Fire fighting Robot for Server Rooms
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Abstract: Fire fighting is an essential but dangerous task. A fire fighter must be able to get to a fire quickly and safely extinguish the fire, preventing further damage and reduce casualties. Technology has finally bridged the gap between fire fighting and machines allowing for a more efficient and effective method of fire fighting. This paper discusses about a method for fire fighting in server rooms. The equipment inside server rooms is very costly, so that in accurate fire extinguishing techniques will result in huge economic losses. The robot consists of a master and a slave. The master robot always checks the surrounding area. Upon receiving a fire signal from a flame sensor, master robot get sahig in put signal and them as ter robot identifies the area of fire. After identifying the area, the master robot navigates the slave robot towards the fire. At the same time the master robot transmits the fire signal to the fire station and security system. The simulation has been carried out and the results have been included in this paper.

I. Introduction

The advancement inthescience and technology reduces the man efforting a great extent. As a part of this lot of substitutions were made for humans especially in situations which threaten human life. Fire hazards are such situations which is very dangerous for humans when it out of control. Robots are introduced in this situation which effectively handle the situation. They can effectively detect the fire and control it within minimum casualties. The mode of extinguishing the fire varies with the cause of fire. In the presented scenario, humans are directly involved to extinguish the fire. But when the situation is very critical, human life gets spoiled. Such situations demand the firefighting robots instead of humans because, human life is always preciously than any thing in the world. If we lose a robot in a critical situation, it does n't matter; we can go for another one. We cannot compromise on human life. Fire fighting robots can be introduced in industries as well as in server rooms. The operating speed of the firefighting robots is very important. Operating speed is proportional to the casualties made by fire hazards.

The proposed system consists of a station and robot. When the station detects the fire, it sends commands to the firefighting robot regarding the location. If the intensity of the fire is more, then the station will inform it to the near fire station. The robot will march to the target area receiving commands from the station. Then extinguish the fire and comes back to the initial location. The robot movement is based on the inertial tracking system.

Firefighting is important to ensure safety of people and avoid loss of lives and fields. A robot triggered by the flame and navigate to the maze within a single model of fire extinguishing robot. After extinguishing the fire, the robot returns to the original position avoiding the complexity of programming the controller. One limitation is that the robot should navigate to the within 30 cm of the flame. If we use a robot with a calcium silicate coating, it enables the robot to withstand high temperature. A thermocouple can be used to detect the fire. The thermocouple end absorbs heat temperature beyond that the robot starts to respond to the fire. Amplified voltage from the thermocouple can be used for the water pump. The objective of obstacle avoidance and motion control of the robot. High dynamic range camera provides human recognition. Upon detecting human recognition, the robot’s laser machine is turned on. Lack of technological advancement in firefighting areas has made it necessary to add many additions. Additional with a wireless camera and map representation via Bluetooth handhelds enable smoke detection, door opening, and communication. The signal from digital compass passed onto the MATLAB via Bluetooth provides information about the current position of the robot on the personal computer. The use of fan and smoke indicates the fire avoids the problems associated with the water leakage. Differential drive systems avoided difficulties in rotation of the motors. The design of motor driving circuitry with bipolar junction transistors and Pulse with modulation is a great method of controlling the amount of power delivered to the load without dissipating any wasted power. The maze navigation algorithm to drive the robot to plan the path voids confusion about the obstacle. The autonomous and semi-autonomous mode of a robot lowers human interaction with the robot requirement. The objective of the master–slave mode of operation is to reduce the cost. The slave robot does not have any self-intelligence. The ability of the robot to work as a group improves the effectiveness of putting off the fire. New fire extinguishing robots are proposed, which is employed in server rooms. The design of the robot is such that it reduces the cost. The robot transfers fire signals to the security system and fire station when the fire is detected.

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Datacenters are the backbone of present world's highly engineered society. Applications such as social media, cloud computing, online banking, and healthcare solutions impact our everyday life. Failure of the internal datacenter poses a significant problem within a short time. Formaximum protection, a fire safety system is needed to ensure business continuity, personnel safety etc. Human failure or technical reasons can lead to fire. So it is important to design the server room with necessary fire detection systems. Current measures taken in server rooms to prevent fire are not that much effective. There are twoprimarystype of fire suppression systems, water sprinklers, and gaseous agent fire suppression solution. The major problem with water sprinklers is that they could cause significant damage to the equipment. Since water is a good conductor of electricity, it can cause high fire disaster. Additionally, water sprinklers could accidentally become activated and cause unnecessary damage. Halongaseous agent is longer in production due to being a health risk and environmental danger and also it is expensive. This system can provide effective and moderate costfire suppression. The robot will detect the fire at the starting stage, move towards the fire and extinguish the fire.

II. Design

The fire extinguishing robot consists of a stationary master robot and many slave robots. The slave robots are controlled by the master. The block diagram of the system is shown in Fig. 1.

![Fig. 1. Block Diagram](image)

Control system of this robot consists of a microcontroller, which is used to send and receive information to the slave robots. An ATmega16 is selected as the microcontroller. It provides all the control signals. Fire detection system is used to detect fires at the right time. The fire detection system is made up of sensors. Zigbee module is used to facilitate communication between the master robot and the slave robots. GSM module is used to get emergency alarm signals to the security system and fire station. The motor driving module and the line follower module are used to control the movement of the robot. In the desired direction, the master robot continuously monitors the variation of the surrounding area using the sensors. Whenever the temperature exceeds a limit value, a flame is detected, the master robot identifies that there is a presence of fire. Then the slave robot moves according to the directions from the master robot. When the slave robot identifies the fire area, the fire extinguisher is actuated. The slave robot returns to the original position after extinguishing the fire. When a fire has occurred, the master gives signals to the firemen and the nearest fire station through GSM.

III. Hardware Implementation

**Power supply:** The fire extinguishing robot has a power supply from the 12V rechargeable battery. The battery supplies power to the LM293D motor driver, microcontroller, and all the sensors in the robot. These selection of different types of batteries was made based on size and power requirements.

**Zigbee module:** Zigbee is a low-power, low-cost wireless mesh network targeted at battery-powered devices in wireless control and monitoring applications. Zigbee delivers low latency communication. It is used to facilitate the communication between the master and slave robot. The master robot gives instructions to the slave robot through a zigbee module. The slave robot moves according to the instructions.
Flamesensor: Flamesensors are used to detect the fire. The fire extinguishing robot automatically detects and extinguishes the fire. The flamesensors in the server room initially detect the flame and send a signal to the master robot through the GSM module. Using this signal, the master robot identifies the area and navigates the slaverobot to that area.

GSM module: The signals from flamesensors are transferred to the master robot through the GSM module. Also, the fire alarm to the fire station and security system are given through the GSM module. With the signal, we can follow the robot.

DC motors: The drivemotors are permanent magnet DC motors, with a maximum speed of 30 RPM at 12 volts using 8 cm diameter wheels.

Motor driver module and line follower module: L293D motor driver is used to drive the vehicle. Motor drivers act as current amplifiers. They amplify low-current signals to provide a high-current signal which is used to drive the motors. In this common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The L293D is designed to provide current of up to 600 mA at 4.5V to 36V.

The line follower is made of black tape pasted on a white reflecting background. We used infrared, LEDs, and LDR sensors to sense the black line. Since the light from the emitter could reflect from the white area and reach the photodiode optically, it is isolated from the detector, and could not reach the detector due to the non-reflecting surface of the black line. The black line and white area could be differentiated. When a sensor is above the white area, light is being detected by the detector connected to the interrupt pin of the controller. However, as soon as the sensor comes above the black line, the controller is interrupted. Once the obstacle is investigated, whether it is some deviation or junction, and the corresponding action is taken according to the situation.

IV. Software Implementation

The entire operation of the robot can be divided into two phases:

1) The Master robot detects the fire.
2) The Master robot navigates the slaverobot towards the fire area and extinguishes it.

The master robot always checks the surrounding area. There may be many flamesensors in the server room. Here we are considering four flamesensors. Upon receiving a signal from a particular flamesensor, master robot gets a signal on the signal line and the master robot identifies the area, referencing that flamesensor. After identifying the area, the master robot navigates the slave robot towards that flamesensor. Here, line follower is used to control the motion of the slaverobot. The specified temperature in the server room, if the temperature sensed by the flamesensor is greater than the specified value, the fire extinguisher is activated, and fire signal is passed onto the nearest fire station and security system. The slaverobot returns to its original position after the fire is extinguished.
Fig. 2. Flowchart

Fig. 3. Master
V. Conclusion
Through the advancement of technologies, the robotics find a crucial role in the firefighting. The substitution of firefighting robots instead of human makes a drastic change by reducing the casualties as well as saving human life. Our proposed paper demands the importance of the firefighting robots in the server room. The master slave approach makes a smooth control of fire within the server rooms. The signals from the sensors are detected by the master. The navigation of the slave robot is handled by the master via Zigbee module. The firefighting robot accurately and efficiently detects the fire and extinguishes in the sever room within a minimum interval of time. The proposed paper points an updated version of firefighting in the server rooms in a most efficient way.

References