DESIGN AND IMPLEMENTATION OF REAL TIME SECURITY SURVEILLANCE SYSTEM USING IoT

S.Naga Jyothi, M.Tech, Student,
Department of ECE,
Vignan's Lara Institute of Technology & Science,
Vadlamudi, Guntur, A.P
Email:snjyothi28@gmail.com

K.Vijaya Vardhan, Assistant professor,
Department of ECE,
Vignan's Lara Institute of Technology & Science,
Vadlamudi, Guntur, A.P
Email:kvvardhan405@gmail.com

Abstract*— In recent years, there has been an increase in video surveillance systems in public and private environments due to a heightened sense of security like, CCTV and RFID. There are several defects in the video surveillance systems such as picture is indistinct, complex structure, Poor stability, lot of storage space is needed to save the surveillance information and prices remain relatively high. This paper proposes the real time security surveillance system using IoT. The system design uses Motion Detection algorithm written in Python as a default programming environment. This significantly decreases the storage usage and save investment cost. The algorithm for Motion Detection is being implemented on low processing power chip Raspberry pi 2 and Pi camera, which enables live video streaming with detection of moving objects and get alarm when motion is detected and sends photos, videos to a cloud server directly using pi camera. When cloud is not available then the data is stored locally on raspberry pi and sent when the connection resumes. The camera is mounted on the motor and its movement (Left/Right) is controlled through IoT webpage by the user, thus providing user with enhanced view of the surroundings.

***Keywords*—Internet of things, Pi Camera, Raspberry pi, Motion Detection.**

1. INTRODUCTION

Video surveillance has been evolving significantly over the years and is becoming a vital tool for many organizations for safety and security applications [1].These systems play an increasingly important role to maintain social security. It has been widely used in many fields such as finance, public security, banking, and home. Traditional video surveillance can generally achieve close distance monitoring, by using the PC as a monitor host, monitor host connected monitor camera with coaxial cable. Initially, it was dominated by analog cameras connected using coaxial cables[2]. For cost and performance reasons, there was a switch to digital switching systems and now IP-based delivery of data[1].

Detection and tracking of moving objects are important tasks for computer vision, particularly for visual-based surveillance systems. Video surveillance application, most times imply to pay attention to a wide area, so omnidirectional cameras or mobile cameras are generally used [3]. In this system, we use the Raspberry pi chip as the microprocessor. Video data is captured from a Pi camera, compressed into the MPEG format, transferred through the internet under control of the ARM Cortex a7 chip. Then the monitor client will receive the compressed data frame to restructure and recompose video images. IoT video monitor system provide a practical solution for remote wireless monitoring with low cost.

2. EXISTING SYSTEMS

In existing systems, Closed-Circuit Television (CCTV) system is the use of video cameras to transmit a signal to a specific place, on a limited set of monitors. It needs a command and control center to monitor all the activities using cameras. In these types of surveillance systems, the person who is stationary and is located in that particular area can only view what is happening in that place. But it is costly for normal residents to setup such kind of system and also it does not inform the user immediately when the burglary happens [4].

Radio Frequency Identification (RFID) use radio waves to automatically identify person or objects. An RFID system consists of a reader and one or more tags to transmit radio frequency energy. These systems are not covering more surveillance area. And also which are very expensive

PIR sensor based systems [5] is designed to identify the slowly changing conditions that would happen normally as the daily progresses and the environmental condition changes, but it responds by making its output when sudden changes occur, such as when there is a motion. This device is designed mainly for indoor use[7]. Which are not used for some condition like rapid environmental changes and strong shock or vibration and also not working in direct sun light or direct wind from a heater or in air condition [11].

In proposed system, When motion is detected the Pi camera is used as a video capture device. All the data

processed, compressed, and transferred by the Raspberry pi processor. Then video data are sent to the cloud server by wireless network. The camera movement can be controlled with the help of IoT [13].

3. PROPOSED SYSTEM

In this system, we use the Raspberry Pi chip as the microprocessor and Pi camera used for captures the image of an object in the surveillance area. When motion is detected by the motion detection algorithm, then the camera captures that image and then send to the user through the email server and also sends SMS alerts to the user mobile automatically through GSM modem. And it records video that is happening in the surveillance area which is directly uploaded to the cloud server (you tube). When cloud is not available then the data stored locally on the raspberry pi and sent when the connection restarts. We can access the live streaming video from camera on any web browser with the internet enabled device. The movement of the camera at the surveillance area is controlled trough IoT platform to increase coverage area.

The main aim of this system is to provide security to our homes and other control applications. The hardware module includes Raspberry Pi [4], Pi Camera, DC motor, GSM modem, MAX 232IC and fire sensor. The block diagram of proposed system is shown in fig 1.

Here Pi camera module is connected to the Raspberry pi board directly through the CSI (camera serial interface). That can be used to take high definition videos, as well as stills photographs. MAX232 IC is a hardware layer protocol converter IC commonly known as RS-232 Transceiver. It consists pair of drivers and receivers. At a very basic level the driver converts TTL and CMOS voltage levels to RS232 voltage levels. Which are used for serial communication between Raspberry pi processor and GSM module.

Fire sensor detects the high temperatures in the surveillance area. In this system we are using thermistor for the detection of high temperatures.

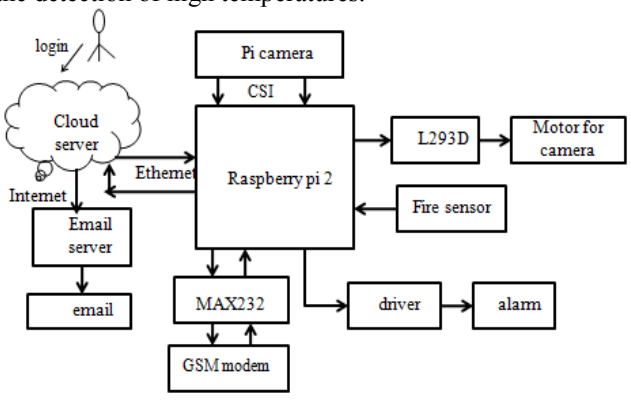

Fig.1: Block diagram of proposed system

Generally we can't drive a DC motor directly with a microcontroller, as DC motor because it requires high current and high voltage than a microcontroller. Micro controller usually operates at +5V or 3.3 V supply and it I/O pin can provide only up to 25mA current. Commonly used DC motor requires 12V supply and 300mA current, moreover interfacing DC motor directly with microcontroller may affect the working of microcontroller due to the back emf of the DC motor. For this reason we use L293D H-bridge circuit. It is a special circuit, by using the 4 transistors we can control the direction of DC motor. If we give logic bits 1,0 then current flow from VCC to motor positive after motor positive to motor negative and then flows to ground. Then motor rotates one direction .We may change the logic bit 0,1 then current flows from VCC to motor negative after motor negative to motor positive and then flows to ground.

Finally, the human movement is detected by the Motion Detection algorithm [6], the system triggers an alarm detecting the presence of unauthorized person in a specific interval of time and simultaneously sends a alert SMS through GSM modem to the user and send captured image to the registered email of the user later recorded video send to the cloud server that is happening in the surveillance area. Using IoT [12] we can monitor surveillance area to cover more distance. The setup Python Open CV script will automatically deliver video data streaming to cloud server. Here 5MP Pi camera module is used that can be capable of 1080p high definition video modes and still image, and it can connect Raspberry Pi directly with CSI (Camera Serial Interface). Hence it supports 2592x1944 image stills.

4. MOTION DETECTION ALGORITHM

Motion Detection algorithm works on the basis of frame differencing –meaning comparing how pixels change location after each frame. Motion detection algorithm [8] primarily depends on converting the image from RGB pattern or any other colorful pattern to gray, then algorithm compare the gray frames with each other. Through these comparisons the motion and movable objects are detected. Simply in other words, Motion detection [8] is the action of sensing the physical movement in a given area. It is also the process of determining the movement of an object from two or more successive images. Once the movement detection occurs, calculations are made from two images to determine the type of movement made.

Algorithm:

1. Converting the current frame and the next frame to the gray type.
2. Comparing pixel peer to peer for the first frame with the corresponding pixel in the second frame.
3. Calculate the average of a selected color in frame 1
4. Wait X seconds
5. Calculate the average of a selected color in frame 2
6. **if** abs (avg Frame1- avg Frame2)>threshold **then** motion detected.

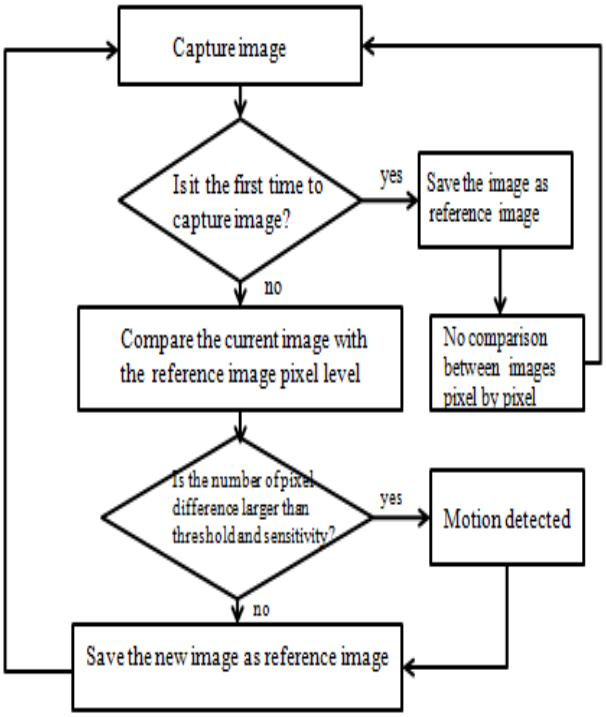

Fig.2: Motion Detection Flowchart

Motion Detection flowchart is shown in fig 2. If there is no motion detected, the program will not save the videos data. Otherwise, if motion detected, the current frame of detected motion will be processed by Motion Detection algorithm. And then the system will record full-hd videos, save them on the SD-card packed into MP4 container while the live preview continuous.

5. IMPLEMENTATION

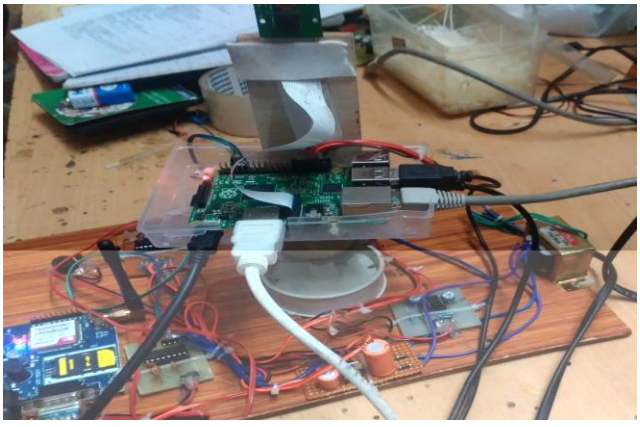

Fig.3: Experimental setup for the security surveillance system

In this project, we can implement the Motion Detection algorithm for monitoring the camera system from remote end with the use of Internet. When motion is detected by the camera then it captures the image of an object and immediately sends to the email of the user through Email server and also notifies in the form of message from the surveillance system through GSM modem. And it records the video that is happening in the surveillance area then it is directly uploaded to the user cloud server. Live streaming on any web browser can be accessed in the cloud server and also the camera can be moved from left to right or right to left with the help of IoT platform to enhance the surveillance area. Here DC motor and pi camera are being interfaced to the Raspberry pi. The images captured by the camera should be processed very fast to provide real time visualization of environment to the user.

6. EXPERIMENTAL RESULTS

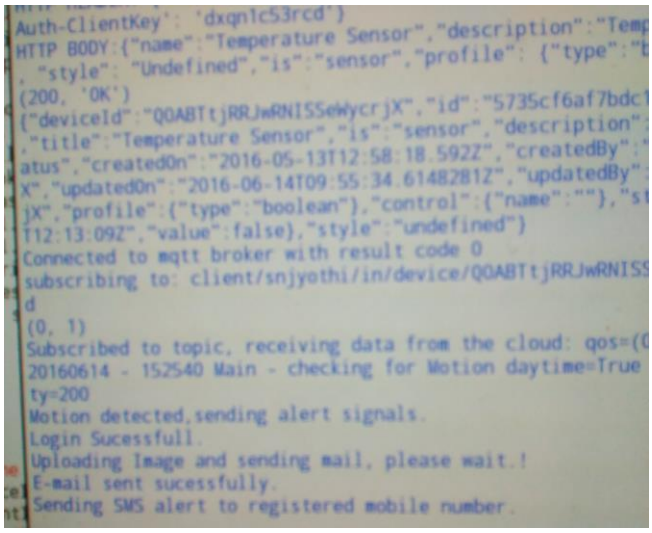

Fig.4: Sending E-mail to the user

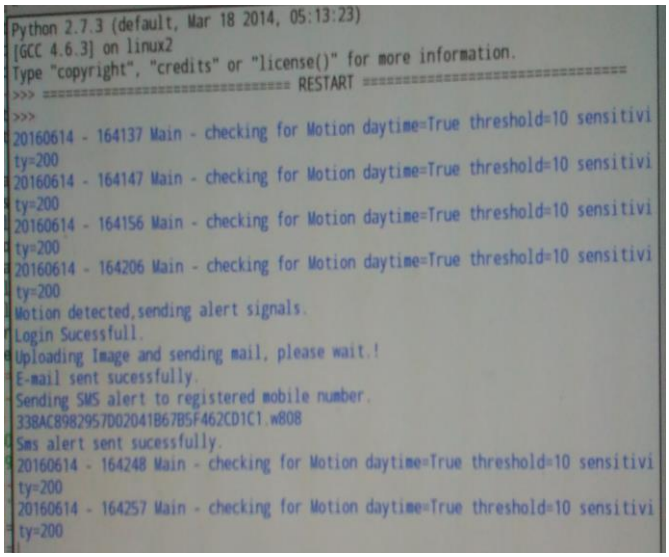

Fig.5: Sending SMS to the registered mobile number

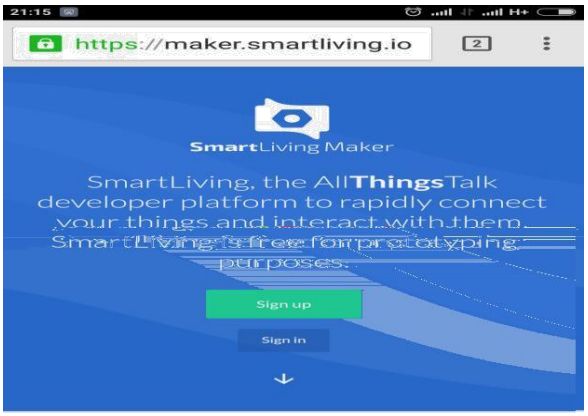

Fig.6: Sign in smartliving.io in IoT Platform account

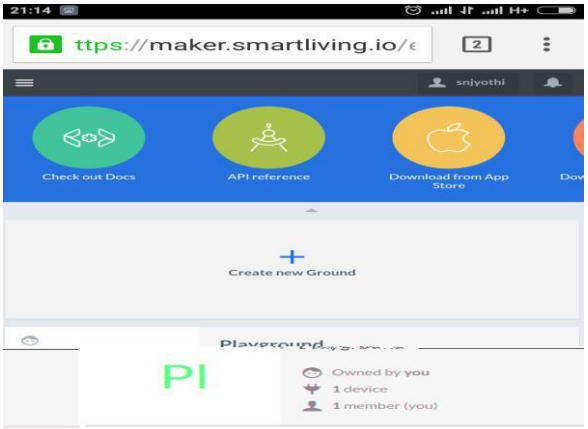

Fig.7: Create raspberry pi device

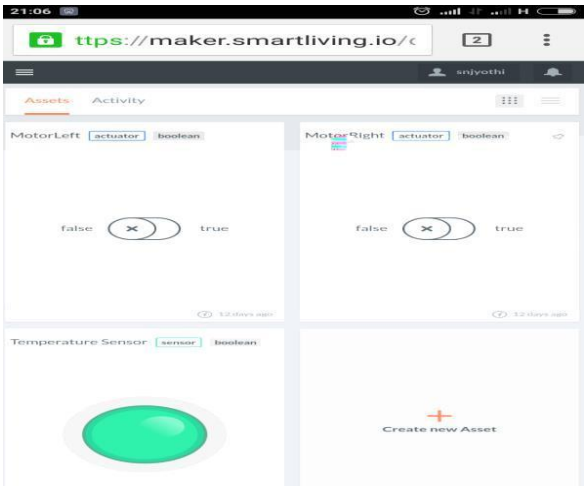

Fig.8: Create monitoring asserts on raspberry pi in IoT

Experimental results shows the sending Email and SMS alerts to the user when motion is detected. Figures 6, 7 and 8 shows creation of an account in IoT platform for user authentication. Here using motor left and right pin asserts for the movement of the camera which is shown in the figure 8.

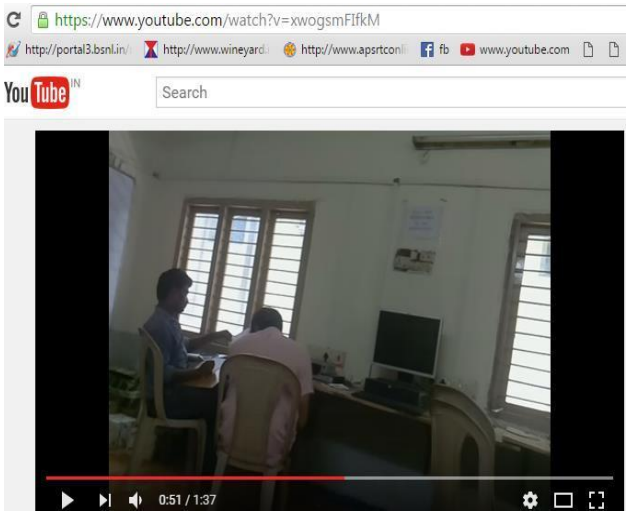

Fig.10: Live streaming in YouTube

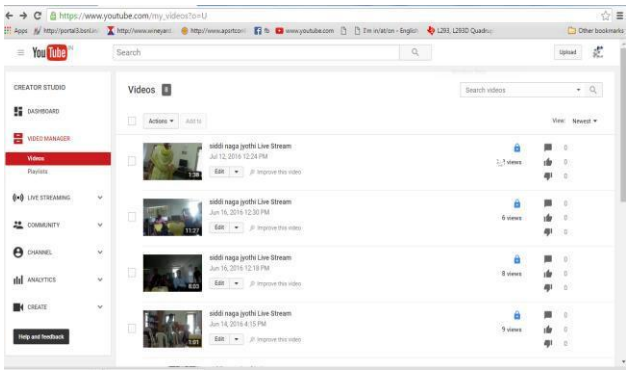

Fig.9: Videos are stored in cloud server (YouTube)

7. CONCLUSION

This Paper presents a cost effective IoT based surveillance security system. The proposed system provides home security and other control applications. Deploying Raspberry pi, GSM and Pi camera helps to detect, report and monitor intrusion events to users. And also the system informs to the neighborhood and alerts user, thereby reducing the damages caused by burglary. The use of cloud network in the system allows for storage of captured images and recorded videos.

8. FUTURE SCOPE

In future we plan to improve the Motion Detection algorithm. Because the algorithm depends on the threshold value. Its mean the performance of an algorithm enhanced by considering certain conditions. And the system cannot know about the intrusion is known or unknown person for this we can maintain shift key by the user in future.

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