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Autonomous Energy-Efficient Wireless Sensor Network Platform for Home/Office Automation

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Abstract-Smart homes and workplaces can aid people in living and working more comfortably with WSNs. Sensors, microcontroller, radio, and antenna are used in these applications to regularly detect, data from a dispersed network of low-power, low-cost, highly energy-efficient electronic platforms to a distant host station for pre-processing and transmission. To address future Internet-of-things (IoT) application requirements, an integrated photovoltaic panel with a rechargeable battery and a power-efficient architecture is provided, which necessitates a large number of interconnected wireless networks being designed and implemented to be energetically self-sufficient.

Keywords-Internet of things, MQTT, Wireless Sensor Network.

I. INTRODUCTION

Users can benefit from supported living and working environments provided by smart homes/offices based on wireless sensor networks (WSNs). The dispersed network nodes in these applications are made up of low-power, low-cost, high-energy-efficient electronic platforms with sensors, microcontrollers, radios, and antennas that can sense, receive, store, pre-process, and broadcast environmental data on a regular basis.

Traditional nodes are often powered by batteries, limiting their longevity and the number of deployed devices. This study discusses the design and implementation of Internet-of-Things (IoT) applications, which is an interconnection of large number of wireless networks. Wi-Fi, ZigBee, and Bluetooth are popular wireless protocols which use a license-free ISM (Industrial, Scientific and Medical) frequency band Wi-Fi are proposed for power saving solution embeds several radio modules to reduce energy consumption and latency for neighbor discovery and opportunistic networking but at the expense of increasing both the size and cost of devices.

Nevertheless, the use of Wi-Fi, Bluetooth and ZigBee as a low power radio is still too costly for applications. Bluetooth Low Energy (BLE) protocol reduces power consumption and provides connection to smart phones with easy setup but has limited operating range devices.

II. LITERATURE SURVEY

In the existing system uses low range antenna for low power and distance covering and controlling which implements the controlling of the home appliances with efficient power is saving. Conventional nodes are usually supplied by batteries, resulting in a significant limitation to the lifetime and to the maximum number of deployable devices

1.Application of Wireless Internet in Networking using NodeMCU and Blynk App:
Wireless internet access is a networking technology. A more pleasant living and working environment may be achieved by incorporating wireless sensor networks (WSNs) into smart buildings and residences. Electronic platforms with sensors, microcontrollers, radio, and antennae make up the nodes in a distributed network, and they allow them to periodically sense and receive ambient data from the environment.

This module that is design at NodeMCU board can work independently without using Arduino board. The advantages and properties of this NodeMCU board make it very efficient to use as home automation systems.

2. ESP8266-based MQTT-based Home Automation System:
MQTT (message queuing telemetry transmission) protocol is described in this article. An esp8266 Wi-Fi development board is used to test the MQTT protocol.

The two types of agents often used in a MQTT connection are MQTT clients and a MQTT public broker, such as a MQTT server. Application messages are the data packets sent through MQTT.

An MQTT client is any device or software that connects to a network and exchanges application messages over MQTT. Publishing or subscribing is possible with MQTT clients.

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MQTT provides the customer with three different degrees of Quality of Service (QoS). Home automation system that is safe, dependable, and easy to use For nodes with limited resources, MQTT outperforms HTTP, according to research published in [8]. With 3G network connectivity, data transmission through MQTT uses just 0.05 percent of a battery per hour.

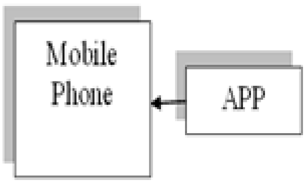
III. PROJECT DESCRIPTION

The proposed system we are using the technology which is used widely in the home and office. By implementing wireless connectivity using Wireless fidelity to control the devices and making using of the sensor technology for the maximum efficiency.

The measured values from the sensor are sent to a microprocessor through ADC converter and it controls the devices based on the specific sensor value.

All the processes are displayed on an App for user convenience. The overall design of the proposed system is built upon power saving and maximum signal efficiency by using the algorithm.

1. Block Diagram:
TX – Section:



RX – Section:

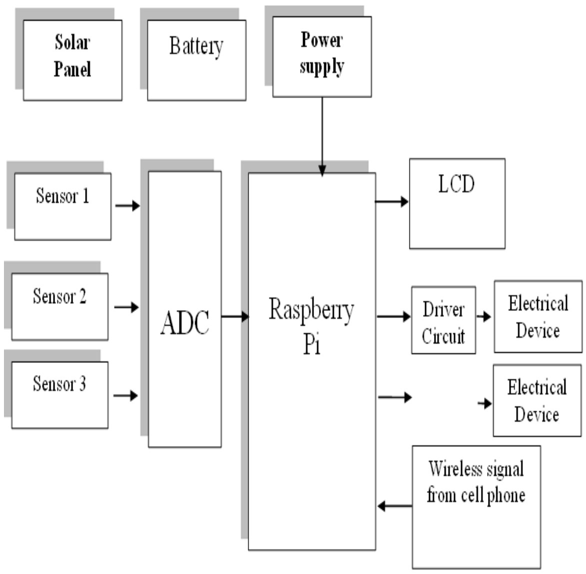


Fig 1. Block Diagram.

2. System Architecture:
The IOT hardware, which is a special board built specifically for homes and workplaces, connects all of the equipment in the house or office. This includes Raspberry pi microprocessor and sensors which is connected to the network for it to be controlled individual appliances over the network.

All the sensor like LDR, temperature and humidity is interfaced to the raspberry pi through the ADC for converting the values to digital. The sense values are reported in real time and can be controlled by IOT application on the cell phone.

3. Flow Chart:

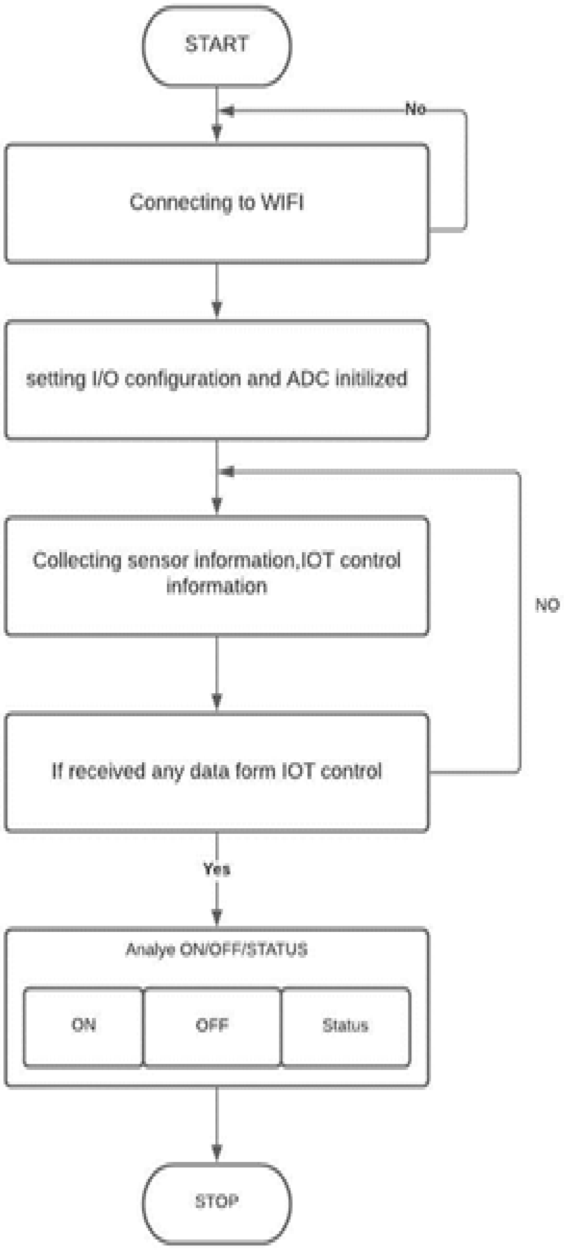


Fig 2. Flow Chart.

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After setting the input /Output configuration of the device and sensors the sensor information is collected. The collected information is analyzed and based on the data received it is processed and controlled.

The ON or OFF of any appliances is done through IOT Application which can be on site or at any remote location, as it uses internet access the system can be accessed from anywhere in the world.

IV. DESIGN AND IMPLEMENTATION

The proposed work is to create a Home/Office Automation Platform with an Autonomous Energy-Efficient Wireless Sensor Network.

1. Raspberry Pi:
Raspberry Pi is a line of single-board computers (SBCs). The Pi 3 series was launched with the Raspberry Pi 3 Model B. In February of this year, it took the place of the Raspberry Pi 2 Model B. The most recent variant of the Raspberry Pi 3 line, the Raspberry Pi 3 Variant B+, is also available.

Fig 3. Raspberry pi.

Features:
- A quad-core processor running at 1.2 GHz A 64-bit Broadcom BCM2837 processor is used.
- RAM of 1 GB
- Wireless LAN and Bluetooth Low Energy (BLE) are provided by the integrated BCM43438 chip.
- Ethernet using 100 base
- GPIO with 40-pin extended
- 4 USB with 2 ports

2. Light Dependent Resistor (LDR):
Depending on the quantity of light hitting it, a Light Dependent Resistor (also known as a photoconductor or a photocell) changes resistance.

Fig 4. LDR Sensor.

3. Temperature Sensor:
The LM35 is a temperature sensor integrated circuit with a voltage output inversely proportional to temperature (in SoC)

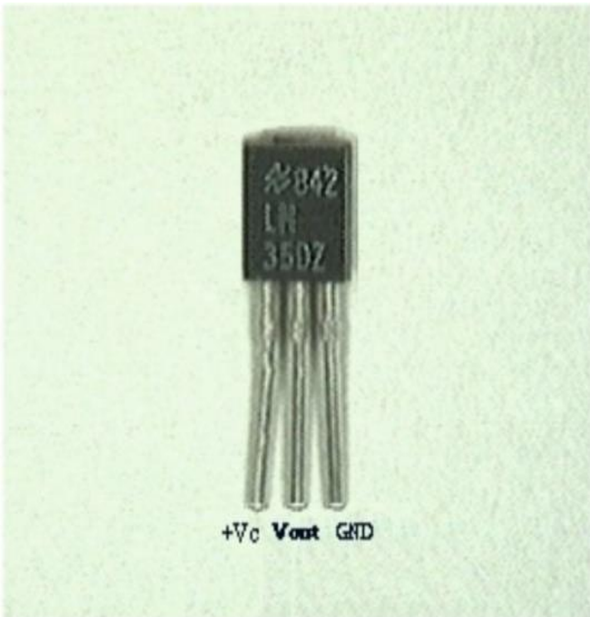

Fig 5. Temperature Sensor.

4. Humidity Sensor:
It detects the quantity of moisture in the air or in other areas using a humidity sensor. Temperature, pressure, mass, or a mechanical or electrical change in a material is all common measures used by humidity monitoring

devices. By calibrating and computing, these values may be utilised to compute humidity.

5. Solar Panel:
Light is converted into energy by solar panels. The reason they're termed "solar" panels is because the Sun, dubbed Sol by astronomers, is usually the most powerful light source accessible. The term "photovoltaic" is used by certain scientists, and it simply means "light-electricity."

Fig 6: Block Diagram.

A solar panel's solar power cells turn sunlight into electricity by harnessing the kinetic energy of speeding photons.

6. Relay:
6.1Introduction: A relay is an electrically operated mechanical switch that turns things ON and OFF without the need for human intervention. Figure below shows a general depiction of a double-contact relay. Many applications call for the usage of relays, such as controlling many circuits with a low-power signal (yet maintaining perfect electrical isolation between the control and controllable circuits).

Fig 7. Relay.

6.2 Working:
An inductor coil and spring (not pictured) are common components of relays. Swing terminals and two high-power contacts called normally closed (NC) and ordinarily opened (NO) are other common components (NO). Swing terminal between two contacts is moved by a relay using an electromagnet (NO and NC). The spring retains the swing terminal engaged to the NC contact when no power is provided to the inductor coil (Relay is OFF).

V. SOFTWARE IMPLEMENTATION

NOOBS is a good place for newcomers to start since it lets them choose from a variety of different operating systems. In general, Raspbian is the ideal operating system for home and office use. If you're looking for something else, consider LibreELEC (a Kodi media centre) or Arch Linux.

1. NOOBS:
New out Of Box makes it easy to switch to a new operating system on a Raspberry Pi. Software (NOOBS).
OS choices for new computers: NOOBS.

VI. RESULTS AND DISCUSSION

Fig 8. Hardware Component Connections.

The proposed system we are using the technology which is used widely in the home and office. By implementing wireless connectivity using Wireless fidelity to control the devices and making using of the sensor technology for the maximum efficiency.


Fig 9. After Light on Command through Blynk app using IoT platform.

Fig 10.Blynk App Configuration Page.

The measured values from the sensor are sent to a microprocessor through ADC converter and it controls the devices based on the specific sensor value. All the processes are displayed on an App for user convenience.

Solar panels and rechargeable batteries work together to make the sensor self-sufficient, and they can gather interior ambient light as low as 100 Lux to do so.

The overall design of the proposed system is built upon power saving and maximum signal efficiency.

VII. CONCLUSION

The Internet of Things (IOT) removes the need for human involvement by allowing devices to interact with one another. An autonomous, energy-efficient wireless sensor network platform was developed for usage in home and office automation as part of this thesis. By putting the system in place, overall annual energy usage may be cut by 30-40%, saving money and the environment.

The proposed system facilitates the users to control the appliances such as light, fan, air conditioner just by giving commands from Application. Everything can be controlled from a single location, and the current condition of everything can be viewed. The features help the use to analyze the status of these devise anytime and anywhere. It reduces human intervention in monitoring the devices.

VIII. FUTURE WORK

This System can be further extended for automation ON and OFF of appliances depending upon the number of users in the house/office. This system can be implemented in the hospital and other crowded places to efficiently control the device form the remote location.

Home hospitals may use IOT to monitor and control the environment in real time, depending on the severity of the patient's condition.

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REFERENCES

[1] Home automation using Internet of Thing, ShopanDey; Ayon Roy; Sandip DasPublisher: IEEE 2016.

[2] IoT Based Smart Security and Home Automation, ShradhaSomani; ParikshitSolunke; ShaunakOke; ParthMedhi. Publisher: IEEE 2018.

[3] Design and Implementation of an IoT Based Home Automation,Md. Mohaiminul Islam; Md. NahiyanFarook; S. M. G. Mostafa; Yasir Arafat. Publisher: IEEE 2019.

[4] Smart-home automation using IoT-based sensing and monitoring platform, Majid Al-Kuwari; Abdulrhman Ramadan; Yousef Ismael; Laith Al-Sughair; Adel Gastli. Publisher: IEEE 2018.

[5] IoT Based Home Automation, Abhijit Kumar Pal; Sanjoy Banerjee; NilanjanDey; DigantaSengupta. Publisher: IEEE 2018.

[6] An IoT based home automation using android application, P. Siva Nagendra Reddy; K. Tharun Kumar Reddy; P. Ajay Kumar Reddy; G. N. KodandaRamaiah. Publisher: IEEE 2016.

[7] A Novel Secure IoT-Based Smart Home Automation System Using a Wireless Sensor Network,SandeepPirbhulal,Heye Zhang, Md Eshrat E Alahi,HemantGhayvat,Subhas Chandra Mukhopadhyay,Yuan-Ting Zhang, Wanqing Wu.

[8] Performance Enhancement and IoT Based Monitoring for Smart Home, Jetendra Joshi, Vishal Rajapriya, S R Rahul, Pranith Kumar, Siddhanth Polepally, RohitSamineni and D G Kamal Tej