

# Implementation of Iot Based Monitoring and Controlling Solar System



Vinayak k. Bhatiya, Bharat V. Tank, Nishant Sonawala

**Abstract:** The IoT based system sense, controlled or monitoring remotely to the existing over network structure. With help of IoT creating connectivity computer operated system. The IoT based monitoring and controlling solar system using this system online display uses of power, voltage, current, temperature, weather condition, tracking sun light and dust cleaning with help of wipers. All this monitoring and controlling is done through ATmega328 controller, ModBus to TTL convertor, ESP8266, etc. using this system monitoring to the analysis of the daily uses of data and controlling solar wipers and sunlight toward movement of solar panel.

**Keywords:** Atmega328p au controller, ESP8266, ModBus, MQTT, IoT.

## I. INTRODUCTION

The Internet of Things (IoT) is a system of connection between computing devices to physical device, mechanical devices, objects, animal or people connected to the internet, all collecting and sharing data. That provides unique ID and the able to communicate or transferring data without any Human-to-Human or computer interaction. For example of IoT device like smart home automation in all equipment (light, TV, AC, Fen, etc. ) Interconnected using internet and all operated using the smart phone. We use our project MQTT protocol MQTT is message queuing telemetry transport protocol. Design as a lightweight, broader range of MQTT, binary protocol that uses publish/subscribe operation to change the data between clients or the server. Publish/subscribe pattern: is also alternative to the traditional client-server architecture. Client-server model in client communicates direct to the end point and publish or subscriber model decouple the client sent message (publish) from client or client received that message (subscriber). The publishers and subscribers never contact each other.

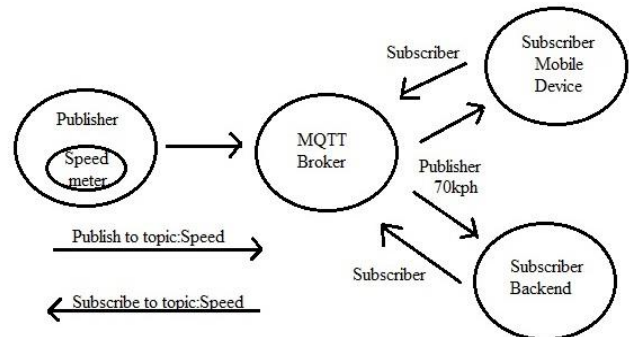


Fig.1. MQTT Publish-Subscribe Architecture

Broker is the hearts of the any publish or subscribe protocol. The broker is the job of all receiving messages filtering the message. And sending the message to this subscribed clients. MQTT broker is specific business needs in the age of machine-to-machine communication (M2M) And Internet of Things (IoT). ATmega328p-au 8-bit controller is 32 pin counts (TQFP-package) that use our system the high performance, low power consumption external and internal interrupt it had advance RISC Architecture the capacity of flash memory is 32kb, clock frequency is 20Mhz. maximum-voltage 5.5V or minimum-voltage 1.8V. Another component we use our system ESP8266 Wi-Fi module it is IoT enabled device. that is self contained SoC with TCP/IP protocol that can access any microcontroller using wi-fi network. ESP8266 is the low cost and high feature device. Last one component we use ModBus to TTL module with protection & auto transmit/receive switching this RS485-module is the receive data from the hybrid inverter and this data is hex form that data convert and transfer to the ATmega328 controller and this data is transfer to the cloud using ESP8266 wi-fi module with help of MQTT protocol.

## II. LITERATURE STUDY

We study In the[1] this proposed system use the raspberry pi, Arduino, using data uploading to the cloud. Raspberry pi is the use central monitoring Raspberry pi is low cost and portable system very easy to handle this system compared to another system. The main focus of this work is the Power system can be monitor using the voltage and current value sensed by using Arduino. The continue watching of the solar system shows the power and energy data. Help of the system to implement smart grid by easy usage.In[2] this literature survey we study the IoT platform these data from the no. of solar panels and analytics data to share the information with specific address. Use the components of the system is the voltage sensor, current sensor, ATmega 328, power supply wi-fi module and LCD. From the solar panel output is goes to the current sensor and voltage sensor this both sensor data is the pass to the controller and pass the lcd and wi-fi module. Wi-Fi module is the pass the

Revised Manuscript Received on March 30, 2020.

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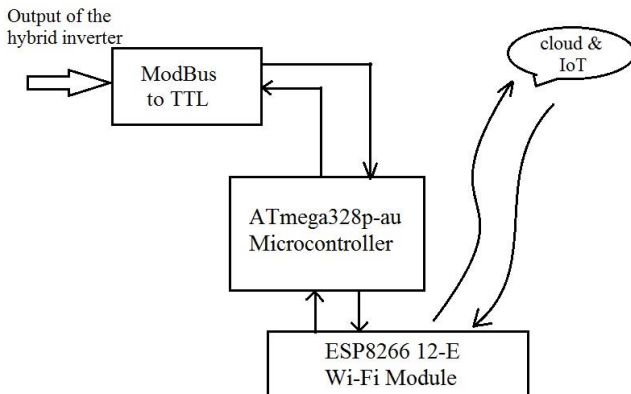
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data on cloud. In[3] this literature survey study the MPPT method (maximum power point tracking ) in this system main focus on continue rotate the solar panel towards the direction of the highly intensity of sunlight. In this system major use of the microcontroller, voltage measurement, PWM method and MPPT method using create hole proposed system. In[4] this literature survey we study the basic of the proposed system the monitoring and controlling voltage output and current output using internet of things (IoT). Iot provide the remotely access the system and operate the distance location and real-time application. Send information to the receive side the data is coded signal form. This[5] literature studied the proposed method in this method use the main components is the LDR, GSMA, PV, Node MCU, LCD etc. main focus of this project to get an optimum power output from the PV. Solar panel is monitoring the sunlight through different parameters like current, voltage and temperature are displayed on the LCD by using Internet of Things. In this proposed system have open source cloud platform application they are use think speak. Get the data from sensor or the things connected system using internet that uses hypertext transfer protocol from the local network to the cloud. It all getted data logs received to the sensors.

### III. DESIGN AND DISCUSSION

Our system is the Implementation of iot based monitoring and controlling solar system in this system we use the major component is the namely ATmega328p-au controller, ModBus to TTL convertor, ESP8266-12e Wi-Fi module.



**Fig.2. Block diagram of the proposed system**

Study the many research paper and we finalized the system we use the output of hybrid solar inverter. Solar inverter is the many types

1. DC Solar Inverter System
2. off grid Solar Inverter System
3. on grid Solar Inverter System
4. Hybrid Solar Inverter System

In DC Solar Inverter System 70% save the electricity when use the DC appliances. For example DC 54 inches fan use the  $P=V \cdot I$ ,  $V=12v$ ,  $i=2.08A$ ,  $P=25watt(55\% \text{ save})$ . AC 54 inches fan  $P=V \cdot I$ ,  $V=220v$ ,  $i=0.36A$ ,  $P=80watt$ . In Off grid Solar Inverter System for example solar produce the 300w and need operate the load 200w then 100w Is the Sharing with the battery. Battery capacity is the 1800w and efficient charge need 180w so, 100w from solar and left 80w from mains so charge efficient. Battery is the fully charge then not overcharge because this handled throw the intelligent charging sharing feature. The absence of sun light then off the

produce energy so operate through battery. On grid Solar Inverter System In this system need mains Supply. For example in this system solar produce the 300w and u need 200w so, other 100w is the save for the future use using bi-direction meter. No need battery. Hybrid Solar Inverter System in this system work as off grid and on grid solar system. For example in this system solar produce the 300w and u need 200w so, other 100w is the save for the future use using bi-direction Meter as well as not available Main supply then switch to the Battery supply. Battery is the discharge then charge both solar and mains. That's way we work with the solar hybrid inverter. Communication with controller using help of the ModBus to TTL convertor it have Transmit and Receive switching safety & both leds Indicator. Easily connect to RS485 network from microcontrollers with transmit and received pin. RS-485 is useful in industrial control systems. These taken data from hybrid inverter this data is the digital form and this modbus protocol transmit the data format show in table:

**Table.1. Modbus protocol**

| Start bit | Slave id | Function Code | Address | Data   | CRC    | Stop bit |
|-----------|----------|---------------|---------|--------|--------|----------|
| 0         | 1-byte   | 1-byte        | 2-byte  | 2-byte | 2-byte | 1        |

Communication between master and slave, master gives request to slave and slave response to the master. They have master slave architecture. Each slave network is assigned a unique address from 1 to 247. Modbus industrial serial protocol makes communication between automation devices it is used with programmable logic controllers. It transmits the information over serial lines that exist between electronic devices.

**Table.2. Function code**

| Function Code | Action         | Table Name                      |
|---------------|----------------|---------------------------------|
| 01 (01 hex)   | Read           | Discrete Output coils           |
| 02 (02 hex)   | Read           | Discrete Input Contacts         |
| 03 (03 hex)   | Read           | Analog Output Holding Registers |
| 04 (04 hex)   | Read           | Analog Input Registers          |
| 05 (05 hex)   | Write single   | Discrete Output coil            |
| 06 (06 hex)   | Write single   | Analog Output Holding Register  |
| 15 (0F hex)   | Write multiple | Discrete Output coils           |
| 16 (10 hex)   | Write multiple | Analog Output Holding Registers |

Communication Data Format:



Table.3. Data Format

| Data Type     | Amount of Register | Amount of Byte | Description                                     |
|---------------|--------------------|----------------|---|
| Short integer | 1                  | 1              |   |
| Integer       | 1                  | 2              | High byte first, and low byte follow            |
| Long integer  | 2                  | 4              | As 2 words, high word first and low word follow |
| Float         |                    |                |   |

For Example:

Read lowest PV voltage for feeding power (Single register at once)

Send Command To The Inverter From Modbus:

| 01H              | 03H           | 00H                       | 00H                | 00H,01H               | 84H | 0AH |
|------------------|---------------|---------------------------|--------------------|-----------------------|-----|-----|
| Inverter Address | Read Function | First Address of register | Amount of register | CRC Verification Code |     |     |

Inverter Response:

| 01H              | 03H           | 02H             | 0AH               | F0H              | BEH                   | A0H |
|------------------|---------------|-----------------|-------------------|------------------|-----------------------|-----|
| Inverter Address | Read Function | Amount of Bytes | High byte of Data | Low byte of Data | CRC Verification Code |     |

Data is 2800, and the unit for the data is 0.1v, so actual value is 280.0v

ATmega328 controller get the data from ModBus to TTL converter in the controller already hundred or more command are uploaded through the coding we choose the ATmega328 because this controller many featured like it has 32 pins in total. It has total 3 Ports are named as Port B, Port C and Port D. Port C is a analogue Port and total six pins. So ATmega328 has 6 analogue pins. Port B and Port D are digital ports and it has 7 pins each. So ATmega328 has 14 digital pins. It also supports Serial Communications and SPI protocol we can perform serial communication via Pin 2 receiver and Pin 3 transmitter. It is the use for crystal oscillator for generating the frequency. It is ranging from 4MHz to 40 MHz. other use in our system ESP8266 Wi-Fi Module ESP full name (Espressif Systems protoco). The ESP8266 is a low-cost Wi-Fi module with full TCP/IP protocol and microcontroller capability. It's small module provide microcontrollers connect to a Wi-Fi network and make simple TCP/IP protocol connections help of Hayes-style commands. We use the network protocol is the MQTT-message queuing telemetry transport protocol

IV. DISCUSION AND RESULT

This system is the Iot Based Monitoring and Controlling Solar System. using this system monitoring to dust, temperature, weather condition, voltages and current and controlling to the wipers, and direction of the panel toward son light solar panel. In this system use the ModBus to TTL convertor,ESP8266-12e & ATmega328p-au and basic AC operated and battery operated power supply circuits

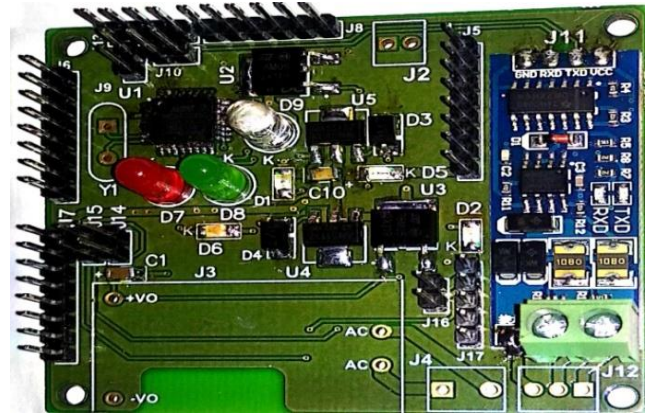


Fig. 3 Hardware PCB Top View

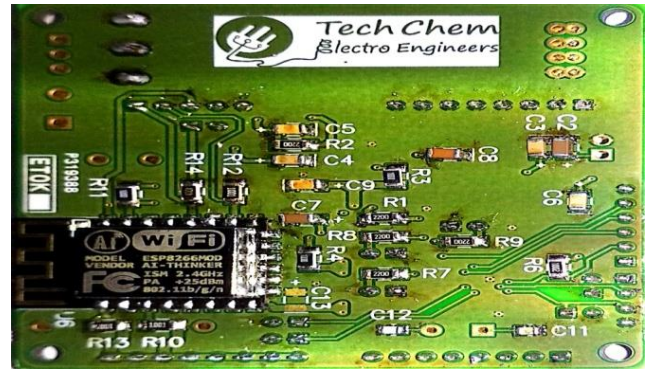


Fig. 4 Hardware PCB Bottom View

V. CONCLUSION

In this work, studied the types of solar inverter system how to work and its merit and demerits after finalized the hybrid solar inverter system I used in our project of IoT based monitoring and controlling solar system. And studied the modbus detailed and how to generate CRC from gives the data and find the result of CRC generation this data get low byte and high byte then after swapping in this code and get high byte and low byte and completed system hardware PCB And hardware ready using OrCAD Capture CIS. IoT based remote monitoring system for solar power plant the approach is studied, implemented and successfully attained. IoT based remote monitoring will upgrade energy effectiveness of the system by making use of low power consuming advanced wireless modules The proposed system refers to the online display and mobile application of the power usage of solar energy as a renewable energy. All this monitoring and controlling is done through ATmega328 controller, ModBus to TTL convertor, ESP8266, etc. using this system monitoring to the analysis of the daily uses of data and controlling solar wipers and sunlight toward movement of solar panel.

ACKNOWLEDGMENT

I would like to express my sincere thanks to Prof. Bharat v. Tank for his guidance. I would also like to express my profound gratitude to Mr. Nishant Sonawala for his external guidance, encouragement and support at every moment of my research work.



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I would also like to thank my colleagues and friend for the things that they have taught me. My greatest thanks are to the almighty God and one who wished me success especially my parents.

## REFERENCES

1. Solar Energy Monitoring System Using Iot Suprita Patila, M. Vijayalashmib And Rakesh Tapaskarc
2. Solar power monitoring system using IoT Manish Katyarmal1, Suyash Walkunde, Arvind Sakhare, Mrs.U.S.Rawandale
3. Review On Solar Power Remote Monitoring And Controlling Using Iot Dr.J.Geetha Ramani, S.Mohana Sowmiya, S.Mirunalinii, U. Nandha Kumar
4. Monitoring of Solar Energy using IOT S.Padma1 , P.U.IIavarasi, Amith Infant.B, Anusan.K
5. IoT Enabled Solar Power Monitoring System R.L.R. Lokesh Babu1, D Rambabu, A. Rajesh Naidu, R. D. Prasad, P. Gopi Krishna

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