A Fire Detecting And Extinguishing Robot

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***Abstract*— For people and property, fire can be a regular problem. The automatic chimney shutoff method provides real-time monitoring, hood, and preset chimney alerts.It offers a reliable and safe chimney protection system, and occasionally it's worth the investment, minimizes fire damage and offers prompt warning in the event of a fire. The techniquecomprises temperature and smoke sensors, and the controller is connected to the working rectangle. This approach often eliminates the chance of false alarms while considering thedamaging characteristics of smoke.**

Keywords— ESP8266, sensitivity, fault tolerance, detectors, controller, and fire extinguisher.

1. INTRODUCTION

With the development of the Automated Firefighting Robot, our dedication to efficiency and safety has advanced significantly in an age of technological wonders. Envision a future where flames are automatically and quickly recognized, lowering the risk to property and human life. This state-of-the-art invention creates a powerful ally in the fight against fires by fusing the capabilities of sophisticated sensors, robotics, and artificial intelligence.

Safety with Sensor Fusion: The flame, humidity, and smoke sensors are the three essential sensors at the center of this amazing development. Together, these sensors create a complete situational awareness system. The robot's reaction is initiated by the flame sensor, which is precisely calibrated to identify even the slightest flicker of fire. The humidity sensor is crucial because it measures the amount of moisture in the surrounding air, which helps to accurately identify fires and choose the best firefighting tactics. In the meantime, the smoke sensor continuously scans the atmosphere for smoke particles, enabling the robot to recognize possible risk areas and take immediate action.

Creative Autonomy:The Automated Firefighting Robot uses cutting- edge artificial intelligence to operate autonomously with unmatched accuracy. The robot instantaneously determines the best course of action upon detecting a fire by utilizing real-time data obtained from its sensors. It assesses environmental factors like wind direction and speed in addition to determining the fire's size, location, and possible course.

Quick Reaction Mechanism: The Automated Firefighting Robot's remarkable dexterity allows it to quickly arrive at the fire-affected area. When it gets there, it activates its water dispersal system, which has been precisely adjusted to maximize effectiveness and reduce water waste. The robot responds to flames with never-before-seen speed and accuracy thanks to its complex coordination of sensor data, artificial intelligence algorithms, and mechanical execution.

Continuous Dependability: In crucial circumstances, the Automated Firefighting Robot's dependability is crucial. Thorough testing and quality control processes guarantee that the robot operates smoothly in a variety of contexts, including homes and offices. First responders are less at risk thanks to its autonomous operation without human involvement, freeing them up to concentrate on other crucial duties.

Creating a Safer Future: The Automated Firefighting Robot is a monument to human creativity in a world where technology is revolutionizing industries and improving our everyday lives. Through the utilization of sophisticated artificial intelligence and robotics in conjunction with flame, humidity, and smoke sensors, we are not only lessening the destructive effects of fires but also reinventing the fundamental principles of firefighting. With the help of technology and human cooperation, safety can now save lives, save property, and ensure a brighter, fire-free future.

2. LITERATURE REVIEW

This paper presents a fire extinguisher robot using flame, temperature, and smoke sensors for accurate detection. It operates autonomously, follows lines, or can be manually controlled via DTMF or smart phone. Remote features include DTMF and Bluetooth, with GSM and GPS integration for monitoring. [1]

In this paper authors develop an intelligent fire-fighting robot equipped with four flame sensors and thermistors. On detecting elevated temperatures, it activates a buzzer and sends alerts via GSM to personnel and the fire station. The robot moves to the hottest point, extinguishes the fire with a water pump, and autonomously returns to its initial position. This proactive approach ensures swift and targeted fire response, surpassing traditional smoke detectors. [2]

Population growth and technology escalation have increased fire accidents, necessitating safer firefighting solutions. Our robot efficiently navigates buildings, and detects and extinguishes flames, sending real-time updates via the cloud and Internet of Things. It's a vital tool for inaccessible fire-prone areas, allowing wireless control globally through a user-friendly console. [3]

This paper introduces a cost-effective fire protection system for buildings, employing a smoke detector and temperature sensor connected to a PIC16F84A microcontroller. The system ensures real-time monitoring, and early fire alarms, and minimizes false alarms by considering smoke density. The design proves effective in reducing fire damage, enhancing reliability, and meeting design requirements. [4]

Fire incidents are dangerous, especially in challenging areas inaccessible to firefighters. Our flame-sensing robot controlled remotely via mobile phone and equipped with Arduino Uno, autonomously detects and extinguishes fires using water spray. Successful trials confirm its reliability and effectiveness. [5]

3. PROBLEM FORMULATION

As we are living a modern life, we are under the risk of fire. Fire can take place in any house, school, or any place. It is mostly caused by electric short circuits, or combustible gases we use at home for heating. Fire causes damage to people and property. In 2011 in the US, statistics say that “370,000 fires have caused 2520 civilian deaths and 13,910 civilian injuries with damages approximated at

6.9 billion dollars.” Therefore, to protect ourselves, our families and our houses, we need a safe fire fighting system to detect and extinguish fires before they spread. What we need is a computerized fire detecting and extinguishing robot assembled with a network of fire sensors to detect the smallest fire and fight it. Other than its main purpose to decrease human and property losses, fire detecting and extinguishing robots could also be a great support to firemen. By using a robot, firemen do not need to risk their lives to extinguish fires, especially that the robot is replaceable at any time.

4. METHODOLOGY

Finding the natural fire and using a water siphon to put it out is the main goal of this project. The ATmega328P is required for the Arduino UNO R3 Microcontroller board to function. An appropriate level for applying autonomy is the ATmega328P. This allows for the continuous smothering of the flames. As opposed to other controller programming, Arduino is much simpler and is derived from C and C++ programming.

In turn, the microcontroller governs the extinguishing mechanism. The controller's working voltage is 5 volts, its clock speed is 16 MHz, and its recommended information voltage is 7 to 12 volts, with a 6 to 20 volt limit. The main goal of this project is to construct a programmable, ARDUINO-based robot that can detect a fire and use sprinklers to put it out when the siphon is triggered. The engine driver board represents the direction of the robot's development. It is employed to supply high voltage and high current as a yield to power the engines used in the project to construct the robot. As of right now, a simple DC engine is used to pivot the wheel, which is responsible for the robot's development. Generally speaking, DC engines transform electrical energy into mechanical energy. To put out the fire, a siphon is used. The water is pumped using a basic motor by pouring water onto the fire. The extinguishing system's pumping motor regulates the water flow that emerges from the pump. The block diagram of the proposed system is shown in Fig.1.

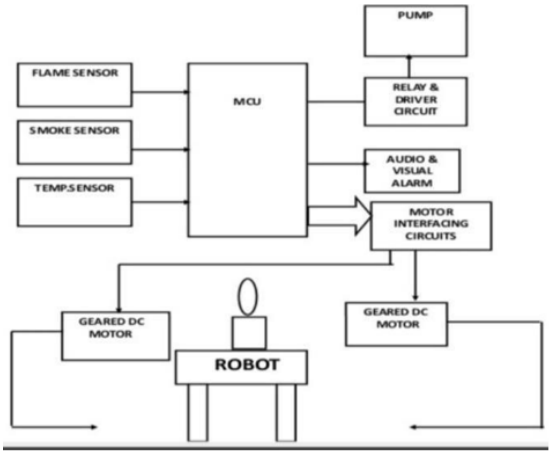

Fig.1Block Diagram of the proposed system

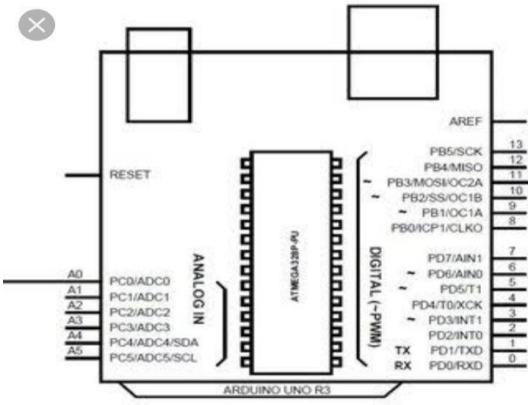

Fig.2 Pin Diagram

A.Components used in the system Hardware of the system includes –

1. Microcontroller based Arduino Uno

2. Flame Sensors: The flame sensor is seen in Fig 4. This sensor uses light wavelengths between 760 and 1100 nanometers to detect flames. The flame size andsensitivity choices determine the test distance. A 60-degree detection angle is used
3. Motor Drivers: The L298N is a 15 lead, multi-watt, SO20 package that contains an integrated monolithic circuit. The driver is a twin full bridge designwith high voltage and high current that can handle standard TTL (Transistor-Transistor logic) levels.
4. DC Motor: The wheels, which are turned by a basic DC motor, move the robot.

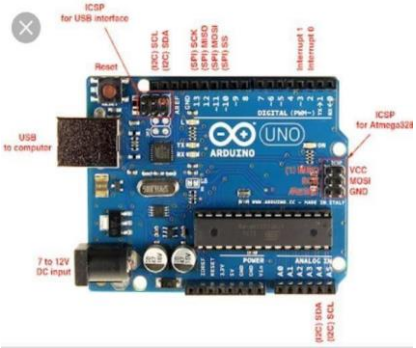

Fig.3 ARDUINO Uno circuit

Fig.4 Flame Sensor

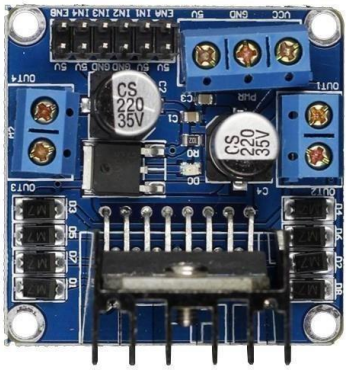

Fig.5 Motor driver

Fig. 6 DC motor

5. Temperature sensor(LM35): A temperature sensor is a device that measures temperature fluctuations across it. It has low self-heating, operates between 4 and 30 volts, is rated for a range of -55 to +150 degrees Celsius, and is calibrated directly in degrees Celsius.

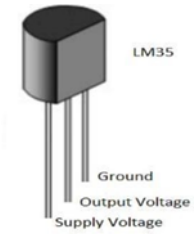

Fig.7 Temperature sensor

Fig. 8 DC motor

Fig.9 Ultrasonic Sensor

Fig.10 Battery

Fig.11 Smog sensor

Fig.12 Battery

6. Pump:

- A micro DC water pump is used.
- 12V is the voltage. Present: 3.0 Amperes 4.0 liters per minute
- driving in DC driving mode

7. Ultrasonic Sensor(HC-SR04):

- Working voltage (DC): 5 V
- Static current: <2 mA
- Sensor Angle: Up to 15 degrees.
- The detection range is 2–450 cm.
- High accuracy up to 0.5 cm.

8. Battery: Battery Specification: 12V, 7.6AH/20HR

9. Buzzer**:**

- OperatingVoltage:3-24V DC
- Current:<15Ma
- Frequency:3kHztoneatan85Dblevel.
- Operating Temperature:-20to+60degreeCelsius

B. Design/Flow Chart:

Fig. 13. Design Flow

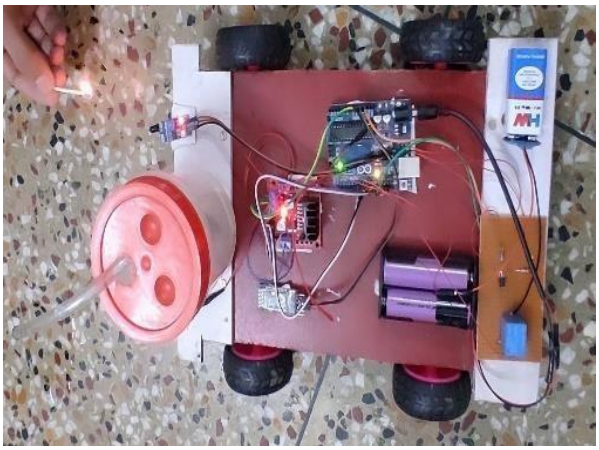

Fig. 13. Working prototype

A. THEORY

First, we assembled all the necessary parts. First, weassembled every part needed for the endeavor. Thus, the major parts of the project were a smoke sensor, an Arduino Uno kit, an ESP8266, a DC motor water pump, a relay module, a servo motor, a buzzer, and a 9-volt battery. In this project, two smoke sensors are being employed.

The smoke sensor can operate on both analog and digitalsignals, but we will favoranalog since it will be easier for us tosee changes in the output as the smoke density rises. To cover the majority of the region, these two sensors are positioned exactly opposite—nearly 180 degrees—from one another. This sensor and the servo are approximately one foot apartmotor is positioned precisely in the middle. The water pipe will be adjusted following the sensor with the aid of a servo motor. The direction of the servo motor will shift based on where there will be smoke observed. The code might be run through the Arduino IDE to do this. The servo motor that fires the water at the prone area will now be coupled to a DC water pump. The entire system activates if any of these two sensors detect smoke (beyond a specific threshold that we will establish through INTEGRATED DEVELOPMENT ENVIRONMENT). After that, when the Arduino Kit detects smoke, the relay—which is utilized as a switch—begins to function. The relay and the integratedin addition to the DC water pump and buzzer. Therefore, as soon as smoke is detected, the buzzer will pop and water will eject from the DCwater at the same time.

Additionally, a message sent by ESP8266 will appear on ourphone at the same time. An inexpensive, open-source IoT platform is the ESP8266.

Because doing so will not only put out the fire but also generate a message and produce a sound to inform us and everyone nearby. Thus, the project mentioned above may becalled a 3-LEVELED.

5. RESULTS AND DISCUSSION

Created a technique for automatically extinguishing fires in a variety of containers. Automatic fire alarm systems' primary goals are to identify fires early on and alert building occupantsthat there is a fire emergency, and notify first responders of the situation.

6. FUTURE SCOPE

The work's long-term goal is to apply a comparable process to any orall fireplace classifications, guaranteeing a comprehensive solution for unintentional fire incidents. Numerous riches and this fire extinguisher has the potential to save lives. It would be extremely beneficial in industrial locations that are prone to fire and where human intervention is not feasible. Its linked alarm would notify the user as soon as a fire occurs, preventing significant harm from happening. To prevent fires, this extinguisher could potentially be used in scientific laboratories.The owner of a company would be informed by the SMS system about the harm that employees have created.

REFERENCES

[1]. Humayun Rashid, Iftekhar Uddin Ahmed, Aasim Ul- lah, MD. Fahim Newaz, Mohammad Sijanur Rahaman Robin, S M Taslim Reza. Multiple Sensors Based Fire Extinguisher Robot Based on DTMF, Bluetooth, and GSM Technology with Multiple Mode of Operation. International Workshop on Computational Intelligence (IWCI), December 12-13, 2016, Dhaka, Bangladesh. [IEEE Xplore] [Research Gate]

[2]. U. Jyostna Sai Prasanna, M. V. D. Prasad. Automatic Fire Sensing and Extinguishing Robot Embedded With GSM Modem. International Journal of Engineering and Advanced Technology (IJEAT), Volume-2, Issue-4, April 2013, ISSN: 2249-8958.[Google Scholar] [IJEAT]

[3]. AKIB ISLAM, P. SATHYA. Intelligent Wireless Fire Extinguishing Robot. International Journal of Control Systems and Robotics. [Google Scholar]

[4]. Papan Dey, Subir Das, Choton Kanti Das, Toufiq Ahmed, C. M. F. S. Reza, Md. Mahbubur Rahman. Design and Implementation of an Automatic Fire Extinguishing System Based on Fault Secure Multi-Detectors. Proceedings of the International Conference on Mechanical Engineering and Renewable Energy 2013 (ICMERE2013), May 1-3, 2014, Chittagong, Bangladesh. [Google Scholar] [Research Gate]

[5]. Aalok Kumar, Piyush Singh, Akansha, Abhay Kumar Singh, Shikhar Saxena, Dhananjay Singh, Anshuman Singh, Pavan Kumar Shukla, Vinod M. Kapse. Design and Implementation of Automatic Fire Sensing and Fire Extinguishing Robot using IoT. NIET Journal of Engineering Technology (NIETJET), Volume 10, Issue summer 2022, ISSN: 2229-5828. [Research Gate]