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Solar Powered Wireless Multifunctional Robot

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***Abstract* – This paper presents an approach for espionage purpose at remote and border areas using multifunctional robot based on HTTP protocol. This robotic vehicle has the caliber to substitute the solider at border areas to provide surveillance. The robotic vehicle works in automatic mode with the help of sensors and in manual mode via instructions from webpage. The medium of communication used for this purpose is internet. This multisensory robot used to detect human, metal, harmful gases and fire at remote and war field areas. Typically, wireless security robot obsoletes due to limited frequency range and limited manual control. In order to overcome these limitations, we are using Raspberry Pi 3 embedded board coded with python programming. Using this system one can monitor and control the military robot from anywhere in the world using IoT. This system is also enhanced with the use of renewable resource of energy by equipping with solar panel. An autonomous operation is controlled by ultrasonic sensor. Manual operation is controlled by the direction keys in the webpage and a camera is used for live streaming purpose and change the path of robot according to real time information of surrounding.**

Keywords -- Raspberry Pi 3; Solar Panel; HTTP; Webpage; PIR; GPS

I. INTRODUCTION

The robot is basically a machine which can be programmed by a computer to carry out a series of complex operations automatically. With the development in technology, scientists come up with new ideas and inventions. Robots are now becoming an essential part of human life. The robotic technology can be used in various areas like hospital, industries and factory [1]. Besides these areas, this technology is also used in Defense forces, Security systems and many dangerous mission execution [3].

Multifunctional robot is one of the technology used in order to substitute the solider at border areas to provide surveillance. The robot operates in an automated mode using ultrasonic sensors fitted on the robot for navigation. It can sense the obstacles in the path it moves. The robot also senses harmful gases, metals etc. [2]. During manual mode the robot is operated via a webpage. The direction keys in the webpage are used for the control the path of the robot. All the above operations are on the whole controlled by a Raspberry Pi which is powered by a solar panel.

In war field areas, robot is usually miniature in size so that they are capable enough to enter into tunnels, mines and small holes in building and also have ability to survive in difficult climatic conditions for a longer period of time [2]. But still there are some problems in earlier developed military robots.

A. Existing System

• Existing robots were operated within a limited range as they are based on RF technology, ZigBee and Wi-Fi.

• Earlier, most of the robots used battery as a source of power supply which reduces the usage of the robot for a longer period.

• Previously, the surveillance robots were used to sense only one or two physical entities.

• Earlier developed robots used GSM module for their communication which operates within a limited range [5].

B. Proposed System

• Use of Raspberry Pi will enhance wide range of coverage as it is a Wi-Fi enabled device.

• Using solar panel as a source for power supply which is a renewable source of energy makes it energy efficient.

• Used to detect more than 3 physical entities.

• Used to send alert messages to the user via way2sms which operates in limitless range.

II. WORKING PRINCIPLE

The main principle of the circuit is to detect the presence of living objects like human using PIR sensor, obstacles using ultrasonic sensor, hazardous gases using gas sensor, temperature is detected using temperature sensor and fire is detected by flame sensor [2]. The wireless robot is operated via a webpage created for the control of the robotic vehicle. The data is transmitted through the webpage for the control operation. Using the received data, robot is operated in the manual mode of operation.

III. PROPOSED CIRCUIT DESIGN

This multifunctional robot consists of 4 modules which have their own functionality as follows:

1) Power Supply Module

2) Sensor Module

3) Communication Module

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4) Obstacle Detection Module

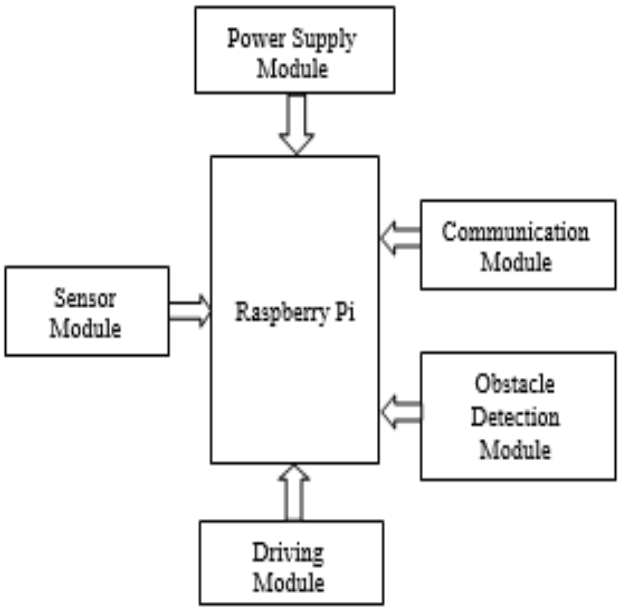

Fig.1: Block Diagram of Robotic Vehicle

The block diagram consists of a Raspberry Pi which is the principal component of the robot. It is powered by means of a solar power system [7]. Since it cannot provide continuous supply to the robotic vehicle, a rechargeable battery is used to provide consistent power supply to the vehicle and it is connected to the solar panel.

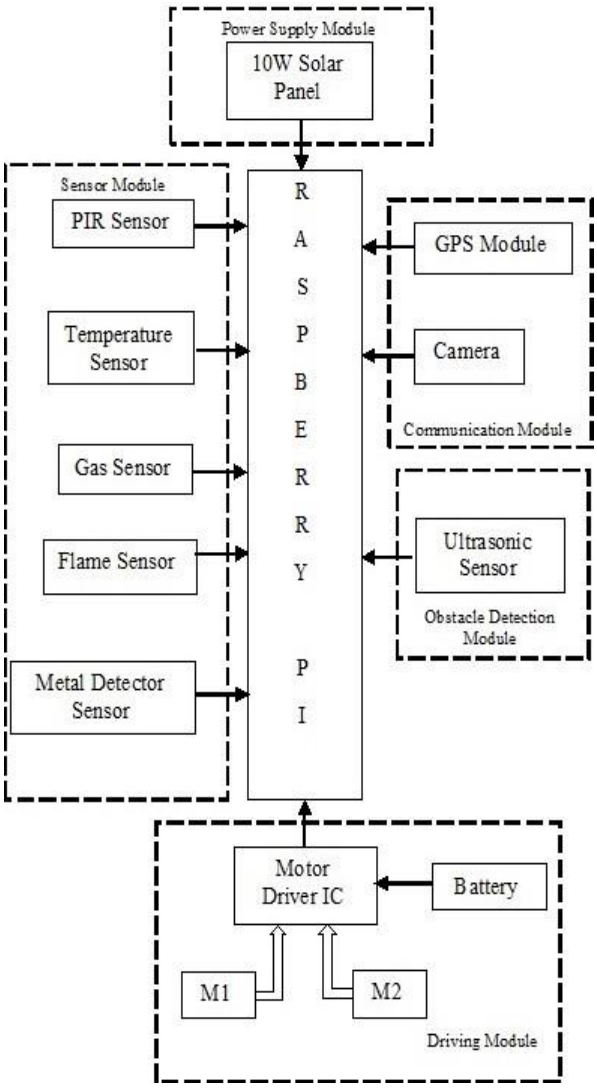

Fig.2: Circuit Diagram of Robotic Vehicle

When any sensors becomes active, it sends an alert message via way2sms to the user in the registered mobile.

L293D is a Motor Driver IC which allows DC motor to drive on either direction. L293D can control a set of two DC motors simultaneously in any direction. It means that we can control two DC motor with a single L293D IC. It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. This voltage is required to drive the motor in either clockwise or anticlockwise direction.

In the above circuit diagram,

M1: Motor 1

M2: Motor 2

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IV. MODES OF OPERATION

- Manual mode
- Automated mode

MANUAL MODE:

In manual mode, a webpage is created for the control of the robotic vehicle. When any type of warning is sensed, it can be viewed through the camera that is interfaced with Raspberry Pi so that robot can be directed manually.

Step 1: Manual mode of operation is initiated by the creation of webpage.

Step 2: The direction symbols are designed by writing a program.

Step 3: The press of ⇧ is set for forward and ⇩ is set for backward movement. ⇦ is set for left and ⇨ is set for right movement of the robot.

AUTOMATED MODE:

Step 1: Robot is initialized for automatic mode of operation.

Step 2: Information from various sensors are used as input. Sensors used for this purpose include

1. PIR SENSOR:

PIR sensor is used to detect the presence of living beings by sensing the heat radiation emitted by the living beings. It is a highly sensitive sensor.

2. GAS SENSOR:

Gas sensor is used to detect the existence of harmful gases like LPG, CO when the gases exceed their defined voltage level.

3. METAL DETECTOR:

Metal detector is employed to detect the presence of metals in the surrounding using the principle of electromagnetic induction.

4. TEMPERATURE SENSOR:

Temperature sensor is used here to detect weather conditions. As the temperature sensor is an analog device, a separate ADC is integrated with it to produce a digital value.

5. ULTRASONIC SENSOR:

Ultrasonic sensor can measure the distance to an object by using sound waves [6]. By sending out a sound wave at a specific frequency and listening for that sound wave to bounce back, the distance is measured [4].

6. FLAME SENSOR:

A flame sensor detects the presence of fire or flames. In extremely hazardous environments, flame sensors work to minimize the risks associated with fire.

V. CONTROL FLOW DIAGRAM

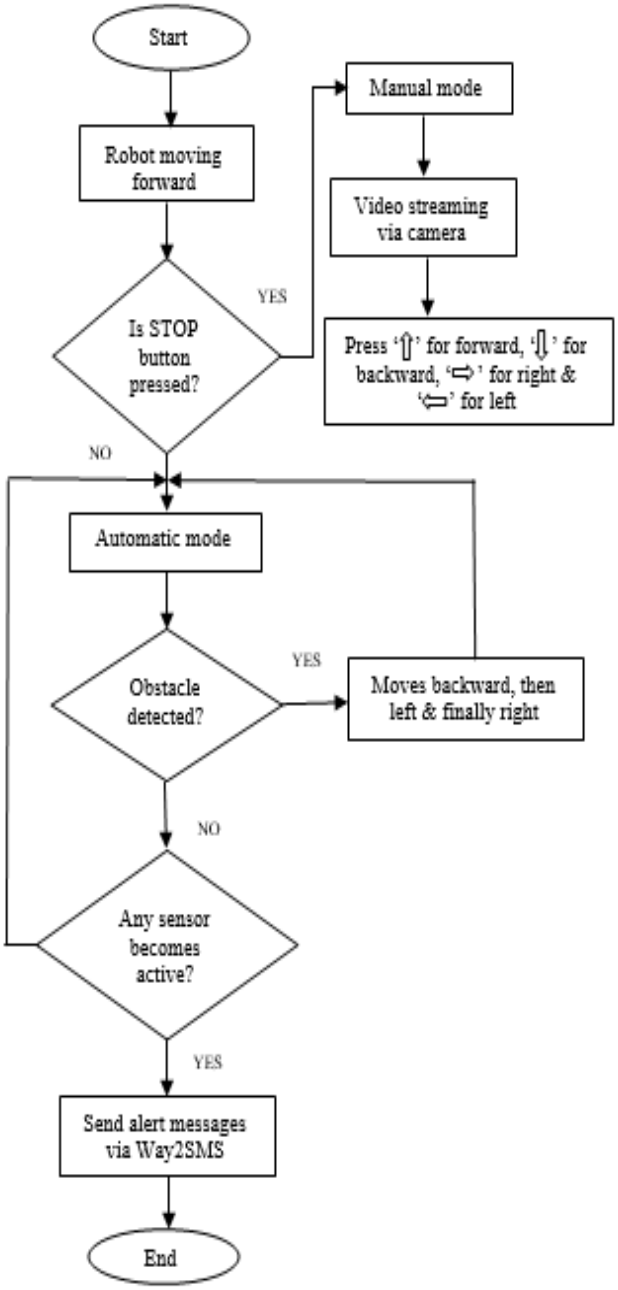

Fig.3: Control flow diagram

VI. IDENTIFICATION OF CURRENT POSITION OF THE ROBOT

The current location and position of the robot is given by GPS (Global Positioning System). It is a satellite based navigation system which provides the current location by providing the global coordinates with minimum distance coverage [8].

During the automatic mode of operation of the robot, GPS plays a major role in defining the current position and location of the robot for its further navigation [6]. When the automatic mode is initiated, the data is received from the satellite and it is redirected to the google maps to determine the current location of the robotic vehicle.

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VII. SOFTWARE USED

The wireless multifunctional robot is implemented by programming it in Python programming language which has the complete feature for Raspberry Pi embedded board.

Python is an interpreted high-level programming language for general-purpose programming.

VIII. RESULT

Using this machine, one can monitor the real time information of the surrounding. The proposed system is practically used to monitor the war field and risky areas, to detect human, hazardous gases, fire, obstacles, metal and temperature of the surrounding. The following figure shows a message received as a result of detection of an obstacle and a metal in the environment in which the robot is controlled.

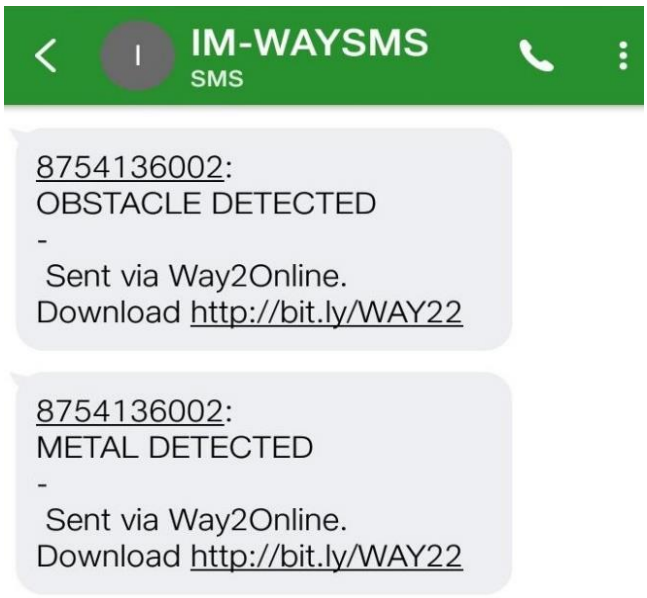

Fig.4: Message received via Way2SMS

The following figures shows the implementation of the robotic vehicle with the components.

Fig.5: Robot equipped with solar panel

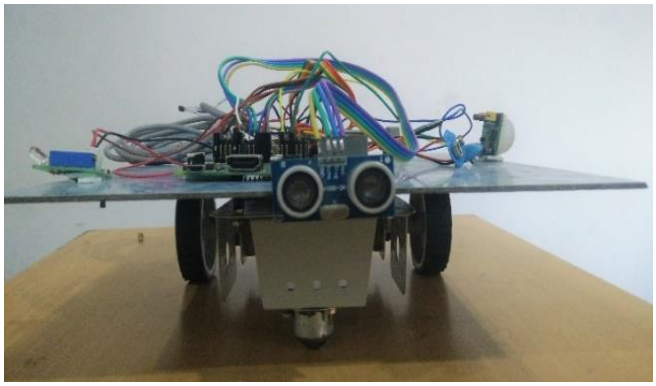

Fig.6: Front view of the robot

The following figure shows the webpage created for controlling the robot in manual mode using the direction symbols. In this webpage, we obtain the temperature of the real time surrounding as well as the distance at which the obstacle is present.

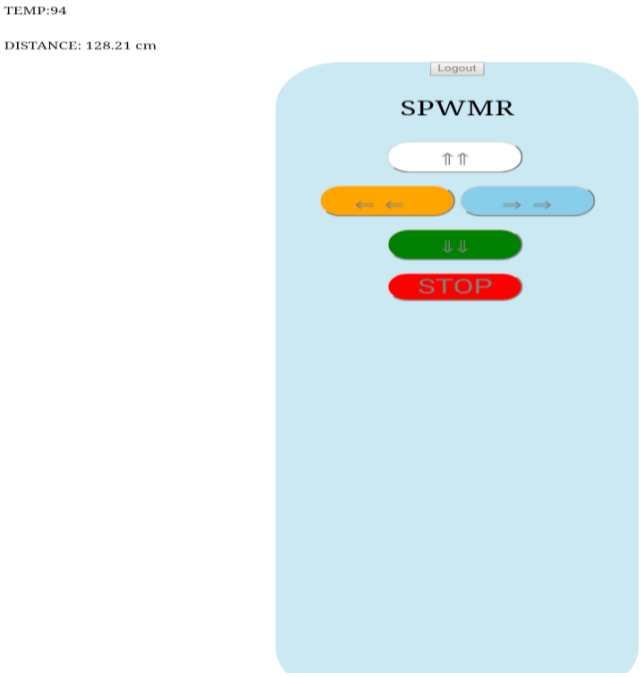

Fig.7: Webpage for manual control of the robotic vehicle

IX. CONCLUSION

The main purpose of the proposed system is to overcome the limited operational region. The earlier robot in war field application used Wi-Fi and other local networks which has very limited range of operations. As the proposed system employs solar power as its power source and wireless camera for live streaming purpose, it makes the system cost effective compared to other proposed systems. This robotic vehicle with a number of modules can be used as surveillance robot for security purpose and also in emergency rescue operations where humans cannot find best results. The user is also alerted about the intruder prior to his premises.

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