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Project Report on

Arduino Fire Fighting Robot

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EMBEDDED SYSTEM

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CERTIFICATE

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ABSTRACT

Fire incidents are disasters that can potentially lead to the loss of life and property. It can also cause damage and permanent disability to the affected victim. Firefighters are primarily tasked to handle fire incidents, but they are often exposed to high risks when extinguishing the fire, especially in a hazardous area. A one-stop solution for all fire-related accidents like fire outbreak, smoke and combustible gas leakage is hereby considered. This study presents the development of a fire extinguishing robot that can sound an alarm to occupants of the building, and also proceed to extinguish the fire unmanned. It is designed to be compact for ease of movement into narrow spaces. The robot is equipped with an ultrasonic sensor to avoid collision with any obstacle and surrounding objects, while the flame sensor alongside a smoke sensor, was used to detect the fire. This developed autonomous system demonstrates the capabilities of identifying fire locations automatically and extinguishes the fire using the stored water in the container on it.

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CHAPTER 1

INTRODUCTION

Fire incidents are disasters that can potentially lead to the loss of life and property. It can also cause damage and permanent disability to the affected victim. Firefighters are primarily tasked to handle fire incidents, but they are often exposed to high risks when extinguishing the fire, especially in a hazardous area. A one-stop solution for all fire-related accidents like fire outbreak, smoke and combustible gas leakage is hereby considered. Autonomous robots can act on their own, independent of any controller. The basic idea is to program the robot to respond in a certain way to outside stimuli. The very simple bump-and-go robot is a good illustration of how this works. L293D is a dual H-bridge motor driver integrated circuit (IC). They are used to control they the 4-motor used in project. There are 2 motor driver IC used in the project one to control front motor and other for rear motors. The development of a fire extinguishing robot with an SMS alert feature that can sound an alarm to occupants of the building, send an alert SMS message to the registered phone number, and also proceed to extinguish the fire unmanned. It is designed to be compact for ease of movement into narrow spaces. This developed autonomous system demonstrates the capabilities of identifying fire locations automatically and extinguishes the fire using the stored water in the container on it. Fire fighter robot can be used to control the fire. This robot can detect the fire by itself and control the fire by throwing water. There are some sensors we are using that can detect fire and robots can move there to fire extinguish. The firefighting robot has the same structure as Bluetooth control RC car. The robot has 3 sensors 1 sensor at the front side which see if there is anything in front of the robot and the other two at the both front corner which also searches for fire. If any sensor detects fire at any site the robot will sensor and move towards it. The firefighting robot has 4 wheels, 3 sensors, one water tank, one nozzle, and a computer which help him to take decision according to the code. Autonomous robots can act on their own, independent of any controller. Microcontroller can be described as a computer embedded on a rather small circuit board. To describe the function of a microcontroller more precisely it is a single chip that can perform various calculations and task and send/receive signals from other devices via the available pins. Precisely what tasks and communication with the world it does, is what is governed by what instructions we give to the Microcontroller. It is this job of telling

the chip what to do, is what we refer to as programming on it. However, the microcontroller by itself, cannot accomplish much, it needs several external inputs, power, for one, a steady clock signal, for another. Also, the job of programming it has to be accomplished by an external circuit. So typically, a microcontroller is used along with a circuit which provides these things to it; this combination is called a microcontroller board. The Arduino Uno that you have received is one such microcontroller board. The actual microcontroller at its heart is the chip called Atmega328. The advantages that Arduino offers over other microcontroller boards are largely in terms of reliability of the circuit hardware as well as the ease of programming and using it. Finally, this project uses IDE compiler for interfacing the Arduino with a PC. This interface is used to setup and compile the Arduino.

Objectives

The objective of the project is:

a. To assemble a robot that can detect fires and extinguish them using water.
b. To integrate SMS and call alert features into the robot, so it can notify people of the fire and its location.

Overview

The project is designed to develop a firefighting robot using Arduino uno. The robotic vehicle is loaded with water pump which is controlled by servos. Arduino is used for the desired operation. The whole operation is controlled by an Arduino. The motors are controlled by the Motor driver. Once the robot is turned on then the Arduino will be turned on. Firstly, the MQ2 sensor senses the gas around that, once the gas is detected the Arduino will send a SMS “GAS DETECTED”, using the SIM800L module. Then the robot continues to move in the direction of fire with the help of the flame sensors, we use 3 flame sensors one at the left side, one in the centre and other at the right-side fixed front side of the robot once detected the robot moves towards it and relay module will be turned on to turn on the pump then the SIM800l will send the Call alert to the registered number. Then the fire with will be cut off. Once the fire is extinguished the robot again continues to do the same when the same is repeated.

CHAPTER 2

LITREATURE REVIEW

Mohd. Shahbaz Khan et al "Bluetooth control cleaning robot using Arduino". They have designed a robot and the robot is controlled using Bluetooth which is present at both transmitter and receiver end [1]. Vijayalakshmi M et al proposed "Smart Vacuum Robot" with progressive technology. S-curve planning is used for efficient working along with sensors to avoid obstacles [2]. Gaurav Dhariwal et al have proposed "Development of Driverless RC Car". In this report, an automatic car is built using concept of neural networks. This detects the obstacles present using sensors. Arduino and Raspberry Pi is used in this model [3]. S Yatamono et al proposed a report on "Development of Intelligent floor cleaning Robot". They have developed a smart floor cleaning Robot that can clean the place by navigating, sucking the dust and polishing the floor. The robot consists of an omni wheel which is equipped with a vacuum cleaner and floor polishing motor. It is coded in Arduino IDE by using Arduino microcontroller and it is equipped with Bluetooth so that it can work from smart phone connected via Bluetooth [4]. Sabir Hossain et al proposed "Deep Reinforcement Learning-based ROS-Controlled RC Car for Autonomous Path Exploration in the Unknown Environment". In this report, LiDAR equipped car using the concept of deep learning is discussed. The software used here is ROS and Arduino [5].R J Ong and K N F Ku Azir proposed "Low-Cost Autonomous Robot Cleaner using Mapping Algorithm based on Internet of Things (IoT)". Here, sensors are used to detect any obstacle and Arduino is used to control the robot. Mapping is applied so that the robot can clean without any huma intervention once it is switched on [6]. Anbumani V et al proposed a report "Development of Ingenious Floor Cleaner using ARDUINO". Here, different modes of cleaning available such as mopping, sweeping or both mopping and sweeping is discussed. For controlling the robot, Bluetooth module is used and other functions are coded in Arduino. This can even clean corners of the floor [7]. Adeel Saleem et al proposed "Design and Implementation of an Intelligent dust cleaner robot for uneven and non-structural environment". In this report, a robot has been designed which stores the plan of the room and makes the working feasible. This can be used for various environments as well. It is a cost-effective system. Md. Farhanul Islam et al have proposed "Designing and Optimization of An Autonomous Vacuum Floor Cleaning Robot". Here, an economic prototype is designed using

Arduino Mega and Raspberry Pi. GPS module is also present which helps the bot to move in the right direction.

Anshu Prakash Murdan et al proposed “A smart autonomous floor cleaner with an Androidbased controller”. Here, a bot is designed which can be controlled through Android. By using the application, the bot can be turned in the desired direction [10]. Amir Talebi Sheikh Sarmast et al have proposed “Designing a Smart Vacuum Cleaner in Two Modes of Remote and Automatic”. In this report, vacuum cleaner is implemented which operates automatically or through android application. If the battery percentage is less, a message is sent to the registered mobile number regarding the same. Md. Rawshan Habib et al proposed “Automatic Solar Panel Cleaning System Based on Arduino for Dust Removal”. In this report, a bot is designed to clean the solar panels using DC Motor which powers the wiper. Water is not used to clean the panels. This system’s efficiency is about 87 to 96 percent [12]. what is used by them. The detail description of the tetromino tiling algorithm and adaptive tiling scheme for segmented dirt area coverage planning described completely in this report. Some of the things discussed are tetromino tiling theory, adaptive tetromino tiling algorithm, comparison with Ttrominoes. There were two experiments performed to validate the vision-based adaptive selective area coverage scheme in their work. The initial one was conducted for validating the dirt detection algorithm with real images of dirt and images collected from dirt database and latter experiment was for validating the adaptive tiling scheme with generated dirt map. The robustness of the visual dirt detection algorithm assessed by measuring the dirt detection ratio of different surfaces with various kinds of dirt types multimedia contents to the MUs. The objective is to eventually maximize the system delivery capacity. Simulation results demonstrate that the CSF provides the best performance in terms of hit rate and system delivery capacity.

CHAPTER 3

REQUIREMENTS

3.1 Hardware

3.1.1. Arduino UNO

The key hardware of the prototype, Arduino Uno is shown in Fig. 1. This is a microcontroller which is used for interfacing hardware and software [13]. To do the same, USB cable is required. Once the board is embedded with the code, it can be operated by a battery supply without using any PC or laptop.

Figure 1 Arduino UNO

3.1.2. Batteries

Fig. 2 shows the heart of the prototype, 2000Mh batteries. These are cylindrical in shape and have positive and negative terminals at the top and bottom respectively which supplies power so as to make the prototype run.

Figure 2 Batteries.

3.1.3. MQ2 Gas Sensor

Fig 3 shows MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide.MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas.MQ2 is a metal oxide semiconductor type gas sensor. Concentrations of gas in the gas is measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm.

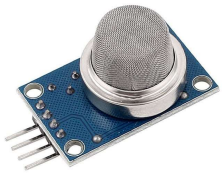

Figure 3 MQ2 gas sensor

3.1.4. DC motor and wheels

Fig. 4 shows one of the DC Motors used in the prototype. These motors essentially are the key components in this prototype. To make the machine move, these are required. As the voltage increases, rpm also increases. The least rpm will be at 6V and maximum at 12V.

Fig shows the wheels which are responsible for the movement of RC car. These are used to move in any specified direction. Wheels are run by a DC Motor with a pre-defined RPM. Wheels rotate in the same direction as DC Motor.

Figure 4 DC motor and Wheels

3.1.5. Motor driver shield

Fig. 5 shows the Motor Driver Shield. This is used to run different types of motors. L293D IC is the main IC present in this shield [14–16]. The direction and speed of motors depends on the motor shield, as the shield is embedded on Arduino UNO board and the speed and direction can be controlled by coding in Arduino IDE.

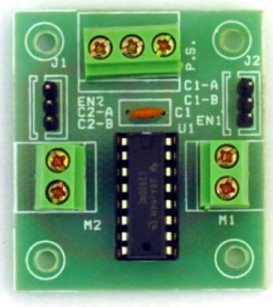

Figure 5 Motor driver shield

3.1.6. Relay Module

Fig. 6 shows Relays are most commonly used switching device in electronics. There are two important parameters of relay, first is the Trigger Voltage, this is the voltage required to turn on the relay that is to change the contact from Common → NC to Common → NO. The other parameter is your Load Voltage & Current, this is the amount of voltage or current that the NC, NO or Common terminal of the relay could withstand, in our case for DC it is maximum of 30V and 10A. Make sure the load you are using falls into this range.

Figure 6 Ultrasonic sensor

3.1.7 Flame Sensor Module

Fig 7 shows A flame sensor module that consists of a flame sensor (IR receiver), resistor, capacitor, potentiometer, and comparator LM393 in an integrated circuit. It can detect infrared light with a wavelength ranging from 700nm to 1000nm.The far-infrared flame probe converts the light detected in the form of infrared light into current changes. Sensitivity is adjusted through the onboard variable resistor with a detection angle of 60 degrees. Working voltage is between 3.3v and 5.2v DC, with a digital output to indicate the presence of a signal. Sensing is conditioned by an LM393 comparator.

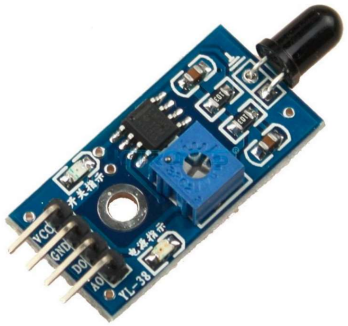

Figure 7 flame sensor

3.1.8 Servo SG90

There are lots of servo motors available in the market and each one has its own speciality and applications. The following two paragraphs will help you identify the right type of servo motor for your project/system. Most of the hobby Servo motors operates from 4.8V to 6.5V, the higher the voltage higher the torque we can achieve, but most commonly they are operated at +5V. Almost all hobby servo motors can rotate only from 0° to 180° due to their gear arrangement so make sure you project can live with the half circle if no, you can prefer for a 0° to 360° motor or modify the motor to make a full circle. The gears in the motors are easily subjected to wear and tear, so if your application requires stronger and long running motors you can go with metal gears or just stick with normal plastic gear.

Figure 8 servo motor

3.2.9 Mini Water pump

The water pump is operated at 5v which can be interfaced with Arduino.

Figure 9 water pump

3.2. Software

Fig. 10 shows the software used in this project, Arduino IDE. This is an application written in C and C++. Programs can be written and uploaded to Arduino boards. The version used in here is 1.8.9.

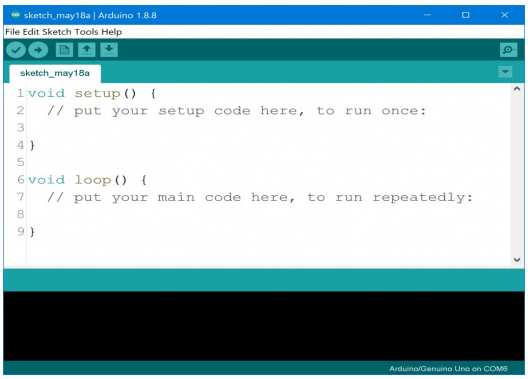

Figure 10 Arduino IDE

CHAPTER 4

Methodology

4.1. Design

Short all the vcc and ground pins of the Flame sensors. Then give the digital pin to the Arduino connect the digital pin of left sensor to the 4th port of the Arduino, right sensor to the 6th port of the Arduino and the forward sensor to the 5th port of the Arduino. Interconnect the vcc and ground pin of Servo sg90 and MQ2 sensor and give digital pin of MQ2 sensor to the 7th port of the Arduino similarly the servo to the 13th pin of the Arduino board. Give the vcc and ground pins one common to the bread board and give the vcc and ground pin of the relay module to the bread board and give the input pin to the 12th port of the Arduino board. Connect the output port of relay module to the Water pump vcc wire and the negative of the pump to the negative terminal of the 18650 battery and the positive terminal of the battery to the relay module. Connect the BO motors to the A0, A1and B0,B1 pin in the motor driver .Connect the LM1 and LM2 to the 10th and 11th port of the Arduino and similarly the RM1 and RM2 to the 8th and 9th port of the Arduino respectively. Connect the vcc and ground to the 18650 battery and give the same to the LM2956 to control the voltage

4.2. Block diagram

Fig. 11 shows the block diagram of the proposed model.

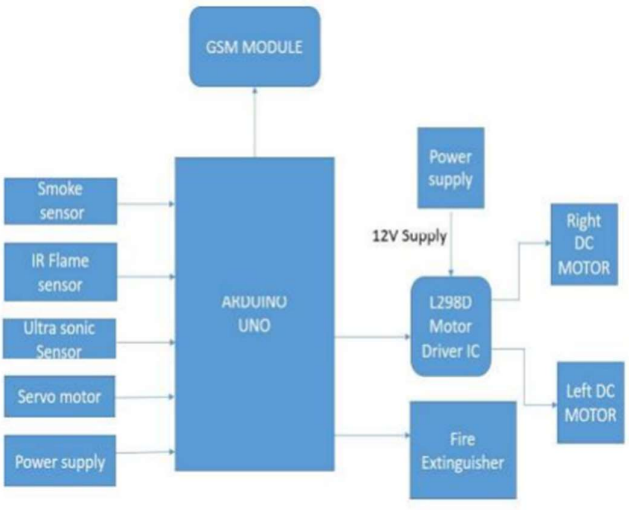

Figure 11 block diagram

4.3. Flow chart

Fig. 12 shows the flowchart of the proposed model.

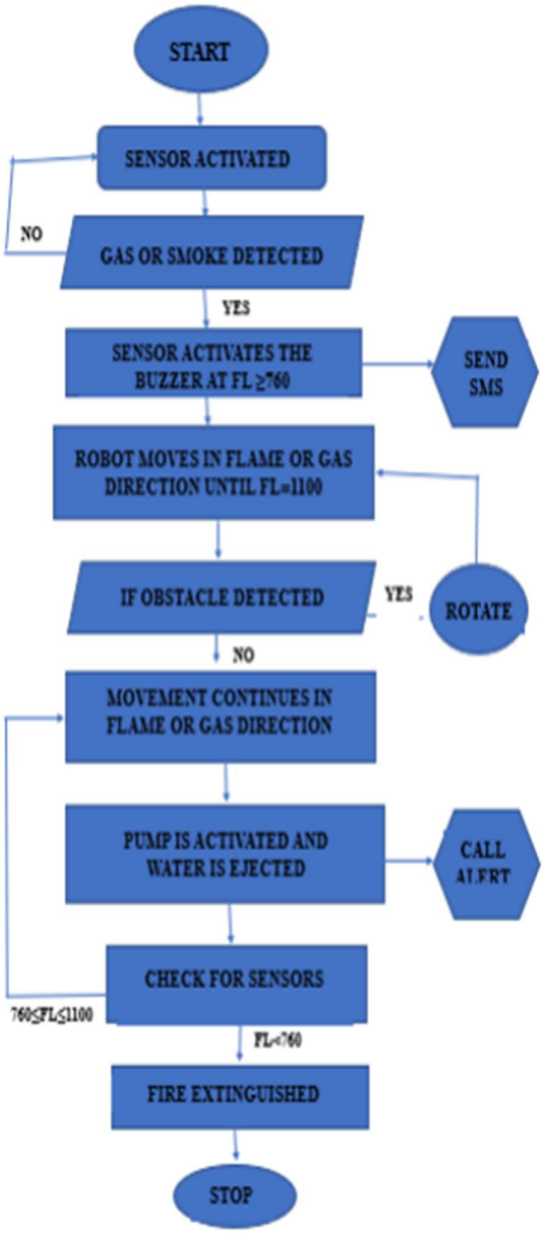

Figure 12 flow chart

CHAPTER 5

IMPLEMENTATION

- Connecting all the VCC and Ground to the Bread board for easy access to the power.

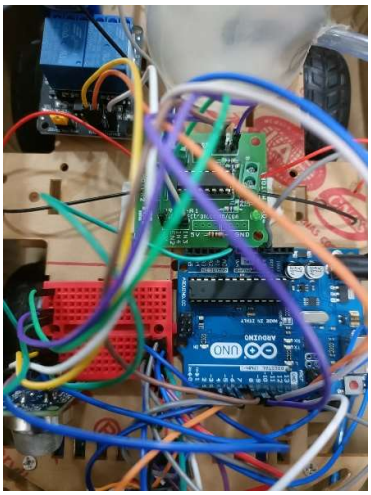

Figure 13 Connecting all the VCC and Ground

- Mounted MQ2 sensor and the flame sensors in the front of the robot

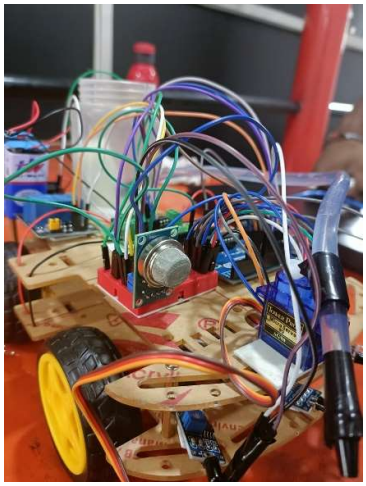

Figure 14 Mounted MQ2 sensor and the flame sensors

- Arduino ports connected to the other components

Figure 15 connect all other components

- Pump kept in the water container to pump the water.

Figure 16 pump the water

CHAPTER 6

RESULT

- Before detecting Gas and fire

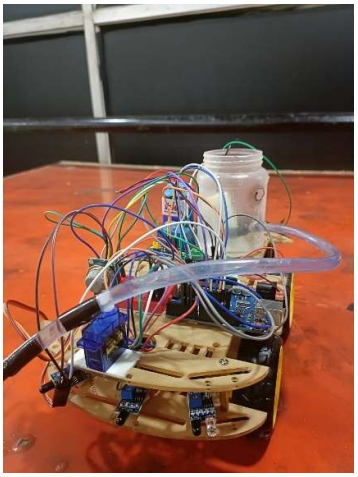

Figure 17 Before detecting Gas

- After detecting gas MQ2 sensor detects the gas

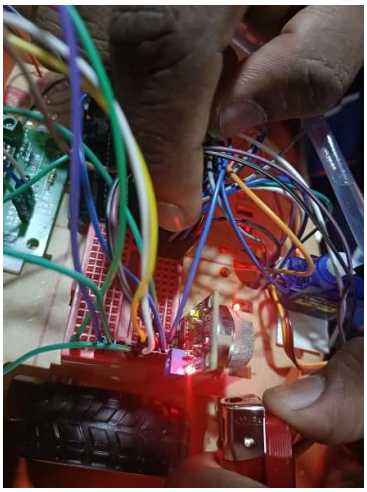

Figure 18 After detecting gas

- After detecting fire flame sensor detects the gas

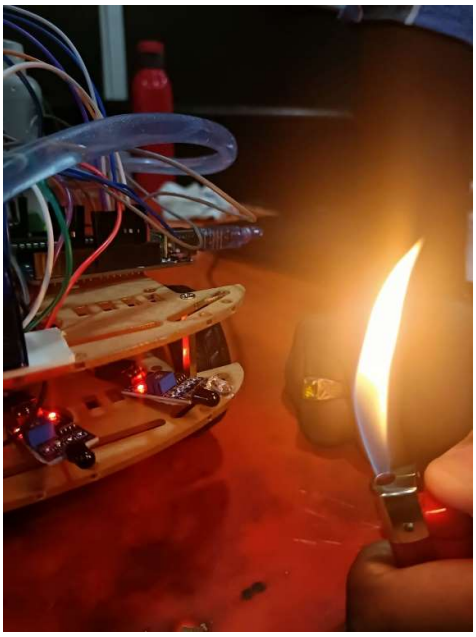

Figure 19 fire detectation

- After reaching near the fire the water is ejected and fire is extinguished

Figure 20 fire is extinguished

CHAPTER 7

APPLICATIONS

- Can be used in extinguishing fire where probability of explosion is high. For e.g., Hotel kitchens, LPG/CNG gas stores, etc •.
- Can be used in Server rooms for immediate action in case of fire
- Can be used in extinguishing fire where probability of explosion is high. For e.g., Hotel kitchens, LPG/CNG gas stores, etc.
- Every working environment requiring permanent operator's attention, At power plant control rooms
- Can be used in search and rescue operation
- Can Used in domestic cold storage places
- Gives an alert in form of SMS and call alert.

5.1 ADVANTAGES

- Prevention from dangerous incidents.
- Minimization of ecological consequences
- Financial loss can be prevented.
- A threat to a human life can be minimized.
- No supervision is required to control robot

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