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INSOLATION GARNER USING IoT

Ms. R. Poorani[1], Ms. P.R. Malavika Thankachy[2], Ms. N. Kavipriyamvadha[3], Ms. G. Manochitra[4], Mrs. R. Vanitha[5]

[1,2,3,4] UG Scholar, Department of ECE, Hindusthan College of Engineering and Technology, Coimbatore.
[5]Assistant Professor, Department of ECE, Hindusthan College of Engineering and Technology, Coimbatore, Tamil Nadu, India.

Abstract - *Solar insolation is sun radiation converted to power and injected into the utility network using grid-connected energy plants. Insolation garner is used to convert radiation into current and stored in an exceeding battery. The approach to this idea involves the right solution to the issues and constraints that other surveillance technologies have. The goal of this project is to manage the position of an device to match the movements of the sun. Because the value of fossil fuels varies, renewable energy is fast gaining relevance as a source of energy. It's consequently vital for engineering and technology students to know and appreciate the technologies related to renewable energy at the tutorial level. the foremost aim of this proposed project is to style a low-cost monitoring system for max electric outlet tracking in photovoltaic (PV) systems. The designed monitoring board consists of an embedded board (Arduino UNO based upon Atmega328), LDR Sensors, etc. The sensor EHS is supposed and fabricated in CMOS 90 nm technology. The monitored real-time data are sent to the concerned person's mobile app through IoT. Here LDR is used to hunt out the sunshine intensity of the sun and makes the cell communicate the respected side. Supported the monitored data the users can check easily if the system works well or not. As a result, we will get a high amount of current from energy.*

Key Words: Internet-of-Things (IoT), Photovoltaic Systems (PV), Light Dependent Resistor (LDR), NODEMCU Microcontroller, Solar Panel.

1. INTRODUCTION

Solar energy is renewable energy that's clean in nature and available in abundance. It's radiant light and warmth from the Sun that's harnessed by employing a range of technologies like solar energy to come up with electricity, solar thermal energy including solar water heating, and solar architecture. Insolation is the amount of radiation that's received by a planet. A number of this energy is absorbed or reflected by the atmosphere if there's one, and a few reach the surface. When solar radiation hits an object, a number of the energy will be absorbed while the remainder is reflected. Generally, the absorbed radiation is converted to thermal energy, which causes the thing to heat up. However, in some cases, the incident energy is often absorbed and converted into another style of energy. This can be the case in photovoltaic cells used on solar panels. To maximize output, factors like the geographic location of solar panels and orientation can be determined by understanding insolation values. Solar insolation is wont to provide heat, light, and power for domestic still as industrial applications. Sun radiations will be converted into current using differing types of solar cells. Thanks to the straight forward installation of all necessary equipment in an exceedingly competitive market, photovoltaic power is the best and least expensive option today in remote and rural areas. These are being employed together with the traditional system in many developed and developing countries. Now, nowadays, every soul needs power for his or her quality of life. The consumption of power is increasing in everyday lives, and at the identical time, other energy sources are depreciating day by day. Therefore, to satisfy the ability demand, other sources of power are required. For the generation of electricity, there are often two ways first one is from non-renewable sources, and another one is renewable sources. Though, solar energy generation becomes cheaper with advances in conversion technology. Radiation is also converted directly into electricity by solar cells (photovoltaic cells). In such cells, a tiny low electric voltage is generated when light strikes the junction between a metal and a semiconductor (such as silicon) or the junction between two different semiconductors. A solar panel, or solar module, is one component of a photovoltaic system. They're constructed out of a series of photovoltaic cells arranged into a panel. They are available in an exceedingly kind of rectangular shape and are installed together to generate electricity. Sometimes solar panels also called photovoltaically, collect energy from the sun in the shape of sunlight and convert it into electricity that is often won't to power homes or businesses. These panels are accustomed to supplement a building's electricity or provide power at remote locations. To form the scheme accessible monitoring at the customer level is that the need of the current. More suitable sources of energy and in a very few upcoming years may overcome non-renewable energy sources completely. Solar technologies convert sunlight into electricity either through photovoltaic (PV) panels or through mirrors that concentrate radiation. This energy will be accustomed to generate electricity or be stored in batteries or thermal storage. Solar PV system consistently generates enough

amount of power. Non-renewable sources aren't regenerated naturally after first use like fossil fuels, coal, gas, and fuel while renewable sources are frequently utilized again and again which isn't depreciating never like sun, geothermal, wind energy, and tidal energy. Alternative energy is, therefore, said to be a sustainable power source.

2. LITERATURE SURVEY

The sun provides earth with a staggering amount of energy enough to power the great oceanic and atmospheric currents, the cycle of evaporation and condensation that brings freshwater inland. The San Francisco earthquake of 1906, with a magnitude of 7.8, released an estimated 1017 joules of energy, the amount the Sun delivers to Earth in one second. Earth's ultimate recoverable resource of oil, estimated at 3 trillion barrels, contains 1.7 × 1022 joules of energy, which the Sun supplies to Earth in 1.5 days. The number of energy humans use annually, about 4.6 × 1020 joules, is delivered to Earth by the Sun in one hour. The enormous power that the Sun continuously delivers to Earth, 1.2 × 105 Terra watts, dwarfs every other energy source, renewable or nonrenewable. Concentrated or not concentrated sunlight can produce heat for direct use or further conversion to electricity.

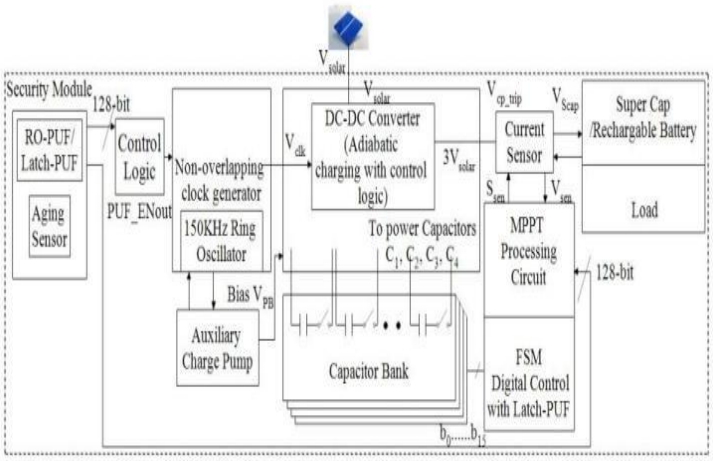

Fig -1: Existing Circuit Diagram of Solar Harvesting

The primary objective of this work is to design an ultra-low power solar energy harvesting system (SEHS) with a security mechanism. The reuse of the ring oscillator (RO) available in EHS as an aging sensor would provide information about the EHS IC, whether is fresh or otherwise. These PUF uses less hardware and is cost-effective. The detailed design process and validation of the proposed concept are discussed in subsequent sections. Due to the development of silicon technology, the chip size is shrinking with time. System-on-a-chip (SOC) implementation of smart nodes in IoT is a reality and consumes a small area. The IoT intelligent nodes are SOC capable of sensing, processing, and transmitting useful information. The IoT is two-way communication in WSN, where appropriate decisions are taken and implemented in real-time. The sensors used in IoT need to be functional for a prolonged period(maybe tens of years) regardless of the area of deployment. A continuous power supply requirement for these end node devices is mandatory. Usually, small batteries have used that drain out after an interval. Hence, it demands the design of an uninterrupted power supply. Therefore, EHS is gaining more attention from the researcher's perspective. The safety of the EHS chip is an unexplored domain starting from the fab lab till deployment. To secure the EHS chip from adverse scenarios, and during its functioning, PUF is used as security primitive. The establishment of the Solar Parks has the potential of reducing the cost of electricity from solar power. The sensors are used to monitor and collect information about the climatic condition of the farm like temperature, humidity, day/night mode, and also to check the power generated on the field. GSM-based Wireless Sensor Network (WSN) has the features of high bandwidth and rate, non-line-transmission ability, large-scale data collection, and high cost-effectiveness realized with Zigbee. For the wireless section, GSM type network has been used because it is a modern wireless sensor network.

3. PROPOSED SYSTEM

In the proposed system, the Arduino microcontroller is used here to interface with the solar panels and sensors used. All the data is transmitted to a remote server with the help of a microcontroller which transfers the data to the cloud through the Internet of Things. The cloud data is retrieved by the user using the mobile application. An array of solar cells can produce maximum electricity if the solar panel is placed exactly at a right angle to the sun's rays. The proposed system for monitoring the solar module using helps to implement a low-cost monitoring system. The parameters like voltage and temperature are monitored by using the voltage sensor and temperature sensor used here, and they are mounted on PV panels and Power Conditioning Units (PCU). The power produced from the solar panels is stored in the battery and delivered this stored power to the corresponding loads. The battery rating and the number of batteries required depend on the load requirement. The toggle switch is used for increasing and decreasing voltage levels. Solar tracking is also a major feature attached to this system. Which helps to track the solar panel automatically to the concerning direction. This helps to store a high amount of renewable energy in the battery. The motor is attached to the solar panel setup and 2 LDR sensors are placed which find out the directions of the sun and its light intensity. Based on that solar panel moving in their direction is identified. The solar panel converts the solar energy into electrical energy and is stored in the battery for our future use. Here toggle for making manual abnormality for this project. If we have

any abnormal voltage fluctuations in the system, the system detects automatically and also detects the error and the buzzer will sound, and the gathered information sent to the Internet of Things. All collected data of voltage, and temperature sensor is then fed to a microcontroller which converts the signals into digital using a serial interface and microcontroller unit acts as a gateway and sends this data over the cloud server and then this data is accessed via user over the mobile application. In case any sensor value varied than an alarm system will also be turned ON and therefore buzzer sounds.

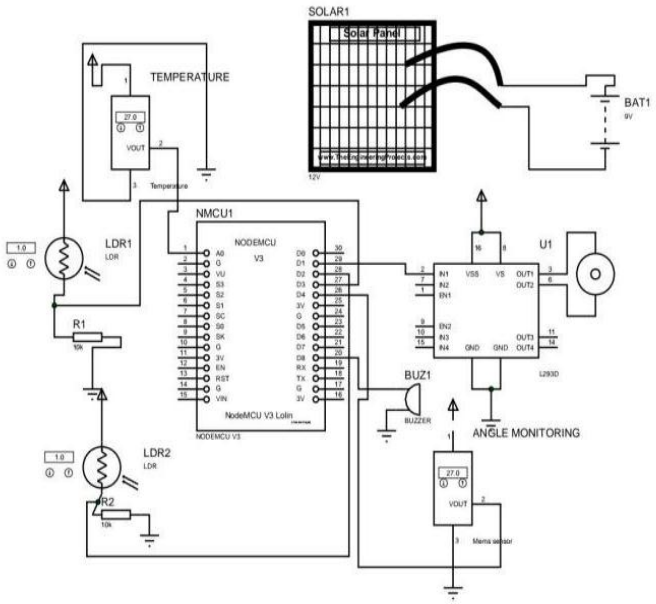

Fig -2: Circuit Diagram of Insolation Garner using IoT

The circuit setup is done as shown in Fig. 2 and all the connections are made as per the requirement needed. 12V 40RPM Gear motor is fixed with the solar panel grids for the motion and to and fro rotation of the motor. Since the battery is considered a main source of the system, so major concentration is given to the health maintenance of the battery. The battery value is fixed as a 12V 1.3AH battery. If any abnormalities happen to like high voltage or high temperature, the whole system will fail and burst out due to high temperature. In case of low temperature and low voltage, the system will slow down the process, but it will not cause any damage to the other parts of the system. Nodemcu Microcontroller is fixed to control the entire system efficiently. The analog pin A0 is given to the temperature sensor. The input pin D1 in a microcontroller is connected to the input pin of the drive motor and the input pin D3 is connected to the LDR and the input pin D4 is connected to the MEMS sensor and another input pin D8 is connected to the buzzer for the output. The output pins from the drive motor are given as input to the drive motor. An Embedded C program will be written for the internal work of the system. It includes delay and timing of buzzer sound and also the on and off of the alarm system. Light Dependent Resistor(LDR) is used to observe the sunlight. Radiation waves from the sun. LDR 1 and LDR 2 are fixed in either direction of the solar panel to observe the light. Micro Electro Mechanical System(MEMS) sensor is used for the rotation of the solar panel according to the sun rays, the angle is fixed. Thus, we can get a high amount of solar power without any interruptions and the collected solar power is converted into electrical energy. The alert system is also seen on mobile through a cloud and the application used on the mobile is named blink. Thus, the application shows the temperature level and voltage level of the battery, and it is used by the user who is all working on the installation of the solar panel and also the resource person. It helps us to easily identify malfunctions in the system. The converted electrical energy is used for many purposes like industries, homes for larger areas and smaller areas without any power cut and there is no need to spend a lot of money on the non-renewable resources and been a replacement of coal in upcoming days.

Node MCU microcontroller is used here to interfacing with solar panels and sensors. Panel voltage is obtained by applying in voltage sensor in the voltage divider circuit. The current is sensed by the current sensing circuit and temperature by the temperature sensor. All the data is then transmitted to a remote server with the help of a microcontroller which transfers the data to the cloud through the Internet of Things. The cloud data is retrieved by the user using a mobile application called Blink. The proposed system for monitoring the solar module using IoT helps to implement a low-cost monitoring system. The parameter's voltage, current, and temperature are monitored by using the sensor mounted on the PV panel and Power Conditioning Units (PCU). For sensing the voltage, the voltage sensor is used in the methodology, we can see that the power flow of the model is explained by that the solar radiance energy. This electrical energy is then sensed by various sensors such as voltage generated by the solar panel is sensed by voltage sensor for measuring voltage. All collected data of voltage, current, and temperature sensor is then fed to Arduino UNO microcontroller which converts the signals into digital using serial interface and microcontroller unit acts as a gateway and sends this data over the cloud server and then this data is accessed via user over the mobile application. In case any sensor value varied then an alarm system will also be turned ON. Solar tracking is also a major feature attached to this system. Which helps to track the solar panel automatically to the concerned direction. This has been done with the help of LDR and MEMS sensors. This helps to store a high amount of renewable energy in the battery.

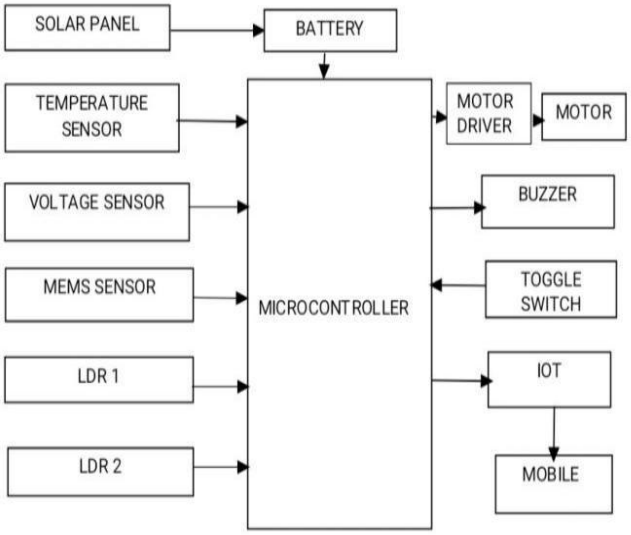

Fig- 3: Block Diagram of Insolation Garner using IoT

The experimental setup is done as shown in Fig.3 and all the connections are made as per the given above block diagram. The solar panel, temperature sensor, voltage sensor, MEMS sensor, LDR1, LDR2, battery, and toggle switch all components are given as an input to the microcontroller, and the microcontroller output is given to the buzzer, motor, and IoT. The obtained output is given to the IoT and accessed through mobile. Since it is a low-cost monitoring system, we can get a high efficient amount of electricity from it. Once the installation process is done in the area in which the solar panel wants to be fixed. After installing or fixing the solar panel in the area, only the maintenance charge and maintenance allowance will be there, and also less amount of human intervention. This is a great replacement for coal and all other non-renewable energy sources. The main advantage of insolation garner is real-time monitoring of voltage, pressure, temperature, and current can be monitored.

4. RESULTS AND DISCUSSIONS

The circuit setup is assembled as shown in Fig.4 and Fig.5. The connections are made using connecting wires and the breadboard is used to fix the components perfectly. After successfully connecting all the components with the solar panel, we can get the desired output in the solar panel as well as in the mobile application named blink.

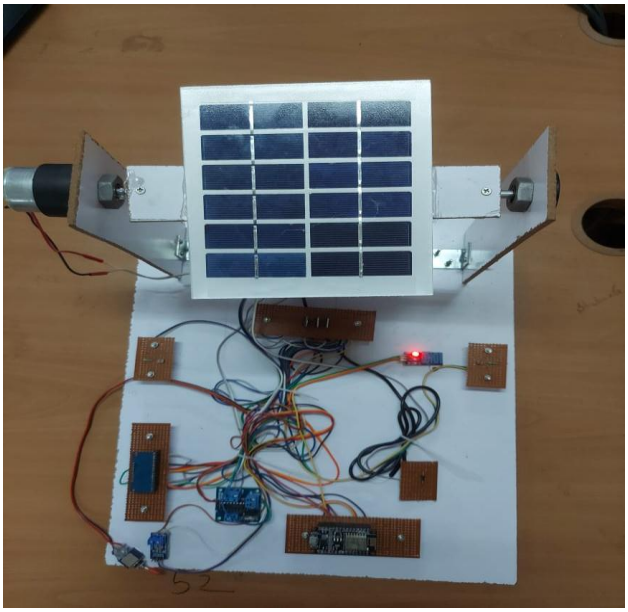

Fig- 4: Complete setup of the project

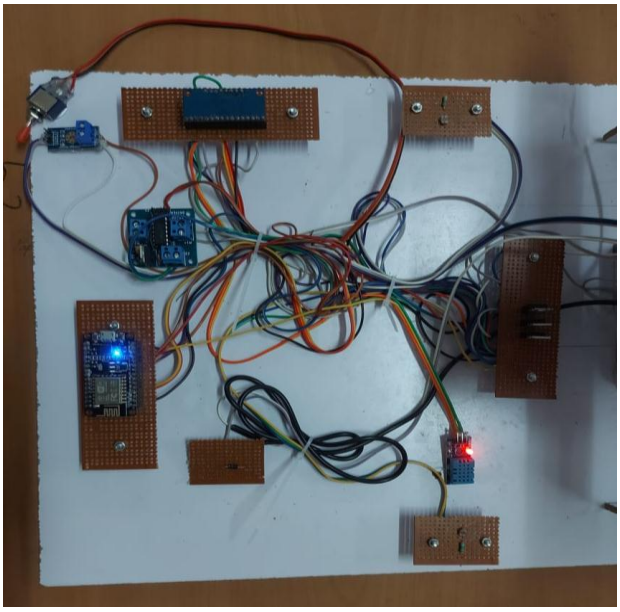

Fig- 5: Circuit connections

The connections are made as shown in the above figure and thus the electricity is generated by using the rotation of the solar panel and the generated electricity is stored and used for the electricity purpose.

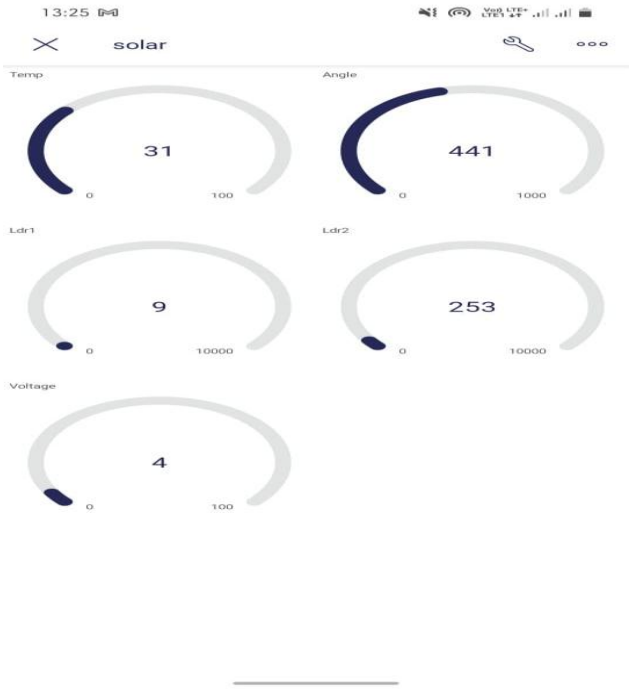

Fig- 6: The result is shown in the mobile application

Thus the battery voltage and temperature are measured and the tilt ratio of LDR is also measured using this mobile application via the IoT module.

5. CONCLUSION AND FUTURE SCOPE

In this project, a low-cost monitoring system for optimum power tracking in a very photovoltaic module is meant. The failure of sensor nodes within the IoT may be a catastrophic situation. Identifying the recycled IC and securing the EHS(energy harvesting system) IC may be a challenge. Keeping these facts into consideration, the proposed secure self-sustainable solar EHS may be a state-of-the-art technology outcome for clean energy and handling IoT edge node devices in smart cities and other related applications. The secure solar EHS has inbuilt PUFs (a two-stage security mechanism) for securing the IC. The aging sensor within the chip will help in identifying the recycled EHS chips. The upper bias voltages required are generated on-chip, such no external bias is required. The secure self-sustainable alternative energy harvesting system (solar EHS) designed is compatible with a minimum voltage of 1.22V as MPP within the range of 1-1.5 V. The resulting output is within the range of 3-3.55 V, which is the requirement of the many IoT edge node devices. The IoT technique is employed to watch data like voltage and temperature levels of a solar photovoltaic system. This technology makes it possible particularly to enhance the monitoring, performance, and maintenance of the photovoltaic system. The designed system can analyze and or check the status of parameters being measured in a very photovoltaic system. Solar tracking was also done successfully. For very large solar arrays dual-axis solar panel tracking is done. By analyzing the information it's possible to predict the longer-term values of parameters. Computer science is often implemented using various machine learning algorithms so that the system can become smart enough to form decisions about data and performance.

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