

# Solar Power-Driven Unmanned Vehicle with Utility Sensor

T.M. Thamizh Thentral, A. Geetha, S. Usha, C. Subramani, T.R.B. Ramanathan

**Abstract:** Anti-social elements in the global environment are challenging the society with their destructive activities. Mobile land vehicle robots are becoming a crucial player in National security, search and rescue operations, surveillance networks, border security forces. In order to reduce the chances of danger towards human lives, a land vehicle robot is designed to detect an anomaly that may rise up as a potential threat on the earthly surface surveyed powered via a PV channel. This robot can penetrate the no-man's area with great precision so as to spot the mines, bombs, missiles, explosives and threats on land. Improvement in border security leads to enhancement of high precision sensors generating an extensive stream of data and databases. The intent of this research is to adjunct the robot with human intelligence that can assist in real-time decision making from the stream of data.

**Keywords:** PV Array, Unmanned Vehicles, Arduino Micro Controller, Zig-Bee Transceiver.

## I. INTRODUCTION

Technological enhancement in the field of robotics paved the way for the autonomous Robots that reduce our work to a great extent. As time transcended sophisticated robots were designed that evolved to look more human. [1-4] Penetrating into no-man sector requires high precision tech devices like robots that survey, police, illegal border crossings and advance autonomous with adjunct human-intelligence, the activities that incorporate human can be reduced.

The main aim of this work is to control the robot vehicle using an Arduino microcontroller. The controllers used in the robots are powered via a solar panel. Figure.1 demonstrates the block diagram of the main components of the solar-powered robot. The six main components of the robots are Arduino Micro Controller, Ultrasonic Sensor, Metal Detector, PIR Sensor, ZIG-BEE and Wireless Camera.

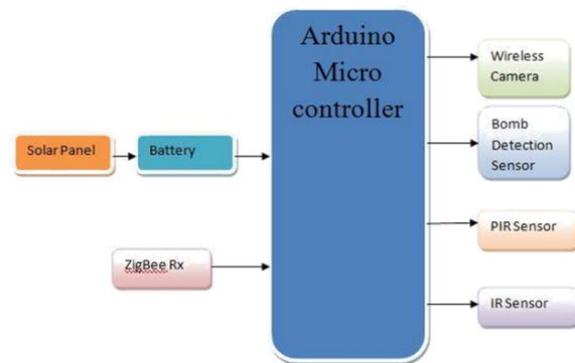


Figure 1 Block Diagram of the Main components of Unmanned Vehicles

The Arduino Micro Controller is responsible for making the Robot to sense, respond and interact with the physical world that makes the Robot autonomous and the elements of Arduino microcontroller are Atmel ATmega328 microprocessor with 2kb of RAM operating at 5 V, 1 Kb of EEPROM for storing parameters and 32kb of flash memory for loading programs. The speed of the clock was made  $16 \times 10^6$  Hz, that can translate of 300,000 lines in C source coding for each second as depicted in Figure 2. The ultrasonic distance sensor detects long-range to short-range precisely without any physical contact IO triggering for about 10 microsecond high level signal. Eight 40 kHz square wave pulses are sent by the module instinctively to detect whether there is a pulse signal back to the receiver, HC - SR04 sensor module providing (2 – 400) cm of non-contacting measuring function, the range accuracy could reach about 3mm. Receiver, ultrasonic transmitters and control circuit are the modules included. The specification of ultrasonic sensor utilized is given in table 1.

Si. No.	Parameter	Specification
1.	Working Voltage	DC 5 V
2.	Working Current	15mA
3.	Working Frequency	40Hz
4.	Max Range	4m
5.	Trigger Input Signal	10uS TTL pulse
6.	Dimension	45*20*15mm
7.	Vcc Trig	Echo GND.

Inductive proximity sensor is a metal detector that can detect metal targets without physical contact [5]. As shown Figure 3 the PIR sensor is a motion detector that senses the distance between the living body and the vehicle. They have proven to be effective at operations like enhancing home security systems. The Zig-bee Transceiver Module furnishes the robot with two-way enabled bi-directional wireless transmission through RTI remote controls, enabling wireless networks which possess least cost and power solutions. It offers an ability of running for many decades together on low cost battery for supporting monitoring and controlling action locations.

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The wireless webcam video camera that permits the server to act as video conference stations and substations, which feeds its real-time images to the server or computer network, often via Ethernet or Wi-Fi, USB ports.



Figure 2 Arduino uno

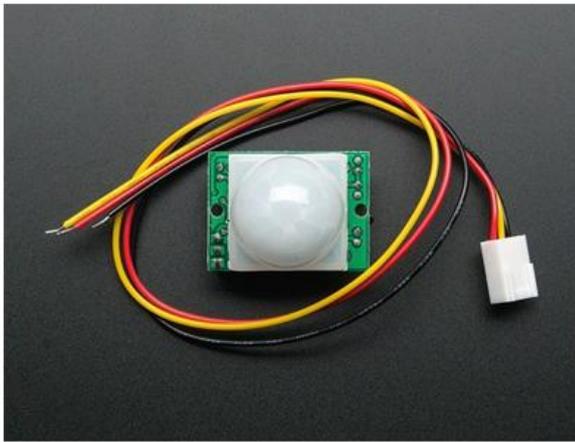


Figure 3 PIR Sensor

## II. TYPES OF UNMANNED AUTOMOBILES

Unmanned automotive is a vehicle that can run without the help of a human on board. Remote ways of controlling or human way of guiding the vehicle are some possibilities of controlling. They have the ability to sense their location and can navigate on its own. The unmanned automotive is classified based on their applications as Unmanned ground vehicle (UGV), they are self-directed vehicle, unmanned surface vehicle (USV), that can operate over the water surface, unmanned aerial vehicle (UAV), Unmanned combat aerial vehicle, unmanned undersea vehicle (UUV) or autonomous underwater vehicle (AUV) which can work under the water, Unmanned spacecraft that can be controlled from remotely areas controlled and autonomous ("space probe" or "robotic spacecraft"). The various types of unmanned automobile details are shown in Figure 4.

An UAV is a car that functions though in interaction with earth and in the absence of on-board person presence. Numerous numbers of sensors are associated with this vehicle for observing the atmospheric environment and can able to take decisions to pass data collected to the operator present at some location. It has the capability of responding to the operations instructions.

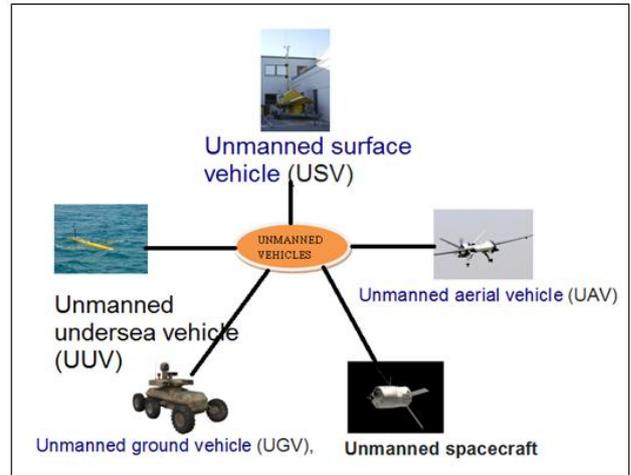


Figure 4 Types of Unmanned Vehicles

There exist several applications for those vehicles where are difficult, hazardous or impossible where the existence of man operator. These vehicles are widely in progress for the use in military.

UAVs are generally recognized to be a drone or a vehicle that run without an aid of man as a pilot (unmanned aircraft vehicle). The UAV flights might remain functioned in the human control or separately by on-board systems. Related to manpowered aircraft vehicles, UAV is frequently chosen for work that is excessively hazardous for persons. It is mostly applicable for military uses in recent scenario. It is also utilized for many additional applications such as drone racing and aerial photography.

USV or ASV is vehicle that runs on the water surface without a team. It is highly capable than weather drifting buoys, nevertheless too inexpensive than other same weather ships. Surface robot which is automatic wave glider is a real time data collection from ocean and communicates over elongated periods and in changing sea statuses armed applications for USV.

An autonomous under water vehicle is a robot which moves underwater without the physical presence of a human. AUV establish a part of higher group of systems undersea called as unmanned submerged vehicle [6-7]. This vehicle is categorized as per the working of autonomous or non-autonomous.

Unmanned spacecraft are spacecrafts without man on board. These unmanned spacecrafts have various stages of autonomy for person inputs, they can be remote control or guiding form the remote. Some autonomous spaceflights have preprogrammed list of operations which will be executed likely. The general categories of unmanned spacecraft are unmanned resupply spacecraft, robotic space craft, space observatories and space probes.

## III. HARDWARE IMPLEMENTATION OF THE UNMANNED VEHICLE

The proposed system consists of the solar panel, Arduino Microcontroller, chassis, Dc Motor, Relay, ZigBee transceiver, wireless camera, bomb detection sensor, PIR sensor, Ultrasonic sensor. The robot is remotely operated by the ZigBee protocol, the robot having the ZigBee receiver, will get command through the ZigBee transmitter. The robot and Arduino micro-controller are completely powered by the solar panel via the battery i.e used to store the charge.

Whenever the bomb is detected or any human is detected, it will send a signal to the ZigBee receiver. The wireless camera is used to survey the environment and will respectively send real-time video data to the wireless receiver, that can be observed on the PC. Figure4 gives the front view of the Vehicle.



Figure.5 Solar powered Unmanned Vehicle



Figure.6 Front View of Unmanned Vehicle

The below Figure.5 shows the rear view of the unmanned vehicle and Figure.6 demonstrates the solar-powered unmanned Vehicle.

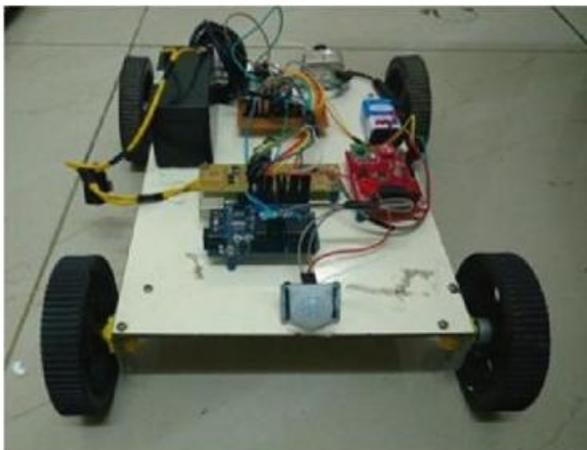


Figure.7 Rear View of Unmanned Vehicle

#### IV. WORKING

The device is powered on using 2 toggle switches, where each one is present between the circuit and the batteries, allowing the system to run accordingly. Instructions from the PC are relayed to the respective components via the Zig-bee module. Hence the forward and reverse direction is controlled, by the interpretation of the Arduino and further sends the signals to allow the motors to rotate. Once the movement is successful, the PIR sensor transmits the information when there is a change in heat or not concluding the object encountered. Since the PIR sensor is designed with a particular radius, as soon as the change of heat is recorded, the results are relayed to the PC. This allows the user to retrieve information and analyse the data. The information can be confirmed using the real-time webcam video that is relaying as the vehicle moves forward. The metal detector also has been designed with a 2.5cm radius of detection of metals. When the signal is relayed back with a change in signal, the respective metal can be verified since each metal and non-metal transmits the signal back to the transmitter with a change in frequency. The ultra-sonic filter relays the signal that is transmitted to prevent any obstacle collision. After the detection of PIR sensor, Ultra-sonic sensor, metal detector (proximity sensor) and a webcam view, the user can maneuver and the detection process will provide the observations on the laptop at each corner of the screen with the Arduino software, webcam video broadcast and the Zigbee status and signal communication.

#### V. CONCLUSION

A solar powered fully unmanned automated vehicle is designed to detect any plausible threats at the border. This vehicle hence helps in verification of the area of suspicion and records observations such as photos. The operation helps to avoid any direct contact with the threat, allowing the border security to take actions in a swifter manner. With this, we can conclude that the system will help provide the complete details in the scanned border area using this simple and fundamental developed unmanned land vehicle.

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