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DESIGN AND CONTROL OF ROBOT CONTROL THROUGH MOBILE PHONE

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ABSTRACT:

Robots are reprogrammable, multipurpose machines that are mostly designed to do tasks that humans would do, such pick and place, loading and unloading, surveillance, medical, industrial, and aerospace applications. As they can operate nonstop for 24 hours, robots can do precise and hazardous tasks to boost efficiency. In this study, an autonomous vehicle-type robot that can travel in the desired direction and take images and movies at the specified area is designed and controlled. A robot that communicates with a microcontroller to control its speed and direction features a WIFI connection system and an Android application created using MIT App Inventor. The purpose of this project is to create a robot and use an Android phone's WIFI gadget to control its mobility.

I. INTRODUCTION

These days, industrial facilities, warehouses, and construction sites greatly benefit from the employment of mobile robots. The applications for mobile robots in material handling are expanding daily and include material handling as well. Mobile robots may be used for material handling and item analysis. Android may be used to control the motions of a mobile robot using wireless navigation. Robots are controlled using fuzzy logic control mechanisms. There is no requirement for any mathematical model governing that model. Firefighting robots were formerly operated by a variety of technological gadgets.However, this limits the firefighting robot's control range.But thanks to more sophisticated methods, we can construct the same robot and use an Android application to direct its movements. Such robots have greatly reduced the amount of labor required by firefighters, and their actions are very efficient. Firemen can identify and put out fires with the help of an Android app.Using ultrasonic sensors, the robot can simultaneously recognize and avoid obstacles. The goal of our project is to create an Android application that will allow us to operate the firefighting robot. Through the Bluetooth module installed on the robot, the fireman is able to communicate orders to the robot. Smart phones are equipped with Bluetooth functionality, which allows firefighters to use it to control the movement of firefighting robots. Two sensors are used in the fire detection process. A temperature sensor is one, while a smoke detector is the other. When a fire is detected, the fire extinguishing system will be triggered.When the sprinkler senses fire, it will begin to sprinkle water. Two motors are interfaced to a microcontroller at the receiving end, while an Android application is utilized at the sending end.

Life, or the lives lost while attempting to save another person's life, is one of the most significant variables in a fire tragedy. Sometimes smoke, extreme heat, and explosive chemicals make it hard for firefighters to reach the scene of a fire. Many terrible things may be avoided with a quick reaction to the fire's detection. It is evident from the provided statistics (Fig. 1) that both residential and commercial settings may experience fires. A little spark may start a large-

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scale conflagration.The inadequate fire control system puts not only the lives of those working in industries but also the lives of those living at home at danger. Many individuals may lose their lives to fire, and many more can have lifelong injuries. However, it is preventable by using appropriate fire safety measures. A robot that fights fires is suggested for these kinds of settings. Many robots are being suggested and developed in this age to take the place of humans in hazardous and lethal tasks. Robots are increasingly being used to safely do dangerous or labor-intensive tasks that humans find difficult or dangerous. Using IOT technology, a fire extinguishing robot is created. Our goal with the Fire Extinguishing Robot is to create a system that can detect a little flame and move to put it out by itself. With flame sensors, it will immediately detect the fire. After identifying the position of the fire breakout, it uses the built-in fire extinguishing technology to route itself appropriately to the fire source and puts out the flames. Three flame sensors are used to detect fires. There are three: one for the left, one for the forward direction, and one for the right. When a fire is detected, the fire extinguishing system will be triggered. When it reaches the breakout point, the water pump senses fire and begins to discharge water. One of this system's primary functions is to offer fire surveillance, which helps to decrease the number of human casualties and avoid significant fire mishaps.

PROBLEM STATEMENT

One of the riskiest issues that may cause significant damage in terms of money and lives lost is a fire catastrophe. Firefighters may have challenges in reaching the scene of a fire due to the presence of explosive materials, smoke, and elevated temperatures. Firefighters are also at danger for injury in such circumstances. Robots that combat fires may be helpful in these kinds of settings. The IOT technology underpins this fire extinguishing robot. Our goal with Fire Extinguishing Robot is to create a system that can detect a little flame and move to put it out by detecting its position. There are many repercussions when fire fighters arrive late. The robot that extinguishes fires keeps an eye on its surroundings constantly and puts out fires quickly.

EXISTING SYSTEM

Sprinklers, hand-held portable fire extinguishers, and fire brigades are among the standard traditional firefighting techniques. These traditional methods take a long time to get to the scene of the incident. For example, the fire department has to dispatch personnel from the fire station, navigate traffic, and reach the area where the fire occurred. Portable extinguishers are also not free because they are typically located on a building's corner, where they can be tricky to reach and require ongoing maintenance. However, the sprinkler and smoke detector setup is a highly unreliable system since enormous areas might be covered by sprinkler lines with defects that could not produce adequate pressure.

PROPOSED SYSTEM

This moveable prototype of our selected system is equipped with a pump control relay that detects and extinguishes fires, gear motors and motor drivers for robot movement, and flame sensors. Prototype movement is usually carried out at a steady, gradual pace. The microcontroller receives certain signals proving the presence of a fire when the sensor picks up a fire in the area. The microcontroller then puts out the fire. The prototype will halt at the fire location, activate the pump, and spray water using a sprinkling nozel after smoke has been eliminated upon a positive fire detection. The robot may be controlled autonomously thanks to an Arduino that is connected to an infrared sensor for all overall controls. This paper's main idea is to automatically detect environmental fires and put them out without the need for human involvement. The three components of the technique are separated. The hardware description comes first, then the design structure, and ultimately the programming design. Following the assembly of these three components, tests were run to create a system that could put out the fire that was started.

II. LITERATURE SURVEY

A firefighting robot model was proposed by Tawfiqur Rakib and M. A. Rashid Sarkar. It comprises a base platform composed of "Kerosene wood," an LM35 sensor for temperature detection, flame sensors for fire detection, and a one-liter water container made of sturdy cardboard that is water resistant. The robot can move on its two wheels. [1] Saravanan P. and Soni Ishawarya suggested a model in which the robot is separated into three fundamental sections based on their functions: a locomotive unit, a fire detection unit, and an extinguisher unit. The model employs an Atmega2560 micro-controller.Every unit carries out its assigned duties with the goal of putting out fires.With the aid of four infrared and four ultrasonic sensors, the locomotive unit moves the robot and helps it avoid obstacles.The temperature sensor and LDR are employed by the fire detection device to identify fire. The extinguishing equipment uses a BLDC motor and a water container to put out the fire.To guide itself in the right direction, the robot is equipped with a Bluetooth module that is linked to cellphones. [2] S. Jakthi Priyanka and R. Sangeetha presented an Arduino UNO R3-powered android-controlled firefighting robot. The robot's components include a gas sensor for detecting fires, a gear motor and motor drive for movement, and a bluetooth module for controlling the robot from a smartphone and connecting it to an Android device. Sprinklers and a water pump are also used in this. Programming and implementing code on the Arduino UNO requires the use of the Arduino IDE, an open source program. [3] Nagesh MS, Deepika T V, Stafford Michahial, and Dr. M Shivakumar proposed a fire extinguishing robot that uses a flame sensor for fire detection that can detect flames with a wavelength range of 760 to 1100 nm and a sensitivity that varies from 10 cm to 1.5 feet. The robot is navigated using DTMF (Dual Tone Multi Frequency Tones) technology. [4] Rajesh Johar, Abhideep Bhatti, Varenyam Sharma, and Sushrut Khajuria suggested an Arduino-based firefighting robot that uses radio frequency (RF) remote control to run the robot and water pump.The user may operate the robot up to seven meters away.Additionally, it has a wireless camera that allows the operator to steer the robot in the desired direction.[5] Simon Hardt, Prof. Dr.-Ing. Klaus-Dieter Kuhnert, and Khaled Sailan proposed the Amphibious Autonomous Vehicle, an obstacle avoidance robot. A fuzzy controller is utilized in this robot to avoid static obstacles in real time.Its goal is to direct the robot or vehicle along its intended route while avoiding any obstacles in its way.[6]

III. DESIGN OF HARDWARE

This chapter briefly explains about the Hardware. It discuss the circuit diagram of each module in detail.

ARDUINO UNO

A microcontroller board based on the ATmega328 is called the Arduino Uno (datasheet). It has a 16 MHz ceramic resonator, 6 analog inputs, 14 digital input/output pins (six of which may be used as PWM outputs), a USB port, a power connector, an ICSP header, and a reset button. It comes with everything required to support the microcontroller; all you need to do is power it with a battery or an AC-to-DC

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converter or connect it to a computer via a USB connection to get going.The FTDI USB-to-serial driver chip is not used by the Uno, setting it apart from all previous boards. As an alternative, it has the Atmega16U2 (or Atmega8U2 up to version R2) configured as a serial-to-USB converter. The 8U2 HWB line on the Uno board is pulled to ground by a resistor, which facilitates DFU mode entry. The Arduino board now includes the following updates:

• 1.0 pin out: two further new pins, the IOREF, are positioned next to the RESET pin, the SDA and SCL pins that were introduced, and they enable the shields to adjust to the voltage supplied by the board. Shields will eventually work with both the Arduino Due, which runs on 3.3V, and the boards that utilize the AVR, which runs on 5V. The second pin is unconnected and set aside for future uses.

• A more robust RESET circuit.

• The 8U2 is replaced with an ATMega 16U2.

"Uno" is an Italian word for one, and it was chosen to commemorate the impending introduction of Arduino 1.0. Going future, the Arduino reference versions will be the Uno and version 1.0. The Uno is the most recent in a line of USB Arduino boards and the platform's standard model; see the index of Arduino boards for a comparison with earlier iterations.

Fig: ARDUINO UNO

POWER SUPPLY:

The purpose of the power supplies is to convert the high voltage AC mains energy into a low voltage supply that is appropriate for use in electronic circuits and other devices. One may disassemble a power supply into a number of blocks, each of which carries out a specific task. "Regulated D.C. Power Supply" refers to a d.c. power supply that keeps the output voltage constant regardless of differences in the a.c. main or the load.

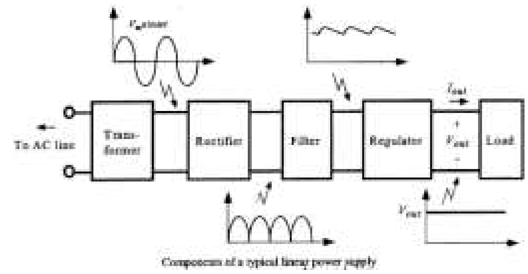

Fig: Block Diagram of Power Supply

LCD DISPLAY

The model shown here is the one that is most often utilized in practice due to its cheap cost and enormous potential. Its HD44780 microcontroller (Hitachi) platform allows it to display messages in two lines of sixteen characters each. All of the alphabets, Greek letters, punctuation, mathematical symbols, etc., are shown. Furthermore, it is possible to show custom symbols created by the user. Some important features are the automatic changing of the message on the display (shift left and right), the presence of the pointer, the lighting, etc.

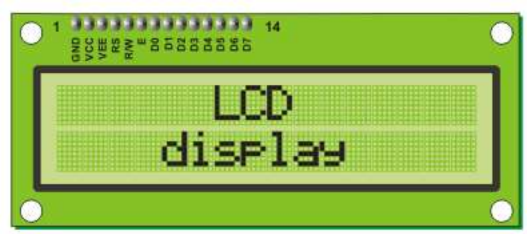

Fig: LCD

BUZZER

Digital systems and microcontroller pins lack sufficient current to drive the circuits like relays, buzzer circuits etc. While these circuits require around 10milli amps to be operated, the microcontroller's pin can provide a maximum of 1-2milli amps current. For this reason, a driver

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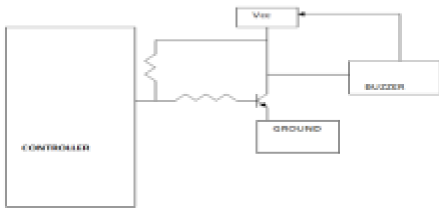
such as a power transistor is placed in between the microcontroller and the buzzer circuit.



WIFI MODULE:

A low-cost Wi-Fi microprocessor with complete TCP/IP stack and microcontroller functionality, the ESP8266 is made by Chinese firm Espressif Systems, located in Shanghai.[1]

In August 2014, a third-party producer named Ai-Thinker's ESP-01 module brought the chip to the attention of western manufacturers for the first time. With the help of this little module, microcontrollers may establish basic TCP/IP connections and connect to Wi-Fi networks by utilizing Hayes-style instructions. But at the time, there wasn't much documentation available in English on the chip or the commands it could execute.[2] Many hackers were drawn to investigate the module, chip, and software on it as well as translate the Chinese documentation because of its very cheap cost and the fact that it had very few external components, suggesting that it may someday be very affordable in production.[3]

With its 1 MiB of integrated memory, the ESP8285 is an ESP8266 that enables single-chip Wi-Fi capable devices.[4]

The ESP32 is these microcontroller chips' replacement.

LED:

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode that emits light when activated.[5] When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons.

This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. LEDs are typically small (less than 1 mm^2) and integrated optical components may be used to shape the radiation pattern.

Early LEDs were often used as indicator lamps for electronic devices, replacing small incandescent bulbs. They were soon packaged into numeric readouts in the form of seven-segment displays and were commonly seen in digital clocks. Recent developments have produced LEDs suitable for environmental and task lighting. LEDs have led to new displays and sensors, while their high switching rates are useful in advanced communications technology.

LEDs have many advantages over incandescent light sources, including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. Light-emitting diodes are used in applications as diverse as aviation lighting, automotive headlamps, advertising, general lighting, traffic signals, camera flashes, and lighted wallpaper. They are also significantly more energy efficient and,

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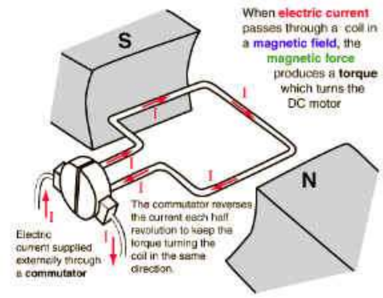
arguably, have fewer environmental concerns linked to their disposal.

L293D:

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo- Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

DC MOTOR

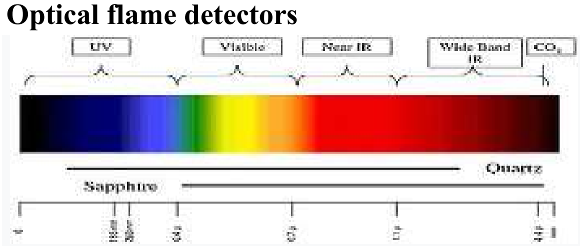
A DC motor is intended to operate with DC electricity. Michael Faraday's homopolar motor, which is rare, and the ball bearin motor, which is a recent invention, are two instances of pure DC designs. The two most popular forms of DC motors are brushed and brushless, which are not strictly speaking DC machines since they require internal and external commutation, respectively, to produce an oscillating AC current from the DC source.



FLAME SENSOR

A **flame detector** is a sensor designed to detect and respond to the presence of a flame or fire, allowing **flame detection**. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system. When used in applications such as industrial furnaces, their role is to provide confirmation that the furnace is working properly; in these cases they take no direct action beyond notifying the operator or control system. A flame detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the flame.

Optical flame detectors



Flame detector type regions

Mini Submersible Pump

Generally speaking, submersible pumps are designed to be completely immersed in water. Because submersible pumps are installed within the reservoir of water that has to be pumped out, they are often used for pond filtration, sewage pumping, drainage during floods, and pond emptying. This article will especially discuss the workings of the tiny submersible pump, a smaller kind of submersible water pump. A tiny

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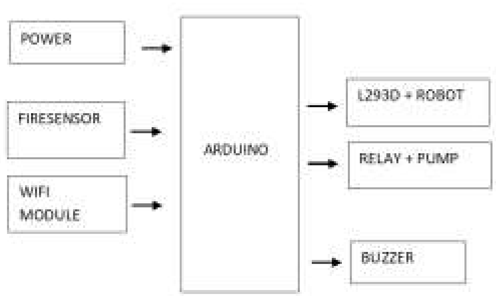
submersible pump is a scaled-down form of a submersible water pump that is quiet, portable, light, and uses minimal energy. In the home, a little submersible water pump is often used for space heating, cooking, cleaning, bathing, watering flowers, and other purposes. A small submersible water pump rotates its impeller to force water outward; this kind of pump is known as a centrifugal water pump. It is powered by a motor. Situated under a watertight seal, the motor is intimately linked to the water pump's body, which it drives. A particular kind of miniature submersible water pump is used in the filtration systems within aquarium fish tanks. To remove water where it is required, a small submersible water pump is mounted within the fish tank itself.

Mini submersible water pumps have the benefit and disadvantage of being very efficient due to the fact that they don't need a lot of energy to draw water into them while submerged. The small submersible water pump's acknowledged drawback is that its seals erode with time, perhaps allowing water to flow into the motor. When this occurs, the motor may become unusable and become very difficult to remove and fix.

IV. BLOCK DIAGRAM AND HARDWARE DISCRIPTION

4.1. BLOCK DIAGRAM:



WORKING:

The process of designing and managing a robotic system using a mobile device include developing a robotic system that can be remotely controlled via a smartphone application. In this configuration, the mobile device and the robot are usually connected by wireless communication technologies like Bluetooth or Wi-Fi. An extensive description of this system's operation may be found below:

1. System Components

- **Microcontroller**: The central processing unit of the robot, often based on platforms like **Arduino**, **Raspberry Pi**, or **ESP32**, which manages the robot's operations and responds to commands.
- **Motors**: DC motors or stepper motors that control the robot's movement (wheels, arms, etc.).
- **Motor Driver**: A circuit that allows the microcontroller to control the motors. It amplifies the signals from the microcontroller to drive the motors.
- **Wireless Module**: A Bluetooth or Wi-Fi module (e.g., HC-05 for Bluetooth or ESP8266 for Wi-Fi) that enables communication between the robot and the mobile phone.
- **Sensors**: Optional sensors (such as ultrasonic sensors) for obstacle detection or environmental sensing.
- **Power Supply**: Batteries or other power sources to power the robot and its components.

2. Mobile Application

- A mobile application is developed to serve as the user interface for controlling the robot. This app can be custom-built using frameworks like **MIT App Inventor**, **Blynk**, or standard mobile app development tools.
- The app provides buttons, joysticks, or sliders to control the robot’s movement and actions, such as forward, backward, left, right, and any additional

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functionalities (e.g., picking up objects, turning on lights).

3. Communication Setup

- The mobile phone connects to the robot via **Bluetooth** or **Wi-Fi**:
  - **Bluetooth**: Establishes a direct connection with a limited range (typically 10-15 meters).
  - **Wi-Fi**: Allows for a longer range, enabling control over larger distances, often through local networks or cloud services.
- The app sends commands in real time to the wireless module on the robot, which relays these instructions to the microcontroller.

4. Robot Movement Control

- Once the connection is established, the user can issue commands through the mobile app. The commands are sent as digital signals to the robot.
- The microcontroller receives these commands and interprets them to control the motors via the motor driver. For example:
  - **Forward Command**: The microcontroller activates the motors to move the robot forward.
  - **Turn Left Command**: The microcontroller adjusts the power to the left and right motors to pivot the robot in the desired direction.
- The motor driver converts the low-power signals from the microcontroller into higher power signals that drive the motors.

5. Sensor Integration (Optional)

- It is possible to add sensors, including ultrasonic sensors, to provide the robot input on its environment.
- By sending back data from these sensors to the mobile app, the user can keep an eye on the robot's surroundings and modify orders as necessary.
- For instance, the robot may automatically stop or reroute if an impediment is identified, or the app may notify the user.

6. Feedback and Control Loop

- The system may be made to provide the mobile app input on things like sensor readings, motor status, and battery life.
- By creating a control loop with this feedback, the user may make choices based on real-time data and modify instructions as needed.

7. Power Management

- Rechargeable power sources or batteries power the robot. Monitoring the robot's battery levels is essential to ensuring that it functions properly and doesn't run out of power while in operation.

8. Safety Features

- The robot may include emergency stop buttons on the mobile app or be set to automatically switch down if it detects major faults (such as low battery or loss of connection) to increase safety.

The main improvement over a regular robot is its ability to detect and put out fires. Other than that, fire fighting robots do the same tasks. The Arduino serves as the project's brain, but three fire sensor modules—the left, front, and right sensors—are used to detect fire; fig. 6 illustrates these modules. By running our motors via the L293D module, we are able to determine the direction of the fire and utilize that information to travel closer to it. When a fire breaks out, we

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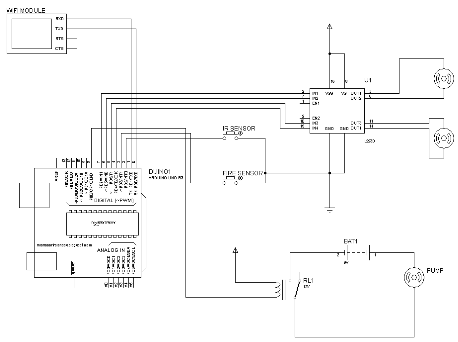
must use water to put it out. We use a tiny container to store water, and when a fire is detected, we can regulate the direction of the sprayed water by placing the pump within the container and the whole container on top of a servo motor.

SCH:



V. CONCLUSION

Fire-related accidents have the potential to inflict serious harm as well as property damage. This study gives a comprehensive evaluation of several fire-fighting robots, together with autonomous robot fire detection and extinguishment techniques. Without a doubt, this will lead to an improved system for monitoring the quality of the water, and prompt action may make the water resources safe. Even though many effective firefighting tools have been developed, the study issue is still challenging. An overview of current research attempts to improve the intelligence, affordability, and efficiency of firefighting robots is given in this study. The use of wireless communication standards for increased efficiency and the use of state-of-the-art sensors for monitoring different quality requirements.

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