Home Security System

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Abstract

One of the most prominent applications of Internet of Things is in the Security Sector. IoT is a remarkably mind blowing technology which uses the natural environment as its input. And later gives suitable outputs to modify the physical environment. It makes use of internet to monitor, alter and control devices. These devices can be connected to the internet. Sensors are the key devices that act as a gateway between the physical and virtual world. Thus by the click of a button the environment can change according to the user's needs. By using IoT the user can control more than one device simultaneously. This is done using a comfortable GUI over the internet. Home security is a very effective application of IoT. It is important to arrive at a unique low cost solution to handle and alter the surrounding environment according to the needs of man. This also includes ensuring the safety of one's abode. Therefore this paper highlights the focal point in the development process of the Home Security System. This security system assists in presence detection, identification and authentication. This system makes use of arduino. The proposed system makes use of USB Webcam to click pictures of any person that comes in front of the door and compares the image with the one already present in the database. The proposed system uses IR sensor to sense the presence of a body in front of the camera.

Keywords: Internet of Things, Arduino, Home Security, Camera, IR Sensor, App.

INTRODUCTION

All the home security systems work on the same basic principle of securing any entry point. It can be anything like doors or windows. But, what is a security system?

A home security system is a secured system of interworking components and devices using the best technology and boards and a network of integrated electronic devices. All of these devices work together along with a control panel to safeguard one's home from potential home intruders. This panel is the central control panel.

A typical home security system includes a control panel- which is the primary controller of a home's security system door. Sensors-usually IR, motion sensors, thermal are used for both interior and exterior needs. Wired and wireless security cameras are used to detect people and high decibel alarms are used to inform the presence of an intruder. Message alerts and updates are also sent.

The interconnection of physical components and other electronic devices, software sensors and actuators that enables the objects to collect and exchange data is known to be Internet of Things. It is an important topic in technological industry. IoT is the major platform in the field of Home Security, and is believed to have a large scope in the future. Today, Wi-Fi and 4G Internet is predominantly used in the field of networking.

The best way to implement home security is through IoT. IoT or Internet Things is referred to a variety of networks connected to the physical world. They can also communicate and exchange information and data just by the click of a button. Human intervention is not at all needed. Initially IoT was the full form of 'Infrastructure of Information Society', as it collects information from surroundings like heat, animals, vehicles, birds, home appliances etc. Therefore, any of the objects in the real world can be used as an input for IoT devices.

Thus these objects can be provided with specific IP addresses. Then they can transfer data over network by embedding hardware and electronic devices like sensors, applications, software, networking gear, hardware, wifi modules, input and output ports etc. [1]

OVERVIEW
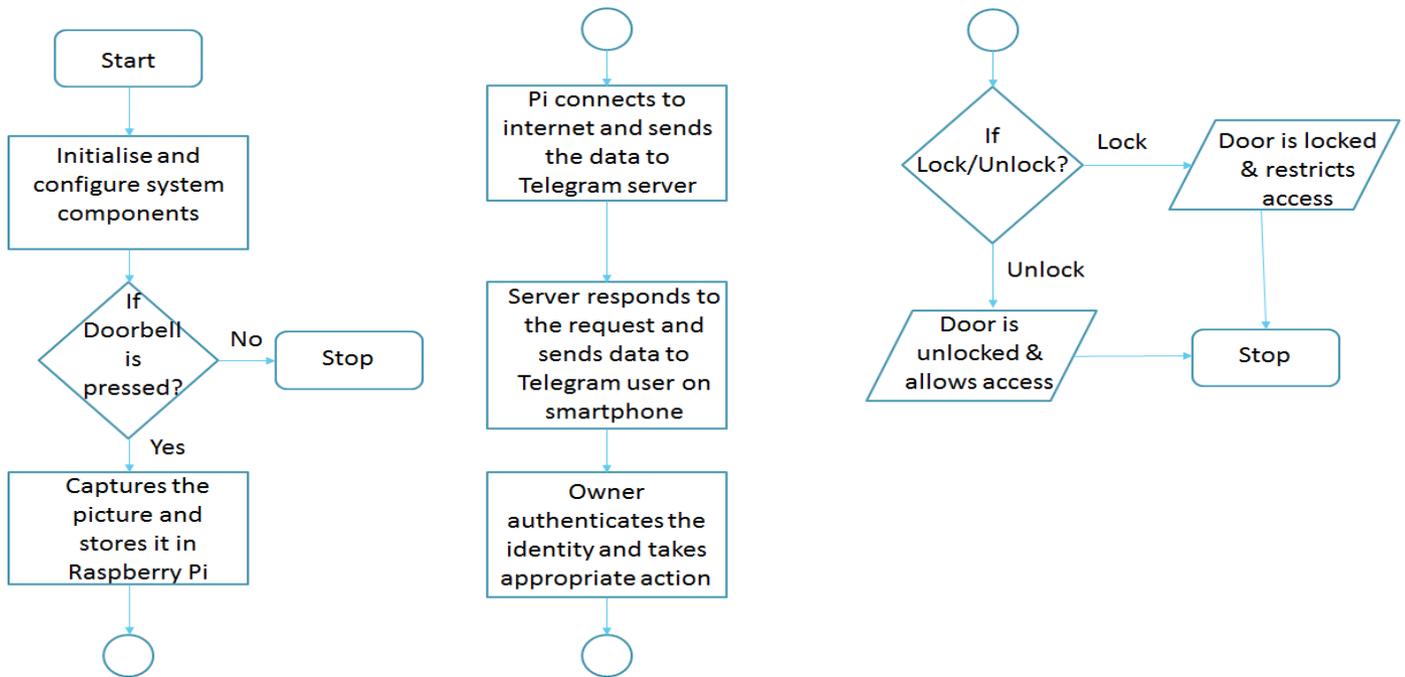
Figure 1. Flowchart for existing system

A.   Exixting System

This security system assists in presence detection, identification and authentication. It aims at providing a low-power, cost effective and IoT based home security system which assists in presence detection, identification and authentication of stranger. The existing solution uses USB Webcam as an image capturing unit, telegram bot, Electric Door Strike as an actuator. It has an amazing feature that build solutions which is compatible with Raspberry Pi.[2]

When a visitor approaches the door and presses the doorbell, a signal is fed in the Raspberry Pi. If the visitor doesn't press the doorbell, the PIR sensor detects the presence of the visitor and activates the webcam to take picture of the visitor. Now the PIR connects to the internet and sends data to the telegram server.

After the data or the captured image is sent to the owner or user, he/she authenticates the identity of the visitor and takes the necessary actions. If the user dives 'unlock' command Pi runs a python code to release the trigger of the relay and unlocks the door.

B. Proposed System

The proposed system is the better and more efficient version of the existing system. This system is more pocket friendly and easy to use. In our system, when a visitor approaches a home an analog signal is fed to arduino. Arduino being more easy to use and understand makes the whole device more efficient. The proposed system doesn't incorporate the use of

a doorbell. Whenever, the PIR sensor detects the presence of someone and it sends an analog signal to arduino which triggers the webcam to take the picture of visitor. An algorithm is deployed on Arduino to process the data. The picture captured is then compared with the pictures of each member of the family which is to be stored in the database before hand. And if the captured picture doesn't match with the picture of any of the family member, then only a notification is send to the user or the owner. The notification is send through telegram as a text message. . In the proposed system the notification or an alert is sent only when there is an unknown person at the door instead of sending the notification for every person that comes across the door. It makes this system more efficient and reliable as the comparison is done by a computer automated system thus reducing the chances of an error. The arduino connects to the internet and then to the telegram server.

C. Ease of Use

- **Used for better security in houses.**
  Our proposed system can be an asset in home security industry. It can be used for better security of houses. The app developed is easy to use and user friendly.

- **To prevent any theft or intrusion in the house.**

  Our system can be incorporated for preventing our houses from theft and foreign intrusions. Its really

important to secure our houses from foreign intrusions and our paper helps to do the same.

- **To authenticate the identity of every visitor.**
  The system proposed in our paper authenticates the identity of each and every visitor that comes at the door. This makes the whole system more efficient and reliable.
- **For paving ways for better and improved home security system.**
  Our proposed system paves way for better and improved home system. It proves to be more efficient than any existing home security system.

DESIGN CONCEPT

This paper proposes a better and efficient home security system. The IR sensor we are using will detect the obstruction in its path caused by thermal waves that is the body heat emitted from anybody. The signal it sends will return to the IR sensor and thus it can detect the presence of a person. The camera present will capture an image and send it to the app. Thus, the image will be compared with those of the pictures of each family member. If it is a family member no notification will be sent and the user can go and open the door.

Thus in the existing system the notifications and alerts are sent every time a person tries to enter and this will reduce the reason it was created in the first place. On the contrary, after comparing if it is not a family member then the alerts and notifications are sent to the mobile phone of the owner along with a picture of the miscreant. In the proposed system the notification or an alert is sent only when there is an unknown person at the door instead of sending the notification for every person that comes across the door. It makes this system more efficient and reliable as the comparison is done by a computer automated system thus reducing the chances of an error. Since the picture of the intruder is sent to the user this will help the cops hunt down the burglar faster. The owner can notify to the police the same as well.

A. Arduino Uno

Arduino is an open source board. It plans and produce microcontroller packs which helps in constructing programmed objects and intelligent devices which can detect and control changes in the real world. The modification of the arduino board and its features was initiated at the Interaction Design Institute in Ivrea, Italy.[1] It is a microcontroller board based on the ATmega328P . This is incorporated with 14 digital input/output pins, 6 analog inputs, 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, a wi-fi module and a reset button. This has all the necessary devices that support and execute the microcontroller data. Just by connecting it to the computer with a USB cable or by giving it a power supply from AC to DC adapter you can charge it. Another easy way to get it started is by using a battery.

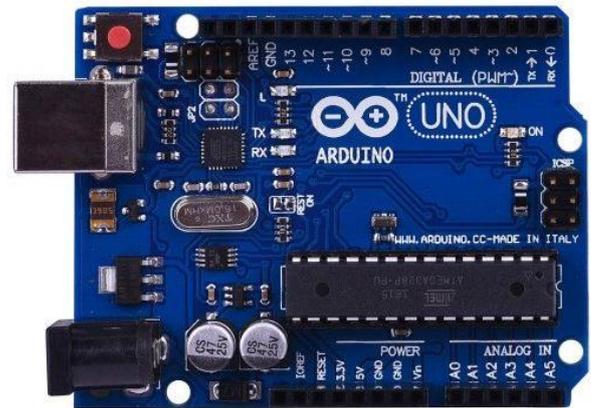Arduino Uno is shown in figure 2.

Figure 2. Arduino Uno

B. PIR Sensor

PIR sensor stands for Passive Infrared Sensor. It is an electronic sensor. It measures all the infrared light that is radiated from all the objects that it is to be sensing. This sensor is mostly used for motion detection or movement detection. The motion detectors based on the PIR sensors are the most go to devices for this purpose.

When an object has high temperature more than that of the absolute zero, it emits heat. These heat radiations are in the form of waves. These waves are called as infrared waves. Such radiations are not visible to the naked human eye. This is because it emits radiation waves of the range 700 nanometer(nm) to 1 millimeter(mm). This is similar to a frequency range of 430 THz to 300 GHz. While humans can see light waves ranging from 390 nanometer(nm) to 700 nanometer(nm). This in terms of frequency ranges from 430 THz to 770 THz. Hence the detectors are used to sense the infrared radiation waves.

The "P" in PIR stands for passive. This is because they do not generate energy or give out energy for detection purposes alone. They wholly work on the detection of infrared light waves which are emitted or in some cases even reflected from various objects. Thus, they don't detect or measure any heat given out by objects.
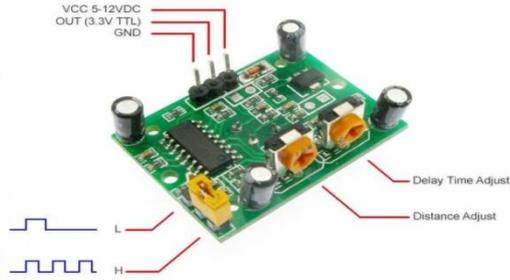

Figure 3. PIR sensor

Figure 4. PIR sensor

C. Wifi Module

Then arduino uno wifi is an integrated wifi device or module. This is a board smaller than the arduino itself. It is based on the ATMega328P along with ESP8266. This is also self contained SoC. The TCP and Ip protocols can give you easy access to any WiFi network present in your vicinity. The arduino UNO WiFi has excellent support for OTA programming. The Arduino UNO wifi is programmed using Arduino IDE that is the Arduino Integrated Development Environment. This is common to all the boards that are halting and running both online and offline.[3]
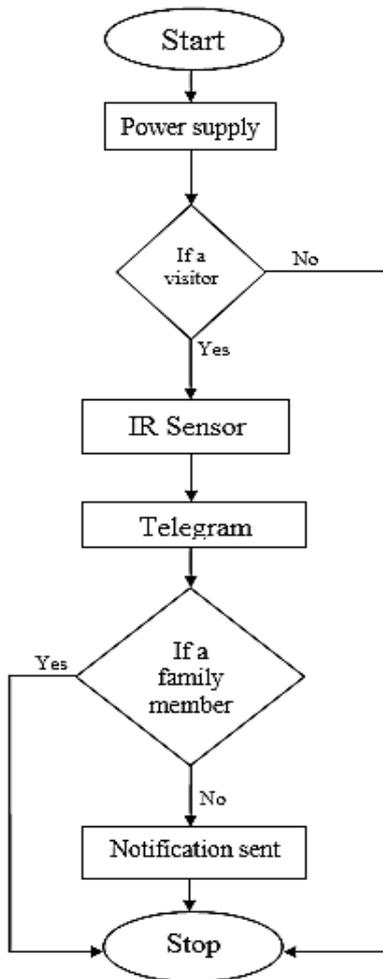

Figure 5. System Architecture for the proposed system

D. Equations and algorithms

1. AdaBoost Algorithm

We can use an algorithm used for face recognition that is the AdaBoost and support vector machines (SVMs) among others, two of the very popular and conceptually similar machine learning tools for good image processing. Viola and Jones' benefaction and contribution for the assembly of AdaBoost machine is remarkably accepted worldwide. They had three major contributions that include the integral images, combining features to find faces in the process of detection, and use of a cascaded decision process when searching for particular faces in each image.

Viola and Jones' machine takes in a square region of size which can be equal to 24×24 pixels or

36×36 or 64×64 as input and determines whether the region is a face or is not a face depending on the wrinkles, creases, angles, distances between various facial features.

2. PCA Algorithm for face recognition:

PCA algoritm has two modules pre-processing module and verification module.

a) Pre-processing module:

The pupose of the pre-processing module is to reduce or eliminate the variations of the face due the illumination or the lighting. It normalizes and enhances the image. In this module The coloured image of the person is converted into gray scale or in black and white image. And then the threshold value of the images are saved.

b) Verification module:

The verification module is used to identify who the user is or to authenticate the identity of the user. The input of the verification module is the image derived from two sources that is the camera and the database. The identification involves comparing of the biometric information against the one stored in the database. The image are again sent for the respective algorithm and the score is generated. There is a particular score obtained. It is then compared with the value that is minimum. This threshold value is later stored in the database for further use.

PCA for face recognition is built on the foundation of the information theory approach. This takes out the important and necessary information and data from the image received. It then further encodes the given data or piece of information. It then recognizes the topological space of the given image. This is done with accurate skill and efficiency. The space of the image is spanned by the training face image information which is then used to reduce the correlation of the pixel values. This image that is obtained is the classical representation. This is extracted by projecting it to the coordinate system. This system is set by components that hold principal reference.

The calculation of facial images into the main component subspace attains data compression, decorrelation and dimensionality depletion to make the process of decision making an easy task. The main component of eigenvectors of the covariance matrix of a group of facial images is to pursue it by getting an image as nothing but a vector. This vector should be in large dimensional space.

Therefore, even if makeup is put on the persons face the distance between eyes and nose still remains the same. Therefore one can detect the person's face without any tardiness.[4]

E. Figures and Tables

Table 1. Comparison between proposed and existing system

PARAMETER	EXISTING SYSTEM	PROPOSED SYSTEM
Device	Raspberry Pi 0	Arduino Uno
Type	General purpose computer	Microcontroller
Usage	Complicated	Easy
Cost	Expensive	Cheap
Clock speed	1GHz	16 MHz
Power supply	5V continuously	Lesser
Coding	Tough	Simple
Image Authentication	No	Yes
Frequency of notifications	Whenever there is a visitor at the door a notification is sent.	Notification is sent only when an unknown member of the family is there.

ACKNOWLEDGEMENT

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