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IMPLEMENTATION OF IoT IN WORKPLACE MONITORING AND SAFETY SYSTEMS

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Abstract

The continuous and rapid development within the facilities of a workplace eventually concerns the need in up gradation of safety of the workplace premises to provide an improved monitoring system. In order to produce the user with the information regarding the safety and security of the premises, a mobile application is made. The mobile application helps in providing the statistical data of usage of supplies like electricity, current and waste generation and also indicates the amount of presence of indoor pollutants. The data is gathered by the Raspberry Pi using the sensors interfaced with it. By the usage of IoT, data received from the sensors are sent to the server for processing; together with the information from the sensors the video feed from the Pi Camera using smart recording is sent to the server for face recognition. The server carries out the role of both a channel and face recognition. The face recognition is done using CNN detection, deep neural network and Open CV. An integrated mobile application is supposed using MIT App Inventor that has alerts and data regarding the safety and security of the workplace using the data received from the server.

Keywords: Deep neural network, Face recognition, CNN detection, IoT, Open CV.

INTRODUCTION

The need for safety and security is of utmost importance in the present than ever before especially in a workplace or an industry. The word safety does not confine its concern only with the physical possessions of an organization but also an integrated protection. The rising need for safety has led to the emergence of various devices that serve the desired purpose. Initially products were designed to serve a single purpose and the majority of the devices were designed only to ensure the security of a workplace or an industry or even houses. The vastly used product was the surveillance camera that helped people monitors their premises without the need for the presence of a human in place. This still remains as the largely preferred device for security but, as far as the entirety of safety is concerned an integrated safety system is the most suitable. An integrated safety system helps in efficiently safeguarding the workplace in all areas possible.

Recently, implementation of IoT in safety systems has been able to provide the user an easier access in monitoring their premises as well as getting to know the state of their establishment. Although it has been helpful in many aspects there are still areas that can be further improved making the safety system even better.

PROPOSED WORK

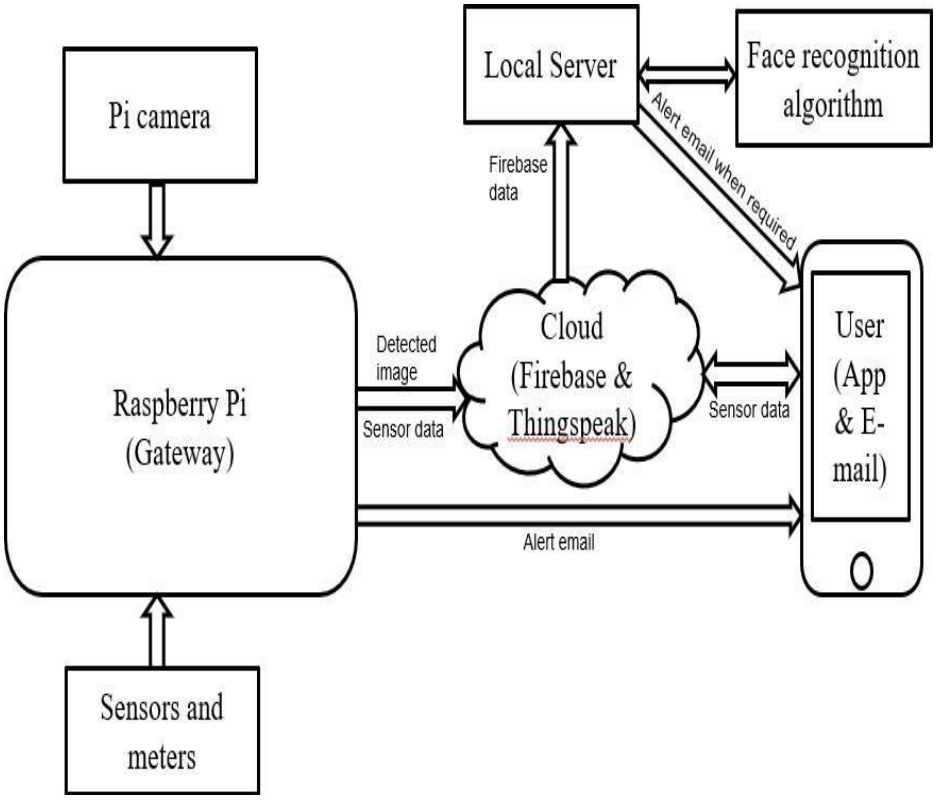

Figure 1. Block Diagram of the proposed System

The system proposed here in the figure 1 makes use of sensors such as PIR motion sensor to help in making a power efficient surveillance system, smoke sensor and air quality sensor are also utilized. These help the user know the state of their premises that includes feature like intruder alert, smoke detection, air pollution detection and additional cloud security.

WORKING METHODOLOGY

The Raspberry Pi receives the output of the interfaced sensors and PiCamera and with the help of the program fed to it it performs the required operations. Along with the assistance of a local server and an IoT platform the information is sent to the user via an e- mail and a mobile application.

a) Face detection and Recognition

The Pi Cam with the assistance of PIR sensor records only while motion detected. When a motion is detected the PIR sensor triggers the PiCamera to record until the presence of the subject is detectable by the PIR sensor, during the recording of the footage face detection is performed on the video with the assistance of OpenCV and imultis. The detected face is highlighted with a square drawn around it and the detected face is sent to a firebase database via internet from where the detected face is utilized for face recognition. The image sent to the firebase database is accessed by a local server where the actual face recognition takes place. The face recognition program in the local server is automated and checks

for updates in the firebase database every minute and by this as soon as an image is uploaded to the firebase database by the Raspberry Pi, the local server is able to access it instantly. The received data is compared with the stored database, when it detects an unknown person the server sends an alert notification to the user via an e-mail as shown in figure 2.

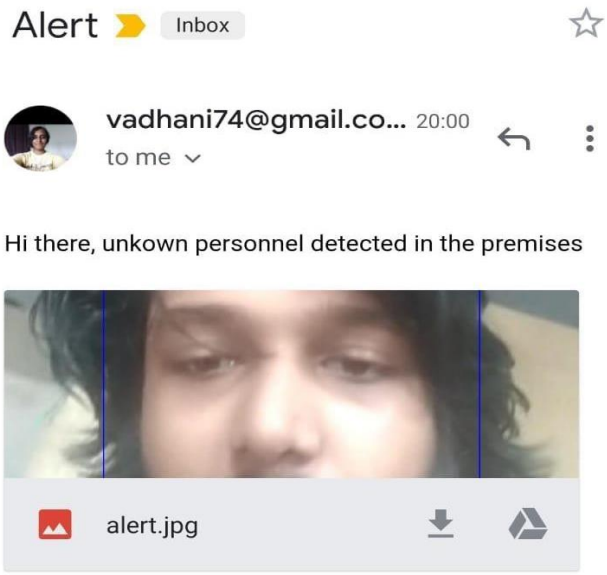

Figure 2. Face detection and Recognition of unauthorized entry

b) Sensor data and its processing

The source program that is fed into the Raspberry Pi also deals with the operations required to send the data obtained from the sensors to the web server. The sensors used along with their purpose is as follows :

- MQ-2 - Smoke detection and Air Quality level detection
- SW-420 - Earthquake detection
- YF-S201 - Measurement of water flow
- Load cell and HX711 – Measurement of weight (waste generation)
- SCT 013 – Measurement of electricity usage

MQ-2 is an analog sensor that is used for both smoke detection and air quality check by setting two different threshold levels in the program based on the calculation. When the levels of the smoke sensor exceeds normal an alert email is sent to the user by the Raspberry Pi via internet as shown in Figure 3.

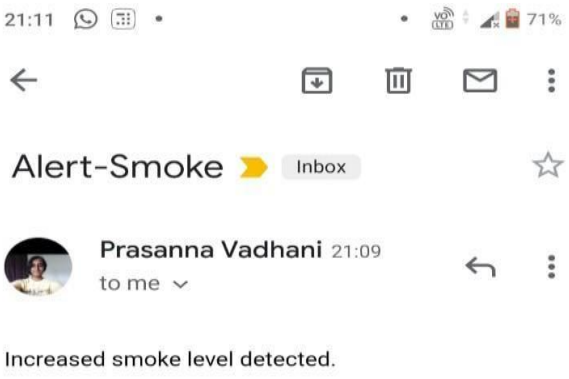

Figure 3. Water usage live status

SW-420 is an analog sensor that is used to detect the occurrence of an earthquake based on the changes in the voltage level due to vibration. When the levels of the vibration sensor exceeds normal an alert email is sent to the user by the Raspberry Pi via internet as shown in figure 4.

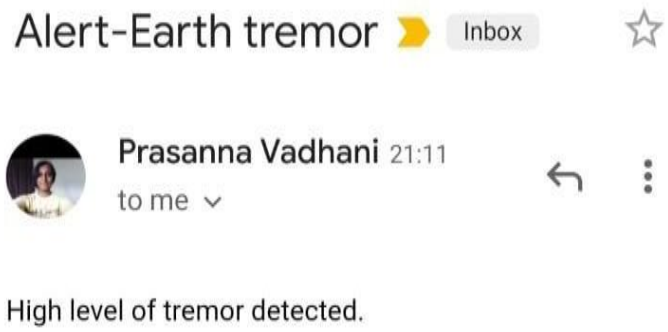

Figure 4. Water usage live status

YF-S201 is fitted at the junction of two water pipes and the number of pulses generated by the sensor per minute as water flows through the hollow space is used for calculating the water usage as shown in Figure 5.

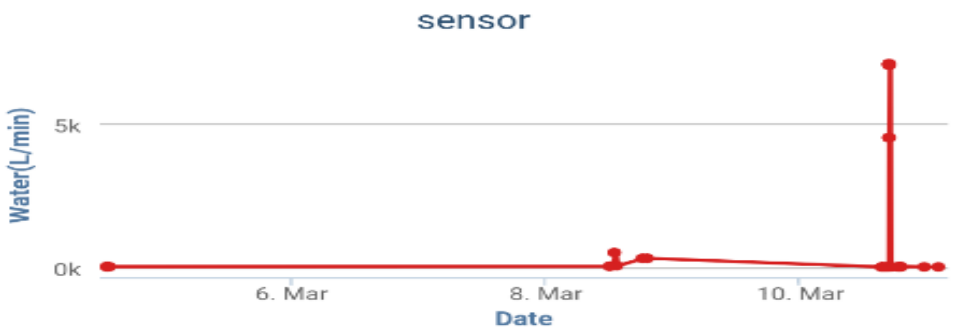

Figure 5. Water usage live status

The load cell is fitted underneath a garbage or waste bin in such a way that the weight of the bin falls upon one end of the load cell which causes a mechanical stress and this mechanical stress is converted into electricity through piezoelectric effect; the voltage thus generated is given to the HX-711 for amplification and this data is used by the Raspberry Pi for computation.

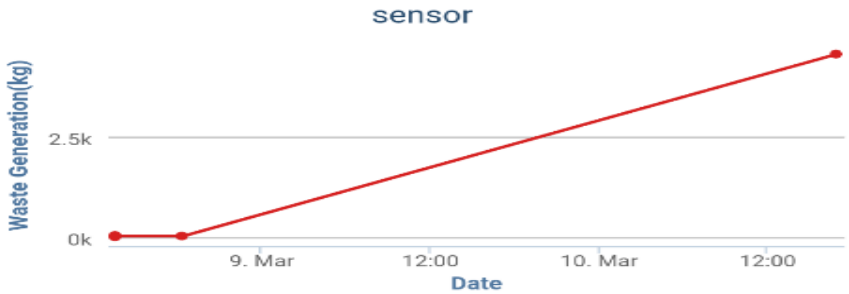

Figure 6. Waste generation live status

The SCT-013 is an analog sensor and is placed around an electricity carrying wire with the help of a protective casing and the magnetic field produced during the flow of electricity in the wire is sensed by the sensor and this data is used by the Raspberry Pi to calculate the amount of electricity usage. The data received from the sensors are utilized by the Raspberry Pi for processing and after processing the outputs of the water flow, electricity consumption, weight and air quality sensors are sent to an IoT platform called thingspeak. In thingspeak, the received data from the Raspberry Pi is plotted as graphs and this graphical representation is sent to the mobile application. Based on the output of the smoke and vibration sensor an alert notification is sent to the user via an e-mail.

c) Mobile Application

The mobile application is built using MIT App Inventor and is designed for Android. The application is designed to display the usage of water, electricity and waste generation in the form of a graph that shows the data along with the date and time. The application also has an indicator that shows the level of safety in air quality.

CONCLUSION

The proposed system is designed in such a way that it integrates multiple features such as surveillance, disaster and accident management and statistical data management into a single system. The compactness and simplicity of the system makes it highly easier to use for the user. The mobile application helps maintain a chronological data of the usage of resources which can be used for further analysis by the user. As far as disaster and accident management is considered, the system sends an alert notification in case of any mishap which helps the user be able to be aware of the status of the premises even when not present. The surveillance system employed is made efficient by using “smart recording” feature and by avoiding unnecessary intruder alerts. The PIR sensor based recording helps save power and increases the speed of execution as it is not always run. The unnecessary intruder alerts is eliminated as an e-mail is sent to the user and the user decides if the person is an intruder or not.

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