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Arduino Based Fire Fighting Robot

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Abstract: *This project is designed to develop a fire fighting robot using RF control technology for remote operation. The robotic vehicle is loaded with water tanker and a pump which is controlled over wireless communication to throw water. An 8051 series microcontroller is used for the desired operation. This mobile robot is controlled using a mobile phone and reaching fire at the transmitting end using push button, commands are sent to the receiver to control the movement of the robot either to moved forward, backward and left or right. At the receiving end four dc motors are interfaced to the microcontroller. Further project enhanced by interfacing it with a wireless technology.*

Keywords: DC motors, Bluetooth module, water pump, servo motor, flame sensor, Arduino

I. INTRODUCTION

Robot is a machine that looks like a human being and performs various complex tasks. There are many types of robots such as fixed base robot, mobile robot, underwater robot, humanoid robot, space robot and medicine robot etc. In this paper a FIRE EXTINGUISHING ROBOT is proposed. This robot is equipped with a Bluetooth module used and feed the signals to the microcontroller in order to trigger the pump which sprinkles water in order to extinguish the fire. This robot is controlled using a mobile phone. This robot implements the concepts of environmental fire sensing, proportional motor control. The motor driver is used for the bidirectional control of the motors equipped in the robot. Every instruction for motion control is given to the robot with the help of Bluetooth.

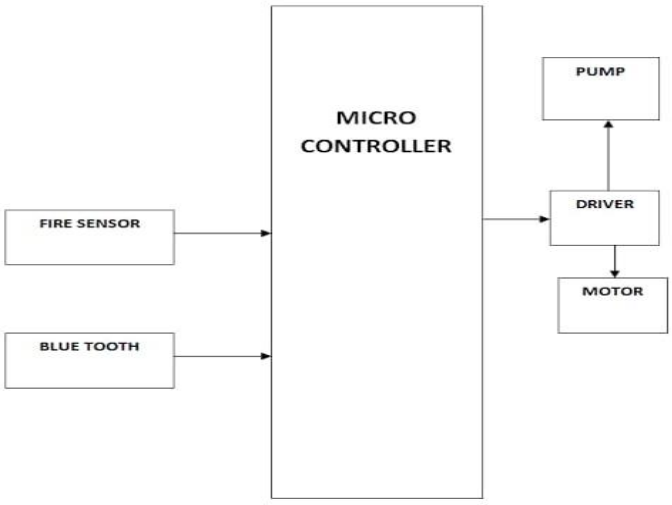

Figure: Block Diagram of Fire Fighting Robot

Thus, the robot processes information from its various key hardware elements such as Bluetooth module via Adriano Uno board (microcontroller). The programming of the robot is done using the arduino C which is derived from C and C++ languages. This paper is presented as follows. Proposed methodology in section II which constitutes of block diagram and components and their explanation. Hardware and software details are included in section III. In

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Section IV, results and conclusions are included. Arduino UNO Microcontroller board based on the ATmega328P. The ATmega328P is good platform for robotics application. Thus the real time fire extinguishing can be performed.

The Arduino software runs on mac, windows and Linux. Simple programming is possible in case of Arduino software. The Arduino libraries play a major role in making the programming easier. There are so many built in libraries available in the Arduino software and it also allows to add additional libraries. Adding of new boards to Arduino software is possible.

II. Proposed Methodology

The main aim of this project is to develop a fire extinguishing robot which detects the fire location and extinguish fire by using sprinklers on triggering the pump. The test distance depends on the flame the direction of movement of the robot is described by size and sensitivity settings. The detection angle is 60 the motor driver board. It is used to give high voltage and degrees, so the flame does not have to be right in front of high current is given as an output to run the motors which the sensor. are used in the project for the movement of the robot. In this project a simple DC motor is used for the rotation of There are two sensor outputs the wheel which are responsible for the movement of the robot. DC motors usually convert electrical energy into i. Digital – sending either zero for nothing detected or mechanical energy. To extinguish the fire a pump is used one for a positive detection to pump the water on to the flame. A simple motor is used ii. Analog – sending values in a range representing the to pump the water. The pumping motor in extinguishing flame probability/size/distance; must be connected to a system controls the flow of water coming out of pumping. PWM capable input.

III. Hardware and Software Details

3.1 Hardware Used

Band telecommunication signalling system using the voice frequency band over telephone lines between telephones.

A) ATmega328P Microcontroller (Arduino UNO)

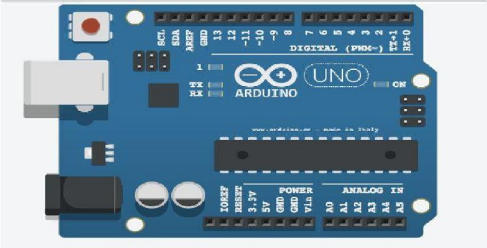
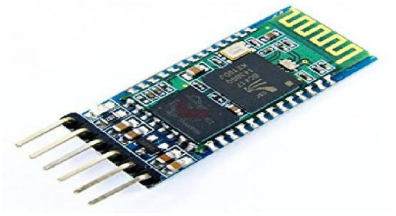


Figure 3.1: Arduino Uno microcontroller based development board

Fig 3.1 shows the arduino Uno board. ArduinoUno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller.

B) Bluetooth Module



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HC-05 Module Information

HC-05 has red LED which indicates connection status, whether the Bluetooth is connected or not. Before connecting to HC-05 module this red LED blinks continuously in a periodic manner. When it gets connected to any other Bluetooth device, its blinking slows down to two seconds. This module works on 3.3 V. We can connect 5V supply voltage as well since the module has on board 5 to 3.3 V regulator.

Pin Description

Bluetooth Module Pin Description: Bluetooth serial modules allow all serial enabled devices to communicate with each other using Bluetooth. It has 6 pins,

1. **Key/EN:** It is used to bring Bluetooth module in AT commands mode. If Key/EN pin is set to high, then this module will work in command mode. Otherwise by default it is in data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode.
   HC-05 module has two modes,
   - Data mode: Exchange of data between devices.
   - Command mode: It uses AT commands which are used to change setting of HC-05. To send these commands to module serial (USART) port is used.
2. **VCC:** Connect 5 V or 3.3 V to this Pin.
3. **GND:** Ground Pin of module.
4. **TXD:** Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)
5. **RXD:** Receive data serially (received data will be transmitted wirelessly by Bluetooth module).
6. **State:** It tells whether module is connected or not.

C) Servo Motor

Servo motors are high torque motors which are commonly used in robotics and several other applications due to the fact that it's easy to control their rotation. Servo motors have a geared output shaft which can be electrically controlled to turn one (1) degree at a time. For the sake of control, unlike normal DC motors, servo motors usually have an additional pin asides the two power pins (VCC and GND) which is the signal pin. The signal pin is used to control the servo motor, turning its shaft to any desired angle.

Wire Number	Wire Colour	Description
1	Brown	Ground wire connected to the ground of system
2	Red	Powers the motor typically +5V is used
3	Orange	PWM signal is given in through this wire to drive the motor

D) Single Channel Relay

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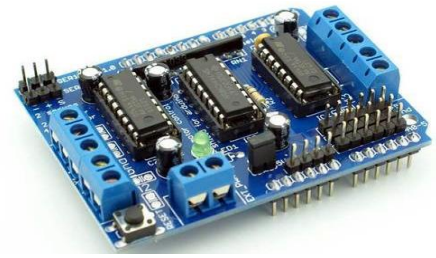
Description:

The Single Channel Relay Module is a convenient board which can be used to control high voltage, high current load such as motor, solenoid valves, lamps and AC load. It is designed to interface with microcontroller such as Arduino, PIC and etc. The relays terminal (COM, NO and NC) is being brought out with screw terminal. It also comes with a LED to indicate the status of relay.

Specification:

- Digital output controllable
- Compatible with any 5V microcontroller such as Arduino.
- Rated through-current: 10A (NO) 5A (NC)
- Control signal: TTL level
- Max. switching voltage 250VAC/30VDC
- Max. switching current 10A
- Size: 43mm x 17mm x 17mm

E) Motor Control Shield



Motor control shield is capable of driving 4 motor shield. It is one of the easiest way to do that to interface **L293D Motor Driver Shield** with Arduino. It can drive:

- 4 bi-directional DC motors with 8-bit speed selection(0-255)
- 2 stepper motors (unipolar or bipolar) with single coil, double coil, interleaved.
- 2 servo motors

F) DC Motors

In this project we use simple DC motor for the rotation of the wheel which are responsible for the movement of the robot. Usually DC motors convert electrical energy into mechanical energy.

G) Pump

Pump is a mechanical device which is used to pump water on to the fire to extinguish it. It uses a simple motor to pump water.

3.2 Software Used

A) **Arduino IDE 1.6.7**

For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages C and C++.The open source Arduino IDE makes it easy to write code and upload it to the board.

3.3 Working

The project consists of a user controllable fire fighter robot which has a water tank and a gun attached to it for extinguishing fires.. For this purpose, an RF remote has been used for remote operation along with RF receiver based

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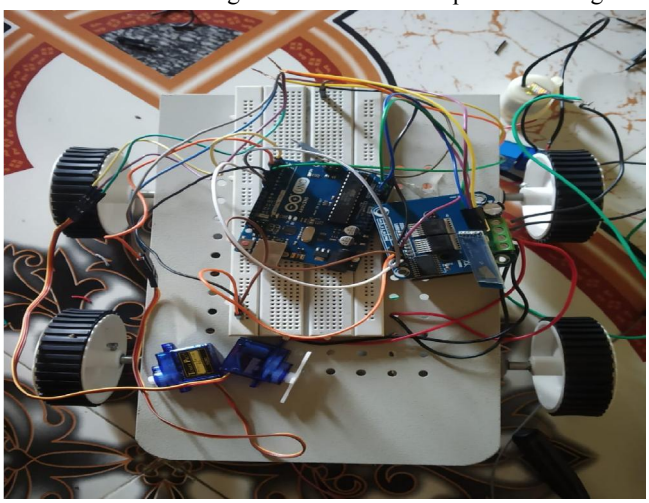
microcontroller circuit so as to operate the robotic vehicle and water pump. The RF based remote transfers the commands sent by the user through RF signals to the receiver circuit. The receiver circuit then decodes the data commands sent. The commands are then sent to the microcontroller which then processes these instructions and then instructs the vehicle motors to run the vehicle in the desired direction. On the basis of the user commands, the water pump is controlled. This allows the user to operate the robot and extinguish the fire by standing at a safe distance. The range of the robot is within 7 metres of that of the remote. This robot also has a wireless camera mounted over it. This camera helps the user to move the robot body in whichever direction as required. By installing the water pump assembly and the camera, the robot is able to extinguish the fire when required ensuring the safety of the user.



IV. RESULTS AND CONCLUSIONS

The Fire Fighting Robot employs DTMF technology to control the directions of the robot. We design the fire detection system using flame sensor that is capable of sensing the flame of wavelength range 760 to 1100 nm, and the sensing range depends on the sensitivity and varies from 10cm to 1.5 feet. The robot can operate in the environment which is out of human reach in very short time, the delay employed is very minimal. The robot accurately and efficiently finds the fire and within minimum time after the fire is detected it is extinguished.

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