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FIREFIGHTING ROBOT OVERSIGHT IOT-ENABLED MONITORING AND CONTROL SYSTEM

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ABSTRACT: The goal of this work is to create a robot capable of putting out flames. The proposed firefighting robot should be small, but also extremely powerful and flexible. It locates and names flames in areas where catastrophes are likely to occur. Using the XLR8 board makes it easy for us to develop our idea. For its part, it can detect and regulate fire on its own. We can use the Internet of Things (IoT) technology to manually operate our computer. We can select either manual or automatic mode and swap between them at any time. A camera records events, while a Raspberry Pi keeps track of the robot's location at all times. When the fire detecting robot detects an obstacle, it goes to a road with no barriers to avoid colliding with anything.
KEYWORDS:XLR8 board, camera, RaspberryPi, Fire, IOT, L293D.

1. INTRODUCTION

The autonomous firefighting robot is a self-contained equipment that includes a flame sensor for detecting and extinguishing fires, as well as a fire extinguisher. Sensors on the robot's flanks allow it to turn while continually scanning for flames. When the robot detects a fire, it can walk toward it, halt in front of it, and use the fire extinguisher to put it out. The goal of this project is to create a robot capable of putting out flames. The proposed firefighting robot should be small, but also extremely powerful and flexible. It detects flames in disaster-prone areas. This will be implemented with the help of an FPGA board. The fire detection robot can recognize obstacles and moves toward clear paths to avoid colliding with them.

In the future, firefighting robots may save the lives of both those injured in a fire and the firefighters themselves. This technology can be useful in scenarios involving potentially explosive gas tanks, radioactive chemicals, or other areas that represent a major hazard to human safety. While it may be unusual to see robots assisting firefighters, there are already robots designed particularly for this purpose. These technologies include large fire extinguishers that can be operated from a distance and robots that can be deployed into a fire to investigate it. The robot's job is to put out fires in areas where humans cannot reach them. The device can pinpoint the exact position of the fire, navigate without the assistance of a person, and change route on its own if it encounters any difficulties. As soon as the robot detects a fire, it can capture multiple images of the area at regular intervals and send them to the main system.

2. DESIGN AND ANALYSIS

Block diagram

The block diagram for the suggested system shows two temperature sensors, an XLR8 board, an L293D current driver, two motors, a relay, a pump, a Raspberry Pi, and a camera.

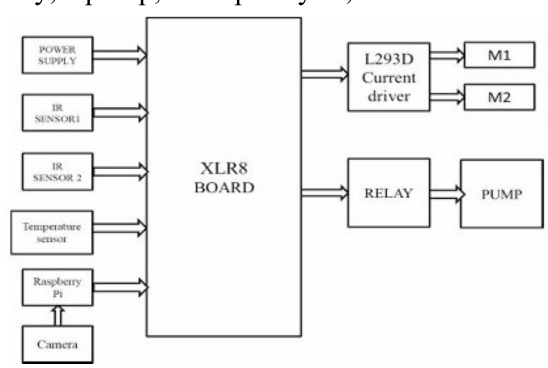

Fig: Block diagram

XLR8

Field-Programmable Gate Arrays (FPGAs) are the principal processors on the Arduino-compatible XLR8 board. The FPGA is a programmable and changeable piece of hardware. It also incorporates a microcontroller that supports the ATmega328 instruction set. Furthermore, the FPGA can speed up certain tasks that an 8-bit CPU might struggle with, complete slowly, or be unable to perform. XLR8's offloading and FPGA-based hardware acceleration dramatically boost performance without requiring any changes to the dimensions or toolchain of a conventional Arduino Uno board. This research board is Arduino compatible. The issue is with a microcontroller that uses an 8-bit AVR code set and is an integral part of a bigger system. FPGA technology was used to develop the CPU. It is possible to program with the Arduino IDE.The key advantages of this XLR8 board are its faster application speed and clock rates. Furthermore, hardware-accelerated features increase its speed, and it may be programmed using custom FPGA accelerator modules. XLR8 enhances the performance of your Arduino-based projects and applications.

Working

A 12V 1 Amp battery is used to power the XLR8 board. A voltage regulator, namely the LM7805, is used to restrict the voltage. This regulated voltage is then fed into the XLR8 board, which is supplied by a 3.3V supply. An LM1117 voltage regulator is also used to set the maximum permissible voltage for two DC motors, which is 5 V. The filter generates all of the DC pulsating energy when it is in operation. Because of the much lower voltage, the computer supplies 5V of power to the motors. As a result, a 5V signal is supplied to the actuators via an L293D driver. As a result, the L293D acts as a middleman between the microprocessor and the robot's actuators. The temperature sensor receives a threshold value in order to quantify the temperature. Two infrared cameras are used to maintain the obstacle avoidance feature. The XLR8 is initially created using built-in C code.

They are activated when an object is placed in front of the robot's thermal sensors. The left infrared (IR) sensor is activated when an impediment is detected on the motor's left side. Moving the motor to the opposite side follows. Similarly, the infrared sensor on the right side is used to steer the motor to the opposite side when an obstacle is detected on that side. Thus, infrared cameras are responsible for ensuring that obstructions are avoided. Additionally, the temperature sensor captures the temperature whenever it reaches a predetermined threshold. When the board's relay is detected, the pump is engaged immediately, resulting in an automated water outflow.

The user can decide between automated and manual techniques. When in automatic mode, the robot detects a fire, activates its relay, moves to the source of the fire, and extinguishes the flames with water spray. By enabling human control, a Raspberry Pi can be used to run an automaton and create an Internet of Things-connected server. This server page gives real-time information on the robot's environment. The robot's self-monitoring process takes longer in automated mode, thus human control is preferred to automatic control. Nonetheless, the operator has more control over the fire in manual mode, limiting further damage and maximizing time management by providing real-time progress updates.

In terms of functionality, we've incorporated Internet of Things (IoT) technologies. The Internet of Things (IoT) refers to an interconnected network of physical items. A "thing" in the context of the Internet of Things is a physical object with an IP address that can gather and transmit data across a network without human involvement or assistance. These gadgets include autos with built-in sensors and people who wear pulse monitors. The things are equipped with technology that allows them to communicate with their home countries or the outside world, perhaps influencing their judgments. As part of our task, we need to operate and educate our robot.

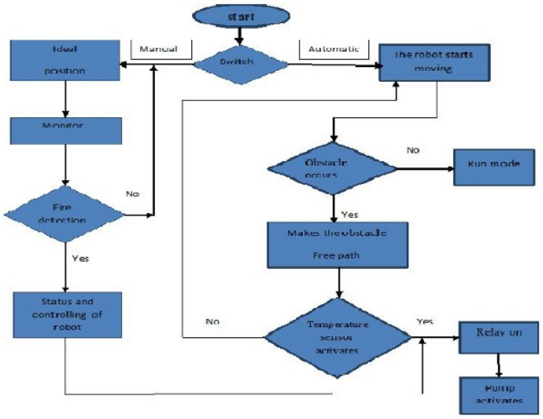

Fig:1 Flow chart representation

The figure depicts the project's framework. The slide mechanism ensures a smooth transition between manual and automatic modes.

Future scope

The development of a system capable of detecting combustion and responding appropriately has been the driving force behind this research. It is feasible to convert it into an efficient fire suppression by adding carbon dioxide to the water and allowing users to adjust it via the Internet of Things. This permits us to delegate hazardous duties that were previously performed by people to robots. This form of automation has an obvious and sensible application in firefighting. Because of the high incidence of fatalities during firefighting, the strategy we propose should be widely adopted. Clearly, this work has only begun to scratch the surface. These types of technologies have enormous potential for the future. The fundamental goal of our project is to illustrate the practicality of our concept, as evidenced by the limits on execution and the streamlined design. An effective autonomous firefighting system necessitates a network of robots capable of communicating and collaborating in order to complete their duty. Furthermore, while performing a task, the system must demonstrate its capacity to navigate around barriers in the event of a fire and adapt to changing conditions. These difficulties were not initially addressed in the project's blueprint. Nonetheless, significant research has been conducted on various elements of these components in different situations, such as mobile agent coordination, obstacle detection and avoidance approaches, real-time human-mobile agent interaction, and so on. It will be both exciting and difficult to combine these components into a self-sufficient fire brigade.

3. RESULTS

You can achieve the required effect manually or automatically. The camera can be connected to the XLR8 board, which is then connected to the Raspberry Pi board.

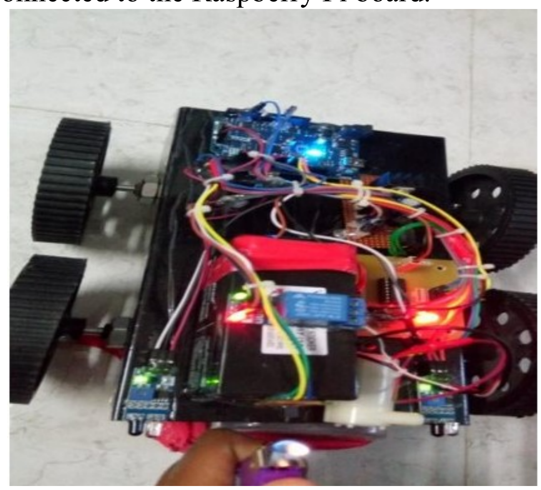

Fig:2 Fire detection with the help of temperature sensor

When the robot is in the automated phase, it may move autonomously, as shown in the image above. To do this, it uses infrared sensors to identify obstructions and clear the road around them if any are found. The phrase for this method is obstacle evasion. As the temperature in the surrounding region rises, the robot stops moving, activates the switch, and starts the pump.

When you pick manual mode, the camera is active. As we create a server page, we must watch and record everything that happens. The footage acquired by our camera will be shown on the server website that we are currently building. We learned about our automaton's current location. Robots can enter restricted locations as well as hazardous environments where people may be wounded or killed. The robot's functions are easily controlled from anywhere on the earth. In addition, we have the option of offering folks job prospects or addressing the situation internally. The robot's forward-facing camera helps it determine its location and transmit commands more effectively.

Fig :3 Front view of robot with camera.

The image below illustrates the server page that we created. Five different instruments are available for use.

Fig:4 Web Server page

The robot received the following five commands: halt, left, right, forward, and reverse. The robot implements our commands with efficiency and precision. It follows our instructions and completes the assignment. We can dispatch extinguishing personnel to the exact site of the fire in a moment. In the forward operation, the robot moves forward. When using the reverse operation, the object goes forward. Simply put, "robot stop operation" disables the robot. The terms "robo left operations" and "robo right operations" refer to the actions of a robot making a leftward and rightward turn, respectively. The image currently being shown or recorded is located beneath the operation keys.

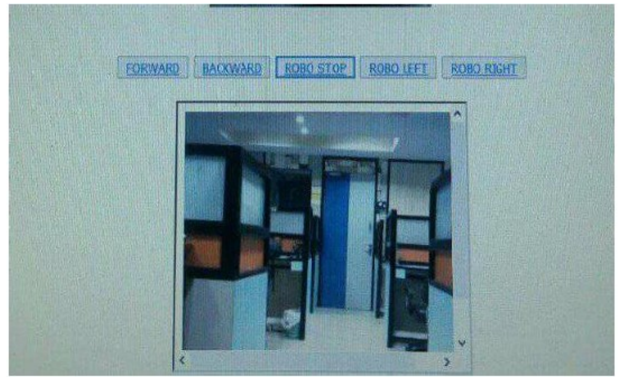

Fig: 5 Camera view of the Robot

4. CONCLUSION

A temperature sensor is used to aid in the construction process. Water is used to extinguish and combat flames. Monitors the exact location of explosive detonations and natural disasters. Currently, the automaton monitors the temperature. This robot is useful in risky areas prone to explosions and natural calamities. A relay system detects the existence of a fire and operates the water pump, either manually or through sensor input. It has been proved that the proposed technique is extremely effective in both security and industrial environments. Using an automaton instead of a human minimizes the likelihood of a fireman dying. They are used in laboratories, homes, offices, and other settings because of their utility. They can pinpoint flames with higher accuracy, allowing us to extinguish fires faster and avoiding any injury or discomfort to people. Thus, this tool has the potential to become tremendously valuable.

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