Home Security Using IOT And Machine Learning

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Abstract- *Now a day's home security has become an important issue in real world. Although there are good quality security systems available, there is scope for improvement in the area of cost effectiveness and utility features. Current advances in the field of internet–of-things (IOT) including machine learning can bring about improvements in the home security systems. The main input in this project is from infrared (IR) sensor also other indoor sensors like fire, gas, level sensors and it is fully controlled by microcontroller embedded on NodeMCU board while the output is buzzer to startle the theft and also alert the neighbours around and lastly Android application communicating through MQTT server to the hardware components accessed by admin to monitor the activity around house without physical presence. We propose a multifeatured intrusion and hazard detection alarm system using IOT and object detection.*

Keywords- Internet Of Things, Object Detection, Machine Learning, YOLO, Tensor flow

I. INTRODUCTION

Home security alarm frameworks are the need of the day. Home security system provides ways of monitoring and tracking the inside and outside of a house through camera and other sensing devices and send notifications to the user about the actions performed inside and outside the home. Home security system consists of various internetworked components and interrelated devices. Home intrusion detection systems secure the entry points into a house with sensors that communicate with a control board or command centre installed in a convenient location somewhere in the house. They aim to protect against potential home intruders. The hazard detection systems warn homeowners to situations like fire, gas leaks, smoke water logging, etc. The design and development of a home security framework is as yet an evolving field. It vigorously makes use of the fields of machine learning and IOT. Advances in these technologies and advances in sensing, storage, communication, cloud and mobile technology can better the effectiveness of these systems. A cost effective solution using these advancements can increase the utility of a home security systems.

A basic home security consists of a control board, which is the essential controller of the system, door and window sensors, and motion sensors for both inside and outside the house, wired or wireless security cameras and a high-decibel siren or alarm.

The sites [4, 5] discuss the issues which hamper the proper working of a home security system. These issues are false triggering of alarm, dependence on power, loose connections, insufficient camera coverage and inability of threat prevention. The following situations may adversely affect the system: an alarm can be falsely triggered when a motion and sound detection system recognize movement by harmless entities e.g. pets, vehicles or birds near the system. Low sensor battery power and subsystems working only on uninterrupted power supply can obstruct proper working of the system. Loose connection between sensors, other devices and the circuitry can make system ineffective. Insufficient area coverage by camera can be bettered by wide angle safety cameras and using correct locations for deployment. Hacking, harming or incapacitating of the system itself directly by intruder is another threat to the system. These issues need to be handled in any home security system.

II. LITERATURE SURVEY

A smart home requires a security system. Many system rejuvenate the functionalities providing more utility. The advancement in technology facilitate this. This section provides a survey on various aspects of advancement in technology which makes enhancement of a home security system possible.

A. IOT Hardware

Internet of things used to communicate between hardware and software system. The hardware consisting of electronic gadgets are a major choice to make while building a home security system.

Many systems use Raspberry Pi boards as the main controller and to integrate various types of sensors [1, 2]. Raspberry pi connect all components for proper functioning of the whole system. System captures image of a visitor using camera connected to Raspberry Pi and a mail is send to the owner using SMTP (Simple mail transfer Protocol). IOT layered architecture is used to differentiate the system

components like raspberry pi which triggers the camera to take the image of intruder and send to the owner through Telegram - an application which is used for sending message to user in [2]. For sending message via Telegram in [2] all the libraries of telegram have to be installed into Raspberry Pi and create a new telegram account for Raspberry Pi by registering mobile sim number after which mobile number code will send to the mobile for activation.

Arduino is a well-known open source microcontroller-based kit for creating digital devices and it is an interactive device that able to interact perfectly with devices [20]. Arduinos are also used in various implementations of home security applications which are provided with externally implemented Wi-Fi modules[19].The Arduino system provides a range of analog and digital pins [20]. An USB serial communication interface is used for loading the program codes from computer to Arduino board [19].

In [3] researchers have used configured NodeMcu for connecting to internet and for ease of programming. These devices gather data from various sensors which can then be recorded within a database. NodeMcu (Esp8266) has an inbuilt Wi-Fi module which enables connection to an online database. NodeMcu is an open source firmware created for ESP8266 WiFi chip [22]. As NodeMcu is open source stage, their design configuration is open for manufacture. NodeMcu Dev Kit/board comprise of ESP8266 WiFi empowered chip.

Various sensors are used for various purposes like fire sensor used for detecting smoke and fire, gas sensor used for detecting gas leakage [1]. Infrared (IR) sensors are used for detecting certain attributes of its surroundings by either emitting or identifying infrared radiation. Passive infrared (PIR) sensors are used for motion detection in its surrounding area. Their drawback is that they detect any general movement, and if connected to an alarm can blow it unnecessarily. Temperature sensors are used for detecting high temperature in a room [3, 7]. LM35 sensor detects temperature in [7].

B. Object Detection:

Object detection is a technology that falls under the more extensive area of computer vision. It manages identifying and tracking items present in images and video recordings. Object detection and recognition is an effective security mechanism in crowded or public areas. An objectionable, suspicious or dangerous object, like weapon, if detected before its use, can prevent many dangers in public places. This can be used for security in a home security system

as well. IOT and computer vision are used together for detecting faces of people [6]. In [8, 9] object discovery is performed using single shot multibox identifier calculation (SSD). In [10, 11, 12] authors use artificial neural network (ANN), Convolution Neural Network CNN, and improved binary gravitational search algorithm for object detection.

Process of circular object detection is discussed in [14]. The method used detects the object from the background image by using colour processing used as the 1st filter to eliminate the background image, 2nd step by using greyscale filtering and lastly by binary filtering and Circular Hough Transform (CHT) for circular object detection. The use of colour processing is due to it's one of the powerful technique to detect the object as in real colour processing it contain a lot of information as human eyes does. While for the grayscale filtering, it filters the pixel and smoothness the image to make the edge clearer. Lastly, CHT take place to detect the circular objects and display the total number of it.

As the significance for providing high-levelled and multiscale features representation and the successful applications in many correlated computer vision tasks, such as semantic segmentation, edge detection, and generic object detection, in [11] authors say that it is feasible and necessary to extend CNN to salient object detection.

CNN agent, You Only Look Once (YOLO), is used in [13] which gets through the CNN family's tradition and enhances a complete new way of solving the object detection with a simple and highly efficient way.

C. Face recognition:

Face recognition requires face detection in an image. Face detection involves face identification and extraction from scenario. After face is extracted it can be recognized based on available data set. In [15] the OpenCV technique using Eigen faces was discussed, which reduces the scale of face images without dropping critical features. In [16] for extracting and recognizing faces fully connected layered of CNN was used. The authors used Georgia Tech Database and it was an improvement in face recognition.

III. PROPOSED SYSTEM

The proposed system is an intrusion and object detection home security system, which can be built in a cost effective manner. The system uses IOT and object detection. If an intruder forcefully wants to open the gate or enter via fence area, IR sensor will detect and sends alert message to android application using mqtt server. If high temperature and

fire is detected then temperature and fire sensor will be activated. If water logging occurs level sensor will get activated. Gas leaks will be detected via gas sensors. When these sensors get activated an alarm will sound and notification to android application will be sent. Any outdoor activity is captured by outdoor camera. When known or unknown person is standing in front of the gate image will be captured and searched in the database and if unknown person is there user/homeowners will be notified via Android application. Camera captured image will be send to Android application. If any suspicious object is detected in premises its image will be sent to the Android application. In case of high alerts, emergency signal will be send to the nearby police station through the system.

The modules of the system are as follows:

Camera module: Records the goings-on in the area outside the house and sends continuous video data to be processed by face recognition and object detection module.

Face recognition and object detection module: Live streaming video can be given as input to object detection, so that the system can detect continuously objects that are present in fencing area. E.g. persons, bags, etc. The face recognition module can distinguish between known and unknown faces. A dataset, consisting of persons staying in the house, can be build, which will be used for filtering out persons not categorized as intruders. Faces detected other than faces in dataset, may be intruders and their images can be sent to home owners. For face recognition neural network can be built.Region-Based Convolutional Neural Networks (R-CNNs), they are popular for object detection because of their detection speed, often demonstrated in real-time on video or with camera feed input. CNN is given with supervised Pre-training, then the CNN module is finely tuned according to specific domains.[21] CNN learns an **individual** linear SVM (Support Vector Machine) classifier for each class, that detects the presence or absence of an object belonging to a particular class. Then bounding box regression for boxing the detected objects.

Sensor module: Comprises of IR sensor at gate or fencing area, and fire, heat and level sensors inside the house deployed at strategic location. IR sensor is used to detect movement of intruder, while fire, heat and level sensors are used for detecting smoke, heat and water logging respectively [24] When the devices are activated a buzzer alarm is generated. These sensors are connected to the MQTT Server via NodeMcu.

Controller module: NodeMcu is utilized as main controller which is combination of controller and WiFi device. WiFi device is used to send information from hardware system to MQTT server. NodeMcu is cost effective and can provide basic functionality (i.e. connectivity) easily. MQTT server is used to communicate between hardware and an Android application built for communicating with home owners [23]. MQTT is used for machine to machine communication. MQTT allows to send commands to control outputs, read and publish data from NodeMcu. It make it easy to establish a communication between the multiple devices.

User Communication module: There are many way to send alert notification to user like sending mail using SMTP (simple mail transfer protocol) and Telegram [2]. To simplify this task, an android application for sending notification to the users is a solution included in the proposed system. Android App is featured to access the images captured by the security system or the camera for better implementation of security system. Through the android application the past history can also be retrieved for getting help about any past experience. It has recently updated images on home screen so that user device don't have memory issues, every time the images are directly loaded from cloud dynamically.
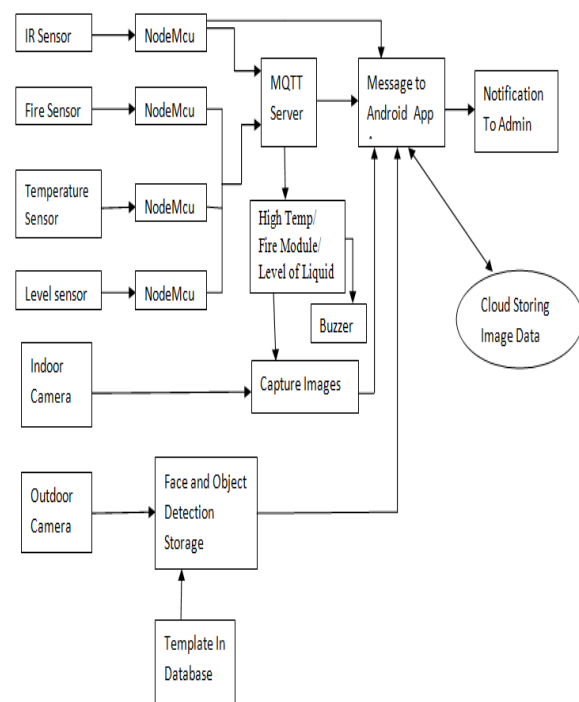
III.1 System Architecture

Fig.1 System Architecture

The home security system design can be divided into two parts which are hardware architecture and software

features.For software details, the whole system will be working accordingly set in the program code which was written in NodeMCU. System has plotted IR sensors as outdoor sensors whereas indoor sensors such as Fire, temperature and level sensors can be plotted with the help of NodeMCU and NodeMCU is connected with mqtt server through inbuilt Wi-Fi-module. Outdoor camera is used for Face and Object detection, images are generated according to Templates in database which is trained and executed with the help of yolo libraries including CNN algorithms.

This system components are accessed through Android Application which fetches the data from cloud storage.

And notifications are generated on Admin device and Images captured of scenario or intrusion are sent over Android application.

IV. CONCLUSION

A home security system is proposed displaying multiple features, which can be built in a cost effective manner as well as provide much needed utility. A home security system contains an association between wireless communication, sensors, monitoring and processing. The system discussed the design of modules like sensor, controller, communication and processing. An Android app, for connecting with user for notifications was also discussed. This system can provide the much needed functionalities in a cost effective way.

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