of possible taste and odor complications or a controlled parameter in industrial effluents [7]. Although, TDS is not a fully specified parameter, yet its low cost and simplicity make it widely accepted variable in research [8]. Thus, in most research activities, electrical conductivity test is being substituted for TDS. Empirical relationships are mostly adopted to convert electrical conductivity into the concentration of total dissolved solids [9]. A suitable conversion factor could be developed when water samples are somewhat stable over time and are well embodied [10].

1.2 Relationship of Total Dissolved Salts and Electrical Conductivity

Water is a good solvent. The amount of total dissolved salts as well as electrical conductivity of water increase in the solution when the salts are dissolved in water. Thus, electrical conductivity test is used as correlated parameter of total dissolved salts. It gives an indication of the amount of total dissolved replacement or exchange. Actually, an electrical conductivity for groundwater is the ability of 1 cm^3 water to conduct an electric current at 25°C and is measured in micro Siemens per centimeter [10][11].

$$TDS(ppm) = 0.64 \times EC(\mu S\ cm) \tag{1}$$

Electrical conductivity depends on various factors such as depth of the collected samples, concentration of ions, groundwater movement, temperature and nature of soil. Temperature changes rely on the level of different salts in solution, thus it influence the electrical conductivity. In dilute solutions, an increase of 1°C temperature can increase the conductance of about 2% - 3%. It also increases with the increase of the amount of total dissolved salts in the solution [12]. Once the level of electrical conductivity is known, the amount of total dissolved solids can be estimated using a factor of 0.55 to 0.90 by converting electrical conductivity into the amount of total dissolved solids. Units used for measuring electrical conductivity of water are (μS/cm), (mS/cm) and (dS/m). EC value of water obtained from different locations is given in Table 1 [13]. The relationship of total dissolved solids and electrical conductivity for groundwater can be approximated with the help of Equation 2,

$$TDS = keEC \tag{2}$$

where TDS (mg/L or ppm) and EC (μS/cm) at 25°C. The correlation factor, ke is between 0.55 - 0.8. TDS

Water Collection Point	EC (ÂţS/cm)
Absolute Pure Water	0.055
Distilled Water	0.5
Power Plant Boiler Water	1.0
Deionized Water	0.1-10
Good City Water	0.5-1
Ocean Water	53
10 % NaOH	355
10 % H2SOÂŋ4	432

TABLE 1: Electrical Conductivity at various water collection units

reported in the freshwater range from 0 to 1000 mg/l, brackish water from 1000 to 10000 mg/l and saline water 10000 to 100000 mg/l [14]. Mishra et al. [15] reported that the permissible range of pH is 6.5 to 8.5, EC at 1000 (micro mhos/cm), and TDS at 500 mg/l. It is deduced from literature review that the level of total dissolved solids and electrical conductivity of drinking water quality must be within standards to make people healthy and fit. Otherwise, the consumption of higher TDS and EC water may cause complicated health issues to the people of the area. Thus, this study aims at investigating the concentration of total dissolved solids and electrical conductivity from Taluko Chachro of District Tharparkar. It may help to see whether there is short-term or long-term health risks for human population consuming groundwater prior to treatment or not.

2 Materials and Methods

Chachro is a Taluka (Tehsil) in the District of Tharparkar, Sindh, Pakistan as shown in Figure 1 and Figure 2. Twenty Six different locations of Taluka Chachro have been chosen for this study. Out of these, seven from private owned dug wells and nineteen groundwater samples were taken from government owned water supply schemes as shown in Table 2 and Table 3, respectively. Water samples taken for the analysis were stored in sterilized plastic containers of 500 ml immediately after collection from the site. Four water quality parameters, namely pH, temperature, TDS and EC were assessed following the standard protocols and by using standard instruments. pH and water temperature of the samples were noted at the time of sampling at the site, whereas, TDS and EC were examined in the laboratory. The pH of water samples was made with calibrated Hanna 3910 pH meter with glass electrode and reference internal electrode. Electrical conductivity was recorded with calibrated Hanna 2210 EC meter and total dissolved solids (TDS) with Hanna 103 TDS meter.

Water Collection Point	EC (ÂţS/cm)
Absolute Pure Water	0.055
Distilled Water	0.5
Power Plant Boiler Water	1.0
Deionized Water	0.1-10
Good City Water	0.5-1
Ocean Water	53
10 % NaOH	355
10 % H2SOÂŋ4	432

TABLE 2: Location of villagers owned water wells of Taluka Chachro

Water Collection Point	EC (ÂţS/cm)
Absolute Pure Water	0.055
Distilled Water	0.5
Power Plant Boiler Water	1.0
Deionized Water	0.1-10
Good City Water	0.5-1
Ocean Water	53
10 % NaOH	355
10 % H2SOÂŋ4	432

TABLE 3: Location of government owened water supply schemes of Taluka Chachro

3 Results and Discussion

The values obtained from Government owned water supply schemes (GWSS) for TDS and EC are shown in Figure 3, and Private owned dug well schemes (PDWS) are given in Figure 4. The maximum TDS from GWSS was found as sample G-1 with 10656 mg/l while second, third, fourth and fifth maximum

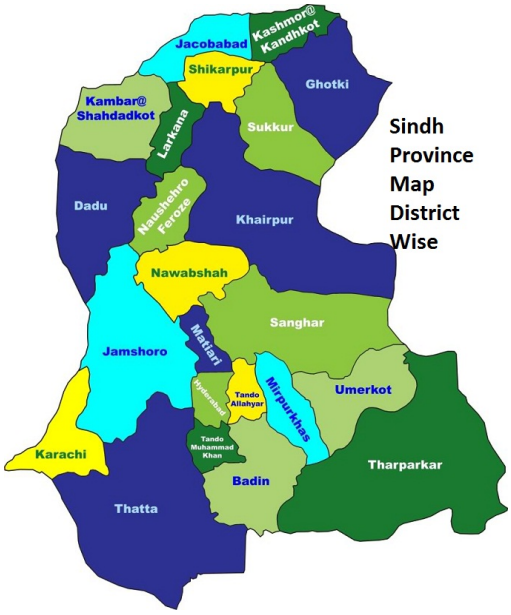

Fig. 1: Location of District Tharparkar in Sindh Province

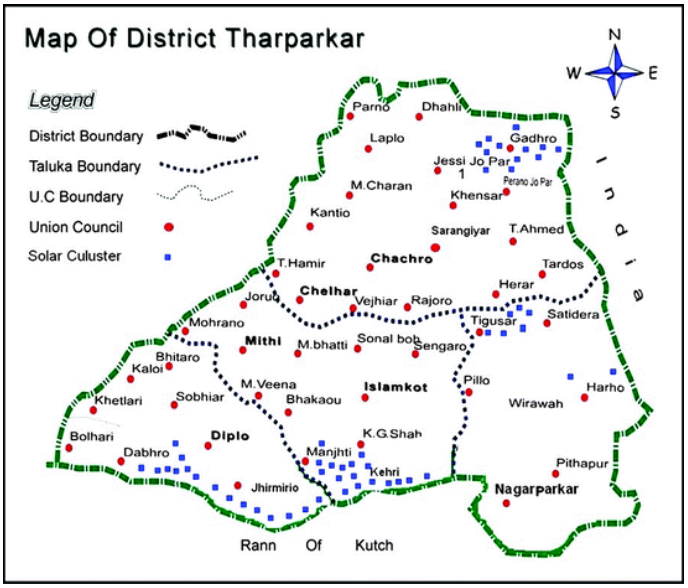

Fig. 2: Location of Taluka Chachro in District Tharparkar [16]

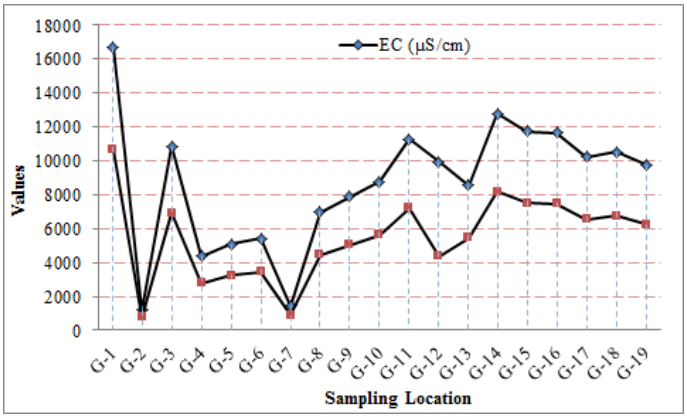

Fig. 3: TDS and EC of government owned water supply schemes

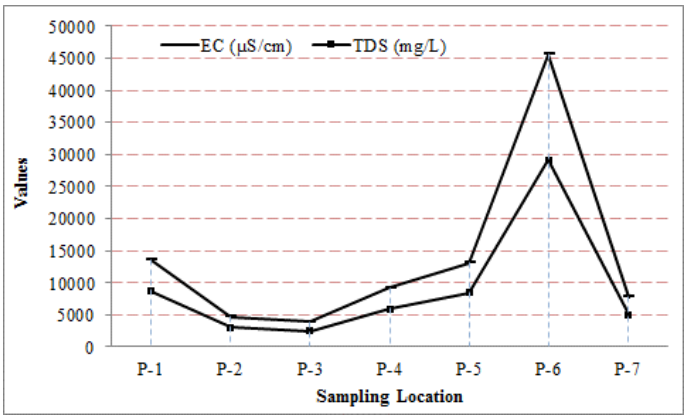

Fig. 4: TDS and EC of private owned water supply schemes

values were recorded from G-14, G-15, G-16, and G-11 with 8185 mg/l, 7513 mg/l, 7462 mg/l, and 7200 mg/l respectively.

The minimum value of TDS was observed in G-2 with 766 mg/L. Similarly, the maximum electrical conductivity (EC) was observed from sample G-1 with 16650 μS/cm, and minimum from G-2 with 1197 μS/cm. It can be seen from the analysis that all values of electrical conductivity showed similar trend as that of total dissolved solids. On the other hand, from dug wells owned by private people, the maximum TDS was found from the sample P-6 with 29152 mg/l and minimum from P-3 with 2476 mg/l. Similarly, maximum EC from sample P-6 with 45550 μS/cm and minimum from sample P-3 with 3870 μS/cm.

The values obtained from Government owned water supply schemes for pH and water temperature (T) are shown in Figure 5 and private owned dug well schemes are shown in Figure 6. Maximum pH of the samples taken from government owned water units was noted from the sample G-7 with 8.4 and minimum from G-11 with 6.6. No major change in pH and temperature was reported from different locations of both GOWSS and PODWS. Maximum pH of samples taken from dug wells were found from two samples identified as P-3 and P-6 with 7.6, and minimum from sample P-4 with pH of 7.2. Moreover, the maximum temperature of samples taken from government owned water bodies was observed from sample G-12 with 36.1°C, and minimum from sample G-19 with 30.8°C. Similarly, maximum temperature of dug well samples was noted from P-6 with 34.7°C, and minimum from P-1 with 31.2°C. It is because samples taken in different timing, therefore different pH and temperature were recorded. In addition, a correlation study of TDS and EC was conducted by using Pearson Correlation. The analysis revealed that there is strong correlation between total dissolved solids (TDS) and government owned with a correlation of 0.983 and 01.

4 Conclusion

It is revealed from the analysis of examined groundwater samples that the amount of both total dissolved solids (TDS) and electrical conductivity of Taluka Chachro is very high from the standards set by World Health Organization (WHO). Thus, the groundwater is not good for human as well as livestock without any prior treatment for reduction of TDS and EC. The regular consumption of this groundwater may increase various health anomalies in people, including kidney stones, joint pains, etc. Strong correlation between total dissolved solids (TDS) and electrical conductivity

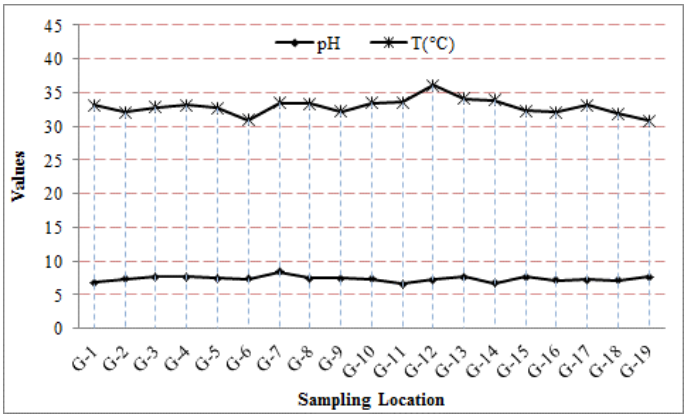

Fig. 5: Sampling time pH and water temperature of Government Owned Water Supply Schemes

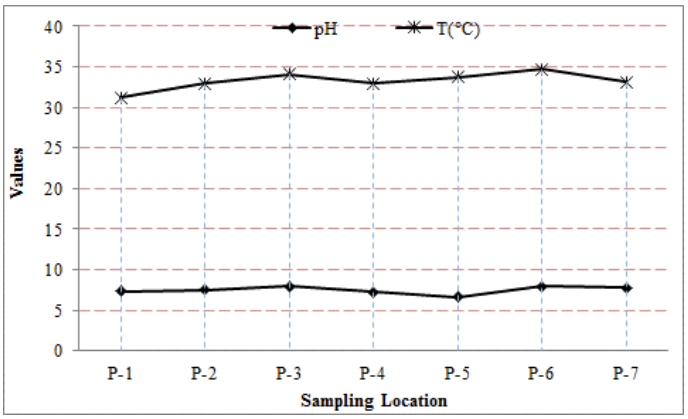

Fig. 6: Sampling time pH and water temperature of Private Owned Water Supply Schemes

(EC) was found both from the government as well as private owned water supply scheme with 0.983 and 1.0, respectively. Moreover, no deviation of water temperature and pH was observed than WHO guidelines values in all examined water samples. On the basis of present observations, further study could be carried out to make actual correlation between TDS and EC. On the basis of our present observation, there arises a provision to investigate the actual relation between these two parameters (TDS and EC). This should have the need of some further analysis of water of these water bodies and a detailed study of these parameters.

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A Hybrid Decision Model For Renewable Energy Source Selection In Pakistan

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Abstract

Energy needs are increasing all over the world. The current sources of energy are decreasing rapidly and their usage is causing environmental pollution including air and water pollution. Due to this reason, the need of the hour is to switch towards renewable and sustainable energy sources. The selection of a suitable renewable energy source is the most important task to meet the country's energy need, especially in a scenario where these alternatives negatively affect the surrounding environment. Involvement of multiple benchmarks such as technical, environmental, economic, land occupy, and sustainability are making energy planning more complex for decision makers. Wind, biomass, hydro-thermal, geothermal and solar are the alternative renewable energy sources in Pakistan. In such circumstances, companies need tools and techniques to find out the best solution in the contest of conflicting objectives, multiple alternatives and different criteria. Multi-Criteria Decision Making (MCDM) techniques are the decision supporting techniques which are ideal for such scenarios. After accessing the potential of energy generation from different renewable energy resources in Pakistan through literature review and discussion with experts, this research work presents a hybrid model for decision support about the selection of the renewable energy source in Pakistan. In order to develop this model, two MCDM techniques, i.e. Analytical Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) are employed in this study. The results of the analysis suggest that solar power is the best option in Pakistan. The proposed model will help the policy makers and energy planners for the development of long run energy policies for the country.

Keywords—Analytical Hierarchy Process (AHP), Energy Planning, Renewable Energy, Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS).

1 Introduction

Energy production is essential for human development. The demand of energy is increasing rapidly due to increased population. Fossil fuels are covering almost 80% of global demand of energy. Renewable energy and nuclear energy are contributing only 13.1% and 6.5% respectively [1]. Increase in the demand of energy all over the world is forcing policy makers and planners to consider the decentralized concept of renewable energy systems which has been recognized as the solution for the current demand of energy both in the domestic and industrial environment [2]. In this modern age, it is not possible for a society to survive without continues energy production and by increasing the sources of energy. In fact, the progress and development of any nation or society can be scaled in terms of per capital energy consumption [3].

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Pakistan is facing the energy shortfall where nearly half population has no or poor access to electricity [4]. The energy demand per capital is increasing remarkably. Pakistan's energy supply mainly depends upon fossil fuels which is more than 60% of total energy production, while the renewable energy resources like solar, thermal, wind and biomass need dedicated infrastructure and special attention to exploit properly [5]. Since fossil fuels are limited and decreasing rapidly, and their usage causes significant effect on the environment, the need of the hour is the exploitation of renewable energy resources. This is necessary not only because of less dependency on fossil fuels, but also for the protection of the environment as these alternative renewable energy resources are environment-friendly [6].

Multi-Criteria Decision Making (MCDM) methods are very prevalent and well-known in efficient energy man-

agement. These tools are used for the solution of the problems involving multiple and conflicting objectives. These techniques have helped in most countries to mitigate energy poverty. In these techniques, results are dependent upon the decision-makers [7]. Many countries use these techniques for the identification of the best model solution or for the selection of the best alternative in the selection of renewable energy resource, such as Ighravwe et al. [8] made a mini-grid business model for a community in Nigeria under the criteria of economic and envi-ronment, Chia-Nan Wang et al. [9] used this technique for choosing the optimal location of solar power plant in Viet Nam and claimed that this approach is flexible and practical. Pouya et al. [10] made a hybrid model of all renewable energy sources and applied MCDM technique to rank all renewable energy sources in Iran. Yunna et al. [11] applied fuzzy MCDM technique for the selection of most efficient and appropriate renewable power source in China.

The purpose of this work is to develop a hybrid decision model for ranking the renewable energy source in Pakistan. The hybrid decision model is composed of two existing MCDM techniques: AHP and TOPSIS. For making criteria-based decision matrix, the AHP method is used and TOPSIS is used for making the decision matrix of alternatives and then to rank alternatives.

2 Methods

In this research study, "Analytical Hierarchy Process"(AHP) and "Technique for Order of Preference by Similarity to Ideal Solution"(TOPSIS) methods are employed to evaluate the alternatives of renewable energy production pathways. A questionnaire was developed to gather the data from experts. It included the criteria and alternatives. A scale of 1 to 10 is used as low to the high importance of criteria for TOPSIS and Saaty's scale is used for AHP. Weights are given to each alternative and the criteria by experts. The average of all responses of specific alternative and criteria is used for further calculation.

2.1 AHP

Analytical hierarchy Process (AHP) is a multi-criteria decision support technique developed by Thomas Saaty in 1977 [12]. In this decision aiding technique, expert's opinion is used for weighting the individual alternatives and the alternatives are compared with respect to criteria. Subsequently, a priority score is derived for each alternative. The alternative with the highest score is preferred [13]. Table 1 and Table 1 show the templates of the criteria matrix and the pairwise comparison matrix used in this analysis. In Table 1, $C_1..., C_n$ represents *Criteria 1* to *Criteria n*. In Table 2, C_i and $A_1..., A_n$ represents the i^{th} Criteria and Alternatives respectively.

The steps of AHP are given below [14-17].

1) State the problem and its objective.
2) Make a hierarchy, keeping objective at the top, the criteria at intermediate level, and alternatives at the bottom level.
3) Develop pairwise comparison matrices $(n \times n)$ of alternatives based on each of criteria by using the Saaty's scale to weight the alternative. The dominant alternative gets the higher weight. Similarly construct a pairwise criteria matrix.
4) Normalize the pair wise comparison matrices and obtain individual priorities for all matrices.
5) Synthesize the model by multiplying the priority matrix of all alternatives with priority of criteria matrix.
6) Check the consistency of all matrices by computing the value of $(\lambda \max)$. First calculate the consistency index given by $C.I = \lambda \max - \frac{n}{(n-1)}$. Compute consistency ratio (C.R) as $R = \frac{C.I}{R.I}$, where $R.I$ is a random index and is given in the Table 3 [16, 17].

2.2 TOPSIS

TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) is a multi-criteria decision-making tool designed by Huang and Yoon in 1981 [18]. In this technique, the +ve and -ve ideal solutions are identified and the separation from both are calculated. The alternative at the smallest distance from +ve ideal solution and the largest distance from -ve ideal solution is selected as most preferable alternative [19]. The calculation steps of TOPSIS are given below.

1) Development of decision matrix

$$A = \begin{pmatrix} x_{11} & x_{12} & ... & x_{1n} \\ x_{21} & x_{22} & ... & x_{2n} \\ \vdots & & \vdots & \vdots \\ x_{1m} & x_{2m} & \dots & x_{nm} \end{pmatrix} \quad (1)$$

Where x_{nm} is the average weight of an alternative.
2) Normalization of decision matrix
3) Weighted normalization of matrix $D.C$, where D is the matrix of average weights for all

Criteria Matrix	**Expert 1**			**Expert 2**			**...**	**Expert n**			**Average**		
C1	C1	...	C	C1		Cn		C1	...	Cn	C1	...	Cn
C2													
⋮													
C n													

TABLE 1: Criteria matrix

Ci	**Expert 1**			**Expert 2**			**...**	**Expert n**			**Average**		
A1	A1	...	An	A1	...	An		A1	...	An	A1	...	An
A2													
⋮													
An													

TABLE 2: Pariwise comparison matrix

n	1	2	3	4	5	6	7	8	9	10
R.I	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

TABLE 3: Random index

criteria, $C = matrix(c_1, c_2, ..., c_n)$, where $c_1, c_2, ..., c_n$ are criteria.

4) Calculate Positive Ideal Solution (PIS) and Negative Ideal solutions (NIS).
5) Calculation of Separation from Positive Ideal Solution (SPIS) and Separation from Negative Ideal solutions (SNIS).
6) Calculate closeness to coefficient (CC) ideal solution.

Table 4 shows the weight matrix of criteria. Table 5 shows decision matrix for alternative i.

3 An Application: Renewable Energy Source Selection for Pakistan

The proposed model (Figure 1) is a combination of two different MCDM techniques: AHP method and TOPSIS method. In AHP method, we identify criteria weights and from TOPSIS method selection of alternate renewable energy source is done. Decision makers or opinion of experts are used for making pairwise comparison of criteria. The criteria chosen for the proposed model are most commonly used globally and locally (shown in Table 6) and from opinion of decision makers.

4 Model Development

A hybrid model (Figure 1) is created to evaluate the overall rank of renewable energy pathway. AHP is used to derive the weights of criteria and TOPSIS is used to evaluate the overall rank of alternatives. Hybrid model enhances the reliability of overall results as two techniques are incorporated due to which limitations of techniques are minimized.

5 Results and Discussion

A hybrid model of two MCDM techniques, i.e. AHP and TOPSIS, has been developed. Local weights of criteria are calculated by using AHP as shown in Table 7. These local priorities are index to the importance of each criteria. All weights are based on the subjective judgments made by experts. It is evident from the results that the efficiency has the highest priority value of 53%, the second highest value of 21% for environmental impacts, 11% for overall cost, 8% for the sustainability, and least value of 5% for land use. Environmental impacts are important in deciding the pathway of the energy generation due to the increasing burden of CO2 emission and Ozone depletion. Therefore, it can be inferred that a renewable energy pathway having a high efficiency and lower environmental impacts is desirable based on the local priorities derived from the criteria matrix.

Table 8 shows the weighted decision matrix obtained by multiplying the local priority of criteria by decision matrix. This table shows the integrated result of criteria and alternatives which is further normalized to evaluate the +ve and -ve ideal solutions.

Table 9 is derived from Table 8. It shows the separations from positive (SPIS), negative ideal solutions (SNIS), closeness coefficient (CC) and rank of renewable energy (R.E) alternatives. A desirable alternative should have minimum separation from the positive ideal solution, maximum separation from negative ideal solution, and a highest value of closeness coefficient. The solar energy alternative has 0.041 unit separations from positive ideal solution and 0.285 unit separation from negative ideal solution with the highest

Criteria	Expert 1	Expert 2	Expert 3	...	Expert n	Average
Criteria 1						
Criteria 2						
Criteria 3						
⋮						
Criteria n						

TABLE 4: Weight matrix of the criteria

Criteria	Expert 1	Expert 2	Expert 3	...	Expert n	Average
Criteria 1						
Criteria 2						
Criteria 3						
⋮						
Criteria n						

TABLE 5: Decision matrix for the alternatives

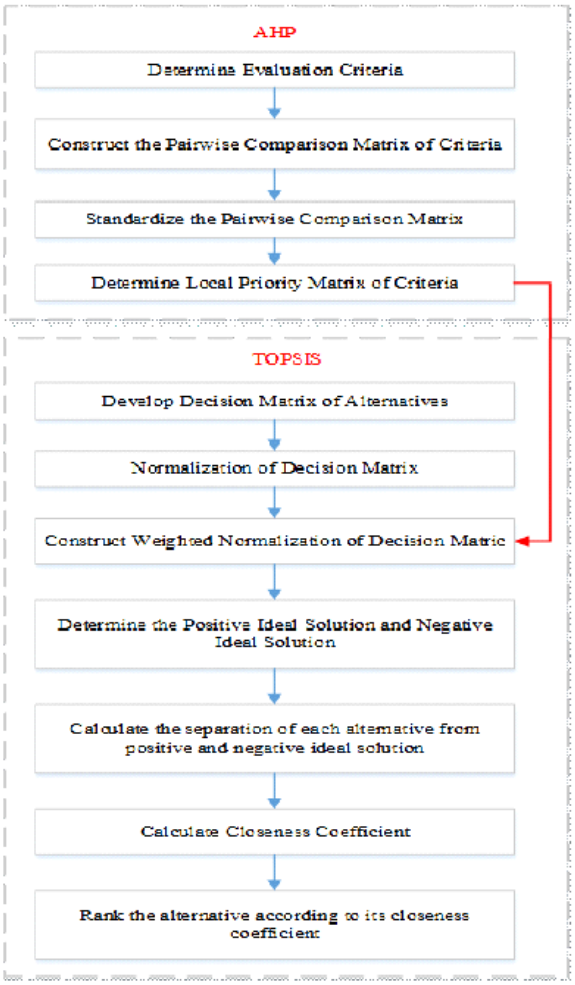

Fig. 1: The proposed model

Criteria	Reference
Technical Efficiency	[20] [21] [22] [23] [24] [25]
Overall Cost	[26] [22] [21] [27] [28]
Environmental	[21] [27] [29] [20]
Land Use	[21] [29] [30] [25]
Sustainability	[29] [27] [31] [32] [33] [34]

TABLE 6: Decision table for the alternatives

Criteria matrix	Priority
Land use	0.053
Sustainability	0.080
Overall installation cost	0.116
Environmental impact	0.213
Efficiency	0.538
Sum	1.000

TABLE 7: Local priority of criteria matrix

value of closeness coefficient. Hence, the solar energy alternative has been ranked number 1 among other alternatives. In the same way, hydro-thermal, wind, geothermal and biomass energy alternatives have been ranked as 2,3,4,5, respectively.

6 Conclusion

The purpose of this study was to select a suitable renewable energy resource using proposed hybrid decision model. The result of this research study shows that solar energy is the most suitable renewable energy source for Pakistan. Solar Energy capacity in Pakistan is estimated to be 2,900,000 MW, but only 200 MW of solar energy power plants were installed till 2018 [35]. Hence, the proposed research study and the resulted ranks in Table 8 will help the policy makers and energy planners for making long-term energy policies for Pakistan. However, changing the criteria or alternatives

Decision Matrix	Wind	Solar	Biomass	Geothermal	Hydro-thermal
Land Use	8.00	8.67	4.33	4.33	9.33
Sustainability	6.00	8.33	5.33	6.67	6.67
Overall Cost to install	5.33	8.67	6.00	5.00	7.67
Environmental Impacts	3.67	4.67	5.67	3.33	5.00

TABLE 8: Decision matrix of the alternatives

Alternatives	SPIS	SNIS	CC	Rank
Wind	0.184	0.119	0.392	3.000
Solar	0.041	0.285	0.874	1.000
Biomass	0.277	0.097	0.259	5.000
Geothermal	0.209	0.098	0.319	4.000
Hydrothermal	0.085	0.211	0.713	2.000

TABLE 9: Computation of SPIS, SNIS & CC

using this model may change the ranking. Alternatives can also be assessed with the simulation model.

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Video Image Detector: A Tool for Finding Similarity in Video Contents

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Abstract

Nowadays, when a sheer volume of multimedia data is being generated on daily basis, video piracy has become a genuine issue. In this paper, we propose a technique for matching video frames in two (or more) video files. Most of the work in this domain has been done on object detection, text detection, and spatio-temporal methods, however, the detection of copyright contents in videos has not been well-addressed. In this paper, we propose a technique to detect the copyright video frames in two or more videos. The given videos can be an advertisement or an especially worked-out video file by a journalist which is legally owned by the person who made it. Such a video files/clips can be matched with certain video streams or files to check if they contain the whole or a part of the given video file. The given video clip is composed of individual frames which could be matched on frame-to-frame basis with other (live) video streams to find the similarity extent between the successive images/frames. The method/technique to be proposed in this project will be mainly helpful for tracking or identifying the copyright digital video contents (e.g., songs, ads, news, etc) being played/transmitted illegally by a digital channel.

Keywords—Video similarity, content matching, feature matching

1 Introduction

COPYRIGHT videos can be utilized maliciously by an association with no permission to the video's proprietor. The copyright material is more earnestly to recognize when it is duplicated, i.e., replicating a couple of casings from a video. The majority of past works in this context focus on object detection, text detection, spatio temporal methods etc. and so forth, however, to the best of our knowledge, there is no work on video-to-video content matching for piracy detection. Some of the video contents transmitted by the TV channels violate the copyright rules and do not properly acknowledge the videos' owners. In this regard, we propose a technique for automatic detection of the copyright contents in a video. Our proposed technique attempts to find the solution of the following questions /challenges.

- Finding a specific sequence of images in a video file.
- Deciding whether direct matching of two video files is possible.
- Determining the extent of color variation in a pixel to be accepted as identical.
- Determining the threshold/criteria based on the number of matched frames/images in a video to decide whether the contents are similar?

Our proposed technique has the ability to work with following types of videos.

1) Videos with same resolution for pixel-to-pixel comparisons
2) Videos with different frame rates, data rates and bit rates.
3) Videos with different resolutions with different data and bit rates.

In this technique, the movement calculation is utilized to satisfy the above parameters. The technique works well on small video contents, however, for larger videos, frames comparison requires huge storage.

Section II characterizes the related work in this domain. Section III gives an overview of video similarity detector. Section IV describes the motion detection algorithm. Section V depicts the diagram of the entire

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application. Section VI characterizes the operational outline in which it finds the comparability substance between recordings. Section VII explains the tracking process for matching images. Section VIII describes the experimental results. Section IX concludes the paper.

2 Related Work

In [1], the authors propose a technique based on multi-frame end-to-end learning of image features and cross-frame motion. In some other techniques [2] [3], the authors present a programmed video subtitling model that joins spatio-temporal correlation and picture arrangement by neural network structures based on long short-term memory. The resulting system is demonstrated to produce state-of-the-art results in the standard YouTube captioning benchmark while also offering the advantage of localizing the visual concepts (subjects, verbs, objects), with no grounding supervision, over space and time. In [4], the authors address the issue of content based action recovery in video. Given a sentence portraying an action, the undertaking is to recover coordinating clasps from an untrimmed video. To capture the inherent structures present in both text and video, the authors present a multilevel model that coordinates vision and language. First, the authors inject text features early on when generating clip proposals to help eliminate unlikely clips and thus speeding up processing and boosting performance. Second, to learn a fine-grained similarity metric for retrieval, the authors use visual features to modulate the processing of query sentences at the word level in a recurrent neural network. In [5], the authors propose a content-based copy detection technique. This approach is based on the contents of media files. In this technique, the main focus is based on resolution, compression and digitization effects during detection of content based videos. In [6], the authors proposed a new motion signature. A different application of ordinal signature and experimental comparison of these methods to the color signature is proposed. This technique also matches content-based signatures to detect copies of videos as opposed to watermarking, which relies on inserting a distinct pattern into the video stream. In the end, the statistical features from this technique indicate that it has an impressive performance.

In [7], authors propose another copy detection technique which detects the key frames by using color histograms. This technique basically relies on color; however, dissimilarities in color are expected to be reasonable complications in this approach. In [8], the authors present a comparative study of background subtraction strategies. Methodologies extending from straightforward foundation subtraction with global thresholding to increasingly complex measurable techniques are implemented and tested on various videos with a ground truth. The objective of this investigation is to provide a strong systematic ground to highlight the qualities and shortcomings of the most widely used movement discovery strategies. The techniques are contrasted based on their vigor with various kinds of video, their memory requirement, and the computational exertion they require. In [9], the authors propose a new algorithm for motion detection. In this proposed scheme, the moving object is detected by using a stationary camera within a scene. Another successive result is to compare the frames on both sides with the calculation of n consecutive frames. It finds out the percentage area in which the motion exists. In [10], the authors discuss the visual surveillance integration system that achieves better performance with respect to visual tracking in motion detection. However, the information and motion of tracking algorithm is combined into an appearance model and is used as a particle filter framework for tracking the object in subsequent frames. In [11] [12], the authors propose a simple recursive nonlinear operator, used along with a spatial temporal regularization algorithm. By using a static camera, these motions are performed by approximating the fixed part of the videos. The extensive range of motion is detected in a complex scene with different time constants.

Most of the work in this domain is done on background subtraction calculation which is focused on distinguishing an item in one frame to another frame. During the video playback, it is hard to identify moving objects from one video to another video. In [13], the authors present an algorithm for identifying moving objects from a static scene based on frame difference. Firstly, the first frame is captured through the static camera and the successive frames are captured at customary interims. Secondly, the absolute difference is calculated between the consecutive frames and the difference image is stored in the system. In [14], the authors present a survey on the most recent strategies for moving object detection in video sequences captured by a moving camera.

3 Video Similarity Detector

Video identification is a technique that discovers those edges that are coordinated with one video into another video. This technique contrasts with the current motion picture outlines and the prior casings or with

something that will be called as foundation. If an object in the frame is moving slickly, lesser variation is obtained by the smaller predefined threshold. This calculation additionally matches both the video outlines one by one amid the running video streams. Amid correlation of recordings, the entire moving edge is identified autonomously by its movement speed.

4 Motion Detection Algorithm

Motion detection [9] is the primary procedure in the abstraction of data concerning moving entities maintaining in efficient regions such as tracking, cataloging, acknowledging, etc. The background of video frames are calculated by taking means of n successive frames and matching them with the existing frames using the sub blocks of the matching-based scheme.

BS techniques take the notion to experiential video sequence. Image I is made up of a static background B in front of which stirring entities are observed. By the observation of every moving object that is made up of color distribution different from the one in B, BS methods can be applied by the following formula,

$$X_{t(s)} = \begin{cases} 1, & \text{if } d(I_{(s,t)}, B_s) > \tau \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

where τ is a threshold, $X_{t(s)}$ is the motion label field at time t, d is the distance between $I_{(s,t)}$ and pixels, and B_s is the background model at pixels.

The reasonable way to model the background B is to conclude by a single gray scale color image void of moving objects [10]. By the instruction of handling with brightness changes and background adjustments, it can be iteratively updated as follows,

$$B_(s, t+1) = (1-\alpha)B_(s,t) + \alpha I_(s,t) \quad (2)$$

where α is a constant whose value ranges between 0 and 1. In the case of mean method, background is the mean or average of the earlier frames and mathematically it is written by the following formulae.

$$B(x,y,t) = \frac{1}{n}\sum_{(i=0)}^{(n-1)}(x,y,t-1) \quad (3)$$

$$|(x,y,t) - B(x,y,t)| > Th \quad (4)$$

The background model is subtracted from the n previous or existing frames. The threshold value used in this technique checks if the value of pixel is greater than the other pixel, in which case it is treated as a foreground pixel. Otherwise, if a pixel's value is smaller than the threshold value, it becomes a background pixel.

5 Overview of the Application

A given video clip which is required to be monitored in another video can be a notice or a particularly worked-out video document by a columnist which is legitimately claimed by the individual who made it. Such a video records/clasps can be coordinated with certain video streams to check in the event that they contain the entire or a piece of the given video. The recordings might be songs and ads, etc.

We initialize both the videos and start the tracking process. If the frames are found, they are stored into the resultant directory. This comparison will run till it completes the last n^{th} frame to be matched with the whole video. If the initial frame is not matched, the recognition procedure analyzes the whole moving frame independent of its motion speed. Frames and background are intended to be calculated by taking mean of n successive frames and comparing them with the existing frame. The subsequent frames use the threshhold values. These qualities demonstrate the variation of colors which is increased up to 10%, whereas, if the frames are not compared during detection process, then the comparison process itself continues and checks the next frame to compare with the previous or current frame. Figure 1 gives the logical view of this application.

6 Finding Similarity in Video Contents

To determine the similarity between two or more videos, some small or large videos are collected through different media programs. First video is contrasted and the second video in the given time span can be chosen from the client's decision. Figure 2 depicts the overall framework of our application.

- Stage 1: Choose two videos that have diverse time frames and begin correlation.
- Stage 2: Two directories are created automatically before the start of the comparison process. First directory is made when the video document is stacked into the video stream. This directory is named as "Resulting Matched Frame Folder".
- Stage 3: The second directory is created and named as "Advertisement Image". The frames are separated and stored into this directory. We wait until the application completes its procedure.
- Stage 4: In Figure 2, two cases are conceivable during the video matching phase. The first frame of the advertisement video clip is matched with the first frame of the video file. If the frame is matched, it is stored into

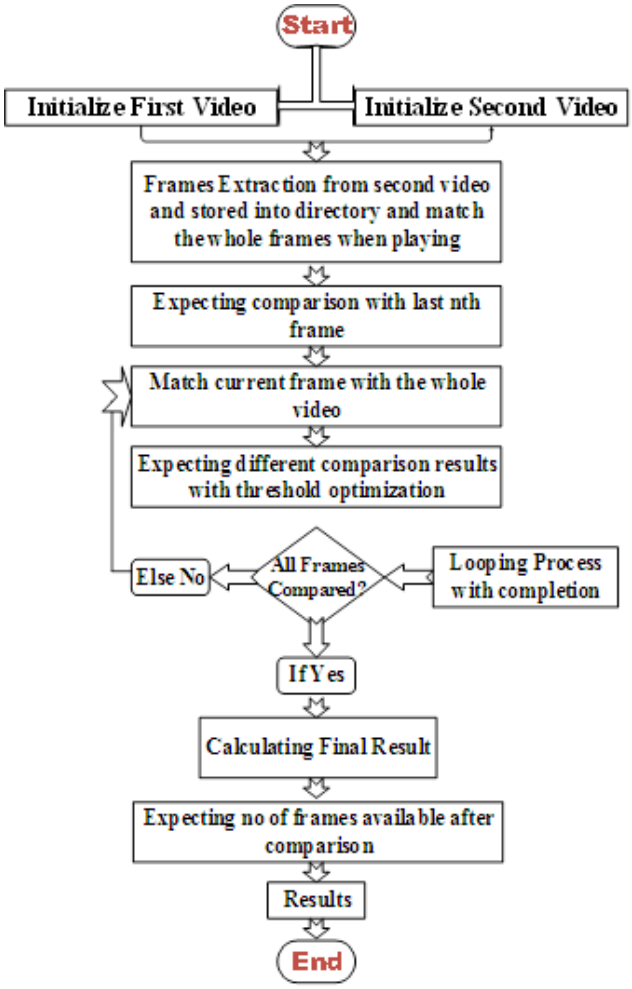


Fig. 1: Logical view of this application (operational model)

the directory "Resulting Matched Frame Folder".

Step 5: After consummation, the coordinated casing will likewise check amid or after the correlation.

Step 6: After completion, the matched frame will also check during or after the comparison. This application uses the motion detection technique in which the examination relies upon the shading variety and blend of different calculations in which the comparison relies upon the variety of changing nature between videos and blend of different calculations.

7 Tracking Process for Matching Images

The accompanying procedure shows the tracking frames between two recorded videos. Figure 3 demonstrates the tracking process while the threshold values

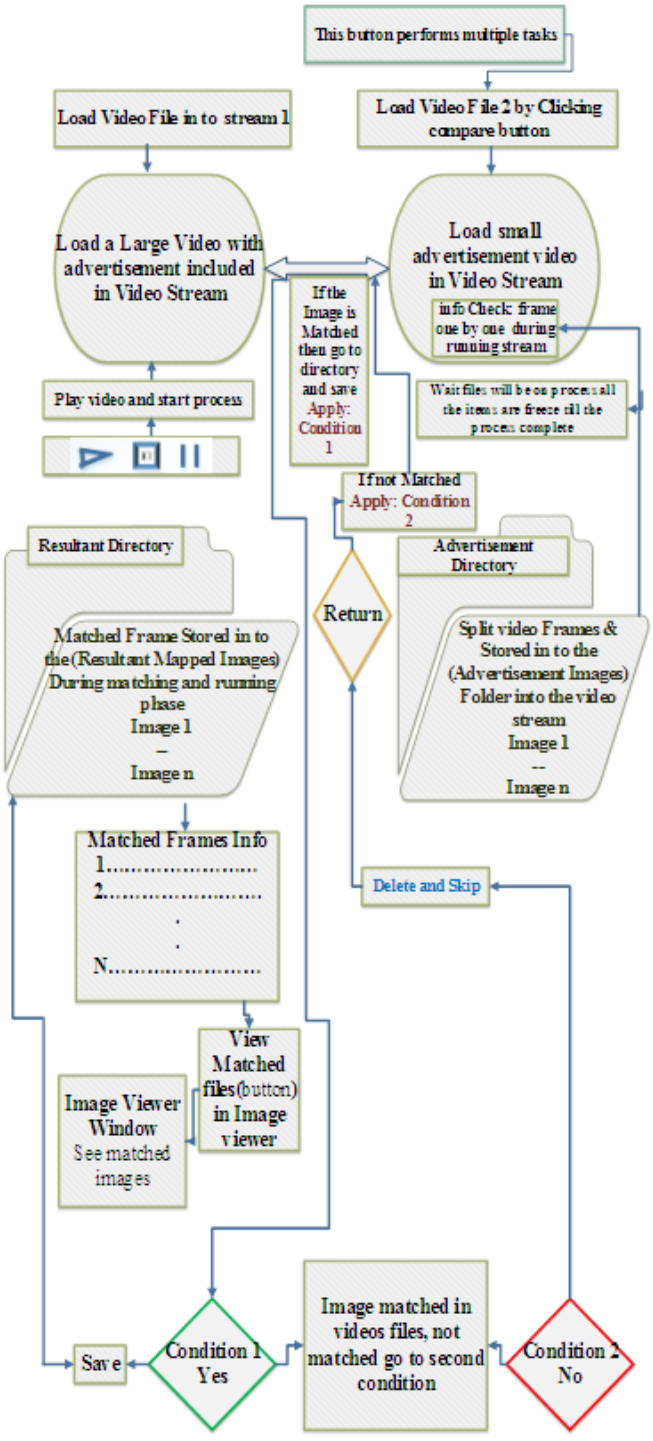


Fig. 2: Flow Chart for finding similarity in video contents

are compared with all the values of the running videos. In figure 3, the center box shows the threshold values and by using these parameters, following cases are tested. If the condition is more prominent than the threshold values, it can not distinguish the frames of the video, the values of comparable videos are less than or equal to thresh hold values or the application detects the related frames in both the videos, if and only if the related video frames are available in both the recorded videos.

This following procedure additionally utilizes the limit esteems, yet it likewise utilizes the framework's current date and time that recognizes the related frame. Without the utilization of framework date and time, the following procedure does not track the frames correctly. In this procedure, the frames are isolated into milliseconds, for instance, one edge is extracted into thirty frames for each second and th

The comparison frames are detected in 0 to 5 milliseconds. It detects the frames one by one, next frames are detected between 5 to 10 milliseconds and so on. By utilizing the present framework's date and time with the video length, it distinguishes the edges in milliseconds.

8 Experimental Results

The proposed procedure is feasible to detect the copyright frames by utilizing diverse clasps/video. Examination is done on various kinds of situations.

- Videos with same resolution
- Videos with different frame rates, data rates and bit rates.
- Videos with different resolutions with different data and bit rates.

8.1 Videos With Same Resolution

We pick two recorded videos that have distinctive time periods and begin comparison. Two directories are made on the beginning of the application. First directory is made amid the video document is stacked into the video stream. This Directory is named as "Resulting Matched Frame Folder". Second directory is made and named as "Advertisement Image".

Figure 4 demonstrates the correlation procedure where two cases are conceivable amid the video coordinating stage. The primary frame of the commercial video cut is matched with the first frame of the recorded video. If the frame is matched, it is stored into the directory. Then again on the off chance that the frame isn't matched, the value returns and afterward goes to the next frame to compare with the entire video.

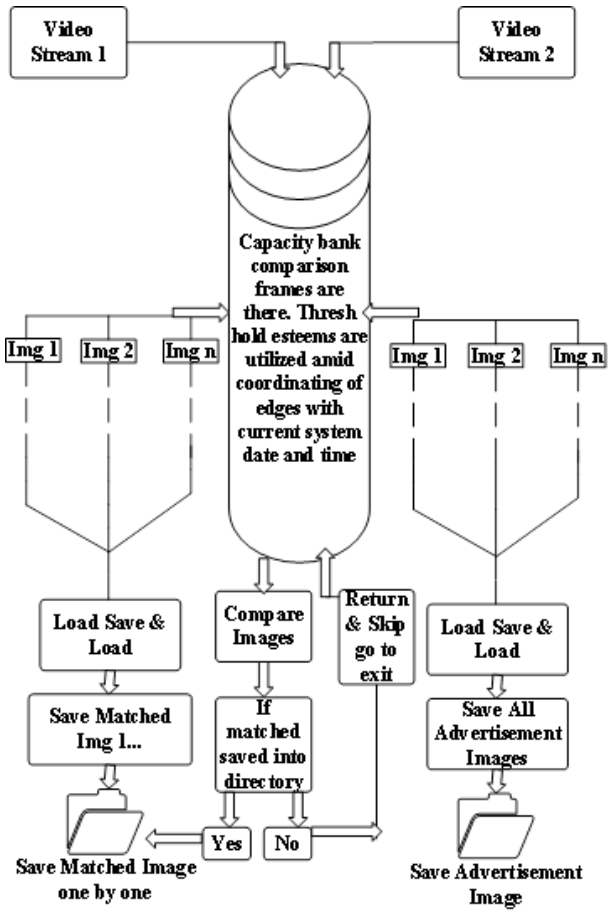


Fig. 3: Tracking Process by using threshold

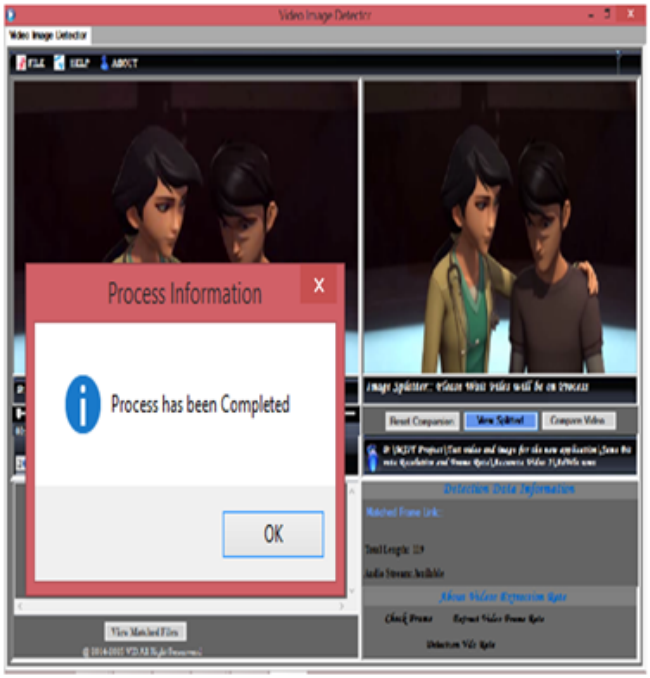


Fig. 4: Extracting video clips

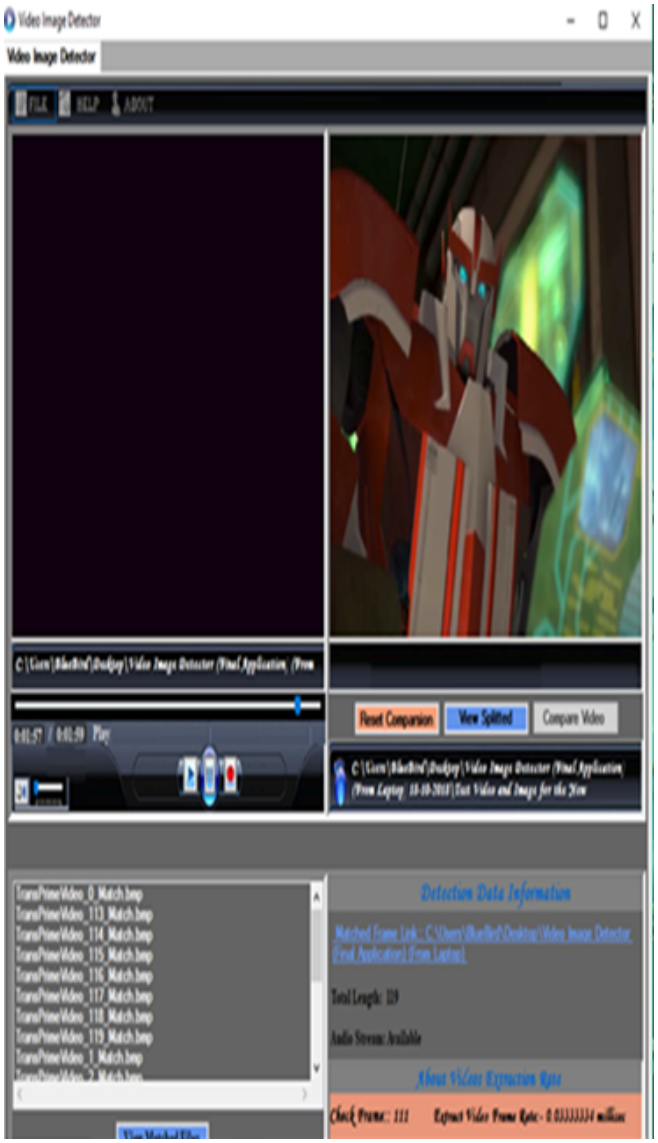
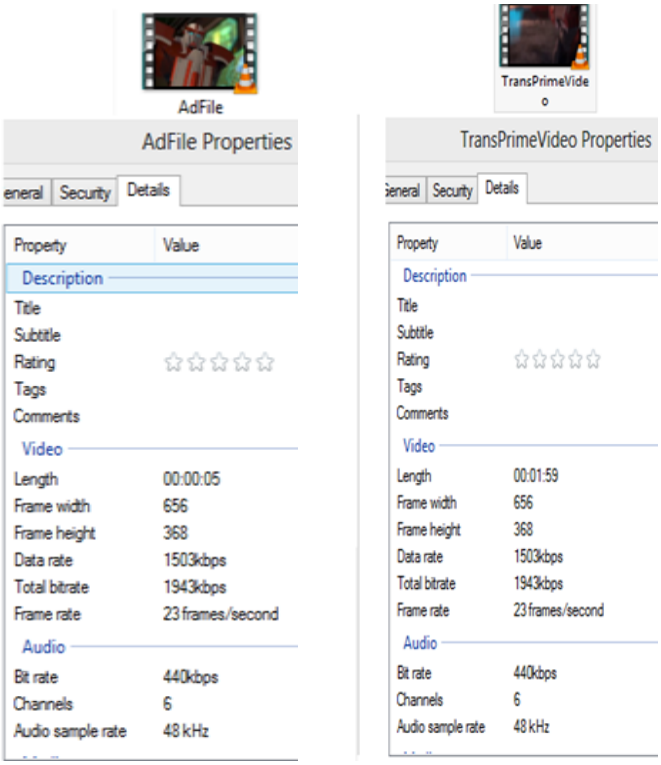


Fig. 5: Comparison process



(a) Advertisement video

(b) Full video with advertisement clip

Fig. 6: Videos with similar resolution

Table 1 shows the original video data. Note that the resolution, data, frame rate and total bit rate of both the videos have the same data but their duration times are different from one another. Figure 5 demonstrates the correlation procedure in which the frames of a video files are coordinated with each other. The data is stored with frame numbers and is made available in the application. It can be seen in Figure 6(a) and 6(b) that the advertisement video clip are compared and the length, frame width, height and other related characteristics of both the videos are matched. During the comparison of both videos, the frames are detected and the parameters in this figure show that the contents of the video are copied. Figure 7 focuses on both the directories of the matched video frame. After comparison, the outcome among Adframe_0 and the matched frame TransPrimeVideo_0 has same properties. Just a single frame of both the directories is pronounced to exhibit the properties after matching. Table 2 shows the results of the comparison. Out of 165 frames, the number of matched frames are 14. The resolution of both the videos is 720x480. The frame rates of both the videos is 23 frames/second, and their bit rate are 1943 kbps.

8.2 Video With Different Frame, Data & Bit Rates

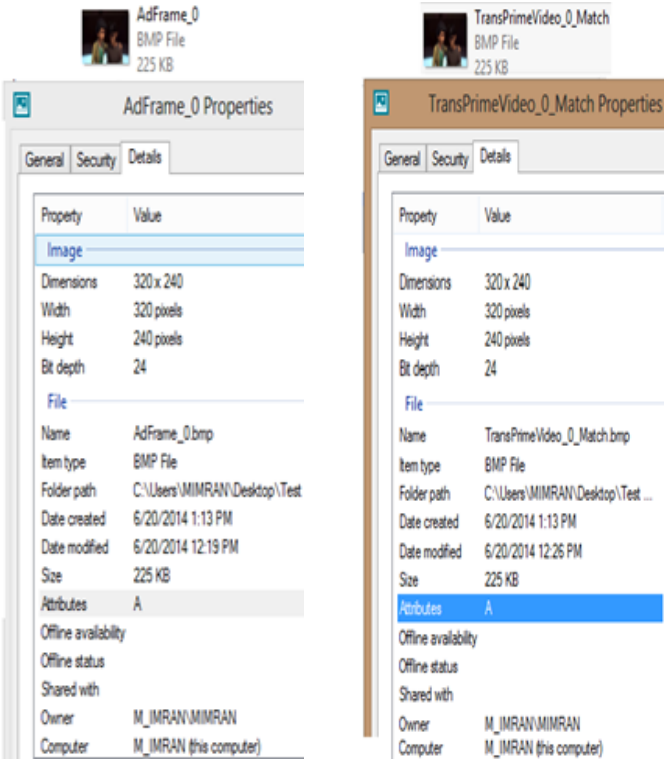
We also test different resolution, frame rates and bit rates. The threshold values must be higher or like the perfect qualities. In the case when the threshold is higher than the other values during video comparison, the resultant is not identified and the procedure will proceed until the next frame is matched. Figure 8 shows video comparison of different length, date rate, and bit rate. Figure 9 delineates that these edges are distinguished effectively. Figure 10 shows that these frames are coordinated by utilizing diverse data rate and bit rate. Hence, our proposed technique distinguishes the video frames with different date rate and bit rate. Figure 10 also shows the matched (copyright) frames of the videos. Table 3 shows that out of 249 frames, the numbers of matched frames are 9. The

Original Video Data			
Video 1 (Advert. video clip)		**Video 2 (Normal video with Advert)**	
Original Video		**Original Video**	
Video Resolution	720 * 480	Video Resolution	720 * 480
Video Data rates	1503 kbps	Video Data rates	1503 kbps
Video Frame rates	23 frames /sec	Video Frame rates	23 frames /sec
Total bit rates	1943 Kbps	Total bit rates	1943 Kbps

TABLE 1: Video resolution, data, frame and total bit rate

Matched Image Data b/w two videos			
Advertisement video clip		**Normal video with Advert**	
Experimental Results			
No of original matching frames	165	No of frames matched	14
Video Resolution	720 * 480	Video Resolution	720 * 480
Video Data rates	1503 kbps	Video Data rates	1503 kbps
Video Frame rates	23 frames /sec	Video Frame rates	23 frames /sec
Total bit rates	1943 Kbps	Total bit rates	1943 Kbps

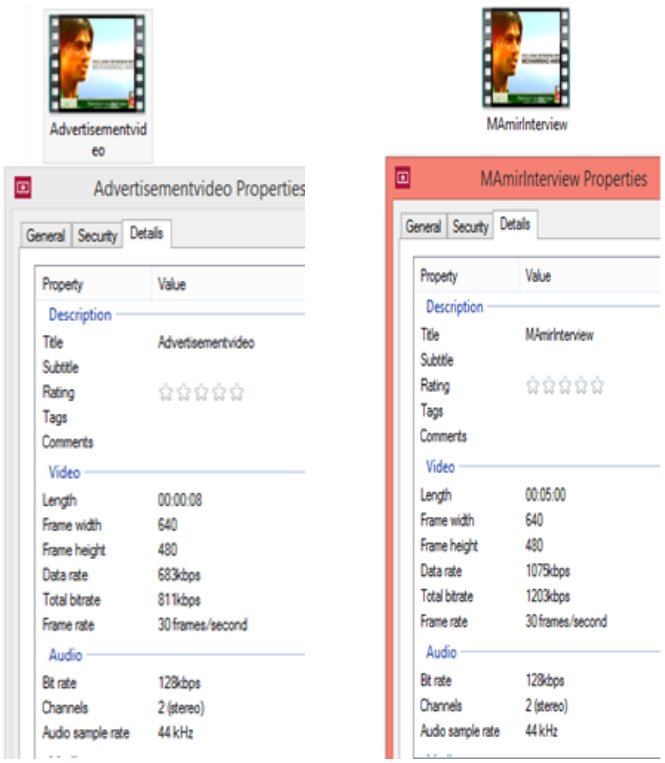
TABLE 2: Total 165 frames 80 frames are similar, No of matched frames are 4.



(a) Advertisement video

(b) Full video with advertisement clip

Fig. 7: Advertisement & Matched frame properties



(a) Advertisement video

(b) Full video with advertisement clip

Fig. 8: Video Frame detection rate

Fig. 9: Frames are detected & displayed in the directory

Fig. 10: Resultant Frames

resolution of both the videos is 640x480. The frame rate of both the videos is 30 frames/second. The bit rates of the two videos are 811 kbps and 1203 kbps, respectively.

8.3 Video With Different Resolutions, Data Rate & Bit Rates

In the third scenario, the experiment is done on different resolutions, data and bit rates. The outcome appeared in Figure 11(a) and 11(b) demonstrates that the two videos are different and there bit rates are entirely different with one another. The comparison between the two videos begins from different parameters mentioned above. In this figure, the conceivable results may be 8-10 frames.

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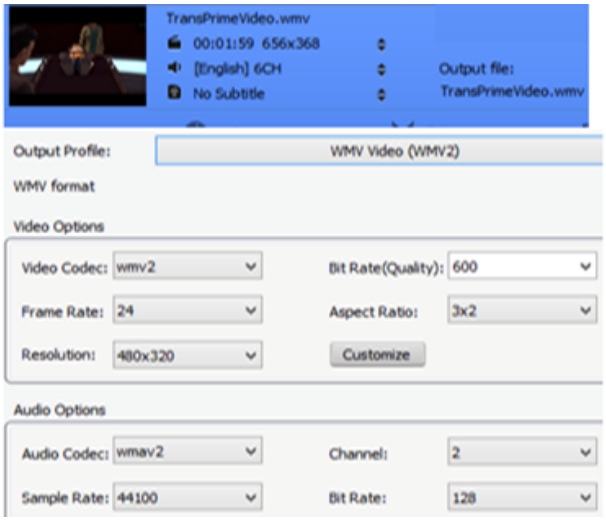
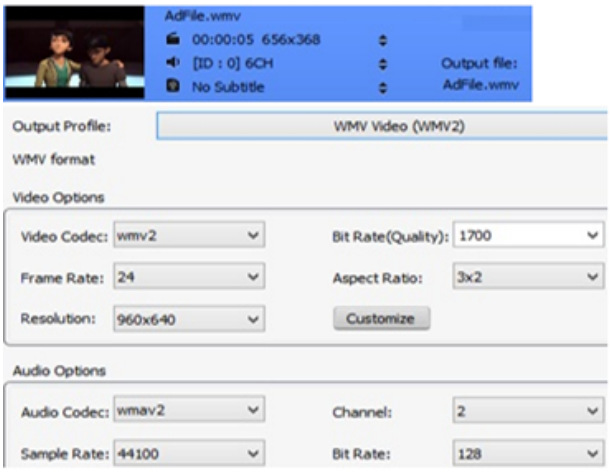
Original video data			
Video 1 (Advertisement video clip)		**Video 2 (Normal video with Advert)**	
Original Video		**Original Video**	
Video Resolution	640 * 480	Video Resolution	640 * 480
Video Data rates	683 kbps	Video Data rates	1079 kbps
Video Frame rates	30 frames /sec	Video Frame rates	23 frames /sec
Total bit rates	811 Kbps	Total bit rates	1203 Kbps

TABLE 3: Total 249 frames, 73 frames are similar, No of matched frms 9



(a) Different Resolution, Frame rate, bit rate of a Full Video



(b) Full video with advertisement clip

Fig. 11: Video with different resolutions, data rate & bit rates

Spectrum Sensing in ISM Band Using Cognitive Radio

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Abstract

Wireless communication is one of the essential parts of contemporary technology. Although, the popularity of the wireless communication is growing day by day, the quality and data transfer rate is limited and wireless spectrum needs to be focused more clearly. The telecommunication workers and internet service providers are facing problem of the wireless spectrum in case of the large amount of data transfer rate with respective to the need of customer. The Cognitive Radio (CR) shortage has gradually inclined towards progress. CR ensures the efficient usage of under-utilized spectrum. Spectrum sensing performs the key functionality in identifying the free gaps in the spectrum. The aim of this research is to validate the under-utilization of unlicensed ISM band in the vicinity of Nawabshah. A spectrum analyzer is used to collect the raw signal data. The study of the free space in the spectrum is done with different techniques such as cycle stationary, feature detection, wavelet based edge detection and energy detection. The performance of all three techniques are compared and the optimum technique is suggested. Our in-depth analysis presented in this paper provides a critical review of the spectrum sensing methods and contract spectrum sensing.

Keywords—Spectrum sensing, Data Acquisition, Probability.

1 Introduction

Wireless communication spectrum needs to be utilized as efficiently as possible in order to cope with the modern challenges. We have to interrupt down the spectrum carefully and reason assumptions in order to assist us in developing spectrum operation prepare mo e frequency spectrum are widely used in telecommunication system for the efficient and rapid communication over network. This is important to make standard frequency range of spectrum that is 30 Hz to 300 GHz. In telecommunication system, a spectrum is a concept which is used to refer to some time frequency band. It is actually a specific frequency band which is called spectrum. This spectrum is divided into low frequency rang and high frequency range. However, each frequency band has certain boundaries usually called upper and lower limit.

An electromagnetic radio spectrum can be reflected as a feature asset. Radio spectrum is deployed with the help of different exceptional receivers and transmitters which are operated through means of numerous controlling government and agencies. Cognitive Radio (CR) is considered one of the candidate solutions for the spectrum practice problem at some distance like spectrum sensing strategies. Spectrum sensing takes dual method. Initially, accessible spectrum is sensing then its miles allocated to non-adjusted clients for effective use. The underutilized frequency sub-bands are generally referred to as "white spaces" or "spectrum holes". Spectrum gap could be characterized as a band of frequencies. It can not be used through an overhauled patron at a specific period and particular geographical position. There are a few specific measurements of spectrum detecting inclusive of code, attitude, space (geographical place), time and frequency. Significant number of spectrum sensing procedures exist to discover spectrum holes. The concept of basic spectrum frequency management and finding holes in spectrum is one crucial part of research.

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The study presented in this paper shows the use of spectrum sensing by electricity detection and wavelet transformation set of rules utilizing GNU Radio and GW-Instek Spectrum Analyzer with the aid of frequency and time measurements. The most capable method of analysis of all reachable spectrum sensing methods is displayed. Spectrum sensing of the CR is deliberated as the high component of spectrum. The difficulties in the frequency spectrum can be found via unused frequency bands.

2 Motivation

Cognitive radio is the developing innovation for supporting element range access. To identify the closeness of the primary clients in an authorized range is considered as an important issue for CR. In Cognitive radio, execution of the range detecting relies upon the detecting time and the combination plan. These plans are utilized when agreeable detecting is connected. In this proposition, range detecting systems, for example, vitality identification, coordinated separating location, cyclo-stationary recognition and waveform based detecting techniques are examined. Vitality recognition is most generally utilized as a part of neighborhood range detecting. This case study provides an outline about examination between various strategies. It also highlights the better technique for range detecting.

3 Related Work

The study of software defined radio and CR technology is an important aspect of research community. For instance, GNU radio is focused in terms of the CR [8]. Relevant literature demonstrates a number of techniques addressing the diverse parts of spectrum sensing and CR. Majority of continuous level regulated discussion is focused on the appropriate spectrum sensing. Procedures for CR, channel distribution and transmission power taking care of Physical (PHY) and MAC layer usage [9]. The important factor for any spectrum is to detect the underutilized bandwidth [10]. Consequently, a number of phases are accessible for the usage of CR as a SDR. One of them is Open source (SCA) usage Embedded (OSSIE) in [11]. The OSSIE supports the open source facility for the radio suite which can support SDR and CR operations. Different stages incorporate large power SDR (HPSDR) [25] and Flex Radio [26]. Nearby few distinct strategies which can be reflected as contrasting option towards range detecting. Among these strategies is cognizance empowering pilot channel (CPC) [6]. As indicated by CPC, the database of authentic manipulators to identify and use on the screen recognition spectrum is created by making next channel and spreading spectrum opportunities in auspicious way. Be that as it may, this results in extra infrastructure and utilization of alternative network referred to as CPC. That is not a better way to deal with spectrum shortage, as this results in additional overhead in radio supply.

4 System Methodology

In this study, quantitative and qualitative experimental and analysis procedures have been used to investigate the research problem in concern. We started work with survey literature of CR. Initially, the detailed study of cognitive radio pattern was conducted. Subsequently, after getting familiar with working values of CRs, we narrowed down the possibility to more precise area of concern, i.e. spectrum sensing. Spectrum sensing was selected for the reason of its vital role in making CR feasible. Additionally, sophisticated examination was conceded out on spectrum sensing to acquire information about existing state-of-the-art research in the capacity of spectrum sensing. On the basis of the information collected over a period of time, we demarcated research questions of our study. We prepared deductive and statistical hypothesis to address the research question. To reinforce our defined hypothesis and to inspire our answer, we first assumed that there are some white spaces in congested 2.4 GHz ISM band. The most crucial part of any CR is to discover underutilized bandwidth in obtainable radio spectrum in an efficient way. The underutilized bandwidth or spectrum holes should be created with least data about spectrum as it is challenging to contemplate entire measurements of radio spectrum, however, observing spectrum for spectrum holes. Research about entire available spectrum sensing practices was conceded out in terms of qualitative analysis. For experimental and quantitative exploration, we tried a GW Instek Spectrum Analyzer for sensing purpose and MATLAB for data analysis. Firstly, we collected signal information using Spectrum Analyzer for 2.4GHz ISM band. After collecting the real time data, we employed algorithms over MATLAB and collected outcomes in the form of raw data comprising of FFT values of spectrum in the order as shown in Figure 1. The information collected in real time was prescribed in tables so that outcomes could be observed in graphical manner. One of the key chores was to show the data in a graphical way so that all three measurements, i.e., gain, time, frequency could be taken under consideration at the same interval. For this persistence, we developed spectrograms and 3D-plots to acquire reasonable appreciative results and to confirm outcomes in contrast to hypothesis in

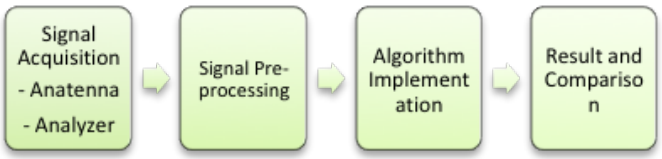

Fig. 1: Research Methodology

concern. In Figure 1, an antenna is a device (normally steel) for sending or receiving electromagnetic waves. In transmission, a radio transmitter applies a radio frequency to the terminals of the antenna and then the antenna radiates the strength from the antenna as electromagnetic waves. In reception, an antenna intercepts some of the electricity of an electromagnetic wave to provide a radio frequency at its terminals that is implemented to a receiver a good way to be amplified and demodulated. In some cases, the equal antenna can be used for each transmitting and receiving. A 2.4 GHz Antenna series covers 2300-2600 MHz band applications for IEEE 802.16 and 802.11 [12][13]. An analyzer is a device that analyses the given data. It examines in element the shape of the given facts and tries to discover styles and relationships between components of the records. An analyzer may be a piece of hardware or a software program application going for walks on a computer. A spectrum (plural spectra or spectrums) is a circumstance that is not always confined to a selected set of values but can vary infinitely within a continuum [14]. The phrase was first used scientifically inside the discipline of optics to explain the rainbow of colors in visible mild when separated the use of a prism. It miles the procedure of sampling signals that degree actual global physical conditions and converting the ensuing samples into digital numeric values that can be manipulated with the aid of a computer. The records acquisition systems, abbreviated as DAS or DAQ, commonly convert analog wave forms into virtual values for processing. The components of statistics acquisition systems encompass Sensors to transform bodily parameters to electric alerts, sign conditioning circuitry to transform sensor signals right into a shape that can be transformed to digital values, and analog-to-virtual converters to convert conditioned sensor indicators to digital values. Statistics acquisition applications are generally controlled by means of software applications advanced in the use of numerous popular reason programming languages including meeting, primary, C, C++, C#,

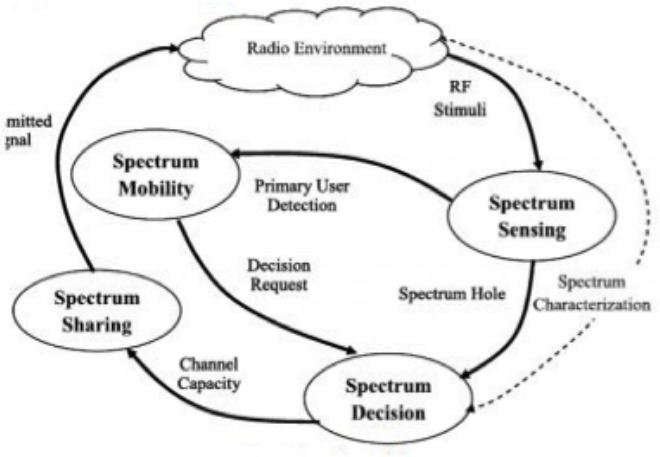

Fig. 2: Cognitive Cycle

Fortran, Java, Lab VIEW, Lisp, Pascal, and many others.

There are also open-source software programs providing all the important tools to acquire information from a specific hardware equipment. This equipment comes from the scientific community where complicated test requires fast, bendy and adaptable software. These programs are usually custom suit, however, greater standard DAQ package like the maximum integrated facts acquisition device may be easily tailor-made and is utilized in numerous physics experiments. There are four main steps in cognitive cycle, as shown in Figure 2 [15], by which we acquired signal data. The digital implementations provide more flexibility by means of spending FFT-based totally spectral approximations. Figure 3 displays the framework for virtual execution of a power indicator [4]. Electricity detector based technique is the best corporate technique of spectrum sensing due to small computational overhead. When primary person signal is indefinite or receiver can not acquire appropriate statistics about primary sign user, a power detection technique is used. This technique is ideal for identifying any indefinite zero-mean collection signals and must be imposed to cognitive radios (CRs). Procedure stream of energy detector in the received signal is passed by ADC after measuring the FFT constant form and average of observational interval. In order to decide primary user occurrence/non-occurrence, the output is compared to the predefined initial value. Figure 4 shows simulation the steps using MATLAB. These steps are defined as under.

- **Initialization-** After the completion of all basic configurations, carrier frequency bands, message frequency and sampling are initialized for the user.

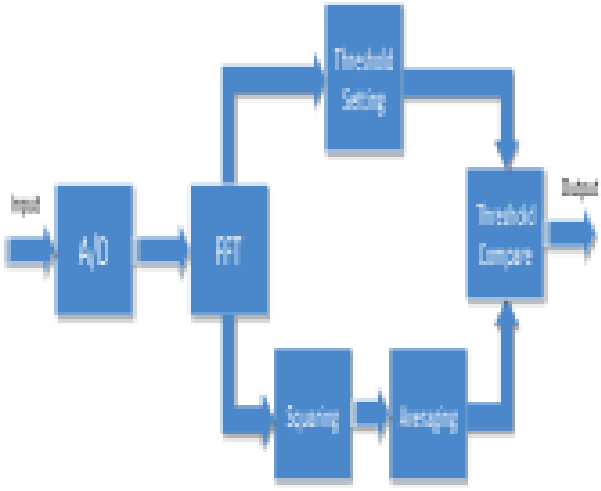

Fig. 3: Digital implementation of an energy detector

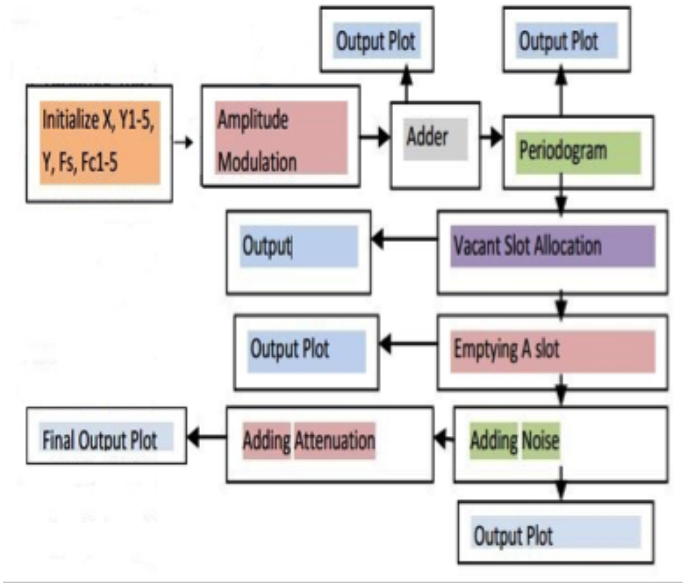

Fig. 4: Simulation Set up using MATLAB

- **Modulation-** The process of modulating data over elective frequency band by AM.
- **Adder-** Sum of totally modulated signals to generate the transmitting signal
- **Periodogram-** Estimation of power spectral density of conventional signal.
- **Vacant Slot Allocation-** Different Users are allocated to first spectral hole while it stretches.
- **Emptying a slot-** Ask a user to vacant the particular slot if all slots are busy.
- **Addition of noise-** The addition of noise is the amount which is to be added. .
- **Attenuation-** The status of the distorted signals which directly affects the single strength.

5 Results and Discussion

The data of spectrum, collected by using GW Instek, is stored in csv files. MATLAB tool can be an effective tool to import all these files for the processing. Algorithms and complete results are designed/generated in MATLAB 2014. The obtained results show the use of 2.4 GHz Wi-Fi channels in QUEST Nawabshah and also show the free spectrum holes and channels as well. The results are obtained by the implementation of 2.4 GHz center frequency. Further, it is evaluated for the results that vary from different spectral consequences below in detail.

Figure 5 illustrates the consequences achieved for 2.4 GHz ISM band with the use of frequency of 50 MHz, i.e. signal gain across ISM band in stages of 50 MHz starting from 2.3 GHz and completion at 2.550 GHz. Purpose of this graph is to monitor the improvement of the channel under observation. However, exact channel utilization of Wi-Fi (802.11) cannot be observed.

Spectrogram in Figure 66 shows the relationship between the time frequency affiliations to advance. In this regard, the spectral representation of signal with respect to the time is called spectrogram. This depicts the variations in spectral density of signal with respect to time. The highlighted bar in the graph shows various levels of loss and gain of energy values.

In order to find the availability of spectrum at the predefined threshold, the comparison of the color with time and frequency alliance can be analyzed. The instance of time and frequency spectrum holes are represented in red colors in this spectrogram. Here, we can simply observe channel operation in the QUEST WLAN. Each stem value in the spectrogram shows outcomes collected throughout distinct cycle of data for every step of frequency. The utilization of channel for CR can be exploited at the channel frequencies for which we have completely obtained data at certain instant of period t. The spectrogram shown in Figure 6 precisely depicts the spectrum holes in the form of red tiled apparent in existence of further shades showing diverse gain values of energy spectrum.

Results of energy detection, Cyclostationary Feature Detection (CFD) and wavelet based detection based on the possibility of primary user detection, possibility of miss detection and the possibility of false detection has been compared. In this discussion, we refer to Ho as null hypothesis. Ho shows that the Primary User (PU) has not occupied the channel and it can be utilized by a Secondary User (SU). H1 is the alternate hypothesis that shows that the channel is engaged by the PU.

5.1 Probability of False Detection

False alarm is a condition when PU is detected even when a free channel is essentially free. In other words, we can say H1 is declared under Ho hypothesis. This results in the wastage of channel resource. Therefore, the probability of false detection should as low as possible. Figure 7 shows the probability of false alarm detection with respect to SNR. It can be observed that the wavelet based detection outperforms the other two methods. Energy detection, despite being less complex, shows worst performance in terms of false detection.

5.2 Probability of Detection

It is possible that the primary user is occupying channel and it is detected as such. Ideally, the probability of detection can be as much probable for lower SNR as possible.

Figure 8 depicts the comparison of probability of detection of all three sensing techniques under consideration. It can be viewed that the probability of detection of wavelet detection is greater than rest of the techniques at lower SNR. Whereas, the energy detection requires more SNR for better probability of detection.

5.3 Probability of Miss Detection

Miss detection occurs when the channel is employed by PU, but it is detected to be idle. Miss detection results in the interference to the communication of PU. It is, therefore, the probability of declaring Ho under H1 hypothesis. For a better CR system, miss detection should be minimum.

Figure 9 shows the results of miss detection. In this case again, the wavelet based detection performs better at sufficiently lower SNR as compare to the Cyclostationary feature detection and energy detection.

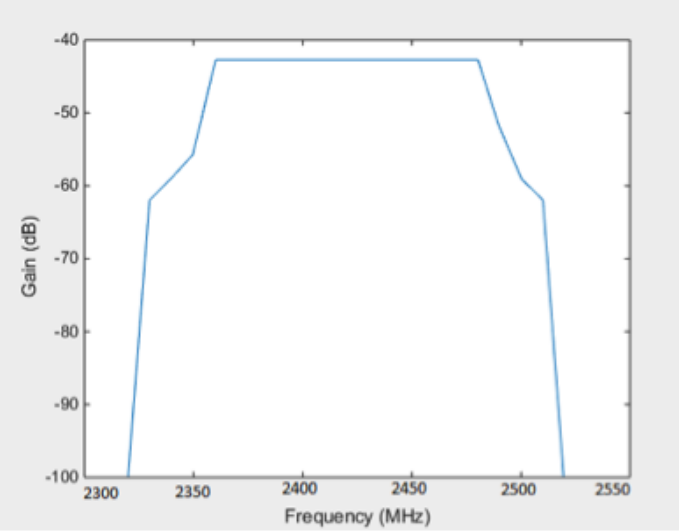

Fig. 5: Sensed signals bandwidth at 2.4GHz

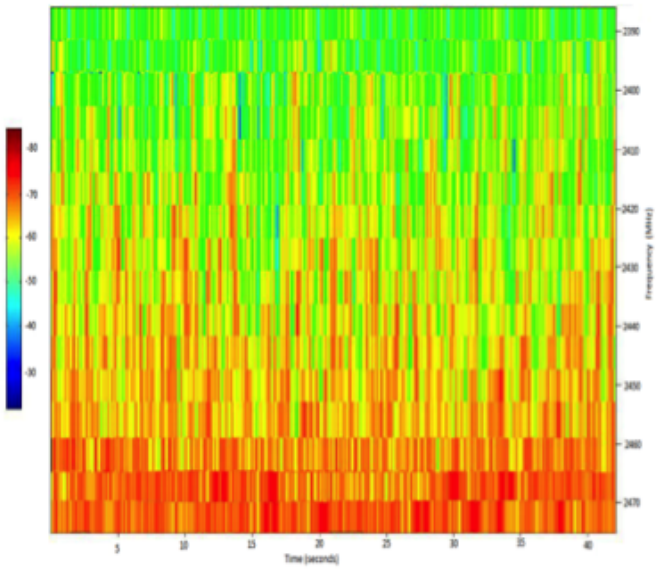

Fig. 6: Spectrogram of sensed signal

6 Conclusion

The study presented in this paper gave a comprehensive detail regarding implementation of energy detection, cyclostationary feature detection method, and wavelet based spectrum sensing. These three spectrum sensing techniques were analyzed for various SNR values. To find the spectrum holes in 2.4 GHz allocated ISM band, different number of simulations were performed. The statistics data were collected by using the GW-instek. The final qualitative investigation of the sensing techniques indicated that the wavelet based method is most consistent and accurate technique for spectrum sensing as it showed optimum results for primary User detection, miss detection and false detection for the lower SNR values. The material collected in the form of FFT bins, proved to be an effective technique of collecting data for spectrum sensing as it needs some signal processing procedures. Other work is implemented in GW-Instek. The obtained results showed that this is possible to discover an underutilized bandwidth in the spectrum apart from having earlier understanding of PU and SU. However, the Spectrograms, frequently utilized in acoustics and astronomy, can be used to detect spectrum holes as displayed in outcome by drawing spectrograms. The threshold level for few particular

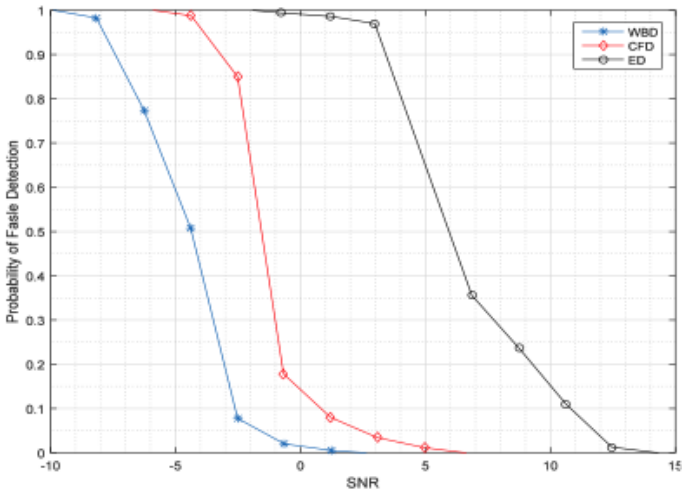

Fig. 7: Plot of Probability of False Detection Vs SNR

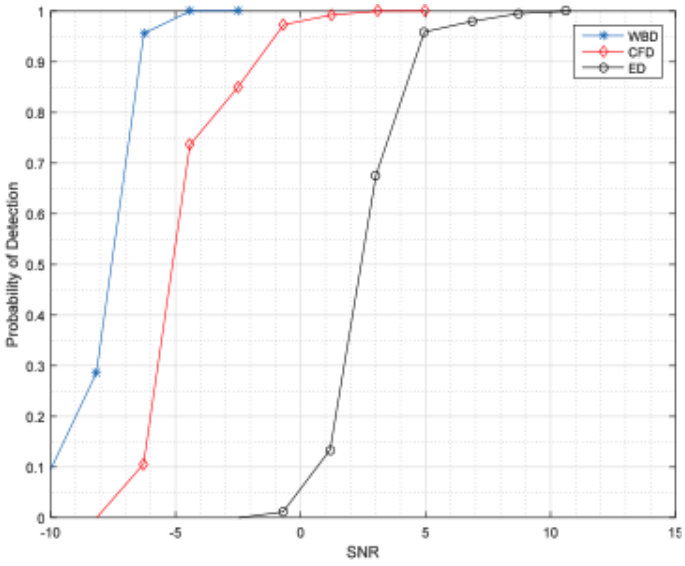

Fig. 8: Plot of Probability of Detection Vs SNR

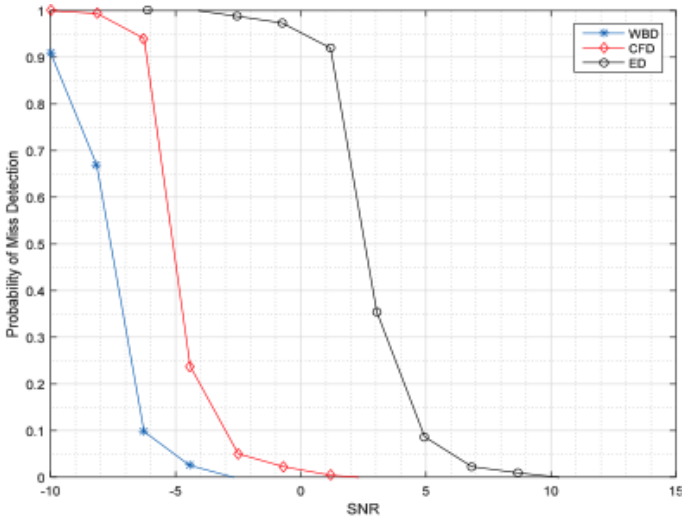

Fig. 9: Plot of Probability of Miss Detection Vs SNR

spectrums of frequencies consists of some features like receiver sensitivity and the number of energy transmitting/receiving nodes and dimensions occupied under consideration.

Proposed Research could be enhanced by performing similar experimentation for licensed frequency bands. The results obtained could be matched with ISM band results to acquire good understanding of an area of study. In order to find the availability of spectrum at the predefined threshold, the comparison of the color with time and frequency alliance can be analyzed.

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A Review of Agro-Industry in IoT: Applications and Challenges

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Abstract

IoT and WSN, the two emerging fields, introduced efficient and reliable agricultural and livestock monitoring. Researchers are focusing these fields to introduce several new trends and techniques for agricultural automation industry. The automation industry is now seeking new opportunity in the field of agriculture and livestock. The idea of IoT is to embed a particular framework by adding computer software, sensors, and actuators and to establish the connection over internet for the purpose of uploading and processing the data over a cloud. However, IoT devices require less processing power, limtited life, heterogeneity support, platform independence, RFID, WiFi and blutooth. This support made IoT devices more suitable for the remote sensing. It is used to perform rapid and quick response on decision managment. Micro-controller technology has several application areas in agriculture where IoT devices can be implemented for the further monitoring, processing and upload semantics which improve the agriculture automation industry and crop product. In this paper, IoT in agricultural and its respective applications and challenges are discussed.

Keywords—IoT, machine learning, agriculture.

1 Introduction

Internet of things (IoT), also called internet of everything (IoE), is a growing network of smart physical devices with the integration of the sensors, actuators with smart energy . IoT is the network of physical objects having heterogeneous nature which can work together for a specific purpose. IoT is one of the leading technologies these days for the development of industry, education, health and agriculture. Monitoring and recording the events in real-time has made it easier and convenient to get up-to-date information about the agriculture. The smartness of the devices brought a revolution in human life with several real-life applications [3]. IoT covers almost all fields of life. Any device, any time, can be fixed anywhere without any restriction for getting the things better. The idea of IoT is to embed a particular framework by adding computer software, sensors, and actuators and to establish the connection over internet for the purpose of uploading and processing the data over a cloud. However, energy is a main concern due to limited battery life and it constraints the processing power of IoT, but at the same time it makes IoT suitable for remote sensing and processing [4]. Micro-controller technology has brought new trends and developed in several application areas where IoT devices can be implemented.

1.1 IoT and the World

IoT became more prominent technology since last decade. The population of IoT devices has been increasing day by day. According to international data corporation (abbreviated as IDC), the 2013 prediction about the IoT devices was an estimated number of 41 billion IoT devices till 2020. This increase of the IoT devices may lead a revenue of about $8.9 trillion in the world. The purpose of the increase growth of the IoT technology and smart devices is to switch from the problem of manually developed methods to smart automatically controlled systems. Furthermore, connectivity of the internet made it easy to upload statistics over cloud for further assessment [5]. Cloud computing is the part of internet of things which offers the remote data access facility over the internet without the problem of distance. It is basically a solution to

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remote data access problem and offers several features such as security, reliability and authenticity of the data access. IoT with integration of different technologies offers efficient and reliable methods of automation without the human involvement.

2 Related Contribution

IoT's major contribution related to the latest methods and techniques brought remarkable changes in computational science and several applications are made in this regard for the easiness. It covers almost all fields of life such as the robot-based model designed in [9] which works in the field and performs several tasks automatically. In their study, a remote GPS-based robot system has been introduced to work in the remote places. The robot can perform a number of tasks in a field such as weeding, spraying, soil monitoring and moisture monitoring, etc. Furthermore, it can also control irrigation system by statistics of soil status [6]. The important parameters monitored in this study include temperature, humidity and theft detection. The study in [6] focuses on agricultural soil monitoring with the effective usage of the soil monitoring using soil sensors. Soil sensors are deployed in the field for monitoring agricultural soil status. The objective of this study is to enhance the quality of soil and improve the crops production. The concept of remote monitoring is focused in this study for the evaluation and monitoring of the soil. Smart irrigation control is focused in [12] where a smart module of the Wi-Fi kt is deployed for the internet connectivity to upload and connect the IoT kit with internet. In their work, a number of sensors are deployed in the field where all the sensors are connected with smart micro-controllers [7]. The automation industry is now seeking new opportunity in the field of agriculture and livestock. Agricultural crop disease diagnosis has become easy which is a crucial part of the researchers' focus in these days.

The concept of remote monitoring is focused in another study [17] for the evaluation and monitoring of the soil. Smart irrigation control is focused in this study where a smart module of the Wi-Fi Kit is deployed for the internet connectivity to upload and connect the IoT kit with internet. In their work, a number of sensors are deployed in the field where all the sensors are connected with smart micro-controllers. After connectivity, the data is uploaded over an android application for updating the status of agricultural soil which is obtained from the soil and temperature sensors.

3 Applications of IoT in Agriculture

IOT is gradually becoming the important stockholder of the industry due to its reliability, efficiency and smart working principle. With help of other emerging technologies such as sensor, micro-controller and actuator [1], IoT framework can sense the data from environment.

3.1 Agricultural field Monitoring

The traditional methods of monitoring agricultural fields are very time consuming and also have lack of accurate field monitoring. The sensitive parameters of the agricultural fields cannot be monitored with acceptable accuracy. Plants diseases are very important factor and have direct impact on agriculture product and it is very difficult to diagnose them manually. IoT technology is one of the interesting aspects of the IoT smart frame work. The automated calculation of the product samples and the quality measure features can easily be implemented by the help of smart monitoring of the precision agriculture frame work [2]. The harvesting in fields are very critical for the IoT based agent like robots. These robots can work efficiently with the implementation of sensor based technology and actuators for moving and performing the harvesting tasks. For this purpose, a number of sensors are needed to implement such as temperature, humidity, human detectors, locomotion, etc.

3.2 Green House Monitoring

IoT technology, with emerging role of the related fields, have brought a revolution in automation of the real life. Agriculture science is one of the most important area of focus in these days. The parameters includes temperature, humidity, soil monitoring and evaporation rate of water, etc [13]. These physical parameters can be measured with implementation of the micro-controller based smart devices having integration of different types of tiny sensors. Sensors are smart devices used to measure the physical parameters of the environment. Improving smartness of the agricultural farming LM–35 temperature sensor is used to measure the temperature of the fields. PIR sensor is used to measure the radiation from the devices. Likewise, soil moisture sensor are used to monitor the real time status of the agricultural soil.

3.3 Agricultural Drones

IoT with drone technology has become very popular in modern technology which can monitor and regulate the activities of any environment. In agricultural

S.No	Author Name & Year	Contribution
1	Goldstein, A., Fink, L. (2018).	Crop yield prediction from the collected data form soil and environmental variables which applied on eight plots. However machine learning algorithms applied different for the classification and regression of the efficient crop yield.
2	Ana Laura Diedrichs (2018)	Presented a model of machine learning algorithms which predicts the agricultural frost prediction system on the basis of different condition of the crop yield. They monitored thermodynamics conditions from the environment to predict suing training set of the data obtained from sensors.
3	Anat Goldstein1 , Lior Fink1, Amit Meitin1(2017)	The study is about predicting irrigation recommendations. Different regression and classiïňĄcation algorithms were applied on this dataset to develop models that were able to predict the weekly irrigation plan as recommended by the agronomist.
4	Keith H. Coble (2018)	An efficient analytical techniques related to the agricultural and applied economics contribution. Big data concepts are discussed in detailed which is part of the research and development of the agricultural data analytics.
5	Tiantian Yang et.al (2016)	A robust reservoir outïňĆow simulation model is presented, which incorporates one of the well-developed data-mining models (ClassiïňĄcation and Regression Tree) to predict the complicated human-controlled reservoir outïňĆows and extract the reservoir operation patterns.
6	Sami Khanal et. al (2017)	A review focuses on the application areas of thermal RS in agriculture discussed here include irrigation scheduling, drought monitoring, crop disease, detection, and mapping of soil properties, residues and tillage, field tiles, and crop maturity and yield. Some of the issues related to its application include spatial and temporal resolution, atmospheric conditions, and crop growth stages.
7	Rehman, T. U.(2019)	The study is to review the statistical machine learning techniques including supervised and unsupervised learning for the agricultural environment. The study is to apply machine vision approach in agricultural data and suggest some future implementation of the machine vision approaches.
8	Park, S (2016)	The study is to research six drought factors were selected based on the relative importance by their category to develop drought indicators that represent meteorological and agricultural drought by using the relative importance as weights. While TRMM showed higher relative importance for meteorological drought, LST and NDVI showed higher relative importance for agricultural drought in the arid and humid regions, respectively.
9	Vineela, M. T (2018)	Automated irrigation control with the same approach is also discussed in (Vineela et al.). The study also focused on the implementation of the IoT and WSN technology for the monitoring of the water stress in the pipe, water need in the agricultural field with the water arrival of the each and every part of the crops.

TABLE 1: IoT and Machine Learning Research Contribution

science, the drone technology can be used to monitor the activities of the agricultural crops [1]. The drone technology brought revolutionary changes in the agricultural monitoring activities with accuracy and frequent updates which is difficult to manage by using traditional methods. A number of activities can be monitored using the drone technology such as spraying the plants with desired amount of pesticides, and monitoring the theft of the crops from the premises of the agricultural farm, to name a few. Drone technology can be implemented in the agricultural 3D maps which are very important for seeding and spraying the fields. Pod shooting with the nutrition of the plants and the soil level nutrition can be monitored by using the drone technology. Drone technology is also useful for the remote sites monitoring of the agricultural fields to monitor which area is dry and which one is wet, so that the necessary measures can be taken for the improvements of agricultural crops.

3.4 Livestock Monitoring

IoT, with the implementation of the emerging fields, has turned out to be an efficient way of the livestock monitoring [10]. Livestock monitoring is used to monitor location and health parameters such as temperature, blood pressure measurement, etc, and the environmental parameters of the animal farm such as temperature, humidity and carbon dioxide of the farm area where animals are kept. The herd area can be monitored easily using the sensor technology and IoT has made it easy to perform real time monitoring time to time. Animal monitoring has become easier to implement with the help of GPS system for the detection of animal location. The animal location with

continuous monitoring is very important for an animal farmer. In the area where animals are moving and have the proper grass monitoring is also important in this regard. The feasibility of grass status can also be investigated by the implementation of a smart IoT framework.

3.5 Smart Irrigation Control

Water supply regulation and controlling the water usage in agricultural field is a very important area of research. The time management of the water pouring in the field is very important for the soil. This gives the need of IoT to give the automated status of the soil. The soil update and water level measuring is important for the automated water supply management. IoT gives a method of smart agricultural field monitoring to check whether the agricultural area is completely poured [14]. The implementation of the smart IoT framework can enhance the capability of the agricultural field monitoring better than the traditional methods. Polluted water is a big issue in Pakistan, especially for the agricultural crops. The water quality can also be measured easily with the implementation of water quality sensors that measure the water pollution.

3.6 Agriculture Warehouse Monitoring

In agriculture water monitoring, IoT has brought the concept of smart warehouse monitoring. IoT enhanced this capability with a very rapid and fast threat detection. Agricultural warehouse can be monitored real time with the implementation of the human detection sensors, temperature status of the warehouse by the temperature sensors, and other important parameters related to the staff monitoring and owner awareness related to the warehouse status [16]. This can be achieved by the implementation of the IoT devices with cloud connectivity and having the proper updating mechanism for the owner. Anything, any time, can be connected and monitored with real time update. IoT made it an easy and smart solution to monitor the real-time environment of the warehouse and detect potential threats to the products.

3.7 Soil Monitoring

Soil is a key component for the agricultural crops. For monitoring the soil, IoT made it easy to control and coordinate the changes in soil. Nitrogen (N), CO2 and other important parameters can be monitored and updated to the cloud in real time. A robust recommendation system can be designed for the betterment of the soil fertilization [18].

4 IoT Challenges

The challenges in the field of IoT are summarized as follows.

4.1 IOT Security

In IoT, security and privacy are one of the most critical issues and special focus of research these days. Some of the things can be more important with the aspect of security. It is a real challenge to integrated proper security mechanisms in IoT devices due to their heterogeneity. Several security threats have been found in the smart IoT devices during the environment monitoring. According to the report of enterprise firm in 2013, 25% of the device manufacturers are not computer related firms and have no professional knowledge of the computer security risks. They manufacture the devices like game devices, monitors like toys and other home usage electronic products. This has led to the weak security management for the implementation of the IoT in smart monitoring to provide security against the unwanted attacks. The personal information and important data can easily be captured if the weak security policies are followed in the smart framework, despite of the fact that IoT devices are very smart and can perform rapid and efficient job in any environment of real life. The device infrastructure deployment needs certain parameters for the focus of the study.

4.2 Battery Life

There are several factors which which can directly impact the battery life of the IoT devices such as heterogeneity of the devices, large data processing, less energy power and longtime processing. In remote areas, IoT devices are often deployed with the sensors and actuators to monitor certain parameters in real time. In this sense, the power consumption is very important and devices are deployed with chargeable battery. However, in remote places, it is very difficult to provide the proper power for the devices. It is important to manage the power source for the battery life time. A plethora of research has been conducted on the energy efficiency and energy efficient protocols for the IoT technology deployment. It is also very important research area in this regard for the future improvement of the IoT technology in real sense.

4.3 Heterogeneity of the Devices

Heterogeneity refers to the devices having different nature and architectural structure with different features of working capabilities. IoT provides flexibility in terms of heterogeneity, but also introduces few issues

Sensor	Application
Soil sensors Volumetric water content sensors Tension meters Soil profiling	Measures soil water volumetric content, soil water potential, soil moisture respectively
GrainPro EcoWise Standard	Wireless system designed to remotely monitor the temperature and humidity
Wind Speed (PK 100-02) and direction (110 âĂŞ 2) sensors	Measures the speed and direction of the wind
Pyrometer (PK 200 - 03) and solar radiation (200 - 04) sensors	Measures the intensity of the solar radiation
Water sensors: OTT Orpheus Mini Water Level Logger OTT ecology 500 Water level logger OTT CTD sensors	Used to measure the water pressure, water level, water pressure and water conductivity

TABLE 2: Agricultural IoT devices

which can be difficult for the real time monitoring, e.g., security and connectivity issues. The security in IoT is very crucial due to different nature of the devices having their own vendor configuration, connectivity, memory and security policies which may not be compatible with other devices and can cause serious problems in IoT devices connectivity.

4.4 IoT Agricultural Advance Sensing Devices

Some of the IoT devices are related to the specific applications that are sometime called application specific devices. These application have their own merits and demerit related to the platform and device compatibility.

5 Conclusion

The study presented in this paper provided an overview of IoT and emerging technologies which covers the agricultural monitoring with several IoT devices. The new applications were discussed which are latest focus of the study in the research community. Furthermore, it can be more comprehensive if other areas of the livestock is merged for the further implementation of the study. The new applications can also be developed if required. IoT provides the ease of heterogeneity, but still has certain issues which can be difficult for the real time monitoring, e.g., security and connectivity.

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Road Traffic Accidents (RTAS) Safety Issues On Highways: A Review

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Abstract

Nowadays, besides the fast development of technology (particularly in the field of the information technology), the number of vehicles on the highways/roads has increased enormously. In developing countries, with the increased number of vehicles, the significant number of road accidents (RTAs) have been reported. The major reasons for the RTAs in these countries are the lack of proper management (including RTAs data) and guidance to the consumers. A study was conducted on Hyderabad-Karachi M-9 Motorway section during half of the year 2017. The data revealed that total 17 accidents encountered during the reported time in which 15 human lives were lost and 54 people were reported as injured. In addition, 30 vehicles were damaged. Keeping those causes and reasons for RTAs in view, this paper has focused on undertaking a review of the reported RTAs in the available literature. The data analysis reveals that the causes of accidents are careless driving, bad road conditions and improper condition of vehicles.

Keywords—Highway, Careless Driving, Road Traffic Accidents (RTAs), Safety Issues.

1 Introduction

In developing countries, according to estimates by 2030, road traffic accident claims more than 2.5 million people losing their lives and in addition around 60 million people (i.e., death and injured) got injured in these road accidents. Most of the accident involve children, pedestrian, cyclist and public transport users. Pakistan is a developing country with the population of around 207,774,520, facing the road crashes crisis. According to unconfirmed data, lack of adequate road standard safety measures and violation of traffic laws took more than 100,000 lives in last 10 years. However, three main factors of road accident were identified. These are human error, vehicular defect and failure in road environment. In Pakistan, most of the road accidents occur due to over speeding, wrong over taking and carrying overloading material, etc. The mechanical faults like tire bursting and brake failure are massive contributor of the road accidents. In Pakistan, initially highways were used as feeders to railways that were the main transport source for long distances and transport goods. However, nowadays, the usage of highways has increased, and the length of the roads increased from 249,972 km (in 2000–01) to 263,356 (in 2015–16). A similar increase is recorded in the number of vehicles, from 4,701,600 (in 2000–01) to 17,317,600 (in 2015–16) [34]. In Pakistan, the maintenance and construction of roads is under the Government and national highway authorities. For this research article, a brief literature review is carried out to determine the road traffic issues in the era of road traffic accidents (RTAs).

2 Literature Review

The authors in [1] investigated about road accident cost including hospital expenses, court expenses and also the cost of intangible consequences like pain and suffering. During the last two decades, rapid increase in the number of vehicles is the major reason of increasing number of accidents. To minimize the road accident impact, the necessary measures include organizing safety programs, developing vehicle design, making a suitable plan and implementing traffic laws to reduce the accident on the roads. It is concluded that organizing safety programs as per requirement for reducing the number of accident and fatalities on

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the road in future is indispensable.

The authors in [2] revealed that a safety awareness programs is conducted with the collaboration of Regional Transport Offices in 2011. The main aim of this program is to educate the people about the road rules. In Kerala, highest rate of road accident occurred in the country. Each year 3800 people lost their lives due to road accident. In these accidents 40% victims were two-wheeler rider and many more were permanently disabled. The increasing road accidents occur due to inadequate road space in view of this ever-increasing number of vehicles. The two-wheeler rider often does not wear helmet. The state government needs to organize safety programs for public to reduce the severity of road accidents. It is concluded that organizing such type of programs and safety classes in the educational institutes on regular basis is vital.

The authors in [3] concluded that day-by-day growing population and increasing the number of vehicles at proportional rates with the population is also the root cause of the increasing number of RTAs. In addition, untrained vehicle driver become a main source of accident. Driver education should be introduced in schools, with its future success will also change the behavior of the person. Well-equipped traffic aid centers should be installed at every 30-50 km on the highway which must contain patrol vehicles, ambulances, crane and traffic staff who regulate the traffic rules and laws and provide first-aid to the RTA's victims.

The authors in [4] used Geographical Information System (GIS) to identify the most frequent accident spots in the district of Enarkulam and Alappuzha. To identify these spots, the use of WSI method for collection of data at different location includes ten spots in Enarkulam and six spots at Alappu-zha. According to the collected data, two spots were identified in Enarkulam and one spot was identified in Alappuzha. It is concluded from the study that some possible measures should be taken to reduce RTAs and improve those areas where accident were taking place on regular basis.

The authors in [5] concluded that India is the 2nd most populated country in the world, yet there is little research on RTAs in India. To prevent injuries (to make effective policies regarding the accident) safety policies and social and economy based policies must be envisaged in the country.

The authors in [6] revealed that road traffic accidents is the leading cause of death and property damage due to complex flow pattern of vehicles on the highways. In year 2011, the rate of death has been increased which is estimated that 1200 person died in 100 accident, whereas in 2001, it is estimated that 700 person died in per 100 accident. Mostly, the road accident occurred in rural areas due to the damage of roads and improper and untimely maintenance. It is concluded from the study that most of the road accidents occurred in year 2001 in Palakkad, Enarkulum, Kannur and Alaphuzha. In year 2011, most of the accidents occurred in Kannur, Malapuram and Palakkad. The comparison of the accidents and death ratio in the years 2011 to 2001 reveals that the ratio of death increases and the rate of accident decreases.

The authors in [7] concluded that road accident is a human tragedy, which results in loss of lives, injuries and loss of properties. A little amount of research is conducted on road accident to investigate the main causes of accident. In India, there were 500,000 road accidents in calendar year 2010. From the numbers, in every minute ten road accident were reported in which every 4 minutes one death occurred due to road accident. Most of the victims are under the age group of 25-65 years. To reduces these unwanted tragedies, many of the countries are adopting road safety measures including quality and design of roads, traffic management, road worthy vehicles, effective law enforcement and first-aid training programs to attend the victims with immediate response. It is concluded that the government alone can not take sufficient measures to resolve accident problems. It is rather a nation-wide problem and must be resolved with the cooperation and support of the whole nation.

The authors in [8] revealed that during year 2005-2006, there were 38361 and 42363 accidents, respectively and the trend was rising. There is a slight decrease in road accident in year 2006 and it comes to 36,282 in year 2014. Road accident causes a major social, health and economic problem. Several safety programs have been organized in the country to minimize the impacts of road injuries occurring due to road accidents. The state government addressed road safety awareness programs as well as introduced a tough license issuing act.

The authors in [9] concluded that the major causes of road accident is recklessness and ignorance. The people do not follow the traffic rules and laws. The government can play a vital role to create educational institutes and offer courses regarding safety awareness and distribute material among the public and drivers. Governments need to ensure tough process of driving license issuance after proper examination of the driver. Other main reasons of road accident include over loading, use of cell phone during driving, and

use of drugs by the drivers. These problems should be coped by imposing penalties to the offenders and organizing awareness programs.

The study in [10] concluded that in 2001, road traffic injuries are the fourth main cause of death in Korea after stroke, heart and cancer diseases. Analysis by age (1-29) shows that road traffic injuries were the first leading cause of death among the young adult, second leading cause of death among the age group of 30s, and third leading cause of death among the age group of 40s. However, many people around the age of 50s die due to road injuries and majority of them die due to heat stroke, heat and cancer problems. The main reason of road traffic injuries is due to over loading, over speeding, reckless driving, drunk driving and disobeying the traffic rules. It is concluded that the multiple stakeholders such as policy maker, Korean police, public and media are able to reduce road traffic accidents as a joint effort.

The authors in [11] opined that road traffic accident is an unpredictable event which remain a huge burden for any country. Every year, 1.2 million road accidents occur in the world. In addition, 90% of the accident occur in developing countries and 50% road accident occur in Asia pacific region. In the severity of RTAs, 50% of death happen within five minutes due to serious injuries including heart failure and brain hemorrhage. Nearly 35% victims die in next 1-2 hours due to bleeding and remaining 15% victims die in the next 30 days due to road infection and negligent hospital treatment. It is concluded that the road safety knowledge among the drivers and general public must be enhanced .

The study presented in [12] shows that the transporter and general public in Pakistan do not follow the traffic laws. The competent authority is failed to enforce wearing of helmet and seat belt during the driving. The road traffic injuries model established especially for one city is generally applicable for other cities as well. Furthermore, multi-disciplinary private and public sector organizations arrange road safety programs to reduce road traffic accidents.

Another study [13] revealed that a huge number of accidents occur due to reckless driving. In Pakistan, by the year 2000 to 2010, Punjab has the highest and Baluchistan has the lowest ratio of road accidents. However, Sindh province has a higher ratio of fatal accidents. The number of RTA deaths in Punjab is higher than other provinces of Pakistan. The population growth results in higher number of vehicles, leading to the higher probability of road traffic accidents.

The authors in [14] state that road traffic accident is the eights main cause of deaths worldwide. According to WHO (2004), road traffic accidents would become the 3rd main cause of death in year 2020, if not controlled properly. Furthermore, the available data is not reliable due to under reporting. However, road traffic accidents is one of leading causes of death and injury all over the worldwide. An international comparative study was carried out to investigate various regions in terms of motorisation (vehicles per individual), individual hazards (passings per person), and traffic chance (passings per vehicle). The study shows that the developing countries has higher motorization, but lowest risk. Whereas, Africa has least motorization, but have high traffic risk. Southeast Asia, Africa and the Middle East have the highest risk in terms of personal safety.

The authors in [15] stat that the seat belt law was introduced in 1994. According to the hospitals record, 1200 road accidents were reported after enact seat belt law in Kuwait. The fatality and injuries were slightly increased for the use of seat belt as to non-user of seat belt. It is concluded that seat belt non-users received higher number of face, head, abdomen and limb injuries.

The authors in [16] state that road transport is the most important mode of travel in a country. Nowadays it is an emerging problem which almost all the governments have tried to cope with. Road accident causes both economical and social impacts on the individuals. The increasing number of vehicles on roads creates a social problem as well as high rate of loss of lives. Furthermore, it is concluded that bad road condition is one of the main causes of injuries, permanent disability and sometimes death. The government and the private agencies should repair the bad portion of the highways on time. The driver education to induce good driving habits must be carried out.

Another study [17] concluded that in developing countries the abrupt increase in the use of vehicles is the major reason of increasing accidents . In year 2020, road traffic accident will become the third leading cause of death, if not controlled properly. Road accidents mainly affect males in their productive and active period of life. It creates huge economic losses for the family whose dependent is on the single source of income. To reduce these accidents, several safety awareness programs must be organized.

The authors in [18] revealed that road traffic accident rate is higher in most of the Gulf countries. Saudi Arabia is also facing problems of morbidity and mortality due to RTAs. Road accident deaths and injuries are avoidable by safety awareness programs

that educate the road users and vehicle drivers about the traffic laws.

The authors in [19] concluded that in rural areas road accident causes huge loss of lives of young, male adults who mostly belong to poor families. Most of the victims travel by public private transport, persued by motorcycles and cars. Motorcycle is most economic and common source of transport in rural areas of Sindh province for poor and lower-class families. To reduce these vehicle accidents, struct security measuers must be enforced. There is also need of paying attention on improving vehicle condition in rural areas of Sindh.

In [20], the authors suggested that a proper training to the employees regarding latest skills and knowledge to the road traffic investigator must be provided. The city must apply road traffic standards and improve future road safety facilities such as first aid, cameras, ambulance, computers and well establish offices.

The authors in [21] stated that the worldwide road traffic accident fatalities and injuries have become a serious problem. In Nigeria, road accident fatalities and injuries have become alarming and ranked among the other countries with higher rate of accidents worldwide. However, by introducing road safety concepts and awareness campaigns can significantly reduce RTAs. Furthermore, such campaigns have been introduced through media and road side slogans such as "drive to stay alive", "drive carefully", and "accident kill more passenger". Effective safety programs must be organized by tear round and should not be kept limited to festival season.

In [22], the data collected in Keral, India from 2010-2016 reveals that the ratio of deaths is on the rise. Road accidents are the main source of loss of lives, injuries, polluting the environment and also destructing service sector. The study also found other road accident occurring frequently in the state's highways. In rural areas, road conditions are very poor and also the main cause of increasing road accident.

The authors in [23] state that road accident is one of the main sources of loss of lives and injuries. It becomes not only a social problem, but it is also putting an adverse impact on the dependents of family members. The increasing trend of road accidents enact a negative impact on the individuals as well as on dependents. Young age groups of people are unsafe due to road accidents which cause economic loss, but also pain, grief and suffering, etc. It is concluded that design-friendly transportation policies, road infrastructure as well as improved vehicle design to reduce the impact of road accident must be envisaged.

In [24], the authors investigated the magnitude and pattern of fatalities in Sindh, Pakistan. The collected data indicated that every 1 or 2 road traffic crashes produce fatal accident. In addition, every day more than four people lose their lives and these are common in rural areas as compared to urban areas. Road traffic crashes mostly affect male adults who are passengers or pedestrians.

The study in [25] reveals that pedestrians are more injured in road accidents due to lack of awareness. They are not conscious about the risk of an accident when they move on the road. However, limited number of officials perform their duties from Dhaka to Sylhet highways followed by one car. The main reason of road accident is the domestic and wild life animals coming on the highway and creating problems for drivers, leading to accidents.

The authors in [26] conducted a survey on Hyderabad-Karachi Highway for two years (2015-2016) in terms of traffic accidents, loss of lives and vehicles. In addition, they investigated the causes of the occurrence of road accidents. Their data has revealed that careless driving is the major cause of RTAs on the motorway. Due to this reason, 29 and 19 people died in year 2015 and 2016, respectively and total 293 numbers of people got injured in both the reported years. As far as economical loss is concern, 93 numbers of vehicles were damaged 2015 and 110 numbers of vehicles were damaged 2016. The condition of the road/highway has been recognized as a reason for the RTAs. The data has shown that 16 people died in accidents due to bad road conditions. Furthermore, 40 people got injured and 34 vehicles were damaged in the accidents which occurred due to bad road condition.

The study presented in [27] concluded that pedestrians are the common victim of road accident. The collected data indicated that 46.55% male victims were of the ages between 21-40 years. Mostly, the accidents occurred during daytime (62.06%). In addition, 79.31% of victims lost their lives on the spot due to severity of the accidents. Pedestrian were common victims of road traffic accidents (81.89%). The main reason of death occurred on the spot due to head injury is about 45.68%. It is concluded that to reduce death toll rate, various prevention measures must be taken such as seat belt and helmet wearing while driving on the highways. Strict laws should be enforced on the road users to control over speeding, consumption of alcohol, improving road infra-structure, providing hospital care centre, and medical services, etc.

Authors in [29] carried out a research on the occurrence of RTAs in Jordan, based on the accidents registered in hospitals. They concluded that majority of the accidents occurred on first day of a week and

during summer time.

The authors in [30] state that road traffic accident pose a serious challenge. The government of India revises its policies and rules time-to-time regarding the road traffic accidents. Although, it still fails to address the appropriate legislation and policies.

A study in [31] states that one in two road traffic accidents in Sindh cause a loss of four human lives per day. The data was obtained from government documents and daily newspapers reports on accidents. The results show that the total annual number of RTAs, fatal RTAs and RTA deaths were 2272 (±293), 1104 (±89) and 1321 (±136), respectively. The results revealed that 85% of victims were male between the ages of 15-49 years. The most common victims are pedestrians, motorcyclists and drivers. In rural areas, the death rate is higher as compared to the urban areas. The most common cause of RTAs was '*hit by the vehicle*', collision of motor vehicles, breakdown and over speeding.

The authors in [14] state that RTAs cause significant social and economic issues for people and society. Shara-e-Faisal, one of the busiest road of Karachi city, was selected for study purpose knowing the patterns of RTAs. Due to high flow of vehicles in weekends and on Mondays, the percentage of road accident higher as compared to the other days of the week was higher. Young people between the ages of 20-30 are generally affected due to RTAs. The proportion of male affectees in RTAs is higher than female affectees. It is due to higher demand of travel by males. Day Time Crashes (DTCs) were found to be higher in number as compared to Night Time Crashes (NTCs). The frequency of crashes was recorded higher in the mid-block as compared to intersection. Nevertheless, the data revealed that crashes increased with the passage of time. Bike riders are the highest contributor in road traffic accidents because of reckless riding. Rear end and side-swipe was observed to have a significant impact on RTAs. More RTAs were reported on the road sections where street lights and lane markings were not present. The arrangement of these basic needs may help to reduce RTAs on this busiest road in the city. An investigation was carried out to identify harmful road sections. The analysis revealed that the areas without street lights and lane markings were the most risky sections. An evaluation model was proposed with the help of LDFA to mitigate the risks of RTAs on Shara-e-Faisal. The model depends on MVK, DTCs and NTCs, and can predict the condition where a risky section of the road can be named as perilous. This model can be used as a successful tool in the improvement of a traffic safety program to reduce RTA risk in Pakistan.

A study by World Health Organization (WHO) [32] on Global Burden of Disease (2004) states that road traffic accidents in 2004 were 9th main source of loss of lives. The study forecasts that at current rate the RTAs will rise to 2.4 million deaths by 2030 and will become third major causes of death, even superseding the deaths by HIV and diabetes.

RTAs injures affect all age groups, but their impact is most striking among the young. RTAs have become second major cause of deaths worldwide in age of 5 to 14, 15-29, and 30-44.

The authors in [33] state that in Dhaka, heavy vehicles including buses, mini-buses and trucks are the main source of road accidents. Around 79% of RTA cases involve the heavy vehicles (buses 20%, mini-buses 22% and trucks 37%). Both in urban and rural areas, pedestrian accident are a most dominant accident type which (26.95%). This type of fatal accident follows by head on 13.95%, rear end 15.95% and run off road 17.95%. The majority of victims of accidents involved young males, about 29% falling in between the age of 25-35. The gender-wise statistics are as follows: 37% female falling in the age of 35-45, and 31% are fall in between the age of 55. It is noticeable that 62.50% of the victims were below the age of 10 years, and 37.50% were between the ages of 10-15 years. Most of the victims were primary school level students who do not follow the traffic rules and regulation. It is concluded that pedestrian are the primary victim of road accidents.

3 Problems in the area of road safety

The problems pertaining to the area of road safety can be summarized as follows.

1) Traffic education is the area that could help promulgate a safety culture on roads in Pakistan by inculcating traffic rules among the people. Unfortunately, traffic education and awareness programs have never been given much importance in Pakistan.
2) The road environments need significant improvements. Roads are full of potholes which have become death traps. Maintenance of roads has never been a priority from the government. The billions earned by the government every year from the fuel duty, motor registration dues, and driving license fees are not gainfully spent on the maintenance of roads. Besides, over speeding is almost uncontrol-

lable and offenders are conveniently ignored by the enforcing agencies.

3) The majority of the commercial vehicles in Pakistan are not road worthy and there is no system of banning their entry on roads. Many accidents happen due to faulty engines, poor brakes, worn out tires and ill trained drivers. There is too much laxity in the laws and it is very difficult to punish errant drivers.
4) There is a dearth of dual carriage ways preventing head-on collisions on intercity roads. There are no special safety measures near public places like hospitals, schools, mosques and shopping centres, etc. No street lighting provision exists which impose serious threats to security.
5) A large number of fatalities on roads involves pedestrians. These deaths occur simply because the pedestrians have to share the carriage way with the vehicles in the absence of proper and adequate space. Similarly, proper pedestrian crossings are not provided on the roads and junctions in urban areas. The random and unchannelized pedestrians crossing causes many accidents.
6) In Pakistan, education to inculcate traffic sense among the people has never been given due importance, which is evident from the fact that important passive measures like wearing a helmet by the motorcycle riders and use of seat belt in the vehicles are rarely observed.
7) Above all, the law enforcing agencies are not performing their role effectively. Corruption and malpractices are rampant among the relevant government departments.

4 Conclusion

In Pakistan, one of the major concerning issues is traffic management. From the detailed literature review, the main causes of road accident were found to be unskilled drivers, lack of training institutes, bad road condition, use of cell phones during driving, hazards of alcohol/drugs, and overloading. In Pakistan, issuance of driving license is not well regulated and monitored. Road safety audits must be conducted on regular basis before and after the completion of a road. The black spots, where accidents occur repeatedly, must be repaired on priority basis. The traffic rules and legislation must be enforced by introducing heavy penalties to the offenders.

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