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SMART HOME AUTOMATION SYSTEM FOR ENERGY-EFFICIENT HOUSING

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ABSTRACT

Most of the present-day resources of energy are limited and can't be replaced. The next generation will face an acute energy crisis if alternate resources of energy are not developed concurrently. Increasing cost and import of conventional resources have a tremendous effect on the economy of a country, and the only cheaper remedy is "unlimited power" from the sunlight. The use of solar energy is so far less consumption in household applications. If we harness only 0.0034 percent of the solar energy reaching the Earth's surface, the energy needed of the whole world will be supplied from the sunlight. In the proposed work, a substitute for conventional home loads has been implemented by a solar power source. The developed solar system is budget-friendly, portable, user-friendly, and free from maintenance. The system stresses the need for the replacement of conventional electric power by solar power in every home for reducing the energy crisis at present. The proposed system is based on a sensory network. A high sensing system is used to control the appliances very fast and accurately with the help of a smart automation protocol. The project is implemented using an Embedded microcontroller with a low power design. The appliances are monitored and controlled by the sensor networks with commands from the microcontroller. To reduce the power wastage in homes, offices, and industries by automatically controlling the devices based on human presence as well as environmental conditions. The controller is used to execute the predesigned program to control the electrical appliances through the relay driver unit according to the input signal from sensor networks. The buzzer is also connected in this system which is used to activate the alarm sound when the emergency period. The LCD unit is present in our system for displaying information about the monitoring status of the appliances.

Keywords: *solar energy, smart automation, sensor network, etc.*

1. INTRODUCTION

The scarcity and cost of fossil fuels combined with their greenhouse gas emissions make the development of non-fossil fuel-based methods of transportation leads a high-priority task. This interest was further fueled by world problems concerned with nuclear wastes and nuclear safety on one hand and global warming on the other hand. These considerations make solar energy the big strategic choice as a source of world energy. As a result of current-day satellite technology, designers now have a less or more clear picture of solar energy intensity distribution worldwide. Solar energy research emphasis over the last three decades was concentrated on two main aspects of this subject. The first is concerned with solar energy direct heat production from the sun and the second is involved with solar energy electricity production. Recent technological developments in thin-film photovoltaic cells, such as amorphous silicon and hybrid dye- sensitized/photovoltaic (PV) cells, are leading to new generations of consumer portable solar cells. These new arrays are less weight, durable, and flexible and have been reported to achieve power efficiencies of up to 10 percent.

There are many types of solar power systems that can be used to generate power for your home and surrounding and at the same time save natural resources. These power systems will not only save electricity but also cause less pollution, by emitting minimal amounts of heat when compared to conventional lighting sources like bulbs. Though a lot of work has been done on solar energy, its commercial utility of miniature size, portable, and cheaper solar devices for every home has not been in use so far. The present work demonstrates an experimentally tested portable solar energy system for every home for saving the energy of the world.

Home automation is a type of building automation for a home, called a smart home or smart house. This system presents a new approach to utilizing technology in a practical and meaningful manner within a smart home system that can be widely used in a residential setting. The proposed system consists of the following steps: direct environment sensing, collecting and analyzing data, and then allowing the user to customize the settings and use specific commands. This research will present the design and implementation of a practical and simple smart home system with an energy-efficient system, which can be further extended. The system is based on: a group of sensors, a Microcontroller NUVOTON device as a server system, and an LCD Display.

EXISTING METHOD

Developments in the Internet of Things (IoT) have enabled innovations in smart home and industrial automation, providing possibilities for devices in homes to be monitored and controlled remotely from any location. Such solutions have resulted in energy efficiency and cost savings, as appliances are monitored remotely and controlled by small, resource-constrained embedded devices. The paper contains a design of an ESP8266 NodeMCU smart home solution, using Message Queuing Telemetry Transport (MQTT) and Node-

RED. The smart home solution design utilizes an MQTT mosquito broker on raspberry Pi 3B+, a single board computer development board. A DHT 22 sensor is interfaced with the ESP8266 micro-controller to collect sensor data for temperature and humidity in the environment, with the raspberry Pi performing functions of the MQTT broker to relay sensor data to a Node-RED dashboard.

Problem Statement

- Hackers can be control the home devices through network which may influences for hazards.
- Home automation time can be varied due to network signal traffic.
- There is chance to reset the program in NodeMCu unit due to electrical interference. So that the command data can mismatched. Result cause malfunction of the automation system.
- Linker error may occurred in sharing the Wi-Fi connection

PROPOSED METHOD

The project is developed using a Free energy i.e., solar energy cum Embedded microcontroller with low power design. The appliances are monitored and controlled by the sensor networks with commands from the microcontroller unit. To reduce the power wastage in homes, offices, and industries by automatically controlling the devices based on human presence as well as environmental conditions in the room. The controller is used to execute the predesigned program to control the electrical appliances through the relay driver unit according to an input signal from sensor networks triggered by the environmental conditions. The buzzer is also connected in this system which is used to activate the alarm sound when an emergency time. The LCD unit is present in our system for displaying the information about the monitoring status of the appliances which are working.

2. LITERATURE REVIEW

Paul Machesoae, Tiwonge D. Manda [1] Developments in the Internet of Things (IoT) have enabled innovations in smart home and industrial automation, providing possibilities for devices in homes to be monitored and controlled remotely. Such solutions have resulted in less energy usage and cost savings, as appliances are monitored and controlled by small, resource-constrained embedded devices. The paper shows a design of an ESP8266 NodeMCU smart home solution, using Message Queuing Telemetry Transport (MQTT) and Node-RED. The smart home solution design utilizes an MQTT mosquito broker on raspberry Pi 3B+, a single board computer development board. A DHT 22 sensor is interfaced with the ESP8266 micro-controller to collect sensor data for temperature and humidity, with the raspberry Pi performing functions of the MQTT broker to relay sensor data information to a Node-RED dashboard of the circuit.

Athira K1, AryadeviRemanidevi Devidas2, [2] Because power grids experience dynamic variations in energy generation and demand of the usage, the inclusion of renewable energy alone will not assure the self-sustainability of smart buildings in the developing world. Energy sustainability can be achieved by developing an energy-friendly, context-aware wireless sensor network that is overlaid on the existing electrical network. This smart environment is supported by efficient algorithms for dynamic energy management in smart buildings in this current times. Generally, the home energy management system has different functions to done. These include a) controlling the energy consumption at peak times in the usage, b) updating consumers about the real-time power consumption inside the home area network, and c) helping the consumer to schedule the operation of appliances based on the real-time pricing from the utility company. Also, it is very important to analyze how the customers can reduce electricity bills while achieving electrical energy conservation with a reasonable level of consumer comfort. The proposed availability-based management algorithm (AMA) enhances the existing home energy management system by helping the users to supervise and control their monthly electricity tariff burdens. The AMA performs an advance initial distribution of energy for upcoming days which helps to keep the power usage of the residence within a certain limit. This research explains and demonstrates, using real data collected from an office building case example, how the AMA works in different situations. The results show that the AMA offers effective management of monthly tariff plans and energy usage in variable use cases. From the experimentation result, the proposed system achieves a 65.08% reduction in energy consumption with the energy unaware system and30.16% reduction in energy consumption with a pattern-based energy management system.

3. SYSTEM FUNCTION

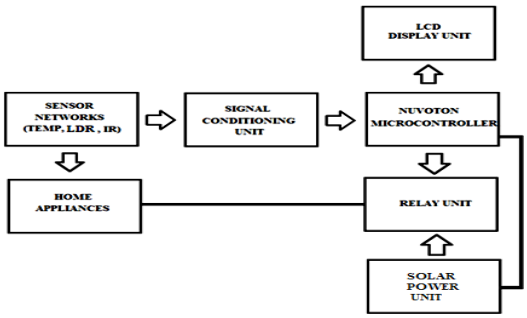

Fig.1 block diagram of the automation unit.

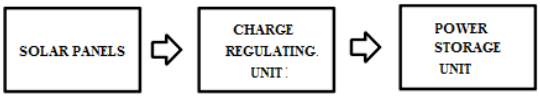

Fig: 2 block diagram of the solar power unit.

This system consists of a thermistor, LDR, IR LED, IR photodiode, transistor drivers, Nuvoton Microcontroller, 2X16 LCD unit, and power supply unit. The thermistor is used to detect the temperature level of the surroundings and the Light-dependent resistor (LDR) is used to detect the intensity of the environment light which is used shows the identification of day and night, the IR sensor is used to detect the presence of the human beings. All sensor outputs (electrical) are applied to the input of the Nuvoton microcontroller through the transistor driver. The transistor drivers act as signal conditioning units. IR LED produces continuously light rays (invisible) and the light rays are fall on the IR photodiode when a human presents in front of the sensor. The photodiode produces the electrical signals according to their input of light. The IR LED and the photodiode is fixed in the entrance of the homerooms. The photodiode produces the electrical output when it receives the input from IR LED. These outputs are applied to the input of the controller for identifying human presence..

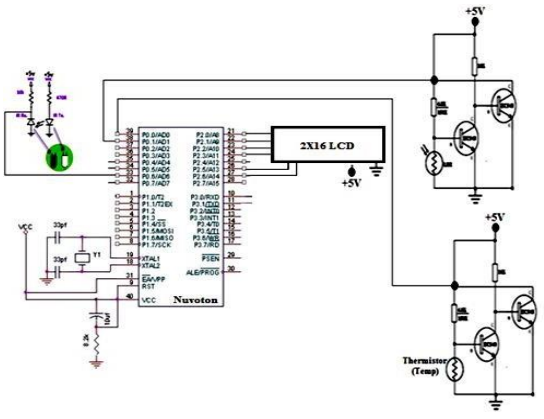

Fig.3 Circuit diagram of the automation unit

The light load is activated by the microcontroller through relay switching unit if the environment is dark and human present otherwise it doesn't turn ON. The FAN is activated by the controller if the temperature level exits above room temperature and human presence; otherwise, it doesn't turn

ON. The LCD display is used to shows information about the home automation process.

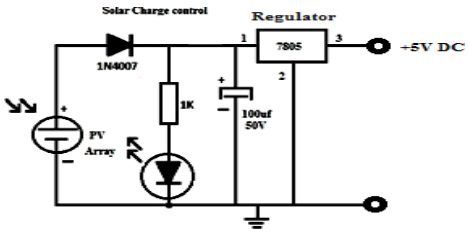

Fig.4 circuit diagram of the solar power unit.

This unit consists of solar panels, a charge controlling unit, battery storage unit. The solar panel contains a series of semiconductor cells that generate the DC electrical voltage according to sunlight as input. The output of the solar system is varied in accordance with the input of the sunlight variation. The solar output voltage is applied to the input of the charge regulating unit. The charge regulating unit is used to produce the constant output voltage is called regulating voltage. The regulated voltage is stored in the battery unit.

4. MICROCONTROLLER NUVOTON

The NUVOTON is a low-power, high- performance CMOS 8-bit microcontroller with 4K bytes of In-System Programmable Flash memory device. The device is designed using Atmel's high-density nonvolatile memory technology and is comfortable with the industry-standards 80C51 instruction set and pin-out. The on-chip Flash will accept the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8- bit CPU with In-System Programmable Flash on a monolithic chip, the Atmel NUVOTON is a powerful microcontroller that provides a highly- flexible and cost-effective solution to many embedded control applications.

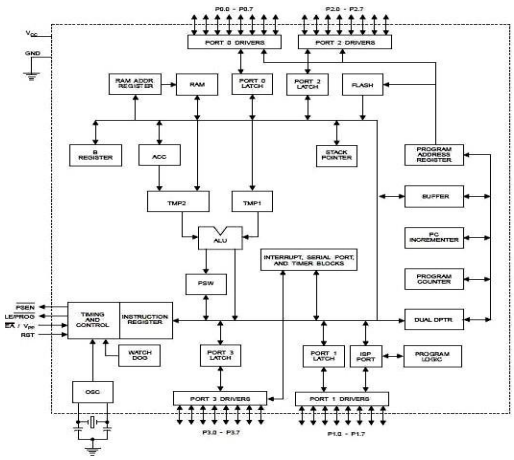

Fig: 1. Architecture of Microcontroller

Interrupt Registers

The individual interrupt allows bits are in the IE register in the microcontroller. Two priorities bits will be set for each of the five interrupt sources in the IP register of the controller.

Dual-Data Pointer Registers

To facilitate controlling both internal and external data memory, two banks of 16-bit Data Pointer Registers are provided: DP0 at SFR address locations 82H- 83H and DP1 at 84H-85H. Bit DPS=0 in SFR AUXR1 selects DP0 and DPS = 1 selects DP1. The user should always initialize the DPS bit to get the appropriate value before accessing the respective Data Pointer Register.

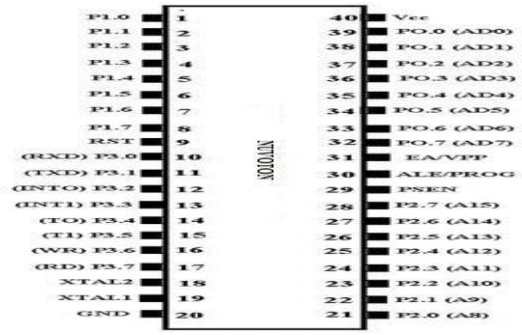

Fig: 2 NUVOTON/52 Pin Configurations

RELAY OPERATION

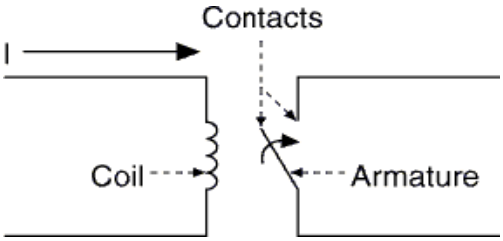

Fig: 3symbol of relay

When a current passes through the coil, the resulting magnetic field will attract an armature that is mechanically linked to a moving contact of the coil. The movement either breaks or creates a connection with a fixed contact. When the current in the coil is switched off, the armature is returned by a force approximately half as strong as the magnetic force to its rest position. Usually, this is a spring, but gravity is also matters in industrial motor starters.

Solar Cell

A solar cell (also called a photovoltaic cell) is an electrical device that converts light energy into electricity by the photovoltaic effect. It is a form of the photoelectric cell (in that its electrical characteristics—e.g current, voltage, or resistance—vary when light is incident upon it) which, when exposed to light, can create and support an electric current without being attached to any external voltage source.

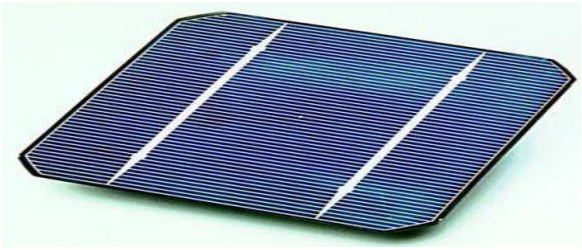

Fig. 4 schematic of solar cell (panel)

Photo Voltaic Cell

The operation of a photovoltaic (PV) cell requires 3 basic conditions:

1. The absorption of light, will create electron-hole pairs or excites.
2. The charge carriers are to be separated into opposite types(anode, cathode).
3. The separated of that carriers are to be extracted to an external circuit.

Indifference, a solar thermal collector collects heat by absorbing sunlight, for the purpose of either direct heating or indirect electrical power generation. "Photo electrolytic cell" (photo electrochemical cell), on the other hand, refers to either a type of photovoltaic cell (like that developed by A.E Becquerel and modern dye- sensitized solar cells) or a device that splits water directly into hydrogen and oxygen using only solar illumination.

5. CONCLUSION

Home automation using sensor networks has been experimentally proven to work satisfactorily by connecting simple devices to the internet and the devices were successfully controlled remotely through portable devices like mobile. The designed system not just monitors the sensor data, like temperature, light, motion sensors but also did a process according to the requirement, for example switching on the light when it gets dark whether it is night or by some cloudy conditions. It also stores the sensor parameters in the controller in a timely manner. This will help the user to analyze the condition of various conditions in the home anytime anywhere by using the internet.

Future work: Using this system as a framework, the system can be expanded to include various other options which could include home security features like detecting the movement and capturing the photo of a person moving around the house and storing it on to the cloud. The motion detection and taking photos will reduce the data storage than using the CCTV camera which will record all the time and store it. The stem can be expanded for energy monitoring devices or weather stations. This kind of system with respective changes can be implemented in the hospitals for disabled people or in industries where human occupation is impossible or dangerous, and it can also be implemented for environmental monitoring.

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