ISSN: 2454-9940

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

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INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

ISSN2454-9940
www.ijsem.org
Vol 15, Issuse .1 Feb 2024

SMART FIRE FIGHTING ROBOT

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ABSTRACT

The outbreak of a fire is a dangerous act that has a number of consequences. Detecting fire at an early stage and extinguishing it can help in preventing various accidents. So far we rely on human resources .This often puts the person's life at risk. Therefore, fire protection becomes an important aspect for saving human lives. A firefighting robot was designed and designed to detect the fire location and extinguish the fire using sprinklers when the pump is started.This robot uses three flame sensors for accurate fire detection. This proposed model of firefighting robot using Arduino is used to detect the presence of fire and extinguish it automatically without any human intervention. It contains gear motors and a motor controller to control the movement of the robot when it detects any occurrence of fire and automatically starts a water pump to extinguish that fire. This robot model has a water ejector that is capable of releasing water at the scene of a fire. The water ejector tube can be moved in the desired direction using a servo motor. The entire operation is controlled by the Arduino microcontroller.

INTRODUCTION:

A robot is a machine that perform tasks usually human do it. The first uses of modern robots were in factories as industrial robots. It is a machine with manufacturing tasks, which allowed production without the need for human assistance . The robots divided into several groups such as Tele-robots, Telepresence, Mobile robots and Autonomous robots .Telerobotic or teleportation is a technical name given to any handled device doing operations controlled by the operator, unlike the robots, the Tele-robots are restricted based on how the operator has a limited range of function and commands compare to the robots.Teleoperation known as telepresence, the human operator, has a sense of being on location so that the experience resembles virtual reality. A telepresence robot is similar to a telerobot, and the only difference is providing a data response, such as video and sound.Therefore, telepresence robots commonly used in many fields requiring monitoring procedures, such as child services in nursery and education . The mobile robot is requiring human beings to navigate and carry out tasks , while autonomous robots can perform the task independently without the involvement of human beings . Moreover, the industrial robots are multi-function manipulators designed for more specific materials, tools or devices through numerous programmatic drives to perform several tasks.Many studies and projects have shown that robot can be valuable in medicine , rescue operation , industry and rehabilitation . The use of

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ISSN2454-9940
www.ijsem.org
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robots is increasing and become more common today than ever before, and the fire extinguisher robot becomes essential to protect human life. The robot can detect and extinguish a fire by its self . There are many projects related to firefighter robotics have been studied through this project to compare, improve, develop the study of the smart firefighting robot. The following robots are some examples used to fight a fire in different applications, most of them have advantages and disadvantages that helped to improve this study;

PROPOSED METHOD:

This principle is one of the great applications for firefighting that fit in non-industrial buildings such as houses. The main disadvantages are the little period of working time and low storage of water provided. “Pokey the Fire-Fighting Robot” is the robot that listed for coemption and got improved. In there is a detailed description of basic algorithms of operating and the user equipment. The robot equipped with sensors such as a line-sensor, but it does not work very well in a dense smoke area.

The advantages of this robot are using of complex firefighting tool and two types of fire sensors. On the other hand, the disadvantages are working in a short distance paced on the sensors range less than 1.5m, also the absence of optical means of environment perception and low efficiency of the computer. In this paper, a smart firefighting robot (LAHEEB) proposed because firefighters play a significant rule in societies therefore many studies are discussed on the use of robots to minimize firefighters' injuries and losses as well as increasing efficiency, safety, and quality of the task and its procedures .

The primary function of this robot is to detect the source of different types of fire, extinguish it and increase the knowledge about fire behavior from the incident area. There are several existing types of vehicles for firefighting at home and extinguish forest fires . By using such LAHEEB robot, fire identification and rescue activities can accomplish with higher security and without placing firefighters at high risk and dangerous conditions.

All parts were assembled to accomplish the function of detecting fire, extinguish it and increase the knowledge about fire behavior. The first part is the mechanicals design structure of the robot's body. The second part is a hardware implementation of the used parts, while the third is the software design details.

WORKING

The outbreak of a fire is a dangerous act that has a number of consequences. Detecting fire at an early stage and extinguishing it can help in preventing various accidents. So far we rely on human resources. This often puts the person's life at risk. Therefore, fire protection becomes an important aspect for saving human lives. A firefighting robot was designed and designed to detect the fire location and extinguish the fire using sprinklers when the pump is started. This robot uses three flame sensors for accurate fire detection. This proposed model of firefighting robot using arduino is used to detect the presence of fire and extinguish it automatically without any human intervention. It contains gear motors and a motor controller to control the movement of the robot when it detects any occurrence of fire and automatically starts a water pump to extinguish that fire.

BLOCK DIAGRAM

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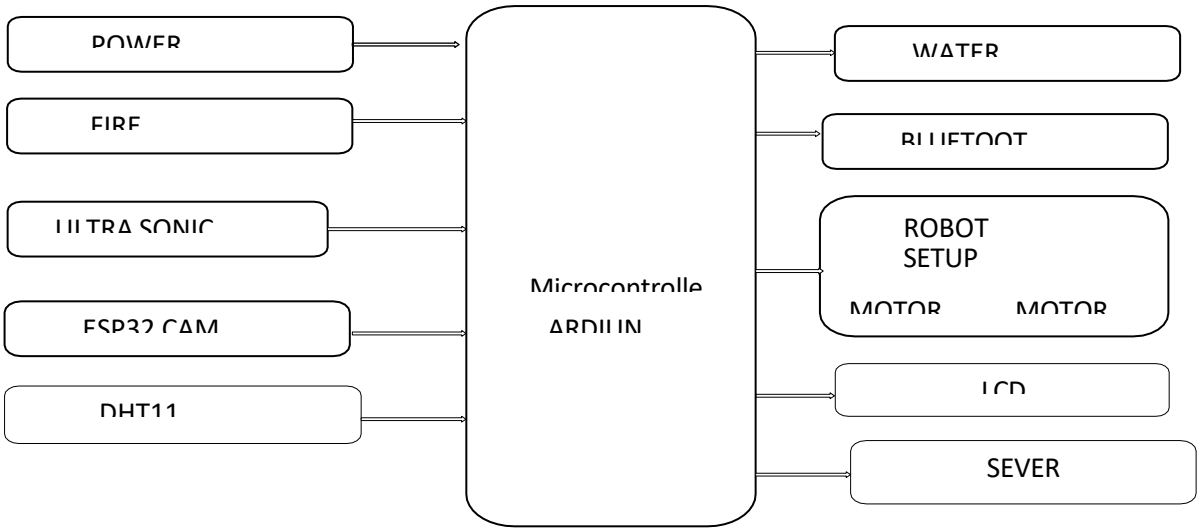

Figure Block Diagram of Smart Fire Fighting Robot

Main microcontroller:

The main IC (integrated circuit) on the Arduino is slightly different from board to board. The microcontrollers are usually of the ATMEL Company.

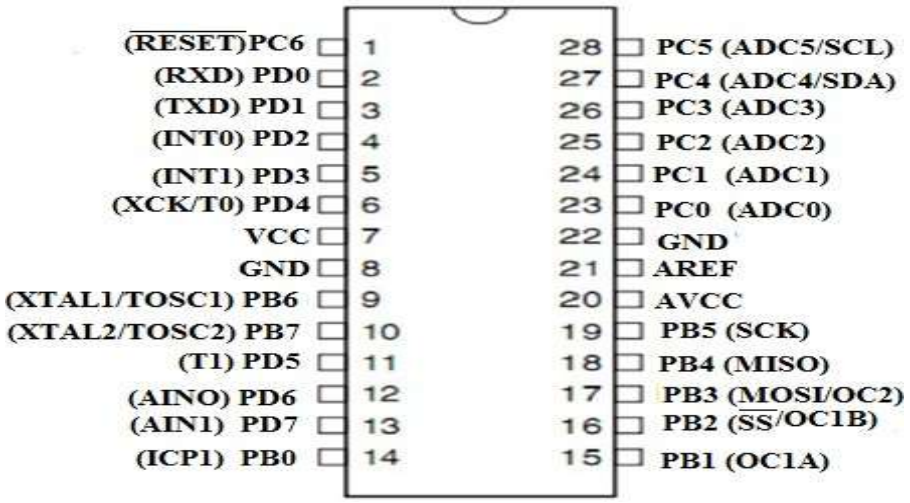

Figure Pin diagram

Power Supply

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others

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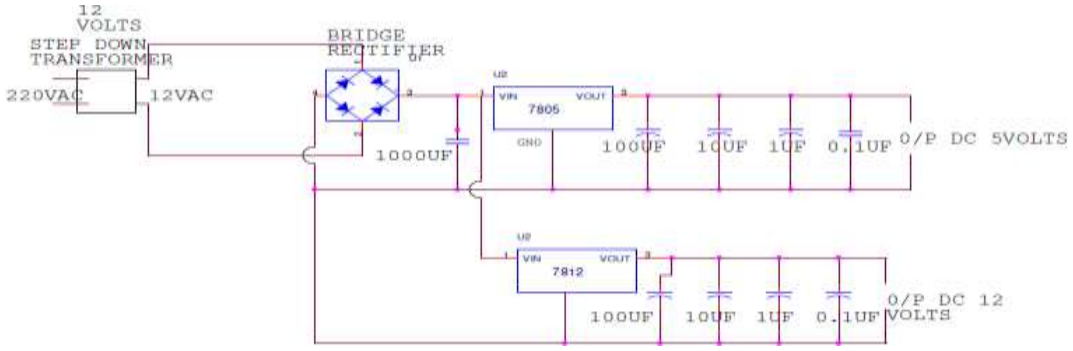

power supply circuit diagram Circuit Explanation

1) Transformer

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled electrical conductors. A changing current in the first circuit (the primary) creates a changing magnetic field; in turn, this magnetic field induces a changing voltage in the second circuit (the secondary).

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

Basic principle

The transformer is based on two principles: firstly, that an electric current can produce a magnetic field (electromagnetism) and secondly that a changing magnetic field within a coil of wire induces a voltage across the ends of the coil (electromagnetic induction).

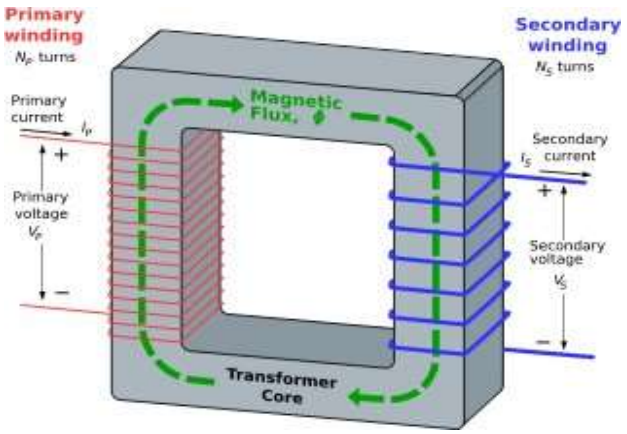

Fig:3.2 An ideal step-down transformer showing magnetic flux in the core

Induction law

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The voltage induced across the secondary coil may be calculated from Faraday's law of induction, which states that:

$$V_S = N_S \frac{\mathrm{d}\Phi}{\mathrm{d}t}$$

Where V_S is the instantaneous voltage, N_S is the number of turns in the secondary coil and Φ equals the magnetic flux through one turn of the coil.

$$V_P = N_P \frac{\mathrm{d}\Phi}{\mathrm{d}t}$$

Taking the ratio of the two equations for V_S and V_P gives the basic equation for stepping up or stepping down the voltage

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

Ideal power equation

If the secondary coil is attached to a load that allows current to flow, electrical power is transmitted from the primary circuit to the secondary circuit.

$$P_{incoming} = I_P V_P = P_{outgoing} = I_S V_S$$

giving the ideal transformer equation

$$\frac{V_S}{V_P} = \frac{N_S}{N_P} = \frac{I_P}{I_S}$$

$$P_{in\text{-}coming} = I_P V_P = P_{out\text{-}going} = I_S V_S$$

If the voltage is increased (stepped up) ($V_S > V_P$), then the current is decreased (stepped down) ($I_S < I_P$) by the same factor.

If the voltage is increased (stepped up) ($V_S > V_P$), then the current is decreased (stepped down) ($I_S < I_P$) by the same factor.

The impedance in one circuit is transformed by the *square* of the turns ratio.

$$Z_S \left(\frac{N_P}{N_S}\right)^2$$

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This relationship is reciprocal, so that the impedance Z_P of the primary circuit appears to the secondary to be

$$Z_P \left(\frac{N_S}{N_P}\right)^2$$

Bridge Rectifier

A diode bridge or bridge rectifier is an arrangement of four diodes in a bridge configuration that provides the same polarity of output voltage for any polarity of input voltage. When used in its most common application, for conversion of alternating current (AC) input into direct current (DC) output, it is known as a bridge rectifier.

Basic Operation

When the input connected at the left corner of the diamond is positive with respect to the one connected at the right hand corner, current flows to the right along the upper colored path to the output, and returns to the input supply via the lower one.

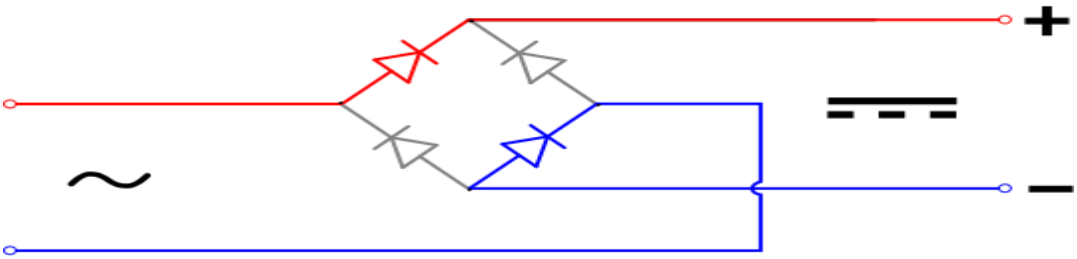

Fig: wave form lower colored path.

When the right hand corner is positive relative to the left hand corner, current flows along the upper colored path and returns to the supply via the lower colored path.

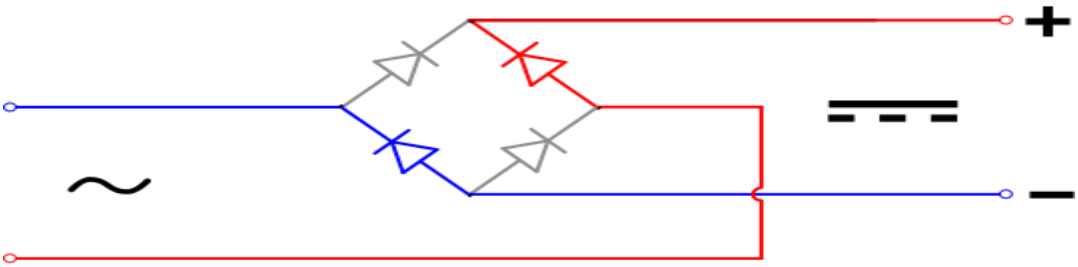

Fig: wave form right

Prior to availability of integrated electronics, such a bridge rectifier was always constructed from discrete components. Since about 1950, a single four-terminal component containing the four diodes connected in the bridge configuration became a standard commercial

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component and is now available with various voltage and current ratings.

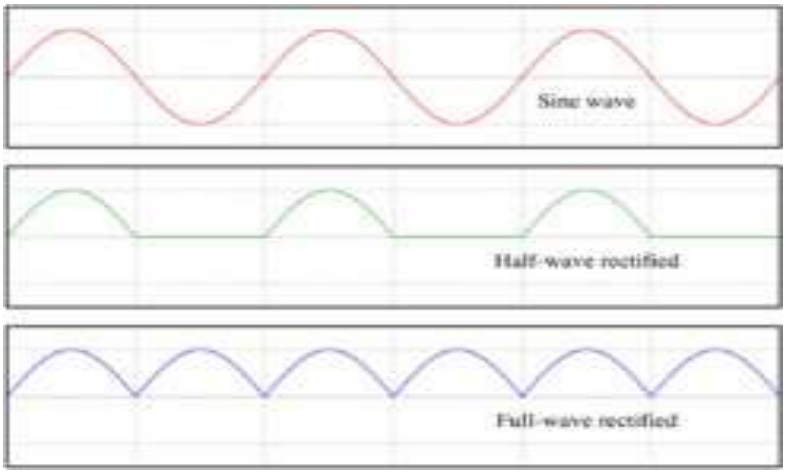

Fig: wave form sine ,half-wave and full-wave rectified.

Output smoothing (Using Capacitor)

For many applications, especially with single phase AC where the full-wave bridge serves to convert an AC input into a DC output, the addition of a capacitor may be important because the bridge alone supplies an output voltage of fixed polarity but pulsating magnitude (see diagram above).

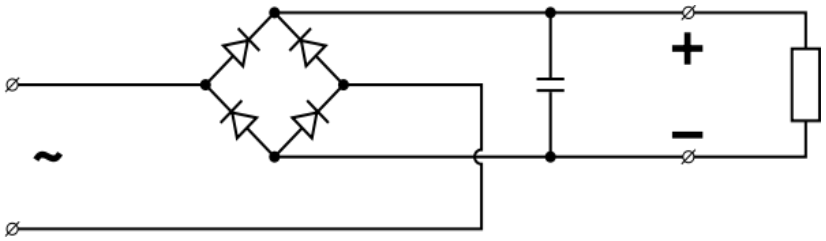

fig: output smoothing

The function of this capacitor, known as a reservoir capacitor (aka smoothing capacitor) is to lessen the variation in (or 'smooth') the rectified AC output voltage waveform from the bridge. One explanation of 'smoothing' is that the capacitor provides a low impedance path to the AC component of the output, reducing the AC voltage across, and AC current through, the resistive load.

Voltage Regulator

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level.78xx ICs have three terminals and are most commonly found in the

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TO220 form factor, although smaller surface-mount and larger TrO3 packages are also available from some manufacturers.

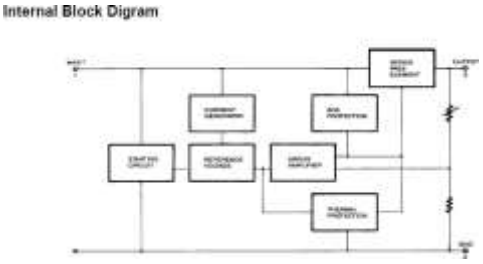

Fig: internal block digram.

Pin Identification and Configuration:

No:	Pin Name	Description
For DHT11 Sensor		
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serial Data
3	NC	No Connection and hence not used
4	Ground	Connected to the ground of the circuit
For DHT11 Sensor module		
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serial Data
3	Ground	Connected to the ground of the circuit

You can buy DHT11 sensor module from here.

TECHNICAL SPECIFICATIONS

SPECIFICATIONS	
Frequency band	2.4 GHz ISM band
Modulation	Gaussian shaped BFSK
Range	10 -100 m
Physical layer	FHSS
Coverage	Omni-directional. Non line of sight transmission
Data rate	1 Mbps/723 Kbps

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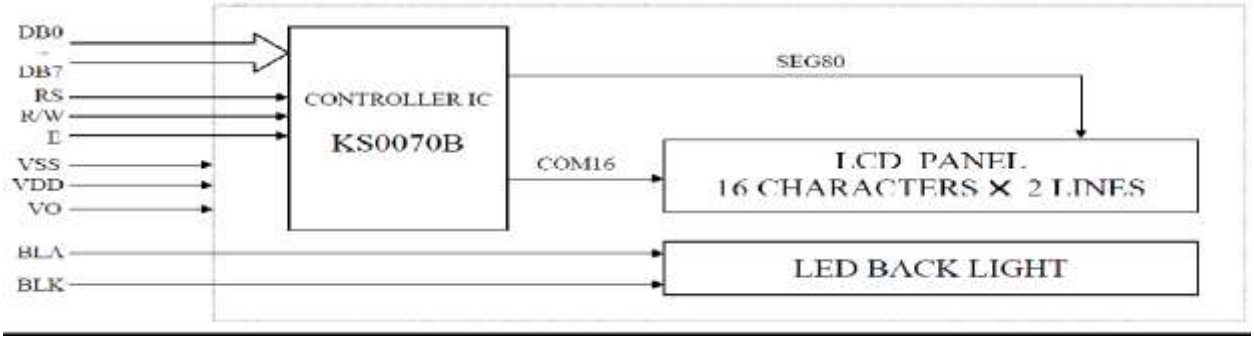
Hopping rate	1600 hops/sec at 1 hop/packet
Channels	79/23 channels
Channel length	625 microseconds long
Data packet	Up to 2,745 bits in length
Reliable and secure	Good. Link layer authentication and encryption
Cost	$ 20 aims at $5 endpoint
Power	0.1 W (Active)
Acceptance	SIG have about 2500 member companies
Data / Voice support	One asynchronous data channel (732.2 kbps and reverse 57.6 kbps) OR Three simultaneous synchronous voice channels (64 kbps) OR Simultaneous asynchronous and synchronous channels.
Piconet	1 master and 7 slaves
Scatter net	Up to 10 piconets in a scatter net
Links	SCO and ACL links

Table: technical specifications.

Block Diagram



lcd block diagram Display

RESULTS

We design the fire detection system using flame sensor that is capable of sensing the flame. The robot can operate in the environment which is out of human reach in very short time, the delay employed is very minimal.

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The robot accurately and efficiently finds the fire and within minimum time after the fire is detected it is extinguished.

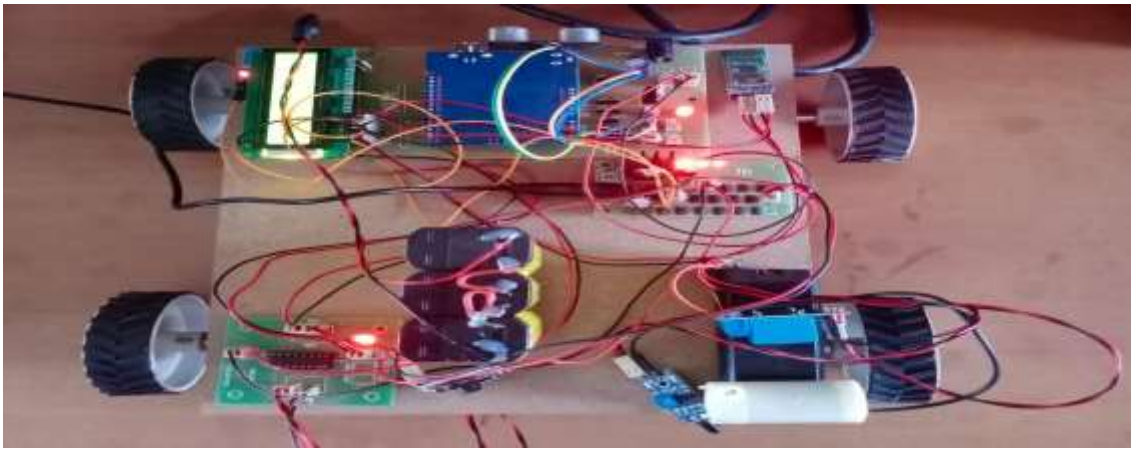

Figure. Photocopy of Smart Fire Fighting Robot

ADVANTAGES AND APPLICATIONS

ADVANTAGES:

1. **Faster Response Time:** Firefighting robots are capable of responding to emergency situations faster than human firefighters. This can be especially beneficial in situations where human firefighters may be delayed due to traffic, bad weather, or other factors.
2. **Increased Safety:** Firefighting robots are able to enter dangerous environments that may be too hazardous for human firefighters. This is especially important when dealing with hazardous materials such as chemicals and toxic substances.
3. **Enhanced Mobility:** Firefighting robots are often equipped with powerful motors and can traverse terrain that may be difficult for humans to access. This can be very helpful in situations where the fire is located in an area that is not easily accessible to human firefighters.
4. **Improved Accuracy:** Firefighting robots are typically equipped with sophisticated sensors that can detect fire, heat, and smoke more accurately than the human eye. This helps to ensure that the fire is extinguished quickly and efficiently.
5. **Cost Savings:** Firefighting robots are often cheaper to operate than human firefighters. This can result in significant cost savings in terms of training, equipment, and manpower.

APPLICATIONS:

- It is used to extinguish fire where possibility of explosion is more.
- It used as home security application.

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- It is used in server rooms in offices.
- It is useful in disaster area monitoring and rescue.

CONCLUSION AND FUTURE SCOPE

From the experimental results, a smart fire-fighting robot (LAHEEB) has achieved its aim and objective successfully. The robot developed to help firefighters in their duty. It has advantageous features such as the ability to detect the source of fire, extinguish it and increase the knowledge about fire behavior from the incident area.

This robot can extinguish different types of fire A, B, C, D, F/K, electric and metal fire without spreading in the shortest time. This robot will reduce the risk of injury for firefighters and possible victims and decrease the monetary losses which increase considerably as fire duration increases. LAHEEB also can avoid hitting obstacles or surrounding objects by using sensors. The robot can be used in a place that has a small entrance or in small spaces because it has a compact structure.

FUTURE SCOPE

In future, we can implement following factors:

Use of Co2 Gas Cylinders: Due to its physical and chemical properties, Co2 is the most commonly used gas on-board ships in order to extinguish fire during accidents.

Use of Dry Chemical Powder: Dry Chemical Powder is discharged by pressure of nitrogen gas stored in bottles without other power source. . Dry Chemical Powder is not electrically conductive and therefore it can be used to electric equipment.

Use of Foam: Foam has been used as a fire-extinguishing medium for flammable and combustible liquids. Foam is made up of three ingredients - water, foam concentrate and air.

Can use Higher Resolution Zooming Camera: By using higher resolution zooming camera we can detect the fire from the long distance.

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