

Arduino based Fire Fighting Robotic Vehicle

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Abstract

With the development in the field of robotics human instruction has become lesser and the robots are being widely used for the safety purpose. In day-to-day life fire mishaps have become common. Many times it may lead to human lives, wealth and ambience from the fire accidents. This project is an advanced project and it incorporates RF technology for remote operation and also uses an Arduino-nano ATmega 328 series microcontroller. This project is help to detect fire and protect human being from fire hazards.

Keyword :- Arduino- nano ATmega 328 series microcontroller, RF (Radio Frequency) technology.

1 Introduction :

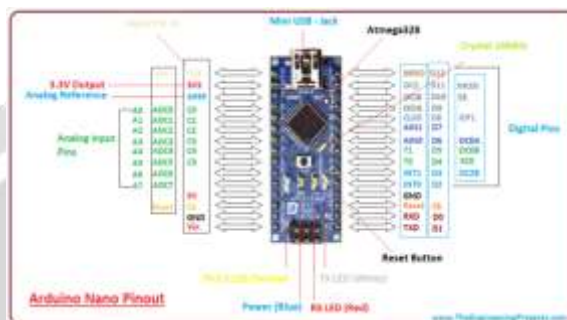
The robotic vehicle is electromechanical design which have the capability of performing a human task, also reduced workload. Our project makes use of RF (Radio frequency) technology for remote operation and also based on Arduino-nano ATmega 328 series application. The main goal of our is to make human life more secure and safe by making used of fire-fighting robotic vehicle in different situation where human life is in danger. There are several possibilities of fire in any remote area or in an industry. For instance, in garment godowns, cotton miles and fuel storage tanks, electric leakage may result in immense fire and harm . This project is designed in such a way that it searches a fire and douses it before the fire could spread out of range and control. We are assured that the role of robotics will be used in a superior way in the future to solve such problems. By using such robotic vehicles. The technology field deals with the design, construction, operation and application of the robotic vehicle also computer system for their controlling, sensing and feedback and processing data is robotics. These are the technologies which deals with automatic machines play the role of human in dangerous environments, behavior, or discernment. Now-a-days many robots are invented by nature to contribute to the field of robotics of bio-inspired. These robots have also designed a different types of robotics: soft robotics.

The design approach and implementation of the “Arduino based Fire Fighting Robotic Vehicle” is presented in this paper. In our project, it is the movable robotic vehicle which is remotely operated, consists of the smoke sensor (MO-7) for detecting the fire, DC gear motor and motor driver for the movement of the robotic vehicle, relay driver board for control the pump and receiver which is used to detects and extinguish the fire. The Arduino-nano having 8 channel relay which is based on the ATmega328 series microcontroller. The ATmega328 series microcontroller is good platform for robotics application and therefore the actual fire extinguishing can be done by this robotic vehicle. The firefighting robotic vehicle includes water tank, that is used to pump the water on fire and controlled over a wireless communication. For the desired operation, an Arduino-nano is used. The proposed system, RF module application is used to send commands from transmitter end to receiver end to control the movement of the robotic vehicle either to move forward, backward, right and left. At the receiver side, two motors are interfaced to an Arduino to control the movement of the vehicle. In this project, there are two different circuits namely, Transmitter circuit and receiver circuit. These circuits are different in person but having same operation.

1.1 Major Components:

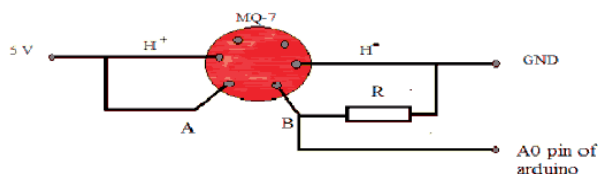
1) Arduino-nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.0) or a ATmega168 (Arduino Nano 2.x). it has more less the same functionality of the Arduino Duemilanove, but in a different package, it lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. The Nano was designed and is being produced by Gravitech. The Nano is automatically sense and switch to the higher potential source of power, there is no need for the power select jumper. It's got a pin layout that works well with the Mini or the Basic Stamp (TX, RX, ATN, GND on one top, power and ground on the other). This new version 3.0 comes with ATMEGA328 which offer more programming and data memory space.



2) Smoke Sensor

Sensitive material of MQ-7 gas sensor is SnO_2 , which has lower conductivity in clean air. It makes detection by the method of cycle high and low temperature, and detects CO when at low temperature (heated by 1.5V). The sensor's conductivity is much higher as the gas concentration rises. When at high temperature (heated by 5.0V), it cleans the other gases absorbed at low temperature. MQ-7 gas sensor has high sensitivity to Carbon Monoxide. The sensor can be used to detect different gases containing CO; it is low cost and suitable for different applications. The encapsulated MQ-7 has 6 pins, 4 of which are used to fetch signals, and the other 2 are used for providing heating current.



3) DC Gear Motor

Geared DC motors can be defined as an extension of DC motor which already had its insight details demystified here. A geared DC motor has a gear assembly attached to the motor. The speed of the motor is measured in terms of rotation of the shaft per minute and is termed as RPM. The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. This insight will explore all the minor and major details that make the gear head and hence the working of a geared DC motor.



Fig: DC Gear Motor

1.2 Literature Survey:

In paper [1], the recommended robot have only two wheels. The robot consist the sensors such as temperature sensor LM35 used to detects the fire and flame sensor used to detects the distance. The water tank is placed on the robot having the capacity of 1 litre and the water tank is made with water resistant strong cardboard.

In paper [2], the vehicle makes use of fuzzy logic to eliminate obstacle. The vehicle prevents static object in static environment. It covers the target in nonexistent environment.

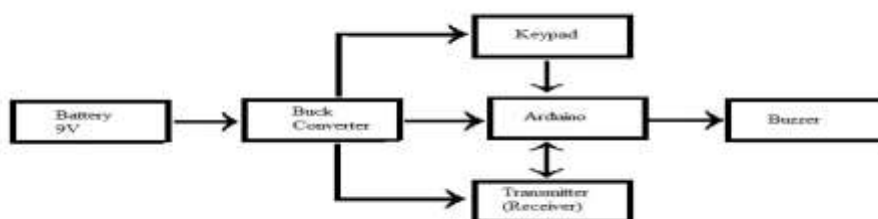
In paper [3], the human controls the robot by making the use of Bluetooth module. The Bluetooth module operates with the android application. In this, the Bluetooth model transmit android application by using to drive the motor, Arduino mega, voltage divider, tires, Bluetooth motor driver.

In paper [4], the recommended fire fighting robot is a semi-autonomous vehicle. The robot is design to extinguish the fire by using android application.

In paper [5], it is consist of an Arduino, gas sensor, motor driver, Relay driver, Bluetooth module, pump and water sprinkler. For arduino-nano programming, open source software Arduino IDE is used. The detection of fire and extinguishing was done by an Arduino Nano which consist the gas sensor, relay driver, gear motor, motor driver, etc. In everyday life like in homes, parking, supermarkets, stores, shops and chemical labs, the “Android controlled firefighting robot” can be used easily. Patrolling is the main function of the robot. The drawbacks of this robot are Bluetooth range and water capacity.

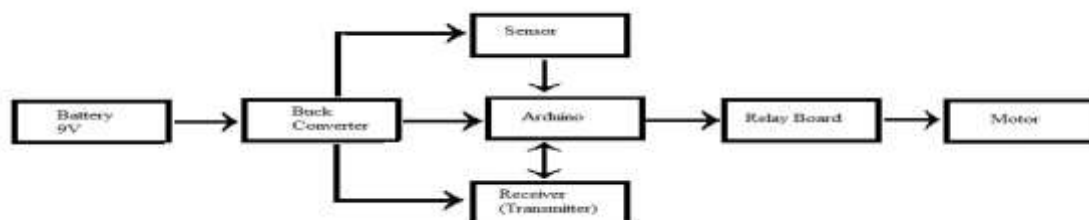
2 Block Diagram :

2.1 Transmitter Circuit



The transmitter circuit consist an Arduino-nano ATmega 328 series microcontroller, transmitter (NRF24L01), Buck converter, keypad and buzzer. In this, 9V supply is given to the Buck converter for converting the 9v DC supply into 5V DC. It is also known as Step-down converter. The Buck converter is used to avoid short circuit and for refresh the circuit. An Arduino-nano, Transmitter (NRF24L01) and keypad are connected to the Buck converter that is the 5V dc supply is given to the Arduino-nano, Transmitter and keypad. An Arduino-nano ATmega 328 series microcontroller having 8 channel relay on it. The output of the Buck converter is connected to an Arduino-nano pin no. 36 which is 5V and pin no. 4 which is GND. Buck converter gives the supply to the Keypad which is in Analog system pin no. 19 to pin no. 26 which are A₀-A₇. The Keypad is connected to the data bus line of Arduino-nano. An Arduino-nano is gives the commands through the programming to the transmitter. The transmitter is connected to the arduino's pin no. 17 and pin no. 39 (GND). The transmitter gives the signal to the buzzer through an Arduino-nano after the detection of fire/smoke and then the buzzer gives the alarm.

2.2 Receiver Circuit



The receiver circuit consist of Buck converter, an Arduino-nano, smoke sensor (MQ-7), Receiver (NRF24L01), relay board and motor. The Buck converter gives the 5V supply to the arduino-nano, smoke sensor and Receiver (NRF24L01). An Arduino-nano having the 8 channel relay on it which is used to gives the commands and to operate the Receiver and the smoke sensor. Smoke sensor connected to an Arduino-nano, sense the smoke/fire and gives the signal to the receiver circuit for the operation of circuit. Receiver receives the transmitting signal coming from the transmitter circuit and gives the command to Arduino-nano to operate the relay board which is connected to the motor. The relay board is connected to Arduino-nano and the output of the relay board is given to motor for next operation of the robotic vehicle.

3 Working :

Firefighting robotic vehicle remotely operated by an Arduino application. The main intention of this project is to design a fire fighting robotic vehicle based on an Arduino-nano ATMEGA 328 series microcontroller. The firefighting robotic vehicle includes water tank, which is used to pump the water on fire and controlled over a wireless communication. For the desired operation, an Arduino-nano is used. The proposed system, RF module application is used to send commands from transmitter end to receiver end to control the movement of the robotic vehicle either moving forward, backward, right and left. At the receiver side, two motors are interfaced to an Arduino to control the movement of the vehicle. In this project, there are two different circuits namely, Transmitter circuit and receiver circuit. These circuits are different in person but having same operation.

In this project, a smoke sensor is fitted on the robotic vehicle is used to detect the fire. If fire occurs in the surrounding, then the smoke sensor (MQ-7) sense the fire and buzzer starts to beep. The buzzer is installed on the remote. It gives the signal to the remote operator for controlling and operating the robotic vehicle. Transmitter circuit transmits the signal to the receiver circuit. The transmitter circuit is fitted on the remote. This remote which have transmitter circuit is used for the movement of the robotic vehicle. The remote is used to direct the robotic vehicle that is to give the direction such as to move right, left, forward and backward. This transmitter circuit consists of Arduino-Nano, Buck converter, transmitter (NRF24L01) and Buzzer. The transmitter circuit is used to control the moving action of the robotic vehicle. All the moving actions signals are transmits through the programming and command given to Arduino-nano.

The smoke sensor is fitted on the receiver circuit which is used to detect the fire. Receiver circuit consist of Buck converter, Arduino-Nano, receiver, relay board. The receiver (NRF24L01) is used to receive the signal from the transmitter circuit for the controlling action and movement of robotic vehicle through the wireless communication. The receiver circuit is placed on the robotic vehicle. In receiver circuit, buck converter is used to supply the power to arduino, receiver and smoke sensor. An Arduino-Nano is used to send the commands to the relay board for driving the motor-3of the pump. The three motors are interfaced to Arduino-Nano, that are M-1, M-2 and M-3. In Arduino-nano programming, if M-1=1and M-2=1, then wheels which are coupled to the motors are rotates in clockwise direction and the robotic vehicle moves in forward direction. If M-1=0 and M-2=0, then the wheels are rotate in anti-clockwise direction and the robotic vehicle moves in backward direction. If M-1 stops and M-2=1 then the vehicle moves in right direction. If M-1=1 and M-2 stop then the vehicle moves in left direction. The water tank have the pump on it, when robotic vehicle reach to the fire, it starts to spray the water on the fire to extinguish it, it is also controlled by the wireless communication between transmitter and receiver.

4 conclusion:

Thus “An Arduino based Fire Fighting Robotic Vehicle” has been successfully developed that can be easily controlled form some distance. It has the ability to detect the fire through the smoke sensor. This robotic vehicle can be used in places like small entrance, in small space because the robotic vehicle has compact in structure. From long distance, the operator is able to control the robotic vehicle and extinguish the fire remotely.

The application of introduced firefighting robotic vehicle is used in petrochemical plants, hazardous area like radioactive environment unstable structure, high pressure vessel. Now-a-days, the implementation of firefighting robotic vehicle still not supported by the local authority or department of fire to developed and implement this robotic vehicle during critical situation and reduced the risk of fire fighter’s life from dangerous situation.

As a conclusion, the project entitled “Arduino based Fire Fighting Robotic Vehicle” has achieved its aim and objective successfully. In addition to advancement, the robotic vehicle arm may br designed for various programs such as gardening, agricultural programs and many others. Restrictive sensor are used have a look at the location of the item and also the whole approach is automatic and it may speak with person through networking.

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