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Agile – Controlled Solar Metering System using IOT and Ubidots

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ABSTRACT
This project introduces an innovative solution: an Agile-Controlled Solar Metering System that utilizes IoT and the Ubidots platform for real-time monitoring and control of solar energy production and consumption. Traditional electricity meters often cause concern with high bills, requiring manual checks. With our smart energy meter using an ESP32 Wi-Fi module, users can monitor appliance load consumption in real-time from anywhere globally via smartphones. This IoT-based system provides convenience, allowing control over devices based on power consumption and budget management.
Keywords: Agile-Controlled, Solar Metering System, Ubidots IoT platform, Electricity meters

I. INTRODUCTION

The Internet of Things (IoT) serves as a catalyst for interactions between machines, humans, and the environment. This concept allows everyday devices to connect over the internet, facilitating remote analysis of connected devices. IoT establishes a crucial infrastructure for bridging the gap between the physical world and computer-based systems. With the proliferation of wireless devices in the market, the IoT concept gains significance. The system employs the ESP-32 Wi-Fi module to enable internet connectivity. The escalating demand for electricity for various purposes, such as agriculture, industries, households, and healthcare, poses challenges in managing electricity maintenance and requirements. To address these complexities and the increasing demand, there's a pressing need to conserve electricity. As the newer generations demand more electricity, technological advancements become essential. The proposed system represents a significant leap forward from traditional energy meters by leveraging IoT technology, providing a 180-degree technical shift. The system tackles issues like power theft, which contributes to economic losses for the country. The key objectives include monitoring, optimizing power usage, and reducing power wastage, ushering in a more efficient and advanced energy management system. The Internet of Things (IoT) catalysesinteractions between machines, humans, and the environment. This concept allows everyday devices to connect over the internet, facilitating remote analysis of connected devices. IoT establishes a crucial infrastructure
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II. DESIGN METHODOLOGY

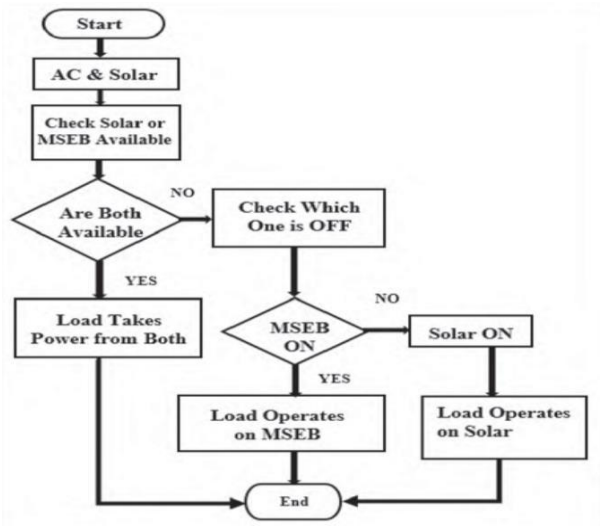

Figure1:Flow Chart

$V/Rpv = V/Rph – V/Rsat[q(I*Rpv + V/RpvRs/AKT – 1], V/Rph = \lambda/1000[V/Rsc + K1(t – 25)]$

where V/Rph is the photocurrent of the solar cell, the generated photovoltaic current is V/Rpv and the equivalent photovoltaic voltage is pv. I*R For a simplified model the shunt resistance Rsh is neglected because of its large value. Also, the small series resistance Rs is neglected. Therefore, the following equation can represent the PV characteristic

III.SYSTEM DESIGN

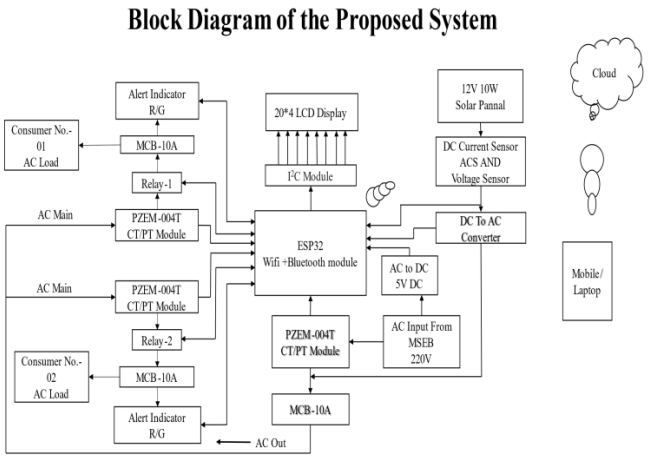

Figure2:Block Diagram

The system works as follows:

A. Solar Plate

Solar radiation may be converted directly into electricity by solar cells (photovoltaic cells). In such cells, a small 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. (See photovoltaic effect.) The power generated by a single photovoltaic cell is typically only about two watts. By connecting large numbers of individual cells together, however, as in solar- panel arrays, hundreds or even thousands of kilowatts of electric power can be generated in a solar electric plant or in a large household array.

B. DC Current Sensor(ACS712)

ACS712 Current Sensor Module - 30A can sense upto 30A of current flow. Sensing and controlling the current flow is a fundamental requirement in wide variety of applications, which includes over-current protection circuits, battery chargers, switching mode power supplies, digital watt meters, programmable current sources, etc.

C. DC Voltage Sensor:Voltage Input Range

DC 0-25V - This is the range of input voltages that the sensor can measure. It can accept voltages from 0V to 25V DC. Voltage Detection Range: DC 0.02445V - 25V - This specifies the range over which the sensor can detect and accurately measure voltages. It can measure voltages as low as 0.02445V (24.45mV) up to 25V.

D. DC TO AC Converter:Input Voltage

12V DC - This is the voltage level of the DC power source that the inverter accepts. Output Voltage: 220V AC - The inverter produces a sinusoidal or modified sine wave AC output voltage of 220 volts, which is compatible with standard household appliances and electronics in many regions.

E. ESP 32(Wifi + Bluetooth)

esp32 development board wifi+bluetooth, dual-coreesp 32 esp 32s esp 32 similar esp8266 esp32 is integrated with antenna and rf balun, power amplifier, low noise amplifiers, filters, and power management module. The entire solution takes up the least amount of printed circuit board area. This board is used with 2.4 GHz dual mode wi fi and Bluetooth chips by tsmc 40nm low power technology, power and rf properties best, which is safe, reliable, and scalable to a variety of applications.

F. AC Sensor=Voltage +Current + P.F + Frequency (PZEM-004T)

This document describes the specification of the PZEM-004T AC communication module, the module is mainly used for measuring AC voltage, current, active power, frequency, power factor and active energy, the module is without display function, the data is read through the TTL interface.

G. LCD Display

5V DC 20 x 4 Lines ASCII Character HD44780 LCD Display With BLUE Backlight Product Overview Product Description: o LCD display module with BLUE Backlight o SIZE : 20x4 (4 Rows and 20 Characters Per Row) o Can display 4-lines X 20-characters o Operate with 5V DC o Wide viewing angle and high contrast o Built-in industry standard HD44780 equivalent LCD controller o Commonly Used in: Student Project, Collage, copiers,

fax machines, laser printers, industrial test equipment, networking equipment such as routers and storage devices o LCM type: Characters ABOUT This is a basic 20 character by 4 line display BLUE Backlight . Utilizes the extremely common HD44780 parallel interface chipset (datasheet). Interface code is freely available. You will need 7 general I/O pins(If use in 4-bit Mode) to interface to this LCD screen. Includes LED backlight.

H. Ubidots

The proposed system can be used to display load energy usage reading in terms of Watts along with money drawn by the devices. The data would be accessed by each and every user from anywhere in the world. Ubidots.com is one such webpage which takes the help of the MathWorks MATLAB analytics to present the device information in a more detailed analysis in both description and visualization.Ubidots.com provides the user to add any number of channels to at least one account and in each account information are fed into 8 fields. An account may be assigned at least one division of an area and n channels are often created to a set of n meters within the locality. The analytics can be viewed by both the consumer and service provide.

I. Relay

The dual-channel relay module can be used to switch mains powered loads from the pins of a microcontroller. Since there are two channels on the same board, two separate loads can be powered. This is useful for home automation.

J. MCB

1) Current Rating: 10 amperes - The MCB is designed to trip and disconnect the circuit when the current exceeds 10 amperes.
2) Breaking Capacity: The breaking capacity indicates the maximum fault current that the MCB can safely interrupt without sustaining damage. It's typically expressed in kA (kiloamperes) and can vary depending on the specific MCB model. Common breaking capacities for MCBs range from 3 kA to 10 kA or more.

TABLE I COMPONENTS USED AND THEIR SPECIFICATIONS

Component	Specification
Solar Plate	10 watts
DC Current Sensor(ACS712)	Voltage: 4.5V ~ 5.5V DC Current Range: -30A ~ 30A
DC Voltage Sensor	0V to 25V DC.
DC TO AC Converter	Input Voltage: 12V DC Output Voltage: 220V AC
ESP 32(Wifi + Bluetooth)	dual core esp 32
AC Sensor	V :80-260V I: 0~10A
LCD Display	20*4
LED	Indicator
Load	100 W and 200W Bulb
Relay	Content: 1x 2 channel 5v relay module
MCB	10A

IV. RESULT AND ANALYSIS

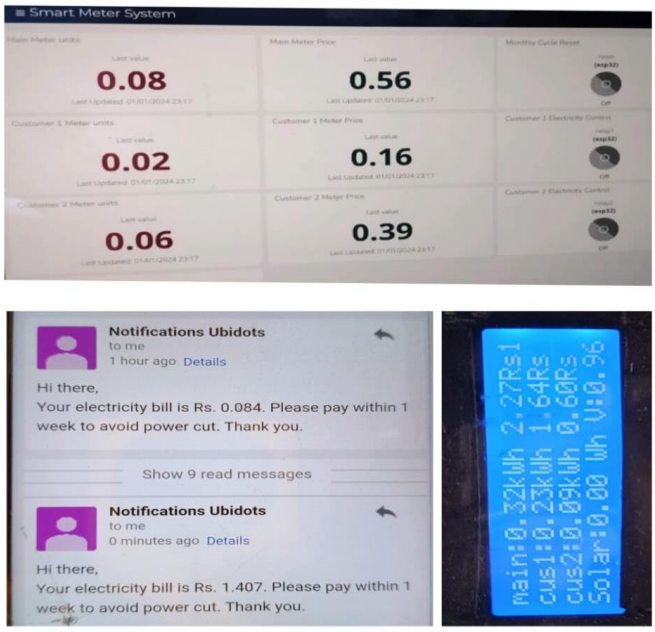

Figure 3 : OUTPUT On LCD And Ubidots

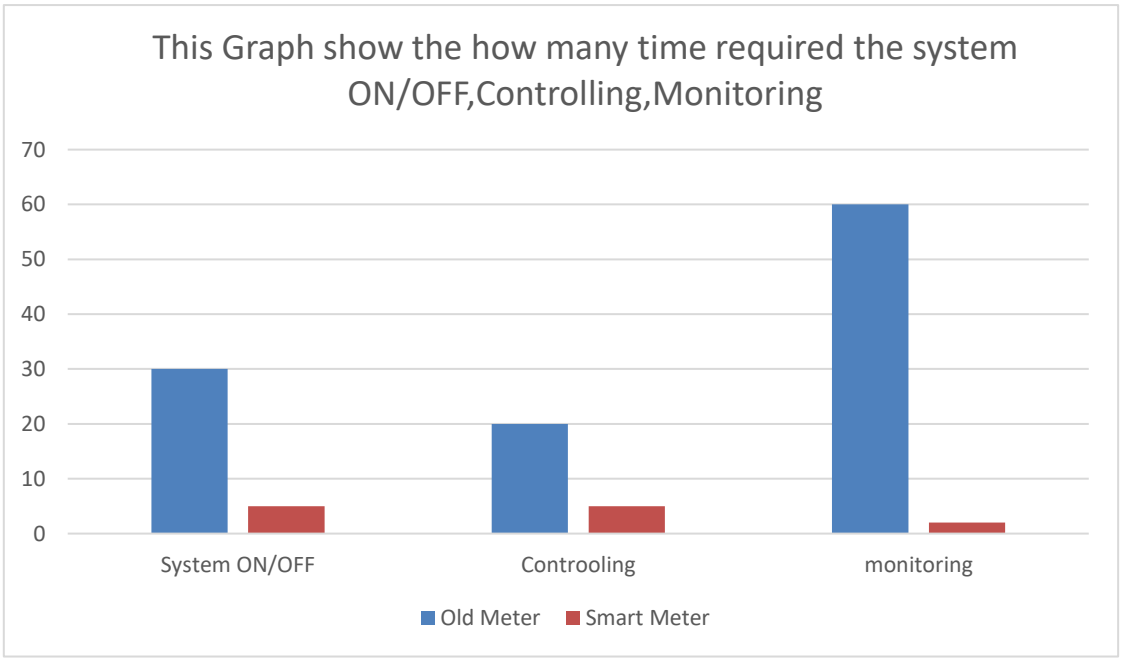

Figure 4 : Difference of Old Meter And Smart meter

A. System On/Off

- Old Energy Meter: Traditional energy meters typically don't have the capability to control the system on/off remotely.
- Smart Meter: Smart meters often come with remote switching capabilities, allowing utilities or homeowners to remotely turn the power supply on or off.

B. Controlling

- Old Energy Meter: Old energy meters do not have any controlling capabilities.
- Smart Meter: Smart meters can provide two-way communication between the utility and the consumer.

C. Monitoring

- Old Energy Meter: Traditional meters typically require manual reading by utility personnel or, in some cases, by the homeowner.
- Smart Meter: Smart meters offer real-time monitoring of energy consumption.

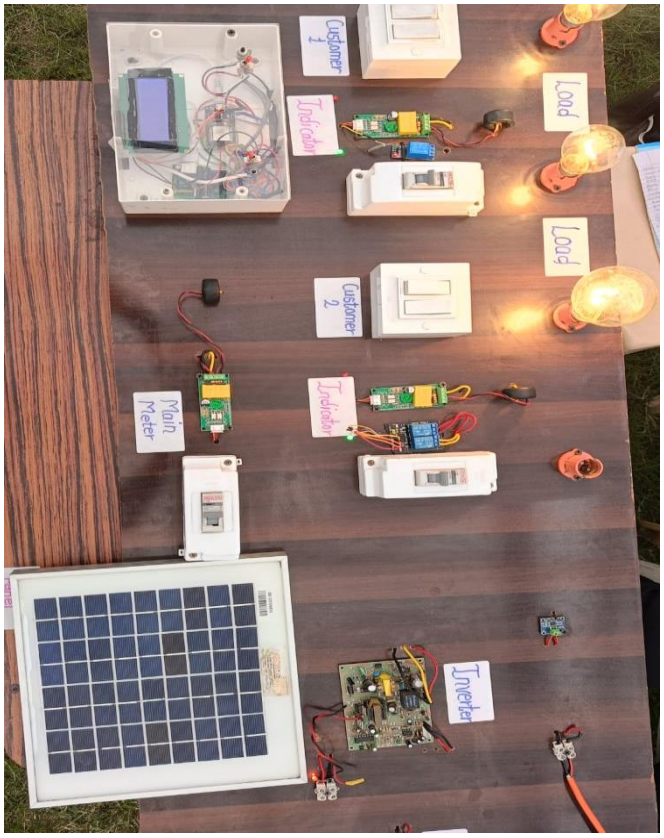

Figure5: Model

V. CONCLUSION

Energy Monitoring through IoT is an innovative and crucial application that is poised to play a significant role in the years to come. This application allows the remote control of home appliances from anywhere globally through cloud connectivity. The proposed project employs a current sensor to detect and display current information on the web using IoT. The system updates information approximately every 3 to 4 seconds, considering a slight delay due to the relay module's connection with appliances for home automation. In this new system, Wi-Fi technology is utilized to access and monitor the load consumption of appliances, empowering consumers to avoid unnecessary electricity usage. The project introduces an IoT system that enables consumers to monitor energy consumption, pay bills online, and receive SMS notifications in case of overdue electricity bills. Additionally, the system offers the advantage of home automation, enhancing the overall functionality and utility of the project.

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