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Development of wireless Fire-Detection and multipurpose Extinguisher Robot

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Abstract: *The research paper describes the designing and development of robot able to motion by using the (rotor motor), beyond the barriers (sensor MZ80), finds the flame by (flame sensor), and extinguishes the fire by (extinguishing methods like fan, water, carbon dioxide), and it progresses in conjunction with the search for the fire to control it and send message to the mobile or tablet by using (bluetooth HC-05) when it founded the fire and all of this is controlled by the microcontroller (Arduinouno).*
This robot is fully autonomous and implements environmental sensing awareness, & proportional motor control. This robot processes information from its various sensors and key hardware elements via microcontroller. It uses Ultraviolet, Infrared and visible light to detect various components of its environment. It is capable of fighting a tunnel fire, industry fire and having many military applications .
Key words *-Arduino,*

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I. Introduction

Jung-HoonHwang et al [1] developed novel fire detection device for robotic fire fighting. They presented a novel fire detection device in the highly complicated urban environment, such as an office building, supermarket, school, etc. Jayanth Suresh [2] developed Fire-fighting robot. He developed robot capable of detecting and suppressing fires. R.C. Luo [3]etal developed Intelligent security robot fire detection system using adaptive sensory fusion method. They developed an adaptive fusion method for fire detection, and uses smoke sensor, flame sensor and temperature sensor to detect a fire Daniel Konings et al [4] developed localization system. Maani Ghaffari Jadidi etal [5] developed RSSI-based Low-cost Indoor Positioning Systems. Khaled A. et al [5] developed Multiple UAVs in Forest Fire Fighting Mission Using Particle Swarm Optimization", International Conference on Unmanned Aircraft Systems..Embedded and Real Time System Design for fire detection had been presented [6-14].

The electrical components required for low budget robotics projects are now readily available. Because of this, robotics research is no longer limited to institutions that can devote extensive resources for new technology. Smaller robotics projects provide a good base for students to apply a variety of engineering skills necessary to develop these low cost embedded systems.

The goal of this project is to design a robotic device capable of maneuvering itself through a model house. A lit candle will be placed within one of the four rooms of the model house and it is the objective of the robot to locate the candle and extinguish it.

The aim of this project is to create a fully autonomous robot that can navigate a model home in search of fire, in the form of a burning candle, and then extinguish it. In the contest, the judge places the robot in the marked start location in the maze and presses the start button. The robot then listens for a 3.8 kHz frequency ±16%, signaling to begin. At the sound, the robot begins its autonomous search for the flame. These requirements are mandatory in order to compete in the competition. According to the contest rules, each robot is required to have a carrying handle, an LED indicating flame detection, a microphone, and a kill power plug. Finally, the robot must also accomplish the goal in the allotted time.

The arena that our robot must navigate is an 8*8 foot plywood square partitioned by walls to mimic rooms and hallways. The robot starts in the marked starting location in the maze and when prompted, navigates the maze to find and extinguish the fire. The flame that the robot must search for is in the form of a candle placed in a random room in the arena. We competed only in the first level of the contest, as this was the most resembling of real-life scenarios. Since time was our project's main limitation, we didn't want to increase the scope of our project unless absolutely necessary.

II. Operation of the Robot

Microcontroller used-

The selected controller for the vehicle is the Arduino MEGA 2560(Figure 3.2.1). It is the brain of the system and it coordinates all the activities of the vehicle. It was chosen because it's more suitable for complex robotics projects. It consists of some technical specifications beneficial to this project. They include: 16 analog input pins; we are using many sensors so that amount is adequate for the project, 256kb flash memory; this space is enough for our program code which requires lot of bits. It is can be configured using the Arduino software and automatically selects its power source which can either USB connection or an external power supply.The detail of operational unit is shown in figure1.

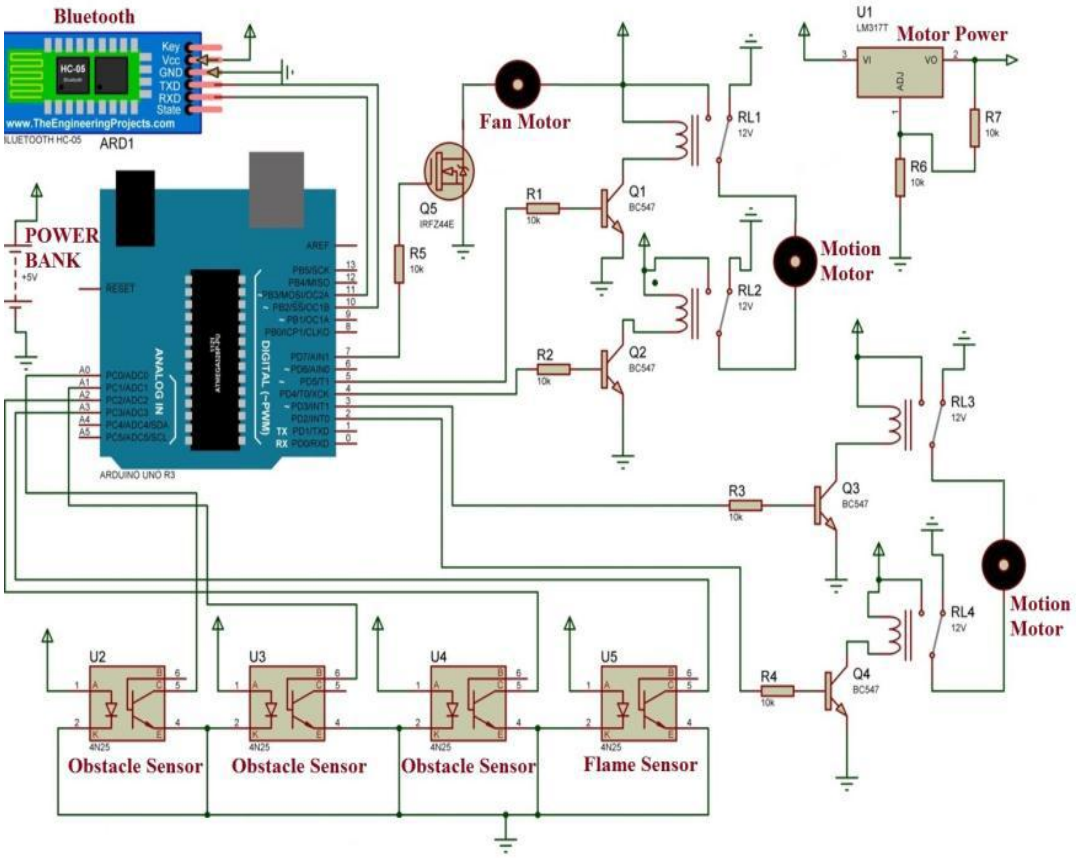

Figure 1: a flow diagram showing the complete operations and interactions between different components in the unit.

Device used – Micro controller ATMEG 2560, Operating Voltage- 5 V, input voltage 6-20V, DC Current per I/O=20 mA, DC current for 3.3 v pin-50mA, Flash memory-256 kB, SRAM-8kB, EEPROM-4 KB, Clock Speed-16 MHz, Microcontroller, Actuators, Locomotion,, Motors, DC Motors, Wheel, Servo Motors.

The device and connectivity is shown in figure1.

Designing robot able to motion by using the (rotor motor), beyond the barriers by (sensor MZ80), find the flame by (flame sensor), and extinguish the fire by (extinguishing methods like fan, water, carbon dioxide), and it progresses in conjunction with the search for the fire to control it and send message to the mobile or tablet by using (bluetooth HC-05) when it founded the fire and all of this is controlled by the microcontroller (Arduinouno).

This robot is fully autonomous and implements the following concepts: environmental sensing and awareness, proportional motor control. This robot processes information from its various sensors and key hardware elements via microcontroller. It uses Ultraviolet, Infrared and visible light to detect various components of its environment. A robot capable of fighting a tunnel fire, industry fire and military applications will be designed and built. Ultraviolet sensors will be used for initial detection of the flame. Once the flame is detected, the robot sound the alarm, the robot actuates an electronic valve releasing sprinkles of water on the flame.

Extinguishing the Candle

The robot can use any method to extinguish the candle that is not dangerous or destructive. The robot must be within 30 cm of the candle before attempting to extinguish the flame. A 30 cm circle will be placed around the candle for judgment purposes. If the candle is touched by the robot before it is extinguished, a penalty will be added to the final score.

Size and Weight

The robot must be able to fit into a 31 cm x 31 cm x 31 cm box, but there are no weight stipulations. In addition, the robot must consist of only one piece; it cannot be split into multiple parts.

III. Software Design

The hardware drivers are the low-level portions of the robot's code. The purpose of these drivers is to provide hardware to software interface that enables access to such hardware as the sensor and motors from within the behavioral code. This was to ensure that the code would be compatible between the upper and lower layers of software. Only two main hardware drivers is necessary for this project. In addition to these drivers several internal routines will be written to handle such things as timer interrupts and MCU initialization.

Get Distance

This function is the low-level driver that communicates with the distance sensors and loads global variables with the returned results. This driver is responsible for initializing the sensors for each reading, taking the readings, processing them, and then loading them for use by the higher level software. The flow chart for this function is shown in figure3.

In order to linearize this relationship the following steps had to be completed for each of the three sensors:

1. Tabulate the relationship for a range of measured distances
2. Graph this relationship
3. Use mathematical software to model the graph as an equation
4. Put this equation and its parameters into the code and perform the conversion for each of the three sensor

Flow chart

The flow diagram of program development is shown in figure2,

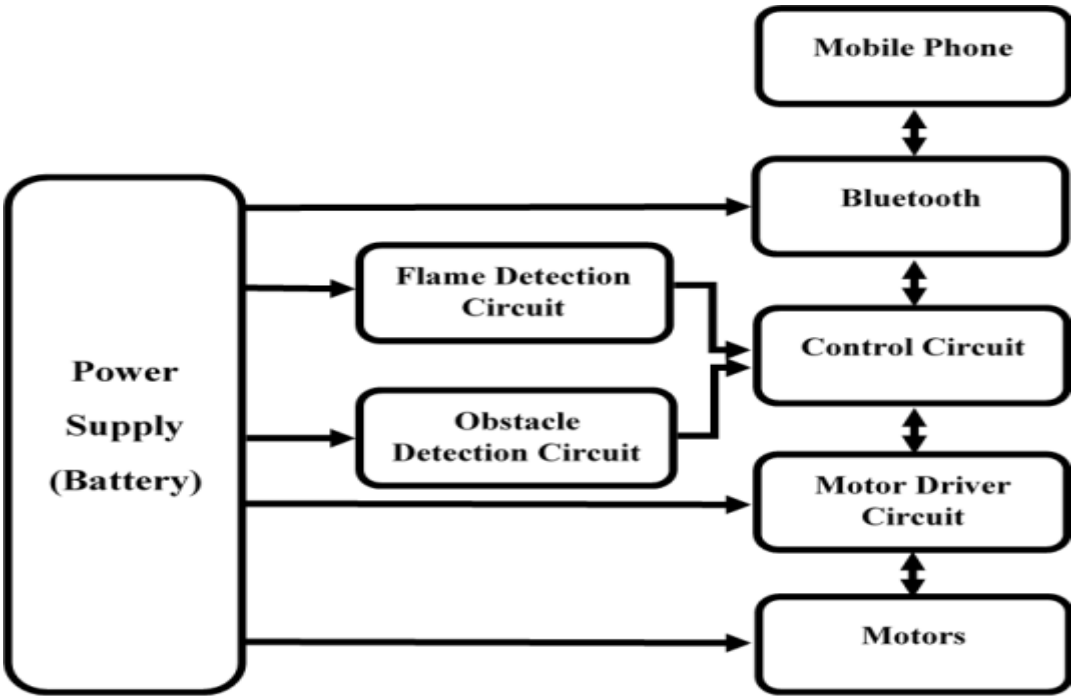

Figure 2 Flow diagram

IV. Conclusion

The need for a device that can detect and extinguish a fire on its own is long past due. Many house fires originate when someone is either sleeping or not home. With the invention of such a device, people and property can be saved at a much higher rate with relatively minimal damage caused by the fire. Our task a is to design and build a prototype system that could autonomously detect and extinguish a fire. Also aims at minimizing air pollution. The objective of this project is to design a robot that can successfully navigate through a floor of a house in order to locate and extinguish a fire. The main purpose of this exercise is to create an autonomous robot which could potentially put out fires to save people from a burning building without putting the lives of others in jeopardy. The goal is to design the robot which can do this in the quickest and most efficient way, to reduce the time that people in the house would be at risk.

The main advantage of a fire fighting robot is that it can go where humans can't. Such robot can easily enter places which have been damaged due to fire and their entrances have been blocked .It can also identify and intercept enemy with the on board Automatic Weapon. Fighting Robot provides real-time reaction and deterrence via remote control operation.

The robot that is fully autonomous. This means that once the robot is started by the user, it navigates, searches for, and extinguishes the fire on its own, with no assistance or input from the user. In order to reach this goal, we made many critical decisions on motors, sensors, fire extinguishing mechanical parts and general design for our robot.

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