

Smart Based Solar Powered House System Design

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Abstract- The design of a solar-powered smart home with a wireless sensor network is presented in this study, which addresses smart energy management, smart health care, smart ventilation, and smart people management. The sensor network is stretched throughout the building, including the entrance gate, corridor, living room, and kitchen. For wireless communication, two Internet of things (IoT) design prototypes is used: one using Bluetooth for short-range offline communication and the other using Global system for mobile communication (GSM) for long-range offline communication. For online control and monitoring, ZigBee and Wi-Fi are employed. The solar panel provides energy to the smart house via an Optimum PowerPoint tracking (MPPT) controller, which ensures maximum efficiency. When the owner is unavailable, internal infrastructure can intervene in some unanticipated situations.

Indexed Terms- Internet of things (IoT), Smart home, MPPT, Bluetooth, ZigBee.

I. INTRODUCTION

The rapid expansion of IoT has been allowed by the widespread availability of smart devices with embedded sensors and wireless interfaces [1]. The Internet of Things (IoT) vision claims that "connected things" would link to a network to collect and exchange data. According to Cisco research, more than 50 billion devices will be connected to the internet by 2025. By 2025, about \$6 trillion will have been spent on IoT solutions [3]. A smart house is one that can perform a variety of automated tasks. Its functionality is controlled by an automated system. It has the ability to predict its power requirements. For efficient monitoring and control of home appliances, a

user-friendly interface should be set up. Fast enough to ensure consistent communication.



Fig. 1 Graphical of representation IoT based control

As illustrated in Fig. 1, this research presented the implementation and operation of a solar-powered smart home. With a wireless sensor network, the house may be controlled and monitored in real-time. Solar energy is used as the major energy source for the complete smart home. It has a cheap cost of upkeep. In this study, the issues of security, fire, and health-care monitoring are discussed, as well as alternative solutions. When the owner is not present in the residence, the system can activate in certain situations. It also addressed the topic of wise personal management by keeping track of issues that develop in daily life and making decisions to address them.

The idea for this study stems from the advancements in IoT that have allowed it to deliver solutions to a variety of real-world problems. G. Vivek et al. suggested an IoT service that uses a Zigbee gateway to connect several protocols and enable access to sensors

and actuators. In 2013, Ming wang suggested a model for an IoT-based application control system for smart homes. Switch modules and RF applications make up the WSN. A. Chakravorty and colleagues Developed a smart home framework for data analytics while maintaining privacy. From data generation to data exchange, this architecture ensures data security. S.D.T. Kelly recommends using the Internet of Things (IoT) to monitor the environment in the home and manage the energy consumption of domestic equipment. The accuracy of sensing data is estimated to be around 95%. J.Byun et al. offered a clever solution.

II. SYSTEM ARCHITECTURE

- The Design Process

The smart home has a wireless sensor network in four locations: the entrance gate, corridor, living room, and kitchen.

As seen in Fig. 2, the WSN is depicted as a block diagram.

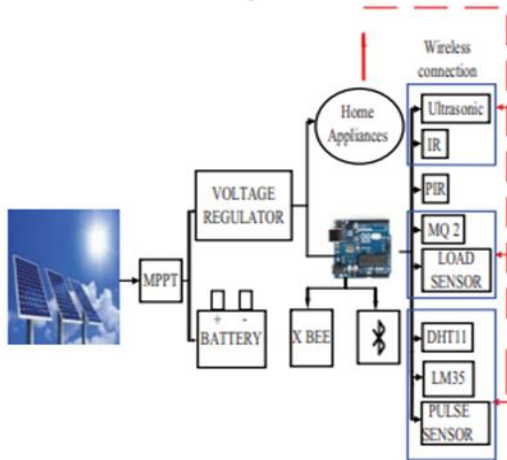


Fig. 2 Block diagram of smart home comprises of WSN

The Arduino microcontroller is used to actualize the smart house concept. The automatic gate opening mechanism includes an ultrasonic sensor and a servo motor. In the kitchen, the MQ-2 sensor is used to detect smoke levels. The weight of LPG is determined using the load sensor. The DHT 11 sensor is used to monitor the temperature and humidity of the inside environment. The PIR sensor's job is to detect any movement in the house's corridor.

The health scanning system in the living room was created using the LM35 and a pulse rate sensor. It ensures the safety of senior citizens who live in smart homes. They receive quick medical assistance so that their health does not deteriorate as a result of the delay. The IR sensor detects the presence of someone in the room and turns the lights on and off accordingly. Bluetooth, ZigBee, and GSM are used to connect the devices to the network. These communication methods are employed in accordance with the requirements.

An Android-based mobile application, is used to receive data on a smartphone, allowing it to monitor and operate the home. The XCTU software portal is used in a ZigBee wireless data transfer application. The GSM module is used to send SMS and make phone calls automatically. The WiFi module sends email.

B. Description of Components Used

(a) Arduino Uno- It is the main controller in this project. It housing ATMEGA processor 328P. All of the sensors feed data to Arduino. It sends a signal to the Actuators, instructing them to do the required action in response to the order.

(b) Bluetooth- Bluetooth allows you to operate and monitor your smart home from your smartphone. This is how all sensor data is delivered to the phone.

(c) ZigBee- It allows for computer-based online control and management. The data is sent by the Router and received by the Coordinator, who is on a different node.

(d) GSM modules—These modules are utilised in this study to make calls and send automated messages. It aided us in establishing long-distance contact for proper monitoring. even from within the home.

(e) MPPT-With continually changing climatic conditions, MPPT aids in PowerPoint performance. It was powered by a dc-dc converter. This is in charge of delivering maximum power to the load.

(f) Sensor- The sensor's specifications are listed in the table.

SENSORS	SPECIFICATIONS
DHT 11	Operating voltage: 3-5 V Operating current: 2.5mA Temp. range: 0-50c Humidity range:10-95%
MQ- 2	Operating voltage: 5V Load resistance: 20kΩ Heater resistance: 33Ω Sensing resistance: 10-60kΩ Concentration range:200-1000ppm Heating consumption: <800mW
PIR	Operating voltage: 5-12V Sensitivity range: 6m Detecting range: 110°×70° Susceptible to emitted IR waves
HC-SR04	Operating voltage: 5V Operating current: 15mA Operating frequency: 40kHz Max. range: 4m Minimum range: 2cm Measuring angle : 15 °
LM 35	Operating voltage: 0-5 V Operating current: 10mA Max temp: 150 °C Min temp: -15 °C
Pulse sensor	Operating voltage: 5 V Operating current: 100mA Output data level:5V TTL Light source: 660nm super red LED

Table1: Specification of sensors

(g) Servo motor-by transmitting a series of pulses to the signal line, the servo motor is controlled. A typical analogue servo motor anticipates receiving a pulse every 20 milliseconds (i.e. signal should be 50Hz).

III. METHODOLOGY

This section discusses the conceptual framework and methods used by sensors for this investigation. It covers the methodical organising and coordination of their activities at various levels. Figure 3 depicts the proposed methodology for IoT-based smart houses. The auto-configuration and device management, auto-monitoring and control, cross-platform communication protocol, and object access control are all covered in this research paper's basic foundation. Smart energy management, smart communication networks, and smart wireless sensor networks are also addressed in this study. The system is scalable and responds to changes in event data's periodic patterns.

By measuring the amount of smoke and the temperature, the house is protected against fire. Intruder protection is given by installing a PIR sensor in the corridor, as well as providing information to residents via a buzzer and a communication network. The switching action of this high-powered electrical equipment is made by giving gate pulse through Metal oxide field effect transistors, which are controlled by Arduino (MOSFET).

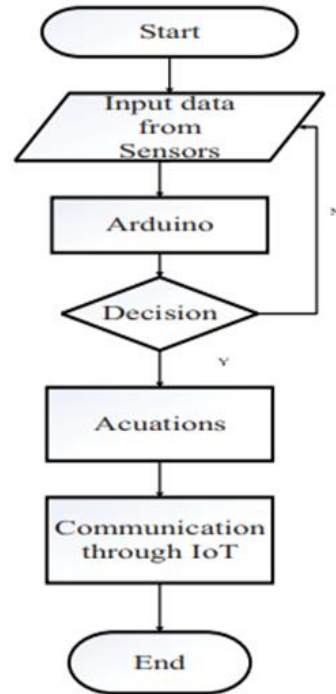


Fig. 3 Flow chart of methodology applied in smart home architecture.

In the smart house, smart personal management is maintained. With the help of Bluetooth, the light and other electrical equipment can be turned on and off. The hose is monitored both online and offline using an IoT platform and a communication network.

IV. IMPLEMENTATION DETAILS

A solar power system is used to meet the energy needs of this proposed smart home. The amount of solar irradiation falling on the panel and the temperature of the cells determine the supply of a solar module. For optimal performance, the system must be forced to use its MPPT. MPPT is a technique for transferring maximum power from a PV module at different times

of the day, in varied weather conditions, with different roof slopes and different numbers of panels per string. We can't use solar throughout the night or on cloudy days, so we store the energy in batteries to compensate.

A voltage regulator is used to regulate the produced voltage, stepping up or down the voltage according to the needs of home appliances. It guards them against burnout and poor performance.

Arduino is also solar-powered, and all of the sensors are powered by Arduino. The actuators are powered by the smart home's main power supply.

Each room has an IR to detect the presence of a person entering the room. When there is someone in the room, the light turns on, and when there is no one in the room, the light turns off. This aids in energy conservation. It aids in limiting the usage of irreversible electricity. This agreement is for smart energy management without the need for human involvement. The light may also be turned off and on with the help of a Bluetooth-enabled mobile phone.

This is good for both the elderly and children who are unable to move around much.

V. RESULTS AND ANALYSIS

Figure 4 depicts the application built for smart device monitoring and control. To turn on and off the light and fan, press the light and fan button.

The Bluetooth button establishes a connection with the Arduino board through Bluetooth. The LED button indicates when the gate is open or closed. The gate is open when the LED is glowing, and it is closed when the LED is off.

The temperature and humidity level displayed the room's temperature and humidity readings. The smoke amount level button displays the amount of smoke. In the same way, the readings of body temperature and heart rate are displayed in level boxes. The mail button will light up if there is any mail from the residence.

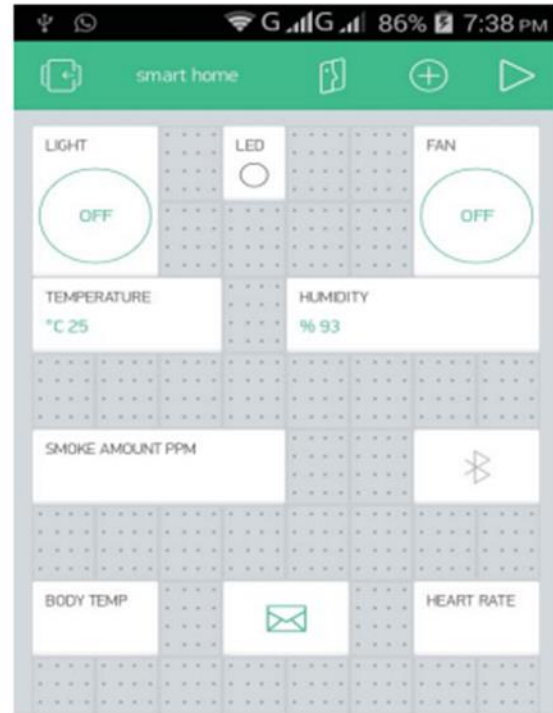


Fig 4: Mobile application to get data on mobile phone

CONCLUSION

This study showed a solar-powered smart system that was constructed utilising the Internet of Things (IoT). Using the ZigBee, Bluetooth, and GSM interfaces, the room's various parameters are monitored and the application is controlled. To provide improved connectivity, we designed an architecture that is extensible and allows for the coexistence of various data collection methods. It maintains a high level of security by modifying and implementing preemptive steps. It envisaged a long-term system with a clean energy source. By installing a grid-connected solar rooftop system with smart metering, this proposed system can be expanded in unique ways. If there is excess electricity created, it is fed into the grid.

The ability to reconnect and resume without losing data should be available. In the event that internet connections are unavailable, the method will be established. To make the system more secure, authentication of alleged devices and identification of unauthorised devices will be required. To make the smart home more efficient, image processing technologies can be included.

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