

Implementation of Smart Anti-Theft System using Raspberry Pi

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Abstract—As technology is advancing in all the fields, providing home security from intrusion has become a vital point of concern. The purpose of this project is to design and implement an Anti-Theft System using Raspberry Pi which detects and alerts the owner of any intrusion.

I. INTRODUCTION

A staggering 88% of all robberies occur in residential areas, with 77% of these being property crimes, with owners losing an average of \$3000. By 2040, it is estimated that 75% of all homes would have been broken into at this unprecedented pace of intrusions. With the capabilities of Internet of Things (IoT) technology, our project aims to prevent such intrusions. We want to reduce intrusions and, as a result, the amount of burglaries that occur every day. In this paper, we will look at how we can detect these intrusions, then design a solution to this problem, and implement the product. We'll implement a few features that will improve the project's functionality by virtue of the user (i.e., the owner of the home). When an intrusion happens while the owner is away from home, our Smart Anti-Theft device will notify the owner (or even when the owner is inside the home) and also implement a way to identify if the owner is entering the home rather than an intruder.

II. LITERATURE REVIEW

There are multitude of solutions proposed for the IOT security system as given in [1] that improves the quality of service delivery. From [2], Researches of Intrusion Detection System explains lot about various techniques and how smart security system can be implemented. Deepak.S.Kumbhar, H.C.Chaudhari, Shubhangi M.Taur, Shubhangi S.Bhatambrekar from [3] made use of analytical perspectives in Pi. In [4], Raju A Nadafa, S.M. Hatturea, Vasudha M Bonala, Susen P Naikb, focus more on Open CV libraries and Python to design a Home-security system. In [5], Ashara Banu, MohamedNorbik Bashah, IdrisBharanidharan Shanmugum, provide brief introduction on how to design the system. From [6], the survey was about the existing types, techniques and approaches of intrusion detection systems in the literature. In [7], the proposed system detects an intruder in the dark using a CCTV camera without night vision capability

which was unique from other systems proposed. From [8], Dr. M.L. Ravi Chandra, B. Varun Kumar, B. Sureshababu, proposed system captures the picture of the intruder and sends it to the authorized mail through internet over Simple Mail Transfer Protocol (SMTP). In [9], Thinagaran Perumal, Chui Y.L, Mohd Anuaruddin Bin Ahmadon, Shingo Yamaguchi, describe a solution for the performance evaluation that focusses on the proposed system which can robustly identify the activities using IoT in smart home environment with high accuracy. From [10], An Overview of Security Issue in IoT Network can be understood. In [11], the system describes specifically the security requirements of the components that make up the smart home system.

III. DESIGN PHASE

The objective of this project is to reduce the chances of thefts happening in homes. This system revolves around intruder, the door entrance and passage of the entrance. We are using this system to detect the intruder and send an alert to the home owner irrespective of whether he is inside the home or outside. In order to reduce the thefts, we can take these precautions using our system:

- 1) Prevent the intruder from breaking into the house by recognising the defined gesture in the system.
- 2) Inform the owner before something is stolen.
- 3) Give the owner time to deal with the situation by giving him instant alerts.

The most efficient way to inform the owner is to send an alert to the owner's phone with detailed information, this alert will include the picture of a entrance/intruder at the time of detecting a motion.

The following are the most important components of this system:

- 1) Data sink - This accepts the raw data and can be used to store the data for performing the activities. In this data sinks are primarily our Raspberry Pi(3), File Stack and moving the captured images to Telegram application.
- 2) Data source - This is a vital source of providing raw data to the system. Data sources in this project is the PIR sensor, that detects the motion.

- 3) Actuators - Actuators are the operation system of this project which provides notifications and alerts the household member in order to take the action.

A. Image Capture

We are placing the system near the door with the camera pointed at the entrance. As soon as the PIR sensor attached to the Raspberry Pi module detects a motion, it captures the image and uploads it to Amazon's object storage Amazon s3.

B. Gesture Detection

We use Amazon's machine learning service Amazon Rekognition to train the data required for detecting the gesture that is shown by the owner, so that the module can differentiate between an owner and an intruder. As soon as the image is uploaded to Amazon S3 bucket, the trained model will utilize this image and analyze it to see if the image has similarities with the trained data. If the image is found to be that of the owner or someone known and if he/she is showing the special gesture, then an alert will be sent to the owners' mobile device. Conversely, if it fails to register a match with the trained model, then again the owner will be alerted.

C. Sending Alert

When the system determines that the person trying to enter the home is not the owner or someone known(as per the trained data), it will immediately inform the owner with the image of the entrance on his mobile device.

D. Software and Operating System

Here, we are using the Raspbian OS in our Raspberry Pi 3 module together with a python program that is run to receive the PIR sensor output and thereby triggering the remaining actions. We are also making use of two AWS service - Amazon S3 and Amazon Rekognition, to store the images as well as to train the system to detect the gesture.

IV. ARCHITECTURE & IMPLEMENTATION

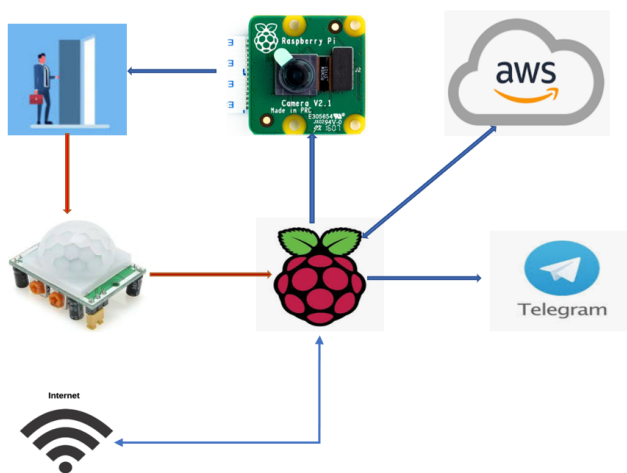


Fig. 1. Architecture Overview

A. Hardware

- 1) Raspberry Pi - Raspberry Pi is a micro controller and a series of single-board computers that maintains all the sensors. Here, we are using Raspberry Pi(3) with 1 as server and other 2 as clients.
- 2) PIR sensor - The Passive Infrared Sensor (or PIR) calculates the infrared light radiating from objects in its vicinity. This sensor is popular as it helps in detecting motion of objects and every object will be unique in terms of infrared radiated by it.
- 3) Pi Camera - This camera is used to capture the image of the household members or intruders. The camera will be triggered from the contact sensor when it detects movement.

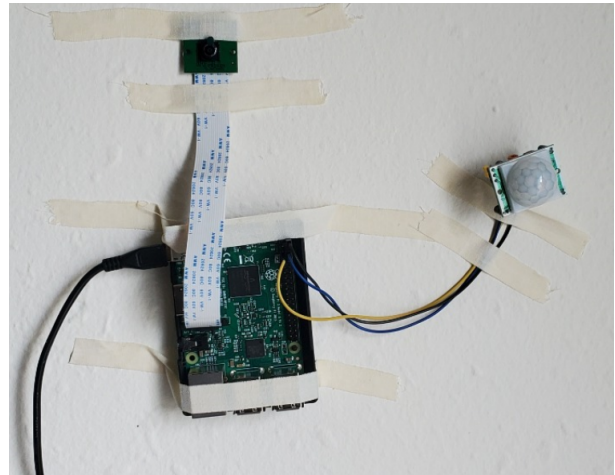


Fig. 2. "Anti-Theft System using Raspberry Pi"

B. Amazon S3

Amazon S3 is the object storage service offered by Amazon Web Services. We are using S3 to store our images captured by the Pi-Camera when motion is detected at the door.

C. Amazon Rekognition

Amazon Rekognition is a machine learning service offered by Amazon Web Services, that we have used to train a model using a set of images to detect the gesture shown by the owner. This trained model is then used to determine whether the person that is detected by the PIR sensor is the owner or the intruder and also verifies if the owner is showing the gesture or not.

D. Telegram

The owner is informed about the intruder as an alert is sent to his mobile device. Here, we are using Telegram application which is a messaging service to receive the alert instantaneously. We make use of another third party service known as IFTTT to push the alert to the owners' telegram account.

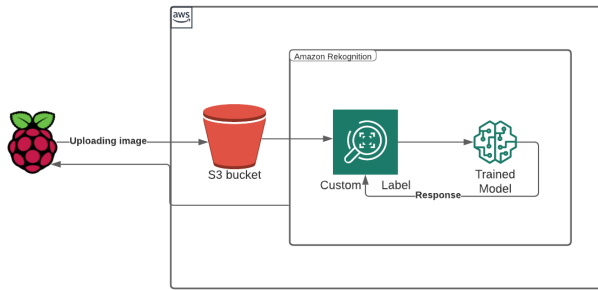


Fig. 3. Gesture Detection using AWS

E. IFTTT

If This Then That also known as IFTTT, is a service that allows a user to program a response to events in the world of various kinds. Here, we use IFTTT to push the image captured when motion is detected, to the telegram account of the owner.

F. Implementation

The first step of the project involved setting up the Raspberry Pi 3 module. This involves installing the Raspbian OS in the module and then connecting to the laptop via Ethernet cable and logging into the module using ssh. Then VNC was enabled on the module and was able to login through the VNC viewer and see the GUI.

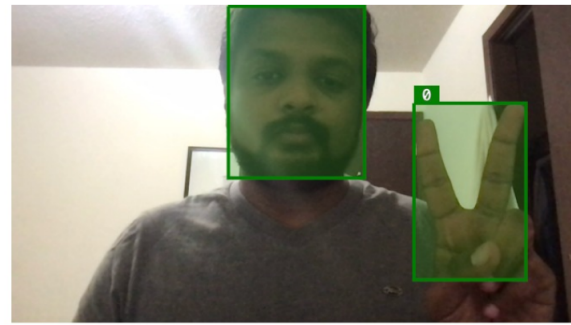
Next step is to connect the Pi-Camera and the PIR sensor to the module and check if they are getting detected. The Pi-Camera is connected to the port situated between the USB and the micro-HDMI ports on the module. The PIR sensor has three PIN - VCC, GND and digital out; the VCC is connected to the PIN 2 on the module, the GND is connected to PIN 6 and the digital out is connected to GPIO4 which is PIN 7. The sensitivity is set between 4m to 7m and delay time is set in a way that we have interval before detecting the next motion.

The image captured after motion detection is stored in Amazon S3. Then, IFTTT was setup to receive an URL of the image and then push that and the text to the owners' telegram account. This was written in the program to be triggered only when there is a motion that is being detected by the PIR sensor.

Gesture Rekognition was setup after this which involved Amazon Rekognition service. The first step is to capture images of the required gesture and store this in an S3 bucket and use these images to train the model. The trained model is then used to evaluate the captured images in real time and identify whether the image is of the owner and with the special gesture.

V. CONCLUSION AND FUTURE ENHANCEMENT

In the proposed system, we have addressed the possibilities of improvising the existing Intrusion Detection System by



| Box # | Labels | Confidence |
|-------|---------------------------------|------------|
| 1 | Owner True positive | 97.1% |
| 0 | V hand gesture True positive | 94.8% |

Fig. 4. Action Recognition

integrating the system with latest cloud technologies, Amazon Web Services where we have used the Amazon Rekognition service for training the model that has a confidence rate of more than 90% to identify the special gestures of the household member and we have also used Telegram Application to keep the owner informed of the intruder.

Various experiments have been left for the future enhancement which requires more profound analysis and contribution to devise new mechanisms. Some of the enhancements include using a night vision camera which can help to detect intruders at night. This project can be extended to the other entrances as well as the roof to make it more secure.

REFERENCES

- [1] Dr. Nagalakshmi Venugopal,Chalamalasetty Edward Pradeep Kumar,Goutham Prashanth V G,Manoharan E,Kesavamurthy K *IOT based Security System using Raspberry Pi* Department of Computer Science and Engineering, Dr.N.G.P. Institute of Technology, Coimbatore, India February-2020
- [2] Sui Xin, *Research of Intrusion Detection System*, 2013 International Conference on Computational and Information Sciences, 1460-1462.
- [3] Deepak.S.Kumbhar, H.C.Chaudhari, Shubhangi M.Taur, Shubhangi S.Bhatambrekar *IoT Based Home Security System Using Raspberry Pi-3* International Journal of Research and Analytical Reviews (IJRAR), 2019
- [4] Raju A Nadafa, S.M. Hatturea, Vasudha M Bonala, Susen P Naikb, *Home Security against Human Intrusion using Raspberry Pi*, Procedia Computer Science, Volume 167, 2020, Pages 1811-1820, ISSN 1877-0509,
- [5] Ashara Banu, MohamedNorbik Bashah, IdrisBharanidharan Shanmugum *A Brief Introduction to Intrusion Detection System*, Universti Teknologi Malaysia, UTM, Kuala Lumpur 2012
- [6] A.J. Deepa, V. Kavitha Dr. *A Comprehensive Survey on Approaches to Intrusion Detection System*, 2012
- [7] Sharnil Pandya, Hemant Ghayvat, Ketan Kotecha, Mohammed Awais, Saeed Akbarzadeh, Prosanta Gope, Subhas Chandra *Smart home anti-theft system: a novel approach for near real-time monitoring and smart home security for wellness protocol* 2018

- [8] Dr. M.L. Ravi Chandra, B. Varun Kumar, B. Sureshababu, *IoT Enabled Home With Smart Security*". *International Conference on Energy, Communication, Data Analytics and Soft Computing ICECDS-2017*
- [9] Thinagaran Perumal, Chui Y.L, Mohd Anuaruddin Bin Ahmadon, Shingo Yamaguchi. *IoT Based Activity Rekognition among Smart Home Residents*, IEEE 6th Global Conference on Consumer Electronics 2017
- [10] R Gurunath , Mohit Agarwal, Abhrajeet Nandi, Debabrata Samanta *An Overview: Security Issue in IoT Network* Proceedings of the Second International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) 2018.
- [11] Jinhee Han, Yongsung Jeon, Jeongnyeo Kim *Security Considerations for Secure and Trustworthy Smart Home System in the IoT Environment* 2015