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Hybrid Model of Smart Energy Consumption Monitoring System

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Abstract - *Electricity is one of the most essential invention that human being has got from science and technology. But people are not aware of the importance of electricity and its demand. In industries electricity consumption is increasing anonymously. Due to huge amount spent over electricity bill there is a need for monitoring system. This monitoring system is combined with special features that provides a end to end monitoring with data backup system. Implementation of such a smart monitoring system uses Internet of Things as the key concept. The construction of this system consist of Sensor Unit, Controller Unit, Relay, Power Supply, LCD & GSM as hardware part and Web Server & Mobile Application as Software part. As a result, the user is provided with notification regarding power consumption after analysing the data acquired. An additional feature is provided along with monitoring electricity consumption that shut downs the total system when the controller identifies high voltage current in order to reduce fire accident due to short circuit.*

Key Words*: *Sensor, Control unit, Relay, Web server, GSM, SIM, LCD.

1. INTRODUCTION

In India the measurement of energy consumption is done either by an electronic energy meter or an electro-mechanical meter which is fixed on the premise for measuring the usage. The meters currently in use are only capable of recording in KWH units. The KWH units consumed, still have to be recorded by meter readers monthly, on foot. The recorded data need to be processed. Losses in the electricity are notably concerned with Industries. Losses in the electricity energy sector can come under two sets: Technical and Managerial. Technical losses of electrical energy are caused due to the functional tendency of the equipment used from generating station to the distributing station. Non-Technical losses are due to a lack of utility labour interference periodically. These losses are much higher in developing countries like India. In India not only losses but there is an increase in Energy anonymously due to unnecessary usage of electricity by the users. The day to day consumption differs in several ways, so it is important for a Real-time monitoring system for monitoring along with intimation to users through mobile. Another Huge problem in this Energy Sector causes Accidents due to high voltage. This occurs when an unexpected High voltage current is conducted, this regulating system to avoid the situation. As the three constraints of Electricity Management are considered hybrid Integration of all the constrains is adapted. The proposed system consists of a Sensor unit, a Controller unit, gateway, GSM and Cloud Storage. As the input checks the readings from voltage and current sensors respectively.

As we propose IoT based Monitoring system Internet plays vital role in storing data in Online. The IoT is generally connecting things to the internet and using that connection to provide some kind of useful remote monitoring or control of those things. It is a machine -to-machine communication through which the electrical appliances are communicated. However, the devices are still primarily things on the internet that require more human interaction and monitoring through apps and interfaces. Smart systems and the internet of things are driven by a combination of:

- Sensors
- Connectivity
- People & processes

These are the components of the IoT. In the same manner of pushing the data into the server, you can get the triggers from the server to operate the device according to that. Here other options are also available such as users are not expected to write the program to operate the devices based on a given trigger and the device's digital pins will be getting high and low based on the operation of the website/app given to the user. If any user/developer wants to operate the device via microcontroller for specific reasons, then they can process on their own. With the help of our internet of things, Users can push 5 to 8 different sensor values to a server within a second of the time interval, So it is accurate in speed.

2. REQUIREMENTS

2.1 Hardware Requirements

The Hardware support for the monitoring system is provided with some major components. They are CT Sensor, Atmega 328, Nodemcu, Relay.

2.1.1 CT Sensor

Current Transformer is the major component involved in measuring energy. The sensor is clamped around the phase or neutral wire to measure the current passing

through. The analog readings obtained is provided to controller.

2.1.2 Atmega328

Atmega328 is the common microcontroller which helps in controlling the sensor and provides output digitally through actuators. This controller acts as a CPU for this system. Every computation and calculation is done with Embedded c language and dumped in the arduino board.

2.1.3 ESP8266

ESP8266 is the gateway in this IoT platform .Here this module acts as a Intermediate between Controller and web server. Here the data acquired is sent to the Server using php and this data stored in the server is retrieved using SQLite.

2.1.4 Relay

Relay is the component which acts as a control signal when high voltage passed through it. It opens when the low voltage is passed and closes when the high voltage is passed through circuit. Using this circuit when high voltage is arrived the total system is turned off.

2.2 Software Requirements

The Software support for the monitoring system is provided with Embedded C, Arduino IDE, PHP Web service, XAMPP Server.

2.1.1 Embedded C

The Microcontroller works with the program dumbed using Embedded C. The program is dumped in the Arduino IDE (Integrated Development Environment). Once the program is uploaded in the microcontroller it works according to the instructions given. The program plays major role in monitoring and controlling the external devices.

2.1.2 Arduino IDE

It includes code editor with features such as syntax highlighting, brace matching, and automatic indentation and is also capable of compiling and uploading programs to the board with a single click. A program or code written for Arduino is called Sketch. Arduino programs are written here in c.

2.1.3 PHP Web Service

It Compile php source code by using Zend engine, thus it works as an interpreter. It is also the reference implementation of php, as it has no formal specification, and so the semantics of zend php define the semantics of php. In order to speed the execution time not have to compile the php source code every time the web page is accessed, php scripts can also be deployed in the php engine's internal format by using an opcode cache, which works by caching the compiled form of a php.

2.1.4 XAMPP Server

It is a free and open source cross platform web server solution stack package consisting mainly of the apache HTTP server, and the scripts are written in PHP and Perl programming language. It is used for creating local web server for testing and the data is stored in it using PHP and the data retrieved using SQLite.

3. IMPLEMENTAION

Hybrid Model of Smart Energy Consumption Monitoring System implements the system in three quarters as Data acquisition, Adminsite, PowerSupply and User Intimation.

3.1 Data acquisition

In figure 1, the basic block of data acquisition is represented. The sensors incopratered in this system are current sensor and voltage sensor in order to take the readings of current and voltage respectively.

Controller accepts the analog values from the sensors and power calculation is done in the controller. For this process to happen suitable program need to be dumped in the controller which is written in the language Embedded C program.

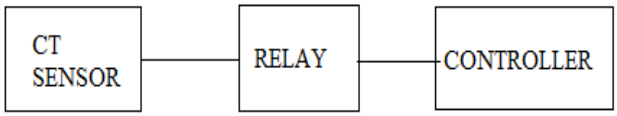

Fig-1: Data Acquisition

4. POWER SUPPLY

All digital circuits work only with low DC voltage. A power supply unit is required to provide the appropriate voltage supply. This unit consists of transformer, rectifier, filter and a regulator. AC voltage typically of 230Vrms is connected to a transformer which steps that AC voltage down to the desired AC voltage level. A diode rectifier then provides a full wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage. This resulting DC voltage usually has some ripple or AC voltage variations. Regulator circuit can use this DC input to provide DC voltage that not only has much less ripple voltage but also remains in the same DC value, even when the DC voltage varies, or the load connected to the output DC voltage changes. The required DC supply is obtained from the available AC supply after rectification, filtration and regulation.

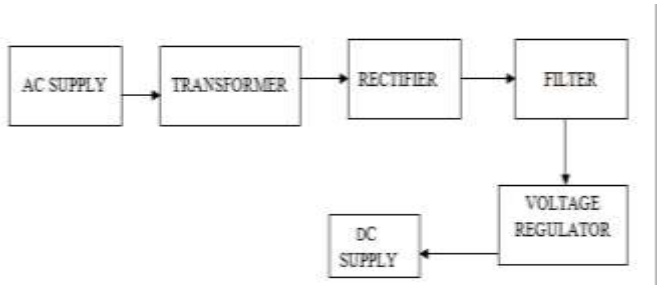

Fig -2: Power supply unit

5. ADMIN SITE

A Server administrator or admin has the overall control of a server. As receiving output from the controller to the gateway, it will upload the output or data in the server. The Admin will store the data from the controller through gateway at periodic interval of time. This is useful for the user intimation purpose and also the user can retrieve the old data anytime and anywhere.

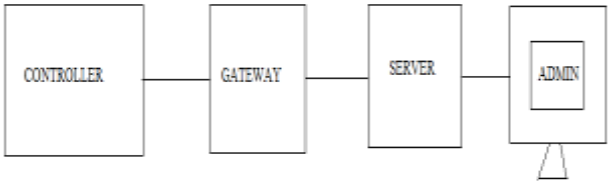

Fig-3: Admin Site

6. USER INTIMATION SECTION

The User intimation section consist controller, GSM and mobile phone. The controller will pass the intimation to the GSM. GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. It is Subscriber Identity Module (SIM). The SIM is a detachable smart card containing the user's subscription information and phone book. It will send the information to the user at periodic interval of time.

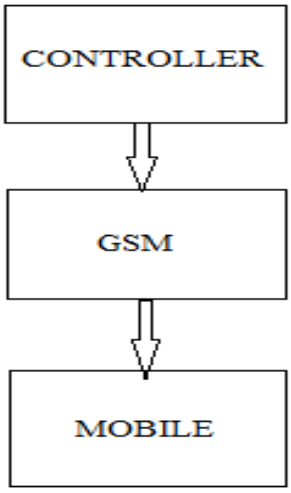

Fig-4: User Intimation Section

7. METHODOLOGY

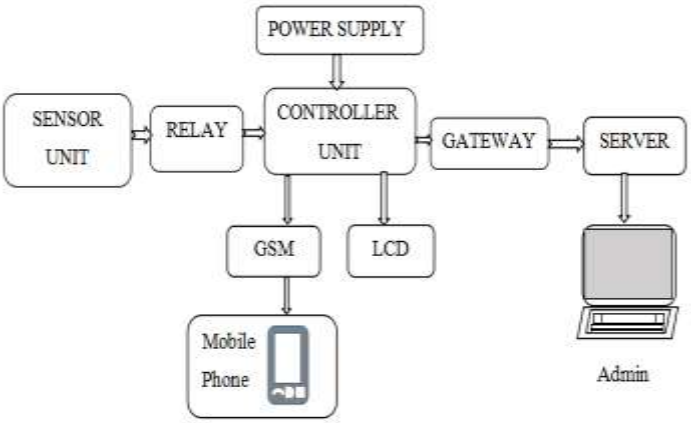

Fig-5: Hybrid model of Smart Energy Consumption monitoring system

The block diagram of smart energy monitoring consumption system is shown in the figure which consists of different blocks as mentioned above. Power Supply Block is basic block in every electrical and electronics circuit, which is used for providing the required power to the microcontroller and other components in the circuit. Generally, this power supply block consists of step-down transformer, bridge rectifier, and IC 7805 voltage regulator. Thus, the required 5V DC power supply is given to the microcontroller. Microcontroller Block can be considered as the main block of the entire circuit, as it is programmed to control all the components to perform the desired operation. Here, in this project microcontroller of ATMEGA 328 is used and programmed using Arduino IDE software. The energy meter is interfaced with the microcontroller using an interfacing device or middle wire device namely Opto-

isolator. Similarly, GMS modem is interfaced with a microcontroller using an interfacing device called as MAX232 and DB9 connector.

Relays are interfaced with microcontroller using relay driver. The loads are connected between the relays and energy meter, such that loads are given a 230V AC power supply for their operation. This 230V AC power supply is given to operate the loads until the relays are switched by the user by sending SMS from the registered mobile number to the GSM modem to turn off the loads. Primarily, we need to register the authorized person mobile number with the wireless electricity consumption meter. This, registered mobile number can only have access or authority to regulate the loads and monitor the wireless energy meter system.

The microcontroller is programmed to give control commands to the relay driver such that to switch on or off the relays. By using registered mobile number, we can send appropriate commands to the GSM modem as per requirement, which are further used to switch on or off the loads using relays through relay driver. Thus, same information regarding the status of the GSM modem communication with energy meter, the status of the load whether it is on or off, the energy consumed by the loads, SMS sent to the GSM modem, the mobile number registered with the GSM modem will be displayed on the LCD display connected in the circuit.

In this energy monitoring system, GSM modem SIM sends message to the registered mobile number (user mobile number has to be registered to get the electricity consumption SMS) for every regular time interval. This wireless meter system facilitates the user to check the electricity consumption over regular intervals based on the requirement. GSM based wireless energy meter reading system used to display the consumption of the energy by the user continuously on LCD display.

8. CONCLUSIONS

A Hybrid system for Integrating Power Theft Control with Automatic Short circuit Resistance and Energy consumption monitoring is proposed and tested. The device is found to work reliably thus ensuring the safety and control measures for power theft and energy consumption respectively where the system is constructed.

REFERENCES

[1] Lusi Susanti and Dicky Fatrias (2018), "A Configuration System for Real-time Monitoring and Controlling Electricity Consumption Behaviour", International Conference on Information Technology system and Innovation.

[2] Long Zhao and Igor Matsuo (2018), "Development of a Real-Time Web-Based Power Monitoring System for the Substation of Petrochemical facilities", 2018/IEEE/IAS 54th Industrial and Commercial Power Systems Technical conference(I&CPS)

[3]Hassaan Th. H. Thabet(2018), "Design and simulation of a monitoring electrical energy consumption system based on PLC techniques", 2018 1st International Scientific Conference of Engineering Sciences - 3rd Scientific Conference of Engineering Science(ISCES).

[4] Darwin Alulema and Mireya Zapata(2018), "An IoT-Based Remote Monitoring System for Electrical Power Consumption via Web-Application", 2018 International Conference on Information Systems and Computer Science(INCISCOS).

[5] T.Nagata(2006), "An electric power energy monitoring system in campus using an Internet", 2006/IEEE Power Engineering Society General Meeting.

[6] Yimin Sun and Zhengli Wang(2011), "The energy consumption monitoring platform design for large-scale industry users based on the GPRS", 2011 Second International Conference on Mechanic Automation and Control Engineering.

[7] Elamvazuthi and M.K.A Ahamed Khan(2012), "Electrical power consumption monitoring using a real-time system", 2012 IEEE Conference on sustainable utilization and Development in Engineering and Technology.

[8] S Visalatchi and K Kamal Sandeep(2017), "Smart energy metering and power theft control using arduino & GSM", 2017 2nd International Conference for convergence in Technology (I2CT).

[9] M. Prathik and K. Anitha(2018), "Smart energy meter surveillance using IoT", 2018 International Conference on Power, Energy, Control and Transmission Systems(ICPECTS).

[10] Danielly B. Avancini and Simion G.B. Martins (2018), "A Flexible IoT Energy Monitoring Solution", 2018 3rd International Conference on Smart and Sustainable Technologies(SpliTech).

[11] Paolo Visconti and Paolo Costantini(2019), "A Sensor-based monitoring system of electrical consumption and home parameters remotely managed by mobile app for elderly habits's control", 2019 IEEE 8th International Workshop on Advances in Sensors and Interfaces.

[12] Luis Cruz and Rui Abreu(2019), "EMaaS: Energy Measurements as a service for Mobile Applications", 2019 IEEE/ACM 41st International Conference on Software Engineering: New Ideas and Emerging Results (ICSE-NIER.

[13] Moonok Choi and Wan-ki Park (2015) "Smart office energy management system using bluetooth low energy based beacons and a mobile app", 2015 IEEE International Conference on Consumer Electronics(ICCE).

[14]Swati Soni and Yugyung Lee (2012), "E-SAVE: Saving energy by smart serves", 2012 IEEE International Symposium on a world of wireless, Mobile and Multimedia Networks(WoWMoM).

[15] Yimin Zhou and Zhile Yang (2018), "The College Campus Energy Monitoring Platform for Artificial Intelligence Application", 2018 IEEE Innovative Smart Grid Technologies-Asia(ISGT Asia).