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RF Controlled Solar Panel Based Robotic Vehicle

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***Abstract*——** **Solar panel-based Radio Frequency managed Robotic system, is applicable in the various surveillance fields. In this project, the vehicle is unified to the multifunction camera, which could detect multiple angles. Users can view multiple angles via an Internet browser. The solar panel provided with a self-rechargeable battery will charge the 360-degree camera, which would display live streaming either in mobile applications or on computers. The transmitting end has a remote having buttons that will control the receiving end vehicle. The microcontroller ATMEGA 338P programmed in such a way that it could control the vehicle movement.**

***Index Terms*—**Radio Frequency, surveillance.

I. INTRODUCTION

This robot is an electro-mechanical machine, integrated with Photovoltaic solar panels convert light to electrical energy via a silicon semiconductor. The recent developments in robotics made robots to be implemented in various fields like the defence sector, space station, automation, and aerospace embedded software applications [1].The AC power from solar panel fed to Rechargeable batteries used to Store up the energy as DC power.[2]. Our project is specially designed for surveillance and security purposes, used in military applications. RF technology controls the robot manually and the wireless night vision camera provides the user to access any were from the world. All the detected quantity viewed in LCD. It has ability to move in different terrain [12].

A. Existing methodology

- The previous method used Bluetooth technology which provides less coverage capacity.
- The solar panel is not self rechargeable. Surveillance technology is poor, Lags in motion detection and night vision.
- Cost-effective because of the expensive microcontroller.
- Stepper motor generate less torque and more noise, they constantly draw maximum current which heats up the motor. Therefore, overall performance of the system is reduced.

B. Proposed methodology

- The new design provide self rechargeable solar panel having maximum silicon cells[9].
- Special night vision camera induced with 360-degree rotation, motion and voice detection along with live streaming accessibility.
- DC motors were used to increase torque speed and reduce noise.
- Radio frequency provides maximum coverage and have ability to penetrate different obstacles.
- LCD module is used to display the voltage consumption, direction of vehicle and camera notification.

II. HARDWARE DESIGN

A. Microcontroller ATMEGA 328P

The 8-bit microcontroller ATMEGA 328p launched by Atmel, is a popular controller used in Arduino Duemilanove boards. It consist of inbuilt 1K EPROM, 2K internal SRAM, and 32K flash memory. To enhance performance, AVR implements havard-architecture. The AVR uses distinct memory and bus for program and memory. Operating voltage is 5.5V.

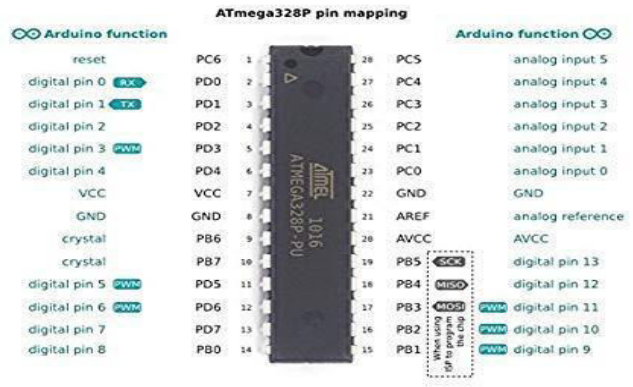


Fig.1. ATMEGA Pin Mapping

B. Solar panel with rechargeable batteries

Renewable solar energy Used to power the camera and ATMEGA [10].Many silicon cells are linked together to form solar panel. The sun activates the panel, cells convert into electrical energy. Lithium-ion batteries are the fastest-growing better form to store the alternative current from cells as a direct current power. In this we use Lithium-ion instead of NiCd batteries because of reduced size, cost, and efficiency.

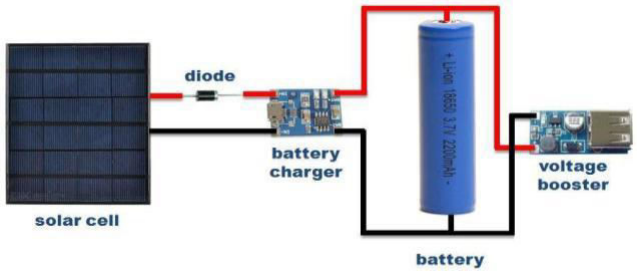


Fig.2. Working of solar panel

C. Voltage regulator

To regulate voltage, we use a voltage regulator. It is like a buffer in protecting the circuit from damage. The project uses a voltage regulator to minimize the maximum 12V coming from the solar panel. this is just because ATMEGA 328 can tolerate only 5.5V, overheat will damage the circuitry. Regulator Lm7805 series provide 5V regulated power with an added heat sink. It can also be used with external components.

D. Rectifier

The rectifier has one or more diode used for converting Alternative to direct current, called rectification. It can be half cycle are full cycle.

D. RF module

RF module is an electronic device, it is suitable for transmitting or receiving radio signals between any two devices [7]..We can communicate wirelessly via antenna connected at pin 4 using RF. Operating frequency of Transmitter and receiver is around 434MHZ, with transmission rate 1KBps-10Kbps.The module has a pair of encoder/ HT12E and decoder/HT12D ICs, are commonly used. The RF encoders have CMOS LSIs for remote control applications [1]. The encoder and decoder used for converting serial data to parallel data vice versa, capable of encoding/decoding 12bits.

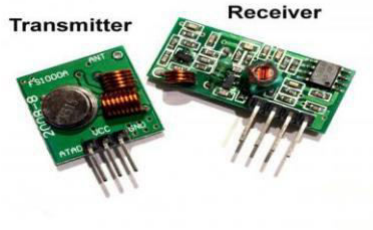


Fig.3. RF Module

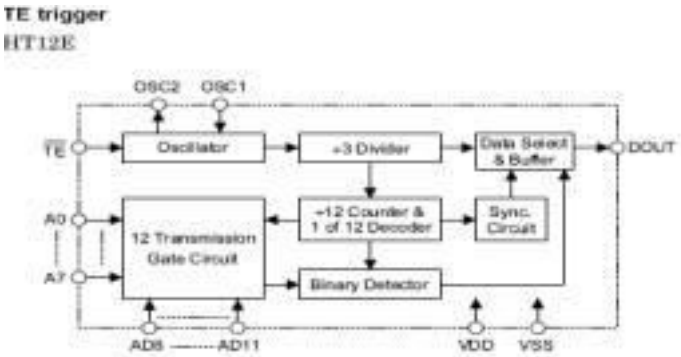


Fig.4. Internal parts of RF Module

E. Motor driver

DC motor is used because it produce high torque and less noise. Arduino L293D is used to control DC motor [11]. Inbuilt structure is made of npn transistor –BC547 [7].

F. LCD

LCD will display voltage supply, direction of robot and camera notifications.

G. v380 camera

v380 camera is a wifi product used for remote viewing. They have 3.6mm HD Lens with 720P or 960P Resolution.

Fig.5. V380 Camera Connected through wifi

III. SOFTWARE DESIGN

A. Arduino IDE

The surveillance device uses the ATMEGA 8 microcontroller which can be coded and programmed using the ATMEL studio 7 IDP. The ATMEL platform can be coded using C, C++ or assembly code. It is a seamlessly free development environment used to edit, build and debug different applications on the microcontroller. The program allows the microcontroller to control the power on and off of the camera and motor. The signals received from the remote is processed by controller and the motor driver moves the vehicle in the respective direction. The vehicular movement along with the camera power supply is maintained by the controller. The seamless movement of the vehicle is completely dependent on the interpretation of the signals and code by the micro controller. The Atmel ide is very similar to that of the Arduino ide and is also open source and allows users to interact

publically to collaborate on various projects. This makes it easy to learn and implement with limited resources and knowledge. This allows for portability, adaptability and software restrictions are minimized to support remote environments and wide access. This uses the processing method to implement code.

Fig.6. Arduino IDE

B. Mobile application

The smart 360 degree wifi enabled camera uses an application called V380. The V380 is a new generation intelligent house hold camera. The main feature is that the application allows cloud streaming and viewing of feed directly via wifi. The 360 degree camera has its own wifi network which can be connected to any android or ios device and the application allows the camera feed to be accessed from any location. This allows for mobility and remote monitoring.. This functionality allows for many applications via the 360 degree camera. In the solar powered surveillance device the camera allows for 360 degree controlled view and movement. Vision can be focused and customizable based on the application preference of the user. The application is user friendly and can be operated by anyone from the world, the camera angle can be easily adjusted and monitored, they are built with motion recognition along with voice detection technique.

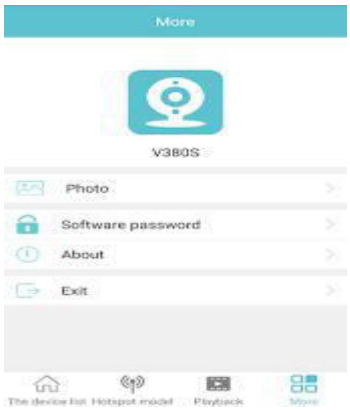


Fig.7. Mobile app v380


Fig.8. 360 degree camera view

IV. ARCHITECTURE

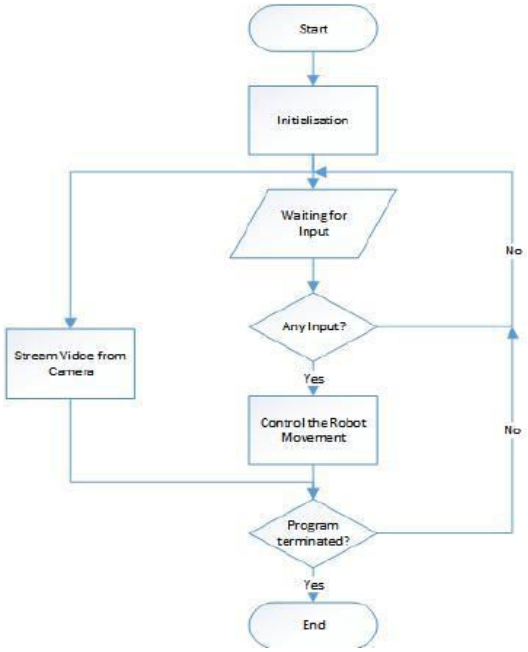
A. Path planning algorithm

The solar powered robot will receive complete renewable energy from sunlight. The robot upon receiving power will boot up the camera. The transmitter on the remote will send signal to the receiver on the PCB board attached to motor. The movement of the wheels will be subject to the signals received from the remote. The vehicle will move forward and backward and will also turn sideways. The mobile application can be used to decide the movement of the camera. This uses wifi to transmit video feed. This device uses the most widely available wifi technology and simple remote controlled navigation.

B. Block diagram

This block diagram explains the working process of the device. The microcontroller powers the motor driver and the 360 degree camera. The regulator regulates the power from the solar panel. The microcontroller powers the antenna which receives signals from the remote transmitter.

Fig.9. Program flowchart



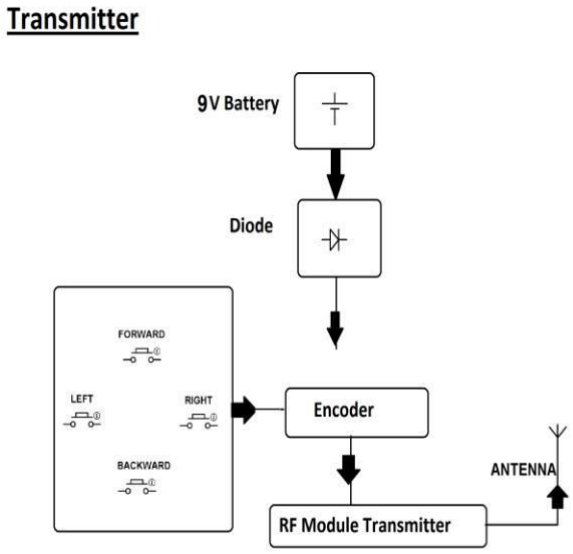


Fig no.10 Transmitter Block diagram

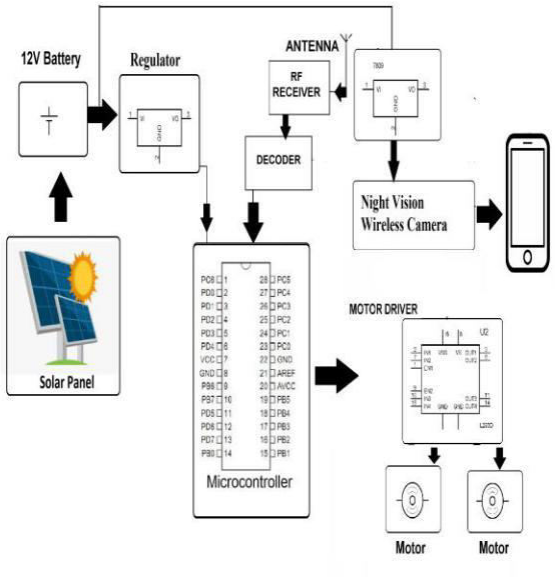


Fig.11. Block Diagram and Working of microcontroller

V. RESULT

A. *Self charging system in solar panel*

When the light fall on the semiconducting material cell, it causes electrons to be set into motion that initiates a flow of electrical current called photovoltaic effect. The working of a solar panel is explained .

1. The semiconducting silicon cell absorbs radiation from sun.

2. Once the light rays penetrate silicon cell, electrons begin to manoeuvre, produce electrical current.

4. The star electrical converter converts direct current from your star modules to alternative current that is deployed in many applications.

Output Power of solar panel:

The amount of maximum power obtained from the solar panel will be decided upon where it is placed and how much it is exposed to the direct sunlight. There are two types of solar panels mono-crystalline and polycrystalline solar panels. We can choose from a range of 50 to 400-watt solar panel, 13-17% efficiency for polycrystalline panels, and 18-19% for mono-crystalline panels

3. They are again captured by a lithium-ion battery and converted to direct current to alternative current.

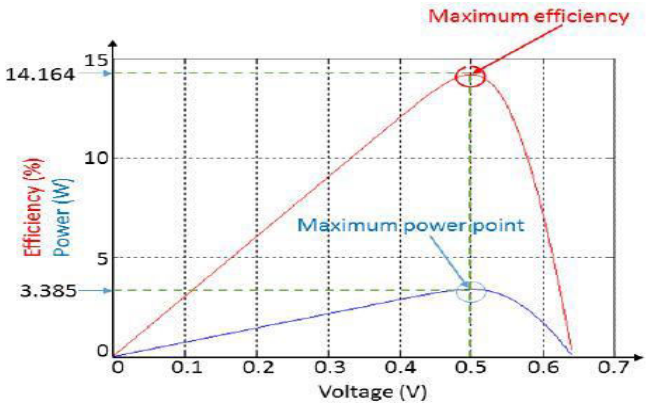


Fig.11. Efficiency and power curve for single solar cell

B. *System Mobility*

Speed of Robotic Vehicle is calculated from the following equations [1].

The wheel diameter and Rotation per motion (RPM) of brushless DC motor decide the speed of the system. Smaller the diameter larger the distance.

Pi = 3.14 or 22/7.

Distance covered per rotation

= Wheel Diameter X pi (1)

= 5 X 22/7= 15.7cm

Speed of Robot per Sec =

(Distance covered per rotation X RPM of motor)/60 Sec (2)

= (15.7* 45)/60 =

11.77cm/Sec Speed in m/sec = 0.11m/Sec

B. Torque

Voltage is 12V
Resistance is 2.45Ohms

Current consumed by motor= I = V / R (3)
I=12 / 2.45 =4.8A

Input power of motor = Pin = I * V (4)
P_{in} =4.8*12=57.6W

Efficiency = 0.1.
Angular speed = ω = rpm * 2π / 60 (5)
=4.7(rad/s)

Maximum torque =τ = (I * V * E *60) / (rpm * 2π) (6)
τ = (4.8*12*0.1*60)/(45*2*3.14)=1.2N.m
Therefore, speed is inversely-proportional to torque of the motor.

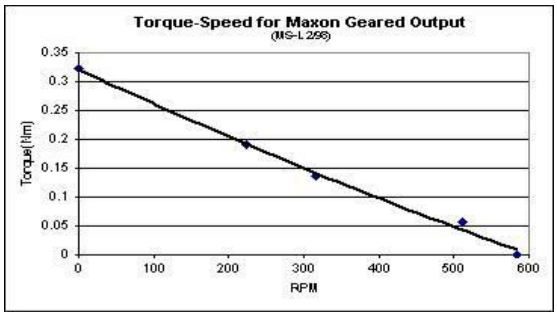


Fig.12. torque vs speed.

C. Camera storage

1 camera with bit-rate 48 Kbps recording for 1 day
Storage calculation = ((48.000/8) * 3600 * 24 * 1 * 1) / 1,000,000,000
Storage = 64GB.

- 48 = bandwidth of camera.
- Storage = Total amount of space in Gigabytes.
- 8 = to change from bits to Bytes.
- 3600 = to change from seconds to hours.
- 24 = to change from hour to day.
- 1 = Total number of cameras.
- 1 =Total number of days.
- 1G = Divide by 1 Gig (1,000,000,000) to convert from KB to GB.

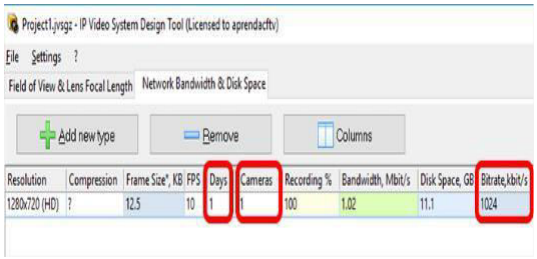


Fig.12. Tool to calculate storage.

D. Overall power consumption of the circuitry

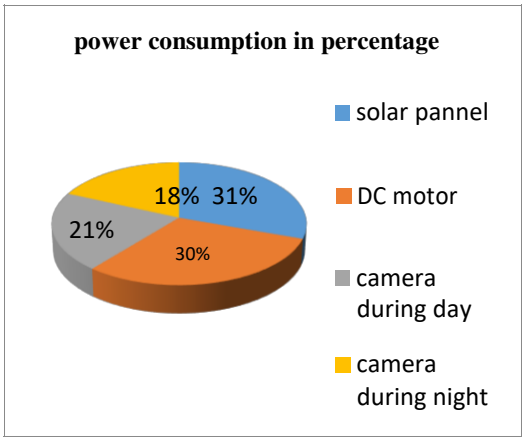


Fig.13. Overall power consumption.

VI. FUTURE SCOPE

This prototype of ours has various advantages over previously existing prototypes. There is always a scope of betterment in technological advancements .hence some extra features can be added to this prototype to increase its efficiency and working. These additions helps user to utilize the device to its maximum efficiency.

A. Wireless Network

Wireless sensor network is a addition of sensor nodes deployed dynamically into organized networks. This ensures wireless connectivity between individual nodes and the central host system. Using this sensor network increases the surveillance coverage range. The primitive objective to deploy this network is to maximize the range and connectivity to the robotic vehicle to the user and to minimize energy consumption by adopting adept routing schemes and algorithms to get enhanced throughput.

B. IOT

As the technology advances rapidly, internet of things will introduce an advanced level of receptivity and control from the user to the deployed device. Advent use of internet has led to it being integrated in all niches. The sensors, RFID tags and the microcontroller can communicate using internet of things (IOT)[12]. As it is an upcoming technology it has certain limitations that include giving unique address to each element so it has unhindered access over internet. With the help of Internet of things we can enhance remote operation through internet. This is rapid growing technology with advanced invocation.

VII. ACKNOWLEDGEMENT

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the project. Also special thanks to Mrs. Kavitha sudha and Mr. Rajkumar for giving their valuable inputs that led us to complete our project successfully.

VIII. CONCLUSION

This mode of communication technology increases its range, where the user can monitor the movement of robot from anywhere in the world by obtaining live video of surroundings. In comparison to earlier versions that worked on local network like wifi , limiting the working range . usage of renewable energy source i.e. solar energy for power supply DTMF and smart mobile phones as output receivers make it more feasible and cost effective. The engineered robotic vehicle can be used as mobile surveillance camera with live streaming from surroundings for security and emergency rescue missions , where human intervention is difficult , hence alerting the host .

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