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A Survey on Energy Monitoring System using Internet-of-Things

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Abstract-*The energy audit may range from a simple walk-through survey at one extreme to one that may span several phases. These phases include a simple walk-through survey, followed by auditing of energy use in the industries, and then analysing usage of computer representation of industrial operations. The complexity of the audit is directly proportional to the stagesinvolved in the energy management program and the cost of the audit exercise. Remote monitoring and control refers to a field of automation that is entering a new age with the development of wireless sensing devices. Different industries sensors, machineries, energy or the power panels are the most demanding products and hence many organizations are in requirement of remote monitoring system. Keeping both the important points in consideration, proposed has been designed to implement the remote energy parameter monitoring system for energy audit and analysis. The proposed hardware modules are device with inbuilt functionality to work as a web client to communicate directly with web services. Providing microcontroller web functionality through GPRS protocol and reading meter parameter over MODBUS protocol is most challenging part of the system.*

Keywords- *Internet of Things(IoT), MODBUS, GPRS protocol, Automation, Energy Audit.*

I. Introduction

In 2017, average electricity consumption in India is 1149 kwh per capita, in which industrial consumption is 41.48%. This number can be reduced by decreasing energy waste through the Internet of Things (IoT). According to researchers, "The IoT is a system ofinterrelated computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction"[2]. Significant progresses can be made in conservation of energy by using field data obtained from intelligent devices installed in substations, feeders, and various databases and models across the utility enterprises. Information acquisition is a key for timely data sensing, processing, and knowledge extraction. So far, the most talked-about information about power network operations is from data collected from intelligent electronic devices installed in substations and various parts of the transmission and distribution networks [3]. In recent years, smart meters are being installed in homes and other premises in many regions of the world [3].

Monitoring System Functions have been logically groupedin four layers that are presented with a top-down approach, starting from the end users' specifications to the low-level data acquisition requirements [4]:

A. Information Presentation
B. Data Correlation and Analysis
C. Data Classification, Transformation and Storage
D. Data Acquisition, Collection and Adaptation

A. Information Presentation

A suitable Software Layer for Information Presentation is required on top to provide appropriate and value added information to several involved responsibility levels in the organization and even to external stakeholders [5].

B. Data Correlation and Analysis

The Monitoring System Software for Data Correlation and Analysis, that feed the upper layer presentation software with value added information, should be modular and scalable to allow a progressive introduction of the needed functions in
accordance with the priorities and the growing knowledge and awareness of the Organization [4].

C. Data Classification, Transformation and StorageCorrelation and Analysis functions described in theprevious section B require a complex set of input data with different characteristics and origin [4].

D. Data Acquisition, Collection and Adaptation LayerThis layer includes all the "measuring devices" (meters,sensors, probes, gauges and in-field data interfaces) that arerelevant for implementing an energy efficiency monitoringsystem in accordance with the scope defined by the interestedOrganization. A correct choice of measuring instruments musttake into account also a suitable measuring accuracy, a periodiccalibration plan and an evaluation of installation costs andburdens that may occur during deployment [4].

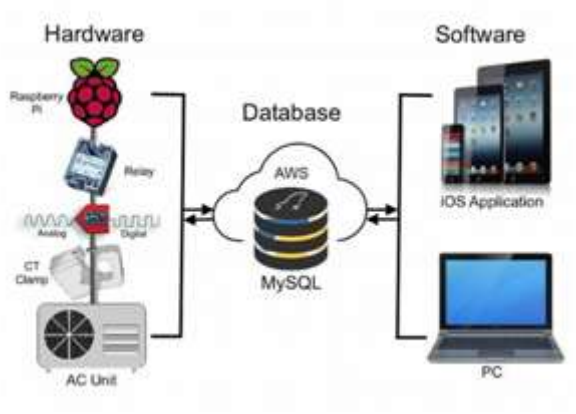

Fig.1

The Architecture Diagram Of The Iot Monitoring And Control System [1]

This project aims toimplement a system in which electrical devices can be securely monitored using IoT technology on an international level (e.g., from any place in the world). Also, it deals with complete front-to-back aspects includinga mobile application, a database, the creation of an API, and hardware development. All the smart units areconnected to devices set up with iOS applications to control the unit's electrical status and monitor energy consumption, which is recorded in a database for analysis. Additionally, it consists of usage reports on the electrical appliances units along with trends in consumption in kWh per unit time. The goal is to observe energy waste that may occur during the daily use of energy consuming appliances such as air conditioning units and standard overhead lighting units[1].

II. Literature Review

1. **Energy Monitoring and Control using Internet of Things**

Authors : Wesley "Tyler" Hartman, Alexander Hansen, Erik Vasquez, Samy El-Tawab, Karim Altaii

This project aims toimplement a system in which electrical devices can besecurely controlled and monitored using IoT technology onan international level (e.g., from any place in the world). Also, it deals with complete front-to-back aspects includinga mobile application, a cloud-based database, the creation ofan API, and hardware development. The goal is to observeenergy waste that may occur during the daily use of energyconsuming appliances such as air conditioning units andstandard overhead lighting units. These smart units areconnected to Apple devices set up with iOS applications tocontrol the unit's electrical status and monitor energyconsumption, which is recorded in a database for analysis.Additionally, it consists of usage reports on the airconditioning units along with trends in consumption in kWhper unit time. The hardware aspect of this project requires a variety ofcomponents that had to be tested before ordering and
implementing into the system. The Raspberry Pi v3 waschosen due to familiarity and its built-in capabilities for allaspects of the project, including general purpose pins andWi-Fi capabilities.[1]

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2. **Energy Management Information System for Energy Efficiency**

Author: Luigi Martirano, Luigi Borghi, Franco Bua, Loredana Cristaldi, Giacomo Grigis, Cristina Lavecchia, MicheleLiziero, Luca Mongiovì, Emanuele Nastri, Enrico Tironi

This paper analyzes the requirements forimplementing an Energy Management Information System(EMIS) and proposes some methodology criteria and tools for itsdesign, deployment and management. An EMIS combinessoftware, hardware, and data modelling and processing to supportpeople in their efforts to daily manage energy at any level (process,system, facility, and enterprise) year after year. A distributed monitoring system (DMS) is a hardware systeminstalled to measure and analyze the Energy PerformanceIndicators (EnPIs) of the structure/organization. The DMS is anetwork of meters, sensors, and devices able to measure both

the energy uses and the site influencing factors.The paper introducesa procedure to assess the DMS introducing the Level of Coverage. Measuring and monitoring systems are key assets in the contextof energy management. With specific reference to EnergyManagement Systems (EnMS) as in ISO EN 50001 [6],measuring and monitoring systems can be seen as energymanagement assets able to analyze energy use and energyconsumption of the organization (activity related to the energyplanning phase) and to analyze organization's energy policyoutcomes (activity related to the checking phase). An EnMSsupports energy auditing, and benchmarking, but it also allowsto analyze dependability performance of the system, in terms ofavailability of the system and support to the maintenance.[4]

3. **Architectural Criteria for distributed Energy Monitoring System**

Author: Luigi Martirano, Luigi Borghi, Franco Bua, Loredana Cristaldi, Giacomo Grigis, Cristina Lavecchia, MicheleLiziero, Luca Mongiovì, Emanuele Nastri, Enrico Tironi

This paper aims at contributing to the work of CENCENELECJWG9 "Energy measurement plan for organizations"by providing background information for the development of itsstandards and for future work. The layered and modular architecture model hereinpresented (see Fig. 1) is intended to provide a generalframework to identify the Hardware and Software componentsrequired for designing a brand-new monitoring system forenergy efficiency or integrating an already existing system. Itprovides a general interconnection and interworking schemeamong these components, as well. The list of functions and equipment indicated in this paperis not exhaustive neither it is required that all of them shall beadopted in a single implementation:

 Type and quantity of acquired data, and therefore of sensorsand data acquisition interfaces, depend on the scope(covered areas and processes, and required depth ofanalysis) of the Monitoring System.

 Data Analysis functions, and Information Presentationinterfaces and outputs should be limited to the realoperational and control needs of the users.[5]

4. **Analyzing Technique for Electrical Energy Monitoring System in Thailand Hospital**

Author: Piampoom Sarikprueck ,Chodchanok Attaphong, Pichit Lumyong, Bandit Ngamwatthanasilpa

This paper proposes K-meanclustering technique, which is one of the effective data miningtechniques, to analyze the big data from the electrical energymonitoring system in hospital. The case study is a large hospitalwith 200 in-patient beds in Thailand. Without loss of generality,electrical load profile is used for analyzing instead of using theelectrical energy. This technique also identify the abnormality ofthese characterized electrical load profiles in various scenarioswhich hospital system operators can use them to consider thesecurity, reliability, and energy efficiency of their operatingsystems. this paper presentsthe analyzing technique for electrical monitoring system usingK-mean clustering method for a large hospital in Thailand.The study focuses on the abnormality of the electrical loadprofile that is the most invaluable data for the security andreliability of the hospital operating system. The indirect impactfor the analyses is the energy saving for the hospital.[7]

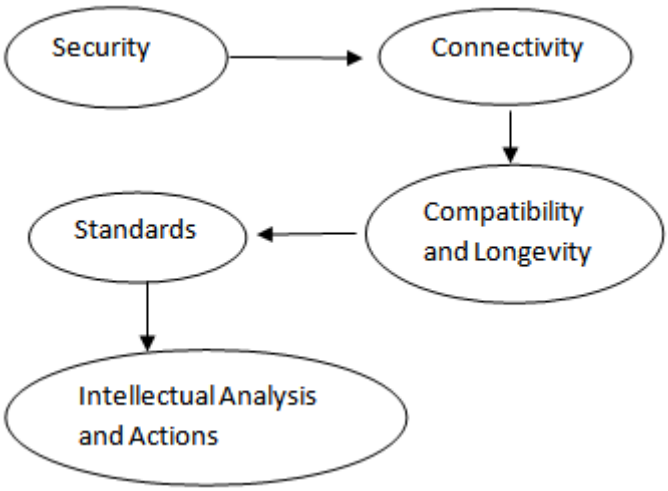
5. **A hierarchical system for Energy Consumption Monitoring and Information Management**

Author: Yimin Zhou, Qingtian Wu and Tingxin Yan

In this paper, an energy consumption monitoringand information management system based on multi-level energyconsumption model is developed. It is based on internet,wireless internet of things and communication technologies ofthe intelligent terminal such techniques. The system consists ofenergy usage equipment, monitoring and control layer, networkand communication layer, intelligence management layer, analysisand decision-making layer and the end-users layer. Based onthe practical experiments, the results identified that the systemdata can be transmitted safely and reliably, and the energyconsumption can be regulated scientifically with bright prospect. The configuration of the HEMIMS is composed of energy usage devices,monitoring control layer, network communication layer, intelligent management layer, analysis & decision-making layerand end-users layer.[8]

III. Problems and Challenges with reference to past work

1.There are many problems, issues and key challenges that would come in monitoring electrical systems. As the applications of IoT are increasing rapidly, it is difficult to handle all the applications in IoT environment. There are three categories of challenges to overcome and this is true for any new trend in IoT :-



2.The system allows the access of electricity which collects distributed precise energy consumption data in real time. The monitoring platform provides precise energy usage load monitoring for the users so as to make usage of electrical energy low. At the same time, it can provide electricity bench marking service for the companies, industries in order to check the energy consumption analysis.

IV. Conclusion

In this survey an energy monitoring system for electrical energy consumption is under development to check out the overall energy usage or consumption the above system can realize and understand the real time energy parameters. IoT has been already designed for various automation systems. This paper presents the automation for industries. It overcomes the challenges in old technology with the use of IoT. Vrious components like GSM network, MODBUS, SMPS are used for the IoT. As the energy audit is need of industries in order to save unnecessary energy consumption and to know the exact requirement of industry, hence the proposed system is taking this development at next level by enhancing the term IoT for industrial remote enegy parameter monitoring system.

References

[1]. Wesley "Tyler" Hartman, Alexander Hansen, Erik Vasquez, Samy El-Tawab, Karim Altaii,"Energy Monitoring and Control Using Internet ofThings (IoT) System",IEEE 2018
[2]. Rouse, M. and Wigmore, I. (2018). What is Internet of Things (IoT)?[Online] IoT Agenda. Availableat: https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT
[3]. Damminda Alahakoon, Member, IEEE, and Xinghuo Yu, Fellow, IEEE, "Smart Electricity Meter Data Intelligence forFuture Energy Systems: A Survey",IEEE transactions on industrial informatics, vol. 12, no. 1, February 2016.
[4]. Luigi Martirano, Luigi Borghi, Franco Bua, Loredana Cristaldi, Giacomo Grigis, Cristina Lavecchia, MicheleLiziero, Luca Mongiovì, Emanuele Nastri, Enrico Tironi,"Energy Management Information Systemsfor Energy Efficiency",IEEE, 2018.
[5]. Luigi Martirano, Luigi Borghi, Franco Bua, Loredana Cristaldi, Giacomo Grigis, Cristina Lavecchia, MicheleLiziero, Luca Mongiovì, Emanuele Nastri,"Architectural Criteria for a DistributedEnergy Monitoring System", IEEE 2017.
[6]. ISO 50001:2011 "Energy Management System"
[7]. Piampoom Sarikprueck ,Chodchanok Attaphong, Pichit Lumyong, Bandit Ngamwatthanasilpa,"Analyzing Technique for Electrical Energy Monitoring System in Thailand Hospital"IEEE 2017.
[8]. Yimin Zhou, Qingtian Wu and Tingxin Yan,"A hierarchical system for Energy Consumption Monitoring and Information Management", IEEE 2017.