Survey on Smart Surveillance with Facial Recognition and Alerting System

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Abstract – *Security is a major aspect of all public places. There are numerous measures including security personnel , cameras and live footages that are continuously monitored. When it, comes to security, the response time to a situation is very important and it is directly dependent on the time taken to detect a threat. The current security systems are largely dependent on in-person monitoring at all times and are prone to human errors and inefficient timing. The purpose of this paper is to propose a system which removes the need for in person monitoring and improves the efficiency in automatic surveillance. We make use of Raspberry Pi boards attached for each camera, hence the cameras have the ability to work as standalone system or as an inter-connected network of cameras forming a surveillance system. A specific server is located at the centre of our system and is called a Controller node. The central node receives the videos or images and performs facial recognition and triggers the alert systems on detecting threats. A card sized Raspberry Pi with image processing capabilities through the use of Open CV and with control algorithms used for facial detection and recognition, identifies the suspect and displays the images to concerned client at the security room and alerts the predefined contact number with a call and a text message.*

Key words – Raspberry Pi, Wi-Fi Module, GSM Module, Real Time Monitoring, Open CV, Short Message Service, Facial Recognition.

1. INTRODUCTION

Starting with shopping complexes, metro stations, airports and all other places of public gatherings, security is always a major concern. Thus surveillance is very essential aspect and is complex in places which are always populated. The majority of these places have 24/7 camera surveillance which is monitored by the security staff in rotating shifts. It takes hours of time to go through the footages to find the video clip that is required hence they are time consuming. The security system is dependent on the person monitoring them and are prone to human errors. Thus there is a need for a smart IOT enabled surveillance system for detecting threats and alerting the concerned security personnel to improve their response time and minimalize the foreseen causalities.

2. Literature Survey

According to the survey, there are various systems which detects an intrusion and sends notification with the image that is captured to the concerned security personnel. These systems are designed to work in places where any movement of people is considered as intrusion.

The paper by Chinmaya Kaundanya ,Omkar Pathak , Akash Nalawade & Sanket Parode ,2017 [1] presents a system with features of remote surveillance, face detection and recognition. Notification is sent when a

person is not recognised from the database. This system makes use of Local Binary Pattern Histograms algorithm for facial recognition. The system consists of Raspberry Pi equipped with GSM module and Open cv libraries.

The paper by A Suresh & K.S.R Murthy ,2013 [2] presents an idea of remote video monitoring in real time with help of Video4Linux on a S3C2440 Microcontroller. Paper by Kavitha Mamindla, Dr.V.Padmaja & CH.NagaDeepa,2013 [3] introduces us to real time monitoring with embedded Linux on Arm. The paper by Zhou, Duanchun & Guangxing Tan [4] Arm-Linux platform and HTTP protocol is introduced. Both of these system sends a SMS notification and also allows the user to control certain simple functions of the system through SMS. The camera video data is got through Video 4 Linux technology and the data is displayed on client monitor with the help of a webserver. Paper by Shivprasad Tavagad, Shivani Bhosale, Ajit Prakash Singh & Deepak Kumar ,2016 [5], Arm based system is proposed which makes use of Video4Linux with Planet technology to transmit data.

Work by Jayashri Bangali & Arvind Shaligram,2013 [6] proposes a system with Atmega644p Microcontroller, LDR, PIR, IR and gas sensors with Yawcam software. Images or videos data is directly saved to a server run on the PC. Images are captured and notification is sent on detecting intrusion. They also provide alerts on detecting fire or gas leakage by using other sensors in the system.

In paper by P.Vamsi Krishna & K.Venkateswarlu Reddy,2012 [7], they explain a system organized with an integrated web server, network cameras, remote control devices and clients which are connected to internet. The compressed video is stored into a video database for further access and analysis. The papers by Neha Patil, Shrikant Ambatkar & Sandeep Kakde ,2017[8] and Tasleem Mandrupkar & Manisha Kumari,Rupali Mane,2013 [9] computer vision with Open CV libraries on Raspberry Pi, a system is proposed to detect intrusion based on object recognition. It also sends a SMS notification on detecting intrusion.

The papers by P.Vigneswari, V.Indhu, R.R.Narmatha, A.Sathinisha & J.M.Subashini ,2015 [10], Dhadiwal Kalpesh Paraskumar, Abhishek Pandey, Dharmendra Kumar, Pankaj Kumar & Deepali Javale ,2014 [11], Akash V. Bhatkule, Dr. Ulhas B. Shinde & Shrinivas R. Zanwar ,2016 [12], B Ameer Suhail,D Sindhu ,Pooja kumari, Snehi Singh Rathore & Ekta Maina,2015 [13] and] Hou, Jun , Wu, Chengdong , Yuan, Zhongjia , Tan,

Jiyuan , Wang, Qiaoqiao & Zhou, Yun [14] provide systems which are suitable for home security. They make use of PIR and Infrared sensors to detect any motion or presence and trigger the system. The system then captures images and notifies the user.

System proposed in papers [10], [12] and Ewunonu Toochi, Okwe Gerald Ibe, Iwuchukwu & U.C,Uzuegbu C.J ,2014[15], sends a SMS notification with a link to access the captured image and thus provides remote monitoring. The system also provides home automation features. In contrary, paper [11] suggested an idea to allow text communication between the unknown visitor and the user. The paper [13] and [14], they propose a system which not only detects intruders, but also makes use of temperature and gas sensors to detect possible threats of fire or gas leakage.

Referred systems	**[1]**	**[2], [3], [5],[7]**	**[4], [6]**	**[8], [9], [10], [11], [12], [13], [14],[15]**
Remote-Monitoring	Yes	Yes	Yes	No
Storage efficiency	No	No	No	No
Scalable	No	No	No	No
Alerting system	Yes	No	Yes	Yes
Facial Recognition	Yes	No	No	No
Database querying	No	No	No	No

Table- 1: Overview of considered key features ofexisting systems

In the above table, we have listed the key features that are required for an efficient security system. The table shows if the respective features are present in the systems which were proposed in the previous papers. It is clearly evident that none of the existing systems provide all the key features that are necessary for providing an effective security surveillance system.

3. Proposed System

The literature survey provides a clear picture of the existing systems and the limitations that needs to be addressed. Here we discuss the

common architecture of the existing systems and then propose a system architecture with required features and compare the features.

3.1 Architecture of existing system

The system consists of a Raspberry Pi controller equipped with Pi camera, PIR sensor GSM module and Wi-Fi module as shown in Fig.1.Raspberry Pi is a card sized, inexpensive computer with good computational capabilities .The Pi camera is activated when PIR sensor senses the presence of a person. The image of the person is captured through the Pi camera. They have made use of Open CV libraries to implement real-time Computer Vision. They have implemented Local Binary Histogram algorithm, which is a classification algorithm to perform facial recognition on the captured image. If the person is not identified, then an alert is sent to the predefined user.

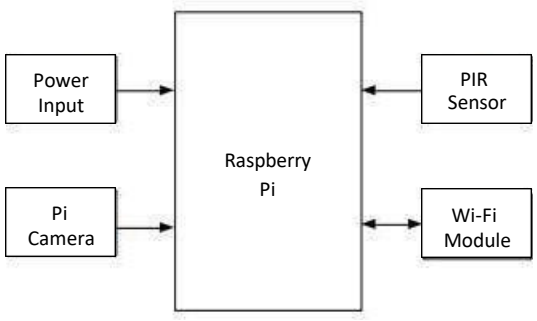

Fig-1: Architecture of Existing Systems

3.2 Need for Video Surveillance

Video surveillance plays an important role in security as it provides various advantages. The data collected can further be used as a piece of evidence and can also be used for various analytics.

- Availability- It guarantees better security 24/7 without the need to depend on security personnel.
- Real-time monitoring- This allows the user to get real-time footages of the location where the cameras areinstalled.
- Remote-monitoring- We can access the live footages from any location without the need to be physically present at the premises.

The use of video surveillance allows us to remotely monitor the security of the premises through a live video stream at any time of the day and also reduces in-person human dependency for surveillance. From this it is clear that the use of video surveillance is beneficial and hence improves the level of security at the premises.

3.3 Proposed Security Surveillance System

The proposed security surveillance system helps overcome the mentioned problems in the prevalent systems. The cameras placed at the entrances of public places near the security check points. As the security personnel scan the person for metal objects, the camera takes pictures of the person and sends it to the controller node. The controller node runs facial recognition on the subject and checks if the person as any criminal records. The positively identified subject is checked for the threat level indexed in the criminal database. If the subject is of higher threat index, then a missed call and message is sent to the pre-fixed emergency number and also flashes the image as an alert in the Real time monitoring system in the security room. If the threat index is lower, the system makes a database entry of the location where the person was detected, timestamp and pictures of the subject that were captured. Hence when required, the details of the subject are easily accessible, given the location and date.

3.4 Architecture of proposed system

The system consists of 4 components namely Camera Node, Controller Node, Frontend application and Database as shown in Fig.2 which work seamlessly. The camera/terminal node is a Raspberry Pi unit attached to a high resolution camera as shown. It takes pictures and sends it to the controller node after each fixed interval. The Controller Node acts as a central server. The controller node receives images from the camera node and processes the images. Facial recognition algorithm is implemented in the controller node as shown to detect the presence of suspects in the images received from the location under surveillance. If a threat is detected, the required database entry is made and alert system is triggered when necessary. The Frontend application is a user friendly GUI which enables us to view live feed and also make various querying operations on the criminal database.

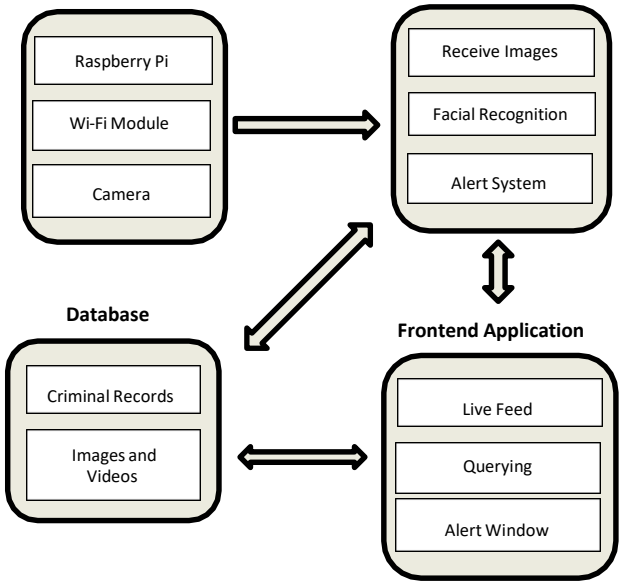

Fig-2: Proposed System Architecture

3.5 Benefits of proposed system

The proposed system is designed to provide a cutting-edge security system which addresses the limitations of the existing systems and also provides much more advantages and functionalities.

- Real-Time Monitoring: The system recognizes the criminals in real time even though the security staff at the facility are unaware. It provides alert almost instantaneously when a threat is detected and hence reduces the response time. The system is not dependent on the operator for efficient working.

- Alerting System: The system sends out alert messages and calls to the emergency numbers when there is a threat. This can give us a big boost in the security of public places.

- Database Querying: The system maintains a record of all the criminals who were spotted along with the timestamp and the location where they were spotted. This data can be crucial in investigations for checking the presence of a criminal in a certain location on a specific date and time. This saves the time of going through hundreds of hours of CCTV footages.

- Efficient Memory Utilization: The system stores only the images in which the threat was detected. Since we are saving images instead of video clips, the memory consumed will be very less compared to regular systems.

- Scalable: The system may be scaled to a larger network with larger coverage by using more camera nodes and increasing the computational capacity of Controller node.

Conclusion

The Security surveillance system significantly contribute to situation awareness and reacts accordingly. Such systems transform ordinary security system to data and information acquiring systems. Real-time analysis provides the systems the ability to react in real-time and hence reduce response time. The proposed system provides real time monitoring and alerting system which allows for quicker response time. It not only utilizes memory efficiently, but also makes it easily accessible when required. The system can be implemented either as a standalone system or as a network of cameras. The system can be further improvised to provide suspect tracking to continuously have a visual on the suspect. This system can also be added as an extension to the existing security cameras and is also low cost which makes it the most functional and affordable system.

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