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SMART METER AND INSTINCTIVE ELECTRICITY MONITORING ORGANIZATION

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Abstract

The Internet of Things (IoT) has generated excitement for a few years now, with start-ups and established businesses placing bets on the industry's growth. Along with the business solutions, IoT has been very vital in connecting things to the internet, there by achieving a communication among the connected devices. The Internet of things (IoT) is getting more attraction in recent years. One of the usage scenarios of IoT is Smart Energy Meter. This study has specifically focused to develop an IOT Based Prepaid Smart Metering System which would be able to address some of the challenges currently available in the regular digital automated metering system in Eurasia. Smart Metering with its unique performance with the Internet of Things (IoT) tend to be an efficient system for electricity management, secure against the intervention by third parties, and reliable for tracking and real-time remote monitoring. In the currently working system, electricity meter reading for electricity usage and billing is done by human workers from home to home and building to buildings. The main aim of the project is to make a system which will help in reducing the usage of electricity and which helps in bringing transparency between the Electricity Board and the customers. This meter needs to be recharged similar to a mobile phone, payment for recharge can be done via online and can monitor the amount deduction and energy consumption. The energy measurement and billing system is automated.

Introduction

In the traditional process, the electricity providing company send their agents to the consumer's location for collecting the consumed energy information from the energy meter. A large amount of manpower is required for monitoring the energy meters on the consumer's site. That also increases the service charge which is a burden to the consumers. Unmonitored power distribution point encourages people to make an unauthorized connection from the power supply. This proposed system describes a technique for sending data to the cloud through internet access. Jai et al introduced a

new approach for reading data from an analog meter using light sensors. A led blink on the analog meter after consuming one-unit energy and this blink can be detected through this light sensor. And the sensor's data is fed into an Arduino which exports this data to a webpage or smart apps through raspberry pi. Some other researchers are also using light-sensing methods for taking data from the traditionally led blinking meters. Win et al developed a wi-fi based single phase energy meter using IoT technology. In this system, an ACS 712 sensor is used for measuring current. Maha et al describe a new approach to smart energy meter. This is a microcontroller-based energy meter that communicates with an android app through Bluetooth module. These apps transmit the user's data to the website. This android application is developed so that the consumer can monitor the used energy even if they are not near to the energy meter display. Yaowaluk et al developed a low-cost smart plug with on-off and energy metering functions using wi-fi. Siakat et al developed an IoT based smart energy meter. An ESP 8266 wi-fi module is used for communicating with the cloud server. All this research is done from a different perspective. Though getting a signal from the led blinking by using a light sensor is not a dependable method. The lighting condition of every place is not equal and the threshold value will vary for different situations. And mounting light sensors properly on an energy meter is a very critical task. In Bangladesh for making a smart energy meter wi-fi communication technology is not e good decision. Everywhere wi-fi access points won't be available. However, this research presents a low-cost microcontroller-based energy meter. This system measures AC voltage, current, phase angle, and determines the consumed energy. A Real-Time Clock (RTC) is used for storing real-time usages data on a micro SD card. For displaying the consuming data and other information an LCD is integrated with this proposed smart energy meter. This smart energy meter is equipped with a GSM modem that offers to make digital bills, consuming energy inquiry, and cut off the consumer's supply through SMS. This energy meter can play a vital role in monitoring the power grid of Bangladesh.

Keywords

IoT, LCD Display, Current Sensor, Buck Converter, I2C Communication Protocol, RFID

Related Work

Diponkar Kundu, Md. Ebrahim Khallil, Tushar Kumar Das, Abdullah Al Mamun, Ahmmad Musha et al, presented a Smart Home Automation System Using on IoT. The modern home automation system gives security and blissful life at residence. That is why the popularity of using home automation technology is increasing day by day. Our paper proposed the design and implementation of home automation, monitoring, and home security through the internet of things (IoT). Our system focuses on the residence to make a smart wireless home security system that sends an email with a picture to the homeowner if any trespass enters into the residence and also gives an alarm if any fire accident happened. Our system can control and monitor the house temperature, humidity, flame condition and all home devices from anywhere in the world. To update data our system takes just 3 seconds. As a result, a concern person can take necessary steps

rapidly. Our system can be controlled via many ways like the Internet, smartphone, voice control and electrical switch. Our proposed method has a small cost design, user flexible interface and simple installation in a house. Through IoT technology, the user can minimize the wastage of electrical power by proper monitoring and controlling.

Ejaz Ahmed, Ibrar Yaqoob, Abdullah Gani, Muhammad Imran and Mohsen Guizani et al, presented a Internet of Things based Smart Environments. The rapid advancements in communication technologies and the explosive growth of Internet of Things (IoT)have enabled the physical world to invisibly interweave with actuators, sensors, and other computational elements while maintaining continuous network connectivity. The continuously connected physical world with computational elements forms a smart environment. A smart environment aims to support and enhance the abilities of its dwellers in executing their tasks, such as navigating through unfamiliar space and moving heavy objects for the elderly, to name a few. Researchers have conducted a number of efforts to use IoT to facilitate our lives and to investigate the effect of IoT-based smart environments on human life. This paper surveys the state-of-the-art research efforts to enable the IoT-based smart environments. We categorize and classify the literature by devising a taxonomy based on communication enablers, network types, technologies, local area wireless standards, objectives, and characteristics. Moreover, the paper highlights the unprecedented opportunities brought about by IoT-based smart environments and their effect on human life. Some reported case studies from different enterprises are also presented. Finally, we discuss open research challenges for enabling IoT-based smart environments.

A survey is conducted in different countries over different households and user ‘s feedback is obtained so that people become motivated to be energy-conscious. A socio-technical review to promote sustainable energy consumption using Smart Meters is done. Answers are proposed for a set of research questions such as 1) Is feedback useful for energy saving and behavioural change? 2) What presentation of feedback is good and effective? Scientific advice on energy saving instruments for household energy consumption is provided. A Smart Metering privacy model is implemented to measure the privacy that a Smart Meter will provide with and without involvement of third parties. The advantages of Smart Metering concept are low metering costs, energy efficiency and easier detection of fraud.

Existing System

The issue of poor signal transmission and manual reading in different countries. Wireless embedded modules have simplified the development of IoT hardware and software devices. The choice and the design are often driven by performance requirements such as operating range, data rate, security, and interoperability with other products. Cellular WAN solutions offer a number of advantages for smart metering applications, but the signal transmission are weak and fails after a certain period. Therefore, there is a need to develop more automatic systems of monitoring.

Drawbacks

- ✓ No prepaid system
- ✓ No automatic Monitoring of electricity consumption
- ✓ Poor signal

Proposed System

- ✓ Monitoring of electricity on a daily basis.
- ✓ Checking current flow rate continuously, as well as automatically.
- ✓ The main objective is to obtain an effective low-cost and transparency between users and the board.
- ✓ Sensing the current and monitoring the electricity consumption along with prepaid system.

Merits

- ✓ Prepaid recharge system
- ✓ Automated electricity monitoring
- ✓ Can closely track usage and spend

Module Description

A module is a Hardware and software component or part of a program that contain one or more routines.

ESP8266 Wi-Fi MCU

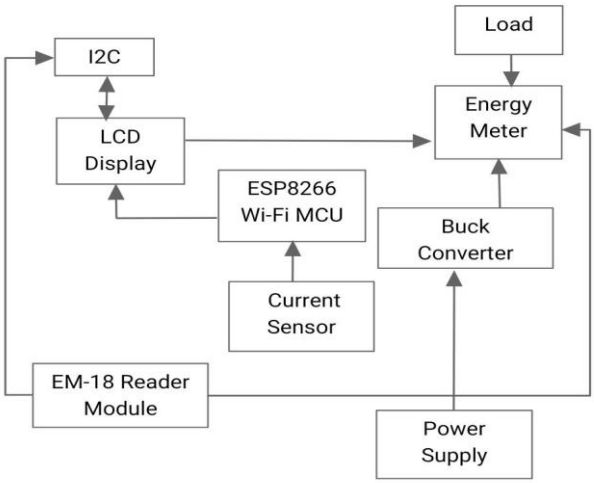
The Microcontroller used here is an ESP8266 Wi-Fi MCU. The UNO is a Microcontroller board based on ESP8266 Wi-Fi MCU. The ATMEGA 328P has 32 KiB instruction RAM The board has 17 GPIO pins, they can be used as digital inputs to read a digital voltage, or as digital outputs to output either 0V (sink current) or 3.3V (source current). The ESP can be programmed with the Arduino software.

Sensor

A sensor is a device, module, machine, or subsystem whose purpose is to detect events or changes depends upon transducer in its environment and send the information to other electronics, frequently a microcontroller. A sensor is always used with other electronics.

ESP8266

The ESP8266 arduino compatible module is a low-cost Wi-Fi chip with full TCP/IP capability, and the amazing thing is that this little board has a MCU (Micro Controller Unit) integrated which gives the possibility to control I/O digital pins via simple and almost pseudo-code like programming language. This device is produced by Shanghai-based Chinese manufacturer, Espresso if Systems.



Results and Discussion

LCD Display:

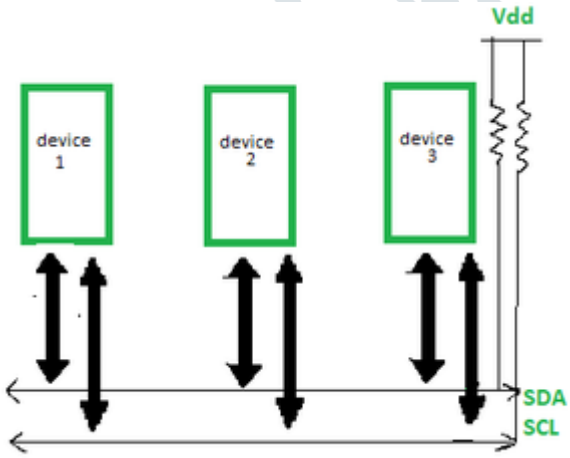
LCD Display is able to display 16x2 characters on 2 lines, white characters on blue background. This I2C 16x2 Arduino LCD Screen is using an I2C communication interface. It means it only needs 4 pins for the LCD display: VCC, GND, SDA, SCL. It will save at least 4 digital/analog pins on Arduino. All connectors are standard

XH2.54 (Breadboard type). Can connect with the jumper wire directly.

I2C Communication Protocol

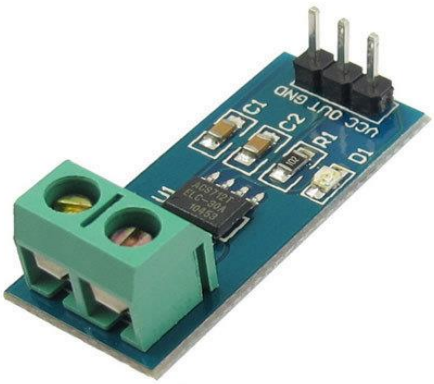
I2C stands for Inter-Integrated Circuit**.** It is a bus interface connection protocol incorporated into devices for serial communication. It was originally designed by Philips Semiconductor in 1982. It uses only 2 bi-directional open-drain lines for data communication called SDA and SCL. Both these lines are pulled high.

Start Condition – 1 bit
Slave Address – 8 bit
Acknowledge – 1 bit



Current Sensor:

A current sensor is a device that detects and converts current to an easily measurable output voltage, which is proportional to the current through the measured path. There are a wide variety of sensors, and each sensor is suitable for a specific current range and environmental condition. Current sensors are based on either open or closed loop hall effect technology. A closed-loop sensor has a coil that is actively driven to produce a magnetic field that opposes the field produced by the current being sensed. The hall sensor is used as a null-detecting device, and the output signal is proportional to the current being driven into the coil

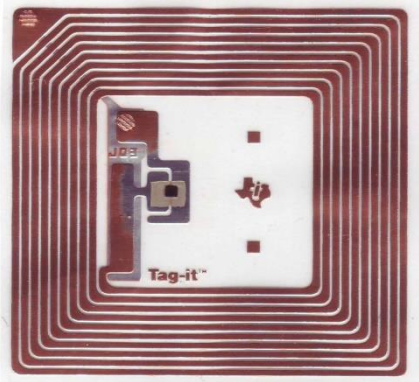


RFID Reader EM18:

Radio frequency Identification (RFID) is a wireless identification technology that uses radio waves to identify the presence of RFID tags. RFID is used in many applications like attendance system in which every person will have their separate RFID tag which will help identify person and their attendance.

RFID Tag:

RFID tag includes microchip with radio antenna mounted on substrate which carries 12 Byte unique Identification number



RFID Reader:

It is used to read unique ID from RFID tags. Whenever RFID tags comes in range, RFID reader reads its unique ID and transmits it serially to the microcontroller or PC. RFID reader has transceiver and an antenna mounted on it.

Buck Converter:

A buck converter is a DC-to-DC power converter which steps down voltage (while drawing less average current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination.

Conclusion and Future Work

From the supplier-consumer relationship perspective, smart meters can redefine the supplier's role to that of an energy advisor. From an industry viewpoint, it can integrate new technologies and innovations across the power grid. To the users' advantage, it can drive down costs, provide transparency and flexible pricing. And from a social perspective, it can improve energy conservation, grid reliability and outage management, besides integrating the supply of renewable energy options. Much of the business case for smart meters hinges on convincing customers to genuinely change their energy usage. A positive bias among most users toward energy conservation (for both economic and environmental reasons) is an encouraging start. What is needed is to create a positive experience, both during and after the rollout. Customer experience during the rollout needs to be driven by timely and personalized information dissemination on schedules, status updates, tariff options, potential benefits and concerns of privacy and health. Post the rollout, it shifts more toward an advisory engagement. Analytics, coupled with the Internet of Things (IoT), can enable companies to provide smart solutions that help customers efficiently manage their energy requirements. In-home displays can provide real-time feedback and empower customers to analyse their consumption patterns and maximize savings. Real time distribution aims towards a uniform distribution of loads throughout the day. Hence, there will not be the need to produces very large power for short duration

of spikes. So, the number of power plants in operation could be kept minimal.

References

[1]. Omkar Natu, Prof.S.A.Chavan (2013),"GSM Based Smart Street Light Monitoring and Control System"(IJCSE),187-18

[2].Nikhil.N.Patil,Sumit.N.Khamkar,Dileep M.Bind, Vivek R.Kurade, Ganesh L.Sonawane (2018), "Smart Wireless Electronic Energy Meter" (IRJET),2662-2665

[3]. Dr.Adithya Tiwary, Manish Mahato, Mohit Tripathi,Mayank Shrivastava,Matnak Kumar Chandrol,Abhitesh Chidar (2018),"Design and Implementation of an Innovative Internet of Things(IOT) Based Smart Energy Meter"(IJFRCSCE),244-247

[4]. M.Faisal ,Thahia Fahrin Karim, Abu Ridwan Pavel, M.S.Hossain Lipu (2019) "Development of Smart Energy Meter For Energy Cost Analysis of Conventional Grid and Solar Energy",(IEEE),91-95

[5]. Syed Assra Shah (2019)," Automatic Electric Bill Generation System "(IOSR-JECE),75-79

[6]. Jayant.P.Pawar, Amirthaganesh.S, ArunKumar.S, Satiesh Kumar.B(2016)," Real time energy measurement using smart meter"(IC-GET),

[7]. Pandurang G.Kate, Jitendra R.Rana (2015)," ZigBee Based Monitoring Theft Detection & Automatic Electricity Meter Reading" (ICESA), 258-262

[8]. Shubham Pahurkar1, Subhash Diwakar2, Harshal Nerkar3, Sunita Patil4 (2017) IOT Based Electric Bill Generation (IJARCCE),4

[9]. Ashna K, Sudhesh N George (2013), "GSM Based Automatic Energy Meter Reading With Instant Billing "(IEEE), 65-71

[10]. Mr.Rahul Ganesh Sarangle, Prof.Dr.Uday Pandi Khot , Prof. Jayen Modi (2012), "GSM Based Power Meter Reading And Control System" (IJERA), 664-671n

[11]. Visalatchi S , Kamal Sandeep k (2017), "Smart Energy Meter power theft control using Arduino & GSM" (12ICT),858-861

[12]. S.P.Karthi, T.Monisha, S.Prathana and T.Radha (2017),"Smart Energy Meter Using GSM" (AJAST),90-94

[13]. Niville McNeill, Harry Dymond , Philip H. Mellor ,(2011),"High Fidelity Low-Cost Electronic Current Sensor For Utility Power Metreing" (IEEE)2309-2317

[14]. Damminda Alahakoon, Xinghuo Yu (2016),"Smart Electricty Meter Data Intelligence for Future Energy Systems: A Survey",(IEEE)425-436

[15]. P.Corral,B.Coronado,A.C.D Lima, O.Ludwig ,(2012),"Design of Automatic Meter Reading Based On ZigBee",(IEEE)1150-1155

[16]. Yederi Kavya, Jhansi Pansdiri , "Raspberry Pi & GSM Based Smart Energy Meter For Advanced Metering & Billing System"(IJECEC),84-89