

DEVELOPMENT OF MICRO RESCUE ROBOT FOR HUMAN DETECTION USING IOT

A PROJECT REPORT

submitted By

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to

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of

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DECLARATION

I undersigned hereby declare that the project report Development Of Micro Rescue Robot For Human Detection Using IoT, submitted for partial fulfillment of the requirements for the award of degree of Master of Computer Applications of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Mrs Minu R Nath , Assistant Professor, College of Engineering Trivandrum. This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title.

Place: Trivandrum

Date: 25-July-2021

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CERTIFICATE

This is to certify that the report entitled **DEVELOPMENT OF MICRO RESCUE ROBOT FOR HUMAN DETECTION USING IOT** submitted by **ARJUN DEV D G** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Master of Computer Applications is a bonafide record of the project work carried out by him under my guidance and supervision. This report in any form has not been submitted to any University or Institute for any purpose.

Internal Supervisor

External Supervisor

Head of the Dept

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If words are considered as symbols of approval and tokens of acknowledgment, then let words play the heralding role of expressing my gratitude.

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ABSTRACT

In this modern era of technology, still conventional methods (human and trained dogs) are being used to find and rescue the victims who are buried under the rubble after natural or human-made destruction. Such operation is very dangerous for the rescue workers and victims as well, especially in the case, if the wreckage is dislocated. These traditional methods increase the chances of casualties due to their risky and time taking approaches. Hence, to make the rescue operation safer and effective, a small ground robot for humanitarian search have been proposed which detect alive human beings. The main aim is to design a PC controlled Robot that detects live human and transmit the location of Robot wirelessly. This Robot is mainly used in disaster-affected areas like earthquakes. The Robot is equipped with PIR sensor to detect live human. Any alive body with a temperature above absolute temperature emits radiations that are invisible to the normal eye. It senses these passive infrared rays to detect the live human. This Robot also includes the camera, IR sensors, Gas sensors, Metal detector and video screen. Microcontroller is used to control the robot and is the core of the robot. The robot consists of a four-wheel geared drive with DC motors attached to perform movements.

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Chapter 1

Introduction

The need for human safety is of key importance. Huge loss of manpower in natural calamities situations can be minimized if an effective method is used despite using conventional way of identifying the buried humans. The core idea of this underlying work is to develop such a robot which could provide the significant help and safety to the rescue workers during the rescue operations in disastrous situations. Based on the fact, that the alive human body releases thermal radiations, a thermal sensor is used to sense the human under collapsed buildings. These radiations are received and used by the thermal sensor to identify living victims.

All the functions are controlled performed through an Android application and the interface between robot and control application is Bluetooth. Arduino Esp32 is used as a central processing unit for taking input information from the user. And after processing, the output is given to the user. Instructions received from users are passed to respective parts as required by the user for getting the demanded results. Henceforth, priceless life can be protected by well-timed finding in ruins even without a large number of rescue people. By using this wirelessly controlled robot, rescue workers do not have to risk their lives during search operations and in risky scenarios. They can make an audio conversation with the victim to find more about the situation. Components like mine detection, metal detectors and tracking systems etc. can be implanted on the anticipated system for several tasks.

1.1 Problem Definition

1.1.1 Purpose

The main purpose of this project is for detecting alive human beings affected due to sudden natural calamities like earthquake, floods, wildfires, storms and also human-induced disasters.

The Existing system contains rescue operations directed by human beings and officials that serves the purpose of detecting alive human beings. Hence, to make the rescue operation safer and effective, a small ground robot for humanitarian search have been proposed which detect alive human beings. This robot provides momentous help and safety to the rescue workers during the search and rescue operations.

1.1.2 Motivation

There are lots of sudden natural calamities like earthquake, floods, storms etc and Man-made disasters like robberies, industrial and transportation accidents. Due to this many times, humans are buried among the debris and it becomes impossible to detect them. So my motivation is to develop a robot that could provide significant help and safety to the rescue workers during rescue operations in disastrous situations.

1.1.3 Objectives And Contributions

The objective is to develop a human detection robot that can be controlled by a Bluetooth android application phone. The main objective is to develop a robot that could provide significant help to the rescue workers during rescue operations. So I used a PIR sensor to detect alive human beings. And I used the Fire sensor because if any fire situation is there, then the robot will detect it and fetch the output to the user. Then for any gas leakage, a Gas sensor is also attached to detect the leakage. My robot also has an Ultrasonic sensor to detect obstacles. And a GPS module is attached to give the latitude and longitude of the location.

1.1.4 Performance Requirements

- Accuracy : Accuracy in functioning and the nature of user-friendly should be maintained by the system.
- Speed : The app must be capable of offering speed.
- Low cost: This app is very cheap to implement and is also user-friendly.

- User Friendly: This proposed system is highly user friendly they enables to create a good environment.
- Time consuming: It is highly time consuming so that the user doesn't need to wait longer.
- Ubiquitous: The user can use this app from anywhere and get ubiquitous solution.

Chapter 2

Literature Review

There are many approaches used for human detecting techniques.

Naeem Farooq, Umar Ilyas, Muhammad Adeel, Sohail Jabbar [1] proposed a paper called “Ground Robot for Alive Human Detection in Rescue Operations” that is used to find and rescue the victims who are buried under the rubble after natural or human-made destruction.

F Matsuno, S Tadokoro [2] proposed a paper called “Rescue Robots and Systems in Japan” which describes the problem domain of earthquake disasters and search-and-rescue processes is clarified with introducing an overview of the Special Project for Earthquake Disaster Mitigation in Urban Areas. It uses the bird’s-eye view algorithm which improve remote controllability.

Anand Vijay K M, Purustut S, Suhas R, Pavan CG, Pragyan Pradhan[3] proposed a paper called “A Live Human Being Detector in War Fields and Earthquake Location Using Robot with Camouflage Technology” which describes alive human detection with robot; in addition, the system performs functionalities like smoke detection, metal detection, and camouflage technology implementation and compared with the existing models.

Chapter 3

Methodology and System Design

3.1 Methodology

In this proposed system, using Arduino ESP32 device is used to control and communicate with Robot using Arduino IDE via USB to subscribe the data/Dump the data. PIR Sensors will turn ON when it senses alive humans. Gas sensors will alert the user when toxic gas is detected and IR sensor to detect the obstacles. It uses GPS to mark the location of human beings alive.

3.2 System Design

The proposed system implies that when we power on the robot, it connects with user's Bluetooth app and can exchange data between them. The user can control the robot by passing instructions. The robot then detects obstacles, fire and human beings and sends the data to the user.

3.2.1 Overall Design

The system is a Hardware model that incorporates IoT to detect alive Human beings . The Ultrasonic sensor detects any obstacles coming in front of the robot. The PIR sensor detects alive human beings. It also has gas and fire sensor . The ESP32 is the micro controller used to control the robot. An android Bluetooth app is used to control the direction of the robot. And a website is used to display the output data of the robot to the user.

3.2.2 User Interface Design

An Android Bluetooth application is used to control the Robot wheels direction. The Bluetooth app should be connected to same wifi as that of the robot. It also contains a switch to on/off the PIR sensor.

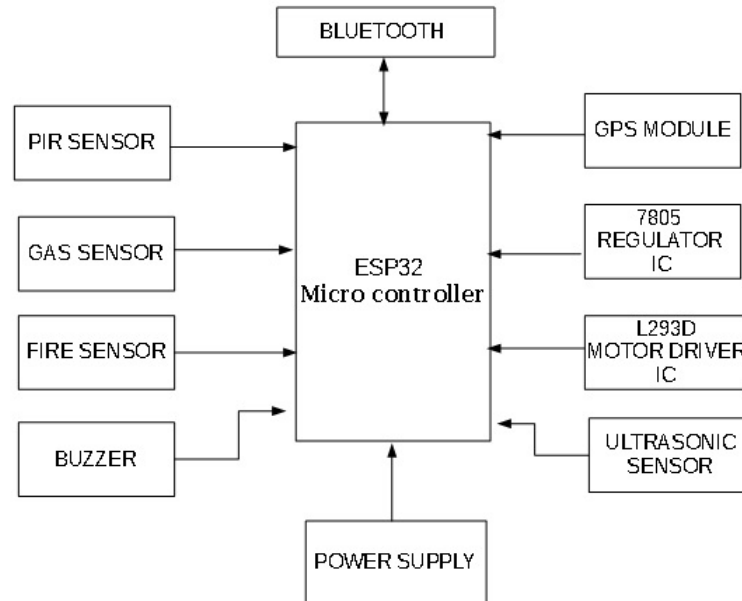


Figure 3.1: Design

3.2.3 Product Functions

The main functions of the proposed system include:

- Senses when there is any alive human being is present.
- Senses any fire and Gas present in that environment.
- GPS module gives the latitude and longitude of the location.
- A Bluetooth Android app is used to control the wheels of the robot.
- Sends the data to the server using NodeMCU.
- Display all data in the server.

3.2.4 Hardware Requirements

- An Android Smart Phone
- ESP32 Microcontroller
- Gas Sensor
- Fire Sensor
- Ultrasonic Sensor

- PIR Sensor
- GPS Module
- Wheel Motors
- Buzzer
- Chassis
- Wheel Motors
- Laptop

3.2.5 Software Requirements

- Windows 10
- Arduino IDE
- XAMPP
- Bluetooth Electronics (App)

3.3 Technologies Used

3.3.1 ESP32 Micro controller

The ESP32 has integrated Wifi and Bluetooth connectivity for a wide range of applications. It is highly integrated with in-built antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters and power management modules.

3.3.2 PIR Sensor

PIR sensor allows to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. They are often referred to as "Passive Infrared".

3.3.3 Fire Sensor

A Fire sensor detector is a sensor designed to detect and respond to the presence of a flame or fire. When fire burns it emits a small amount of Infrared light, this light will be received by the Photodiode(IR receiver) on the sensor module. Then we use an Op-Amp to check for a change in voltage across the IR Receiver, so that if a fire is detected the output pin(D0) will give 0v(LOW), and if there is no fire then the output will be 5v(HIGH).

3.3.4 Gas Sensor

The MQ-6 Gas sensor can detect or measure gases like LPG and butane. The MQ-6 sensor comes with a digital pin which makes this sensor to operate without a micro controller and that comes in handy when you are only trying to detect one particular gas. When it comes to measuring the gas in PPM the analog pin has to be used.

3.3.5 GPS Module

The NEO-6MV2 is a GPS(Global Positioning System) module and is used for navigation. The module simply checks its location on earth and provides output data which is longitude and latitude of its position. Its maximum navigation update rate is 5Hz.

3.3.6 7805 Regulator IC

They provide a constant voltage for a varied input voltage. The name 7805 signifies two meaning "78" means that it is a positive voltage regulator and "05" means that it provides 5V as output. So 7805 will provide a +5V output voltage.

3.3.7 Buzzer Module

Buzzer Module is for giving an alarm sound. It has a continuous beep sound. Its rated voltage is 6V DC and its operating voltage is 4-8V DC.

3.3.8 Ultrasonic Sensor

The HC-SR04 Ultrasonic Sensor is a 4pin module. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and receiver. The ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor.

3.3.9 DC Geared Motor

The DC Motor with Metal Gear Head is ideal for low RPM, High torque application. The DC motor is used here for wheel controlling.

3.3.10 Arduino IDE

Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino module. The IDE environment mainly contains two basic parts: Editor and compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module. It supports both C and C++ languages.

3.3.11 XAMPP

XAMPP is an abbreviation where X stands for Cross-Platform, A stands for Apache, M stands for MySQL and the P's stand for PHP and Perl, respectively. It helps to create and test the programs on a local web server.

3.4 DataFlow Diagram

A data Flow diagram (DFD) is a design tool to represent the flow of data through an information system. A context level DFD can be used to show the interaction between a system and outside entities; it can also show the internal data flows within a system. It often shows the information system as a single circular shape with no details of its inner working: what it shows is its relationships with the external entities. A data ow diagram graphically represents:

- Processes - Jobs done using the data. A method translates incoming flow of data into outgoing flow of data.
- Data stores - Databases, files, archives. They may be digital, manual or temporary.
- External entities - Other systems, or individuals beyond the existing system's control.
- Connecting data flows - Arrows demonstrate how data flows from one location to another.

Notations in a Data Flow Diagram

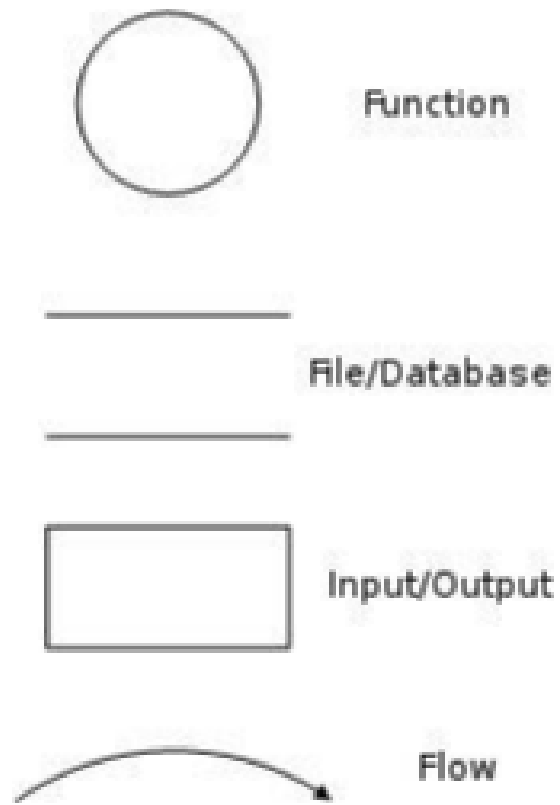


Figure 3.2: Notations in dataflow diagram



Figure 3.3: Level 0 DFD

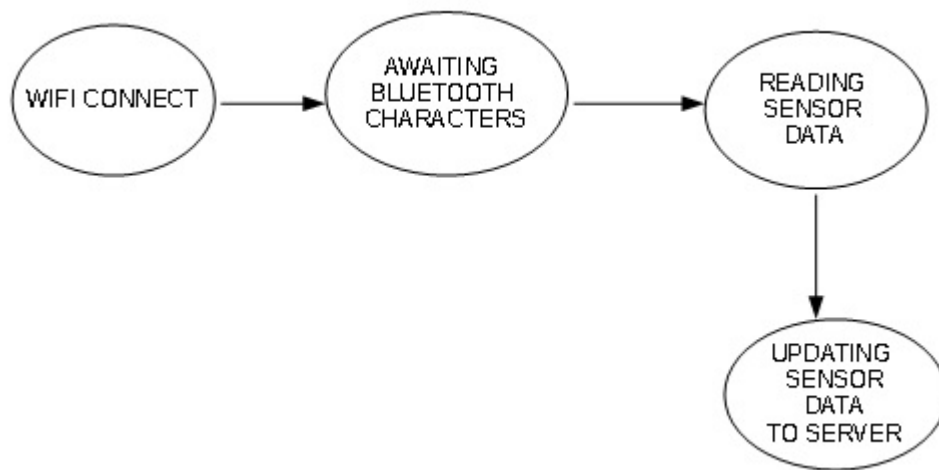


Figure 3.4: Level 1 DFD

3.5 Circuit Diagram

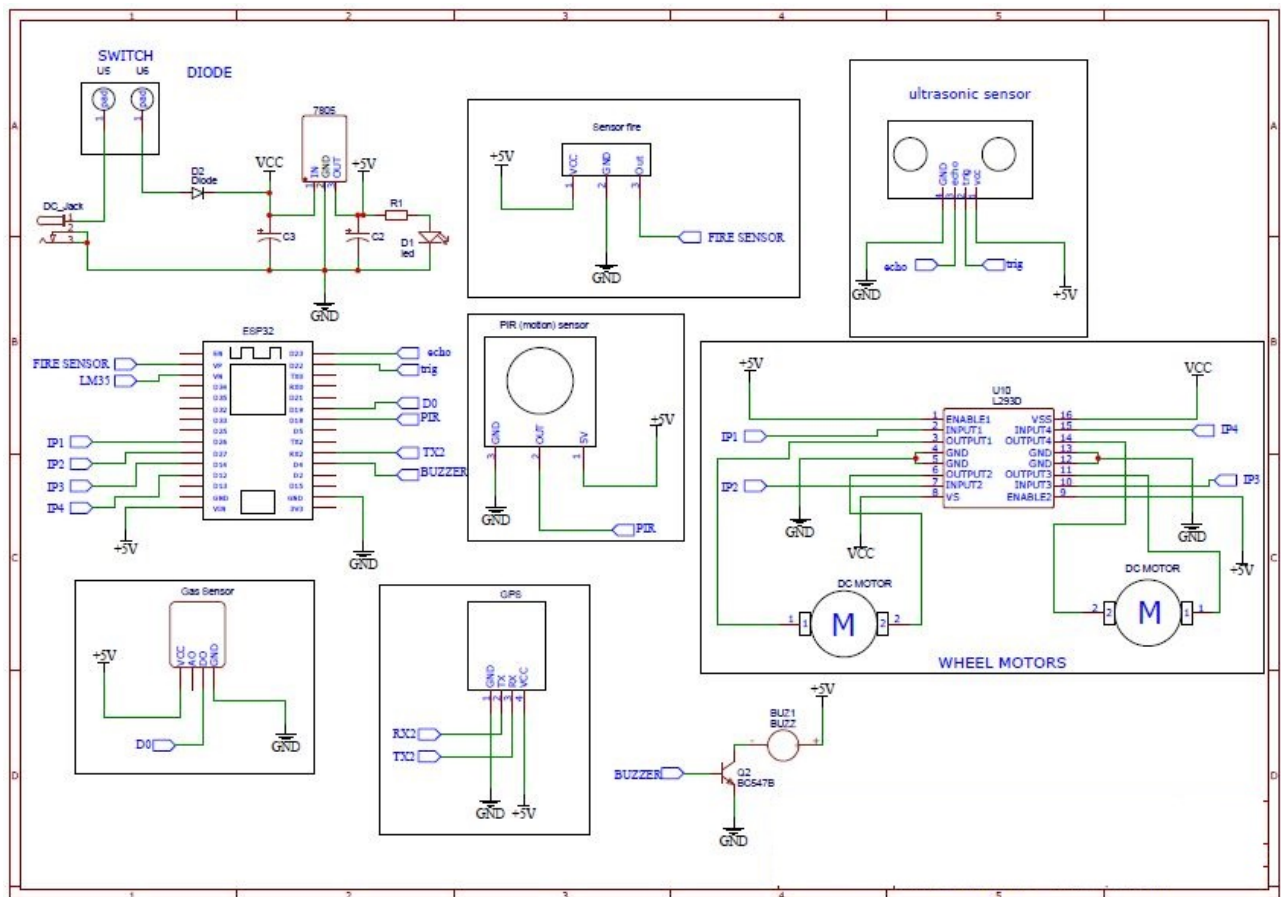


Figure 3.5: Circuit Diagram

3.6 Screenshots

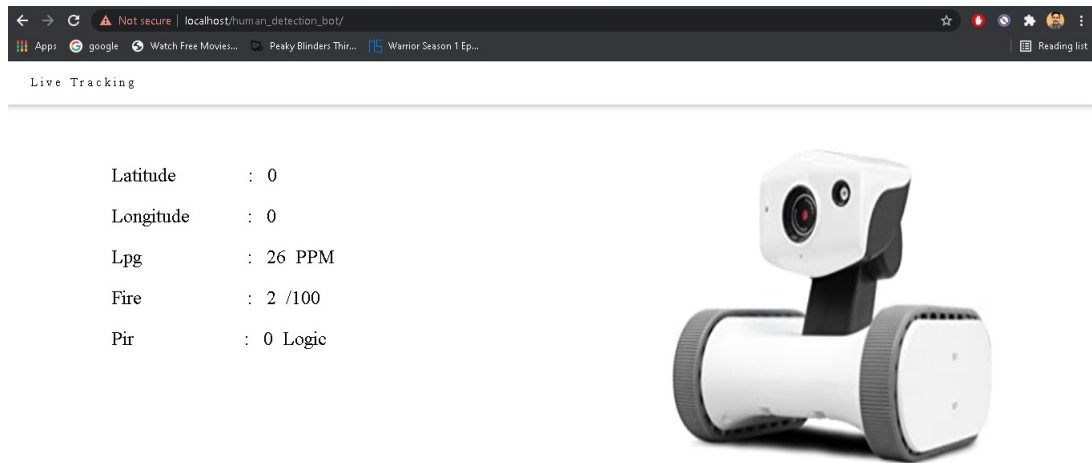


Figure 3.6: Website



Figure 3.7: Mobile App

Chapter 4

Coding, Implementation and Testing

Algorithm 1 Algorithm: Connection of database and upload to server

- 1: Start
 - 2: Create a User interface to display the output from all the sensors
 - 3: Connect with Mysql database to store and get data
 - 4: Create a notification if any alive human are detected
 - 5: Create another notification if any fire or gas leakage is detected
 - 6: Activate all sensors and upload data to the server.
 - 7: Check the status of all the sensors
 - 8: Notify if any failure occurs
 - 9: Stop
-

Algorithm 2 ESP32 Microcontroller

- 1: Start
 - 2: PIR sensor detects alive human being
 - 3: Display the status to the user
 - 4: Gas and Fire sensor detects any leakage
 - 5: Upload it to the server if any leakage is there
 - 6: Sends all the data from sensors to Mysql database using ESP32
 - 7: Stop
-

4.1 Testing methods done for the project

System testing is the implementation stage which aims to ensure that the system works correctly and efficiently before live operation begins. Testing is the execution process of the program with the intention of finding errors and missing operations and also complete verification to determine whether the target is met and user requirements are met. The ultimate aim is to guarantee quality. Tests are carried out, and the results are compared with the document expected. In that case, debugging is done for the erroneous results. On each module a test plan is carried out using detailed testing strategies. The test plan sets out the approach to unit, integration and system testing. The test scope includes the following: A primary aim of evaluating application systems is to ensure that the program fulfills all functional requirements including consistency requirements (Non-functional requirements). The user will consider at the end of the project development process which the project has achieved or surpassed all the criteria as set out in the specifications. Any improvements, enhancements or removals to the requirements, technical specifications or design specifications document must be recorded and reviewed to the highest quality standard during the project's remaining time span. Within the Test Team potential. The secondary goal of testing application systems is to detect and disclose all problems and associated risks, and to communicate all known issues before publication. This paper on the test methodology outlines the relevant methods, procedures, workflows and methodologies used to schedule, coordinate, perform and conduct problem of the project "Development of Micro Robot for Human Detection Using IoT".

4.2 Unit Testing

Sl No	Procedures	Expected result	Actual result	Pass or Fail
1	Sense alive Human being	PIR sensor gives beep sound	Same as expected	Pass
2	Sense fire	Fire intensity is calculated	Same as expected	Pass
3	Sense Gas leakage	Detects the gas leakage	Same as expected	Pass
4	GPS location	Latitude and longitude are detected	Same as expected	Pass
5	ESP32 Microcontroller	Sends the output to the user	Same as expected	Pass
6	Ultrasonic sensor	Detects obstacles	Same as expected	Pass

Table 4.1: Unit test cases and results

4.2.1 Integration Testing

Sl No	Procedures	Expected result	Actual result	Pass or Fail
1	Integrate the NodeMCU and Mysql to store data	NodeMCU and Mysql database integrated	Same as expected	Pass
2	Integrate php and XAMPP to retrieve data	Server integrated with database	Same as expected	Pass

Table 4.2: Integration cases and result-1

4.2.2 System Testing

Sl No	Procedures	Expected result	Actual result	Pass or Fail
1	Detects alive Human	PIR sensor fetch the result to the database	Same as expected	Pass
2	All other sensors	Fire sensor,Gas sensor,Ultrasonic sensor gives status update	Same as expected	Pass
3	Shows the solution	With the given sensors data, the solutions is provided to the user	Same as expected	Pass

Table 4.3: System test cases and results

Chapter 5

Results and Discussion

It is observed that the system performs all the functionalities as expected. The Robot sensor gives notifications about the human detection, fire detection, obstacle detection, Gas leakage detection. The main aim behind this project was when the robot detects humans, it can notify the user by giving continuous beep sound.

5.1 Discussion

The proposed system features a lot of advantages over the existing system. The proposed system is way more cost efficient than the existing systems. Like any other system, this application also has its own advantages and limitations.

5.1.1 Advantages

- Effective for rescue operations, in natural and man made disasters.
- It eliminates human need to access hazardous regions.
- User friendly and interactive.
- Minimum time required.

5.1.2 Limitations

- The battery backup is weak and can be overcome by using solar panels.
- GPS location is affected due to environmental conditions.
- It is operated manually.

Chapter 6

Conclusion and Future Work

In this, we have proposed a small ground robot for the search of alive victims in the remains of disaster sites. This robot is very helpful in searching the buried victim in no time more accurately and efficiently than any of the compared search and rescue robots. There is no danger to risk worker's life during a search operation in risky scenarios. So the death rate of rescue workers is decreased significantly during search and rescue operation. The implementation of this design is purely driven by usage of PIR sensor, fire sensor, Gas sensor and ultrasonic sensor etc. During crisis and particularly in urban disasters, this system will be highly useful. The robot can move in all directions with the help of remote controlled Bluetooth app.

6.1 Future Works

- During the emergency situations and especially in urban disasters, this project will be a great requirement. The disasters can be sensed in a quicker time and rescue operation will be there for the stake to help victims.
- This circuit is mainly using in land rovers by making its movement more effective on rough surface and in advance this will also use in drone applying the same circuit and idea with advance techniques.
- This robot can be used in the field of war to detect enemies.
- The robot can be made weather proof, durable and easy to control.

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