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IoT based smart surveillance security system using Raspberry Pi

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ABSTRACT

Communication mainly is the transfer of whatever thing or exchanging of data, so that the Internet of things is naught but the transferring or exchanging of anything with several other things. The using of internet authorized system or devices roughly calculated as that by 2020 there will be nearly about billions. The purpose of the paper is to define a safekeeping alert device spending little handling power by the Internet of things which help out to observer plus alerts when gestures or else motion are there then send images to a cloud server. Besides, the internet of things cantered use can be used tenuously to observe the action as well as acquire warning when gestures or else indication are there. The images are shown straight to a cloud attendant when the cloud attendant is not accessible at that time the records are put in storage close by on a Raspberry Pi. A credit card size Raspberry Pi with an advantage of Open Source Computer Vision (Open-CV) software knobs the image processing, control algorithms used for the attentiveness then shows taken images to concern person email by the use of Wi-Fi module. The system uses an ordinary webcam.

Keywords— Web camera, Wi-Fi module, Raspberry Pi, Keyboard, Open CV

1. INTRODUCTION

Surveillance is a must for small houses to large-scale industries as they fulfil our safety aspects because theft and burglary have always been a problem. By combining this Surveillance idea to IoT and some Machine Learning stuff this will be a major product. A world where just about anything you can think of is online and communicating to other things and people in order to enable new services that enhances our lives, the world you know is set to undergo a major technological shift forward. This shift is collective as the Internet of Things (IoT). The basic premise and goal of IoT are to “connect the unconnected”. Surveillance means observing a particular incident using electronic devices such as cameras [1].

In this Surveillance project, there are two different modes of monitoring, Online and Offline mode. In Online mode, we can able to live stream of what is happening in that place and we also pattern recognize using the LBPH Recognition algorithm. The camera will give us live feed in the browser using OpenCV tool, if the camera detected any face or upper part of the human body it will send an SMS (Short Message Service) to the house owner. In Offline mode, we can set time for how many hours should the camera be recording, and it will record only motion part and other it will simply trim off.

The challenges we had been faced in these projects is that pattern recognition in which it can detect each object like it was detecting the face from the images/pictures taken from mobile. To overcome this challenge, we made the live face detecting so that it should not detect faces of still images/pictures [2-4].

The demonstration of this paper is listed below as Section II describes the methodology. Section III describes the system architecture. Section IV describes the experimental result of this project. At last, Section V concludes the paper.

2. METHODOLOGY

Preinstalled noobs operating system is already available in many authorized as well as an independent seller, there are many other operating systems for Raspberry Pi in the market like Raspbian and third-party operating system also available. There are different steps to setup the Raspberry Pi [5].

Step 1: Formatting the SD card

Download the SD card formatted 4.0 from SD card Association website either for Windows or Mac. Insert the SD card into the computer or Laptop SD card reader. Open SD card formatted select the drive letter and format it.

Step 2: Operating system installation

Go to the Raspberry Pi foundation website and download the Raspbian Operating System. Extract all the files from ZIP. Now

download the Etcher portable for installing OS into the SD card. Run the Etcher portable application and select the extracted file of Raspbian OS and flash it into the SD card.

Step 3: First boot

After the successful installation of the OS into SD card, now insert the SD card into the Raspberry Pi 3 Model B and power up. Now again you must install two more software, one is WinSCP (Windows Secure Copy), this application is used for copying the file from computer to the Raspberry Pi device. And the second software is the Putty, this application is used for the terminal for command execution.

Logging into the Raspberry Pi. The default login for Raspbian is username “pi” with the password “raspberrypi”. After successfully login into the Raspberry Pi, the next step is to install the MQTT protocol (Message Queuing Telemetry Transport). MQTT is a reliable, lightweight and cost-effective protocol to monitor and control many sensors and their data from a central server location, as typically used by the oil and gas industries. An MQTT client can act as a publisher to send data to an MQTT server acting as an MQTT message broker. MQTT control packets run over a TCP transport using port 1883. TCP ensures an ordered, lossless stream of bytes between the MQTT client and MQTT server.

This project is simply ensuring to get in touch with all the device using IoT so that every connected device should get the data. This supports more elasticity, relaxation capacity and protection. The below figure shows the data flow of Surveillance security how it is working using the MQTT protocol. This shows how the python script from the Raspberry Pi execute the code of the web camera using OpenCV and how the Raspberry Pi using the MQTT server send the data to the subscriber. The subscriber may be a cellular phone or may be the Desktop.

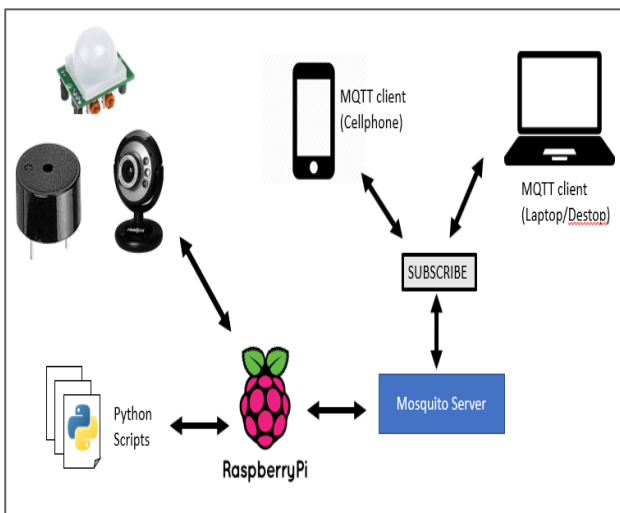


Fig. 1: Data flow of surveillance security

3. SYSTEM ARCHITECTURE

In this project the web camera is connected to the Raspberry Pi and record the videos of motion when the motion is detected and capture/detect the face using pattern recognition. The captured data is sent to the owner through email. The Raspberry Pi also sends the data to the subscribers using the MQTT protocol [6-7].

The System architecture shows two different processing, one is in “Application Server” and the other one is in “Raspberry Pi”. In the application layer it consists of two processes, one is the User Interface layer in which it contains the Client layer and Web layer. In the Client layer, the owner can create an account and

can manage the surveillance system and in the Web layer, the owner can give his/her background details, password etc.



Fig. 2: System architecture

In application logic, it consists of MQTT configuration where the devices can subscribe/unsubscribe to the Raspberry Pi. In the control centre, the owner can set the time intervals of the video recordings so that only trimmed video can be viewed. The motion detection history stores the motion video in the memory card of the Raspberry Pi so that afterwards can be downloaded and can be viewed.

In the Raspberry Pi, we can execute the python script of motion detection and face recognition using OpenCV. The PIR sensor will sense the motion and it will execute the code as per the detection of motion. The face recognition is done using the LBPH Recognition algorithm. This will detect the Region of Interest of the face that has been recognized. The Raspberry Pi consists of the processor of Broadcom BCM2837 SoC with a 4xARM Cortex A53 with a memory of 1 GB. It has a 40 GPIO pin for input/output of the data.

4. EXPERIMENTAL

This project is having two phases one is application phase another is processing phase. The application phase is the Graphical User Interface (GUI). In this phase, user can create his/her own account by giving his/her details. After successful registration. The owner can log in into the Smart Surveillance Application.

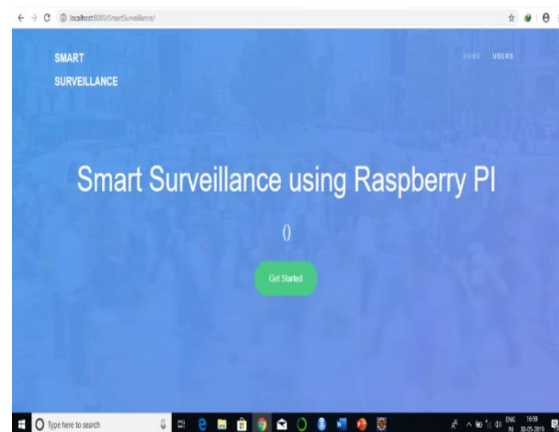


Fig. 3: GUI of smart surveillance system

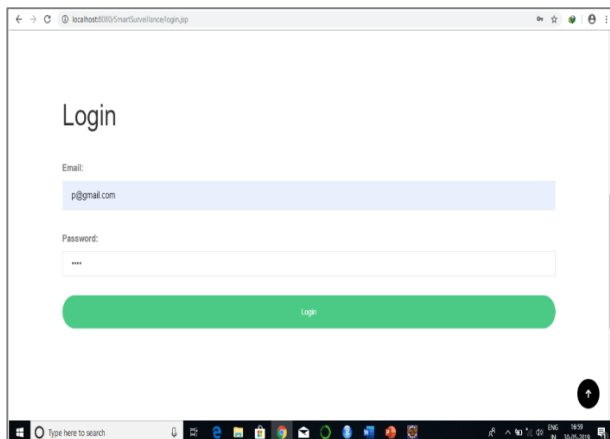


Fig. 4: Logging into smart surveillance

The second phase of this project is the Processing phase. In this phase, there are two different modes in which one mode only shows the motion has been taken place and the other mode shows the full live streaming. In live streaming, it recognizes the faces using the LBPH Recognition algorithm. If the camera detected face matches with the trained datasets, then it will print the name of the person or else the face doesn't match with the faces in datasets then the algorithm takes the person and sends it to the owner through email.

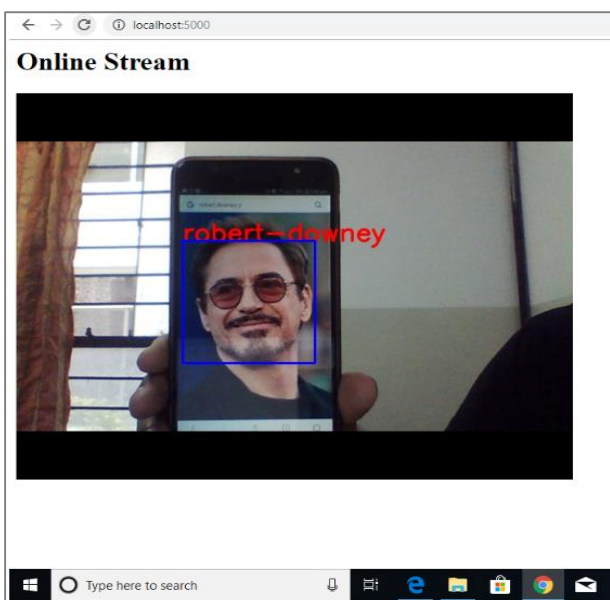


Fig. 5: Face recognition using OpenCV

5. CONCLUSION AND FUTURE SCOPE

The Smart Surveillance System using the Raspberry Pi and the camera has been successful tested. The two modes of Surveillance System run the project better. The Offline mode, where the user can set a time interval. In this, the camera will record till the time interval has been set and it will trim off some video part where there is no motion available and remaining else it will save in the memory. The Online mode will detect the face of the person and recognize it using the face recognizer. If the person wears the masks and comes the camera will capture the snap and send it to the owner through email.

Apart from this, we can implement a fall detection method, Behavioral recognition method where it can detect the facial expression and so on. After the completion of all this, we are going to set up these in cities to develop the smart city. For Security purpose, this project will secure the whole city from theft and burglary.

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