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Implementation of Dual Energy Meter using IOT

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Abstract: ***Solar energy is a renewable resource. The power is sent by the electricity department and billing will be done to the supplied load. This type of billing system is little time consuming and very expensive. This conventional Electrical billing system can be replaced with dual energy meter by utilizing the solar power at home and also to send the remaining amount of power to the electricity department if, excess amount of power is produced. We introduce Internet of Things for tracking the solar generation unit to monitor the collected power, usage and Reselling the power to Electricity board. All data's will be store into cloud. So user can view the data at anytime.***
Keywords: Solar energy, Dual energy meter, Internet of Things.

I. INTRODUCTION

In human evolution, mankind has exploited naturally available resources such as Wind, Water & Solar energy. The availability of resources restricts the use of Wind and Water energies as alternative power sources. But Sun is available since birth of solar system and will remain there as single infinite energy source. There are some hopes that the sun will become a main source of energy in the 21st century. By then, sources of oil will be almost exhausted and will only play a minor part in the supplying of energy. The present interest in solar energy is therefore not surprising. Some work has already been done with solar cells and solar panels .Most of the energy that we get from the greatest reservoir of energy, the Sun, remains unused. The only way to store the energy from the sun is to convert it into electrical form and then using this electrical signal to charge batteries and thus store the energy in chemical form. For this we make use of solar panels consisting of solar cells. The solar cell gives an electrical output which is proportional to the intensity of light falling over it. The readings at our home will be noted down by the controller which we are consuming and amount we are producing is also being noted. If the production is equal to the consumption at home then there will be no bill to be paid at that month. If the production is less than the consumption then the bill will be produced to the remaining number of units and if there is excess power that can be diverted to Electricity Board and also can get the money from them. All this details will be displayed on the LCD.



Fig 1: Solar Energy

A dual electrical energy meter is an advanced device that measures and records the amount of electricity consumed by a household or a commercial facility. Unlike traditional meters, smart meters have advanced features that enable them to communicate with the utility company and transmit data in real-time. This two-way communication allows for greater control over energy usage and more accurate billing. Smart meters are an important component of the smart grid, which is a modernized electrical grid that incorporates digital technology to improve efficiency, reliability, and sustainability. By providing real-time data on energy consumption, smart meters enable both consumers and utility companies to make informed decisions about energy usage.

In addition to providing accurate and timely energy usage information, smart meters can also detect and alert homeowners to potential issues such as power outages, voltage fluctuations, and equipment malfunctions. This early detection can help prevent costly repairs and reduce the risk of electrical fires. The other novel feature of this system is to check the day-light intensity and accordingly switches the appropriate loads. This decision is done by electronics means and one or two loads are switched on, which are needed to that condition.

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II. METHODOLOGY

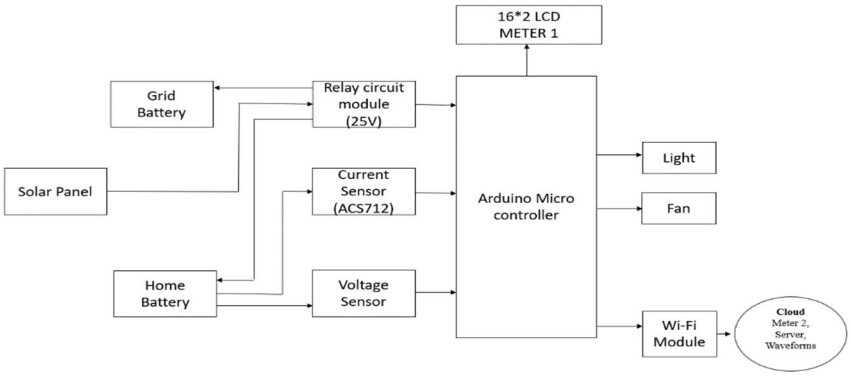


Fig 2: Block Diagram of Dual Energy Meter

Solar panels, also referred to as photovoltaic panels, are built from a large number of individual solar cells. This absorbs solar energy or photon energy and it converts this into electrical energy. There are 2 sets of Li-ion batteries used here one for the domestic purpose and another for sharing the electricity to Electricity Board. During non-peak hour, we don't utilize much power then the battery will be charged fully, As the battery is fully charged the extra energy coming from the solar panel is not used anywhere. To utilize such energy without wasting it, we will shift the power line towards the grid battery. The relay circuit is connected to this batteries where it aims in closing and opening the circuit electronically as well as electromechanically. ACS 712 current sensor is the sensor that can be used to measure and calculate the amount of current applied to the appliances without affecting the performance of the system. A voltage sensor that can be used to measure and calculate the amount of voltage applied to the batteries without affecting the performance of the system. The amount of energy we have utilized for domestic application and amount at energy we have supplied to the grid both will be measured using voltage and current sensors and is controlled by Arduino. The WIFI module acts as a transmitting station where it is connected to the cloud wirelessly and provides the information and the waveforms of the current used, saved, provided and sold of individual users. The cloud (ThingSpeak) holds the database about the basic information of owners, the amount of electricity they use, store, purchase or sell will be recorded here and the billing will be done according to this information at the month end. Here in this proposed system Arduino Uno is used and programmed using Arduino software. An LCD module is used to display all the data of solar power, battery power, sale unit, purchase unit. This gives the consumers a clear view about energy usage. Here we are going to assume battery as a grid. If the battery power and solar power is less than threshold value, home appliances will be connected to grid so that we will be purchasing energy from the grid. If the battery power is greater than threshold value, then solar panel will be connected to grid so that we will be selling energy to grid directly to avoid wastage of solar energy. Here we are implementing IOT concept using ThingSpeak software where all the data are stored in to cloud so that user can visualize and analyses live data stored in the cloud ThingSpeak web page is used for displaying the information of our project which we have posted by our device to ThingSpeak. Ex: solar voltage, battery voltage, purchase unit, sale unit etc.

III.IMPLEMENTATION

Installation of Solar Panels: The first step is to install solar panels at your home or business. This involves selecting the right type of panels and positioning them in a way that maximizes their exposure to sunlight.



Fig. 3: Solar panel Installation

Installation of Dual Energy Meter: Once the solar panels are installed, the next step is to install a smart energy meter. This meter will monitor the amount of energy generated by the solar panels and track how much energy is being consumed in real-time.
Connection to the Grid: Once the solar panels and smart energy meter are installed, they need to be connected to the power grid. This is typically done by installing a special inverter that converts the DC power generated by the solar panels into AC power that can be used by the grid.

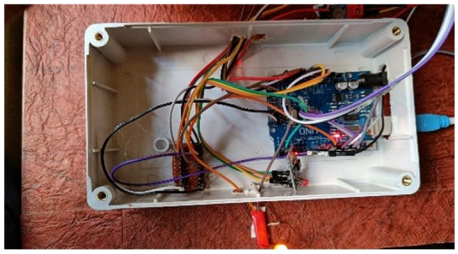


Fig. 4: Arduino connection

Monitoring and Analysis: With the solar panels and smart energy meter connected to the grid, you can start monitoring the amount of energy being generated and consumed in real-time. This data can be analyzed to identify opportunities for further optimization and efficiency improvements.

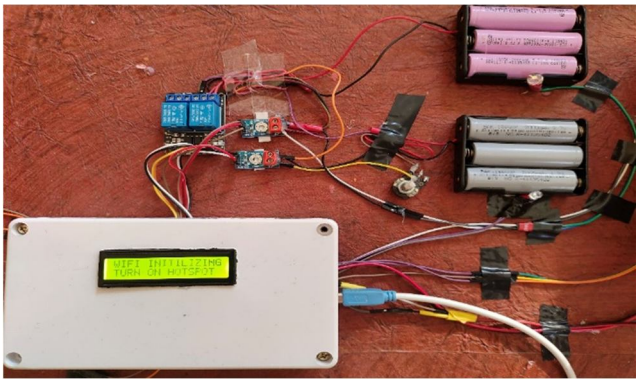


Fig. 5: Monitoring and Analysis

Smart Energy Management: One of the main benefits of Dual energy meter is the ability to manage energy usage intelligently. By analyzing energy consumption patterns, the meter can help you optimize energy usage to minimize waste and reduce costs.
Integration with Smart Home Systems: Finally, a smart energy meter can be integrated with other smart home systems, such as smart thermostats, to further optimize energy usage and improve overall efficiency.

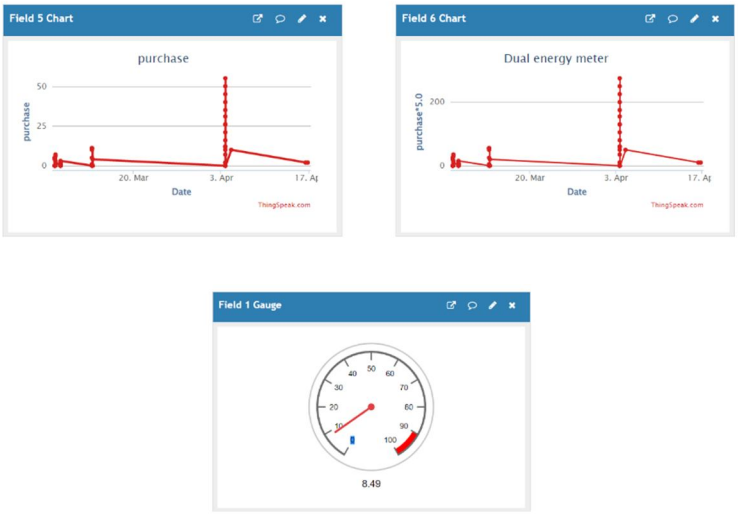


Fig. 6: Smart Energy Management

A. Results

The proposed system works on three conditions

1) Condition 1

When Home battery < 12V AND Solar Output > 11V: Solar panel is connected to the Home battery and Home battery starts charging as shown Fig. 7

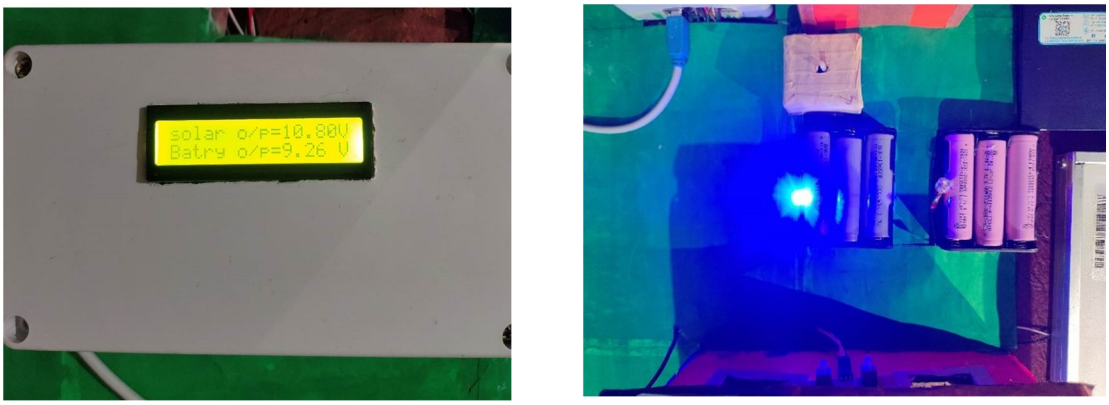


Fig. 7: Home battery starts charging when Home battery < 12V AND Solar Output > 10V

2) Condition 2

When Home battery is Full AND Solar Output > 11V: Generated Energy is diverted to the grid battery ,the grid battery starts charging and the Energy meter records the number of sold units as shown in Fig 8 .



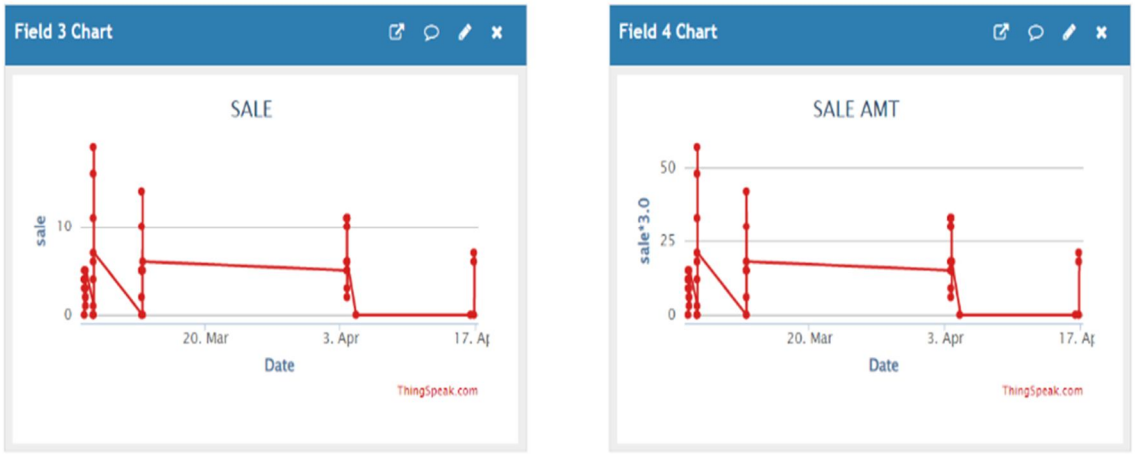


Fig. 8: The grid battery charging when Home battery is Full AND Solar Output > 11V with sale graph

3) Condition 3

When Home battery <10V AND Solar Output < 11V: The home battery starts buying power units from the electricity board and The bought unit is recorded in the energy meter as shown in Fig 9.

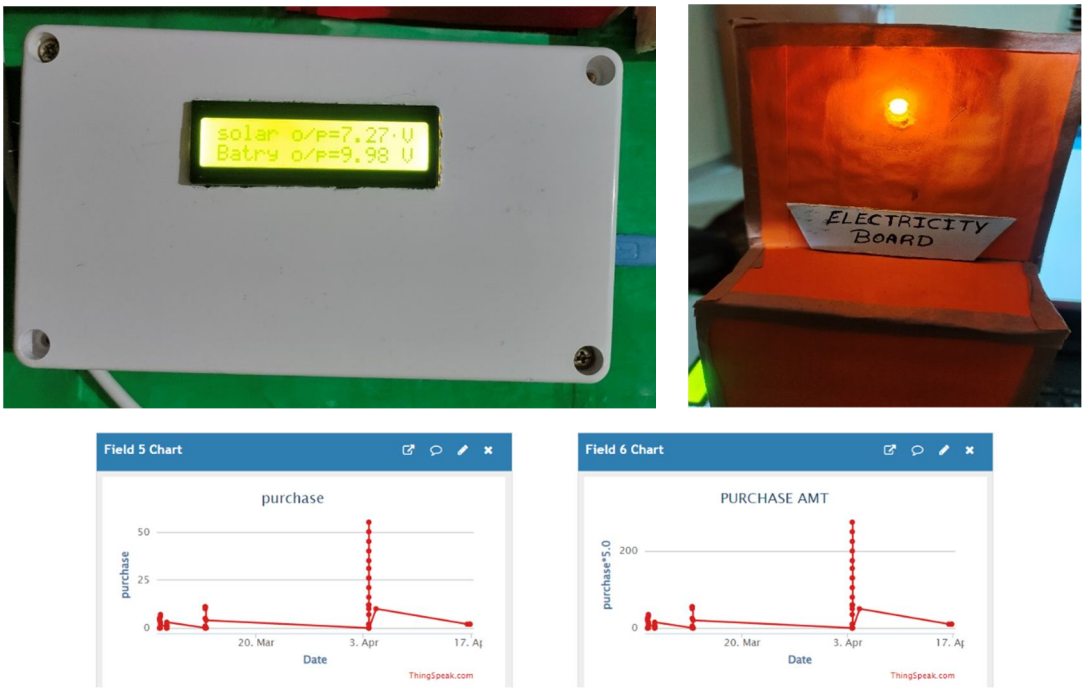


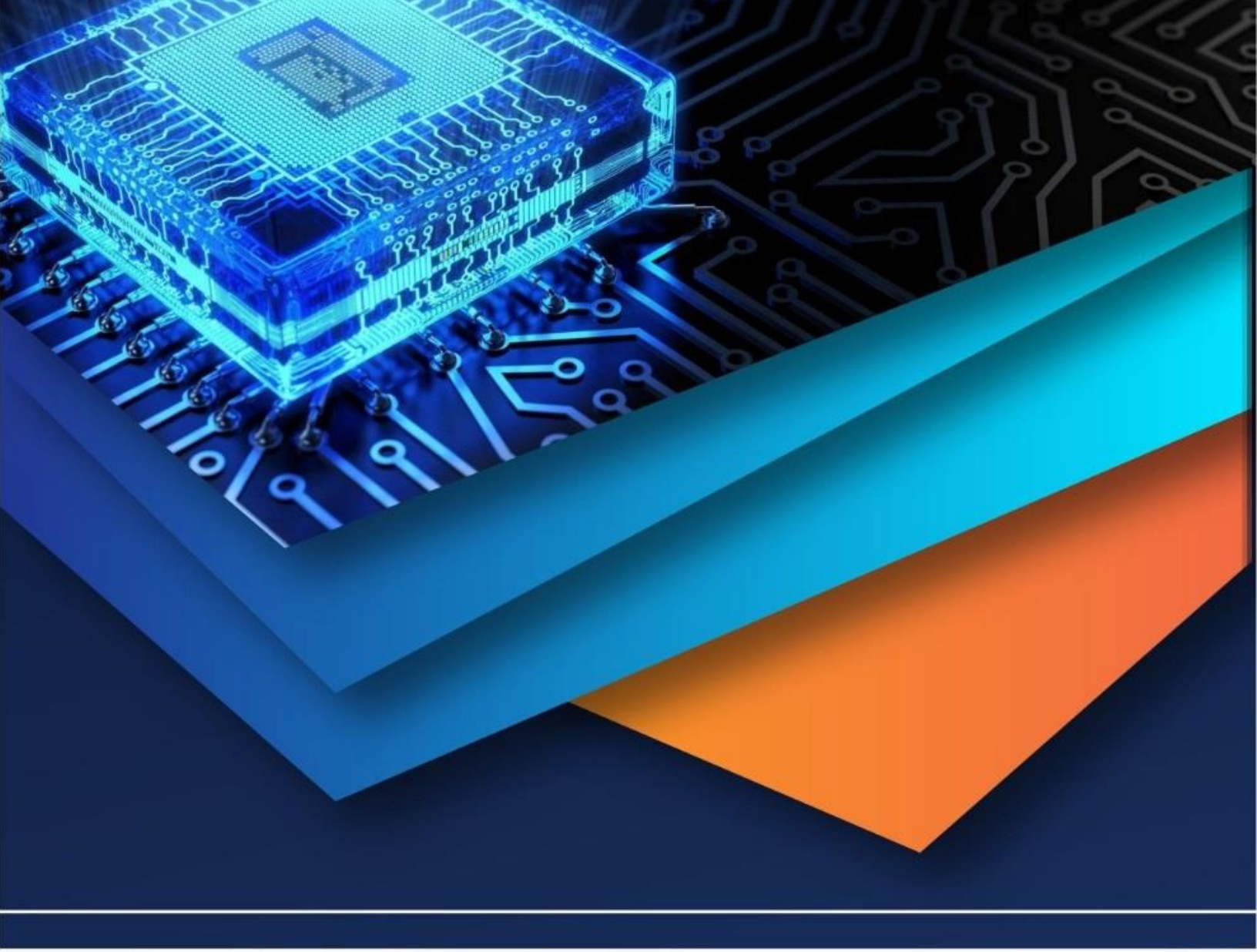
Fig. 9: Buying electricity from Electricity Board when Home battery <10V AND Solar Output < 11V with purchase graphs

IV. CONCLUSION

The existing type of billing system is little time consuming and very expensive. This conventional Electrical billing system can be replaced with dual energy meter by utilizing the solar power at home and also to send the remaining amount of power to the electricity department. In the proposed system, the implementation of dual energy meter can offer numerous benefits, including real-time monitoring, automatic data collection, efficient energy management, and cost savings. Dual energy meters can provide accurate billing, promote energy conservation, and encourage the integration of renewable energy sources into the grid, making them a valuable tool for both utilities and customers alike.

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