Fire Detection and Direction Control of Fire Fighting Robot

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ABSTRACT
Firefighting has been a traditionally dangerous occupation, and a lack of technological innovation has resulted in many and many losses. In addition, current fire-fighting techniques are ineffective and ineffective, relying too much on people who, no matter how well trained, can make mistakes. The use of robots instead of humans to deal with fire hazards is a recent trend that has attracted attention. This is because they can be used in a situation that is too dangerous for anyone to get involved in. A fire can start in a factory or in a remote area for a variety of reasons. Leaks in electricity, for example, can cause serious damage to the cotton industry, the textile industry, and the petrol industry. In addition, it is a very serious condition, leading to significant financial losses and the destruction of nearby communities. Robots are a viable option to protect human life, prosperity, and the environment. The goal is to create a FIRE FIGHTING ROBOT utilizing an embedded system. It will be created and manufactured a robot capable of battling a simulated home fire. It must be able to travel a modelled floor layout automatically while aggressively scanning for a flame. Under addition, the robot may function as a path guider in regular circumstances and as a fire extinguisher in an emergency. Robots built to detect a fire before it spreads out of control might one day operate alongside firefighters, drastically lowering the danger of human harm. The project will serve to create interest and creativity in the domains of robotics while working toward a practical and attainable result to save lives and reduce property danger.

General Terms
Fighting Robot, Fire detection

Keywords
Arduino, Flame Sensor, Ultra Sonic Sensor, L293Motor Driver

1. INTRODUCTION
A robot is a machine that performs tasks that are normally assigned to humans and is loaded with a series of repetitions or flexible behaviors. Numerous studies have shown that robots can be effective in medicine, rehabilitation, convalescence and industrial settings. Robots have been used in many industries over the years. Robots in this industry are manipulators with many numbers. It is intended to perform various functions on specific objects, partitions, widgets, or tools that use various system functions. According to the Fourth Industria Revolution (4IR), there is a need for a single system that can use, connect and integrate robots with multiple types and specifications. Machine learning has also sparked interest in robots, so far only a small part of the current growth of robots can be calculated. The latest robot development project has an integrated machine learning algorithm to increase the intelligence of robots. This will improve industrial productivity while reducing costs as well as electrical waste over time. The fire truck is believed to have evolved.

The main function of this robot is to transform it into a self-propelled fire extinguisher. Various vehicles are available to fight domestic and forest fires. The proposed robot is designed to be automated or remotely controlled. With the help of such robots, fire detection and rescue operations can be carried out with better security and externally threatening the safety of firefighters. By using such robots, rescue and rescue operations can be carried out quite safely without endangering the firefighters. Put another way, robots can reduce the need for firefighters to enter potentially dangerous situations. In addition, the size of the robot is small and independent, allowing it to be used in case of fire in dangerous areas, such as nuclear power plants or power plants.

2. RELATED WORKS
Hossain, MdAnowar, Himaddri Shakhar Roy and others are the members involved [1] this work involved a robot having an automatic fire extinguisher as its hardware component which it used to put out fire immediately. The shield of the robot is made of calcium silicate plates which can withstand temperatures up to 300 °C. The robot starts responding and reacts to the fire when the ends of the thermocouple are heated up after which their temperature will begin to decrease.In places which are very remote and non-accessible by the fighters, these robots come into picture. It is an automatically controlled robot. As soon as a fire is detected, thermocouple is activated to detect the fire. Additionally temperature sensor is used as a backup in the thermocouple. IC741 is used as both an amplifier and a simulator in combination to pump water. MATLAB is used for image capturing and processing

Hemalatha K N, Pramod B N are the members of this survey[2] Internet of Things based robot is built here in order to support firefighters in all critical situations. The presence of flammable gases is detected by the gas sensor. The temperature sensor transmits information about temperature and humidity. A passive infrared sensor is used to ensure human existence .This robot being both manually and automatically workable is its prime advantage. monitoring the affected area over Wi-Fi is done using IoT-based communication system.

Sreesruthi Ramasubramanian, Senthil Arumugam Muthu Kumaraswamy, et al., [3] The server is designed to serve a bot . Android phone's camera is used to take continuous pictures of the server. monitoring the temperature is done using the temperature sensor. On account to increase in temperature it is monitored using a smoke sensor. Obstacles are detected in the path of the robot using IR sensor. Information from the robot is delivered to the Android phone using the Bluetooth module connected to the controller. These messages are then forwarded to the web server by the web browser . It is a fixable fire extinguishing system with a small built-in controller.

Mittal, Shiva, Manish Kumar Rana and others. [4] This model was designed to assist firefighters in real-time emergency situations. Water and carbon dioxide were used to extinguish flames .Fog sprays were used for thermal protection. The study accomplished in the development of a robot that functioned as a fire extinguisher. It remotely controlled a wireless communication channel.The robot was found to have more control and weight with more torque. The system is examined in order to test the design of the machine as well as the adequacy and functionality of the robotic software. The robot performed all the tasks as predicted which demonstrated its ability to handle real-world situations. A transceiver was used in a controller that offered a maximum distance up to 1.8 km.The remote-controlled fire extinguisher, could monitor the situation using an internal camera. In order to contact victims trapped inside damaged buildings, the volume of the fighter played a major role. The robot was built as predicted and it was constructed using intentionally built flames. The robot's positive response when placed in front of a fire, demonstrated its ability to operate with the same accuracy and fluency when considered in real-world situations.

P. Anantha, Raj and M. Srivani[5] If quick actions were taken with respect to fire accidents the risk of losing live's would reduce. This paper provides an idea to integrate a non-dependent manual firefighting robot with Internet of Things (IoT) to excel in pre-fire extinguishing condition. In case of a fire, the IoT apparatus will send a message which contains the details of location. Afterwards, the robot utilizes an algorithm based method to the median and performs the necessary operations and later transfers the video to the robot in the control manager. The robot works by detecting the fire and by sending warning signals. The robot then connects with the world via live video and map display via Bluetooth. It conglomerates computer ideas and machine learning with robot intelligence to identify major outbreaks in the particular area. The idea of this project is to ameliorate the system and they can interlace in the premature stage of an industrial fire, thus stopping harmful damage to the place. In the future, machine learning, computer vision and other sensors can be added to strengthen the efficiency of the robots. Fire alarm systems will be an additional system increase the efficiency of the IoRT system.

Sampath, B. Swetha, [6] Fire fighting robots are mainly utilized in home fire detection and other extinguishing devices. To detect fire we use fire sensors. Wide range of fires can be detected by using artificial intelligence. To identify object we use Haar Cascade Classifier which uses machine learning. This classifier learns from the previously trained YOLOv3 model which was used to train so that it would detect the fire to improve the efficiency. This classifier is an advanced model to identify objects with the help of videos and images. To classify the images learning based algorithm is often utilized. In most of the scenarios the camera is always positioned horizontally .The disadvantage of this project is that the robot cannot apply the intelligence after it reaches a certain point.

Mohd Aliff, M. Yusof, Nor Samsiah Sani [7] and others. A fire accident can lead to a lot of life and property damage which cannot be repaired. Firefighters are the ones who are responsible for putting out fire and are at major risk. A QRob has been successfully designed in order to put out fire without the help of firefighters. The QRob consists of fire sensor and a ultrasonic sensor that prevents it from colliding with obstacles or objects in the surrounding. Both sensors are connected to an Arduino Uno which controls the movement of the QRob. QRob is designed in such a way that it stands at a distance of 40cm away from fire and extinguishes it. Thr robot can be manually monitored with the help of camera which is connected to a remote device. Because of the compact size of the QRob it can access small doors and small areas. The user can extinguish fires from a long distance using a remote control. Users can also monitor various parameters during the firefighting process using a smartphone and camera. According to research results, the robot can only detect smoke and fire for a short time.

H. Guo, Ting L. Chien, and others [8] the personal safety of a person's residence, workplace, laboratory, and other property affects their health. We created a sophisticated security system for us with numerous sensors and a fire extinguisher. Fire truck with an aluminum frame. The robot has a cylindrical shape. The circular is roughly 50 cm in diameter and is 130 cm tall. programmers that build obstacle and driving systems, design software, detect fires, use remote monitoring, and have a fire truck as a component. Two fire sensors are combined in the fire detection fire extinguisher system. Firefighter fire detection systems and software both employ sensors to identify fires and their causes.

3. OBJECTIVES

- Design a system of fire extinguishing robots using Arduino Uno, fire sensor and L293 car driver.
- Identify the fire and extinguish it properly.
- To determine if there is any understanding of the victims and send a notice to the police.
- Increasing the ultrasonic sensor for barrier detection capabilities.
- Allows you to control the position of the robot with Arduino and sensors by building Bluetooth software.
- Getting started with low cost.

4. HARDWARE AND SOFTWARE REQUIREMENTS

1. **Arduino Uno:**

The ATmega328P-based Arduino Uno microcontroller board was created by Arduino.cc and is open source. The board has groups of analogue inputs/outputs (I/O) and digital pins that can be connected to other boards (shields) and areas. The board is prepared using the Arduino IDE (Integrated Development Zone), and it comes with a USB type B cable. It includes 14

digital I/O pixels (six PWM outputs), six PINM analogue I/O pixels, and is formatted. For receiving voltages between 7 and 20 volts, either a USB cable or external 9-volt battery can be used. The design and production files for different hardware versions are also accessible, and the hardware reference design is still made available on the Arduino website under a Creative Commons Attribution Share-Alike 2.5 license.

2. Ultrasonic sensor:

Devices that produce or sense ultrasound force include ultrasonic transducers and ultrasonic sensors. Transceivers, receivers, and transmitters are the three broad categories into which they can be separated. Ultrasound can be sent and received using transmitters that transform electrical impulses into ultrasound, and receivers that do the opposite. Airspeed may be measured and tracked using ultrasound. The device uses a number of indicators to indicate speed or direction and calculates speed based on the distance to air or waterborne particles. The sensor measures the distance to the liquid surface for tank or channel liquid level readings and for sea level as well.

3. Flame sensor:

A fire detector is a sensor that is created to recognise and react to the presence of flames, allowing for the detection of fire. At a distance of around 0.8 m, flames like lighter flames can be seen. A 60 degree angle is the detection angle. The flame spectrum is one to which the sensor is especially sensitive. Because of the techniques it employs to detect fires, a flame detector is typically able to react quicker and more precisely than a smoke or heat exchanger.

4. BO Motor with 100 RPM:

Plastic Gear Motor, BO Series, 100RPM. A major benefit of these motors is the BO series motor's ability to operate with good torque and speed at low operating voltage. Both a multifunctional wheel with an 87mm diameter and a 69mm diameter wheel for plastic gear motors can be used with this motor. inexpensive DC motor It is a part of the DC motors we use. It has a working voltage range of 3 to 12 volts and can be used to make tiny and medium-sized robots. both 60 and 150 rpm are available. For DIYers, the motor is perfect. This motor kit is ideal for use in a portable robot car because it is affordable, portable, quick to install, and tiny. On our 2WD platforms, they are commonly utilised.

5. L293D Motor Driver Shield:

A monolithic integrated, 4-channel, high-voltage, high-current driver is the L293D. The L293D chip, also known as an H-type chip, can offer a maximum current of 600mA per channel, which essentially means you may use it with DC motors up to 16 Volts, a very good motor. - fruit juice. An H-bridge is often a type of electrical circuit that enables the application of electricity to the entire load in any direction to the socket, such as a car. The L293D is four times as powerful as the H-drivers of today. At voltages ranging from 4.5V to 36V, it is intended to give drive supply currents of up to 600mA. Relays, solenoids, DC and traction motors are only a few examples of the inductive loads that both devices are made to drive.

6. Relay as switch:

An electrical switch is a relay. It has a set of active communication terminals as well as a set of terminals for the input of one or more control signals. In most contact forms, such as contacts, broken contacts, or a combination of yours, a switch can have any number of contacts. Relays are employed when a single signal has to control many circuits or when a circuit needs to be controlled by a separate, low-power signal. Long-distance telegraph circuits started utilising relays as signal multipliers, regenerating the signal coming from one circuit by passing it to another. In order to complete important jobs, relays are frequently utilised in telephone exchanges and early computers.

7. Bluetooth Module:

Bluetooth is a widely accepted short-range wireless technology that may be used to create personal area networks (PANs) and exchange data between stationary and mobile devices in the UHF radio wave region. It is frequently used to connect mobile phones and music players to wireless headphones, exchange files between adjacent mobile devices, and replace telephony. The transmission power in the most common mode is estimated to be 2.5 milliliters, giving you a very modest range of up to 10 meters (33 feet). The Bluetooth Special Interest Group (SIG), which has more than 35,000 members, owns Bluetooth. Companies involved in computing, networking, and consumer electronics.

8. Temperature sensor:

A temperature sensor is a device that uses an electrical signal to provide a legible measurement of temperature. It is typically a thermocouple detector or temperature resistor. The most basic type of thermometer used to measure temperature and humidity is the thermometer. In the geotechnical profession, thermometers are used to track the structural changes that occur in concrete, structures, soil, water, bridges, etc. as a result of seasonal variations. The RTD (Resistance Temperature Detector) is a dynamic protector that modifies its electrical resistance in a precise, repeatable, and almost linear manner in direct proportion to variations in temperature.

9. GSM Module:

The European Telecommunications Standards Institute created the standard known as GSM (Global System for Mobile Communications, formerly Groupe Special Mobile) (ETSI). operating in more than 219 nations and territories, accounting for more than 90% of the market. A chip or circuit known as a GSM module or GPRS module is used to link a computer or mobile device to a GSM or GPRS system. The modulator is crucial in this situation (modulator-demodulator). These modules have a connector and a power circuit that power a GSM or GPRS module (eg RS-232, USB 2.0, etc.). The GSM modem may be a portable GSM modem or a dedicated serial, USB, or Bluetooth modem device..

10. Arduino IDE:

Java was used to create the cross-platform Arduino Integrated Development Environment (IDE), which runs on Microsoft Windows, macOS, and Linux. It is built using strings and an IDE for language processing. With just one click, it offers simple ways to integrate and upload programmes to the Arduino board. It comes with a code editor that contains capabilities like cut and paste text, search and replace text, auto-loading, brace matching, and syntax highlighting. A message section, a text terminal, a toolbar with buttons for common operations, and a list of job offers are also included. The GNU General Public License, version 2, is used to release the IDE source code.

11. Bluetooth Electronics:

Utilize your Android mobile to manage your electronic project. The Bluetooth module in your project, either the HC-06 or HC-

05, is used by this programme to communicate. There are 11 Bluetooth Arduino examples in the library that comes with this application. Additionally, it can be utilized with Raspberry Pi and any other fast prototyping platform where a Bluetooth module appropriate for your project has been installed.

5. METHODOLOGY

Our robot has an Arduino UNO microcontroller that is adhered to various sensors. It makes use of flame, ultrasonic and a temperature sensor. The ultrasonic sensor is used to detect an obstacle or human in front of it and stop immediately. The flame sensor is used to detect a flame and send signal to the audio to facilitate pump to put off the fire by pouring out water. An L293D motor shield is used to protect the Arduino board and to facilitate movement of wheels by switching on the BO motor. BO motor is powered by L293D and rotates the wheel. Bluetooth module is used for remote control to facilitate the backward, forward, left and right movement of the robot and also to fetch information regarding the temperature using the temperature sensor. Pump is used to pump out the water when it receives signals from the Bluetooth module to extinguish the fire. Relay acts as a switch for the pump and when logic 0 is given, connection is made between the batter and the pump and water is pumped out. If logic 1 is given, then the connection is broken and pump is turned off.

Figure 1: Block diagram of Fire Fighting Robot

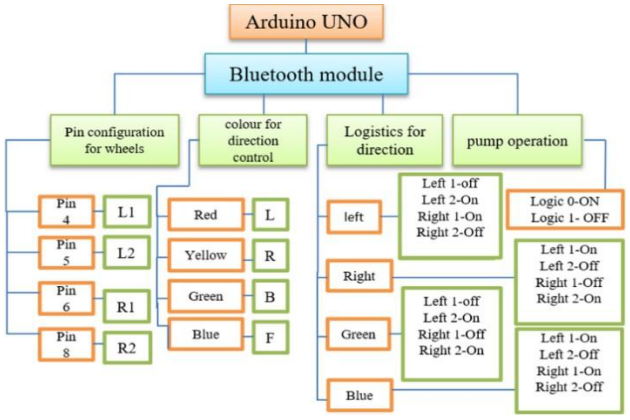

Figure 2: Flow Chart of proposed work

6. RESULT AND DISCUSSION

A fire fighting robot that could detect small fires by making use of the flame sensors was successfully created. The robot could thus pump out water immediately and extinguish it. The pump is based upon the functioning of the relay with a logic low concept. The ultrasonic sensor could successfully detect any obstacle within a set range of 6 cm and stop before it. The Bluetooth software that we used was "The Bluetooth electronics". This was used to maneuver the robot in the forward, backward, left and rightward direction. The keys that were specifically the red for leftward motion, yellow for rightward, green for backward and blue for forward motion. The pump can be turned on using logic 0 and wasused to turn off using logic 1.

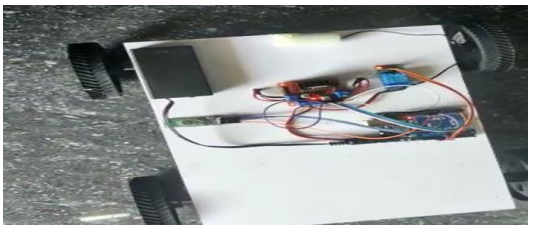

Figure 3: Addition of different sensors and Arduino UNO

Figure 4: Extinguishing fire using fire fighting robot

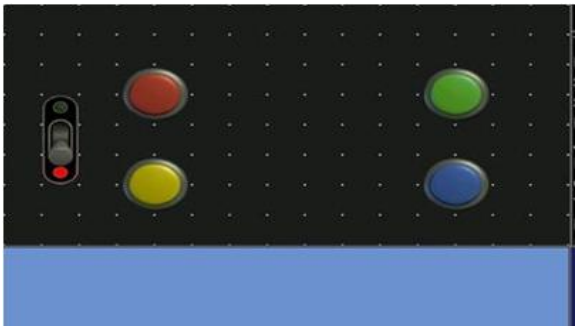

Figure 5: Bluetooth electronics software

- We designed the robot using Arduino UNO, Flame sensorand L293D motor driver.
- The robot could detect the fire and extinguish it properly.
- It could detect the presence of victim or obstacle front of it and stop immediately with the action of ultrasonicsensor.
- The use of the open source software: Bluetooth electronics for maneuvering the motion of the robot was successfully implemented with the usage of particular colour key for particular direction.
- The project was successfully implemented at a reasonableprice.
- GSM module is used to send the notifications to the concerned authorities.

7. CONCLUSION

Accidents caused by fire can result in significant injury and property loss. This paper presents fire detection and

extinguishment using autonomous robot, as well as a complete assessment of several fire-fighting robots. This will undoubtedly result in a better system for monitoring water quality, and the water resources can be rendered safe by fast action. Despite the fact that there has been numerous good fire- fighting devices, the research topic remains tough. This paper provides an overview of current research efforts by researchers to make fire-fighting robots smarter, less expensive and more efficient. The use of cutting-edge sensors for measuring various quality criteria as well as the usage of wireless communication standards for improved efficiency.

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