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Fire Detecting and Extinguishing System Based on IoT

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Abstract

It is difficult for fire-fighters to get into every nook and corner of the area which is being engulfed by fire. Sometime the region being affected by fire is out of reach of humans as the area may be very tight for the humans to get in. In such situation's robots can help to our rescue by reaching into areas where humans cannot. This paper proposes a novel fire extinguisher system which can be controlled by a mobile phone. The robot is equipped with a water tank and a water hose. The robot can be moved to the fire affected area by controlling it with mobile phone. It also has the capacity to sense the fire on its own and start spraying water whenever there is fire. The communication between the fire robot and mobile phone is established using standard mobile communication system.

KEYWORDS: Fire robot, Arduino, Sensors, fire detection,

1. INTRODUCTION

Fire breakout is one of the most harmful problems around the globe as it can lead to devastating effects like loss of life, damage to property and environmental pollution. Some of the main reasons for fire breakout are mishandling of inflammable materials (like fuel, matches, fire-crackers), gas leakage etc [1]. Many factories like the ones involved in fire-crackers and textile lack the basic fire handling facilities [2]. Many factories are also vulnerable to fire as they are old and lack modern infrastructure [3]. Also, many of them do not have the automatic fir extinguishing system using water system as well as an alarm system to notify the employees [4].

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Thus, it becomes critical to have a fire alarm system which can automatically detect fire in the surrounding and notify the employees and start the process of extinguishing the fire at the same time. In this paper, we have designed an IoT based system which can detect the fire around itself and start spraying water to control it. The device rotates at 360 degrees to detect fire in all the directions. The device can be controlled via a mobile phone also so that it can be handled manually for better performance or in case of extreme emergency where the device is incapable of extinguishing the fire on its own and has to be rescued from the site.

The rest of the paper is designed as follows: related work to this topic is described in section 2, section 3 covers the components used for the design, section 4 describes the working of. the system and finally the work is concluded in section 5.

2. RELATED WORK

A system fully capable of identifying the region affected by fire was developed by [5] using Raspberry Pi 3. Multiple Arduino were integrated along with camera and sensors to sense the fire. The camera was controlled using 360 degree relay motor to capture the image at all angles. The system provides fire confirmation message to prevent false alarms. The system sends an image along with the location of sensor to confirm the detection of fire to the admin who can further confirm or decline the identification of fire.If the presence of fire is confirmed, then an automatic message is sent to the nearby fire brigade station.

Sowah et. al. [6] used fuzzy logic for building a firedetection system for vehicles.Different types of sensors were used to sense the fire which included smoke sensors, temperature sensors, and flame sensors. The developed system used air-conditioning system to overcome the fire and it could extinguish the fire in just 20 seconds.

A new paradigm to detect forest fire was proposed in [7]. The authors focused on analysing the sensor data rather than working on fire detection itself by the sensors. The collected data was processed using neural network technique. They used ZigBee wireless network consisting of Arduino Uno microcontroller. The system could detect heat and alarm when the temperature rises above a fixed threshold.

An early fire warning and alarm detection system was developed by [8] which worked by acquiring real-time data from the sensors. The system acquired real time information about pipe flow, temperature, pressure and humidity, and uploaded the data to a client/server architecture. Based on the data collected a neural network model is deployed to predict fire and improve building safety level evaluation.

In [9] a smoke-detection system for fire alarm system as developed which was based on video processing. Chromaticity based static rule and diffusion based dynamic rule were used for smoke detection. The chromatic decision rule works by detecting the gray colour of the smoke while dynamic rule works on spreading attributes of smoke. The system had a low false alarm rate and could be used in military, social security etc. applications.

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In [10], gas sensor, smoke sensor and flame sensors were used to develop a fire monitoring andcontrol system.To identify the exact fire location, GSM/GPS systems were used. The authors used Raspberry Pi which had the capability to handle multiple Arduino systems. On fire detection a fire sprinkler system is used to extinguish fire.

3. SYSTEM COMPONENTS

Microcontroller 8051

It is 8-bit microcontroller, that means MC 8051 can Read, Write and Process 8 bit of data. This is version of microcontroller generally used in the robotics, home appliances like microwave oven, washing machine etc.

Smoke Sensor

Smoke sensor is used for sensing the fire around the robot. Smoke is detected either by ionization or by photoelectric method. On detecting the smoke the signal is passed to the microcontroller which then triggers the spray of the water from the water tank.

Buzzer

Typically, the buzzer and smoke detector are used simultaneously so that whenever a smoke is detected the buzzer should ring so that the user is aware of the smoke; the buzzer has a buzzer driver that is to be connected to the microcontroller.

Geared and DC Motor

L293D motor driver is used to control the DC motor. The working mechanism used is that of H-bridge. The DC motor is used to convert the electrical energy to mechanical energy.

Water Pump

A small water pump is used to sprinkle water on fire. It is powered by batteries. Small size electric water pumps, such as those used in homes, typically small DC motors. DC motor is contained in a seal case connected to the impeller and powers it through a simple gear drive. Through a series of pushes, the rotor continues to spin, driving the impeller and powering the pump.

Mobile Phone

A mobile phone is a device that is used to communicate wirelessly between two locations. A mobile phone can also be known as a cellular phone.The main purpose of a cellular phone is to connect people wirelessly so that communication can happen easily; a cellular phone requires a cellular network for communication, usually provided by a SIM which means Subscriber Identity Module.A cell phone is primarily a two-way radio, consisting of a radio transmitter and a radio receiver. Whenever there is a communication between two people, a mobile phone converts your voice message into an electrical signal and vice versa. The process is used on the receiver side.

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Batteries

A battery is a device that converts a chemical energy into electrical energy. A battery produces a DC electricity.A DC electricity is unidirectional in nature means a charge travel in one direction, a battery is the best example of DC power source, a DC power source can travel through any medium it need a conductor like wire to flow through

Resistors

Resistor offer resistance in the path of current, the resistivity of the resistor depends upon the colour band used different colour has different resistivity; we read colour code from left side.

4. SYSTEM DESIGN and WORKING

The robotic body has a mounted water tank and is operated through a suitable signal from the end transmitted from the microcontroller output. All the system operations are controlled by 8051 microcontroller. The controller handles the motor through a motor driver IC which is interfered to the microcontroller. The project is controlled wirelessly using the DTMF IC MT8870. It is a double tone multiple frequency generator. A total of two mobiles are used here, one mobile phone is always with the circuit and the other will be with the user as shown in the block diagram above as the user's cellphone and the circuit cellphone. When we press any key in our cell from 0-9, a special type of double tone multiple frequency is generated. This frequency is carried into the circuit via headphones. We can wirelessly transmit this

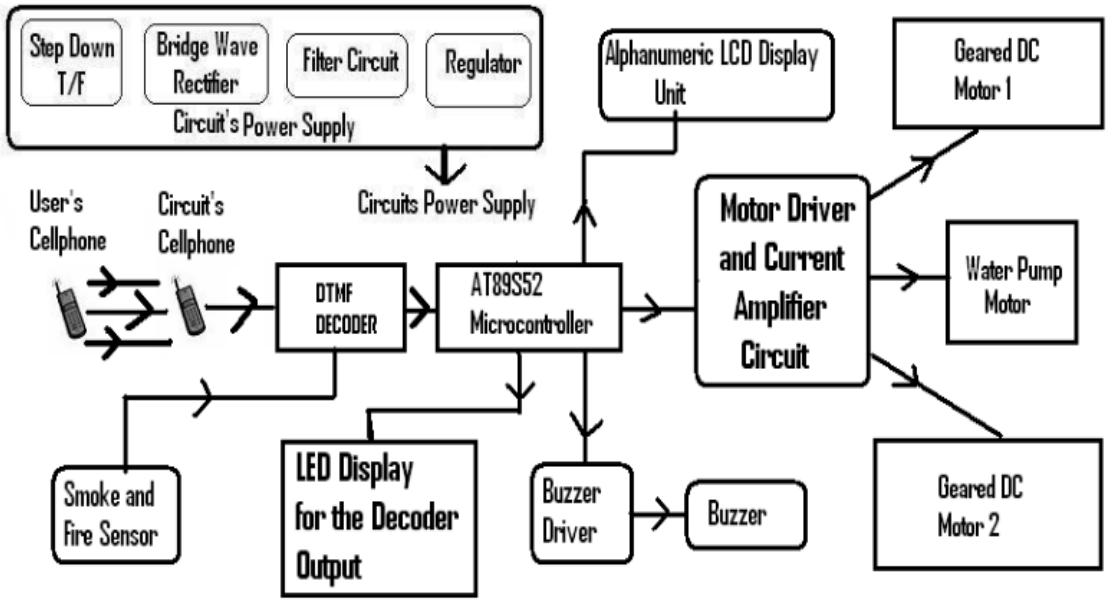

Figure 1: System Design

multiple frequency from one cell to another. Multiple frequencies are decoded by the decoder MT8870 IC and the decoded signal is sent to the LED display for a clear visual indication of whether the signal is coming from behind for further processing and then to the microcontroller. According to the keys the press sends a signal to the microcontroller current driver IC l293d which in turn sends amplified signals with high current and voltage gain. We

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have set a sound on the robot. It appears when the robot detects any fire near it. The fire is detected with a fire sensor or smoke sensor. As soon as the fire sensor detects the fire, it immediately sends a signal to the microcontroller and the controller activates the buzzer so that the user is aware of the fire in his house. The buzzer sign is most important when the house is on fire when we are in a state of sleep. Buzzer signals wake us up and control the robot to extinguish the fire.Figure 1 shows the system design while Figure 2 shows a snapshot of the actual system.

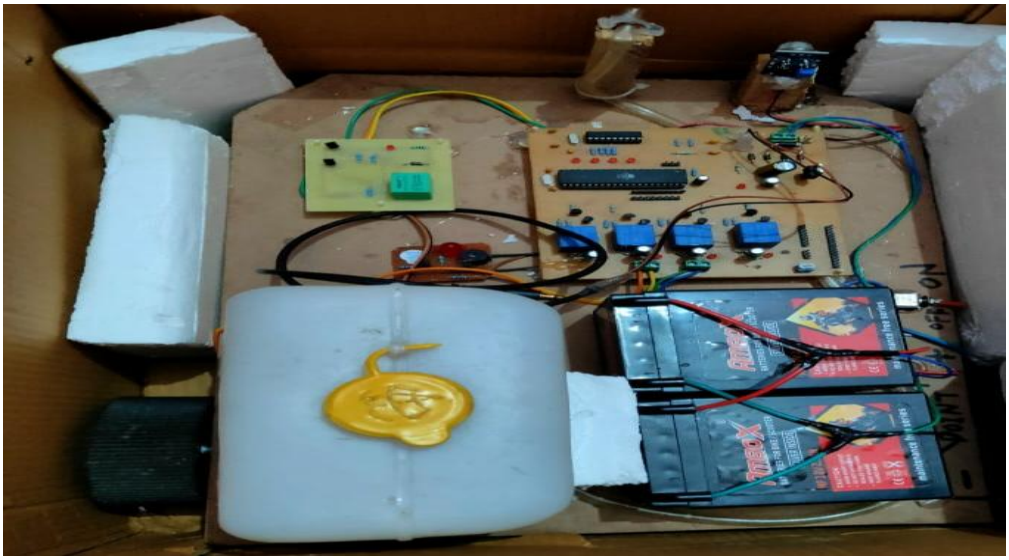

Figure 2: Snapshot of the developed system

5. CONCLUSION

This paper develops a novel low-cost fire detecting and extinguishing system. The proposed model rotates 360 degree to detect any fire in its vicinity. On detection of fire water is sprinkled in order to extinguish the fire. The system can be handled from a remote location with the help of mobile phone. It can also be manoeuvred by using mobile phone keys. Based on its simple design and operation, it can be as on-line monitoring and fire alarm system also. It is a small-scale model and can be further enhanced on to commercial scale.

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