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AUTONOMOUS FIRE DETECTION AND CONTROLLING ROBOT

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ABSTRACT

These are the days of the technologies, automatic machines and self-driving vehicles. firefighters are constantly at risk of losing their life in many dangerous situations. Fire spreads rapidly if it is not controlled. In case of a gas leakage there even maybe an explosion. So, to overcome this issue and help assist the fire fighters we came this idea Fire controlling robot. This advanced firefighting robotic system independently detects and extinguishes fire. This firefighting robotic system is powered by an AtMega328 development board it consists of a fire flame sensor LM393 comparator chip for detecting fire and approaches through the motor Driver and a water spraying nozzle mounted on the servo motor to cover a maximum area. This robot also programmed to stop before the robot hit the flame. This robot also can extinguish fire at 45 degrees for left side and 45 degrees for right side.

Keywords: *Fire Fighters, robot, fire accident, life risk, AtMega328, servo motor, spraying nozzle.*

I. INTRODUCTION

Nowadays, machinery and robotic design become important in helping human. This Fire Protection Robot was design to help people in any destructive burnt situation where this robot can extinguish burnt area immediately using autonomous system. In the event of a fire breakout, to rescue people and to put out the fire we are forced to use human resources which are not safe. With the advancement of technology especially in Robotics it is very much possible to replace humans with robots for fighting the fire. This would improve the efficiency of firefighters and would also prevent them from risking human lives. This autonomous system will be designed using programming in PIC18F4550 and others additional circuit. In real life, destructive burnt area often happens without our realization. The stated firefighting robot is competent of detecting the smoke raised in the air due to flame, with the help of smoke sensor MQ2. Likewise, presence of the fire can be detected by the robot with flame sensors intact on anterior of the prototype robot. Fire detected gets douse with water from water tank mounted on the robot.

The robot firefighter is designed to look for fire in small houses of specific dimensions. An ideal firefighting robot is also capable of warn the service man about the outrage via SMS or a call. Water pump sprays water on the fire to stop it from further spreading. In addition to being able to be installed in homes, laboratories, stores, shops, etc., firefighting robot is easily portable and can be used once installed. The objective of the project will be to design autonomous fire controlling robot which can replace the traditional Fire Protection Robot. The toolkit capture video of the accident area and streams it to the remote user. So, the user can take additional actions according to the requirement or can do the things which can't be done by the robot in the automatic mode.

II. LITERATURE REVIEW

The circuit implemented consists mainly of two different sub-circuits. The first part comprises of making the robot follow a black strip. This was done using a comparator circuit using the LDR whose reference voltage was fixed using the potentiometer. This was based on the phenomenon that the resistance of the LDR decreases as the intensity of light falling on it increases. In our case, the light reflected from the white surface is more than that from the black surface. Therefore, the voltage in positive terminal of the comparator remains high as long as the robot is moving on white surface. If the black surface come under

one of the two LDR's the motor corresponding to that LDR stops. The second part comprised of using LDR's and IR receivers to detect flame. The dual Op-Amp LM358 was used for the same. The two comparator circuits were used. For LDR, the working was same, but for IR receiver the voltage and not the resistance vary according to the intensity of light. Thus, the two ends of IR-receiver were connected to ground and positive terminal of the comparator. Thus, this will make sure that the fire is extinguished before moving ahead. Once the fire is extinguished it will retain its original motion.

Robust communication systems between fire-fighting robots and remote operators are investigated. The communication system consists of two components; a digital packet data communication system and an analog image communication system. For a reliable data packet communication system, we adopted the commercial CDMA (Code Division Multiple Access) network architecture. Using the CDMA modules, it is possible to transfer serial data after a connecting procedure that is specified by the network service provider. Digital packet data communication systems transfer data packets back and forth in order to control fire-fighting robots and to monitor their status. Remote operators can view a video display of robot surroundings via an analog image communication system.

Objectives:

The objectives for this project are:

i. To study a robot which can search, detect, and extinguish burnt area immediately and develop a program to control the movement of the robot according to. Besides, lean how to connect microcontroller and wi-fi modem.

ii. To design the robot that includes the flame sensor to detect the fire and provides a live video broadcast of accident area.

iii. To analyze how the robot performance to detect the angle of burnt area in front of the robot and detecting burnt area in 0m ~ 2m in radius.

III. PROPOSED SYSTEM

To overcome the limitations of the existing system, this proposed system is added with features. The fire robot can be controlled from remote distance with wireless communication. A wireless camera Esp32 cam module fixed at the front face of the robot provides the live stream of the accident situation and is useful to control the robot from remote distance to control in manual mode. So, the monitoring of the accident area will make it easier and clearer to handle the situations.

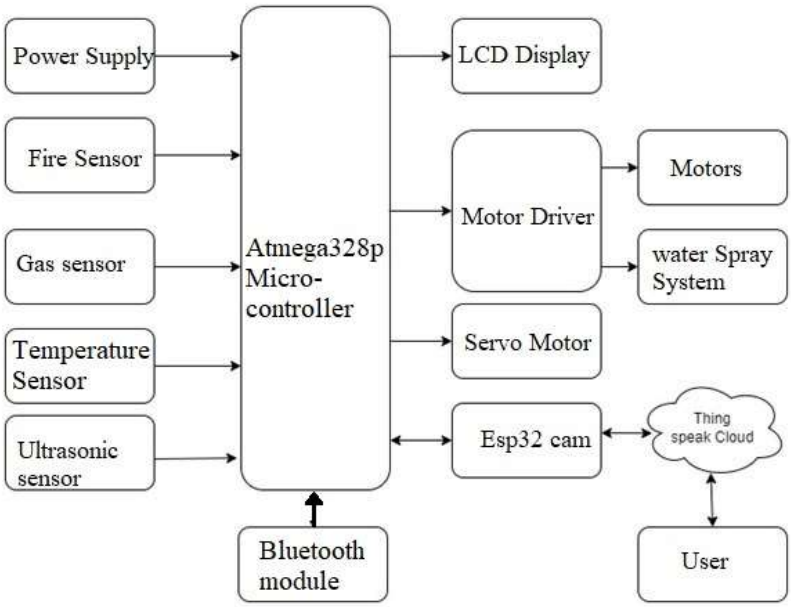

Fig 1. Autonomous Fire Detestation and Controlling Robot model.

The whole system is operated by Atmega328p Microcontroller, an Arduino UNO unit. The system is

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programmed into two modes. The Fire sensor and the Ultrasonic sensors are primary input for the system to take respective actions in the automatic mode. During the manual mode the system receives the commands through the Bluetooth module from user.

3.1 Atmega 328U microcontroller

ATMEGA328U is high performance, low power controller from microchip. atmega328p is an 8-bit microcontroller based on AVR RISC architecture. it is the most popular of all AVR controllers as it is used in Arduino boards. with program memory of 32 Kbytes Atmega 328u applications are many. with various power saving modes, it can work on mobile embedded systems.

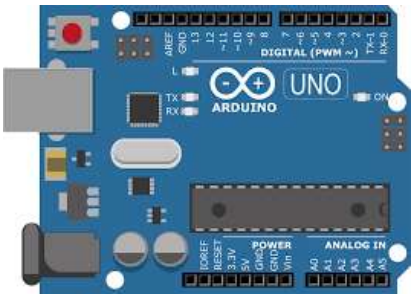

Fig 2. Arduino Uno

The ATmega328 is one kind of single-chip microcontroller formed with Atmel within the mega AVR family. The architecture of this Arduino Uno is a customized Harvard architecture with 8 bits RISC processor core. Other boards of Arduino Uno include Arduino Pro Mini, Arduino Nano, Arduino Due, Arduino Mega and Arduino Leonardo.

3.2 Fire Sensor

Fig 3. Fire Sensor

A flame detector is a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system.

3.3 LCD (Liquid Crystal Display)

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector.

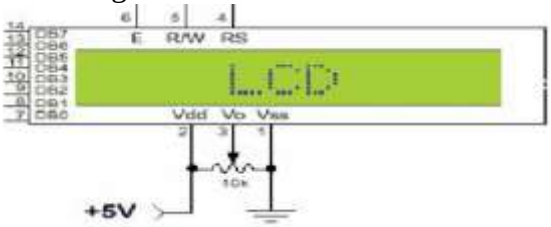

Fig 4. LCD Display

Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

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3.4 BUZZER

Fig 5. Buzzer

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a pre-set time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong.

IV. EXPERIMENTAL RESULTS

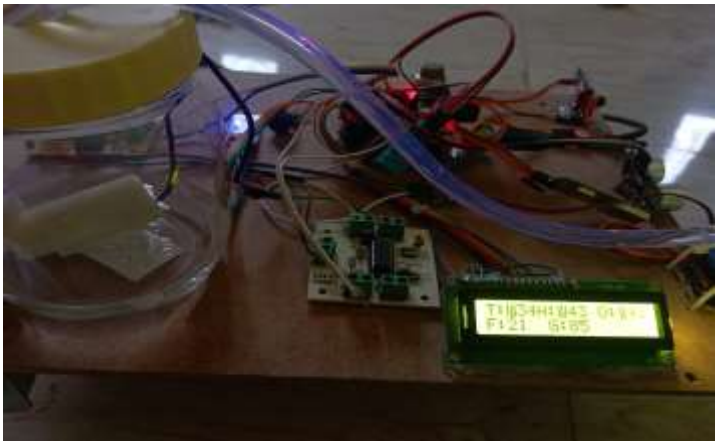

Fig 6. System Initially after Start

Fig 7. Fire Detected and Responsive action.

The fire sensor positioned at the front face of the system detects the fire and alerts the system about fire accident. Then the control system activates the fire suppression modules (water pump and servo motor nozzle).

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Fig 8. Indicating Object at 11CM and 5CM

Here in the LCD display the "O" indicates the Object Distance, which is indicated in Centimetre's.

Fig 9. Displaying the Gas values around the robot.

The letter "G" indicates the flammable Gas levels around the robot.

V. CONCLUSION

After completing the development and testing of the fire extinguisher robot, it can be concluded that the robot is an effective and efficient solution for combating fires in enclosed spaces. The robot was designed to be small and agile, allowing it to navigate tight spaces and reach areas that might be difficult for humans to access. The use of sensors and artificial intelligence technology enabled the robot to detect fires quickly and accurately, allowing it to respond promptly to potential fire hazards. During the testing phase, the robot successfully extinguished several controlled fires, demonstrating its effectiveness in combating small fires. The robot's performance was consistent and reliable, and it was able to operate autonomously without the need for human intervention. Overall, the fire extinguisher robot provides an innovative solution for fire suppression in enclosed spaces, and it has the potential to reduce the risk of injury and property damage caused by fires. With further development and refinement, the robot could become a valuable tool for firefighters and other emergency responders.

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