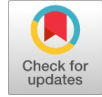# Smart Home Surveillance System using IoT with an Efficient Data Analytics

J. Santhosh, J. Praveenchandar

Abstract--- Security in our daily life became one of the basic need for all of us now a days. Drastic growth of the technology results sophisticated life, and other side directly or indirectly it can be applied to save one's life and to safeguard the properties we earned .But we should know how to use the technology. Home burglary and crime is one of the major problem, when we are not in our home. The whole movable asserts may be taken by thieves because of lake of monitoring systems in our home when gone for out station. There may be possibility of losing the whole property, which we earned for our better future. So we need an effective monitoring system in our home which may be enabled the above said situation. There are so many monitoring systems are available for the same scenario, but In this paper we propose a new efficient monitoring system with dynamic cloud resource allocation process and improved data analytics which gives most accurate results.

Index Terms--- Real Time Video Surveillance, IOT based Home Security, IOT based Surveillance

1. INTRODUCTION

The proposed system is designed using IOT technology. The basic architecture of IOT involves the standard model discussed bellow .It involves the connected devices which processing the data. The system starts with the module called as sensors for acquiring the data. It talks about IOT Devices, IOT Connectivity and Embedded Intelligence. In our proposed system, we use the surveillance video camera as IOT sensor device .It may be wired or wireless. The primary part of this module is data sensing in terms of Data capturing, sensing the accurate data's and storing the same. Based on the output, sensors may be categorized as analog sensors and digital sensors. And based on data type, it can be categorized as scalar sensor and vector sensor. Next module Internet gateways, data Acquisitions system which is used for data aggregation, analog to Digital, measurement and control. And it also ensures the Data transport and Access which means focus on access networks, cloud and edge data transmission. After that we need to have Edge IT, which means analytics and preprocessing part of the proposing system, in which we have proposed an Improved data analytics techniques for image comparison algorithm for better analysis. Because, based on the results made by this analysis, some decision must be taken in the system. So we

have given most impotence to this Data analytics part. This data analytics involves Big Data analytics, Artificial Intelligence and also cognitive analysis at the edge. Then the next one is Data value and Action taken, which involves analysis to action, API and processes and Actionable Intelligence. This is last module in the setup .It is also an important part of this IOT Architecture. Based on the decision made, as per the analysis, action will be taken or automation can be implemented. Anyway we have implemented an IOT based application, we need to concentrate the following challenges for the better performance. That is Hardware Compatibility issues. We use more number of devices in this application. All devices we use must be compatible each other .The second issue is Data Connectivity. During the data travel from the first module to last module we must ensure the data connectivity. It means at any moment, data should not be lost. Because even single minute of delay, will affect the performance of the system. Major possible data lost area in the proposed system is communication of sensor devices with Gateway devices. Almost all gateways devices available are compatible with GPRS and Wi-Fi. Next challenge is Data Analytics, one of the most important part too. Next challenge is the analytics challenge .The real worth of this IOT system is realized through the effective and most appropriate actions taken from the collected data and analysis done at the final state. So the analytics we used must be capable of handling enormous datasets. Then incorrect data capture difficulties must be addressed in this section. Due to this issue the whole system will became incorrect. So we must analyze the data's coming from the sensors and ensure that we are processing with the right dataset. Finally a data security issues can be consider for the given setup. Securing the system from many ransomware and other attacks. And, all IOT applications we need to ensure that the data is being processed safe. The flow of data in our system will be from sensor to gateway then gateway to Internet through proxy server. From the internet to cloud server via web socket .There an improved analytics algorithm is enabled .From the results made actuation will be stimulated. Video sensing is the technology of Digital image Analysis. The proposed systems can range from wireless house security cameras to sophisticated alarm systems that reports law enforcement at the first sign of trouble. The presence of video sensing cameras can serve as a deterrent to thieves, whereas hidden cameras can protect discretely. The communication between the cameras and the gateway may be wired or wireless, anyhow maintaining the system with standard Wi-Fi technology can be advisable. All IOT Devices in the setup is in the network. So each will have its own unique identification address called   as Internet Protocol address.
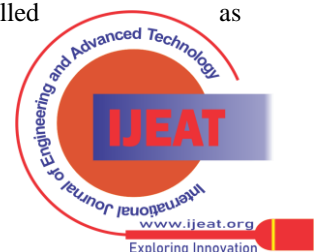
IOT devices will interchange the data with other connected device or it only give/get the data from another device and communicate the data to cloud or server. Global cloud Communication will be taken place with the help of IOT Protocol. It consists of Data link layer, Network layer, Transport layer and Application layer. Data link layer supports 2G/3G/4G.And all other communication medium like LR-WPAN, Wi-Fi, WiMAX and Ethernet connection. Network layer or Internet layer supports IPv4 and IPv6 capabilities. Then transport layer will give the support over the TCP and UDP which deals about wired and wireless medium. Finally the Application layer deals with HTTP, CoAP, Web Socket and DDS. Here TCP provides connection oriented reliable transmission. Also provides error detection facility to ensure that no duplication of packets. But, UDP is connectionless doesn't have reliable transmission. And it is not providing the proper ordering of message. It is stateless and transaction oriented. Then the logical design of this IOT application involves devices, communication, services, management, security and application. And it needs the help of the technologies such as wireless sensor networks, cloud computing, big data analysis and embedded systems. In the proposed system we have four types of communication models such as device to device communication, device to gateway communication, device to cloud communication and backend data sharing model.

2. EXISTING SYSTEM

The Existing system in surveillance mechanism available that video capturing device is working based of the motion detection algorithm. It detects the motion inside the home and sends the data to the cloud for analysis through gateway. Based on the decision made an SMS will send and the captured video will send to the mail id [1]. In the next approach, when a sensor detects the unauthorized movement in the home, it sends the sensed date to the to the cloud and that image will be send to user mail id and alert SMS will be send to the user mobile number[2]. In both approach Raspberry Pi is used for the human detection. In our proposed

work also we use High definition video surveillance camera is used as a sensor device. Then with the help of Raspberry Pi human moment is being identified, then the SMS alert will be send to the registered mobile number and also one more module is added with the existing system. That is live streaming will be initiated to the user mobile with the help of an application installed in the actuator side..

3. WORKING PRINCIPLE

We propose an Improved smart home surveillance system with enhanced facilities which provides the most accurate results .The system architecture of the proposed system is given and discussed .From the sensor side data is being collected and that will be transmitted to the internet cloud through the gateway. Analytics will be done as a part of the proposed system. Whether any moment is there in the locked room or not using Human motion analysis. In which the moment of the human being is detected with the help of background segmentation and background subtraction algorithms. Once the analysis got over and the motion is detected, the immediate action will be taken. The part will be done in the actuator side. This will be an SMS alert to the registered mobile number and the live video streaming will be initiated to the application as specially designed for this surveillance system which is installed in the user's mobile. If user starts the App, he can see the live video streaming of his home. And In addition to that, we have given one more provision. Since we have used the Surveillance video camera contains small speaker, while seeing the live streaming itself, he can warn the intruder of his home through the mobile phone. We use the video surveillance camera for the sensing part. Raspberry Pi is a set of small programmable one-board computer which can be operated on Linux operating system. Windows 10 IoT core, NetBSD and openBSD are some of the system used in this. And, we use Background subtraction algorithm to detect the intrusion in the locked home.
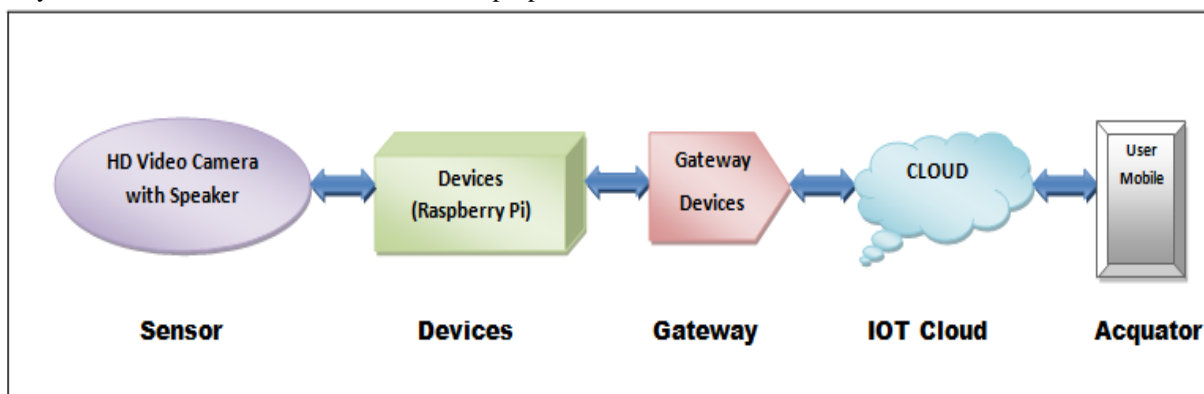
Fig. 1: Proposed System architecture

4. BACKGROUND SUBTRACTION ALGORITHM

Background subtraction is technique to extracting out the foreground objects from the background in the sequence of the frames of a specific video. It is one of the extensively used approach for identifying moving objects from static cameras. In this approach, All frames of every two seconds

are captured and the last two frames are taken for consideration for processing. Estimation of background for time 't' is done. Then subtraction of estimated background from the input frame is processed.

By Appling the threshold value' td', we could get the absolute difference between the two frames of the video playing. The threshold value 'td' can be less then the difference between two taken frames

$$td < F_x - F_{x-1} \quad (1)$$

Let us take image at the time 't' is A(x,y,t) and Background at the time 't' is B(x, y, t),As per the background subtraction algorithm the equation will become

$$td < | A(x,y,t) - A(x, y,t-1) \quad (2)$$

Here the sensitive part of the background subtraction is finding the threshold. Though, there are so many techniques to find this, we have taken most accurate approach called automatic thresholding. Pixel values are modeled as a mixture of adaptive Gaussians. Because, in a pixel multiple surfaces appears and there may a change of lighting. In every

Iteration, using simple heuristic method, Gaussians are evaluated to determine which is mostly likely to correspond to the background. Other pixels are compared with background Gaussians. Different pixels will be categorized as foreground. And, All foreground pixels are grouped together. Since we are dealing with various threshold for each pixel, it adapting by time .And All objects are permitted to be a part of background along with the existing background model. Deletion of existing background model is not allowed. One of the major advantage of this technique is fast recovery. And one of the disadvantage of this method is sudden light changes. The will be able to work efficiently with out any sudden light changes and drastic light changes. Because this algorithm supports poorly in this scenario.
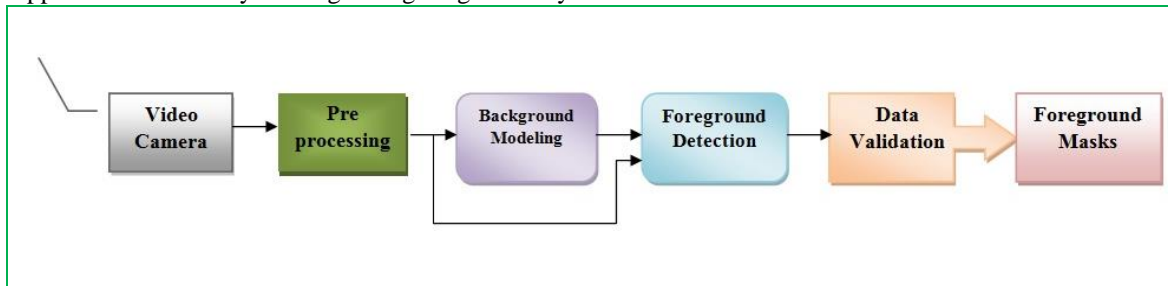
Fig.2: Background Subtraction Algorithm

Major four tasks of this algorithm are preprocessing, background modeling, foreground detection and data validation. After the frame gets preprocessed, Background modeling is applied .This process is the major process. Though there are various background modeling are there, we use recursive one. Finally we could identify the intruder in our home using this technique. Fig 3describs that the intruder at home. Then fig 4 tells that how this background subtraction algorithm works. Our proposed data analysis system, comparing the subsequent frames of the camera at a particular time interval, if it detects any intruder or motion of any object, the background subtraction algorithm employs. It extracts the foreground image from the background image and analysis will be done. After the image is analyzed with the help of foreground and background images, once it is identified that there is something is going wrong, immediately message 'will be send to the registered mobile number and the notification will be send to the same mobile phone to initiate the live streaming .


Fig.4: Subtracted foreground image

5. EXPERIMENTAL SETUP AND RESULT

Above said Smart IoT based video surveillance system has implemented with the help of necessary equipments such as Video surveillance camera, Arduino board with IoT components shown in Fig 5.

Arduino board is connected with batteries for power supply.

And analysis will be made based on the conditions we have given with the raspberry Pi. Sensors fig 6 are connected with the gateway for data transmission.

Fig. 3: Intruder at home
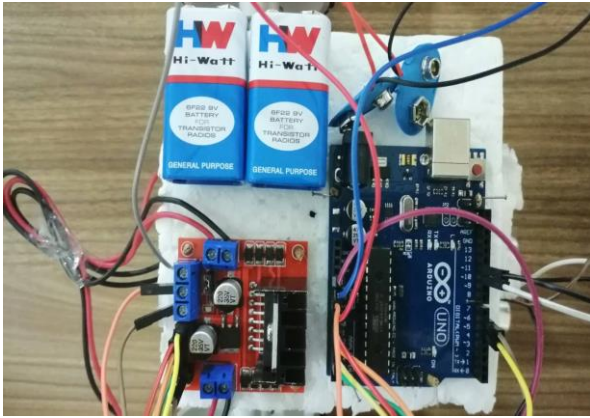
Fig.5 : IoT System Set up

From that the sensed, data will be analyzed with the help of proposed background subtraction algorithm. In that, two subsequent image frames will be analyzed by foreground and background segments of the image. Once the intruder is confirmed, immediately the action taken part will be activated, which means, a notification message will be send to the registered mobile number and the live streaming session will be initiated with a small notification alert. Then, from the registered mobile phone the live streaming could be monitored.

Fig. 6: Sensor of the proposed application

Then finally the out is shown as following figure fig. 7 that is live streaming of the sensor and the with one alert message . And the limitations of this proposed approach is lighting and some unwanted disturbances like pet animals entering to the frame.

Fig. 7: Actuator of the applications (Live Streaming)

6. CONCLUSION

In this, proposed IoT based smart video surveillance system with efficient data analytics has given the new solution to the surveillance with live streaming approach .Sensors will sense the data and efficient data analytics has been applied to identify the intruder accurately .For that background subtraction algorithm is used. Finally the actuator part is for action taken, which is in terms of sending the message and initiating the live streaming with the user's registered mobile number. For future enhancements, we have considered to ensure the consistence accuracy with various lighting situation.

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