On line monitoring and control of grid-interfaced PV system using zigbee

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Abstract. Grid connected photovoltaic system is used to watch the soundness and execution of the framework. The easiest strategy is to gather and transmit the information across information links. Customary wired checking framework gives dependable arrangement in information transmission yet experiences a few restrictions. The utilization of information links likewise builds establishment and upkeep cost. Information links are influenced by the sun pillar and downpour. Checking station should be found sensibly near the observing plant. To conquer these issue Zigbee based remote checking framework is created for web based observing of a lattice associated photovoltaic framework. A PC-based application coordinated with online capacity is planned and executed so as to permit controller of the framework just as simple access of the information over the web. Boundaries like temperature, illumination, PV power yield and framework inverter power yields are checked. To approve the presentation, the framework has been executed on 100Wp network associated photovoltaic framework.

1. Introduction
As the worldwide vitality request increments with the developing total populace, nations everywhere throughout the world are putting increasingly more accentuation on the improvement of sustainable power source. Among numerous wellsprings of sustainable power source, sun based vitality is viewed as the most encouraging and solid vitality source [1]. In the light of this, legislatures in numerous nations have given different motivations to arrangement sunlight based vitality based force plants, to supplement the current force plants which are running on petroleum product. So as to guarantee dependability and unwavering quality of a PV framework, observing framework is frequently liked. As matter of actuality, numerous ongoing sun based vitality transformation frameworks have included observing capacity as a fundamental piece of the framework to guarantee information can be gathered and broke down in precise way [2].

Ordinary wired checking framework gives dependable arrangement in information transmission yet experiences a few restrictions. Aside from the physical imperatives during laying of the information links, the utilization of these links likewise expands establishment and support cost. In addition, for open air application, for example, PV frameworks, ceaseless introduction to sun shaft and rains may diminish the life expectancy of the framework. To defeat these issues, remote observing framework is preferred over its link based partner. In this paper, a Zig Bee-based remote observing framework is structured and worked as a substitution to the customary link based checking framework for a matrix tied PV framework. This configuration makes it possible for the different parts of the framework, from plan to development and testing, is point by point here. Other than that, a PC-based application coordinated with electronic capacity is structured and executed so as to permit controller of the framework just as simple access of the information over the web [3].
2. Existing system

2.1 Wired system
So as to guarantee dependability and unwavering quality of a PV framework, observing framework is frequently liked. As far as information move instrument, both wired and remote frameworks have been presented before. For wired frameworks, information transmissions are generally done utilizing RS232 link or RS485 link with the checking frameworks being PC-based. Customary wired observing framework gives reliable arrangement in information transmission however experiences a few restrictions, for example, physical imperatives during laying of the information links, the utilization of these links additionally builds establishment and support cost. Plus, for open air application, for example, PV frameworks, consistent introduction to sun pillar and downpours may lessen the life expectancy of the framework. In this paper, the MATLAB result also shown [4].

2.2 Wireless system
To conquer these issues, remote checking framework is preferred over its link based partner. For framework utilizing remote information transmission, a more extensive assortment of information transmission innovation has been accounted for, for example, the utilization of Satellite, GSM, Bluetooth, WiFi, Zigbee and other vague RF gadgets.

2.3. Satellite
A communication satellite is an artificial satellite that relays and amplifiers radio telecommunication signals via a transponder. Wireless communication uses electromagnetic waves to carry signals. Information transmission by means of satellite was accounted for to be moderate, taking around 8 to 12min and require significant expense of establishment.

2.4. GSM
The Global System of Mobile correspondence is progressively solid with exactness of information transmission by means of SMS upto 100%. It additionally show low retransmission rate and low all out information misfortune pace of roughly 2.73% and 0.66% individually. The principle downside of GSM is its high working expense, as the client needs to pay for the information transmission administration.

2.5. RF Device
RF information transmission was a serious mainstream methods for remote information move framework. Radio correspondence has the chance of sending and getting a tremendous measure of data requiring little to no effort of transmission, and it is additionally a decent option in far off region which doesn't have phone lines. Its primary burden is the trouble in acquiring authorization for the transmission recurrence and the significant expense of its establishment.

2.6. Bluetooth
Bluetooth is one of the straightforward remote systems administration framework however it just spread the short separations contrasted with different remote systems administration framework.

2.7. Wi-Fi
Wi-Fi is the another elective innovation in remote correspondence where it is large information move geography. In any case, the main burden is the expense of Wi-Fi gadget is generally higher contrasted with Wi-Fi.
3. Proposed method

To improve the performance and reduces complexity restriction that is brought about by the current framework, another framework proposed here [5]. ZigBee is that it apportions exceptional schedule opening to stay away from information impact. At the point when the past information is still in support, ZigBee will spare the approaching information to a unique schedule opening and hold up until the cradle is cleared before recovering the information from the time allotment. In this manner, it is necessary to determine the information crash can be maintained a strategic distance from[6]. Moreover, the ZigBee work geography permit the joining of different remote hub which makes it upgradable to help enormous system limit up to 65,536 hubs contrasted with 7 and 32 hubs for ZigBee and Wi-Fi individually, While working in work geography, ZigBee is open minded to disappointment, for example, gadget drop, where it empowers the gadget to build up another connection between accessible hubs. These highlights make ZigBee a well known alternative for information transmission [7-8].

3.1. Design Specification

3.1.1. Solar panel
This block consists of solar panel to give electrical power to charge battery. It is a 22V and 51W Solar panel. The power output is varied with sun intensity, so at day time power is stored in battery and used at night (or) low intensity time.

3.1.2. Battery charger control
This block consists of a full wave bridge rectifier circuit which converts the generated AC voltage to DC.

3.1.3. Battery
This block consists of 12V/7AH for battery to store the power.

3.1.4. Temperature sensor
For this application, the heat has for fever sensors must be some place in the scope of 0°C and 100°C. Two units of LM35 Precision Centigrade Temperature Sensor are used to check the vibe and board temperature. The sensor has an evaluating range from +2°C to +150° C.Thusly, it has a touch of room over direct temperature sensors balanced in Kelvin as it encourage the arrangement technique using progressed multimeter and thermocouple. Since temperature is a moderate advancing variable, only a solitary data is obtained for each assessing stretch.[17-19]

![Square Diagram of transmitter](image)

**Figure 1** Square Diagram of transmitter
3.1.5. Solar current and inverter current detecting
Current sensor for DC and AC current must have the option to gauge input current scope of 0-80A LA25-NP is utilized as current transducer and it can quantify up to 36A DC and 25A AC current. The gadget bundle takes into account simple usage by the client. Ordinary applications incorporate engine control, load recognition and the executives, exchanged mode power supplies, and over current deficiency security. The gadget comprises of an exact, low-balance, straight lobby sensor circuit with a copper conduction way situated close to the outside of the kick the bucket. [16]

3.1.6. Light intensity measurement
Light Dependent Resistance (LDR) connected with 3.3K ohm resistor. As light falls on LDR, opposition of LDR diminishes, because of which simple voltage is produced, later apply this voltage to Arduino.

![Figure 2 Square Diagram of receiver](image)

![Figure 3 Circuit diagram](image)
4. Circuit specification
In this project, four sensors are used. The temperature sensor type LM35 which is connected to the Arduino analog input pin A0. For the measurement of light intensity, LDR is used which is connected to the Arduino analog pin A1. ACS712 is used for current measurement that is connected to the Arduino analog input pin A2. Voltage from the solar panel is connected to the voltage divider, whose output is fed to the Arduino analog input pin A3. Supply for the sensor units is given by the power supply circuit. The Arduino here is used for the data logging purpose. The stored data is viewed at that place itself by using 16*2 LCD display and then it is transmitted via the ZigBee transmitter which is interfaced with the Arduino. The transmitted data is received by using ZigBee receiver which is located at the far end from the transmitter section [9-10]. Transmission of the data is done by the serial port USB cable. The ZigBee receiver is connected to the personal computer using serial port to USB converter cable and it is continuously monitor by personal computer [11-12].

4.1. ARDUINO
Arduino is a device for seeming well and good and control a greater amount of the physical world than your PC [13]. It's an open-source physical figuring stage dependent on a basic microcontroller board, and an improvement domain for composing programming for the board. Arduino can be utilized to create intuitive items, taking contributions from an assortment of switches or sensors, and controlling an assortment of lights, engines, and other physical yields. Arduino undertakings can be independent, or they can be spoken with programming running on PC (e.g. Flash, Processing, MaxMSP.) The sheets can be collected by hand or bought preassembled; the open-source IDE can be downloaded for nothing [14-15]. Arduino can detect the earth by accepting contribution from an assortment of sensors and can influence its environmental factors by controlling lights, engines, and different actuators. The microcontroller on the board is customized utilizing the Arduino programming language (in light of Wiring) and the Arduino improvement condition (in view of Processing). Arduino tasks can be independent or they can speak with programming on running on a PC (for example Streak, Processing, MaxMSP). Arduino is a cross-stage program. Arduino is utilized in following OS.

- Windows
- Mac OS X
- Linux

4.1.1. Description
This is the new MEGA2560 R3. Notwithstanding all the highlights of the past board, the MEGA currently utilizes an ATmega16U2 rather than the ATmega8U2 chip. This mulls over speedier trade rates and more memory. The capacity to have the Uno appears as a console, mouse, joystick, and so on [16].

4.1.2. Characteristics
- Schematic plan of the open source advancement interface free download, and furthermore as indicated by the requirements of their own changes.
- Download the program is basic and helpful.
- Just with the sensor, a wide scope of electronic segments association, (for example, LED light, bell, keypad, photo resistor, and so on.), make a wide range of fascinating things
- Utilizing the rapid small scale preparing controller (ATMEGA328).
- The improvement of language and advancement condition is exceptionally basic, straightforward, and entirely reasonable for fledglings to learn [17-18].
5. **Results and discussion**

5.1. **Transmission side**

Sun based radiation; a pyranometer from Li-Cor is set on the PV board. The chose pyranometer has an estimating range from 0 W/m² to 1276 W/m², and creates a corresponding voltage yield of 0–5 V. This estimating range is satisfactory for this venture, since the irradiance level of the site area is relied upon to be under 1000 W/m², The sun powered irradiance is estimated once every examining span.

5.2. **Receiver side**

The force created and vitality from PV module, vitality yield from converter and combined force produced from PV module, are shown. Utilizing the "View" button, clients can likewise observe the constant estimations of the checked boundaries as show, as illustrated in Fig. 5 & 6.
5.3. LCD display

![Figure 6 LCD display](image)

5.4. System output
Since the information estimations are done at an inspecting time span min, the invigorate pace of the website page is set to be 1 min too., the data indicated will reliably have a 1 min delay from the constant information gathered by the observing framework.

![Figure 7 System output](image)

By and by, considering the way that the framework is proposed to screen all the boundaries 24 h daily, this postponement can be viewed as decent.

6. Conclusion
In this task, the usage of an online remote checking framework for matrix associated PV converter is introduced. Subtleties in general procedure of the usage, beginning from framework structure plan, equipment execution, control framework programming to the electronic checking interface have been secured. Other than having control work which can screen the framework distantly, the framework is likewise outfitted with online capacity which made it available at wherever and whenever through the web. Usage results show that the framework can work with great execution.

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