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Article in *IJITEE (International Journal of Information Technology and Electrical Engineering)* · August 2019

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Smart Surveillance with Smart Doorbell

R.V. S.Lalitha, Kayiram Kavitha, N V Krishna Rao, G. Rama Mounika, V. Sandhya

Abstract: Home Security has become an important concept in the modern era. Our Smart Doorbell can alert the resident automatically with an alarm when there is a visitor at the door. As we witness a huge transformation in technology, the world is emerging smart in every aspect. These smart devices are invading into our lives, while offering the required privacy. The Internet-of-Things (IoT) devices remotely monitor objects connected by Internet. In this paper, we have developed a smart doorbell that can alert the residents when it detects human presence and triggers the doorbell to notify its residents and also can send the data to the cloud or any storage devices spontaneously. The smart doorbell developed will have PIR or ultrasonic (passive infrared) sensor that detects the presence of humans over a given distance and can capture the picture of the object near the door. Further, this picture is e-mailed to the registered e-mail and also pushed to cloud as well offering the required privacy.

Index Terms: Home security, IoT, Raspberry Pi, Smart Doorbell and Wireless Communication.

I. INTRODUCTION

With the evolution of Internet, Wireless Sensor Network Technologies, IoT [1] has evolved as a concept to enable communication between heterogeneous devices (things or objects like sensors, actuators, RFID tags etc.). These IoT devices operate without a screen or user interface in a resource constrained environment usually dedicated to a single task. There are many constraints in IoT like battery power, memory space, and security as these devices are connected instantly with anything, anyplace and anytime. In contrast to traditional internet the IoT device is intelligently gathering, analyzing the human behavior [2]. The high connectivity of these intelligent objects leads to serious security issues. IoT is formed with network of sensor objects that can communicate via Internet involving activities from the external environment. Any communicating device with a unique identification can be part of the network. In future, IoT-based technology will influence the activities in daily life. Many IoT applications can be found in many industrial, scientific, agricultural equipment, transportation systems etc. According to Gartner report [3] the number of smart phones and tablets will reach up to 7.3 billion units by 2020. As a tremendous growth is observed in IoT, the communication network has challenges in terms of huge amount of data,

processing power with energy consumption, security threats, and efficiency of cryptographic algorithms. Home Security has become an important concept in the modern era. The home security system provides continuous monitoring with CCTV surveillance. As we witness a huge transformation in technology, the world is emerging smart in every aspect. These smart devices are invading into our lives, while offering the required privacy. These Internet-of-Things (IoT) devices remotely monitor objects connected by Internet. We are living in a digital world where every activity needs to be recorded through Closed Circuit Television (CCTV) surveillance cameras. It is neither possible to continuously monitor the CCTV footage nor inspects the door every minute. Also, there is a need for monitoring our premises; we need an alert immediately when a stranger is seen in-front of the door. Our Smart Doorbell can alert the resident automatically with an alarm when there is a visitor at the door. In this paper we have developed an IoT based Smart doorbell to can alert the resident automatically with an alarm when there is a visitor at the door. The smart doorbell is connected to the internet and can capture the visitor at the door and transfer that information to the cloud or any storage devices spontaneously. In case of any break into the house, we have the evidence of crime from the video footage available[17]. Such systems only serve as monitoring system. In case of any unforeseen event this camera footage can be helpful in providing eye witness for post event analysis. The system can alert the home owner about the visitor waiting at the door. This surveillance is done 24*7, so the system requires huge memory to store the video data. Obvious reasons are that these devices are wireless networks and also due to continuous capture of video leads to higher memory requirements in the device. The Raspberry Pi based applications for motion detection finds ease in developing intelligent based communications. The Smart Doorbell is helpful in remote monitoring the premises of a house even from office as now-a-days family members are out for most of the times and feel insecure about their home. This IoT based system provides a secure and reliable solution. Prior to this, various systems came into existence like pi camera and GSM module which included various incompatibilities i.e., delay in alerting the user, functioning with systems of heavy equipment which are not portable. In this Paper, we devise a method to maintain such networks at a very low price. Our IoT based application can monitor the home premises and alerts if any object is detected at doorstep. This security system can be placed at the main door of home or office and can be monitored from anywhere in the world via internet. This automated system proves to be useful for people in providing security, comfort and ease in access. In addition,

Revised Manuscript Received on June 05, 2019

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there is no need for continuous video surveillance recorded 24*7 to be monitored with human eye or playback later to find out who was roaming around the home premises. Rather the system sends an alert message the moment it identifies any object around the premises along with the image of the object as attachment to the message. Upon looking at the message the owner reacts positively if he is a known person or alerts if he is a stranger. Now, we present the related work in the Second Section. The implementation details are presented in the Third Section along with detailed procedure about the application development using Raspberry Pi. Finally, we present the conclusion in Section Four.

II. RELATED WORK

Our Literature review suggests the following developments in the home security devices. Bluetooth, ZigBee, 802.11, and wireless USB are widely used technologies in the field of wireless networks [4]. Internet of Things (IoT) based applications are very easy to deploy. Many video surveillance applications are developed and monitored remotely using mobiles as pointed in [5]. There are some applications related to PIR sensor for deploying them in critical areas [6]. Many home security applications for short range use Bluetooth as it is efficient and well suited [7]. The application like Intelligent Home Systems with IoT [8] is developed with latest technology like Raspberry Pi [9]. The CCTV became a powerful tool in investigating crime. The data available from CCTV may not be so clear, as it covers the entire crime scene in parts. So, mechanisms need to be developed to improve evidence for police, investigators in crime analysis. The authors in [10] developed a Multilevel Home Security System (MHSS) using CCTV. Universal Asynchronous Receiver/Transmitter is used to interface with a computer and to enable communication between the sensor nodes. A Graphic User Interface (GUI) is developed for remote monitoring. The project in [11] designed an IoT based home security and automation. This is a smart phone application for intruder detection. If the intruder is detected by motion sensors, his image will be sent over mail to police station. In the prototype, PIR sensors are installed around the main door. As soon as any unexpected motion is detected, alarm will be ON and SMS will be sent. After particular time interval, they will be off automatically. As soon as image is detected at entrance, owner receives a video call from system. Also owner can put on lights, fan, A/C remotely by pressing 3 for lights, 4 for fans etc. on the mobile phone. The work in [12] developed a Neighborhood Watch Security System (NWSS) based on house address. The functionality is limited to only capturing images. Java Script and PHP are used to develop application. The system is implemented using Arduino and Passive Infrared Sensor (PIR). The authors in [13,15] designed smart home automation using IoT for helping the disabled and handicapped people using Arduino, temperature sensor and humidity sensor. The authors in [14] proposed home security system to monitor the window and door locks using CCTV along with external light monitoring etc. In this Section we have given the various works related to home security using some of the latest technologies. Smart phone based robotic application is developed using Android for controlling environment. Some home based applications are developed using Java and some are developed using mobiles. But, so far none have proposed feasible home security system that is affordable by many domestic users.

III. IMPLEMENTATION DETAILS

This IoT based application is devised to perform video surveillance of home premises and alert in case of any object detected. This system will detect the presence of person and alerts the user by sending an e-mail with the image of object as attachment. Instead of the CCTV set-up we have used PIR Sensor and a web camera. Whenever an object is found within the range of PIR sensor, web camera captures the image through Raspberry Pi and sends commands to click the picture and save it. When the system detects the presence of an object, the camera captures it and sends it through FTP server of Raspberry Pi by an e-mail. In addition an SMS alert is generated when the object presence is detected and is sent to the corresponding user address through an application called "pushetta". In this application PIR sensor is used to detect the presence of a person or any object and web Camera used to capture the detected presence. When this detection takes place in the range of PIR sensor, it triggers the Camera through Raspberry Pi which in turn sends commands to camera to click the picture and save it. Whenever anyone comes in range of PIR sensor then the emitted infrared radiations of the object are detected as a motion within the respective area. Web Camera is used to capture the images when the presence is detected and then the Sensor triggers Camera to capture the image and is sent to respective mail address. It creates a message alert through "Pushetta" which is an application used to send broadcast messages to group of subscribers at a time. It is a simple and reliable way of communication instantly with less maintenance cost. Raspberry Pi creates a message and a mail to send it to the defined user address. The mail contains a message and image of person as attachment along with date and time. Initially an object presence is detected and the buzzer vibrates [16]. A message alert is generated through an application gateway called "Pushetta" and web camera Captures the image and it is sent as attachment to the defined mail address as shown through a circuit diagram in Figure 1. We present the application development as following series of steps in a desktop or laptop with the internet connectivity.

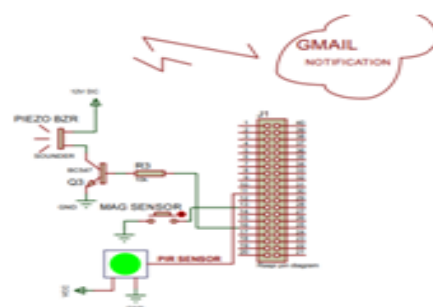


Fig.1.Circuit diagram of the Smart Doorbell

Step 1: Setting up Raspberry Pi

The Raspberry Pi needs to be installed and SD card needs to be preloaded with Raspbian Operating System. The micro USB, SD card along with HDMI cable are to be attached correspondingly and connect them to the power supply as shown in Figure 2.





Fig.2. Setting up Raspberry Pi

Step 2: Installing Virtual Network Computing (VNC) client
Download VNC client and install it with the corresponding IP address of Raspberry Pi to operate pi through the desktop. Along with Secure Socket Host (SSH), Pi could be situated anywhere with the following commands in the console.
\$ sudo apt-get update
\$ sudo apt-get update install tightvncserver
Step 3: Running VNC Server
After we install the Client, we proceed with the VNC server installation. The system works remotely through GUI display of pi. The hardware configurations are as shown below in Figure 3.

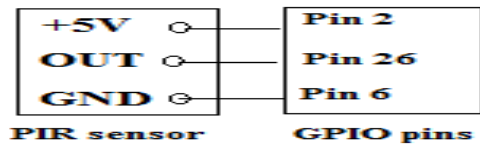


Fig.3. PIR Sensor and GPIO pin configuration

Step 4: Object Detection

We use PIR sensor for detecting the object presence when any object comes in range of the sensor. Fig.4 shows the PIR Sensor. It can sense in a range of 20ft. and Figure 5 shows how it senses an object.



Fig.4. PIR Sensor

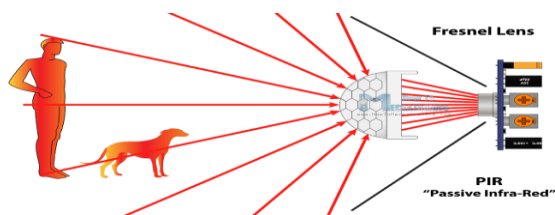


Fig.5. Sensing using PIR

Step 5: Message communication using Pushetta

We receive a message as an alert immediately whenever an object is detected. For this purpose, we use an application called Pushetta as a message gateway for alerting the user immediately without any delay. Fig. 6 illustrates about the message sending operation to phone using Pushetta application.

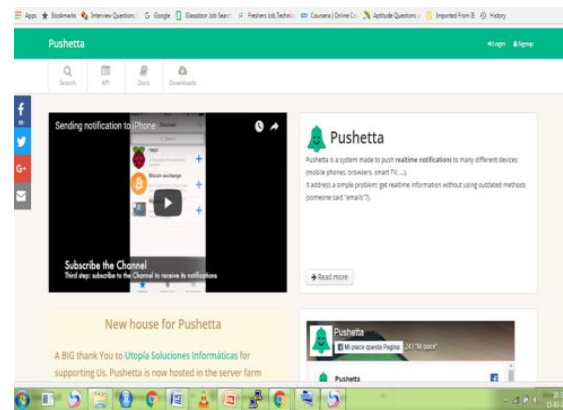


Fig.6. Message communication using Pushetta.

Step 6: Creating channels

The first step in pushetta is registering a channel. The channel is to be created for sending and receiving information from subscribed users. It provides unique authentication key address. Fig.7. depicts channel selection for communication and Fig.8. shows the alert sending activity from the application.

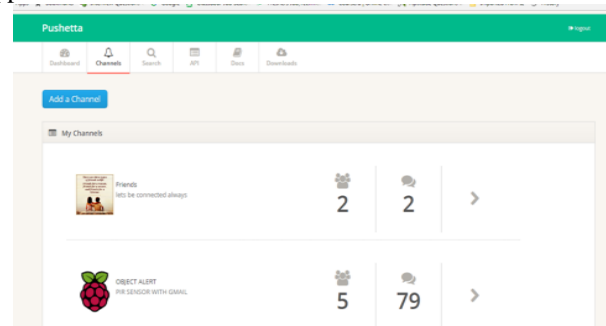


Fig.7. Selecting the required channel



Fig.8. Alert through pushetta when object is detected

Step 7: Capturing image through Web camera and sending alert

As soon as the message is sent, a mail is generated correspondingly with an attachment of Image captured by the web camera. We use web camera for image capturing. Web camera provides HD video calling on most of the instant messaging applications. It provides clear live stream data, ex. Skype, Yahoo, Facebook messenger etc. The captured image is sent along with a pre written alert of user. The application takes care of security to view the mail address of home owner to get access of viewing the object detected.

Fig.9. shows the notifications received through email.

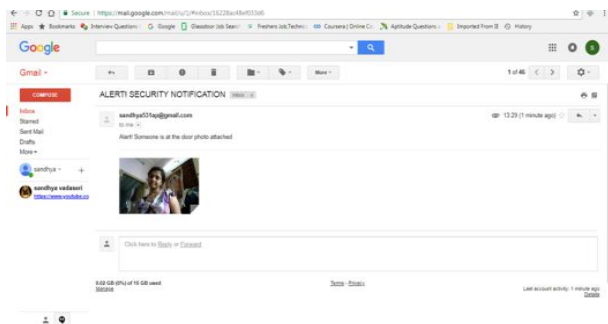


Fig.9. Notifications received through email.

IV. CONCLUSION

We have presented the implications of Smart Doorbell based on IoT. This system can perform remote surveillance for home premises effectively. The information coming from the smart security system can be viewed from mobile phones, tablets, desktops/laptops etc. for taking instant decisions. Whenever the system detects an object, it alerts the user with an alarm and also by sending an e-mail with the image of the object as attachment to the mail. As future work, we have plans to identify the object too with some training data given to the system so that the system itself can identify the object before sending the alert.

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