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Research Article: IOT

PROACTIVE HOME DEFENCE SYSTEM USING IOT AND MACHINE LEARNING

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Abstract—As Home Security Systems and IoT technologies combine, we are seeing a new class of smarter intruder alarms emerging. This includes mechanisms that boast improved ac- curacy in intrusion detection while reducing the incidence of false alarms. The proposed system is a proactive home defence system consisting of two parts. The system consists of a camera through which live video from strategic entry points of the home is collected. This video data is analysed for intruder activity. The system is pre calibrated to recognize the natural inhabitants of the home as friendlies and any uninitiated face as a threat. We use facial recognition for this phase. When a threat is detected, the system sends an alarm to the nearest law enforcement and alerts the smartphone initiated with the owner. The second part involves proactive defence with online monitoring. The system is equipped with a Raspberry Pi controlled turret capable of 360- degree engagement. The system engages identified threats with pointing a laser light. Once the threat is immobilized and stays that way, the system stops engagement. The system re-engages if the threat becomes mobile again. The system stays on the threat until law enforcement arrives and the threat is neutralized.

Index Terms—Home Defence System (HDS), Proactive De- fence, Turret, Surveillance System Controller, Face Detection, IP Camera

I. INTRODUCTION

Security can be considered as an important factor in the case of home automation. Home security has made many changes in the past few decades, and it will continue to advance in the coming years. Home Security Systems possessed an alarm that would go off when the intruders would break-in. The problems that affected the traditional security systems can be solved by smart technologies. Therefore, the main objective of our project is to design and develop a system which can alert the owner of an intruder break-in by sending an alert to the owner's e-mail, and at the same time pointing a laser towards the identified threat. The system will help the users to safeguard/protect their homes by placing the system at different endpoints of the home and can monitor the entire activities taking place via their smart phones.

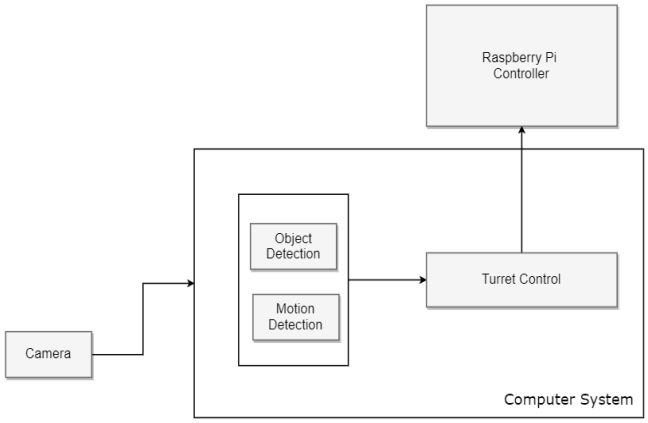
Home Defence System is a Real Time Security System based on Human Motion Detection developed for home security purposes. We are replacing the existing home security systems with the help of technology. Existing Home Security Systems are combined with IoT technologies and there a new class of smarter intruder alarms are introduced. This includes mechanisms that boast improved accuracy in intrusion detection. We develop an intelligent system able to send real-time video and motion detection. The main components of the project are Raspberry Pi 3 Model B, Stepper motor HAT, Relay Module, IP Camera, Laser and few other components. Raspberry Pi controlled turret has the ability to scan its field of view using a camera and can point automatically towards the target. The camera image is processed with the help of a web application and the target is fixed with the help of stepper motor. This project can be used for the local security purpose, businesses or as a house guard. The benefit of this system gives more accuracy, safety, less cost, nil risk for the guard.

II. RELATED WORK

A. Motion Tracking Gun Turret using Raspberry Pi

An airsoft gun controlled by Raspberry Pi capable of motion tracking is developed. It possesses two operation modes, Au- tomatic and Manual. In the Automatic mode, when a motion is detected,

the gun moves automatically and fires. In the Interactive mode, the user can control it manually. The turret can be controlled remotely according to the motion of the object. Live feed is streamed by the camera from various points. The software does not know the position of the gun on start-up, you will need to calibrate the turret when it is turned on. The python program will prompt you to use the keyboard to adjust the elevation and yaw angles of the turret, and confirm that it is levelled and centred. The software will calibrate the exposure level of the camera and a reference image is selected for motion detection. This is done after calibrating the turret position. The subsequent images are compared to the initial reference images for changes.



B. Face Detection in Surveillance Videos

A video surveillance system that includes a network camera and an algorithm to automatically detect human faces that shows up in the observation space, via real time video content analysis is developed. The images received from the camera is processed and face-detection process takes place. The live stream will be saved as a video file. The algorithmic rule for face-detection is predicated on the integral image. The calculation of the total of all pixels values from any rectangul space within the original image by doing solely four operatio of addition or subtraction. The appliance conjointly includ a file containing information regarding required tests with the detection algorithmic rule by analysing multiple pictur as templates. The application is written in C language a experimental results are given for pictures with complete different sizes and backgrounds.

III. METHODOLOGY

The system will be actively monitoring the surroundin 24x7. The IP camera attached to the system streams the liv feed. It will be recorded in the database of the system. Wh an object is detected, the image streamed from the IP came will be cross-checked with the data of the members that are already stored in the database. If the image matches with any of the data in the database, the system identifies it as a known member. But if the image does not match with that in the database, the system identifies it as a threat. The system will send an alert to owner's e-mail. At the same time, the proactive defence part of the system gets activated. The Raspberry Pi controlled turret connected to the system which is capable of 360-degree engagement gets initiated.

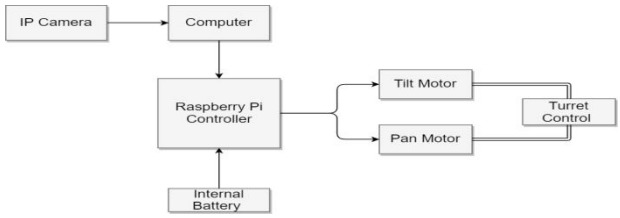


Fig. 1. Hardware Block Diagram

Fig. 1 shows the basic hardware block-diagram of the system. It consists of an IP camera through which the live feed is streamed. The image processed are transported to the computer. If an intrusion is detected, the computer system sends[1] commands to the Raspberry Pi controller. The

Raspberry Pi controller initiates the servo motor attached to the system. It contains a pan motor that helps to hold the turret, and a tilt motor which helps to rotate the turret. Finally, the turret starts tracking the moving object and the laser is pointed towards the object.

Fig. 2 shows the basic software block-diagram of the system. Ip camera is connected with the computer through serial ports. The data from camera is collected through the processing software. After the face detection, the data is sent to the Raspberry Pi to control the motion of the turret with the help of servo motor.

IV. PROPOSED SYSTEM

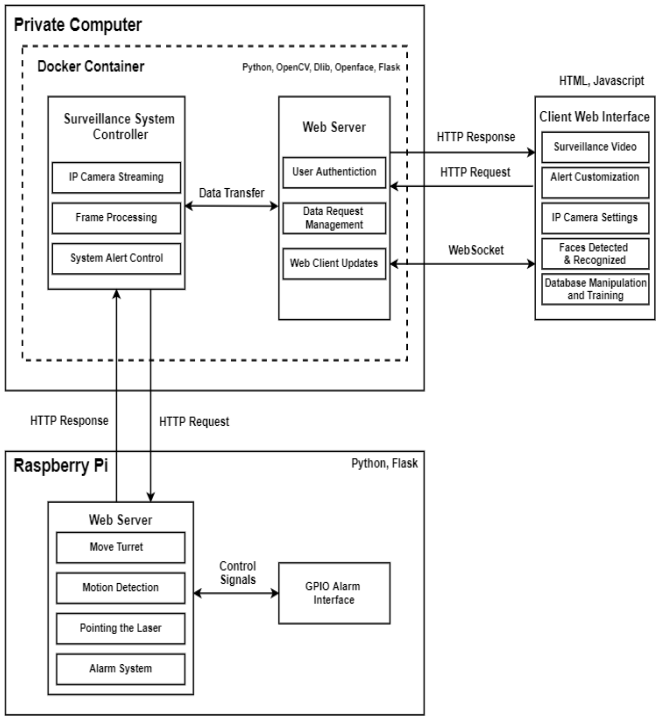
The proposed system consists of a hardware part and a software part. An Interactive Mode and Motion Detection Mode is created. Interactive Mode allows to control the turret and stream live video. Motion Detection uses OpenCV to track moving targets in front of the camera.

A. The Embedded System

The embedded system comprises of a Raspberry Pi 3 Model, Sensor, Stepper Motor HAT, Relay Module, IP camera, and a laser. The Raspberry Pi controlled turret is capable of moving and pointing towards the object when it detects motion in front of its sensor. IP camera is connected with the computer through serial port. Data from the camera is collected through processing software and is sent to the Raspberry Pi board to control the motion of the turret through servo motor.

B. Web Application

The Web application is a surveillance system monitoring dashboard. The admin can monitor, manipulate, verify and control the entire system. The admin can add, delete the users. The system can process several IP cameras and can distinguish the unknown faces and the faces that are stored in the database.The system server consists of the Docker container in which the data are transferred to and from the surveillance controller and the web server. The IP camera object streams the live feed and the frames are processed and is streamed to the user via FlaskSocketIO object. It transfers JSON data using HTTP POST requests and web sockets. Each IP camera possess its own



Face and Motion Detector. The faces captured are cross-checked with the images stored in the database. If an unknown face is detected, the system sends an alert. This activates the alarm control interface hosted by the Raspberry Pi.

Fig. 3. Surveillance Monitoring System

V. WORKING

The two phases of the system are Facial Recognition and Proactive Defence with online monitoring. The figure 4 illustrates the working of the system.

A. Facial Recognition

A Face Recogniser object provides functions for training a linear SVM classifier using the face database and includes all the functions necessary to perform face recognition using Openface's pre-trained neural network. Multiple images are used to perform accurate face recognition. A person is clas- sified as unknown if they are recognised with a confidence lower than mentioned(threshold-20%), or are predicted as unknown by the classifier. The system consists of an IP camera through which live video from strategic entry points of the home is collected. This video is analyzed for intruder activity. The system is pre-calibrated i.e. the system identifies natural inhabitants of the home as friendlies and uninitiated face as a threat. When a threat is detected, the system sends an alert to the owner's e-mail. Dashboard contains a panel named Faces Detected. The detected faces are shown in that panel.

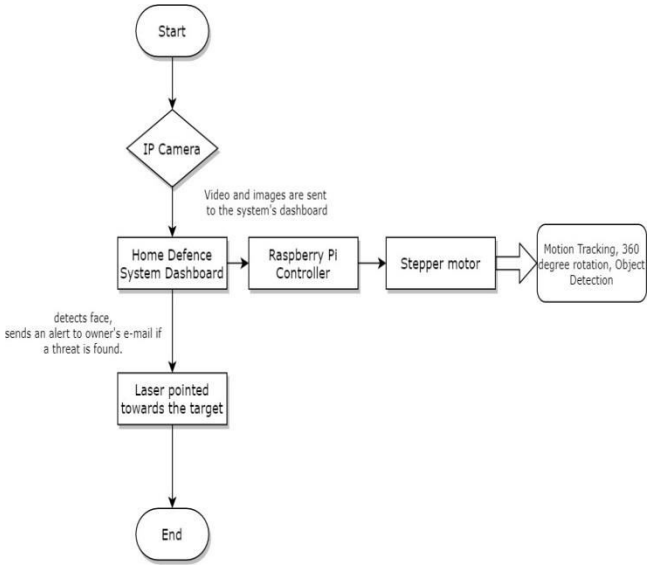


Fig. 4. Working of proposed system

B. Proactive Defence

The second phase of the system is the proactive defence with online monitoring. The system consists of a Raspberry pi with a turret capable of 360-degree engagement. When a threat is detected, the video/images from the IP camera is sent to the dashboard, and the system gets initiated. At the same time the Raspberry Pi controlled turret connected to the system which is capable of 360-degree engagement gets initiated. The turret starts tracking the moving object and the laser is pointed towards the object. Once the threat is immobilized and stays that way, the system stops engagement. The system re-engages if the threat becomes mobile again. The system stays on the threat until law enforcement arrives and the threat is neutralized.

VI. RESULTS AND DISCUSSIONS

The embedded system comprising of a Raspberry Pi 3 Model, Sensor, Stepper Motor HAT, Relay Module, IP camera, and a laser is developed. The Raspberry Pi controlled turret gets activated when a threat is identified. Simultaneously an e-mail alert is sent to the owner. A surveillance system monitoring dashboard is developed. The admin can login to the system and can monitor all the activities that are taking place. The system can process several IP cameras and can distinguish the unknown faces and the faces that are stored in the[1] database. The faces captured are cross-checked

with the images stored in the database. If an unknown face is detected, the system sends an alert. This activates the alarm control interface hosted by the Raspberry Pi.

VII. CONCLUSION

The development and design of the Home Defence System for security applications are discussed by detection as well as the engagement of the target. The system developed is a 24x7 active system. The priority of the system is to identify the threat and alert the owner. The hardware of the system mainly consists of accessible components that make it a low budget system. This part simultaneously works with the software part of the system. The proposed system assures efficiency in various tasks related to home security. As future scope, the system we developed can be modified by adding so many other features. In military battlefields, the laser can be replaced by a defensive gun or weapon. Other features like engaging the threat with auditory commands to stay down to disengage the defence system is also possible.

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