EB Energy Meter Monitoring System Using IOT

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ABSTRACT - The effort of collecting electricity utility meter reading for every individual housing is a tedious process and needs a huge manpower for this work. In addition to this there are many risk factors involved in it, like availability of the consumer, accessing point of the meter etc., In order to overcome this problems we have developed an unique idea using Internet of Things (IoT) which presents an efficient and coeffective to transfer the information of energy consumer wirelessly as well as it provides to detect the usage of the electricity the main intention of this project is measure electricity consumption in home appliances and generate it's bill automatically using IoT. Another advantage of the project is that it alerts the user when he exceeds the free units limit (In Tamilnadu 100units are free for Domestic Consumers). The energy grid needs to be implemented in a distributedtopology that can dynamically absorb different energy sources. IoT can be utilized for various applications of the smart grid with distributed energy plant meter, energy generation and energy consumption meter smart meter, energy demand side management and various area of energy production.

I. INTRODUCTION

In the present billing system, the distribution companies are unable to keep track of the changing maximum demand of consumers. The consumer is facing problems like receiving due bills for bills that have already been paid as well as poor reliability of electricity supply and quality even if bills are paid regularly. The remedy for all these problems is to keep track of the consumers load on timely basis, which will be held to assure accurate billing, track maximum demand and to detect threshold value. These are all the features to be considered for designing an efficient energy billing system.

The energy consumption can be monitored by using an electric device called energy meter. The cost and the regular usage of Power consumption are informed to the user to overcome high bill usage. The Energy meter shows the number of units consumed and transfers the data to both the customer and to the electrical board so this helps in reducing man-power. The user can check their Power usage from anywhere and at any time interval. The IoT is used to Turn on/off the household appliances using relay and Arduino interfacing. The objective of this system is to monitor the amount of electricity consumed.The distributer and the consumer both will be benefitted by eventually reducing the total Power consumption.

Objective:

Themain objective of this project is,

- The process of manual meter reading calculation, monitoring the function of electric system in homes or offices from a remote location.
- Providing updated data which will be useful for balancing electric loads and reducing power blackouts in power stations.
- Creating the awareness among user to use power resources more efficiently.
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II.LITERATURE SURVEY

Anitha et al., [1] proposed “Smart energy metersurveillance using IoT” about IoT, internet of things as an emerging field and IoT based devices have created a revolution in electronics and IT. The foremost objective of this paper is to create awareness about energy consumption and. efficient use of home appliances for energy savings. Due to manual work, existing electricity billing system has major drawbacks. This system will give the information on meter reading, power cut when power consumption exceeds beyond the specified limit using IoT. The Arduino esp8266 micro controller is programmed toper form the objectives with the help of GSM module. It is proposed to overcome all the disadvantages in the already existing energy meter. All the details are sent to the consumer’s mobile through the IoT and the GSM module and it is also displayed in the LCD. It is a time savings and it helps to eliminate the human interference using IoT.

Devadhanishini et al., [2] “Smart Power Monitoring Using IoT” that energy Consumption is the very important and challenging issue. Automatic Electrical Energy meter is used in large electric energy distribution system. The integration of the Arduino WIFI and SMS provides the system as Smart Power Monitoring system. Smart energy meter provides data for optimization and lessthe power consumption. This system also includes a motion sensor such that if there is no human in house or house it will automatically turn off the power supply.

Mohammed Hosseiu et al., [3] presented a paper titled "Design and implementation of smart meter using IoT" describing the growth of IoT and digital technology. The future energy grid needs to be implemented in a distributed topology that can dynamically absorb different energy sources. IoT can be utilized for various applications of the smart grid consisting power consumption, smart meter, electric power demand side management and various area of energy production. In this paper, the Smart Energy Metering(SEM) is explained as the main purpose of SEM is necessary for collecting information on energy consumption of household appliances and monitor the environmental parameters and provide the required services to home users.

Himanshu K Patel et al., [4] demonstrated "Arduino based smart energy meter" that removes human intervention in meter readings and bill generation thereby reducing the error that usually causes in India. The system consists the provision of sending an SMS to user for update on energy consumption along with final bill generation along with the freedom of reload via SMS. The disconnection of power supply on demand or due to pending dues was implemented using a relay. The system employs GSM for bidirectional communication.

BibekKanti Barman, et al., [5] proposed "smart meter using IoT" on efficient energy utilization plays a very vital role for the development of smart grid in power system. Hence proper monitoring and controlling of power consumption is a main priority of the smart grid. The energy meter has many problems associated to it and one of the key problems is there is no full duplex communication to solve this problem, a smart energy meter is proposed based on Internet of Things. The smart energy meter controls and calculate the consumption of energy using ESP 8266 12E, a Wi-Fi module and send it to the cloud from where the consumer or customer can observe the reading. Therefore, energy examine has been by the consumer becomes much easier and controllable. This system also helps in detecting energy loss. Thus, this smart meter helps in home automation using IoT.

Rishabh Jain, et al.,[7] prposed "Energy Meter Monitoring and Controlling" energy meter reading system which includes fault indication. Unit usage after (i.e., for 15 days once). Mode selection (automatic& manual) and SMS alert to user. Mode selection option is included. To avoid more power consumption automatic mode is used to cut-down the appliances for the user convenience. If there is a fault in the e-meter it sends a notification to the user. If there is any fault in E-meter the LED will glow. EEPROM (Electrically Erasable Programmable Read Only Memory) used as flash memory to store a data. The proposed system neglects the regular digital meter reading system and allows remotely access the electronic meter. Legitimate validation, user can get to the created webpage points of interest from anyplace on the planet. The advantages of this project are to reduce cost and save more power and also reduce man power and time consumption. This project is implemented is hardware and software used are ARUDINO IDE

Architectural Model:

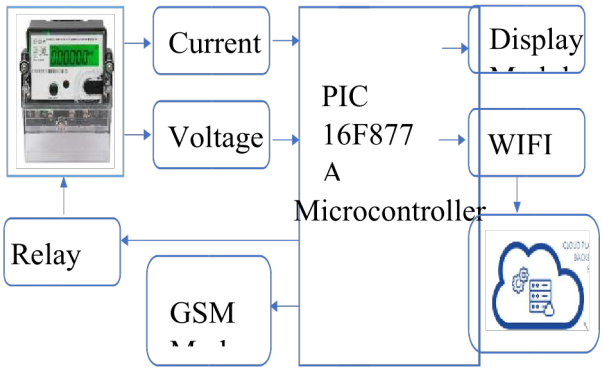

Fig 1: Functional Block Diagram

III.METHODOLOGY

The system designed here is a replacement for existing EB Meter, here a voltage and current sensors are used, the line voltage is measured by voltage sensor and current sensor for load measurement. The sensors are connected to the microcontroller's ADC pins, the values are digitalized for processing, watts/hour calculations are done in the microcontroller and the readings are displayed in an LCD module. The module used here is two-line module which is capable of displaying the voltage, current, units, amount etc. Here a 40 pin PIC 16F877A microcontroller is used. To send a text SMS to the user a GSM Module is connected to the serial UART port of the microcontroller. It sends warning message when the free units limit is exceeded and to remained the user to pay his bill due. To the power station to monitor the performance analysis and the maximum demand the noted parameters are transferred to a server (Thingspeak) via an ESp8266 WIFI module. A local Hotspot is needed to give internet

connection to the WIFI module, if connected it transmits the current reading to the server. The server information can be monitored from any where in the world. The readings are stored in the cloud and can be retrieved as EXCEL sheets. The live readings are shown graphically. If user has not paid the bill due, the supply can be disconnected, for that a relay circuit is used which disconnects the supply.

IV.RESULT AND DISCUSSION

The final output results for this papert is discussed below, the circuit uses PIC 16F877A Microcontroller as main components, the function of this microcontroller board is to interface all sensors, get data from it, process and calibrated the received data, display the contents in an LCD module, change the data into a serial format, transfer it to the WIFI module ESP8266. Without this Microcontroller board accompanying this paper is very tedious process. The chip has 40 pins in that 8 analog channels are there; these analog pins are used for sensor interfacing. Digital I/O pins are used for LCD display connections and Serial port acts as communication protocol between PIC board and WIFI Module. A code is developed by using Arduino IDE in C++ language, the program is compiled and burned into the chip present in the Arduino board. The program mentions the port where sensors and display are connected, and also it calibrates the sensor readings. While writing this program we have come across many errors and logical mistakes, all this are corrected by proper learning and repeated trial checking. By developing this paper in machine level, I have learned chip level C++ programming.

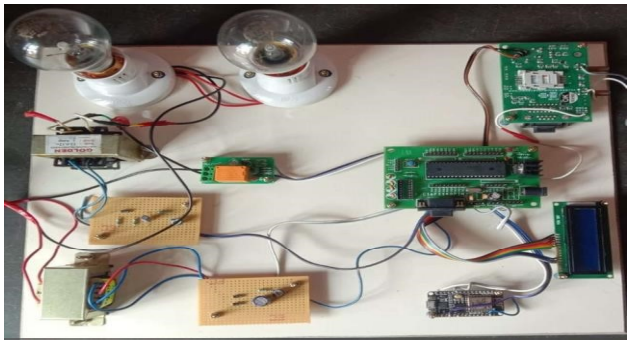

Fig 2: Working Model of the Smart Energy meter using IOT

The schematic is designed using Proteus Software, which acts as simulator also. The code is loaded in the schematic microcontroller and the results are viewed in virtual terminal. The below fig3 shows the schematic connections of the system we have developed.

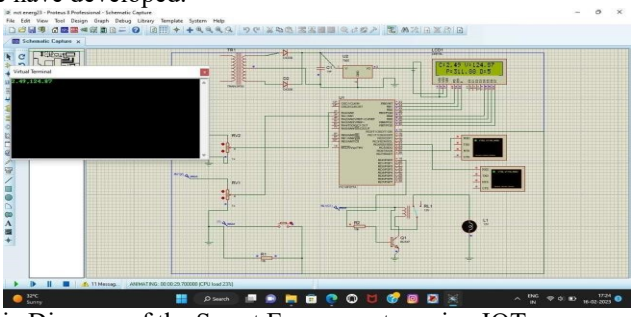

Fig 3: Schematic Diagram of the Smart Energy meter using IOT

The current sensor used here is simple CT coil, which gives output voltage proportional to the input current passing through the coil. The coil is a non-contact type, spherical in shape the current flowing conductor is passed through the hole of the coil. The resultant voltage is AC and rectified using a diode, then fed to the input of ADC channel in the PIC microcontroller.

Fig 4: LCD Display showing the readings of the system

The voltage sensor senses the input line voltage for that a potential transformer is used to step down the supply and a rectifier with filter for pure DC supply, this voltage is given another ADC channel of the microcontroller. The program fed in the controller calculates the power, watts/hour and displays in the LCD screen.

The display used in the system is an LCD, which has 2 rows and 16 columns, the columns are used as characters, so a total of 32 characters can be displayed at a time. The display is connected to the microcontroller by using digital pins and refreshed by the controller at regular intervals, so that the user can know the current reading.

To transmit the measured data to an IoT server we need a gateway device, here ESP8266 WIFI module is used as gateway device, it connected to a local hotspot and serial communication is used between this module and microcontroller unit. The WIFI module receives the data, rearranges it and transfers the IoT server, here we use THINSPEAK server for this purpose, it has a trail version for research students and we use this version of IoT server for our project. The blynk serve runs in android and iOS phone, the app can be downloaded form play store, the project creation is done in the APP. An authentication token is generated for each project, the code is loaded in the ESP8266 WIFI module, a display window is created in the APP and the resultant values are displayed here. The APP updates every 15 seconds, the updating is done by the code written in the ESP8266 module.

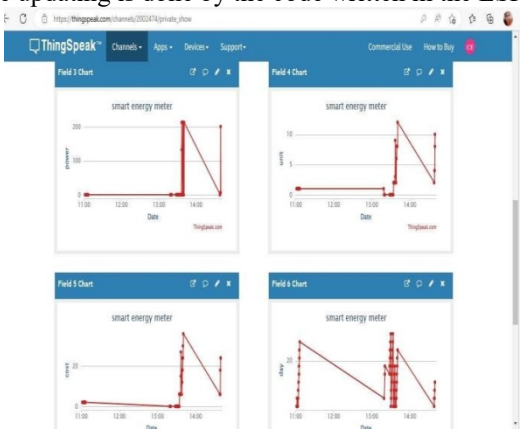

Fig 5: IOT charts on ThinsSpeak website

The ThingSpeak API is an opensource interface which listens to incoming data, timestamps it, and outputs it for both human users (through visual graphs) and machines (through easily parse-able code).

In addition, the system uses a GSM modem to send SMS to users who does not use smart phones, the readings and the usage limit as send as text the user mobile phone. The below fig6 shows the SMS screen shot from a user mobile.

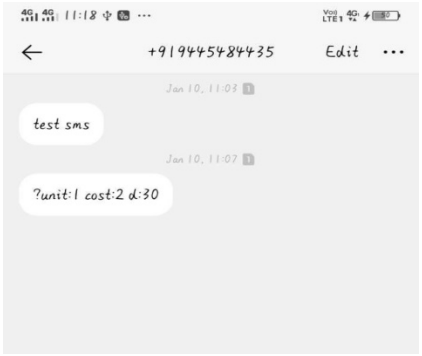

Fig 6: SMS Screenshot

V.CONCLUSION

The paper is based on the internet of things concept. This is aimed at replacing the old energy meters with an advanced implementation. Smart energy monitoring system includes PIC Mirocontroller, Sensors, GSM Modem, WI-FI, energy meter. The system automatically reads the energy meter readings and provides user about his usage, if he is in free limit or exceeded beyond it and also power management can be done through IOT server. The proposed system consumes less energy and it will reduce manual work. By using this system on can receive monthly energy consumption from a remote location directly to centralize office. In this way we reduce human effort needed to record the meter reading which are till now recorded by visiting the home individually.

REFERENCES

[1]. Rui Yang, HongFa Ding, Yun Xu, Lei Yao, and YingMengXiang,"An Analytical Steady-State Model of LCC type Series–Parallel Resonant Converter With Capacitive Output Filter" IEEE trans. power electron, VOL. 29, NO. 1, JANUARY 2014

[2]. Ahmed A. Aboushady, Khaled H. Ahmed, Stephen J. Finney, and Barry W. Williams "Linearized Large Signal Modeling, Analysis, and Control Design of Phase-Controlled Series-Parallel Resonant Converters Using State Feedback" IEEE trans. power electron, VOL. 28, NO. 8, AUGUST 2013

[3]. Chien-Hsuan Chang, En-Chin Chang, and Hung-Liang Cheng, "A high-efficiency solar array simulator implemented by an LLC resonant DC–DC converter," IEEE Trans. PowerElectron, VOL. 28, NO. 6, JUNE 2013

[4]. Thiago B. Senior, Jonas Mühlethaler, JörgenLinnér, Per Ranstad, and Johann W. Kolar, "Automated Design of a High-Power High-Frequency LCC Resonant Converter for Electrostatic Precipitators" " IEEE trans. power electron VOL. 60, NO. 11, NOVEMBER 2013

[5]. ing-Chun Chuang, Yu-Lung Ke, Hung-Shiang Chuang, and Jung-Tai Chen "A Novel Loaded-Resonant Converter for the Application of DC-to-DC Energy Conversions" IEEE trans. industry applications, VOL. 48, NO. 2, MARCH/APRIL 2012

[6]. Il-Oun Lee, and Gun-Woo Moon,"Analysis and design of a three-level LLC series resonant converter for high and wide input voltage applications," IEEE Trans. PowerElectron, VOL. 27, NO. 6, JUNE 2012

[7]. R. Beiranvand, B. Rashidian, M. R. Zolghadri, and S. M. H. Alavi, "A design procedure for optimizing the LLC resonant converter as a wide output range voltage source," IEEE Trans. Power Electron., vol. 27, no. 8, pp. 3749–3763, Aug. 2012

[8]. GovindarajThangavel," Finite Element Analysis of the Direct Drive PMLOM" In book: Finite Element Analysis - New Trends and Developments, Chapter: 6, InTech online Publisher, 10 Oct 2012.

[9]. Y. M. Lai, S.-C. Tan, and Y. M. Tsang, "Wireless control of load current sharing information for parallel-connected DC/DC power converters," IET Power Electron., vol. 2, no. 1, pp. 14–21, Jan. 2009

[10]. Milan Ilic and DraganMaksimovi "Interleaved zero current transition buck converter,"IEEE Trans. PowerElectron,VOL. 43, NO. 6, NOV/DEC 2007

[11]. J. P. Lee, B. D. Min, T. J. Kim, D. W. Yoo, and B. K. Lee, "A novel topology for photovoltaic series connected DC/DC converter with high efficiency under wide load range," in Proc. IEEE Power Electron. Spec.Conf., 2007, pp. 152–155.

[12]. G.Neelakrishnan, K.Anandhakumar, A.Prathap, S.Prakash "Performance Estimation of cascaded h-bridge MLI for HEV using SVPWM" SurajPunj Journal for Multidisciplinary Research, 2021, Volume 11, Issue 4, pp:750-756

[13]. G.Neelakrishnan, S.N.Pruthika, P.T.Shalini, S.Soniya, "Perfromance Investigation of T-Source Inverter fed with Solar Cell" SurajPunj Journal for Multidisciplinary Research, 2021, Volume 11, Issue 4, pp:744-749

[14]. Sharaf A.M , Elbakush. E ,Altas I.H "Novel Control Strategies For Photovoltaic Powered PMDC Motor Drives" Electrical Power Conference,IEEE Canada 2007,pp 461 - 466

[15]. [20] Changrong Liu, Amy Johnson, and Jih-Sheng Lai, "A novel three phase high power soft switched DC/DC converter for low voltage fuel cell applications," IEEE Trans. PowerElectron, vol. 41, no. 6, NOV/DEC 2005

[16]. C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of ELECTRICAL ENGINEERING, Vol.63 (6), pp.365-372, Dec.2012.

[17]. C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011.

[18]. C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor & Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011.

[19]. Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- Iranian Journal of Electrical & Electronic Engineering, Vol.8 (3), pp.259-267, September 2012.