

Fire Detection and Quenching System Using Image Processing

V S MAHIMA CHOWDARY MOVVA¹, THUMMAPUDI SRAVANI², REDDYBOINA PRIYANKA³,
VEMURI SUJANI⁴, TADI SHALINI⁵

^{1, 2, 3, 4} Student, Department of Electronics and Communication, Vasireddy Venkatadri Institute of
Technology, Andhra Pradesh, India

⁵ Assistant Professor, Department of Electronics and Communication, Vasireddy Venkatadri Institute of
Technology, Andhra Pradesh, India

Abstract- Fire detection is an important issue which is related to human life and social security. This is an image processing based fire detection and quenching system using OpenCV. The other important components used in this project are Arduino, webcam, buzzer and pump. Arduino is used as controller to control relay, buzzer and LED. The pump is connected to the relay. The system is divided into two parts, namely Fire detection and Fire extinguisher. In the first part, the fire is detected using image processing. OpenCV and python are used for fire detection. Cascade classifier is trained and used in the detection of fire. In the second part, camera preview will be shown, if fire is present, it gets detected and turns ON the pump and the buzzer starts the beep sound.

Indexed Terms- Arduino, Cascade classifier, Fire detection, OpenCV, Python.

I. INTRODUCTION

OpenCV is an open source computer vision and a software library in machine learning. OpenCV provides a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. OpenCV is a BSD-licensed product and it is easy for businesses to utilize and modify the code.

The library has more than 2500 optimized algorithms, which including both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can detect and recognize faces, identify objects, classify human actions in videos, track moving objects, extract 3D models of objects,

produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc.

OpenCV has C++, Python, Java and MATLAB interfaces and it supports Windows, Linux, Android and Mac OS. It leans mostly towards real-time applications and takes advantage of MMX and SSE instructions when available. A full featured CUDA and OpenCL interfaces are being developed right now. There are over 500 algorithms and are about 10 times as many functions that compose or support those algorithms. OpenCV is originally written in C++ and it has an interface that works seamlessly with STL containers.

II. EXISTING METHODS

Existing systems include Fire Detection systems which employ heat sensors or temperature sensors or smoke sensors or a combination of these.

Limitation of existing systems:

- It takes long time for the smoke detectors to detect the smoke.
- Even if there is any fire, the smoke may be generated quite later after burning the surroundings.
- There may be damage to the surroundings by the time fire is detected.

III. PROPOSED SYSTEM

The main purpose of the proposed system is to reduce the loss of life and money during the fire accidents by detecting and extinguishing the fire as early as possible.

The system is basically divided into two parts:

- Fire Detection
- Fire Extinguisher

1) Fire Detection

Webcam is used for capturing the video and then the extracted frames are checked for the fire. Cascade classifier is trained to detect the fire and by using OpenCV along with the classifier, the fire can be detected.

2) Fire Extinguisher

When fire is detected, the Arduino will turn ON the LED, buzzer and relay which in turn will turn ON the pump.

3.1 Arduino Description

Arduino is an open source computer hardware and software single-board microcontroller meant to make the applications more accessible which are interactive objects and its surroundings. It senses the environment by receiving inputs from sensors and effects the surroundings by controlling the actuators.

It has 14 digital input/output pins in which 6 can be used as PWM outputs and a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button.

Features of Arduino:

- Microcontroller : ATmeg328
- Operating voltage : 5v
- Input voltage : 7v – 12v
- Flash Memory : 32KB
- SRAM : 2KB
- Clock Frequency : 16MHZ
- Digital I/O pins : 14
- Analog input pins : 6



Fig. 1: Arduino Uno module

3.2 Relay Module

The relay used is of 5v of voltage and 10A of current with 2-channel interface board. With large current, it can control various appliances. It can be controlled directly with 3.3v or 5v signals from Arduino.

There is 1*4 pin header for connecting power and for controlling two relays.



Fig2: Relay module

3.3 Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. The typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.



Fig3: Buzzer

3.4 Operation

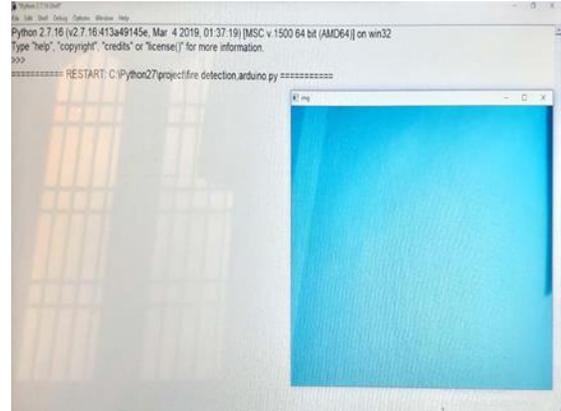
The sequence of steps for circuit operation are:

1. When the power is given to Arduino through USB, initially the relay is OFF.
2. The webcam will be continuously capturing the video, and frames are extracted from it.
3. Each frame is checked for the presence of fire. It is done by using the HAAR cascade classifier.
4. If the fire is detected, the Arduino will turn ON the relay, LED and the buzzer.
5. When the relay is ON, it will turn ON the pump.
6. The pump will be ON until the fire is quenched or extinguished, which means none of the frames has fire.

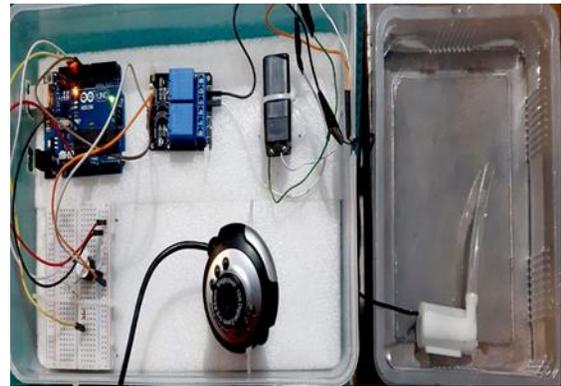
IV. RESULTS

In industries, if there is fire, it may cause a lot of damage and there would be a huge loss of money. So the sole purpose of this project is to detect the fire as early as possible and to extinguish it. So that there will not be any damage to the equipment and no loss of money and life. The CCTVs installed previously in the industries can be used for extracting images so the cost required will be less.

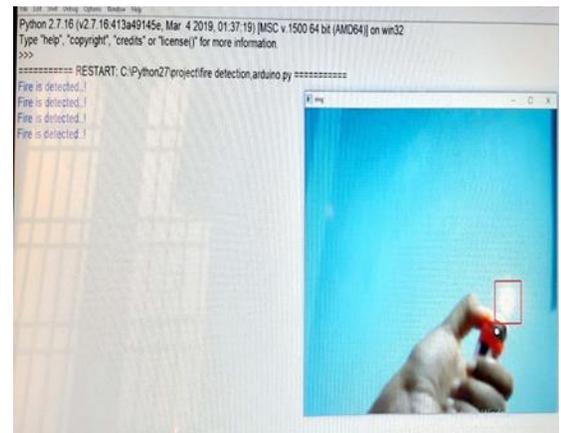
The below figure depicts the output of the project when the fire is not detected



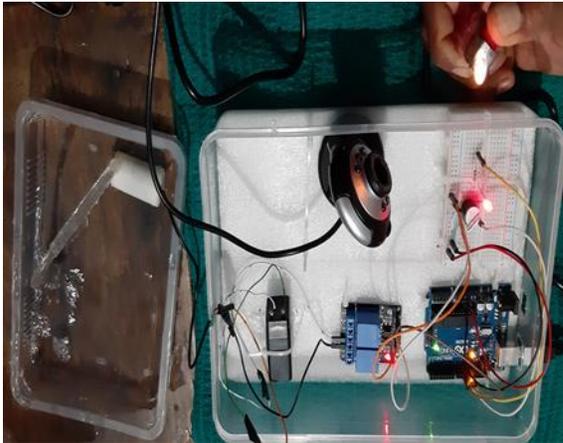
When the fire is not detected, the pump is OFF



The below figures depict the output of the project when there is fire, the screen shows the message fire is detected.



When fire is detected, the pump is turned ON



- [7] MP Sivaram kumar; S Rajasekaran; “Detection and extinguishing forest fires using wireless sensor and actor networks”

CONCLUSION

The fire detection and quenching system can reduce the loss of life and money when there is an occurrence of fire. It does so by detecting and extinguishing the fire when it is still small. It reduces the time required for locating the fire and it provides the service to the owner 24 hours a day. It is very cheap since the CCTV can be used for extracting the frames and the hardware required is also minimal.

Future studies will focus on determining the exact point of occurrence of fire and providing the appropriate evacuation guidance to the people in that area.

REFERENCES

- [1] C Yu, X Zhang-“A real time video fire flame and smoke detection algorithm”
- [2] www.electronicshub.org
- [3] <https://randomnerdtutorials.com/guide-for-relay-module-with-arduino>
- [4] High-rise building fire safety standards development research, Korea fire safety Association(2012)
- [5] P.G Smith- Fire Detection and alarm systems, iee.org volume 1977, issue 3
- [6] Huide Liu; Lili Gao; Suwei Li; Tao Wu “About automatic fire alarm systems research”, The 2nd IEEE International Conference on Information Management and Engineering (ICIME).