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WEB CONTROLLED MULTI-PURPOSE SECURITY ROBOT USING ARDUINO

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ABSTRACT
This paper proposes the design and development of an embedded system with a robot for safety and security application using wi-fi communication and a web server. This compact design has a robot along with various peripherals and sensors for detecting hazardous gas leakage and performing necessary control actions like alarms for fire accidents and sending an alert message to the local system. The aim of this project is to develop a prototype of a smartphone-controlled robot car that performs various functions in order to provide a very powerful and versatile robot while also reducing hardware usage as much as possible. In this project, Arduino UNO is used as a central component, with which all the other components are interfaced. The designed vehicle is controlled wirelessly through a smartphone with the help of a Wi-Fi module. On detecting an obstacle, a notification is sent to the Smartphone. A combination of Temperature sensors, Gas sensors, and Fire sensors are used to provide explosion sensing and detection and a buzzer goes on with the detection of explosion-prone regions.
KEYWORDS:- Arduino UNO, L293d Module, Wi-Fi Module, Thing Speak

1. INTRODUCTION

Robotics is a new booming field, which will be of great use to society in the coming years. Though robots can be a replacement for humans, they still need to be controlled by humans themselves. These days many types of wireless robots are being developed and are put to varied applications and uses. Controlling robots or electronic devices by voice and gesture provides both easy use and a rise in efficiency. When people use robots and automation systems, then daily life will be easier, fertility will increase, and cost and dissipation of time will increase. One of the most important characteristics used in robots is the interaction between people and robots. Many robots are expected to fulfill people's directives. Beyond controlling the robotic system through physical devices, recent method of gesture control and voice control has become very popular. The motor driver circuit is used to control the speed of the robotic system. The robot stops when it is parallel to the ground. With the increase of technological advancements, everyone wants multitask-enabled products. In the past, numerous robotic cars were built to perform a certain types of tasks. It uses a flame sensor, gas sensor, and temperature sensor for detection purposes. The robot can move freely based on the controls via a smartphone while actively scanning for fire, gas, and temperature. For this purpose, a variety of sensors are mounted onto the vehicle. When an obstacle is detected, the robot can indicate into IOT Site. The aim of this project is to develop a prototype of a smartphone-controlled robot car that performs various functions in order to provide a very powerful and versatile robot while also reducing hardware usage as much as possible. In this project, Arduino UNO is used as a central component, with which all the other components are interfaced. The designed vehicle is controlled wirelessly through a smartphone with the help of a Wi-Fi module[2]. On detecting an obstacle, a notification is sent to the smartphone and the robot performs pick and place operation with the help of a robotic arm mounted onto the vehicle. A combination of Temperature sensors, Gas sensors, and Fire sensors are used to provide explosion detection[6] and a buzzer goes on with the detection of the explosion-prone region. It can be useful in detecting other forms of accidents where the atmosphere is very dangerous to humans, such as operating around toxic or radioactive products or the easily explodable propane tank. The robot can be used for surveillance because it can easily cover areas where humans are unable to reach, and then automatically execute their functions when there are obstacles.

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2. LITERATURE SURVEY

[1]V. Ramya and B. Palaniappan discussed in detail how the toxic gases have to be monitored; such that increase in the normal level of them could be known and proper precautionary measures can be taken. An embedded system is designed using a PIC 16F877 microcontroller, for the purpose of detection of hazardous gas leakage. The system also supports the provision of real-time monitoring of the concentration of the gases present in the air.

[2]This paper discusses an autonomous agent for gas leak source detection. The robot estimates the localization of the gas leak source in an indoor environment without any human intervention. The agent implements a SLAM (simultaneous localization and mapping) procedure to scan and map the indoor area. The robot samples gas concentrations with a gas sensor in order to estimate the source of the gas leak. The robot will use the info from the onboard sensors in order to define an efficient scanning path.

[3] The author discussed building a system that can be used universally at any scale to monitor the parameters in the environment. Raspberry-pi and sensors collect all the real-time data from the environment and this real-time data is fetched by the web server and displayed it. Users can access this data from anywhere through the Internet. Wireless sensor networks (WSN) have been employed to collect data about physical phenomena in various applications such as habitat monitoring.

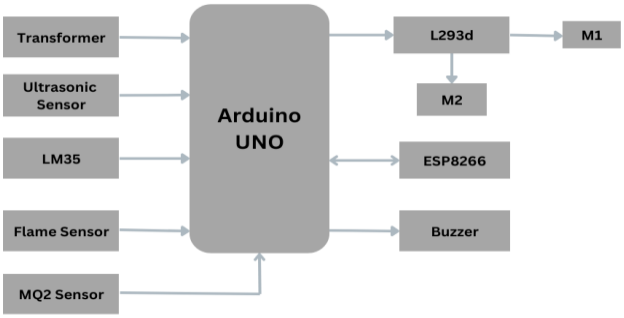
In all the above work the researchers have worked on different applications of robots like line following, detection of hazardous gas leakage, and firefighting robots. But there is no single design available where the robot can be used for multiple purposes so there is a necessity to develop a robotic embedded system for multiple purposes like monitoring gas leakage, detecting intruders, and extinguishing a fire at night when no one is available in the industry and send the critical information to the local system using wi-fi module.

3. DESIGN AND IMPLEMENTATION

The proposed system uses Arduino UNO along with an ESP8266 Microcontroller with a combination of different sensors and motors which will result in continuous monitoring of the industry and can be operated from a long-range distance. The Robot will send real-time data, which could be seen on a monitor or mobile through the wireless connection of the Wi-Fi module. The Vehicle can be controlled with the help of a mobile or laptop through the Internet of Things (IoT).

In this work, an embedded system robot is designed for safety and security purposes using wi-fi communication. It is an autonomous robot that detects the leakage of hazardous gases such as LPG, methane, natural gas, etc. in industries and raises alarm. The robot also performs necessary control actions like alarms for fire accidents and sends alert messages to the local system. The robot can extinguish the fire and monitors the area inside the industry and sends data to the local system. A low-cost microcontroller and other peripherals such as high-sensitivity gas sensors, ultrasonic (PING) sensors, wi-fi module, and Temperature sensor is used to serve multiple purposes. The microcontroller is embedded with a C program that processes the sensor's data and provides safety and security information through wi-fi communication. The whole system is compact.

4. BLOCK DIAGRAM



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5. HARDWARE USED

Arduino UNO:

Arduino Uno is an open-source microcontroller board based on the processor ATmega328P. There are 14 digital I/O pins, 6 analog inputs, a USB connection, a power jack, an ICSP header, and a reset button.

ESP8266:

The ESP8266 Wi-Fi Module is a self-contained SOC with an integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network.

L293D Motor Driver:

L293D Motor Driver Module is a medium-power motor driver perfect for driving DC Motors and Stepper Motors. It uses the popular L293D motor driver IC. It can drive 4 DC motors on and off, or drive 2 DC motors with directional and speed control.

DC Motor:

A DC motor is an electrical machine that converts electrical energy into mechanical energy. In a DC motor, the input electrical energy is the direct current which is transformed into mechanical rotation.

Power Supply:

The voltage requirements for an Arduino board vary depending on the model, but most commonly, a voltage range of 7-12V is recommended to power the board

Ultrasonic Sensor:

An Ultrasonic sensor is a device that detects an object and measures its distance to it. It measures the distance by emitting ultrasound and receiving the wave that the object reflects.

Flame Sensor:

A flame sensor definition is a type of detector that is used to detect as well as react to the occurrence of a fire or flame.

Gas Sensor(MQ2 Sensor):

The MQ2 gas sensor operates on 5V DC and consumes approximately 800mW. It can detect LPG, Smoke, Alcohol, Propane, Methane, and Carbon Monoxide concentrations ranging from 200 to 10000ppm.

LM35 Sensor(Temperature Humidity):

A temperature and humidity sensor are low-cost-sensitive electronic devices that detect, measure, and report both dampness and air temperature.

Buzzer:

A buzzer is understood as a device that creates an audible tone under the influence of an applied external voltage.

16x2 LCD Display:

An electronic device that is used to display data and the message is known as LCD 16×2. As the name suggests, it includes 16 Columns & 2 Rows so it can display 32 characters (16×2=32) in total & every character will be made with 5×8 (40) Pixel Dots. So the total pixels within this LCD can be calculated as 32 x 40 otherwise 1280 pixels.

6. RESULTS

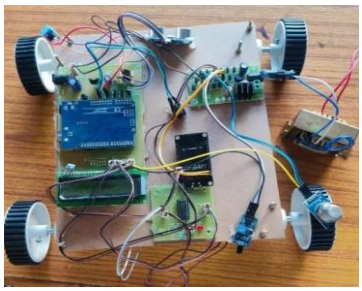

Fig-1 Working of Web Controlled Multi-Purpose Security Robot Using Arduino

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Fig-2 Temperature Output

Fig-3 Object Detection Output

{"channel":
{"id":2019806,"name":"Robotics","description"
:"Web Controlled Multipurpose Security
Robot","latitude":"0.0","longitude":"0.0","fi
eld1":"IOT Data","created_at":"2023-01-
30T04:31:25Z","updated_at":"2023-02-
02T10:02:54Z","last_entry_id":112},"feeds":
[{"created_at":"2023-02-
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D_OBJECT_ALERT"},{"created_at":"2023-02-
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{"created_at":"2023-02-
04T09:18:50Z","entry_id":16,"field1":"b"},
{"created_at":"2023-02-
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D_OBJECT_ALERT"},{"created_at":"2023-02-

Fig-4:- Web Server Output

7. ADVANTAGES

- The robot can be used to inspect areas that are difficult/risky for humans.
- Robots can navigate the environment and independently perform programmed tasks with minimal human oversight.
- It can operate for longer distances and is easy to handle.
- It improves security which results in less damage.

8. CONCLUSION

This security system is cheaply made from low-cost available components and can be used to control more than others. This system is easily adjustable in any industry or office space. The designed system was tested a number of times and successfully control from a different place. Finally, this security system can be also implemented over Bluetooth, Infrared, and WI-FI connectivity without much change to the design. Hence, this system is scalable and flexible.

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9. FUTURE WORK

In this project, we have a large scope to develop and work with this project. We try to list some tasks that would be added in the future. Future advancements include robotic software that provides data about performance, potential issues, and efficiency. Developers are also working on incorporating AI with robots for advanced machine learning, and robot self-programming.

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