

Automotive Fire Fighting Robot

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ABSTRACT: Our project “Fire Fighting Robot” is robots that autonomously detects and extinguish fire. It use thermal sensor for detection ,It detects until 10m range, and Arduino UNO R3 for processing, Here the robot will automatically detects the fire by means of temperature sensor and by manual Bluetooth method and ultrasonic sensor it moves near to the flame ,after the detection of fire by automatic method, The robot vehicle is loaded with water tank which contain up to 2Ltr of water and pump motor which is controlled through motor driver circuit to spray water, It which flows by connecting stepper motor with the shaft which connects with gear will comes out automatically to splashing water to extinguish fire, After extinguishes the shaft returns to its original position and then temperature sensor checks the temperature of fire until room temperature constrain. And it designed by SOLIDWORKS 2015.

KETBOARD: D6T sensor, pump motor, buck converter, ultrasonic sensor modelling in solid works 2015.

I.INTRODUCTION

There are a variety of robotic systems being developed to support firefighters due to the wide range of fire events including fires involving structures, vehicles, aircrafts, ships, and wildlands. These robots which we used for detect and extinguish fire by means of various sensor. The use of robotic systems in firefighting is being increasingly studied due to firefighters routinely being exposed to dangerous conditions to save lives. A robotic system is a mechanical device that performs a task using sensors to perceive its environment, computer programs to control the robot based on its environment, and a human operator to assist with robot operation. In 2011, 70,090 firefighters in the U.S. alone were injured in the line of duty with 61 deaths.

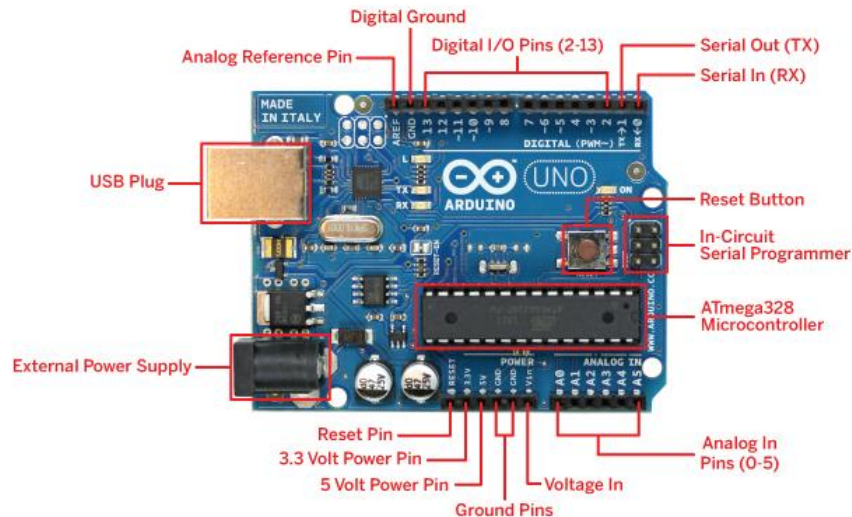
There are two general types of robotic systems that have been developed for firefighting:

1. fixed systems
2. mobile systems

Fixed systems, such as automated fire monitors, are being used in applications where there is a significant fire hazard and the fire needs to be extinguished rapidly. Some example applications include aircraft landing areas, warehouse storage. These systems have UV and/or IR sensors to assist with fire localization to target the suppression agents onto the fire.

ARDUINOUNO R3

Arduinos an open-source electronics platform based on easy-to-use hardware and software. Arduino was born at the Ivrea interaction Design institute as an easy tool for fast prototyping. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenge by 8 bit board to product for lot of application



Block diagram of Arduino Uno r3

WHY ARDUINO?

Arduinos simple and accessible user experience and it has been used in thousand of different projects and application. Arduino software is easy to use for beginners.

II. BLUETOOTH MODULE HC-05

HC-05 module is an easy to use **Bluetooth SPP (Serial Port Protocol) module**, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified **Bluetooth V2.0+EDR (Enhanced Data Rate)** 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses **CSR Blue core 04**-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

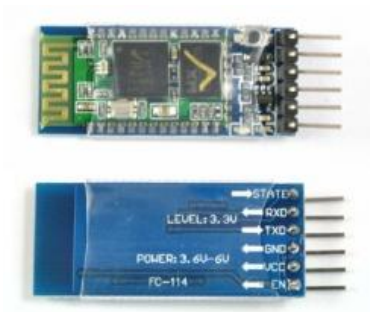


Diagram: Hc-05

HARDWARE FEATURES:

- Typical -80dBm sensitivity.
- Up to +4dBm RF transmit power.

- 3.3 to 5 V I/O.
- PIO (Programmable Input/Output) control.
- UART interface with programmable baud rate.
- With integrated antenna.
- With edge connector.

SOFTWARE FEATURES:

- Slave default Baud rate: 9600, Data bits:8, Stop bit:1, Parity: No parity.
- Auto-connect to the last device on power as default.
- Permit pairing device to connect as default.
- Auto-pairing PINCODE:”1234” as default.

PIN DESCRIPTION:

The HC-05 Bluetooth Module has 6pins. They are as follows:

ENABLE:

When enable is pulled **LOW**, the module is disabled which means the module will **not turn on** and it **fails to communicate**. When enable is **left open or connected to 3.3V**, the module is enabled i.e. the module **remains on** and **communication also takes place**.

Vcc:

Supply Voltage 3.3V to 5V

GND:

Ground pin

TXD & RXD:

These two pins act as an UART interface for communication

STATE:

It acts as a status indicator. When the module is **not connected to / paired** with any other Bluetooth device, signal goes **Low**. At this **low state**, the **led flashes continuously** which denotes that the module is **not paired** with another device. When this module is **connected to/paired** with any other Bluetooth device, the signal goes **High**. At this **high state**, the **led blinks with a constant delay** say for example 2s delay which indicates that the module is **paired**

III.MOTOR DRIVER

A **motor controller** is a device or group of devices that serves to govern in some predetermined manner the performance of an electric motor. A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and faults.

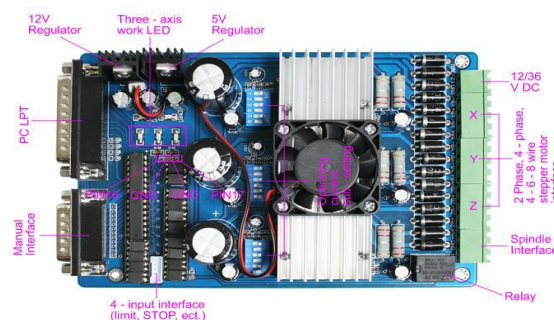


Diagram: CNC motor driver

IV. STEPPER MOTOR

Stepper motor or **step motor** or **stepping motor** is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed.

INDEXERS:

The indexer (or controller) is a microprocessor capable of generating step pulses and direction signals for the driver. In addition, the indexer is typically required to perform many other sophisticated command functions.

DRIVERS:

The driver (or amplifier) converts the indexer command signals into the power necessary to energize the motor windings. There are numerous types of drivers, with different voltage and current ratings and construction technology. Not all drivers are suitable to run all motors, so when designing a motion control system, the driver selection process is critical.

STEPPER MOTOR:

The stepper motor is an electromagnetic device that converts digital pulses into mechanical shaft rotation. Advantages of step motors are low cost, high reliability, high torque at low speeds and a simple, rugged construction that operates in almost any environment. The main disadvantages in using a stepper motor is the resonance effect often exhibited at low speeds and decreasing torque with increasing speed.

V. BUCK CONVERTER

A **buck converter** (**step-down converter**) is a DC-to-DC power converter which steps down voltage (while stepping up current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter).

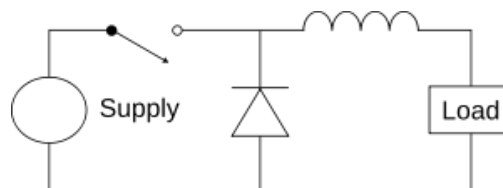


Diagram: Step down buck converter

VI. WORKING

In "Firefighting robot", Which is to detect and extinguish fire, the microcontroller which is used here is Arduino, two methods to work with firefighting robot

1. Detection method
2. Extinguish method

DETECTION METHOD

In the detection part there are 2 methods,

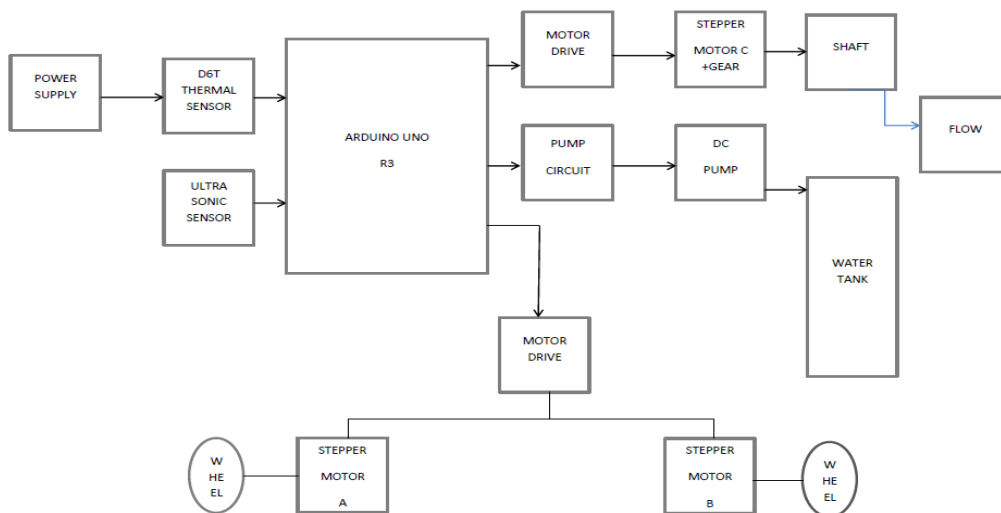
1. Sensor used for the detection that is thermal sensor which is to detect the temperature of fire.

2. Bluetooth module: Bluetooth module as a manual control of robot which is to move near to the fire, these both detection methods are connected to the micro-controller.

Motor drive:

2 motor drives are used, which are connected to Arduino, In 1st motor drive it has two stepper motors for the movement of wheel A and B

BLOCK DIAGRAM



BLOCK DIAGRAM OF FIRE FIGHTING ROBOT

EXTINGUISH METHOD

In extinguish part, we used water in which pump motor gives the waters level, quantity, pump motor which gives the waters behavior by pump circuit,

2nd motor drive are connected to Arduino, Another stepper motor connects with it shaft where the flow occurs this process is the rack and pinion.

APPLICATION

- Automatic fire extinguishers are recommended for use in:
 - ✓ Hazardous materials storage facilities
 - ✓ Military vehicles
 - ✓ Mass transit systems
 - ✓ Data centers and server rooms
 - ✓ The pharmaceutical industry
- Disaster area monitoring and rescue

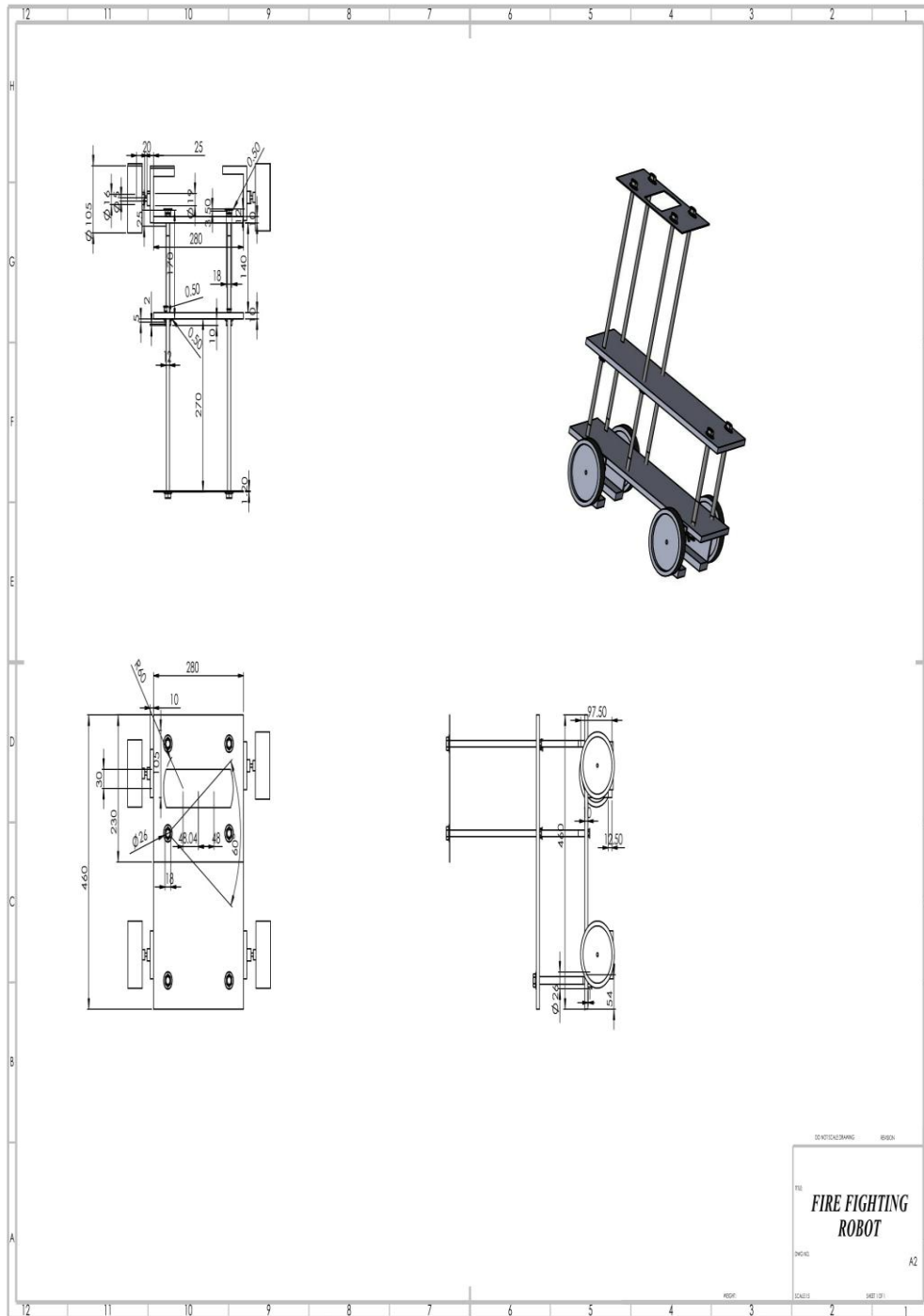
ADVANTAGE

- Reduce human effort
- Reliable and economical
- Not sensitive to weather condition
- To detect the exact direction of the fire source

DISADVANTAGES

- No monitoring system for the vehicle
- No automatic control for the robotic movement
- Our system used only for less than 10 kg application
- It is not used to put out large fires

DESIGN OF CHASSIS



VII.CONCLUSION

This paper has presented a unique vision of the concepts which are used in this field. It aims to promote technology innovation to achieve a reliable and efficient outcome from the various instruments. With a common digitalized platform, these latest instruments will enable increased flexibility in control, operation, and expansion, also eventually benefit the customers with improved services, reliability and increased convenience. This leads interface designing for improved man machine interaction. The mechatronics application ensures a convenient way of simplifying the life by providing more delicate and user friendly facilities in computing devices. Now that we have proven the method, the next step is to improve the hardware. Instead of using cumbersome modules to gather information about the user, it will be better to use smaller and less intrusive units. The day is not far when this technology will push its way into your house hold, making you lazier. This paper present the major features and function of the various concepts that could be used in this field in detail through various categories. Since this initial work cannot address everything within the proposal framework and vision more research and development efforts are needed to fully implement. This autonomous robot successfully performs the task of a fire fighter in simulated house fire

REFERENCES

1. <https://www.elprocus.com/projects-on-fire-fighting-robotic-vehicle/>
2. www.instructables.com/id/Autonomous-Fire-Fighter-Robot/
3. nevonprojects.com/fire-fighter-robot-project/
4. [https://prezi.com/tiquin0du5lo/fire-fighting-robot-using-arduino/.](https://prezi.com/tiquin0du5lo/fire-fighting-robot-using-arduino/)
5. www.ti.com/lit/slyb165
6. www.instructables.com/id/Arduino-6-wire-Stepper-Motor-Tutorial/
7. www.egr.msu.edu/classes/ece480/capstone/spring12/.../Austin_ApplicationNote.pdf
8. <https://learn.adafruit.com/all-about-stepper-motors/types-of-steppers>