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Analysis and Design of Fire Guard Robot (FGR)

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Abstract: Now a day's, fire accidents are very common and somewhere it is very difficult for a fireman to monitor everywhere. As automation can minimize human exertion, Automation can be achieved through robots. Robots can be mostly useful in mechanical industries. FGR is capable of detecting smoke by making use of smoke sensor. Arduino Uno is used for providing the controlling and processing of commands. As in market, there are robots available, but FGR stand out in terms of cost effective. User can operate this robot through smart phone via connectivity of Bluetooth module. With the help of a water spray mounted on it, user can help to reduce affected burnt area.

Keywords: Fire detection, Obstacle detection, Fire extinguish, Automation, Arduino Uno.

I. INTRODUCTION

Now a day's robots are being used for smart and accurate work. Robots will be very useful in laboratory, construction area, warehouses and in manufacturing companies. Robots can also be used for handling heavy loads and can control through applications. Previously, many of the robots uses components that were costly. Most of the existing robot's working was automatic from detection of smoke to minimization of fire. FGR is programmed in such a manner, that user can provide commands and directions as needed, instead of giving automatic directions for extinguishing fire. Moreover, as technologies gets advanced, robots are being controlled by android application which help in reducing cost, human exertion and complexity. Such applications are tremendously used day by day. As compared to existing robots, FGR is a cost effective concept. With the invention of the robot, the tedious job office man's work has enormously reduced. This robot can help ensure safety to our arena.

II. LITERATURE SURVEY

In 2017 Anjitha Krishnan et.al has designed 'GSM Based Fire Fighting Robot' [1]. This system detects the fire using four temperature sensors that continuously monitors the temperature. If the value of temperature increases above the predetermined value, then the buzzer sounds to notify the contingency of fire mishap, and at the same time a warning message will be sent to the corresponding industry with the help of a GSM module provided to it. In 'GSM Based Fire Fighting Robot', all the operations and movements of robot, as well as extinguishing methods were automatic. This feature is an advantage for processing implementation, but sometimes automatic system may not work exactly as needed. FGR can help in overcoming this problem, by providing movements and directions manually according to user. Sahil S. Shah (2013) et.al [2] discussed about design of a fire fighting robot using embedded system. A robot capable of fighting a simulated household fire was designed and built. It must be able to automatically navigate through a modeled floor plan while actively scanning for a flame. The robot can even act as a path guider in normal case and as a fire extinguisher in emergency. Robots designed to find a fire, before it rages out of control, can work with fire-fighters greatly reducing the risk of injury to victims. The result shows that higher efficiency is achieved using the embedded system. In "fire fighting robot using embedded system", The robot designed by them works only on a path which is already predefined, this can be an advantage for a small floor plan with restricted predicated path. But at the same time, it can be quite difficult to design this predefined path on all floor evenly. FGR can help in such cases, as there is no need of restricting path for implementation. Prof. Dr. S.N. Kini, Rutuja Wadekar et.al proposed a "firefighting robot" that aims to promote technology innovation to achieve a reliable and efficient outcome. The movement of the robot was controlled by the sensors which were fixed on the mobile platform [3]. This robot consists of intelligent multisensory based security system that works as a fire fighting system. In "firefighting robot", issue encountered is that sensors were actively functioning and movements for extinguishing fire were also automatic. The main feature of this robot is that the controlling was totally sensor dependent. As this can be confusing in some cases for providing direction, for reaching affected area and robot can also cause damage to its body. FGR helps to overcome this problem by providing directions manually. The intelligent fire fighting tank robot developed by Kristi Kokasih et.al [4]. Tank robot was made from acrylic, plastic, aluminum and iron. Robot components includes two servo motors, two DC motors, ultrasonic sensor, compass sensors, flame detector, thermal array sensor, white detector (IR and photo transistor), sound activation circuit and micro switch sensor. Robot is equipped with ultrasonic sensors and compass sensor to navigate in certain area to find and extinguish the flame, robot is equipped with a flame detector to detect the flame and a thermal array sensor to know the position of flame. In

process to detect the flame it is possible that robot cannot enter the room because of various door locations. algorithm has a main role for solving the problem. Besides equipped with sensors that have different functions and specifications, algorithm for robot navigation is also needed. In "Tank robot", proposed robot was designed with many heavy components that are very expensive. The advantage of this robot is its stability, but at the same time making use of heavy material may cause issues in mobility. FGR can overcome this problem in a way that can help move faster as compared.

## III.METHODOLOGY

A. Features

The designing of FGR comprises of different kinds of components such as Smoke sensor MQ, Bluetooth module HC05, Arduino Uno, Motor Shield, DC Motor. Smoke sensor MQ is used for gas or smoke detection. Due to its high sensitivity and quick response time, measurement can be taken as soon as possible. HC-05 is used for Bluetooth Serial Port Protocol designed for setting up transparent wireless serial connections. It can be used in a Master or Slave configuration. Arduino Uno is an open-source platform used for electronics projects. It consists of both a physical programmable circuit board which referred to as a microcontroller and a piece of software, or IDE that runs on computer, used to write and upload computer code to the physical board. Motor Shield is a dual-motor controller for Arduino. Based on the L298 H-bridge, it can drive DC motors up to 2A per channel. It is used to drive the FGR simultaneously.

B. Working

Once the microcontroller initializes, the FGR will continue to sense the smoke through the smoke sensors. As soon as smoke detected a buzzer is used and added for indication of smoke detected. Through the buzzer indication, user would come to know about fire mishap. User will be connected to robot through Bluetooth connectivity which is possible be making use of hc05bluetooth module. User will have full access to robot for providing directions and commands. Robot may encounter some barriers in path, for avoiding obstacles, ultrasonic ranging module is used which continuously search for obstacles. through the Bluetooth connectivity, connected user can operate FGR by using android application All directions will be manual and according to users. The user can transmit command like moving right, left, backward and forward to FGR through Bluetooth module.

The ATmega32P microcontroller execute commands as well as Motor Shield are used to control DC motor. As soon as FGR reaches the affected area, there is a water sprinkler mounted on robot body, which can be accessed through android application that can help reduce fire or smoke mishap. After sprinkling of water to the affected area the FGR will stop. There is logic control mechanism which is used to control robot, as shown in fig.1

C. Flow-chart Diagram
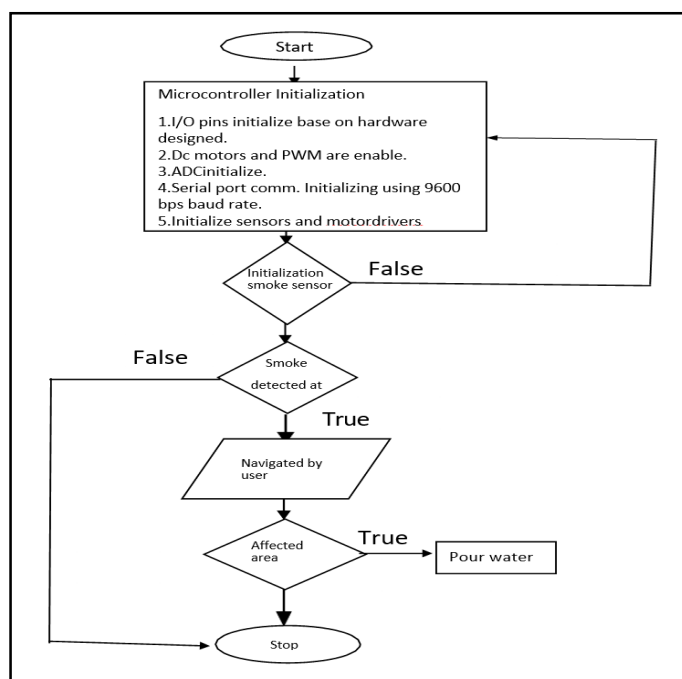
D. Components

1) Bluetooth Module HC05

Specifications

a) Serial Bluetooth module for Arduino and microcontrollers.

b) Operating Voltage: 4V to 6V (generally +5V).

c) Follows IEEE 802.15.1 standardized protocol.

d) Range: < 9m.

e) Works with Serial communication (USART) and TTL compatible.

f) Can be easily interfaced with Laptop or Mobile phones with Bluetooth.

2) Smoke Sensor MQ

Specifications

a) Operating Voltage is +5V.

b) Can be used to Measure/detect LPG, Alcohol, Propane, Hydrogen, CO and even methane.

c) Preheat duration 20 seconds.

d) Can be used as a Digital or analog sensor.

3) HC-SR04 Ultrasonic Sensor

Specifications

a) Operating voltage: +5V.

b) Theoretical Measuring Distance: 2cm to 450cm.

c) Practical Measuring Distance: 2cm to 80cm.

d) Measuring angle covered: <15°.

4) Arduino Uno

Specification

a) ATmega32P– 8 bit AVR family microcontroller.

b) Operating Voltage 5V.

c) Analog Input Pins 6 (A0 – A5).

d) Digital I/O Pins 14 (Out of which 6 provide PWM output).

e) Flash Memory 32 KB (0.5 KB is used for Bootloader).

f) SRAM 2 KB.

g) EEPROM 1 KB.

5) DC Motor

Specifications

a) DC supply: 4 to 12V.

b) RPM: 300 at 12V.

c) Motor diameter: 36mm.

d) Gear head diameter: 37mm.

6) Motor Shield

Specifications

a) Wide Supply-Voltage Range: 4.5 V to 36 V.

b) Separate Input-Logic Supply.

c) High-Noise-Immunity Inputs.

d) Output Current 600 mA Per Channel.

IV. CONCLUSIONS

FGR is enabled with such features, that are simple in implementation. FGR makes use of an Arduino Uno kit, which helps one gain accuracy and cost effectiveness is achieved largely. As studied in literature survey, we have found certain advantages of existing robots, and some drawbacks. As one common drawback with most of the robots was that the whole process of implementation was automatic. That is from process of detecting smoke to final fire extinguishing method, all were automatic. This feature can be lacuna for some cases in which manual directions are needed. FGR can help to overcome such drawbacks, as commands and directions are fully user accordingly. As far as future scope is concerned monitoring camera can be added for viewing the arena and GSM can be added for providing notification.

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