JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

FABRICATION OF SENSOR-BASED EMBEDDED FIRE DETECTION AND AUTOMATIC EXTINGUISHER SYSTEM

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ABSTRACT: Fires always have the potential to break out in large industrial production facilities, warehouses, and factories. There is a possibility that a significant number of lives could be lost if appropriate firefighting measures are not taken. In addition to financial losses, this could also result in disastrous outcomes. The disadvantage of standard building fire protection systems is as follows: Each sprinkler only emits a small amount of water, which might not be enough to put out the fire. The sprinklers are not directed, but they do damage to computers, furniture, and paperwork by spraying the entire floor or building. This sprayer gun, on the other hand, can only apply the desired quantity of water to the fire outbreak point to put out the flames without destroying the office furniture or electronics. This demo version can be controlled from a distance of a few meters, but a future version will be controlled from the fire department remotely. A high-capacity, aimable water jet used to deal with large fires are fire monitors and sprayers. Unlike Fire extinguishers, Fire Monitors are permanently installed and cannot be moved. This fire monitor has sensor-based control, whereas traditional fire monitor systems require a human operator to adjust the water jet's direction and aim. allowing the user to operate it safely from a distance.

I.NTRODUCTION

In developing nations like India, fire hazards are common, claiming lives and property annually. In 2018, the India Risk Survey (IRS) found that fires are the third-most serious threat to business operations and continuity. Accidents from fires are alarming and devastating So, to minimize losses resulting from accidents and save lives, Fire extinguisher robots will play a vital role. Another factor is the firefighters involved in these accidents, who put their lives at risk to save the victims. Because it has an impact on the target area as well as the surrounding area, the location of the fire accident is crucial, such as chemical mills, garment factories, gas stations, and so on. This type of accident results in loss to lives, and pollutes the environment. Fire safety standards and measures have been established by the government and other regulatory agencies, but execution and vigilance remain crucial issues. When compared to humans, robots are automated machines that are able to carry out

tasks in a way that is effective, economical, and accurate. As technology has improved, its popularity has increased, reducing the need for human intervention. Mechatronics: Using the concept of mechatronics, the development of robots consists of hardware, electronics, and programming to automate our day-to-day activities and make life easier. This paper's firefighting robot uses a programmable microcontroller ESP 8266 controlled by nrf to provide remote maneuvering, detect fire-affected areas with a flame sensor, and allow the user to manually control the robot to extinguish the fire with a water pump connected to a water storage tank. Problem Description Fires are known to significantly damage property and kill a lot of people (victims and rescuers). Fire fighting robots will be useful for putting out fires because of the high temperature and the presence of potentially hazardous materials, especially in places where firefighters can't get there.

II.LITERATURE REVIEW

Firefighting in dangerous places is a difficult real-world problem in today's world. Innovative solutions have been developed by numerous researchers working on Mechatronics, Internet of Things (IoT)-driven methods for firefighting robots. M. Tawfiqur Rakib A. Rashid Sarkar proposed a model of a firefighting robot with a base platform made of "kerosene wood," a temperature sensor for LM35, flame sensors for detecting fire, and a water container with a capacity of 1 liter that is made of strong cardboard that resists water. Two wheels enable the robot to move. [1]

Saravanan P. and Soni Ishawarya came up with a model that makes use of an Atmega2560 microcontroller and divides the robot into three basic units based on their roles: a locomotive unit, a fire detecting unit, and an extinguishing unit. In order to achieve the desired outcome of putting out the fire, each unit does its job. With the assistance of four infrared and four ultrasonic sensors, the locomotive unit is utilized for the robot's movement and for avoiding obstacles. The LDR and temperature sensor of the fire detecting unit are used to detect fire. The water container and BLDC motor of the extinguishing unit are used to put out the fire. In addition, the robot is equipped with a Bluetooth module that can communicate with smartphones to direct it in the right direction. [2]

Boo Siew Khoo shows off the Fire Droid, a robot that can automatically detect and put out fires. The fire-fighting robot will be able to identify the flame and proceed to the fire's origin in the event of a home fire. After securing the fire position and determining the flame distance, water is pumped out of the water tank to put out the fire. [3]

P. Singh developed the control system for a mobile autonomous industrial firefighting robot. The paper shows how to make and design firefighting robots that can do a lot of different things. The structure contains two D.C. engines that are optically separated. The infrared sensor data is transformed by the robot in a variety of ways, from straightforward to intricate. Five infrared sensors are in use. The robots are controlled by two sensors, and the other three are used to detect fire. The douser comes with a water compartment and a DC water syphon. The paper's primary objective is to locate and contain fire outbreaks. This infrared sensor serves as an information sensor, detecting infrared beams emitted by the fire. The microcontroller is in charge of controlling the extinguishing mechanism. [4]

"Design and Fabrication of Fire Fighting Autonomous Robotic System Equipped with Sensitive Sensors for Fire Alarm and Detection, Avoidance Behaviour Mechanism and SMS Messaging Capability," is the title of this undertaking. The title was based on the functions and objectives of the study. However, this project was similarly alike to other robots but this innovative robot was the researchers own idea. Technically, the researchers thought about the features, focusing on how the parts worked together to make a robot. The Construction and Design of Fire Fighting The Autonomous Robotic System, which is equipped with sensitive sensors for the detection and alarming of fires, an avoidance behavior mechanism, and SMS messaging

capabilities, has additional characteristics that set it apart from other systems. It was installed with an alarm system that notifies the owner that flame has occurred. In addition, it has an additional function that allows it to detect the combustion of flames, such as an ultrasonic, flame, or smoke sensor. Robot is a machine that resembles a human being and mimics various complex tasks. Let's take a look at some of the current firefighting robots. The following robots below are the characteristic of the previous robot that have been similar with this robot project and used in the literature review

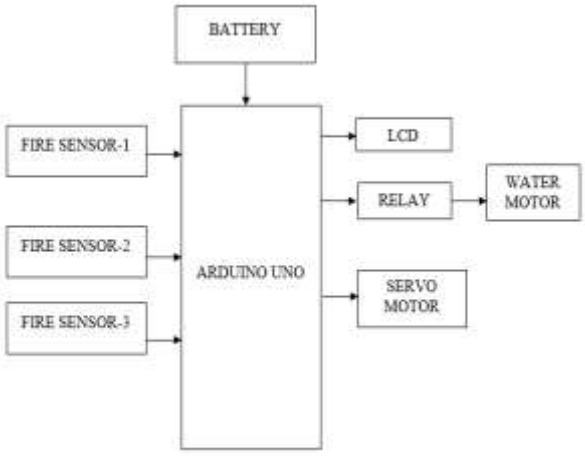
In 2011, Min Chen, Zenghua Zhao, and Lingyan Ran published a paper titled "A 360-Degree Fire Fighting System using Wireless Sensor Networks" in the Journal of Network and Computer Applications. A wireless sensor network-based 360-degree firefighting system that uses a variety of sensors and actuators to detect and put out fires is presented in this paper. With sensors strategically placed to detect fires coming from all directions, the system is intended to provide extensive coverage and quick response times. The system's architecture, sensor placement, and control algorithms are described, and experimental results show that the system works well. In 2018, Hyun-Il Lim, YoungHoon Cho, and Se-Jin Kim published "Development of a 360-Degree Fire Protection System for Smart Buildings" in the International Journal of Electrical and Computer Engineering. A smart building-specific 360-degree fire protection system is presented in this paper. The system utilizes a combination of video cameras and heat sensors to detect fires and uses a combination of sprinkler and gas suppression systems for extinguishment. The authors describe the system architecture and the algorithms used for fire detection and suppression and provide experimental results demonstrating the effectiveness of the system.

"An Intelligent Fire Extinguishing System Based on 360-Degree Coverage," by Yanyan Li, Ming Zhou, and Zhenhua Li, published in the Journal of Computational Information Systems in 2018. A 360-degree-coverage-based intelligent fire extinguishing system is presented in this paper. The system uses a combination of infrared sensors, ultrasonic sensors, and video cameras for fire detection and a high-precision servo motor for accurate positioning of the extinguisher nozzle. The authors describe the system architecture and the algorithms used for fire detection and suppression and provide experimental results demonstrating the effectiveness of the system.

III.PROPOSED SYSTEM:

A high-capacity, aimable water jet used to deal Sprayers and fire monitors are used in large fires. Fire monitors, in contrast to fire extinguishers, are permanently installed and cannot be moved. While traditional fire monitors systems need a human operator to change the direction of the water jet and aim it appropriately, this fire monitor has been equipped with automatic control. allowing the user to operate it safely from a distance. A piping system is used in conjunction with a powerful sprayer motor and servo motor to operate the system. A second servo motor controls the nozzle's movement direction. A wireless remote can be used to send movement commands. The system's receiver circuitry takes user commands and turns on the motors to produce the desired movement. The receiver also initiates and terminates the pump motor. The sprayer mechanism is designed to operate in a two-degree-of-freedom mode to achieve 360-degree water spray coverage and adjust position in the x and y directions..

BLOCK DIAGRAM:



IV.MODULE DESCRIPTION:

A.Arduino Uno Microcontroller :

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button. Arduino can be used to communicate with a computer, another Arduino board or other microcontrollers. The ATmega328P microcontroller provides UART TTL (5V) serial communication which can be done using digital pin 0 (Rx) and digital pin 1 (Tx). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The ATmega16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board.

Fig 1:Arduino UNO controller

B.Flame Sensor Working and Its Applications

A sensor which is most sensitive to a normal light is known as a flame sensor. That's why this sensor module is used in flame alarms. This sensor detects flame otherwise wavelength within the range of 760 nm – 1100 nm from the light source. This sensor can be easily damaged to high temperature. So this sensor can be placed at a certain distance from the flame. The flame detection can be done from a 100cm distance and the detection angle will be 600. The output of this sensor is an analog signal or digital signal. These sensors are used in fire fighting robots like as a flame alarm.

Fig 2:Flame sesnor

MG996R SERVOMOTOR:

The **MG996R** is a **metal gear servo motor** with a maximum stall torque of 11 kg/cm. Like other RC servos the motor rotates from 0 to 180 degree based on the duty cycle of the PWM wave supplied to its signal pin..Next comes the most important parameter, which is the torque at which the motor operates. Again there are many choices here but let us assume the one with 2.5kg/cm torque which comes with the **MG996R Motor**. This 2.5kg/cm torque means that the motor can pull a weight of 2.5kg when it is suspended at a distance of 1cm. So if you suspend the load at 0.5cm then the motor can pull a load of 5kg similarly if you suspend the load at 2cm then can pull only 1.25. Based on the load which you use in the project you can select the motor with proper torque. The below picture will illustrate the same.

Fig 3:Servo motor

RESULTS:

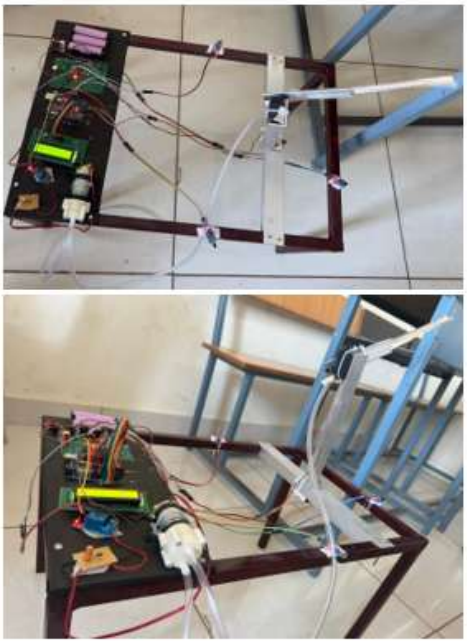


Fig 4:Hardware implementation

CONCLUSION:

Fire has always been a devastating phenomenon but the technology advancements it become easier to tackle it. Firefighters try their best to respond quickly to case of fire and event put their lives at risk of they endeavour to save human life and protect property fromthe fires. Some attempts have been made to automatic fire fighting for the navy (ship board autonomous fire fighting robot). This paper describes one such solution to the problem of fire fighting with help of 360 degree fire protection system. In conclusion thereare many possible ways to put out fires but it always safer to use the constantly this idea toreduce the involvement of fire fighters thereby decreasing the risk of physical injuries and life threats. Comparing this prototype with the existing technology we implement the sensor and wireless technology. Nowadays the fire fighting technologies are fully manual. in scope of future we implement wireless technology to control the fires.

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