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Solar Powered Lawn Mower Robot

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ABSTRACT

The Solar Powered Lawn Mower Robot is a grass cutting robotic vehicle powered by solar energy. Operated by RF remote. The system uses 12V battery to power the vehicle movement motors as well as the grass cutter motor. We can charge the battery either solar energy or by electric power, we have given both options to charge battery. The grass cutter and vehicle motors are interfaced to an ATmega328 microcontroller that controls the working of all the motors. It is also interfaced to 433MHz RF receiver module for receiving signals from remote. The microcontroller moves the vehicle motors in forward, reverse, left and right direction with the help of RF remote. A lawn mower/ Grass cutting machine is a machine that uses a revolving blade or blades to cut a lawn grass. Lawn mowers employing a blade that rotates about a vertical axis are known as rotary mowers, while those employing a blade assembly that rotates about a horizontal axis are known as cylinder or reel mowers.

Keywords :- RF Remote, ATmega328, Solar Panel, Grass Cutter, Battery.

I. INTRODUCTION

From time immemorial, the sun has been the prime source of energy for life on earth. The solar energy was being used directly for purposes like drying clothes, curing agricultural produce, preserving food articles, etc. Even today, the energy we derive from fuel-wood, petroleum, paraffin, hydroelectricity and even our food originates indirectly from sun. Solar energy is virtually inexhaustible. The total energy we receive from the sun far exceeds our energy demands. Ever since the industrial revolutions human have been dependent on fuels, electricity and wind energy. For human development in many countries there is research and trials are going on the Solar energy and the wind energy, So we make our new concept solar powered grass cutting. In these concept we cut grass in lawns and gardens. Remote controlled grass cutter can be described as the application of IR technology to operate a machine on which electric motor rotates which in turn rotates a blade which does the mowing of a grass. The design objective is to come up with the principle of solar powered grass cutting machine. Since manual grass cutting machines are very hectic to operate and electric mowers are subject to availability of electricity and thus limited working range, this project demonstrates the concept of automatic grass cutting machine which can be operated using the remote control. The designed grass cutter comprises of direct current (D.C) motor, a rechargeable battery, solar panel, cutting mechanism and an electronic circuit. Grass cutting is achieved by the D.C motor which provides the required torque needed to drive the cutting blade which is coupled to

the shaft of the D.C motor. The grass cutter is operated wirelessly from a distance using the remote control provided. The remote designed has the facility for switching on and of the cutter using a switch on a remote. The remote is also used to control the direction of travel of the machine and control its navigation.

II. METHODOLOGY

In this system we have used Microcontroller Atmega328P for controlling the whole system. In this system RF 433MHz Tx/Rx module is used to control the robot through wireless remote. In Rf remote we have used a microcontroller with HT12E encoder IC to give signal to the RF transmitter, in which we have used 7 keys each key has different code whenever we press any key from remote the microcontroller send a specific digital code to the encoder and then given to the transmitter module.

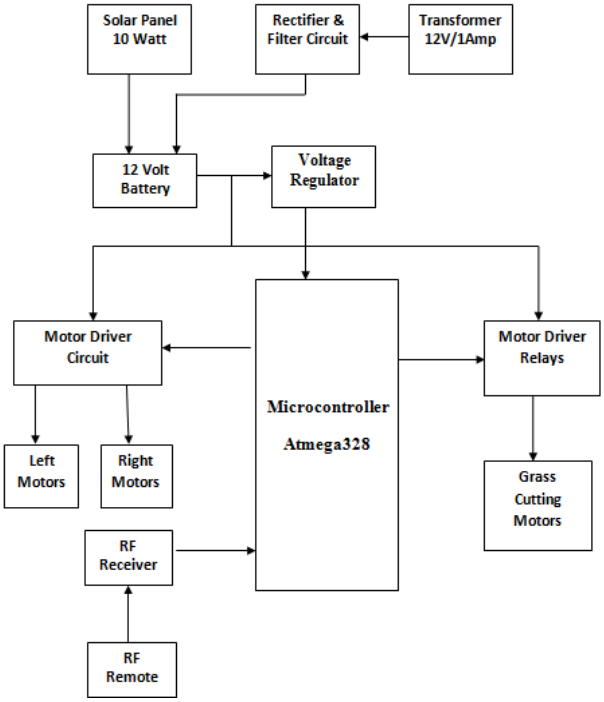

Fig 1. Block Diagram of Survey on Solar Powered Lawn Mower Robot

The receiver circuit in robot receives the signal which is sent by the transmitter, which will be decoded by HT12D decoder ic and then decoded output reads by microcontroller and controller will take action as per received signal and the embedded c programming.

The working principle of solar grass cutter is it has a panel arrangement at an in such a way that can receive solar radiation with high intensity easily from the sun. The solar panel converts solar energy into electrical energy. This electrical energy is stored in batteries by using a solar charger. We have also provided the alternative charging system for battery from electricity using 12V/1Amp center tapped transformer with rectifier and filter circuit. The grass cutter motors are connected To batteries through connecting wires. Between these mechanical circuit relay is used to switch the motors power supply. From this motor, power transmits to the mechanism and this makes the blade to rotate on the shaft this makes to cut the grass. The designed solar powered lawn mower comprises of direct current (d.c motor), a rechargeable battery, solar panel, a stainless steel blade and control switch. Rotation is achieved by the electrical motor which provides the required torque needed to drive the stainless steel blade which is coupled to the shaft and to the gears to the motor. Gears are to increase the rpm and to reduce the power consumption. The solar powered lawn mower is operated by the RF remote. With the help of remote we can move vehicle in forward, reverse, left and right direction and also turn ON and OFF the grass cutter. The battery recharges through the solar power, performance evaluation of the developed machine was carried out with different types of grasses.

III. HARDWARE REQUIREMENT

- ATmega328 Microcontroller
- Solar Panel 10 Watt
- Motor Driver IC L298
- DC Gear Motors 60 RPM

- 433 MHz Tx/Rx Module

IV. COMPONENTS DESCRIPTION

a) DC Gear Motor

Fig. 2 DC Gear Motor

The motors are used for the movement of the robotic vehicle, which are of DC gear motors operated at 12V DC power supply. 4 motors have been used to rotate the two wheels clockwise or anticlockwise. This provides motion to the robot. Motors are arranged in a fashion called H-Bridge. H-Bridge is an electronic circuit which enables a voltage to be applied across a load in either direction. It allows a circuit full control over a standard electric DC motor. That is, with an H-bridge, a microcontroller, logic chip, or remote control can electronically command the motor to go forward, reverse, left, right and stop.

A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. This Insight will explore all the minor and major details that make the gear head and hence the working of geared DC motor.

b) 433MHz RF Module

Fig. 3 RF Module

RF Communication Module

RF communication works by creating electromagnetic waves at a source and being able to pick up those electromagnetic waves at a particular destination. These electromagnetic waves travel through the air at near the speed of light. The wavelength of an electromagnetic signal is inversely proportional to the frequency; the higher the frequency, the shorter the wavelength.

Frequency is measured in Hertz (cycles per second) and radio frequencies are measured in kilohertz (KHz or thousands of cycles per second), megahertz (MHz or millions of cycles per second) and gigahertz (GHz or billions of cycles per second). Higher frequencies result in shorter wavelengths. The wavelength for a 900 MHz device is longer than that of a 2.4 GHz device. In general, signals with longer wavelengths travel a greater distance and penetrate through, and around objects better than signals with shorter wavelengths.

RF Module can be categorized into two parts

1. Transmitter
2. Receiver

RF transmitter

This wireless data is the easiest to use, lowest cost RF link we have ever seen! Use these components to transmit position data, temperature data, and even current program register values wirelessly to the receiver. These modules have up to 500 ft range in open space. The transmitter operates from 2-12V. The higher the Voltage, the greater the range. We have used these modules extensively and have been very

impressed with their ease of use and direct interface to an MCU. The theory of operation is very simple. What the transmitter 'sees' on its data pin is what the receiver outputs on its data pin. If you can configure the UART module on a uC, you have an instant wireless data connection. The typical range is 500ft for open area. This is an ASK transmitter module with an output of up to 8mW depending on power supply voltage. The transmitter is based on SAW resonator and accepts digital inputs, can operate from 2 to 12 Volts-DC, and makes building RF enabled products very easy.

Features

- 434 MHz or 315 MHz Transmitter Operation
- 100 m. Range - Dependent on Transmitter Power Supply
- 2400 or 4800bps transfer rate
- Low cost
- Extremely small and light weight

RF receiver

This receiver type is good for data rates up to 4800bps and will only work with the 434MHz o 315 MHz transmitter. Multiple 434MHz or 315MHz receivers can listen to one 434MHz transmitter or 315 MHz transmitter. This wireless data is the easiest to use, lowest cost RF link we have ever seen! Use these components to transmit position data, temperature data, and even current program register values wirelessly to the receiver. These modules have up to 500 ft range in open space. The receiver is operated at 5V. We have used these modules extensively and have been very impressed with their ease of use and direct interface to an MCU. The theory of operation is very simple. What the transmitter 'sees' on its data pin is what the receiver outputs on its data pin. If you can configure the UART module on a uC, you have an instant wireless data connection. Data rates are limited to 4800bps. The typical range is 500ft for open area. This receiver has a sensitivity of 3uV. It operates from 4.5 to 5.5 volts-DC and has digital output. The typical sensitivity is -103dbm and the typical current consumption is 3.5mA for 5V operation voltage.

Features

1. 434 MHz or 315 MHz Operation
2. 500 Ft. Range - Dependent on Transmitter Power Supply
3. 4800 bps transfer rate
4. Low cost
5. Extremely small and light weight

c) Solar Panel

Fig. 4 Solar Panel

A solar panel is a set of solar photovoltaic module electrically connected. A photovoltaic module is packaged, connected assembly of solar cells. The solar panel can be used as component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each module is rated by its dc output power under standard test conditions (etc) and typically ranges from 100 to 320 watts. The efficiency of a module determines the area of a module. A single solar module can produce only a limited amount of power, most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, an inverter, and sometimes a battery and/or solar track and sometimes a battery and/ or solar tracked and interconnection wiring.

Photovoltaic Principles

The photo voltaic effect can be observed in nature in variety of materials that have shown best performance in sun light is the semiconductors as stated above. When the photons from the sun absorbed in a semiconductor, that creates free electron with higher energies then the created there must be an electric field to induce these higher energy electrons to flow out of the semi-conductor to do useful work. A junction of materials, which have different electrical properties, provides the electric field in most solar cells for the photo interaction in a semiconductor.

d) Blade

A blade is that portion of a tool, weapon or machine with an edge that is designed to cut materials. The blade is seldom sharp enough to give a neat cutting; the blade simply tears the grass resulting in brown tips. However the horizontal blades are easy to remove and sharpen or replacing existing trimmer suffers from high power consumption. Mower blades are the cutting components of lawn mowers. They are usually made of sturdy metals as they must be able to withstand high- speed contact with a verity of objects in addition to grass. The blade may be made from ceramic or other materials. Here we use rotating blade.

e) Grass Cutter

The grass cutter is made up of an electrical motor, linear blade, and a link mechanism. The electric motor forms the heart of machine and provides the driving force for the driving blades. This is achieved by the combined effect of mechanical action of the cutting blades and the forward thrust of the mower. The system is powered by an electrical switch which completes the circuit comprise the electrical motor and the battery. Solar power as an energy source will address a number of issues that slandered internal combustion engines do not. An electric grass cutter with a solar charger will be easier to use. There is no messy dangerous gasoline to deal with most importantly it eliminates the emissions of an internal combustion mower. A grass cutter is a device which by mean of one or more revolving blades issued to grass cut or other plants. Grass cutter employing a blade that rotates about a vertical axis is rotary mower.

f) Battery

Solar cell module produces electricity only when the sun is shining. They do not store energy. It is necessary to store some of the energy produced. The most obvious solution is to use batteries. The batteries are used as a storage device for solar energy which can be further converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage, for small units with output less than one kilowatt. Batteries seem to be only technically and batteries are high in capital costs. It is necessary that the overall system must be optimized with respect to available energy and local demand pattern. Once the blade is mounted we searched for placing battery to sit. As it is moves attached to the

g) Microcontroller (ATmega328)

The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful

instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

V. SOFTWARE COMMUNICATION

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega8U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '8U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an *.inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also support I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. To use the SPI communication, please see the ATmega328 datasheet.

VI. CONCLUSION

It will be easier for the people who are going to take the project for the further modifications. The project is more suitable for common man as it is having much more advantages i.e. no fuel cost, no pollution, and no fuel residue. Less wear and tear because of less number of moving components and this can be operated by using solar energy. This system is having facility of charging the batteries while the solar powered grass cutter is in motion. So it is much more suitable for grass cutting also. The same thing can be operated in night time also, as there is a facility to charge these batteries in day light. The frame which we use doesn't have height adjustment. This can be overcome by keeping wheels arrangement near the blades. The project which we have done surely reaches the average families because the grass can be trimmed with minimum cost and with minimum time. Finally the project may give an inspiration to the people who can obtain better results.

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