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Automation of Smart Fire Extinguisher Using Internet of Things (IoT)

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Abstract - *With the present technology of fire extinguisher installed in buildings like Apartments, Malls, Office, and many other similar. Even with the present technology, there are many structural accidents taking place, taking many lives, and making a difficult job to extinguish the fire for firefighters. It depends upon how quickly the fire is detected, even if it detects in the delay of micro sec it will cost many lives. So, we have come up with advanced monitoring technology, image processing & IOT i.e. smart fire extinguisher by installing a camera instead of many sensors. Here we use cloud computing to update the data to the cloud so that we can access them from distant and at any instant of time. Windows are automated to open along with sliders and sprinklers are activated on detection of fire. By using this, there will be a quick response to detecting fire, and the microcontroller sends SMS to nearby authorities, and using this system we can reduce the hazard on human life during fire accidents.*

***Key Words*:** Smoke detector, Haar Algorithm, IoT, Blynk App *Smart fire extinguisher*

1.INTRODUCTION

A fire alarm system has several devices working together to detect and warn people through visual and audio appliances when smoke, fire, carbon monoxide, or other emergencies are present. These alarms may be activated automatically from smoke detectors, and heat detectors or may also be activated via manual fire alarm activation devices such as manual call points or pull stations. Alarms can be either motorized bells or wall mountable sounders or horns.

Fig. 1: Smoke Detector

They can also be speaker strobes which sound an alarm, and a voice evacuation message which warns people inside the building not to use the elevators/lifts. Fire alarm can be fixed or adjusted to certain frequencies and different tones depending on the country and manufacturer of the device.

A video smoke detection technique comprising background subtraction, flickering extraction, contour initialization, and contour classification using both heuristic and empirical knowledge about smoke has been proposed. The image processing approach involves the extraction of the smoke plume from the background using frame difference technologies. Image features such as motion, flickering, edge-blurring of moving segments and edge-blurring of regions were taken from the video to detect smoke and fire. In the fire safety industry, the use of IoT is still under development and it is seldom used. While we can easily envision new and exciting applications that could take our fire safety systems to the next level, the time lag between innovation and code development remains an important caveat to consider before investing in new IoT technologies.

2. Literature survey

As we know that there are various aspects to a fire hazard we have devised a system which handles these various aspects, such as, in a fire hazard the most dangerous and life-threatening of the fire hazard is not always the fire, but the smoke and gases created by the burning of the various household materials. So, in anticipation of this, we have equipped our system with gas sensor and smoke sensors to keep tabs on the level of gases and the presence of smoke in our immediate surroundings. There can be various different types of gases present during a fire hazard, therefore, in anticipation of this, we have configured our sensors to detect some of these gases. For example, CO_2, methane, etc. In addition to the gas and smoke sensors, we have implemented temperature and fire sensors. The data from these sensors will be used to notify the user through mobile SMS and a notification in the app in case of an incident.

Temperature Sensor: The temperature sensor alerts the system in case the ambient temperature crosses the safety threshold. A pre-defined threshold value is set, if the temperature exceeds that value then the user gets notified through the mobile application and message. Gas Sensor and Smoke Sensor: During the onset of a fire hazard, certain harmful gases are produced. The normal human being can tolerate only a certain level of these harmful gasses, when this level is exceeded, the sensor detects these harmful gasses (carbon monoxide and carbon-di oxide) and alerts the system. In addition to this, whenever there is a presence of smoke in the environment the sensor alerts the system.

Flame Sensor: The system is alerted when a fire is detected in the nearby surroundings. CAMERA: The video feed captured by the camera is sent to the system for monitoring purposes. The user can use the app to view the video feed. The video feed can be used to gauge the situation. The video feed can also be used for security purpose. FIRE EXTINGUISHER: The fire extinguisher present in the device is used to extinguish or control small fires, in emergency situations. ANDROID APPLICATION: The mobile application will be used to keep tabs on the device. This application will be used to notify the user in case of any event and/or fire accident. The user will be able to use the application to check the current status of the device alongside all the readings of the various sensors available in the device. The user will also be able to see the video feed of the camera present in the device. ALARM: The alarm produces the high pitched and attention-grabbing noise which is used to notify the nearby humans of a fire hazard.

A robot is a reprogrammable, multifunctional manipulator designed for performing a variety of tasks. Robots are used for a variety of industrial applications. In industries and houses, fire and leakages of combustible gases will result in hazardous accidents. There are many possibilities a fire can start in an industry or in any remote area. Firefighting robot is a newly developed design where its function is to reduce the fire fighter risk in the dangerous situations. A firefighter must be able to get to a fire quickly and safely extinguish the fire, preventing further damage and reduce fatalities. Technology has finally bridged the gap between firefighting and machines allowing for a more efficient and effective method of firefighting. Robots designed to find a fire, before it rages out of control, could one day work with firefighters greatly reducing the risk of injury to victims. This project is proposing the fire-fighting robot using multiple sensors to detect the fire and extinguish the flame

3. Proposed System Techniques

Navigation system

1. We can remotely monitor and control the robot.

2. Use android application to control the robot.

3. Using fire extinguisher tank.

4. Principle

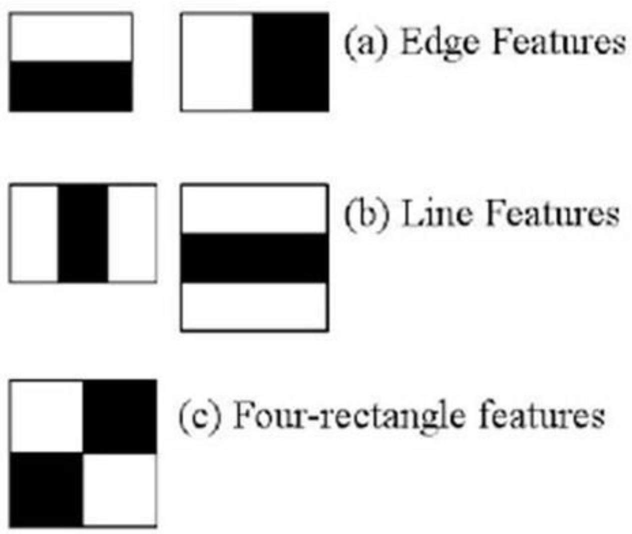
4.1 Hardware Implementation

Whenever Fire or smoke is detected through the sensor, either one of the sensors sends a high signal to Esp32. Now, Esp32 does the following:

- Servo motors are rotated either right/left 180 degrees to open automated windows and sliders.
- The triggers relay and the water pump is switched on to stop the fire.
- Through wi-fi send/receive command from the Blynk app. Can manually control the servo motor of automated windows and sliders.
- Wi-fi is also interconnected with pc/laptop. Pc/laptop it enables the SMS/Email to receive to main authorities (owner of the building, Firefighter, Family member, hospital).

4.2 Software Implementation- Image Processing

Image Processing is a form of processing the signal with the input of the image and transformed into another image as output with certain



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techniques.

Fig. 2: Haar Cascade Algorithm

5. HAAR CASCADE

The Algorithm used in this project is Haar Cascade Classifier, which has a principle method for detecting objects in an image, and the method of Haar Cascade Classifier is an object detection method developed by Viola-Jones. Haar cascade method is based on Haar- like features, combined with the classifier cascade are strengthened. Haar-like features are features that are widely used in the detection of objects, offering a rapid extraction process and can represent a lower resolution image. This method has been successfully applied in many object detections. The classifier is usually employing training from some of the examples of drawings of simple and positive examples of negative images, which have the same size. The area is marked with ‘1’ Classifier for rated similar to object or marked with ‘0’ for objects those are not similar. After the training, the Classifier can be found all across the entire object with a region of the image. And to detect the target area more accurately, the scanning window size changed adaptively by Classifier. During the process of Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, “Rapid Object Detection using a Boosted Cascade of Simple Features” in 2001. It is a machine learning-based approach where a cascade function is trained from vast amount of positive and negative images. It is then used to detect objects in other images.

The set of negative samples must be prepared manually, whereas the set of positive samples is created using the OpenCV to create samples application.

1. Negative Samples First we need to prepare the negative samples. The negative samples are taken from any images that not contain the objects that you want to detect. These images are generated with some method and called the background samples or background images. The image that used in the negative samples should be equal or larger than the size of the object image that you want to detect because these negative samples are used to subsample a negative image into several image samples that have the same training window size.

2. Positive Samples After we did prepare the negative samples, now we need to prepare the positive samples. Positive samples are created by the opencv_create samples command on the Processor. The command is used the boosting process to define what the model should look for when trying to find the objects that you want to detect. And before that, we need to prepare more than a single positive sample to make the positive samples with these commands. The bunch of images on positive samples is created to a text file that similar to the background description file.

3. In Cascade Training the last step to do after we finish preparing negative and positive samples, is the training of the cascade classifiers step. This step is processing the positive and negative samples that were prepared beforehand. The process of cascade training is using the command opencv_traincascade to make the file cascade.

6. Blynk App

After creating the project as mentioned in the above sections. We need to create a switch to control the automated widows and sliders manually in case of an emergency exit and link it with the Arduino code. As you see it below a switch is created. and link it with both esp32 and laptop.

7. CONCLUSION

- By using this system, fire accidents can be reduced.
- Cost-effective since the number of fire sensors required per area is reduced.
- Minimal human intervention in extinguishing the fire.
- The safe evacuation of people in the building.
- Notifying the user in case of an emergency through various means, such as android mobile application, mobile message, and alarm.

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