IOT Based Anti Theft Flooring System Using Face Recognition Technology

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***Abstract*—Security has always been a great concerning issue. When it comes down to the security of the house, bank, office, store, and other important places there aren't many cost-effective solutions out there. That is why we came up with a project that is a cost-effective and efficient system for an individual to be able to detect any kind of theft in real-time and provide instant notification to the owner. The goal of the project is to provide a generally workable framework for notifying a homeowner or member of an ongoing theft or unauthorized access to their premises immediately. To achieve this, a thorough examination of current systems was used to find research gaps. The shortcomings of the earlier systems were that they could not distinguish between human and non-human objects, or could only identify the invader after the theft. Our proposed system will be able to detect any legal or illegal person from live video footage and send notifications to the user.**

***Index Terms*—IoT, Home Security, Face detection, Raspberry Pi, Open CV**

I. Introduction

Security and surveillance are critical issues in the modern era. Recent theft/terrorism incidents have highlighted the critical need for effective video surveillance and on-the-spot notification of ongoing thefts to property owners and other household members.

There are currently a variety of surveillance solutions on the market, such as CCTV cameras and digital video recorders (DVRs) that can record the unauthorized activities of a trespasser but cannot distinguish between human and non-human objects at the same time they are not cost-effective at all. Because of a lack of awareness and the scarcity of smart gadgets, the ratio of theft has risen significantly in recent years.

Whatever the security systems available today, they can't provide extra security other than just capturing the video footage. Sometimes the footage might not be clear enough to identify the intruder.

Our anti-theft flooring system is made to maintain security which is a smart monitoring device that is able to keep the important place under observation 24*7 and provide security by notifying the owner and with great accuracy of face detection in real-time.

II. Related Works

We discovered several papers concerning security systems. Different security systems are used for various purposes. Sushma.N. Nichal and Prof. J.K. Singh have created an abstraction of a smart supervisor system using IOT and an embedded Linux operating system with an ARM11 architecture. They implemented a real-time video monitoring system and collected data for this paper. They have also used PIR, temperature, and humidity sensors in this system. To activate the system, the user must first authenticate. If the system detects a human, it will send that data to the server or the user's smartphone.

Yogita Vijay Narkhede and S. G. Khadke presented a smart security system based on Raspberry Pi and an infrared sensor. If the IR sensor detects a person, the camera will capture an image as well as a video of the person, which is then encrypted and decoded. The user's mobile device will receive a notification. The authors discussed how users can perform live streaming while also providing security. The authors concluded that this system is important for commercial locations and discussed a few of the system's benefits.

R.Chandana et al. implemented monitoring and home security system using think and speak with the help of a Raspberry Pi. They used a Gyro sensor to detect the movement of a person, and if movement is detected, the camera captures an image, which is then sent to the owner's email address. They have also stated the system's significance. The authors have concluded that this system is critical for security.

Harikrishnan G.R. et al. have implemented home automation and security system in which the user can continuously monitor their home from a remote location. If an intruder is detected, the system generates an alarm and captures an image of the intruder, which is then sent to the owner's mobile phone

via SMS, WhatsApp, Call, or E-mail. They discussed a few advantages of this system. The authors concluded that this system is useful for securing commercial spaces.

A. Benchmark Study

After going through these papers we came to conclusion that, these projects have some lacking that our project provides. These includes but not limited to-

- Better safety : as our system is capable of monitoring the specific area 24*7, the system will ensure safety and keep the place protected all the time.
- Cheaper : our system is very cost effective as it used cheaper component as well as very low power consumption without compromising the quality.
- More reliable : Our system works both on AC and DC current using less power. When there is shortage of AC there is always backup power options.
- Provide clear evidence : The system has a very high accuracy in terms of face detection and it stores clear footage of any unauthorised person for further investigations.

III. Methodology

In this section, we discussed how our system will work altogether using different components and how a user will get the notification.

A. Face Recongnition using Open CV

The core functionality of the project is to be able to identify the faces of different people. To do this we will use OpenCV to perform face recognition. To do our face recognition system, we'll first perform face detection, extract face embeddings from each face using deep learning, training a face recognition model on the embeddings, and finally recognize faces with OpenCV

The processes are

1) Create a dataset of face images
2) Extract face embeddings for each face in the image (again, using OpenCV)
3) Train a model on top of the face embeddings
4) Utilize OpenCV to recognize faces in video streams

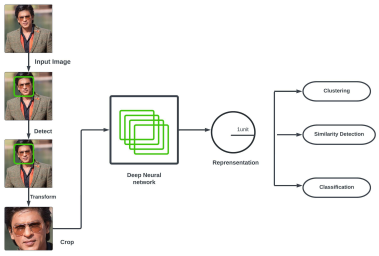

Fig. 1. Face Detection Using Open CV

All of these tasks will be accomplished with OpenCV, enabling us to obtain a "pure" OpenCV face recognition pipeline.

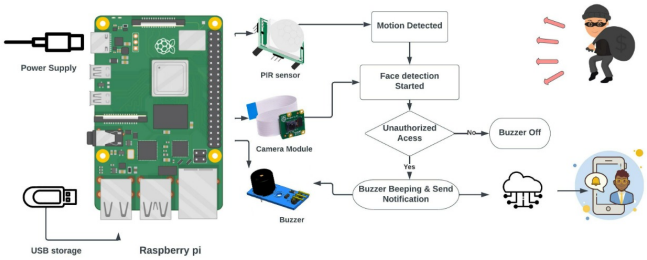

Fig. 2. Proposed Framework

In order to build our OpenCV face recognition pipeline, we'll be applying deep learning in two key steps:

- To apply face detection, which detects the presence and location of a face in an image, but does not identify it
- To extract the 128-d feature vectors (called "embeddings") that quantify each face in an image

The first step is to Extract embeddings from the face dataset. Then we will train the face recognition. we will have extracted 128-d embeddings for each face. Now using a machine learning model such as VM, k-NN classifier, Random Forest, etc. will train on top of the embeddings. After the training process is done we are ready to use Open CV to perform face recognition.

B. Component Desccriptions

1) Camera One of the most important components of our system is the camera module. Robodo 640*480 VGA CMOS is used in this system. It supports image scaling and IO voltage 2.5V to 3V The camera module will be installed in a hidden area yet can capture footage clearly. The camera will be connected to the raspberry pi and all the image processing will be done there.

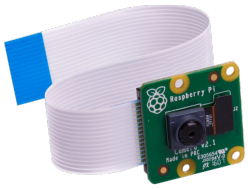

Fig. 3. Camera Module

2) Raspberry Pi plays the most important role here as all the components are connected to it. Feature it provides:
   - Quad Core 1.2GHz Broadcom BCM2837 64bit CPU.
   - 1GB RAM.
   - 100 Base Ethernet.
   - 40-pin extended GPIO.
   - CSI camera port for connecting the raspberry pi camera.
   - It is power efficient.

- Acts as a server
- Captured image will be stored in raspberry pi.

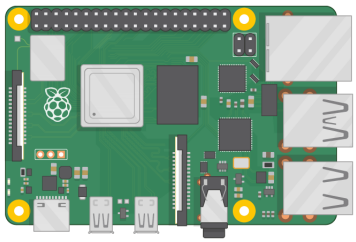

Fig. 4. Raspberry Pi

3) PIR sensor
   - Dual Element Sensor with Low Noise and High Sensitivity
   - Supply Voltage – 5V
4) Buzzer
   - It's a small device to be connected to the raspberry pie
   - Supply Voltage – 5V

C. Basic Workflow

1) All the devices are on and connected to the raspberry pi
2) Camera is installed in a place where it can capture clear footage of any person entering the area.
3) Person enters the area and footage is sent to a raspberry pi. Data is fetched from cloud storage and the face recognition process is done.
4) If a person is not authorized buzzer starts beeping and a notification is sent to the mobile app.

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