

# Solar Powered Robot

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**Abstract**---Robotics is one of the main research fields in modern age in which the nations are concentrating on military purposes in the state of war and peace. This paper presents a modern approach of robot using ZigBee technology at remote and border areas like defense and military applications. This robot is used to detect movement with the use of patch antenna which uses the principle of Doppler shift and harmful gases using Gas sensor. This system highlights the use of renewable energy equipped with Solar Panel. The continuous power supply is provided to the robot by dynamic charging method. Manual operations are controlled with ZigBee to direct the path of robot related to the real time information of the surrounding.

**Keywords**--Firebird V Robot, ZigBee, Solar Panel, Gas Sensor, Motion sensor.

## I. INTRODUCTION

The development of technology has now come up with the invention of robots. The robots developed using latest technologies help humans to lead a comfortable life. One of such concerned areas includes military. The tasks which are difficult to handle in risky areas are handled by the military robots.

A robot is an electromechanical machine that is controlled by computer program to perform various operations. Industrial robots have been designed to reduce human effort and time to improve productivity and to reduce manufacturing cost [5]. This project aims at using solar energy as the main power supply with the help of dynamic charging method. Earlier the robots were controlled through wired network but now to make robot more users friendly, they are framed to make user command work. Therefore to attain the requirements, ZigBee is used as a communication network to control the user friendly robot.

The design of the project encourages developing a robot based on ZigBee technology using solar power as main source. The robot is embedded with Atmega2560 microcontroller for desired operation. Microwave motion sensor of HB series works in X-band which is designed for movement detection and MQ-5 Gas sensor is used to detect harmful gases.

## II. SYSTEM DESIGN AND ARCHITECTURE

### A. Power supply module

The robot uses Solar panel of 10 watt as renewable source of power supply. As the solar panel is not able to provide continuous power to the robot, two rechargeable batteries are used to provide consistent power to robot. A relay circuit is operated by a relatively small electric current that can turn on the second battery when the first battery charge drains [6].

### B. Gas sensor



Figure 1: MQ-5 Gas sensor

Gas sensor detects the harmful gases in an area. This kind of equipment is used to detect a gas leak and other such emissions in a control system. It is important because there are many gases that can be harmful for living beings. Figure 1 represents gas sensor.

*C. Microwave Motion Sensor*

HB series of microwave motion sensor module are X-band Mono-static DRO Doppler transceiver front end module. This module is designed for movement detection, like intruder alarms, occupancy modules and other innovative ideas. The module consists of Dielectric Resonator Oscillator (DRO), microwave mixer and patch antenna as in Figure 2.

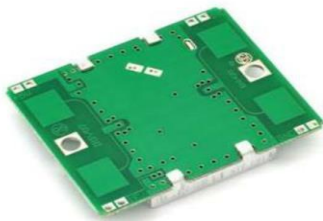


Figure 2: HB100 Microwave motion sensor

*D. Firebird V (ATMEGA2560)*

Firebird V includes micro controller, sensors, indicators, ZigBee and LCD. Firebird V supports ATMEGA2560 (AVR) micro controller. ATMEGA2560 is a high performance, low power microchip 8-bit AVR RISC based micro controller consists of 256kb ISP flash memory, 8kb SRAM, 4kb EPROM.



Figure 3: Firebird V Robot

All AVR microcontrollers can be programmed using In System Programming (ISP), external programmer or using boot loader. Advantage with the bootloader is that one doesn't need any external hardware to load .hex file on the microcontroller. It also protects robots hardware from possible damage due to static electricity and prevents any accidental changes in the fuse settings of the microcontroller.

*E. Motor driver*

L293D is a dual H-Bridge motor driver with one IC. It can interface two DC motors which can be controlled in both clockwise and counter clockwise direction. Microcontroller cannot supply the current required to run DC motor. So to satisfy this requirement ICs are used to drive the motor. The L293 and L293D are quadruple high-current half H drivers. Figure 4 represents DC motor.



Figure 4: DC Motor

The L293D provides bidirectional drive currents of up to 1A at voltage from 4.5V to 36V. All the four I/O's are used to connect up to four DC motors. L293D motor driver can control two motor at one time or called is a dual H-Bridge motor driver. Motor power used is 12V. The four motors are connected in the H-bridge form as shown in Figure 5.

This circuit is an overview of H-bridge present inside the L293D. It has four switches.

- 1 If switch A and switch D is turned ON, the motor will rotate clockwise (right).
- 2 Turning switches C and B ON will make it rotate anticlockwise (left).
- 3 Turning switch A and switch B ON will move the robot in forward direction.
- 4 Turning switch C and switch D ON will move the robot in backward direction.

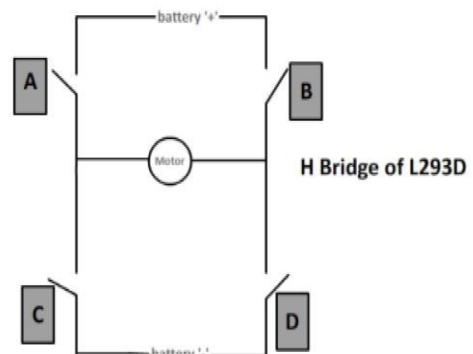


Figure 5: H-bridge

The rotation of the DC motor can be control by combinations of A and B in programming assembling and the truth table 1 explains the rotations of the motor.

Table 1: Logic table for motor direction control

Direction	C	A	B	D
Forward	0	1	1	0
Backward	1	0	0	1
Left	1	0	1	0
Right	0	1	0	1

F. ZigBee module

ZigBee is used for a high level communication protocols used to create personal area networks with small low powered, low bandwidth needs, design for small scale projects which need wireless connection. Frequency operates over 16 channels with 2.4 GHz frequency range. Its low power consumption limits the transmission distances to 10-100 meters and it has a data transmission rate of 250Kbps.

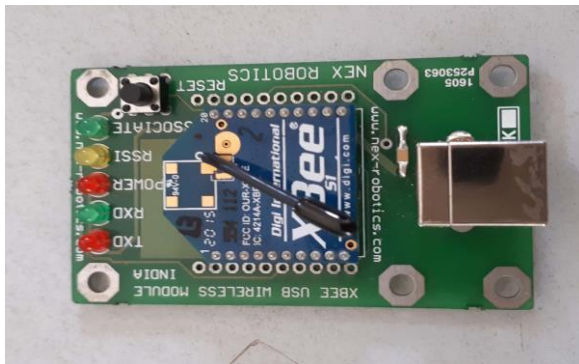


FIGURE 6: ZIGBEE MODULE

III. DESIGN AND IMPLEMENTATION

The robot structure basically consists of the robot body as shown in the Figure 7 that includes gas sensor, microwave motion sensor, ZigBee module, solar panel, relay circuit and motor driver. One of the most interesting aspects of robot in general is its behavior, which requires a form of intelligence.

The block diagram of war field robot consists of two parts.

- Robot block
- Computer block

Firebird V Robot is used to control all operations.

According to the motor operations, the robot will operate as specified in a program. The HB100 radar detects the microwave motion and the movement is detected by Doppler shift.

A Doppler radar is specialized radar that makes use of the Doppler Effect to produce velocity data about objects at a distance. It does this by beaming a microwave signal towards a desired target and listening for its reflection, then analyzing how the frequency of the returned signal has been altered by the object's motion. This variation gives direct and highly accurate measurements of the radial component of a target's velocity relative to the radar.

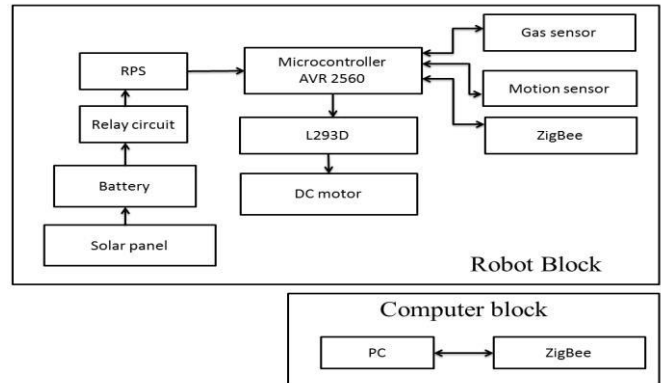


Figure 7: Block diagram of Solar powered robot

When a gas interacts with the gas sensor, it is first ionized into its constituents and is then absorbed by the sensing element. This absorption creates a potential difference on the element which is conveyed to the processor unit through output pins in form of current.

One can control the moments of the robot by passing the commands to move in any directions. Based on the input commands the robot will move as follows.

- moves in forward direction
- moves in reverse direction
- It can even turn left or right while moving forward or in reverse direction

This robot uses Solar panel for power supply. As the solar panel provides continuous power to robot, a rechargeable battery is used to provide consistent power to the robot which is connected to solar panel through relay circuit. A relay circuit is operated by a relatively small electric current that can turn on the second battery when the first battery charge drains.

IV. RESULTS

The robot is controlled through ZigBee module which has detected harmful gases and movement. The robot is powered by solar panel with continuous power supply by using dynamic method. Figure 8 represents Solar Powered Robot.



Figure 8: Solar Powered Robot

Movement of the intruder is detected and voltage obtained from the battery can also be seen as shown in the Figure 9.

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battery voltage:6.85
NO GAS LEAKAGE
battery voltage:6.87
NO GAS LEAKAGE
battery voltage:6.87
NO GAS LEAKAGE
15.78Hz0.81km/h
MOVEMENT DETECTED
battery voltage:6.85
NO GAS LEAKAGE
battery voltage:6.87
NO GAS LEAKAGE
battery voltage:6.85
NO GAS LEAKAGE
    
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Figure9: Movement Detection

Detection of Gas sensor can be seen as shown in the Figure 10.



Figure10: Gas Detection

The Figure 11 shows the voltage obtained from the solar panel when it is placed under sunlight.

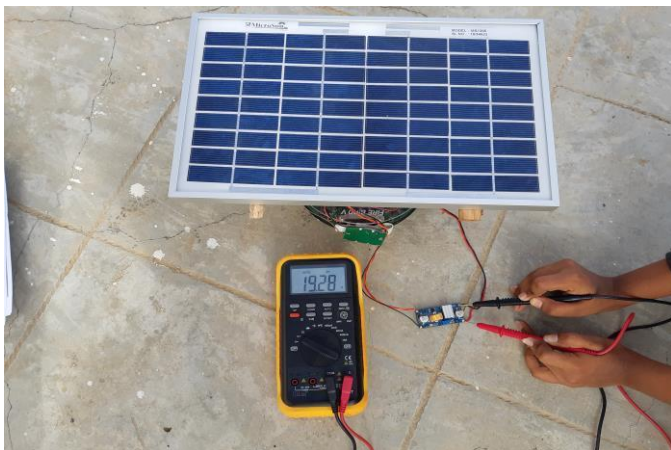


Figure11: Power Module

V. CONCLUSION

ZigBee communication technique enhances its range of operation where the user can control the movement of robot for a longer distance. Use of renewable source of energy, makes it cost effective compared to existing robot.

This robot can detect harmful gases for security purpose and emergency rescue operations where human cannot footpace and detects movement of the intruder in which user will be able to get alert of the intrusion.

VI. FUTURE WORK

In addition to this project, improvisation can be done by taking the pictures of surrounding area by using image processing with the help of camera and can also be used in industries and war field for surveillance. Without the help of user control robot can be made to work on its own by using artificial intelligence.

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REFERENCES

- [1] Swapnil Mishra, "Night Vision Camera TechnologyBased Robot in War Field",International ResearchJournal of Engineering and Technology (IRJET), Volume: 04 Issue: 04, Apr -2017, pg:1187-1190.
- [2] NiharRanjan, ZubairGhouse , NishikaHiwrale, "AMulti-function Robot for Military Application", Imperial Journal of Interdisciplinary Research (IJIR), Vol-3, Issue-3, 2017, pg: 1785-1788.
- [3] AshishZade, PriyankaRahangdale, AkshayGiri, "X-bee Based Spy Robot with Night Vision Camera",International Journal of New Technology and Research (IJNTR) ISSN: 2454-4116, Volume-3, Issue-2, February 2017, Pages 63-66.
- [4] PremangshuChanda, PallabKanti Mukherjee, SubrataModak, AsokeNath, "Gesture ControlledRobot using Arduino and Android", InternationalJournal of Advanced Research in Computer Science and Software Engineering, Volume 6, Issue 6, June 2016, pg:227-243.
- [5] Rahul Kumar, Ushapreethi P, Pravin R. Kubade, Hrushikesh B. Kulkarni, "Android Phone controlledBluetooth Robot", International Research Journal OfEngineering And Technology (IRJET),Volume: 03 Issue: 04 , Apr-2016, Pg:104-114.
- [6] TarunpreetKaur, Dilip Kumar, "WirelessMultifunctional Robot for Military Applications",Proceedings of 2015 RAECS UIET Panjab University Chandigarh 21-22nd December 2015, IEEE.
- [7] Mrs.MeghaDeotale, Ms.ShrutiMokal, Mr.AbhilashGondkar, Mr.AkshayKuckian,"War Field SpyingRobot With Night Vision Camera",InternationalJournal Of Engineering Sciences and Research Technology, July 2015.
- [8] Aniket R. Yeole, Sapana M. Bramhankar, Monali D. Wani, Mukesh P. Mahajan, "Smart Phone ControlledRobotUsingATMEGA328 Microcontroller",InternationalJournal of Innovative Research inComputer and Communication Engineering, Vol. 3,Issue 1, January 2015, IJIRCCE , pg:352-356.
- [9] I. Daut , M. Irwanto and Surya Hardi, "PhotovoltaicPowered Uninterruptible Power Supply Using Smart Relay",The 4rd International Power Engineering andOptimization Conference (PEOCO2010), Shah Alam, Selangor, Malaysia. 23-24 June 2010. pg:453-457.
- [10] Youngwook Kim, Member, IEEE, and Hao Ling, Fellow, "Human Activity Classification Based onMicro-DopplerSignatures Using a Support Vector Machine", IEEE Transactions On Geoscience AndRemote Sensing, Volume. 47, NO. 5, MAY 2009, pg: 1328-1337.
- [11] Victor C. Chen, "Detectionand Analysis Of Human Motion By Radar", IEEE 2008.
- [12] Jae-Young Lee, Kyu-Bok Lee, Se-Hwan Choi, "ADesign of Motion Detecting Sensor using Microwave",IEEE 2007.