Smart Autonomous Fire-Fighting Robotic

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Abstract: **The increased number of fire accidents recorded worldwide has led to an increased demand for systems and styles to help reduce this increase and ensure that lives and properties are protected from the troubles of fire incidents. An essential consideration in this regard is the capability to detect and extinguish fire incidents at early stages to help prevent further damage and reduce losses; this has led to the increased use of technology in firefighting incidents for fire discovery, fire alarms, and fire extinguishers. This proposed system is aimed at the design and perpetration of a Smart Autonomous firefighting robotic that will automatically descry the presence of fire, automatically navigate to where the fire is, and extinguish the fire using a water pump system without mortal hindrance and while extinguishing the fire, it'll shoot an SMS within 5 seconds of cranking the pump and a call alert within 10 seconds of starting the pump to the proprietor of the property where it's stationed.**

Keywords: **Arduino, L293D buck motor, fire detector, servo motor, SIM 800L, DC motor, water pump.**

INTRODUCTION

Technology is fast evolving and has led to automating numerous processes and tasks to make life easier and safer for humans. In the modern world, machines, also known as robots, are being used to perform specific tasks that may be dangerous or delicate for humans to carry out efficiently. As the days go by, there's an increase in the number of tasks being performed by robots, making robotics one of the fastest-growing aspects of technology. The rate at which the number of fire accidents in domestic structures, diligence, laboratories, hospitals, and shops is increasing is intimidating. This is largely due to the increased number of electrical widgets whose failures can spark a fire outbreak, ignitable solids and liquids in laboratories, shops, and indeed domestic structures, electrical hazards, etc. In situations of fire incidents, we need a technology that will help us descry this fire at its early stage, extinguish this fire without mortal hindrance, and also shoot an SMS and call alert to the property possessors notifying them of any fire incident to reduce the number of casualties and lives lost during fire accidents.

LITERATURE SURVEY

1) Arduino-Based Fire Fighting Robot; Aswinth Raj in 2024.
A firefighting robot is an independent or remotely controlled machine designed to detect and extinguish fires without mortal intervention. These robots are generally equipped with advanced detectors to identify fire or bank and carry water, CO2, or other suppression agents to control the flames. Integrated with onboard detectors and a microcontroller, some models of these robots can determine the fire's position, navigate toward it, and efficiently extinguish it.

In this firefighting robot using Arduino, we will use IR detectors to detect the fire and BO motors with a motorist to automatically move toward the fire. Our robot will also carry a small water tank and a pump to spot water on the fire and put it off.

2) Smart firefighting robot; Akshaan Kawar in 2020.
The prototype of the firefighter robot was efficiently designed. This prototype has installations to be integrated with numerous detectors, making it move forward. The toolkit detects the infrared light emitted by the fire with a photodiode and sends a signal to the regulator.

We intend to extend this work to give a keypad programmed to allow the manipulation of the robot to move in a desired direction with the help of the motorist module and extinguish the fires using a water tank, which is rotated at 180 degrees with the help of a servo for faster results. This unborn work will also explore the use of a long-distance detector with suitable tackle to get better and faster results, in addition to the characters.

3) Fire Fighting robot; Choong in 2015.

Our proposed design aims to develop an Android-controlled firefighter robot that can be used to extinguish fires through remote control. The vehicle consists of a water tank along with a pump that can throw water when demanded. The system uses an 8051 microcontroller for this purpose. The Android device is used as a transmitter to send control commands to the vehicle. The Android device provides a good touch-grounded GUI for controlling the robotic vehicle. The Bluetooth receiver on the vehicle is used to transmit those commands transferred by the Android device. These are also fed to the motors responsible for controlling the vehicle movements in front, back, left, and right directions.

The Bluetooth receiver is connected with an 8051 microcontroller for this purpose.

The microcontroller, after entering input commands, operates the motors through a motor driver IC for vehicle movements. The use of Android has one further advantage in addition to a better GUI. It allows Bluetooth technology for communication, allowing the vehicle to operate in a good range from the device. The system can also be later enhanced through the use of a wireless camera to be used for covering purposes.

PROPOSED SYSTEM

In this proposed system, we will have an Arduino, GSM, flame detectors, servomotors, water pump, DC motors, L293D buck motor, and buzzer to design and apply a Smart Autonomous Firefighting robot.

The proposed Smart Autonomous Firefighting robotic system is designed to detect Fires, alert authorities, and extinguish fires using a robotic platform. The system uses Arduino as the microcontroller to control the robot's movements, detectors, and GSM communication.

BLOCK DIAGRAM

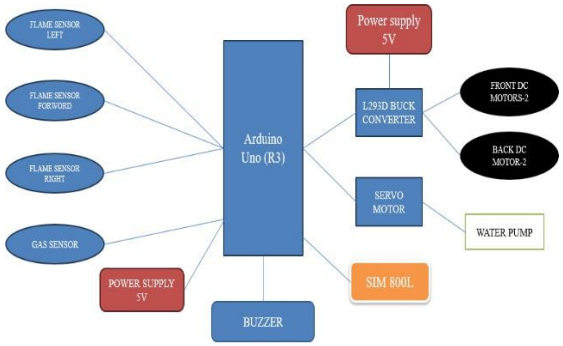

FIG: BLOCK DIAGRAM OF SMART AUTONOMOUS FIRE FIGHTING ROBOTIC

Whenever the force is given to the tackle through a 12V Battery, the voltage controllers will step down the force of 12V to 5V as per the conditions of the factors in the tackle. For illustration, fire detector, servomotor, water pump, etc., factors bear 5V, and coming to gear motors and GSM requires 12V power independently, as per the demand, the power will be converted. The force power will be passed through the periodical harborage to all the factors in the tackle. Whenever the force is given. A robot that will move forward. The robot will be in stir until the fire is detected by the fire detector. Once the fire is detected, the robot takes a step back, and the stir will also be stopped. At that moment, the pump motor and buzzer will be on. The pump motor sprinkles the water to extinguish the fire. “FIRE IS OCCURRING. A communication is transferred by GSM to the fire department.

OVER VIEW OF PROJECT

The firefighting robot consists of several components connected to form a functional system. The Arduino board serves as the brain of the system, connected to sensors such as flame sensors, an MQ2 gas sensor to detect fires. The sensors are connected to the Arduino board through digital and analog pins. The Arduino board is also connected to a GSM module, which enables remote monitoring and notification of fire incidents through SMS and calls. The GSM module is connected to the Arduino board through a serial communication protocol. Additionally, the Arduino board is connected to a motor driver, which controls the movement of the robotic platform. The motor driver is connected to DC motors, which propel the robotic platform. The robotic platform is also equipped with a water pump and sprinkler system, which are connected to the Arduino board through relays. The relays are used to control the activation of the water pump and sprinkler system. The entire system is powered by a battery, which is connected to the Arduino board and other components through a battery.

FLOW CHART

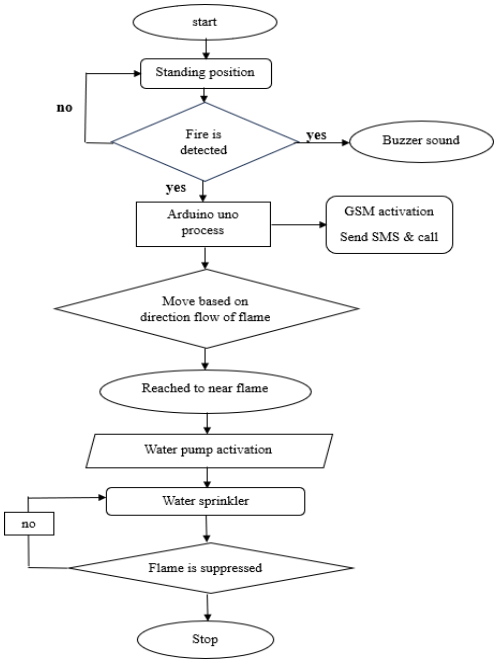

FIG: FLOW CHART

DESIGN OF HARDWARE ARDUINO UNO

Arduino Uno is a microcontroller board based on the ATmega328P microcontroller. It's one of the most popular and extensively used Arduino boards, known for its ease of use, flexibility, and affordability.

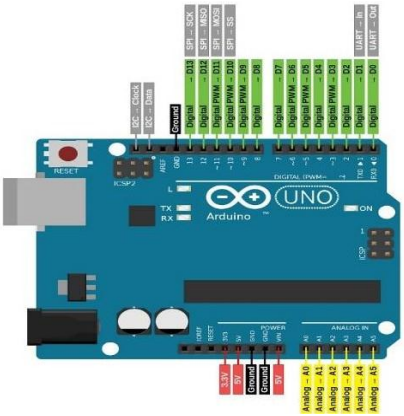

FIG: ARDUINO UNO

The Arduino Uno is grounded on the ATmega328P microcontroller, which has 32 KB of flash memory, 2 KB of SRAM, and 1 KB of EEPROM. The Arduino Uno has 14 digital input/output legs, 6 analog input legs, and 1 serial communication leg. The Arduino Uno has a USB connection for communication with a computer, as well as a serial communication port for communication with other devices. The Arduino Uno can be powered via a USB connection or an external power source. The Arduino Uno operates at 5V, but can also be powered at 3.3 V. The Arduino Uno has a timepiece speed of 16 MHz.

FLAME SENSOR

A fire detector is a device that detects the presence of a fire or fire. It's generally used in fire discovery systems, fire alarms, and other safety measures.

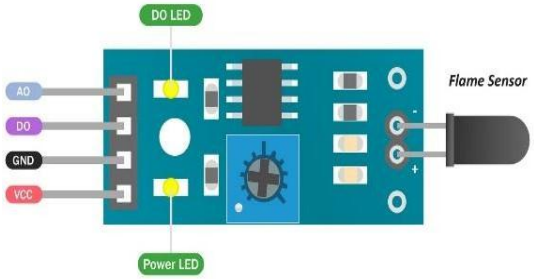

FIG: FLAME SENSOR

A fire detector generally works by detecting the infrared radiation emitted by fire. When a fire is present, it emits infrared radiation, which is detected by the detector. The detector also sends a signal to a control unit or alarm, indicating the presence of fire.

L293D BUCK CONVERTER

The L293D is a quadrangle half-H bridge motor driver IC that can be used to make a buck motor. A buck motor is a type of DC-DC motor that steps down the input voltage to a lower output voltage.

FIG: L293D MOTOR DRIVER

The L293D buck motor works by using the L293D IC to switch the input voltage on and off at a high frequency, generally in the range of 10-100 kHz. This creates a high-frequency AC voltage, which is also filtered to produce a DC voltage.

GSM

GSM (Global System for Mobile Dispatches) is a digital mobile network standard, used for mobile phones, tablets, and other wireless bias. It's an alternative-generation (2G) mobile network technology that was first introduced in the early 1990s.

FIG: GSM

GSM works on dividing the network into cells, each served by a base station. The base station communicates with mobile devices using radio waves. When a mobile device makes a call or sends data, it sends a signal to the nearest base station, which also on the signal to the destination.

BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm bias, timekeepers, training, and evidence of stoner input such as a mouse click or keystroke.

FIG: BUZZER

DC MOTOR

A DC motor is an electric motor that runs on direct current (DC) electricity. It converts electrical energy into mechanical energy through commerce between glamorous fields and electric currents.

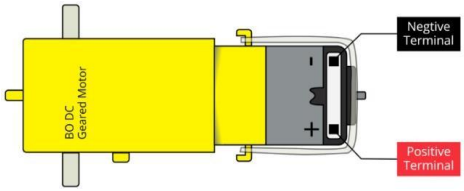

FIG: DC MOTOR

When a current flows through the architecture, it generates a glamorous field. The glamorous field generated by the architecture interacts with the glamorous field generated by the stator. The commerce between the two glamorous fields produces a necklace, which causes the rotor to rotate. The commutator reverses the direction of current inflow to the architecture, allowing the motor to continue rotating.

RESULTS

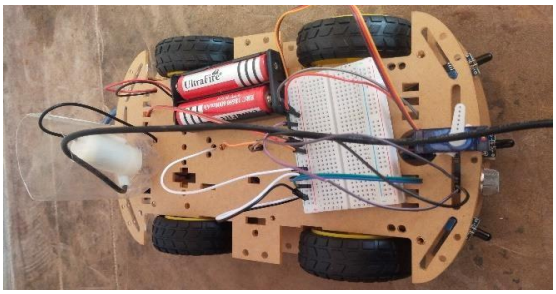

FIG: TOTAL SETUP OF ROBOTIC

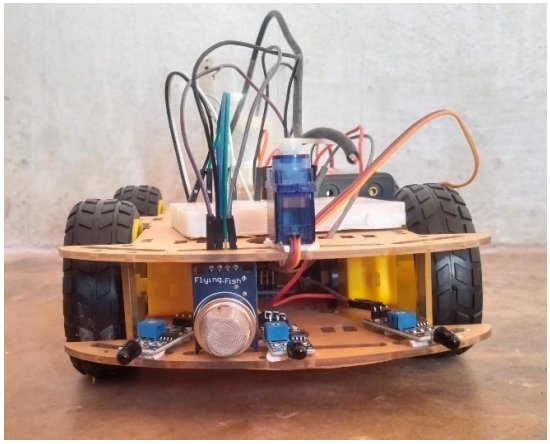

FIG: FRONT VIEW OF ROBOTIC

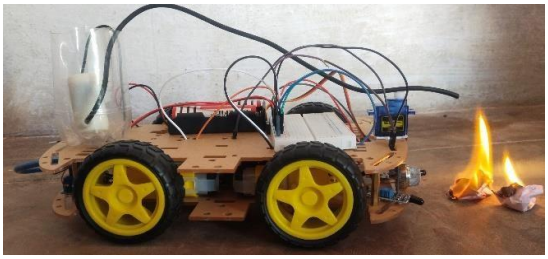

FIG: FINAL ROBOTIC

CONCLUSION

The Smart Autonomous Fire Fighting Robotic is a revolutionary invention that has the implicit to save countless lives and property from fire hazards. This robotic system is equipped with advanced detectors and selectors that enable it to detect fires, navigate through obstacles, and suppress fires autonomously. The integration of GSM technology allows for remote monitoring and announcement, enabling prompt response to fire emergencies.

The success of this design demonstrates the feasibility of using Arduino and GSM technologies to develop cost-effective and effective independent robotic systems for firefighting operations. This invention has far- reaching implications for fire safety and prevention, and its implicit operations extend beyond firefighting to other areas such as hunting and deliverance, environmental monitoring, and artificial robotization.

APPLICATIONS

1) The main purpose of robots is to deliver people by extinguishing fire in structures and diligence, etc. (2) They can be used in garçon apartments for immediate action in case of fire. (3) It can be used to extinguish the fire where the probability of explosion is high. E.g., hostel kitchens, LPG/ CNG gas stores, etc. (4) Every working terrain requires endless drivers' attention. At power factory control apartments, at captain islands, at flight control centers, etc. (5) High-rise structures Robots can snappily respond to fires in high-rise structures, reducing the threat of injury or loss of life. (6) shopping promenades Firefighting robots can navigate through crowded shopping areas to detect and extinguish fires.

ADVANTAGES

1) Reduction of fire accidents without mortal intervention. (2) Reduced labor costs. Firefighting robots can automate Certain tasks, reducing the need for mortal labor and associated costs. (3) Minimized property damage. Robots can snappily extinguish fires, reducing the quantum of damage to property and associated costs. (4) Minimized environmental impact. Robots can reduce the quantity of poisonous chemicals released into the environment during firefighting operations. (5) Real-time data analysis: Robots can give real-time data analysis, enabling firefighters to make informed decisions.

FUTURE ENHANCEMENT

[1] Improving situational awareness: Integrating additional sensors and improving the robot's ability to understand its environment. [2] Adapting to changing fire conditions: Developing algorithms that enable the robot to adjust its response based on changing fire conditions. [3] Integrating with existing firefighting systems: Exploring ways to integrate the robot with existing firefighting systems and protocols. [4] Adding a GSM e-sims module to enable full control while still relying on operating from much further away. [5] Adding more capable and sensitive sensors to detect the fire. [6] Upgrading the battery pack to increase its operating time.

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