GPS based Flame Detector using Arduino With SMS and Call Alert

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Abstract-An advanced fire safety solution that combines several technologies to improve fire detection and emergency response in "GPSbased Flame Detector Using Arduino with SMS and Call Alert". This paper makes use of flame sensors to keep an eye out for any indications of flames or extremely hot conditions. The mechanism activates in response to the detection of a fire. It uses GPS technology to pinpoint the exact position of the fire, enabling precise and quick emergency intervention. The system calls pre-designated emergency contacts and provides SMS alerts to pertinent parties. This multi-layered alert system ensures that the appropriate people receive the notice in a timely manner. Through the integration of SMS notifications, phone calls, GPS location tracking, and flame detection, this work tackles the vital requirement for effective fire detection and prompt in the event of a fire, it shortens reaction times, which is essential for preserving life and limiting property damage. This paper not only improves overall safety and adds value to fire safety, but it can also be customized for a variety of settings, such as homes, businesses, and isolated locations. **Keywords: Fire detection, defuse fire, GPSand GSM module, temperature sensor, sensor systems, fire safety robot.**

1. INTRODUCTION

The fascinating field of GPS based Arduino flame detection with the help of this creative paper, which combines flame detection, GPS technology, and Arduino power, a full system that not only detects fires but also sends SMS and call notifications for switch response is created. An important advancement in fire prevention and emergency response systems is GPS-based flames monitoring with Arduino and IoT technologies. The device can quickly identify fires or flames by integrating flame detectors with Arduino microcontrollers. With the help of IoT, the system is more connected and is able to send vital data, such as the exact GPS locations of the flames, to a cloud or centralized platform. Control and surveillance from afar are made possible by the data's worldwide availability once it is stored in the cloud. Real-time SMS can be received by users.The current environment is becoming more and more automated. Programmable controller and monitoring are the two main parts of today's automations. These days, there is a widespread trend toward the development of intelligent operations to help with laborious tasks and benefit humanity. The Arduino is the central component of the device, managing all of the peripherals that are linked to it. It has reprogrammable memory of the flash type. Additionally, the peripheral devices enter low power operating mode.

II.RELATED WORKS

[1]This model is regarded as effective, economical, and responsive. The paper "Design and Manufacture of Indoor Intelligent Fire Fighting Robots”. The article talks about an intelligent indoor firefighting robot that tries to lessen fire threats and prevent house fires. Many modules are used to gather and handle environmental data.[2] Fire disasters can harm the environment, cause property damage, and result in fatalities. Firefighters' main responsibility is to put out fires, but they also carry a greater risk when doing so, particularly when putting out fires indangerous locations like oil rigs, petrol stations, and nuclear power plants. They have additional difficulties, like as burning in confined spaces inaccessible to humans. [3] One of the main issues in mobile robotics is navigation in an uncertain changing environment. This work provides a technique for mobile robot navigation in an unknown dynamic environment beforehand, modeled after human pedestrian behavior. Using successive sensor data from onboard sonar sensors, an occupancy grid map has been constructed. The suggested navigation scheme trails a path for the robot based on a forbidden region map concept, with a velocity proportional to the distance and rate at which the obstacles are approaching or receding the robot. [4]The absence of early fire detection using smoke or gas sensing, which can become complex and critical, has resulted in several fire situations involving the loss of life and material expenses. In the meantime, engineers from all over the world create and evaluate a variety of smoke and gas detection systems, most of which are based on computer vision, digital image processing, or sensor networks. This research offers a low-cost Internet of Things (IoT) prototype based on sensors and Low Power Wide Area Network (LPWAN) for outdoor fire detection.[5] The fact that Mithun et al.'s work focuses specifically on tumbling objects points to a response to the growing interest in scenarios requiring complicated object dynamics, where conventional control techniques might not be sufficient. By offering fresh ideas or developments in image-based visual servoingpossibly combining advances in image processing, computer vision, and control algorithmsthe work probably adds to the current conversation.[6]All of the methods and procedures that go into early fire detection are compiled into fire

detection. Smoke, flame, and temperature detection are the three primary categoriesdistinguish.An autonomous fire alarm system offers real-time monitoring, surveillance, and alarm activation. Large numbers of detectors that routinely monitor temperature or smoke concentration are installed in buildings to enable early fire extinguishment in the event of a fire disaster. [7]Numerous facets of autonomous firefighting robot research have been investigated, including as navigation, sensing, and control algorithms. Enhancing these robots' autonomy and efficacy is frequently the main goal in order to enable them to react to industrial fire situations quickly and safely.Trends in the incorporation of cutting-edge technology like computer vision, sensor fusion, and artificial intelligence into autonomous firefighting systems are probably shown by the literaturereview.[8]Buildingrobust industrial systems and applications through the use of wireless, mobile, and sensor devices, as well as Radio Frequency Identification (RFID) technology has become more possible thanks to the Internet of Things (IoT). In recent years, a vast array of industrial Internet of things applications has been created and implemented.Main applications of IoT inindustries, importantsupporting technologies, and research trends and obstacles in an attempt to comprehend the evolution of IoT in industries.[9] Scholars acknowledge the necessity of employing intelligent strategies to tackle fires, and this study advances the area by putting forth a robot that is fitted with fire suppression capabilities. Previous research highlights the significance of robotic systems that possess improved intelligence, mobility, and firefighting abilities. According to this research, there is a tendency toward the improvement of response efficiency in difficult conditions through the integration of artificial intelligence into firefighting robotics. [10] Gas-sensing robot for fighting fires. The design will work a lot and is free. Both home and industrial uses are possible for it. The water tank, wireless remote, wireless Android device, gas sensors, and wireless remote control are crucial components in the creation of a robot. Wi-Fi is active. Recorder, an effective wireless robot may be controlled from a distance thanks to its ability to work. It has the ability to be commanded remotely and buffer live video.[11] Among the major research topics for intelligent buildings that are being studied at the moment is the Multisensory Fire Detection Algorithm (MSFDA). For the intelligent building, a firefighting robot is equipped with an extinguisher. An aluminum frame is used in the construction of the firefighting robot. The robot's shape is cylinder-shaped.

Conceptual Framework

This work utilized the Input-process-output (IPO) diagramto visually illustrate its context. Inputs in this study include existing architecture, literature's and technology reviews concerning to fire safety systems, Arduino based fire safety system integrating desired features as seen in the process part of the IPO illustration. Feedbacks are collected and utilized as input to determine the level of usability of developed system.The Conceptual framework is shown in below Fig.1.

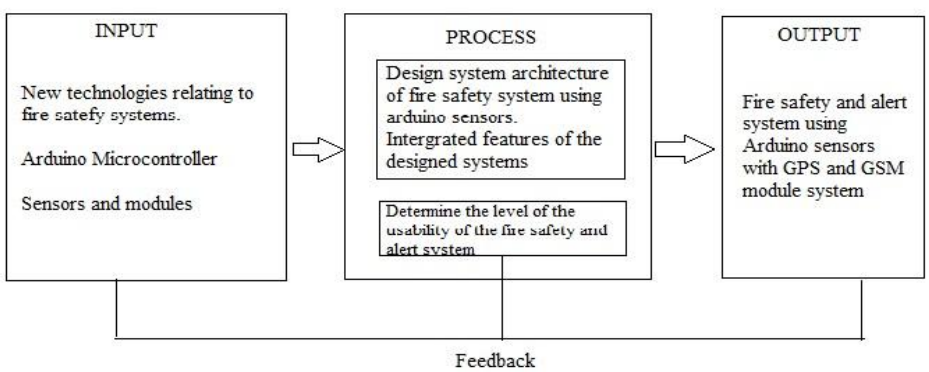

Fig.1.Conceptual Framework

III.EXISTING SYSTEM

A typical robotics fire detection and response system consists of fire sensors, a pump for quenching the fire, and an alarm for alerting. Servo motors are used in certain systems to change the extinguishing agent's direction. Remote monitoring and reporting are made possible by communication modules like GPS and GSM. For these systems to efficiently coordinate the operations of the robot, extensive programming is frequently needed. Although there are differences, the fundamental elements are the same in all implementations, with the goal of offering effective and dependable fire detection and response capabilities in diverse settings.

IV.PROPOSED SYSTEM

The goal of the suggested system is to improve robotics' capacity for fire detection and reaction by integrating cuttingedge technology with sophisticated automation. It will have a wide range of fire detection sensors, such as smoke, heat, and flame sensors, guaranteeing excellent precision and dependability in spotting any fire situations. When a fire of any size is detected, the system will turn on a specialized pump whose output pressure can be adjusted. It will also use servo motors to change the orientation of the nozzle, allowing for accurate fire source targeting and maximum extinguishing efficiency. The suggested system will combine GPS and GSM modules to improve situation awareness and reaction coordination. When a fire is detected, the technology will automatically notify the chosen recipients via SMS with the robot's geographical coordinates, making it easier to promptaction and involvement.

Additionally, the system will use GPS tracking to monitor the robot's movements in real time, allowing for remote oversight and intervention if needed. The suggested system will use sophisticated algorithms and programming approaches to enable self-determining and adaptive behavior in terms of automation and control.Allthings considered, the suggested system is a major step forward for robot’s firedetection and reaction capabilities, providing improved precision, effectiveness, and independence for successfully containing fires in a variety of environments.The Block diagram is shown in below Fig.2.

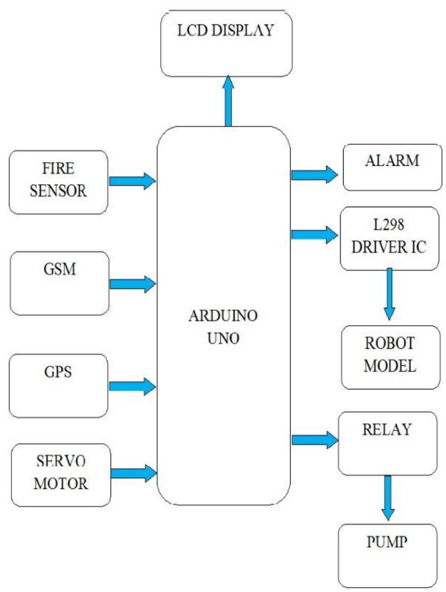

Fig.2.Block diagram

Fire detector:A resistor is used to connect the flame sensor. This link created the voltage divider network, which is coupled to the comparator's inverting input terminal. The input terminal that is not inverting receives the reference voltage. The operational amplifier LM 741 is used in the construction of the comparator. The Circuit diagram is shown in below Fig.3.

The flame sensor turned open circuit while there was no fire. Therefore, the reference voltage is greater than the non-inverting input terminal voltage. Now, the base of the switching transistor BC547 receives the comparator output of -12V. Transistor cutoff area, then. 7404 IC receives the 5 volts. The hex inverter with buffer is the 7404. Therefore, the microcontroller is provided zero voltage. The flame sensor shorted circuited when the fire broke out. Now, the base of the switching transistor BC547 receives +12V from the comparator output. Consequently, the transistor is ON. The 7404 IC is supplied with zero voltage. Thus, the microcontroller receives a voltage of +5 volts.

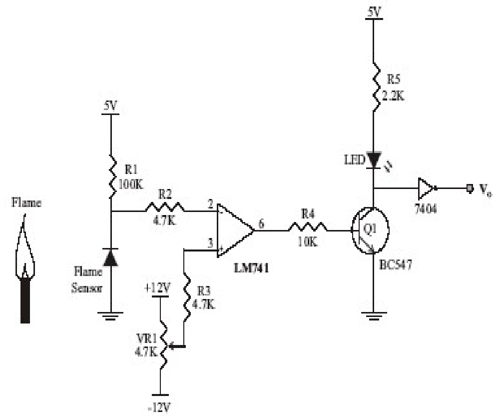

Fig.3.Circuit Diagram

V. IMPLEMENTATION

This work consists of the following blocks.

1.HardwareRequirements:

a) Arduino uno:The ATmega328p CPU serves as the foundation for the Arduino Uno. The microcontroller board can be programmed to communicate with sensors, actuators, and other board-connected devices using the Arduino programming language. The language, which has its foundation in C ++, is meant to be simple enough for non-programmers and beginners to use.A board that contains a microcontroller based on the ATmega328P is called an Arduino or Arduino Uno. It contains a 16 MHz quartz crystal, 6 analog inputs, 14 digital input/output pins (six of which can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything required to support the microcontroller. The Arduino UNO is shown in below Fig.4.

Fig.4.Arduino UNO

b) LCD:LCD include some microwatts for show compared to some mill watts. Liquid crystal display could be a combination of 2 states of matter, the solid and therefore the liquid. Liquid is employed to provide a comprehensible image in liquid crystal display. The liquid crystal display works on the principle of obstruction lightweight. When compared to LED and cathode ray tube, LCD is thinner. Blocking light principle is used for working of LCD. This is used to display the weight of the gasoline content. The LCD display is shown in below Fig.5.

Fig.5.LCD display

c) Servo motor:When work is the control variable in closed loop control systems, servo motors are employed. By delivering velocity instruction signals to the amplifier, which powers the servo motor, the digital servo motor controller guides the servo motor's operation. The servo motor either has an integrated feedback device (resolver) or devices (tachometer and encoder) installed remotely, frequently on the load itself. They give the controller feedback on the position and velocity of the servo motor, which it compares to its preprogrammed motion profile and utilizes to modify the velocity signal. A motion profile, or a collection of instructions encoded into the controller that specify the servo motor's operation in terms of time, position, and velocity, is a feature of servo motors. The Servo motor is shown in below Fig.6.

Fig.6. Servo motor

d) GSM:A GSM modem is a kind of wireless modems that uses a SIM card to link to the GSM network. To send and receive data and SMS messages, it makes use of multiple protocols, such as EDGE, GPRS, and SMS. GSM modems can also connect via serial and USB interfaces to other electrical devices.In the context of this publication, a modem that supports one or more of the GSM evolutionary family protocols including the 2.5G technologies EDGE and GPRS and the 3G technologies WCDMA, UMTS, HSDPA, and HSUPAis referred to as a GSM modem. The GSM modem is shown in below Fig.7.

Fig.7. GSM modem

e) IR sensor or Flame sensor:A flame-sensor is a type of detector primarily used to detect and react to flames. Depending on the fitting, it can be used in an alarm system, natural gas line, propane, or fire suppression system. This type of sensor is used in industrial boilers and serves the purpose of verifying whether the boiler is operating as intended. The mechanism used in these sensors allows for faster and more accurate response than a heat/smoke detector. The IR or Flame sensor is shown in below Fig.8.

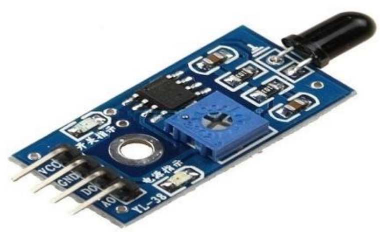

Fig.8.IR sensor or Flame sensor

f) GPS:A satellite-based navigation system that gives time and location data is called the Global Positioning System (GPS). GPS broadcasts navigation signals from a constellation of 31 satellites in orbit around the planet. A tracking system does not require a convenient, typically visual, display for the driver as the navigation system does. Vehicle tracking systems integrate several advanced technologies.

2.Software Requirements:

a) ARDUINO IDE:The Arduino Software (IDE), also known as the Arduino Integrated Development Environment, has a text editor for writing code, a message box, a text console, a toolbar with buttons for frequently used tasks, and a number of menus. It uploads programs by making a connection to the Arduino hardware. Arduino fosters creativity and problem-solving, which makes it a valuable tool in robotics. After plugging it into a computer, it is programmed with simple instructions that allow it to control how an Arduino device functions when it is placed in a circuit. An Arduino sketch must have the functions setup () and loop (). It is necessary to establish additional functions outside of those two functions' brackets. The Arduino IDE is a unique program that functions on your system that enables you to program various Arduino boards with drawings (synchronization program).

b) CONTROL PROGRAMMING:

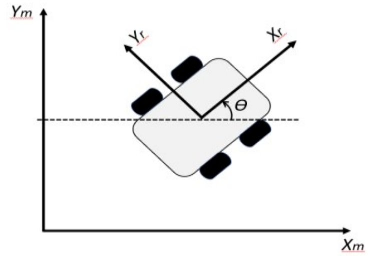

Fig.9.Relationship between Robot

Fig.9. shows the relationship betweenRobot coordinate plane with main surface plane. At first, Robot is originally assumed to be at the center position with the coordinate point at the moment considered as (0, 0). When the rotation takes place on the z-axis, as shown as the θ in Fig. 9, the position change from the original to the final position gives a new coordinate to Robot and is considered as (x, y)on the coordinate plane. (Xm, Ym) in the figure is the main surface coordinate plane and (Xr, Yr) is the Robot coordinate plane.

$[x' y' \theta']$=[cosθ $sin\theta$ 0]v+ [0 0 1] ω(1)

Equation (1) is to determine the coordinate and angular position for the Robot, where, and are the coordinates regarding to the main surface plane (Xm, Ym) and are the driving and turning velocity with respect to the coordinates regarding to the Robot coordinate plane (Xr, Yr). Then, adopting differential drive vehicle as the kinematic model of Robot resulting,

$v = \frac{r(\omega_R+\omega_L)}{2}$ (2)

$\omega = \frac{r(\omega_R+\omega_L)}{d}$ (3)

where r is radius of the wheel and d is the distance of instantaneous center of rotation.

VI.RESULTS

The anticipated result of integrating an Arduino board with a GPS-based flame detector and SMS and phone alert features is an advanced fire safety system that provides vital benefits during emergencies. This device guarantees quick response to possible fire dangers by quickly detecting flames or notable temperature spikes. By using GPStechnology, it will give exact position information, making it easier for rescuers and fire fighters to determine the precise coordinates of the incident. Designated contacts will be promptly notified by the SMS and phone alert system, allowing prompt action and possibly saving lives and property. All things considered, this application improves safety and security by providing people and organizations with a useful tool for emergency management and fire prevention.

a). Time to Extinguish the Fire Depends on Distance with Fire Source:

This system successfully finds fire location automatically and extinguish it by operator control. The operator can monitor the location of firethat is connected to the smartphone.

Fig. 10 shows the time to extinguish fire depends on distance between robot and fire. And theTime Taken Depends on Distance Route of Robot is shown in below Fig.11.

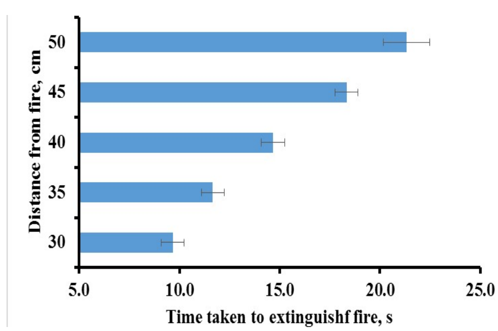

Fig. 10. Time to Extinguish Fire Depends on Distance of Robot with Fire.

From the experimental results, it can be seen that when the distance between Robot and fire is greater, the longer it takes to extinguish the fire. For future planning, it is needed to determine the optimal distance betweenRobot and fire. This is because to prevent Robot being too close to the fire and at the same time can extinguish the fire in a short time.
Fig. 12 shows that Snapshot of the work.

Fig. 12. Snapshot of the work

b)Time Required to Arrive at The Fire Location is Depend on The Distance Route of Robot.
From the experimental results, time taken to arrive at fire location is directly proportional to the distance route of Robot.

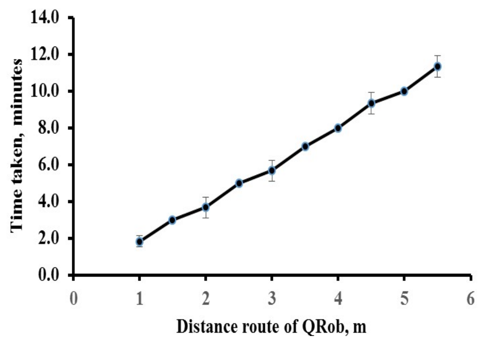

Fig. 11. Time Taken Depends on Distance Route of Robot

VII.CONCLUSION

In conclusion, the paper represents a significant advancement in fire detection and response capabilities in robotics. Through the integration of advanced technology such as comprehensive sensor arrays, adjustable pumps, servo motors, GSM, and GPS modules, the system offers enhanced accuracy, efficiency, and autonomy in detecting and extinguishing fires. Its ability to autonomously navigate through complex environments while providing real-time monitoring and reporting ensures swift and effective response to fire incidents. With its intelligent automation and adaptive behavior, the proposed system holds great promise for mitigating fire hazards in various settings, contributing to improved safety and security in both residential and industrial environments.

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