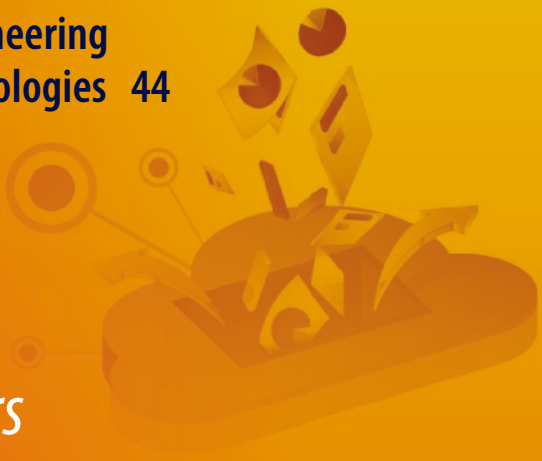
Lecture Notes on Data Engineering and Communications Technologies 44



S. Smys
Tomonobu Senjyu
Pavel Lafata *Editors*

Second International Conference on Computer Networks and Communication Technologies

ICCNCT 2019

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Lecture Notes on Data Engineering and Communications Technologies

Volume 44

The aim of the book series is to present cutting edge engineering approaches to data technologies and communications. It will publish latest advances on the engineering task of building and deploying distributed, scalable and reliable data infrastructures and communication systems.

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S. Smys · Tomonobu Senjyu · Pavel Lafata
Editors

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Editors
S. Smys
Department of Computer
Science Engineering
RVS Technical Campus
Coimbatore, Tamil Nadu, India

Pavel Lafata
Department of Telecommunication
Engineering
Faculty of Electrical Engineering
Czech Technical University in Prague
Prague, Czech Republic

Tomonobu Senjyu
University of the Ryukyus
Okinawa, Japan

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We are honored to dedicate the proceedings of ICCNCT 2019 to all the participants and editors of ICCNCT 2019.

Foreword

It is with deep satisfaction that I write this Foreword to the Proceedings of the ICCNCT 2019 held in Coimbatore, Tamil Nadu on May 23 and 24, 2019.

This conference was bringing together researchers, academics, and professionals from all over the world, experts in Computer Communications and Networks.

This conference particularly encouraged the interaction of research students and developing academics with the more established academic community in an informal setting to present and to discuss new and current work. The papers contributed the most recent scientific knowledge known in the field of Computer Networks, Ad hoc and Sensor Networks, Internet and Web Applications, and Ubiquitous Networks. Their contributions helped to make the Conference as outstanding as it has been. The Local Organizing Committee members and their helpers put much effort into ensuring the success of the day-to-day operation of the meeting.

We hope that this program will further stimulate research in wireless ad hoc and sensor networks, information-centric networking, embedded networks, and opportunistic networking and provide practitioners with better techniques, algorithms, and tools for deployment. We feel honored and privileged to serve the best recent developments to you through this exciting program.

We thank all authors and participants for their contributions.

Coimbatore, India
May 2019

S. Smys
Conference Chair, ICCNCT 2019

Preface

This Conference Proceedings volume contains the written versions of most of the contributions presented during the conference of ICCNCT 2019. The conference provided a setting for discussing recent developments in a wide variety of topics including Network Operations and Management, QOS and Resource Management, Wireless Communications, and Delay-tolerant networks. The conference has been a good opportunity for participants coming from various destinations to present and discuss topics in their respective research areas.

ICCNCT 2019 Conference tends to collect the latest research results and applications on Computer Networks and Inventive Communication Technologies. It includes a selection of 107 papers from 337 papers submitted to the conference from universities and industries all over the world. All of accepted papers were subjected to strict peer reviewing by 2–4 expert referees. The papers have been selected for this volume because of quality and the relevance to the conference.

ICCNCT 2019 would like to express our sincere appreciation to all authors for their contributions to this book. We would like to extend our thanks to all the referees for their constructive comments on all papers, especially, we would like to thank organizing committee for their hard working. Finally, we would like to thank the Springer publications for producing this volume.

Coimbatore, India
May 2019

S. Smys
Conference Chair, ICCNCT 2019

Acknowledgements

ICCNCT 2019 would like to acknowledge the excellent work of our conference organizing the committee, keynote speakers for their presentation on May 23 and 24, 2019. The organizers also wish to acknowledge publicly the valuable services provided by the reviewers.

On behalf of the editors, organizers, authors, and readers of this Conference, we wish to thank the keynote speakers and the reviewers for their time, hard work, and dedication to this Conference. The organizers wish to acknowledge Dr. Smys for the discussion, suggestion, and cooperation to organize the keynote speakers of this Conference. The organizers also wish to acknowledge for speakers and participants who attend this conference. Many thanks are given for all persons who help and support this conference. ICCNCT would like to acknowledge the contribution made to the organization by its many volunteers. Members contribute their time, energy, and knowledge at a local, regional, and international level.

We also thank all the Chair Persons and Conference Committee Members for their support.

Contents

Monitoring Air Pollutants Using Wireless Sensor Networks

Shweta A. Patil(✉) and Pradeep Deshpande

BLDEA'S V.P. Dr. P.G. Halakatti College of Engineering and Technology, Vijayapur, Karnataka, India
shweta_agp@yahoo.co.in

Abstract. IOT is an emerging area of network which acts as a future technology trend of sensing, computing, and communication. Internet of things integrates several techniques as wireless sensor network, Radio frequency identification and embedded devices with existing internet. IOT extends the concept of internet from network of homogeneous devices to network of heterogeneous devices. Air pollution is a major issue for providing healthy environment to the mankind. Healthy environment keeps mankind healthy. Hazardous gases detection becomes important. Hence a system for measuring and monitoring of air pollutants is to be provided. Wireless sensor network is found to be an efficient method of measuring and monitoring air pollutants.

Keywords: IoT · WSN · Zigbee · Sensor · Microcontroller

1 Introduction

IoT is an emerging area of network that integrates several techniques as wireless sensor network, Radio frequency identification and embedded devices with existing internet. IOT extends the concept of internet from network of homogeneous devices to network of heterogeneous devices [12]. Internet of things means inter-connecting the different devices which can sense the required data, transmit the data, and process it by using wireless sensor network. Wireless sensor network is one of the most powerful tools for measuring, remote controlling and monitoring. WSN is a network of small sensing devices called as sensor nodes which are distributed over the area to gather the data. Wireless sensor network establishes a channel to process and communicate data with each other and to communicate with centralized control. They have wide range of application in variety of fields such as health care, home automation, agriculture, industry, environment monitoring, structural monitoring, disaster management, emergency response etc. Sensor nodes have various energy and computational constraints because of their in-expensive nature and ad-hoc method of deployment [11].

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Population of mankind in city is increasing drastically day by day which has resulted to various problems as traffic congestion, environmental degradation, lack of resources, job stress etc. In order to overcome these problems different innovative operations under urban and management mode are to be taken. Clear, systematic and scientific planning along with intelligent building and efficient management helps to overcome the problems. Hence smart city construction becomes essential. Smart city is nothing but the combination of digital city and internet of things. In the application of smart city environmental protection has caught more attention. The environment is badly affected due to the continuous and rapid growth of industries and wide spread use of vehicles because of which 2.4 million people die every year world-wide, hence leading to Air pollution which in turn leads to global warming and acid rains. Air pollution affects the human-health, environment and quality of life. Thus air pollution monitoring becomes important and becomes necessary to balance the nature [8].

Wireless sensor network is an efficient method for the measurement and monitoring of air pollutants. Many advantages like low cost, multifunctional etc. can be achieved by WSN. WSN can be implemented with different wireless protocols for data transmission as Bluetooth, UWB, and Zigbee, WI-FI etc. Air pollution monitoring system measures different air pollutants such as Carbon dioxide (CO_2), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), Carbon Monoxide (CO), Hydrocarbon (HC), Ammonia (NH_4). The information is collected from the sensors and then stored in central server using the means of internet periodically. Then the message is sent from server to the users [2, 8].

2 Existing System

Air pollution lead to extreme distraction and harms the human being and environment very badly. Thus it is life threatening. Hence it's important to monitor air pollution [2].

Conventional monitoring system uses laboratory analysis which used large equipments, complex technology. Thus this system was complex, huge and costly.

To overcome all these disadvantages different experts started using internet of things concept in their systems. Some developed the system using sensors for measuring different compositions of air and used machine learning algorithms for air quality indexing [4]. Some system used AVR A Tmega-32 microcontroller [14]. In some systems results of air quality was displayed on city map. In some systems Carbon nano tube is used as a Metal Oxide (MOX) gas sensor which needs to be heated up for a longer periods. These nano tubes are sensitive and costly. Some methods use sensors which consume more energy. Hence they are not efficient. In some methods pollutant quality information transmission is done within small distances. Thus many systems were developed to measure the pollutants of air. Different approaches emerged to measure the air contamination and monitor it.

3 System Architecture

The block diagram shown below represents the architecture of environmental monitoring system.

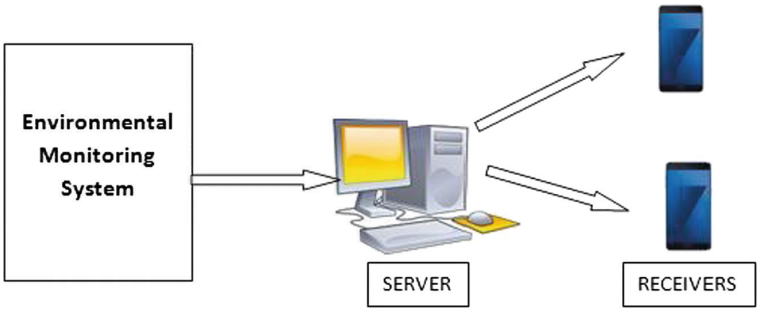

Fig. 1. Architecture of environment monitoring system

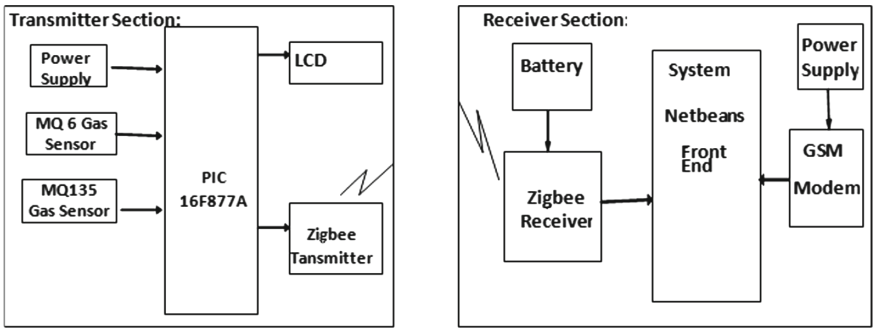

Fig. 2. Transmitter and receiver sections

Figure 1 shows the architecture of air pollutant monitoring system. It consists of a transmitter and a receiver section (shown in Fig. 2). The aim of the system is to monitor the environment. The contents of the air such as CO_2, O_2, SO_2, and NO_2 are to be monitored; we need to gather this information using different sensors. These sensors are placed as terminals at different locations in the city. The sensed data is to be transmitted to central server. Hence the sensed data passing through the microcontroller (PIC16F877A) get collected at the central server through Zigbee transmitter. The central server is nothing but a personal computer. At the server, the Zigbee receiver collects the sensed data of air from each location which is further stored in server through microcontroller at that unit. Location wise the sensed content of constituents of gas are compared with the normal values, if the content of pollutant gas exceeds the normal range then a message will be sent to the people over that location through the server to their mobiles about the percentage of pollutant present and message as "Air is Polluted" is displayed. Thus the system finds whether the air is polluted or not. If polluted, it finds the percentage of pollutant and transmits this information wirelessly to the mankind. This helps the people to know about the air quality.

Many different technologies are available for wireless sensor technologies. Some of them are Wi-Fi, Bluetooth, cloud computing based transmission, Zig-bee etc. In this paper Zig-bee technology is used as a mode of transmission method to transfer the data from different nodes to central server. Zig-bee has more advantages over others. Some of advantages are low cost and high performance.

Zigbee is one of the best means of communication built for sensor networks on IEEE 802.15.4 standard for wireless personal area networks (WPANs). It is the product from Zigbee alliance. This enables physical and Media Access Control (MAC) layers to handle many devices at very low-data rates. These Zigbee's WPANs operate at different frequencies as 868 MHz, 902–928 MHz and 2.4 GHz frequencies. The two way transmission of data between sensors and controllers can be done at 250 kbps data rate. Zigbee is low-cost network. Its power consumption is very low hence it is widely used for controlling and monitoring applications. The distance of communication ranges from 10 to 100 m. The distance of communication in network can be increased by using routers and thus communication can be achieved in wider area network. Zigbee communication is less expensive and simpler than any other shortrange wireless sensor networks such as Bluetooth and Wi-Fi. Zigbee supports different network configurations for master to master or master to slave communications. Zigbee facilitates two modes of operations for which the battery power is conserved [13].

This system has following advantages

- System
  - It is very Simple to use.
  - It is compact so portable.
  - Very easy to handle.
  - System is Real time.
- Sensors
  - Life time of sensors is very high.
  - Low cost sensors are used.
- Operating voltage: System uses very low voltage of 5 V, −20 °C to +50 °C.
- System can be used to check quality of air indoor as well as outdoor.
- Continuous update of change in percentage of quality can be got.
- Very much helpful for patients especially for asthma patients.

4 Results and Discussions

4.1 Hardware Implementation of Transmitter Section

Each nodes act as transmitters which are placed at different areas where environment needs to be monitored. Figure 3 shows transmitter section. It consists of sensors, microcontroller unit and Zig-bee.

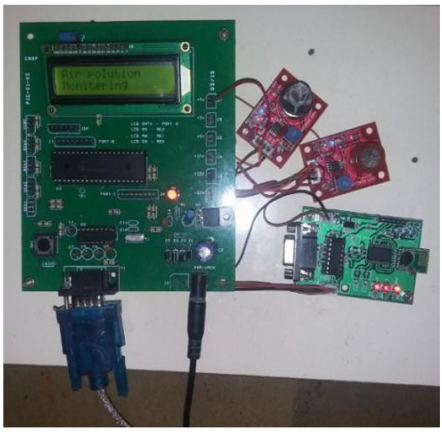

Fig. 3. Hardware implementation of of Transmitter

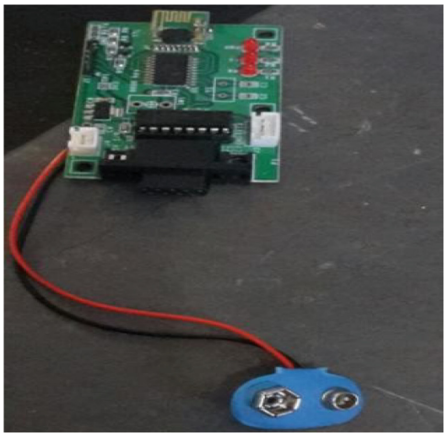

Fig. 4. Hardware implementation Receiver

Figure 4 shows the receiver section which contains Zig-bee module which has to be connected to central server.

4.2 GSM Section

Figure 5 shows the GSM module used at the receiver side at the central server to send message to the mankind about polluted air and its percentage of contamination.

Fig. 5. GSM module

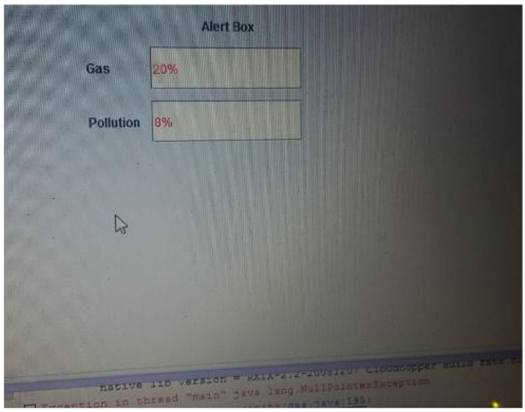

Fig. 6. Output display at server section

Figure 6 shows the display at the central server. The sensed gas is transmitted to the central server through the Zigbee transmitter. Here the percentage of pollutant is compared with the standard amount of that content in the air. If that content is more than the set value then air is polluted. So the percentage of Gas sensed and the percentage of pollution present is displayed as shown in figure.

5 Applications

Below are few applications of air quality monitoring using IoT.

- In agriculture: Many gases like SO_2, NO_2, fly ash etc. affect the growth of plants and can cause different diseases in plants. By monitoring of such gases we can give appropriate treatment and pesticides to the plants and we can avoid the occurrence of diseases in plants thus can be applied in agriculture to improve plant growth.
- In gas leakage detection: It can be used in Gas leakage applications where gas sensors detect the presence of LPG leakage which helps to get information of gas leakage inside and outside home. This will help to prevent causalities and fatalities.
- In indoor/outdoor air quality monitoring: It can be used to measure the percentage of different components present in the air. If the percentage of any hazardous gaseous substance is more it sends the information to the surrounding people.
- In public transport vehicles: All vehicles are fixed with sensors that measure the emission of fuel. If the smoke emission is more than the system intimates the same to the driver by which fuel emission of transport vehicles can be monitored.
- In health monitoring: The system can be applied in health monitoring of patients by sending them information of air quality in their surroundings.

6 Conclusion

The air quality monitoring is an emerging issue in the area of Internet of Things. We address the possibility of air pollution by using different gas sensors. The proposed model uses Zigbee transmitter and receiver to transmit the sensed data to the server, where the amount of pollutants is calculated, and if the pollutant value is more than threshold value then, the proposed model sends the message about the percentage of pollutant to the registered mobile numbers wirelessly. This is the efficient method of transmitting the data over certain distance of 1 km. The repeaters are used to extend the distance. Thus this monitoring system is useful for asthma patients to find the quality of air. Thus intimates the person about air pollution in the different areas which helps to monitor effect of air pollutants on health. This system can also be applied to find gas leakages, fuel emission in vehicles etc. This air monitoring helps to avoid global warming and removes the threat of acid rain. Further this model can be enhanced for different applications food quality monitoring, agriculture, etc. by using different sensors.

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Framework for Data Hiding Operation Using Motion Vectors for Effective Imperceptibility Performance

K. Manjunath Kamath[1(✉)] and R. Sanjeev Kunte[2]

[1] Yenepoya Institute of Technology, Moodbidri, India
kamathsjce@gmail.com
[2] JNN College of Engineering, Shivamogga, Karnataka, India
sanjeevkunte@gmail.com

Abstract. Data Hiding is one of the frequently used security approaches for safeguarding the sensitive information of the available data as well as to transmit secret information among different ends in a vulnerable network. However, majority of data hiding scheme evolved till date is focused on its embedding capacity or else focused on introducing the distinct parameters of encryption. However, all these approaches will not only make the embedded file bulky but also, they will lose its imperceptibility characteristics. Therefore, the proposed paper introduces a simple and robust reversible data hiding process where a secret image is embedded within a video as a cover image. Motion prediction and histogram shifting approach is also utilized for obtaining highly secured bit-streams. The outcome of the study shows that the proposed system offers a better signal quality and retains maximum imperceptibility irrespective of the size of the secret image.

Keywords: Reversible data hiding · Image imperceptibility · Video encoding Secret image · Compression

1 Introduction

With the recent progressive growth of multimedia technologies, almost all the commercial applications have started using it in a commercial way. In this regard, the usage of various multimedia file system are mainly shared and exchanged by the user from a practical viewpoint. Various studies have already been carried out to prove that the multimedia security still remains as a big challenge to overcome [1–6]. Hence, security approaches have been evolving in order to counter-attack the threats [6–10]. One of the most frequently used counter-mechanisms is data hiding scheme where a secret data is embedded for security purpose. The embedding of information, in most cases, causes the carrier to lose a part of the data, so the carrier cannot be completely recovered after it gets extracted. In some special applications, such as in the fields of medicine, military, and law, false positives would be caused even by slight distortion of a digital image. Therefore, any irreversible loss of carrier data is not allowed. Basically, Reversible Data Hiding scheme is capable of extracting the actual set of information from the given source ensuring the highest quality of information i.e. zero loss of data.

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Therefore, this topic is currently a center of attention for various researchers. Therefore, the proposed system introduces a very simple and novel reversible data hiding process by considering video as a cover file, which mainly targets on accomplishing the imperceptibility of the embedded secret image. The organization of the paper is as follows – Sect. 2 briefs of existing studies while research problem is briefed in Sect. 3. Adopted methodology and system design is discussed in Sect. 4 and Sect. 5 respectively. Result analysis is discussed in Sect. 6 while conclusion is briefed in Sect. 7.

2 Related Work

This section discusses about recent research work towards reversible data hiding. The most recent work is carried out by Puteaux and Puech [11] where a predictive scheme of *most significant bit* is used emphasizing on improving the high capacity. Qian et al. [12] have used a dual embedding scheme towards generating an encrypted bitstream. Qian et al. [13] have also used an iterative process of data hiding where first the encryption of image is carried out followed by embedding on extra information for obtained ciphered image into the server. A unique three-dimensional data hiding process using mesh framework was introduced by Jiang et al. [14]. According to the scheme, the vertex coordinates are used for mapping the integers from the decimals followed by usage of the least significant bits. Usage of homomorphic encryption is carried out by Xiang and Luo [15] along with the usage of Paillier encryption approach. The work of Yi and Zhou [16] has used a labeling scheme based on binary tree structure over the image pixels in order to facilitate encryption over image. Chen et al. [17] have used sorting of pixel approach as well as extension of the errors caused due to prediction for data encryption mechanism using directional property of the predictor. The work of Wu et al. [18] has adopted a color partitioning process for developing a unique data hiding scheme. Usage of motion vector over video encoded by H264 is carried out by Niu et al. [19]. The study discussed by Hou et al. [20] have considered the distortion problem and used reversible steganography for data hiding. Xiong et al. [21] have used homomorphic encryption while Wang et al. [22] have used histogram shifting approach for data hiding. The work of Zhang [23] used have optimal value of host data where pixel and auxiliary information is used for estimating errors. Many researchers have proposed theories for video steganography as well as compressed domain reversible video steganography using various conventional approaches of compression. Steganography system proposed by Hu et al. [24] is based on non-uniform rectangular partition uses an uncompressed domain. It uses secret video to hide inside a cover video, and the size of cover video and secret video are of same size. Similarly, various others authors e.g. Ni et al. [25], Hong et al. [26], Zhang et al. [27, 30], Ma et al. [28], and Shanableh et al. [29] have also carried out work towards addressing the problem of data hiding scheme where different conventional methodologies are applied for data hiding operation. The next section outlines the research problem.

3 Problem Description

From the review of the existing system, it can be seen that there are various forms of solutions towards strengthening the process of reversible data hiding procedure. Almost all schemes that are recently evolved are very unique and distinct from each other where the performance is found to offer a better data hiding scheme. However, a thorough investigation of its performance shows that existing system is not claimed to offer a good balance between the image quality and embedding policies. Not all work has actually emphasized on imperceptibility concept that is mandatory in data hiding scheme. Apart from this, the studies towards data hiding scheme over video is quite a less to found. The few work carried out towards video encoding scheme and data hiding actually doesn't consider imperceptibility factor associated with reversible data hiding.

4 Proposed Methodology

The main idea of the proposed system is to offer a cost effective data hiding scheme where a multimedia file system is considered as a cover file. The proposed system implements an analytical research methodology where a unique operation flow is constructed in order to obtain a secured bit-stream of data (Fig. 1). Another interesting part of the proposed methodology is that it uses the process of video encoding mechanism, which is a part of signal compression approach where a balance between compression and data security is achieved.

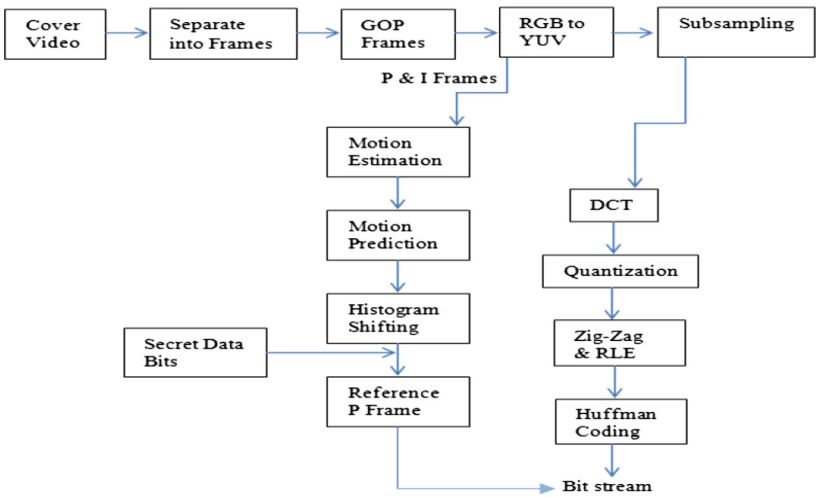

Fig. 1. Operational flow of proposed system

A closer look into Fig. 1 shows that proposed system uses the concept of motion estimation followed by prediction operation where histogram shifting operation is carried out in order to obtain reference P frame. It also applies discrete cosine transform for better compression performing after sub-sampling is carried out. The complete operation leads to generation of an encoded video where data is hidden. An illustrative discussion of this method is carried out in next section.

5 System Implementation

The proposed approach deals with embedding and extraction of the secret image pixels into a MPEG2 compressed video using Histogram shifting method in motion vectors. The cover video considered in this work is an MPEG2 compressed video file. This system presents an efficient way of transfer of information from sender to the receiver as data is hidden in the motion vectors of the selected frames. An uncompressed video is selected as cover video to hide secret image. Initially the frames are extracted and Group of Pictures (GOP) is formed from the extracted frames [11]. These frames are subjected to YCbCr color conversion. The proposed system uses luminance value obtained from the red component while other color components i.e. U and V are obtained from green and blue components respectively. In the next stage reduction of the resolution is done using Chroma subsampling. The proposed system then applies the concept of motion compensation for the purpose of minimizing the redundancy factor with respect to the temporal data in it while this operation is followed by applying standard discrete cosine transform scheme for obtaining better compression outcome. Finally, quantization operation is applied on the top of this process for effective compression as well as for better control of redundancy factor with respect to spatial data. At the end, the proposed system applies a lossless compression scheme of run length encoding for achieving better encoding performance and further Huffman encoding scheme is also continued on it. At the receiver side the process has to be reversed that is called as decoding. In decoding stage the de quantization of the data is to be carried out. The proposed system uses motion vectors where the chunks of the ciphered data is basically hidden in the form of P frame and this operation is carried out only after histogram shifting is done. During the compression, the secret image bits are extracted from the corresponding motion vectors and histogram is shifted back. This achieves reversibility characteristics. This section discusses about the algorithm implemented for this purpose.

5.1 Algorithm for Reversible Data Hiding

The steps of the proposed system are as follows: The proposed algorithm takes the input of cover video (I), which is then used for framing up group of pictures G_{op} (Line-1). After digitizing the secret image (which is required to be hidden), the next step is to distinguish all the obtained frames into different macroblock size (Line-2). The proposed system then performs following operation on all the macro-blocks (Line-3): a standard discrete cosine transform (DCT) is applied on the macro-blocks from the spatial to frequency domain (Line-4) which is followed by applying standard quantization