IOT Based Advanced Solar Power Monitoring System

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Abstract: The idea behind the Internet of Things is to bring commonplace objects into a world where the internet is present. A pure integration of the physical world into computer-based systems is made possible by the Internet of Things (IoT), which also reduces the need for human intervention while improving efficiency, accuracy, and economic gain. Many uses for this technology exist, including solar cities, smart villages, microgrids, solar street lights, and others. As Throughout this time, the use of renewable energy increased more quickly than at any other point in history. The online visualization of solar energy utilization is referred to as renewable energy in the suggested system. Flask is used to perform this monitoring on the Raspberry Pi.

Keywords- Cloud, Flask, IoT, Renewable Energy

I. INTRODUCTION

As an IoT object with a unique IP deal, each household tool in existing devices does not always connect with a data acquisition module. This results in a large wireless mesh network. Less privacy and security is created by the device community. Additionally, using current methods, the data acquisition System on Chip (SoC) module is incapable of gathering data on each smart home's tool's power consumption and transmitting it to a centralized computer for processing and analysis. Because of this, the software's server does not accumulate this data from all residential regions as large facts, resulting in a less accurate result. Prepaid energy metering issues are resolved by IoT-based smart power meters by reducing complexity and mitigating non-technical losses, by helping to ensure the veracity of the information. Additionally, it adds new crucial functions, such as real-time viewing of consumption data and remote management of home appliances [1]. The amount of energy utilized is calculated using a single section static watt-hour meter, and the data is extracted using an LED.

II. EXISTING SYSTEM

As an IoT object with a unique IP deal, each household tool in existing devices does not always connect with a data acquisition module. This results in a large wireless mesh network. Less privacy and security is created by the device community. Additionally, using current methods, the data acquisition SoC module is incapable of gathering data on each smart home's tool's power consumption and transmitting it to a centralized computer for processing and analysis. Because of this, the software's server does not accumulate this data from all residential regions as large facts, resulting in a less accurate result. Prepaid energy metering issues are resolved by IoT-based smart power metres by reducing complexity and mitigating non-technical losses, by helping to ensure the veracity of the information. Additionally, it adds new crucial functions, such as real-time viewing of consumption data and remote management of home appliances [2]. The amount of energy utilised is calculated using a single section static watt-hour meter, and the metre's data is extracted using an Light Emmiting Diod LED.

III. METHODOLOGY

In this section we present the system design of the Solar Energy Monitoring System.

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A. System Design

The Raspberry Pi serves as a host. Through the RPi, the info from the Arduino is displayed on a web page. The tracking data is uploaded to the cloud via RPi, as shown in Fig.1.

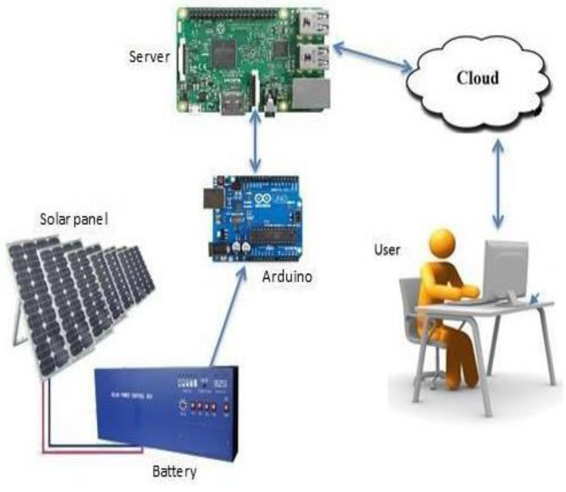

Fig 1: System Design

B. Block Diagram

The suggested system uses IoT to monitor solar energy. The battery's ability to hold energy is aided by the solar panel. Battery contains the power that is advantageous for electrical equipment. The Arduino is linked to a battery. To read the sensor readings, a microcontroller called Arduino is used. The Arduino is connected to a voltage divider and current gauge. Through a USB cable, Arduino is linked to the Raspberry Pi. The Block diagram of the system is shown in fig. 2.

Arduino

The Arduino Uno has been used, which reduces the programming complexity while still taking into account the system's simplicity and financial limitations. Arduino uses analog ports to measure current and voltage. These numbers are used by the Arduino programming to determine power and energy.

Raspberry Pi

The project uses a Raspberry Pi as a central monitoring mechanism. The system costs are decreased by the portable and affordable nature of the Raspberry Pi device. Due to Python's widespread use, a dynamic computer language that is level, all-purpose, and interpreted. Python is being used as the programming language on Raspberry Pi for this endeavor. One main callable object serves as the foundation for all Python web apps. This is an instance of the Flask class in Flask. The upload of tracking data to the cloud is done with the aid of a Python program. A Python-based, lightweight web application framework called Flask is built using the Jinja2 template engine and the WSGI tools. Using the adaptable Python computer language, Flask offers a straightforward template for web development [5].

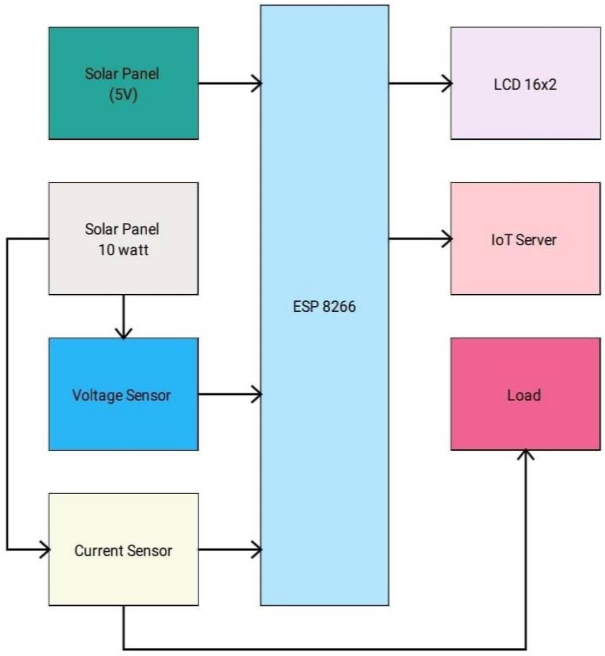

Fig.2 : Block diagram

Current and Voltage Acquisition Circuit

An Arduino's analogue inputs can detect up to 5V. We connect the Arduino to a 5V circuit while using a resistor to safeguard it from short circuits and unexpected voltage surges. Fig. 3 depicts the voltage divider circuit. A potential divider made of two resistors works to reduce the voltage being measured to a level that the Arduino can sense.

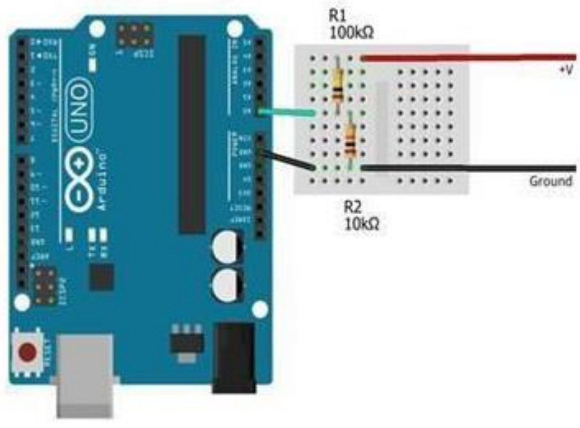

Fig. 3: Voltage Divider

The voltage divider circuit is shown in Fig. The voltage circuit is lowered to 5V using 10kohm and 100kohm registers. Arduino's analogue pin displays the voltage number. This circuit's construction on a breadboard actually increases the usable range.

Vout = [R2 / (R1 + R2)] is the formula for determining values in a potential divider.

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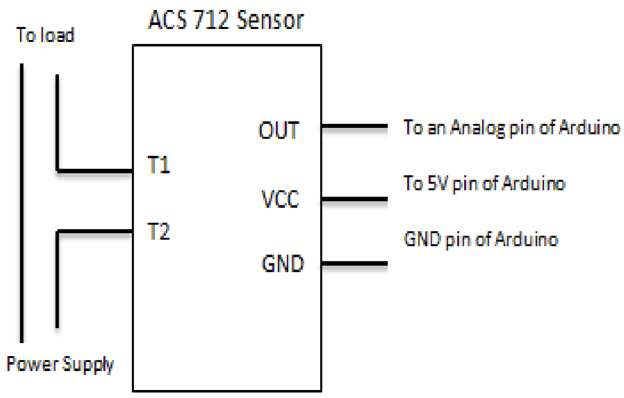

Fig.4: Current Sensor Circuit

C. Process Flow Chart

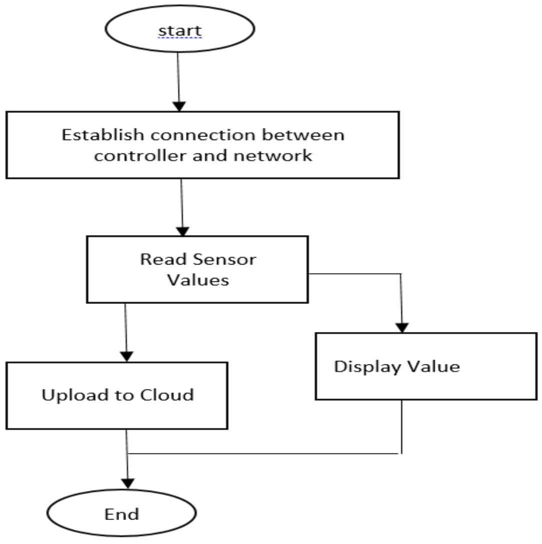

Fig. 5: Process Flow Chart

The layout of solar monitoring devices and the dissemination of the data via the IoT are the main objectives of this job. Where the device's energy is the primary focus of the task can be tracked using the voltage, the ESP32 can track time, and the solar power machine's display can track power and energy consumption. The device is used to measure solar energy, with the ability to store energy in batteries depending on solar power. The electricity that we can use for electrical home appliances comes from the battery [2].

Most monitoring systems use wired sensors and other components. The number of sensors that can be installed on a given system is restricted despite the fact that they are efficient due to the cost and maintenance needs. With wireless IoT installations, hardware costs and related maintenance are considerably reduced, enabling amazing monitoring capabilities and subsequent learning/AI applications. Many devices use Wi-Fi and cellular networks to communicate. Due to its extensive geographic coverage, cellular coverage is a popular choice, but it can be quite pricey. While many IT departments are reluctant to let third-party IoT devices onto their networks due to security concerns, Wi-Fi has its own set of problems. Often found in commercial solar power systems is a subscript [3].

D. Hardware Setup

The Hardware setup of the system is shown in fig. 6. The system allows the user to monitor the parameters of solar panels. The parameters that can be monitored are current, voltage, temperature, power, and energy. These parameters are monitored at intervals of time. The interval of time can be set on per daily basis or on a fixed gap of time. The parameters are measured using different sensors.

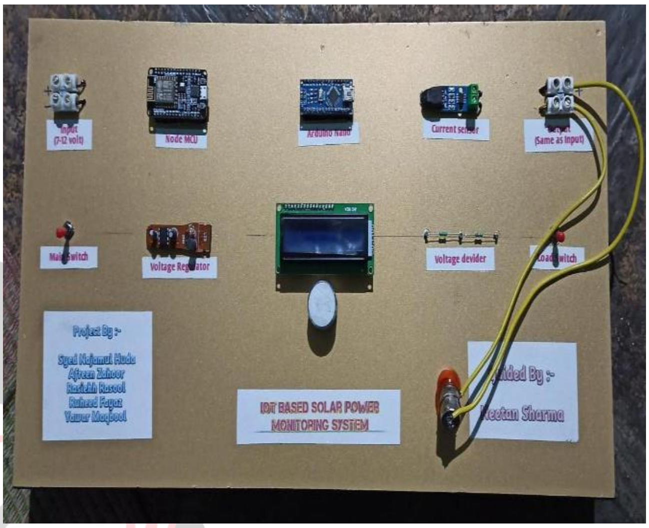

Fig.6: Hardware Setup

IV. Result and Discussion

The graphs provide information about the working and generation data by parameters to the user focusing on the real-time generation parameters.

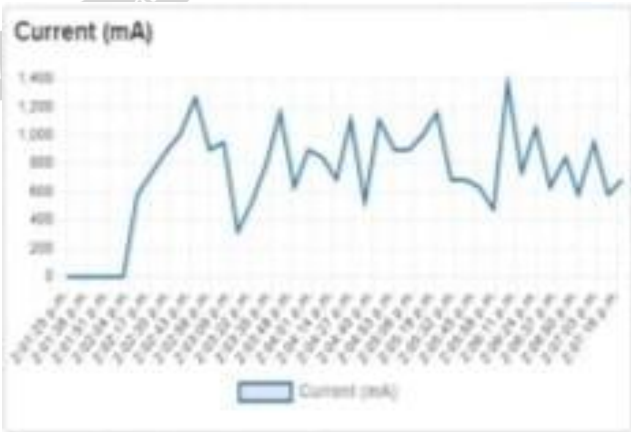

Fig.7:Current Graph

In Fig. 7 graph represents the current when the load gets lit itself, it's the real time presentation of loads behavior towards the current which is used to get our load live. The graph shows a certain time cycle of the load from start to end respectively.

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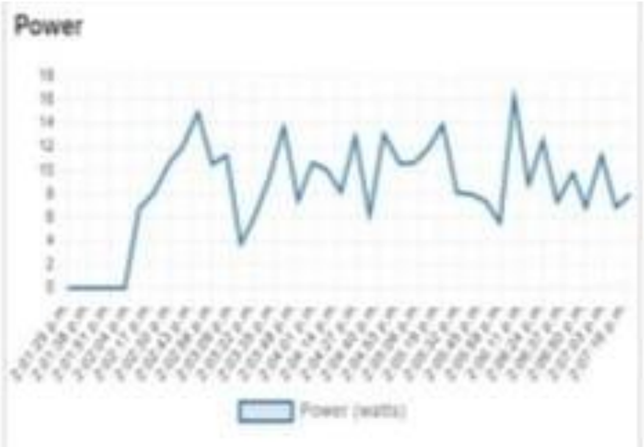

Fig.8: Power Graph

In fig 8 the graph represents the power derived by the load itself, it's the simple presentation of the power which is used to get our load live, and the variation in the real time consumption of power.

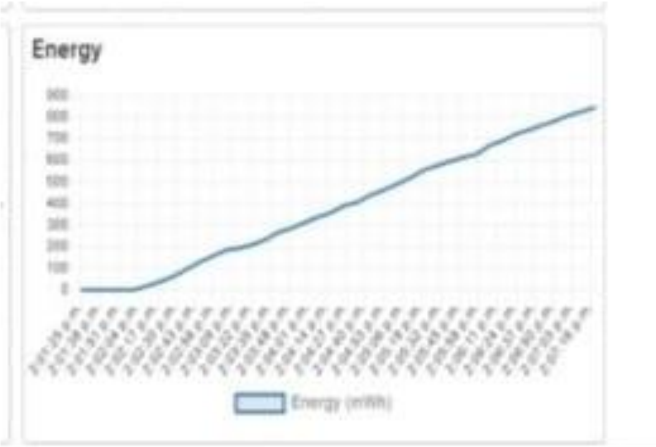

Fig. 9: Energy Graph

The graph shown in fig.9 represents the energy consumed by the load itself, when the load is on and the Voltage and current applies to the load hare we can se the energy output in graphical form

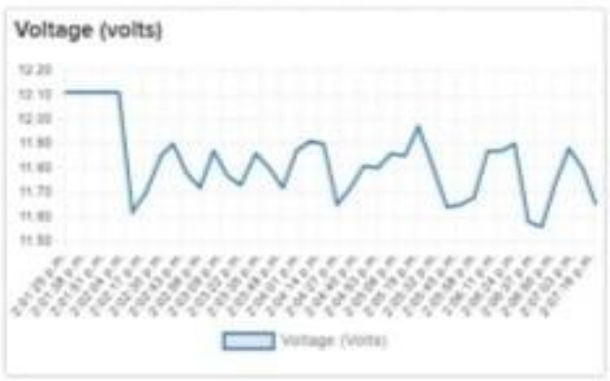

Fig. 10: Voltage Graph

The graph represents the potential difference generated by the solar panel itself, this is also real time presentation of Voltage which is drawn by the load, at the start of the graph shown in fig.10, the Voltage available without load and the further variation in graph represents the Voltage drawn by the load respectively as per requirement.

CONCLUSION

The 25 Watt solar panel's power, current, voltage, and temperature are all tracked for this study. A 10W DC servo motor is powered by a 12V 5Ah lead acid battery that has been charged with energy from solar panels. Using the Thing Talk platform, sensor output data graphs for the parameters under observation were obtained. This project demonstrates how simple it is to use a solar energy application that allows users to record data, analyse it, and forecast how much energy the installed solar energy system will produce. The outcomes of this project can be used to improve it in the future. The observed values can be used to forecast the values of the system's operational parameters.

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