

# MPPT BASED BATTERY SWAPPING SPY ROBOT FOR DEFENCE AND COAL MINE PURPOSE

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**Abstract**—This project presents the spy robot for defence and rescue purpose with the solar panel to charge the batteries. To maximize the energy obtained from the sunlight we are using MPPT (Maximum Power Point Tracking) technique. Maximum power point tracking (MPPT) is used in the photovoltaic (PV) system to maximize the PV output power, irrespective of the temperature and irradiation conditions. The MPPT system consists of a buck-type Direct Current (DC)/DC converter, which is controlled by a microcontroller unit. The microcontroller is programmed with a simple and reliable MPPT technique. The PIC microcontroller will be used to collect the maximum power to the battery. This robot has the capability of swapping the battery between two of them to extract the power to operate, whenever it detects the battery which provides the power supply to the robot is dead. The robot is controlled by a remote controller which has RF transmission to send commands to direct the robot and to receive the information from it. The robot continuously senses about the metal detection, obstacle detection and the present temperature value for defence purpose with that we are using carbon monoxide sensor, oxygen sensor and fire sensor to inspect coal mine. This information is transmitted through RF transmitter and the information is received and displayed at the receiver end on the LCD display which is interfaced with the remote controller. If the in the gas sensors senses the changes in the value which is beyond the preset value they will make to glow the LEDs and buzzer sound to alert the critical situation. Meanwhile the video of the remote environment is captured by the wireless camera which is mounted on the robot and transmits with the help of RF transceiver. Now a days army requires LASER gun. So the LASER gun is fixed with the robot which can be operated remotely.

**Index terms**—Obstacle sensor, Micro-controller, LCD Display and Remote, Gas sensor, Pressure sensor, Coal mine.

## I. INTRODUCTION

This project explains about the multipurpose robot. We can use it mainly for rescue and spy purpose. We can also use it as a human assistance robot. For defence purpose, initially we have to know about the hostage situation to attack them or take the action against the trouble given by them so we are making the robot is in form of a vehicle mounted with a web camera, which acquires and transmits video to a TV or PC<sup>[3]</sup>.

This robot also detects the metals and obstacle<sup>[4]</sup>. The information is transmitted to the user with the help of RF transceiver. The movement of vehicle is controlled by microcontroller. Our deal is to make a robot to tackle the hostage

situation & the worst conditions which cannot be handled by human being. Humans are moved out from direct exposure to potentially dangerous situations. Robotic system can perform many security and surveillance functions more effectively than humans.

The available system is to transmit the image with wired camera which has the possibility of disconnection of connecting wires which are controlled through internet. But in this system we are proposing the wireless camera and RF transmission which is cost effective comparatively with the internet. We need to know about the environmental temperature for making the precautions<sup>[5]</sup>.

The robot is controlled by the user from the remote area which is efficient in the defence region and the information about the remote environment temperature, metal and obstacle detection is obtained by the LCD display which is interfaced with microcontroller at the remote controller section. It has the laser gun on the robot which can be operated from the remote.

The power supply required to operate the robot is acquired from the renewable energy (solar energy) to manage the demand of power. To operate this robot single battery supply is not enough so we are using two batteries<sup>[3]</sup>. Those batteries are connected in parallel. If one of the batteries is gets drain then the power supply will be taken from another battery. This battery swapping operation is handled by the battery swapping relay.

The main objectives of this project are to design the mobile operated spy robot using web cam with metal detector and weather sensing sensors, to make the instrument cost effective, to implement the maximum power point tracking technique in the solar cells to charge the battery this provides the power supply to the robot<sup>[7]</sup>.

In the case of coal mine alertness system we can use corresponding sensors according to the requirement such as fire sensor, gas humidity etc<sup>[6]</sup>.

We can use alert buzzers and LED display with that as output devices to indicate the hazardous situation.

The existing system is controlled by Wi-Fi and the data is transmitted through the RF transmitter. In this project the entire data is controlled and transmitted through the RF transceiver. Upon the military purpose we can use this robot to detect the flaws and intrusion detection of the water pipeline also. It can be implemented by using Zigbee transceiver also to improve the transmission distance and can use various metal detection circuit

to improve the stability for temperature. It will be very helpful to collect the entire data about the remote environment.

## II. BLOCK DIAGRAM

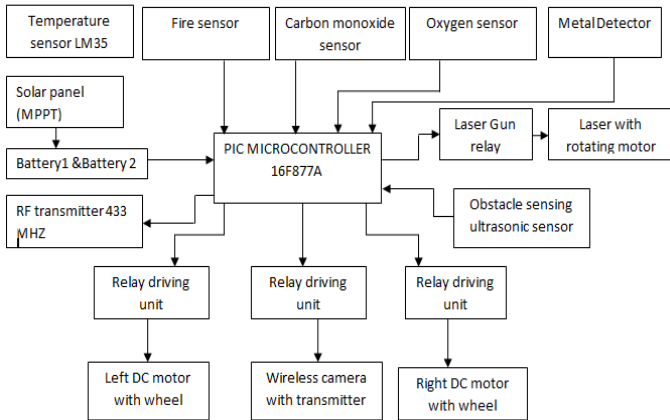


Fig. 1. Block Diagram of Robot

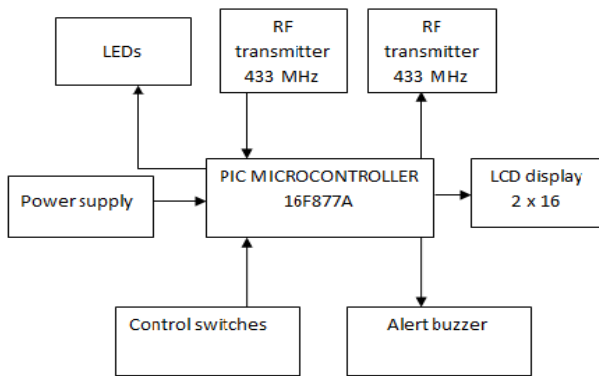


Fig. 2. Block Diagram of Remote

## III. OVERVIEW OF THE SYSTEM

This project contains two units. One is robotic unit and another one is remote controller. The LCD display is interfaced with the remote control. A metal detector, temperature sensor and ultrasonic obstacle detector are interfaced with the microcontroller in the robotic unit. If they sense any metal or obstacles they will transmit that information to the LCD display which is interfaced with the microcontroller on the remote control. It has a temperature sensor to sense the environmental temperature. It is continuously displayed at the LCD display.

It also has gas sensors (oxygen sensor, carbon monoxide sensor) and a fire sensor to enquire about coal mine status at a hazardous situation when humans cannot enter and predict the situation. The controller contains the preset value to identify the situation. In case of unusual happenings in the changes of sensor

values they will send the command to the output device for indication.

The wireless camera is also mounted on the robot to continuously monitor and transmit the video of the hostage situation to the monitor (either TV or PC). The LASER gun is also fixed with the robot. The DC motor is used to run the LASER gun. There are few control switches available in the remote unit.

They are used to direct the robot in any direction and to direct the LASER gun also. The commands, information obtained from the sensors on the robotic unit and the video stream are transmitted and received by the RF transceiver. The range of RF transmitter and receiver will be effective up to 700m.

### A. Solar Panels with MPPT (Maximum Power Point Tracking)

Solar energy is used to give the power to the robot because now a days power demand is increased due to this power failure happens many times. Here extracting useable electricity from the sun was made possible by the discovery of the photoelectric mechanism. The semi-conductive material that converts visible light into direct current. By using solar arrays, a series of solar cells electrically connected, a DC voltage is generated which can be physically used on a load. Solar arrays or panels are being used increasingly as efficiencies reach higher levels and are especially popular in remote areas where placement of electricity lines is not economically viable. Maximum power point tracking (MPPT) is used in the photovoltaic (PV) system to maximize the PV output power, irrespective of the weather and irradiation conditions. The MPPT system consists of a buck-type Direct Current to Direct Current converter, which is controlled by a microcontroller unit. The microcontroller is programmed with a simple and reliable MPPT technique. Then the power is saved in the battery. The power for this robot is obtained from the solar panel to acquire the energy from renewable sources wherever. It provides both open circuit and short circuit current. The open circuit current provides maximum amount but it is useless compared to short circuit current which provides absolute maximum current.

The open circuit voltage is

$$V_{MPP} = K_V V_{OC} \quad (1)$$

$V_{OC}$  is the open circuit voltage and  $V_{MPP}$  is the maximum voltage.

The short circuit current is

$$I_{MPP} = K_I I_{SC} \quad (2)$$

Where, the constant  $K_I$  depends on the type of photovoltaic configuration.  $I_{SC}$  is the short circuit current and  $I_{MPP}$  is the maximum current. Matching panel and load impedances with a DC-DC converter makes sense, because for example, if you have a 5V/2A load, and a 20W panel that has the MPPT at 17.5V/1.15A, connecting the load directly will not work. Considering a simple resistive load, and the short-circuit current of 1.25A, the panel will only be able to provide about 3V/1.2A,

or less than Where the constant  $K_v$  depends on the type of photovoltaic 4W out of 20W.

Fig 3 shows the VI characteristics and Fig 4 shows the PV Characteristics of the solar panel. By comparing these two characteristics we can learn as PV characteristics is more efficient.

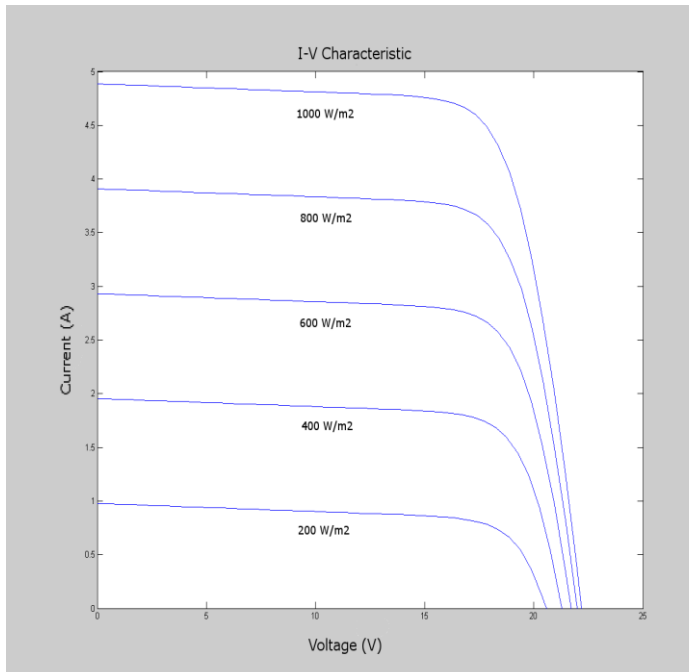


Fig. 3. I-V Characteristics

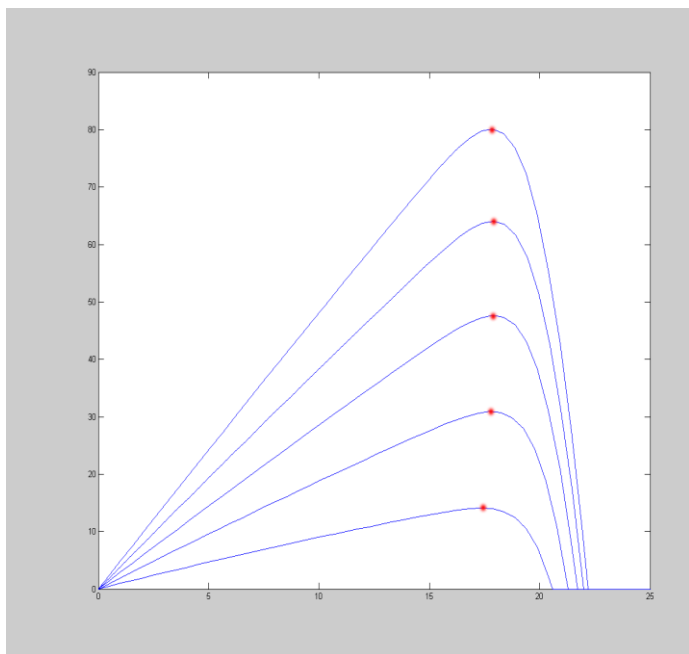


Fig. 4. P-V Characteristics

### B. Robotic Section

This is the primary and essential unit to perform the spy and rescue operation. This unit contains LM 35 temperature sensor

with it to sense the current environment. This temperature sensor is very stable, consumes very less amount of power and calibrated in degree Celsius which is easy to manipulate and send the information. It also has obstacle sensor for the intrusion free movement. It has the feasible and sensitive metal detector to detect the underground materials like bomb. The metal detector is made up of two coils and oscillators. Whenever the oscillator produces the AC current, the current will be pass it to the coil and then the coil will turn the AC current to magnetic field. Those magnetic fields will be passing it on the ground. If it strikes the metal means it will produce the magnetic field which has less strength compared to the transmitted signal. Here another coil is used as the measuring meter for the magnetic field. If the metal detector detects the metal it will send the information to the buzzer which is interfaced with the remote control. It contains gas sensors such as pressure and gas sensors to detect the situation in hazardous situation as input devices and LED and Buzzer as output devices. All those above information is continuously updated at the remote unit. Now a day's army needs LAZER gun to shoot the enemies at the critical situation. So it contains the laser gun which is operated by the motor relay attached with it. According to the instruction obtained from the remote control, the LASER gun changes its position. The RF transceiver STT 433 is used to transfer the information from remote to robot and vice versa via radio frequency.

### C. Remote Unit

It contains all the robotic movement control switches and the LASER gun control switch. It has LCD display unit and alert buzzer as output devices. That information is transmitted as digital signals of zero's and one's. Meanwhile it also receives the information regarding temperature changes, obstacle and metal detection. That information is displayed at the LCD and at occurrences of critical situation which is detected by the gas sensors the buzzer will beep the sound. This section is controlled by the PIC 16F877A microcontroller which has UART terminal to transmit and receive information from robot to remote vice versa. UART can transmit only one character at a time.

### D. Wireless Camera

The wireless camera unit continuously captures the video of the hostage situation and transmits to the Television or Personal Computer. Those receiving devices have the RF receiver to receive the video. This is the important section of this robotic project which is used in all kind of the analysis of the situation where human beings cannot exists. The wireless camera has the capability of easy installation and transmission. We can install this camera by using three to four steps with respect to camera configurations.

### E. Fire warning sensor

The fire sensor is used to sense the existence of the fire and smoke .In some kind of places this makes to a disaster so to alert that situation we have to get the prior intimation about the situation. The LED display and buzzer is used to get the intimation about the situation.

### F. Gas sensors

There are two sensors used in this project for detection of gas. The first one is oxygen sensor and another one is carbon monoxide sensors. In any circumstances the amount of both carbon monoxide and oxygen is very important to breath. Because excess amount of carbon monoxide and less amount of oxygen will leads to cause of death in some situation.

Here we are getting alertness buzzer and LED glow for the changes of the predefined gas values.

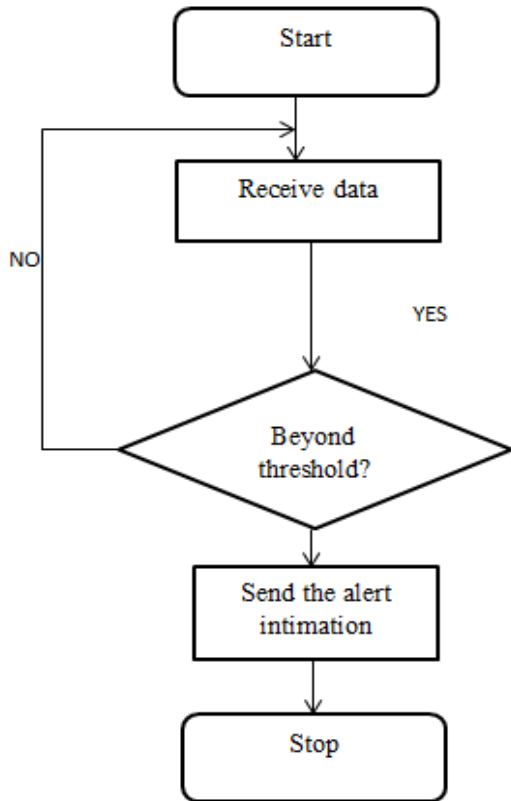


Fig. 5. Flow chart for alert indication

Those sensors continuously monitor the gas value and compares with the preset values. If there is any value beyond the preset value then it will send command to glow the LED and buzzer. There are two LEDs and one buzzer is available. Sometimes there may be chances to miss the LED glow so we are using Buzzer also if any kind of mismatch occurs. The above figure explains the flowchart of the operation both gas and fire warning sensors. The amount of oxygen required is changes from to place. Depends upon the place we can make the threshold value

#### G. Robot direction control

The direction of the robot is controlled by the push buttons available in the remote control. There are four buttons are available at the remote control. The first one for forward control, second one for left, third one for right and the final one for LASER gun operation. To run the robot DC motor is connected through the H-Bridge IC. There are two H-Bridge ICs are available. One for control the DC motor and another one for control LASER gun relay- Bridge IC has the capacity of

controlling two motors so single IC is enough to run both the DC motors. To direct the motor on the left side we have to run the right side motor as well as to turn the motor on the right side we have to run the left side motor. It consumes less power compared with regular LM293 IC. It is operated at 12V DC supply but the microcontroller and LCD displays are required 5V DC supply. The step down transformer is used to provide 12V DC supply to run the motor relay and LASER gun relay but the microcontroller doesn't work with this 12V DC. Voltage regulator 78 series ICs has the capability of the converting the voltage into required voltage from +5 V to +24 V. For this robot I have used IC7805 to step down 12V DC into required +5v.

#### IV. SIMULATED RESULTS

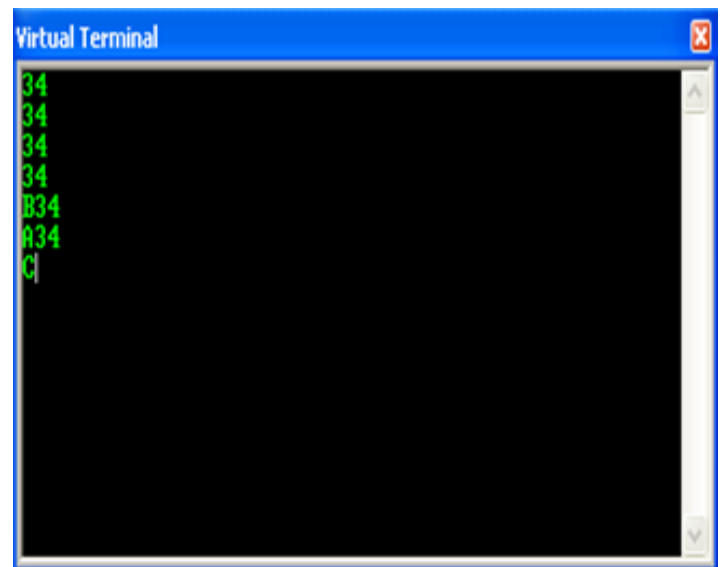


Fig. 6. Data transmission

This is the data transmission of robot. Here the PIC microcontroller is used which uses the UART terminal to transmit the message. In UART we can transmit one bit only at a time.

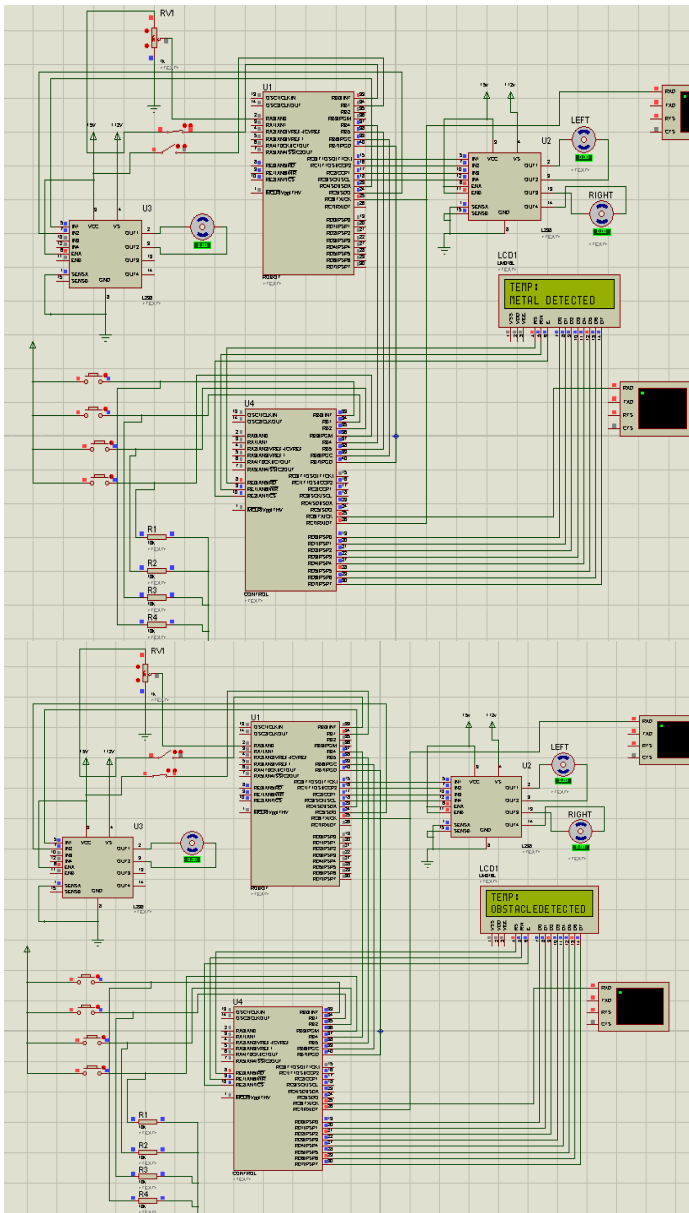


Fig. 8. Result of Obstacle Detection

Whenever the obstacle detector coil receives the positive signal, it will transmit the message to the controller. The LCD Display attached with the controller will display the message.

If both the metal and obstacle is detected at the same time both metal and obstacle detected information will be displayed on the LCD.

V.CONCLUSION

The project is mainly focused on the defence operation for spy purpose but we can use this robot for the rescue purpose also where the existence of the human being is difficult. We can use this as multipurpose robot such as to analyses the faced by the wireless charging process have been sorted out. The future work will be implemented with extended environment such as unused tunnels. The difficulties parametersto sense the environmental

Fig. 7. Result of Metal Detection

Whenever the metal detector coil receives the positive signal, it will transmit the message to the controller. The LCD Display attached with the controller will display the message.

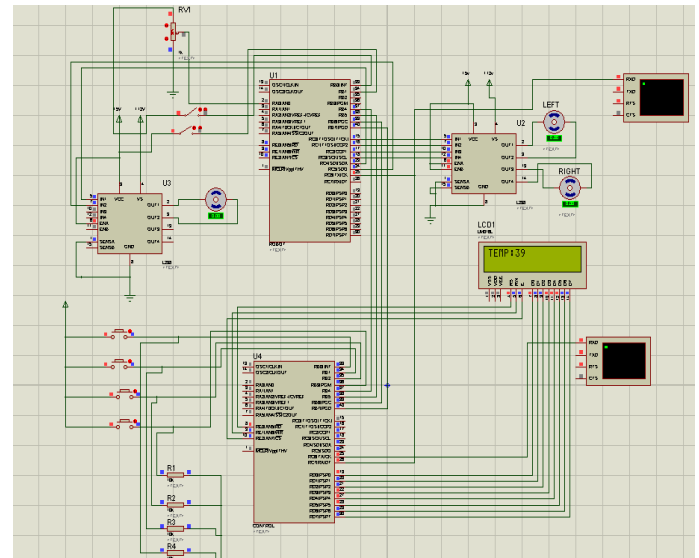


Fig. 9. Temperature Display

The temperature sensor LM35 continuously monitors the temperature changes and updates the information on the display.

parameters and battery power with less power consumed components. Now this project is simulated in the Proteus VSM software .While comparing this project with the existing system it will be more efficient by using dual battery and battery swapping technique. This technique will improve the battery performance for long time where we need to perform long time operation. In future we can reduce the size of robot and efficient algorithms to improve the spy purpose. For long distance transmission we can replace RF transceiver by Zigbee

technology to improve the distance covered while comparing with RF transceiver.

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