IOT BASED GEO SYNCHRONISED MAXIMUM POWER POINT TRACKING OF SOLAR PANEL

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Abstract. - Solar power is the emerging field of energy production in the field of renewable energy. Here for the tapping of this abundant resource is possible only by using solar panels or Photo voltaic cell. Even though it is implemented in a larger scale the energy efficiency or the output efficiency produced is less than 20 percentage. The maximum efficiency achieved by using High-Quality solar panels is roughly around 23 percentage. Using these High-Quality solar panels at a larger scale will not be much economical in ratio to the revenue the plant can generate. Thus various efficiency increasing methods are adopted to produce higher efficiency at lower cost. The fundamental factor for increasing the energy output of an individual solar panel is highly dependent on the time period for which the panel is exposed to the maximum amount of sunlight. The existing methods which are readily available consist of a Timer which rotates the panels to certain angle along the sun's position, here in this proposed setup we have an embedded system, GPS receiver, router, IOT Cloud, Wi-Fi modem, display, motor, motor driver, solar panel, solar panel tracking mechanism, angle sensor, battery, battery charge controller, driver, voltage sensing unit, ADC and display. The embedded system receives current time and date from the GPS receiver. According to time and date, the position of the solar panel is calculated by the embedded system. Then the embedded system triggers the motor driver for controlling the motor. Here the motor is connected to a solar panel tracking mechanism on which the solar panel is mounted.

1. INTRODUCTION

The most generally known reality about sun oriented vitality is that it speaks to a clean, green wellspring of vitality. Sun oriented force is an extraordinary way to reduce your carbon impression. There's nothing about sun based force that contaminates the compelling force of nature. Sun powered force doesn't discharge any nursery gasses, and aside from requiring a wellspring of clean water to work, it utilizes definitely no other resources. Solar power is independent and introducing sun oriented boards is a protected and simple way to contribute to an economical future despite the fact that its effectiveness. So a solution was required which could eliminate the human effort to operate the solar panels to get an efficient output. The existing configuration available contains an embedded system, timer, display, motor, motor driver, solar panel, angle Sensor, battery, battery charge controller, driver, voltage sensing unit, ADC and display. The output efficiency of this setup is 19.9%. So we came up with the idea of using a more efficient method of calculation the angle at which the panel should be placed so that it get's exposed to maximum sunlight and produces higher efficiency with the help of a GPS module and also with the help of IOT we are enabling the end user to constantly monitor the efficiency and power produced by the solar panel with the help of a web application and cloud server. This approach enables us to get a 10 percentage increase in the efficiency of the overall solar plant.

2. LITERATURE SURVEY

Various work that are existing this area are as follows:

A. Design and Development of IOT

This paper sums up the ideas of IOT (the web of things), presents the various perceptions, presents the historical backdrop of IOT, delineates the key innovations of IOT, and depicts the utilization's of IOT.

B. Design and Simulation of Solar PV System

This paper is focused on reproduction and improvement of Solar PV framework which can satisfy the force request in the secluded areas or in independent condition. The framework comprises of different parts like PV sun oriented board, DC-DC converter (Step up converter) and two level inverter associated with load. The controlling of information circle of the sun oriented PV framework is appeared with the assistance of PI controller for keeping up the dc connect steady independent of changes in the info side and yield side boundaries coming about into the consistent inverter yield. The recreations are acted in the MATLAB SIMULINK programming.

C. Design of a Brush-Less DC (BLDC) Motor Controller

A basic BLDC motor control calculation for minimal effort motor drive applications utilizing broadly useful micro controllers has been made and introduced in this paper. Proposed configuration will permit the client to pivot the motor either clockwise or counter clockwise heading. Contingent upon the rotor position the sensor will offer reaction to the controller circuit. At that point the controller circuit will fix the course of current after to the stator. The plan controller circuit is additionally executed. The general structure comprises of micro controller circuit, rationale doors, exchanging gadgets (MOSFET/BJT), BLDC motor, sensors.

D. Design and Implementation of real time tracking system based on Arduino Intel Galileo Following and checking vehicles are coming incomprehensibly used dependent on Global Positioning System (GPS). In this paper an ongoing global positioning framework is proposed. The proposed structure would make incredible usage of new advancement that premise on installed board indication Arduino Intel Galileo. This framework follows up on Global System for Mobile Communication (GSM), Global Positioning System (GPS) and General Packet Radio System (GPRS) which are used for vehicle following and observing. The SIM908 Module is applied which merges three techniques to be unequivocal GPS, GPRS and GSM. GPS gives the vehicle region encourages, GPRS transmits these data to the laborer ultimately the GSM transmits forewarning message to the vehicle owner phone. This paper show the improvement of the vehicle worldwide situating structure model which is used in the vehicle. In particular, the framework will use GPS to increase a vehicle territory organizes and send it utilizing GSM modem to the owner phone and to the web specialist. Starting there forward, the program can carry on the PHP site page that utilization's Google advisers for show the spot in a progressing. To describe the territory exactness of the suggested structure, we differentiated the system proposed results and the various business GPS devices.

E. Increasing Solar Panel Efficiency in a Sustainable manner

Sun powered solar panel yield is controlled by various elements. Clearly there is the sort of board that decides the change in productivity, yet in addition the measure of light falling into the board is of significance, among different states of activity. The yield of a panel for example drop when the measure of light falling onto it is decreased, or in any event, when just a piece of the board is secured. Another explanation behind decreased yield lies in the way that the change productivity drops by about 0.38 % per °C increment in board temperature. Taking into account that a board would have the option to create the majority of its yield on a radiant day, the decrease in effectiveness because of warming up is vital. To accomplish an advanced yield, it is in this manner significant for the board to stay clean, yet in addition keep it as cool as could reasonably be expected. Thusly, this paper takes a gander at a technique for running water on head of a sun powered board so as to clean it and chill it off. To diminish the vitality utilization of moving the water from the base of the board back to the top, it abuses the motor vitality of the water that runs down the board to siphon the water back to the top. Estimations demonstrate that this methodology prompts a normal increment in yield of around 12 %.

3. PROPOSED SYSTEM

The proposed system contains an embedded system, GPS receiver, router, IOT Cloud, Wi-Fi modem, display, motor, motor driver, solar panel, solar panel tracking mechanism, angle sensor, battery, battery charge controller, driver, voltage sensing unit, ADC and display. The embedded system receives current time and date from the GPS receiver. With reference to time and date, the position of the solar panel setup is calculated by the embedded system framework. Then the embedded system triggers the motor driver for controlling the motor. Here the motor is connected to a solar panel tracking mechanism on which the solar panel is mounted. By the motor movements, the solar panel tracking mechanism is adjusted and positioned. An angle sensor is presented and it is used for knowing the angle of the solar panel. The angle sensor updates the current position of the solar panel to the embedded system then the position of the solar panel is adjusted as per calculations. The solar panel is connected to a Battery, so the power produced by the solar panel is stored in the battery. The charging function of the battery is controlled by a battery charge controller. The solar panel and battery are connected to two voltage sensing unit. The voltage sensing unit senses the amount of voltage produced in the solar panel and the amount of voltage stored in the battery. The output of voltage sensing units are connected to an ADC. In ADC, the analog signals from the voltage sensing unit are converted into digital form to deal with embedded system. The embedded system is programmed to show the status of battery and solar panel through a display connected to it. Furthermore, the embedded system sends the data to IOT cloud by using Wi-Fi modem through a router. By this the details about the battery and solar panel are stored into the IOT cloud. The embedded system updates the details dynamically, so the end user can know the current status of the battery and solar panel.

4. ARCHITECTURE OF THE PROPOSED SYSTEM

This project contains an embedded system, GPS receiver, router, IOT Cloud, Wi-Fi modem, display, motor, motor driver, solar panel, solar panel tracking mechanism, angle sensor, battery, battery charge controller, driver, voltage sensing unit, ADC and display

The embedded system receives current time and date from the GPS receiver. According to time and date, the position of the solar panel is calculated by the embedded system. Then the embedded system triggers the motor driver for controlling the motor. Here the motor is connected to a solar panel mechanism on which the solar panel is mounted. By the motor movements, the solar panel mechanism is adjusted and positioned

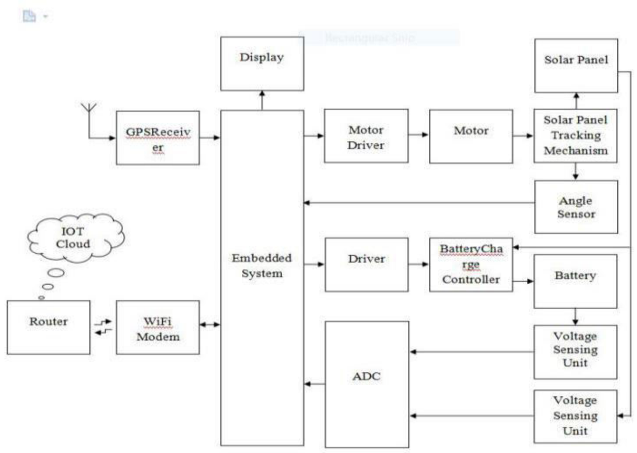

Fig. 1: Shows Architecture of Proposed System

An angle sensor is presented and it is used for knowing the angle of the solar panel. The angle sensor updates the current position of the solar panel to the embedded system then the position of the solar panel is adjusted as per calculations. The solar panel is connected to a Battery, so the power produced by the solar panel is stored in the battery. The charging function of the battery is controlled by a battery charge controller. The solar panel and battery are connected to two voltage sensing unit. The voltage sensing unit senses the amount of voltage produced in the solar panel and the amount of voltage stored in the battery. The output of voltage sensing units are connected to an ADC. In ADC, the analog signals from the voltage sensing unit are converted into digital form to deal with embedded system. The embedded system is programmed to show the status of battery and solar panel through a display connected to it. These details which are acquired by the controller from the sensors are now sent to the **ESP8266** which in turn send the collected data to the cloud server log, from the cloud the data is stored in the clouds database in the form of logs or NoSQL database and the data will be produced for the user in real time monitoring of the solar panels.

5. EXPERIMENTAL SETUP

Hardware used in this research paper are:

PIC18(L)F2X/4XK22

The new micro controllers provide a wide opportunity for the peripherals in a single chip. To power the chip and connect its peripheral devices to the alerts of interest, when powered up, these gadgets need to be configured and monitored with the help of a suitable firmware application. They focus on programming the 28-pin PIC18F26K22 micro-controller and the one having its 40-pin PIC18F46K22 sibling in a simple hardware surrounding.

Solar Panel

The types of the solar panel: Mono-crystalline or single crystal cells. The first heir of solar cells. Excellent conversion rate (12 - 16%) (23% under laboratory conditions). Working out with the process is little strenuous work, therefore expensive process. A drawback is it takes a lot of energy to obtain pure crystal. The Poly-crystalline cells are comparatively lower in production costs, requiring less energy to make 11 - 13% conversion efficiency (18% in the lab). Amorphous cells are the third kind, a greater current generation (mid-70's) lower in manufacturing, but unfortunately lower performance (8 - 10%) (13% in the lab).This process uses a thin layers of amorphous silicon (0.3 - 1.0 microns compared to 500 microns for the other types). Using a vacuum spraying system, skinny layers can be implemented on glass, metal or maybe bendy plastic surfaces. Amorphous silicon are the ones used in calculators and watches. The panels require nearly twice the surface vicinity to supply the identical quantity of energy, and their output needs more speedy through the years, however they react better to diffuse and fluorescent light and paintings higher at better temperatures. A single solar mobile constantly produces a voltage of approximately 0.5 volts. For higher voltages, each cells are connected in SERIES to sum their voltages. Large the solar cell, greater the current. Current is denoted in amperes.

DC Motor

Designing a DC-motor according to the requirements is a great task for all designers. The choice to choose between brush-type or brush less motors can complicate the selection. Even the experienced designers may fail at compromising the necessity parameters and the gadgets to handle by the motor at performance level operation. Dc motor parameters: Though several motor parameters are the identical for both brush and brush less dc motors. One of these is motor constant, Km. It is used during motor sizing as a fact of motor power-to-torque ratio. Km is proportional to the ratio of height torque, Tp, to peak power, Pp, at stall. Km = Tp / Pp. Km is also proportional to the ratio of torque sensitivity, Kt, to motor terminal resistance, Rm:Km = Kt / Rm. The motor is the best part of the machine. As the layout selection progresses, some change-offs typically take place. For example, the motor have to additionally fulfill bodily length and inertia necessities. Winding resistance is a major factor in motor selection because it seriously affects K_m. Winding resistance and motor contemporary produce power loss inside the shape of warmth and motor temperature upward push (TPR). These losses also are referred to as I2R losses and at once devalue motor performance. Motor windings are made mostly by copper wire which has a good temperature coefficient. The winding temperature rise from 25 to 155°C will increase wire resistance as more as 50%. Likewise, a proportional lower in resistance result in temperature drops. A 3-step method provides the value of resistance change from a initial input power. Initially, a quality factor(*F)*, is computed from known wattage and temperature. next, the hot-condition wattage(*Wh*) is calculated. Third, the quality factor is used to find final temperature rise, *Trl*

Quality factor is:

$$F = \frac{1}{1 - \frac{(W_c)(TPR)}{(234.5 + T_{amb})}}$$

where *Wc* = initial input power, cold, W; TPR = motor temperature rise, °C/W; and *Tamb* = ambient temperature, °C.

Hot wattage is *Wh* = (*F*)(*Wf*).

The final temperature is *Trf* = (*Wh*)(TPR).

However, factor *F* is valid only over a restricted range of values for a part of the denominator, where *n* = *Wc*(TPR)/(234.5 + *Tamb*). If *n* >1, then *F* is negative or infinity, signifying thermal runaway that burns open the motor. But if *n* <1, then *F* is positive and the motor will stabilize at *Trf* or less.

The motor inertia and load should be defined for each transient and steady-state conditions. These inertia are essential considering the fact that torque during acceleration exceeds torque at constant velocity. The first example considers the choice and sizing of a brush type dc motor. The second issues a sterile outer-space environment requiring a brush less dc motor.

GPS

The **Global Positioning System (GPS)** is GNSS system formed by united states department of defense. It is the only functional GNSS in the world. It uses the constellation of among 24 and 32 Medium Earth Orbit satellites that transmit single microwave signal, which allows GPS receivers to identify the modern-day place, the time, and their velocity. A GPS receiver calculates its position through exactly timing the alerts remit via the GPS satellites high above the Earth. Each satellite regularly transmits messages holding the time is sent, specific orbital information (the ephemeris), and the general system health and difficult orbits of all GPS satellites (the almanac). The receiver calculates the transportation time of each message and computes the gap information to each satellite. Geometric trilateration is used to combine those distances with the place of the satellites to determine the receiver's region. The position of the GPS is displayed, possibly with a cellular application, display or latitude and longitude. By positional changes the path and speed of the device can be identified for the calculation purposes. It might appear 3 satellites are enough to clear up for position, given that area has three dimensions. However a totally small clock blunders elevated by using the very large velocity of light the speed at which satellite alerts propagate—effects in a large positional errors. The receiver uses a fourth satellite tv for pc to solve for x, y, z, and t that is used to correct the receiver's clock. Most GPS applications use the computed place and effectively hide the very accurately computed time, some specialized GPS uses for traffic signal timing and time transfer.

Receiver specifications: GPS receiver type 20 channels, L1 frequency, C/A code Horizontal Position Accuracy < 2.5m (Autonomous)< 2.0m (WAAS) (50% 24hr static, -130dBm)Velocity Accuracy <0.01 m/s (speed)<0.01° (heading) (50%@30m/s),Time accuracy 1µs or less
TTFF (Time to First Fix) (50%, -130dBm, autonomous) - Hot Start: 1s, Warm Start: 35s
Sensitivity (Autonomous)- Tracking: –159dBm, Acquisition: -142dBm
Measurement data output Update time: 1 second, NMEA output protocol: V.3.00
Baud rate: 4800 (default), 9600, 19200, 38400, 57600, bps (8-N-1), Datum: WGS-84
Default: GGA, GSA, RMC, VTG at 1Hz and GSV at 1/5Hz
Other options: GLL, ZDA, or SiRF binary
Power consumption 40mA, continuous tracking mode
Power supply 3.3V
Dimension (single side) 18 (W) x 21 (L) x 5 (H) mm w/ 18x18x2 (mm) patch antenna
18 (W) x 21 (L) x 7 (H) mm w/ 18x18x4 (mm) patch antenna
Operating temperature -40°C ~ +85°C
Storage temperature -40°C ~ +125°C

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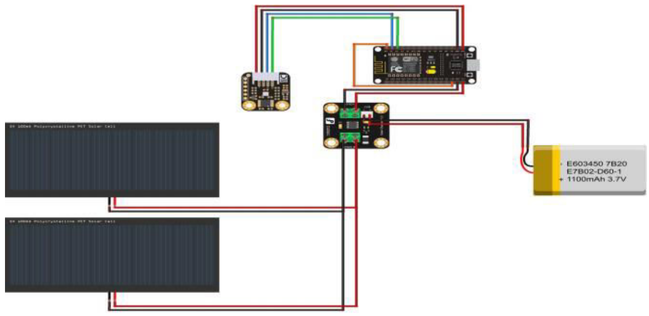
Protocols: Both NMEA and SiRF binary protocols could be supported via serial UART I/O port – RXA/TXA. The default supported protocol is NMEA protocol.
1. Serial communication channel
I. No parity, 8-data bit, 1-stop bit (N-8-1)
ii. User selectable baud rate among 4800, 9600, 19200, 38400, and 57600
(default 4800) bps.
2. NMEA 0183 Version 3.00 ASCII output
I. Default GGA (1 sec), GSA (1 sec), GSV (5 sec), RMC (1 sec), VTG (1 sec)
ii. Optional GLL, ZDA

Antenna: SR-92 has a built-in patch antenna of dimension 18x18x4 or 18x18x2 (mm).
To have the best performance, Pro Gin suggests tuning the RF antenna together with product's outside shell of housing.

IOT

The device is used to display the consumption and usage of the electrical source. This recording is done through raspberry pi using flask framework. Smart Monitoring displays daily usage of electrical sources. This allows the consumer to calculate the electricity usage. Analysis will effect on the energy source. The module used for this operation is ESP8266. The ESP8266 microchip is a low cost chip, with full TCP/IP. It has stack and micro controller capability. Processor L106- 32bit RISC micro-processor core based on the standard 106 micro running at 80MHz of memory, with 32Kib instruction Ram, 32Kib instruction cache RAM, 80Kib user data RAM, 16Kib ETS system data RAM.



The information from the controller is captured by the Wi-Fi device which is connected to cloud database via the internet connection from the router/GSM components. The data of the calculate efficiency, battery percentage day ,date and other log information's are now stored in the firebase database in the form of key value pairs, so with the access to the date we can get that day's overall efficiency and battery percentage and other analytical data. The data is put to the user in the front end by using the web site which is specifically designed to display the information in real time

6. RESULT AND ANALYSIS

The proposed system's main idea is to improve the efficiency as it generates much electricity than their counterparts due to increased direct exposure to solar radiation. The GPS device applies the time and date to angle sensor to move according to sunlight with the help of the other components controlled by the micro controller. We have recorded a week progress of energy obtained from the solar panel from this proposed system with efficiency ranging from 18-20% and compared with the existing system in which timer used and solar panel at a fixed position produces efficiency of 15-17%. This system is aimed to generate power at remote areas where power lines are not accessible and also for domestic backup for various purposes.

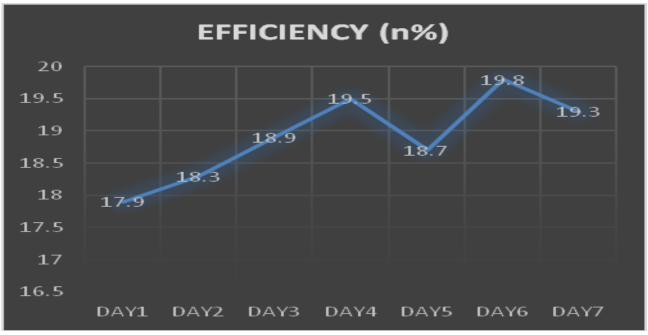


Fig. Graph between the efficiency of the panel and the days observed that is increasing.

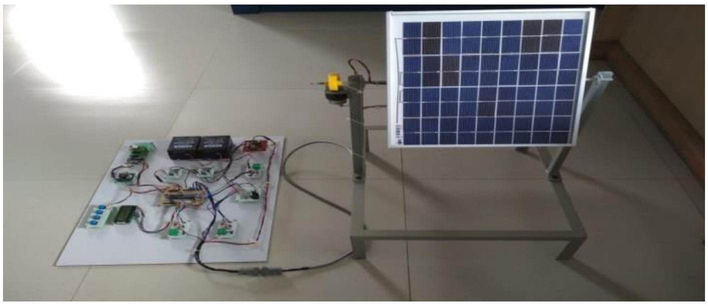


Fig: Front view of the module

7. CONCLUSION

The basic fact about the electrical energy sources is that, it is one of the green energy source that is renewable and doesn't provide a loss for any consumer. Solar electricity is a exquisite way to reduce the consumption of already existing and polluting carbon gases. There is no energy greater than sun's energy to provide a natural source and not by affecting environment. It doesn't produce any green-house gases and more over requires only a little amount of water for the cleaning of panels. Furthermore, the embedded system sends the data to IOT cloud by using Wi-Fi modem through a router. By this the details about the battery and solar panel are stored into the IOT cloud. The embedded system updates the details dynamically, so the end user can know the current status of the battery and solar panel. It enhances the smooth and emission free electricity production. Generates extra power than their stationary counterparts due to increased direct contact to solar radiation, produces extra power in more or less the equal amount of area needed for fixed-tilt systems, making them ideal for optimizing land usage, ability of tracking sunlight at any weather conditions. The major application of this system will be for domestic backup power system. **It can be used for small and medium scale power generations, f**or agricultural applications like grain drying and water heating, and f**or power generation at remote places where power lines are not accessible.**

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