

Intrusion Detection through Image Processing and getting notified via SMS and Image

Prof. Rakhi Bhardwaj¹, Kiran Bera², Onkar Jadhav³, Prachi Gaikwad⁴, Tamanna Gupta⁵

¹Professor, Dept. of Computer Engineering, Trinity College of Engineering and Research, Maharashtra, India

^{2,3,4,5}Student, Trinity College of Engineering and Research, Maharashtra, India

Abstract - Probably, the most invaluable resource of a city is its residents and their belongings. Smart intrusion detection system is the contemporary urban concept which is absolutely necessary for residents of a system to have a quality life. Over the past decade, the use of the smart home intrusion technology along with the concerning security has been increased due to a variety of crimes and intrusion. Using Internet of Things, Image processing and Mobile Computing, our project proposes security system for homes. In this system, we are concentrating on providing immediate notification to the users and Image Processing techniques for intruder detection. Also, face recognition techniques will be used for detecting the intruders face.

This review paper is written with the goal of implementing smart home intrusion detection systems for residents of the country by collecting all the admissible research. The goal of this paper is to understand the current research topics, challenges and future directions from a technical point of view.

Key Words: Intrusion, Notification, Image Processing, Face recognition

1. INTRODUCTION

The Earth is passing through a purplish patch of technology, where there is increasing demand of machinery and intelligence behind it. Every day there is been at least one new invention from people round the globe. This is making people easier to live life due to which there is been increasing demand of engineering science. In this 21st Century humans are surrounded with technology as they are the constituent of our day to day life cycle. With this we are always focusing on the safety and security for ourselves and our earned valuables respectively.

For own safety people have been spending money because that is the first thing. Then for our valuables which we retain in our places, always want it to be secure. For this there are security systems implemented like CCTV camera for surveillance which has continuous streaming for which you need to maintain an additional person for video surveillance as it is performed in opulent societies. This takes our unwanted time by continuously keeping watch along the sieve.

Our basic idea is to develop a system which will detect and capture the details of the intruder in the premises via an

infrared camera and IR sensor and send notification to the user. It should immediately notify the user about the intrusion along with the image captured. The system will compare the image with the datasets provided in the database. If the image matches the datasets then it should notify specifying the name of the intruder along with captured image. If not, the image should be sent. We will be using Raspberry Pi 3B+ kit for the system through which we would be operating our camera and sensors. A GSM module will be attached to it which will help to get the update in case of internet connection failure. This is important to get the instant update through which we can take necessary action about the intrusion before loss. The system would be connected to database which will store and process the image and forward it to the application. An android application will be deployed which will receive the captured image and push notification. The main feature will be the image processing in which we will be using LBPT algorithm.

2. PROPOSED SYSTEM

2.1. System architecture and implementation

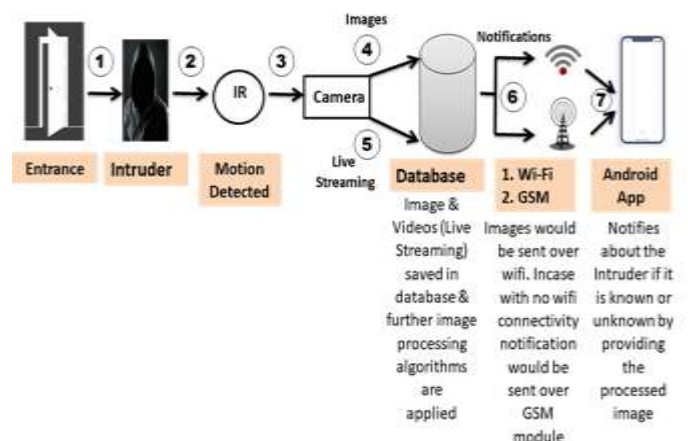


Fig -1: Proposed System Architecture

In this system, we are concentrating on providing immediate notification to the users about the intrusion. Image Processing techniques will be used for intrusion detection. Face detection and recognition will also be done in this project. Fig. 1 presents the block diagram of the proposed system architecture

When a motion is detected by an IR sensor, the camera will start its work. For detection of an intruder, a NoIR camera V2 is used (with dual channels) which is an infrared camera to ensure image detection even in dreary surroundings. Through one channel, the image captured will be crosschecked with the database. The database will be provided with a few datasets. Further, the image will be preserved in the database if the interloper is new and sent along with the notification. The notification will be sent over the internet or GSM to user application. which is its primary work. The other channel of the camera will provide live streaming. The captured image will be saved in the database. The microcontroller will control appropriate appliance.

LBP Algorithm: It was first described in 1994 (LBP) and has since been found to be a powerful feature for texture classification. It has further been determined that when LBP is combined with histograms of oriented gradients (HOG) descriptor, it improves the detection performance considerably on some datasets.

Using the LBP combined with histograms we can represent the face images with a simple data vector.

Steps of the Algorithm:

- Parameters: the LBPH uses 4 parameters:
 - Radius: the radius is used to build the circular local binary pattern and represents the radius around the central pixel. It is usually set to 1.
 - Neighbors: the number of sample points to build the circular local binary pattern. Keep in mind: the more sample points you include, the higher the computational cost. It is usually set to 8.
 - Grid X: the number of cells in the horizontal direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.
 - Grid Y: the number of cells in the vertical direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.Don't worry about the parameters right now, you will understand them after reading the next steps.
- Training the Algorithm: First, we need to train the algorithm. To do so, we need to use a dataset with the facial images of the people we want to recognize. We need to also set an ID (it may be a number or the name of the person) for each image, so the algorithm will use this information to recognize an input image and give you an output. Images of the same person must have the same ID. With the training set already constructed, let's see the LBPH computational steps.

3. Applying the LBP operation: The first computational step of the LBPH is to create an intermediate image that describes the original image in a better way, by highlighting the facial characteristics. To do so, the algorithm uses a concept of a sliding window, based on the parameter's radius and neighbors.

2.2. Development of android application

After the internet part would be developed and the methods worked properly, we would develop an android application for facilitating the internet part.

The android application would be developed using Android Studio for this project. Through this application, the user will get the image through notification. When an intruder is detected, the image would be sent on the application.

3. HARDWARE INTERFACES

1. Camera -NoIR camera V2 compatible with raspberry pi which is 8 mega pixels
2. Microcontroller-Raspberry Pi 3 B+
3. GSM Module-SIM800L Development Board
4. IR Sensor

4. CHALLENGES

A number of systems are deployed for intrusion detection, some work with sensors and some with cameras while others have notification. Some systems have live streaming but not notification system. In some cases, the image captured by the cameras might also be blur and some might not be able to capture proper images in the dreary environments. A few systems may not be able to send notifications due to weak connection.

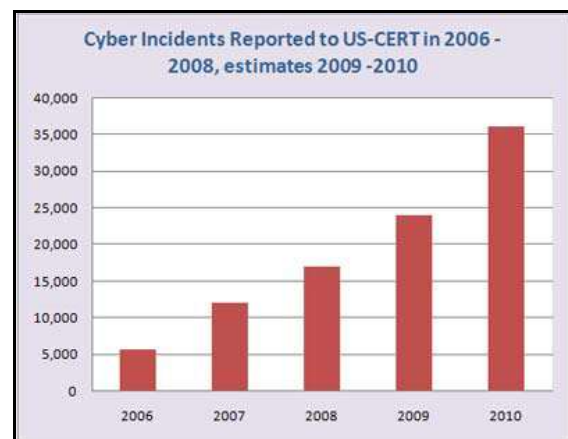


Chart -1: Number of incidents reported

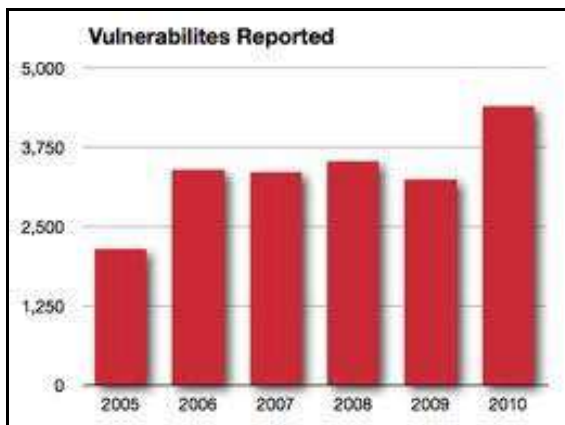


Chart -2: Vulnerabilities reported

5. CURRENT RESEARCH

It has been observed that many Intrusion Detection systems are being deployed with limitations like a few might have a feature which is missing in the other. A system which overcomes all the limitation of an intrusion detection system has not been implemented. [13]. Some of the terms should be understood to develop such a system:

A. Image Processing

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two-dimensional signals while applying already set signal processing methods to them.

Image processing basically includes the following three steps.

1. Importing the image by digital photography.
2. Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.
3. Output is the last stage in which result can be altered image or report that is based on image analysis.

The purpose of image processing is divided into 5 groups. They are:

1. Visualization - Observe the objects that are not visible.
2. Image sharpening and restoration - To create a better image.
3. Image retrieval - Seek for the image of interest.
4. Measurement of pattern - Measures various objects in

an image.

5. Image Recognition – Distinguish the objects in an image.

B. Face Recognition

An IR image of the human face presents its unique heat-signature and can be used for recognition. The characteristics of IR images maintain advantages over visible light images, and can be used to improve algorithms of human face recognition in several aspects. IR images are obviously invariant under extreme lighting conditions (including complete darkness). IR face images are less affected by changes of pose or facial expression and enable a simple method for detection of facial features. There are several aspects of face recognition in IR images. First, we compare the effect of varying environment conditions over IR and visible light images through a case study. Finally, we propose a method for automatic face recognition in IR images, through which we use a preprocessing algorithm for detecting facial elements, and show the applicability of commonly used face recognition methods in the visible light domain. [14]

6. METHODOLOGIES

Mathematical Model

$S = \{s, e, i, o, \text{functions}, DD, NDD, \text{Success}, \text{Failure}\}$

Where,

S = System

s = initial state = Capture image

e = end state = Act according to input and update database i

= Input = Captured image

o = output = Notification to user

functions= {f1, f2, f3, f4}

f1 = Login by the user

f2 = Give captured image to database for processing

f3 = Send notification

f4 = Update database Deterministic data = same output from a given condition and return the same result every time

Non-deterministic data = result will vary every time for given input

NP Complete: Set of I/O is variable

Success condition = Correct notification

Failure condition = Incorrect notification

Depending on our mathematical model, our project is NP Complete.

7. FUTURE WORK

As an extension to our project, we propose a generic IoT framework and use cloud computing infrastructure for connecting and managing remote devices. In addition, we also plan to productize proposed home automation solution so that a greater number of people can use IoT in a smart environment.

8. RESULT



Image 1: Notification through text message

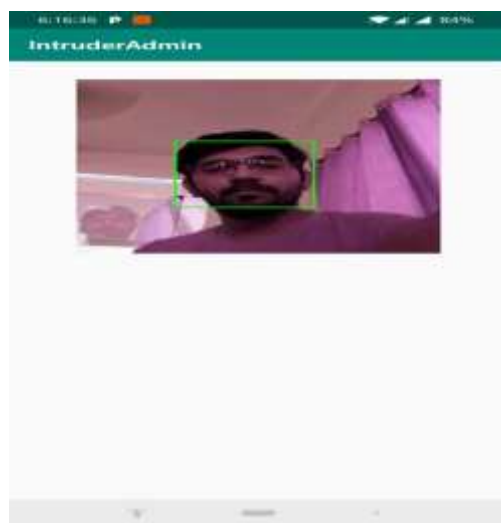


Image 2: Notification on the Android Application

9. CONCLUSIONS

Our system would instantly notify the user about the in-house scenario. The system incorporates security using IoT (Internet of Things). The security module successfully sends notifications upon detecting intruder using wireless techniques where owner further can take necessary actions thus enhance convenience and comfort, and enjoy completely security.

As an extension to our project, we propose a generic IoT framework for connecting and managing remote devices. In addition, we also plan to productize proposed home automation solution so that a greater number of people can use IoT in a smart environment.

10. REFERENCES

- [1] "HIVE: Home Automation System for Intrusion Detection" A. Daramas', S. Pattarakitsophon², K. Eiumtraku¹³, T. Tantidham, N. Tamkittikhun, Faculty of Information and Communication Technology, Mahidol University Nakhonpathom, Thailand, April,2016
- [2] Sagar R, Sharmila S, Suma B "Smart Home Intruder Detection System", Siddaganga Institute of Technology, Tumakuru, India, April 2017.
- [3] Haker Mohsin Saber, Nawzad Kamaran Al-Salihi "IoT: Secured and Automated House", April,2017.
- [4] Syed Ali Imran Quadri, P.Sathish "IoT Based Home Automation and Surveillance System", Chaitanya Bharathi Institute of Technology, Gandipet, Hyderabad, India, April 2017.
- [5] GV Balakrishna, B. Santhosh Kumar," Smart intruder detection using video surveillance," International Journal Of Science Technology and Management, vol no.5, Issue no.2, February 2016.
- [6] Md. Yousuf Hossain, Fabian Parsia George, Mita Halder. "IOT based Home Intrusion Detection system", April 2018.
- [7] "Device-Free Home Intruder Detection and Alarm System Using Wi-Fi Channel State Information" Mohammed Abdulaziz Aide Al-qaness, Fangmin Li, Xiaolin Ma, and Guo Liu, Aug 2016
- [8] "Smart Home Automation System for Intrusion Detection "Danish Chowdhry, Raman Paranjape, Paul Laforge Faculty of Engineering and Applied Science University of Regina, Canada,2015.
- [9] "Intrusion Detection System for Smart Home using Laser Rays" K.Govinda, K. Sai Krishna Prasad, Sai ram susheel VIT University Vellore, India. Aug,2015.
- [10]" Smart Intrusion Detection System for Home Security" V.Gayathri, Malatesh S H,Bangalore,2017.
- [11]"Specification-based Intrusion Detection for Home Area Networks in Smart Grids" Paria Jokar, Hasen Nicanfar, Victor C.M. Leung, The University of British Columbia Vancouver, BC, Canada V6T 1Z4, 08 April 2015.
- [12]" Mobile based Horne Automation using Internet of

Things (IoT)" Kumar Mandula, Ramu Parupalli, CH.A.S.Murty, E.Magesh, Rutul Lunagariya, 2015 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT).

[13]<https://www.secureworks.com/blog/the-evolution-of-intrusion-detection-prevention>

[14] "Seeing People in the Dark: Face Recognition in Infrared Images" Gil Friedrich and Yehezkel Yeshurun, School of Computer Science, Tel-Aviv University, Israel

[15] https://en.wikipedia.org/wiki/Live_streaming