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Home Automation System Embedded in an Internet-Of-Things Platform

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ABSTRACT: The customer domain of smart grid usually a combination with smart home and building systems however our proposed model are distributed centric instead of customer centric, which is inadequately versatile and there by user can be helpful by this model. Our model consists of detailed design and an execution of last meter smart grid which is the last portion of the smart grid on customer premises and is to be embedded in an internet of things platform. Our approach comprises of numerous new perspectives and preferences over existing framework, an addition of new application or routine with smart grid that work smoothly with smart home application in the same infrastructure; data gathering from many sources using sensor communication protocol; the data access is made secured and more customized; and updated in webpage on the Mobile APP. A demonstrator has been built and tested with purposely developed Mobile App, zigbee, smart meter and gateways, distributed IOT server, flexible user interface.

KEYWORDS: Internet of things, power meter, smart grid, raspberry pi.

I. INTRODUCTION

The last meter smart grid is the portion of the smart grid closer to the home, and the one with which customers interact. It allows a two-way data flow between customers and electric utilities, transforming the traditionally passive end-users into active players in the energy market. Considering the seven domains of the conceptual model of smart grids proposed by the National Institute of Standards and Technology, the last-meter smart grid corresponds to the customer domain. It enables residential, commercial, and industrial customersbased on their different energy needsto optimize energy consumption and local generation, and to actively participate to demandresponse policies, one of the most disrupting aspects of smart grids. Nontechnical customers need a simple way to control energy consumption and production, and to exchange power usage data at the proper level of granularity with energy providers or distributors. From the point of view of market acceptance and penetration, the lastmeter smart grid is just one aspect of the broader concept of smart home and smart buildings. The consequence of this consideration is that one can hardly imagine a situation in which the consumer side of the smart grid and other smart home applications rely on different and separate infrastructures or platforms. However, smart-grid architectures proposed in the literature typically focus on the needs of power distributors to manage the complete power grid. They reach customers premises with an ad-hoc network of smart meters connected by General Packet Radio Service (GPRS) or, sometimes, with a dedicated programmable logic controller (PLC) technology. They do not take into account the possibility that customers already have other smart home infrastructures. On the other hand, some solutions proposed in the literature, based on a smart home infrastructure, are not designed to be seamlessly scalable to large deployments. In this system we proposed the newly additional work such as we developed the Mobile App. All information related to our home apparatus will update on the Mobile App in form of webpage. So it is convient to user. Also user can monitor and control the home apparatus if his/her outside home. So in that way the user can save the energy or energy efficiency will be maintained.

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II. MOTIVATION

Recent developments in this direction seem to provide opportunities in implementing energy efficient metering technologies that are more precise and accurate, error free, etc. The implementation of WAMRS provides with many vital features as compared with the analog utility meter reading with man power. Some of these features are listed below. a) Higher speed.

b) Improved load profile.
c) Automatic billing invoice.
d) Real time energy cost.
e) Load management.
f) Alarm warning.
g) Remote power switches on/off Tamper detection.

III. OBJECTIVES

The objectives of the proposed system are given below

- To solve the problem of customer domain of the smart grid naturally blends with smart home and smart building systems, but typical proposed approaches are distributorcentric rather than customer-centric, undermining user acceptance, and are often poorly scalable.
- The gateway can have reduced hardware requirements and computational complexity. Our gateway has only to ensure an IP connection, to implement the encapsulation
  of the nodes native protocol into TCP/IP packets, and to ensure the security level required by the specific application.
- Different applications and new functionalities can be developed and added without modifying the gateway.
- The user side of the platform can communicate at the application level directly with network nodes.

IV. REVIEW OF LITERATURE

In this chapter, detailed literature survey has been carried out on Socket based IOT node home automation system with Smart plug. In recent years, there are many methods of Energy management technology that have been applied for Smart homes. Typically, existing approaches to detect price response are following. In this work [1] they present the architecture of the latest intelligent subway network that is integrated into a platform for the Internet of Things (IOT). The smart grid customers domain is naturally combined with intelligent home systems and smart buildings, but the typical approaches proposed are ”focused on retailers” rather than ”customer focused”, undermining users’ acceptance and are often not recommended To solve this problem, we propose a detailed architecture and implementation of a ”ultimate meter” intelligent network, a portion of intelligent network in client facilities, integrated into an Internet of Things (IOT) platform. In this work [2] this paper focuses on the IOT elements, protocols, and the test bed setup for IOT environments along with the protocols and software designs that have been used to monitor and control consumers energy usage patterns. We have deployed smart home technology in a real world scenario with each housing unit with 3 bed rooms and a living room that can accommodate 6-9 consumers. Each unit consists of sensors, actuators, smart meters, smart plugs, a Universal Home Gateway (UHG), and together establishes a home area network (HAN). Each of these smart devices communicates with the UHG through a different communication protocol. The UHG, on the other hand, interacts with cloud server where most of the processing is done. The implemented system can control and manage energy based on published dynamic pricing information, and can act as an energy management system. In this work [3] in this paper, the benefits of distributed energy resources are considered in an energy management scheme for a smart community consisting of a large number of residential units (RUs) and a shared facility controller (SFC). A nonco- operative Stackelberg game between the RUs and the SFC is proposed in order to explore how both entities can benefit, in terms of achieved utility and minimizing total cost respectively, from their energy trading with each other and the grid. From the properties of the game, it is shown that the maximum benefit to the SFC, in terms of reduction in total cost, is obtained at the unique and strategy-proof Stackelberg equilibrium (SE). It is further shown that the SE is guaranteed to be reached by the SFC and RUs by executing the proposed algorithm in a distributed fashion, where

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participating RUs comply with their best strategies in response to the action chosen by the SFC. In addition, a charging discharging scheme is introduced for the SFCs storage device that can further lower the SFCs total cost if the proposed game is implemented. Numerical experiments confirm the effectiveness of the proposed scheme. In this work [4] this paper focuses on the energy management means to optimize one of the most complex and important technical creations that we know: the energy system. While there is plenty of experience in optimizing energy generation and distribution, it is the demand side that receives increasing attention by research and industry. Demand Side Management (DSM) is a portfolio of measures to improve the energy system at the side of consumption. It ranges from improving energy efficiency by using better materials, over smart energy tariffs with incentives for certain consumption patterns, up to sophisticated real-time control of distributed energy resources. In this work [5] the theoretical aspect of DRM solutions must be discussed and varied in a practical environment to ensure that the scheme is suitable for implementation. In this document [5], they propose a DRM scheme and build an intelligent residential test bench to implement the proposed scheme. In the proposed DRM scheme, they suggest two different types of customer participation plans, that is, a green savoir faire plan and an ecological awareness plan, and design algorithms based on two user discomfort indices to evaluate DRM for the reduction of the maximum load. The test bench varies the effectiveness and efficiency of the proposed DRM scheme. In this work [6] The strong coupling of Information and Communication (ICT) technologies especially via the usage of networked embedded devices with the energy domain, is leading to a sophisticated dynamic ecosystem referred to as the Internet of Energy. In the last mile of the Smart Grid i.e. the future smart home, heterogeneous devices will be able to measure and share their energy consumption, and actively participate in house-wide or building wide energy management systems. The customer domain of the smart grid naturally blends with smart home and smart building systems, but typical proposed approaches are distributor-centric rather than customer-centric, undermining user acceptance, and are often poorly scalable. To solve this problem, we propose a detailed architecture and an implementation of a last-meter smart grid the portion of the smart grid on customer premises embedded in an internetof-things (IOT) platform. A demonstrator has been built and tested with purposely developed ZigBee smart meters and gateways, distributed IOT server, and a flexible user interface. In this work [7] the smart grid initiative and electricity market operation drive the development known as demand-side management or controllable load. Home energy management has received increasing interest due to the significant amount of loads in the residential sector. This paper presents a hardware design of smart home energy management system (SHEMS) with the applications of communication, sensing technology, and machine learning algorithm.

V. SYSTEM ARCHITECTURE / SYSTEM OVERVIEW

The system structure of wireless automatic meter reading system (WAMRS) is shown in fig. The networked meter-

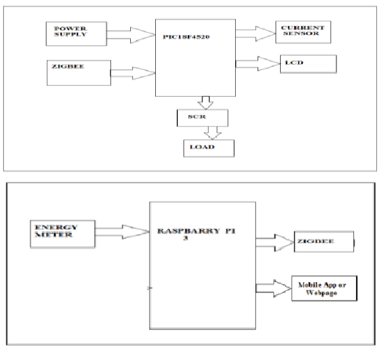

Fig. 1. Block Diagram of Proposed System

reading system consists of terminal measure meters. Proposed Work included a small light weight Web server designed on Raspberry pi board, which will make the system to work much faster and based on IoT technology. As per definition of AMR, it allows easy saving through meter reading, greater data accuracy; improve billing speed and consumer service and also maintained the energy efficiency. An electricity meter, electric meter, or energy meter is a device that

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measures the amount of electric energy. Raspberry Pi acts as a base station or server. Raspberry sends the value of meter to pc the zigbee use to wireless transfer of meter reading by pic microcontroller. LCD displays the value of meter reading. SCR control current load. All data will update on Mobile App in form of webpage as per changes in device parameter such as Voltage, current, Power.

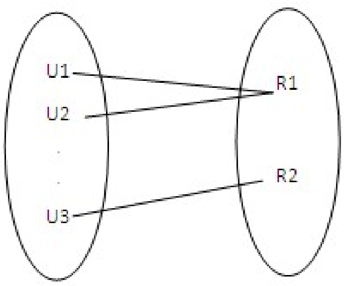
VI. SOFTWARE REQUIRED

For Raspberry pi micro controllers, 3 things are required, Boot Loader, Kernel, Root File System. The main functionality of boot loader is to initialize all the devices that are present on the arm board. Kernel is a computer program that manages input/output requests from software into data processing instructions for the central processing unit and other electronic components of a computer. Root File System will tell how files arrangement there inside the internal standard storage devices. Qt is a cross-platform application framework that is widely used for developing application software with a graphical user interface (GUI) and also used for developing non-GUI programs such as command-line tools and consoles for servers.

- Python
  Python is a high level, interpreted, interactive and object oriented scripting language. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages. Python is processed at runtime by the interpreter. Do not need to compile your program before executing it. Python's features include: Easy-to-learn Python has few keywords, simple structure, and a clearly defined syntax. Python2 is Easy-to-read: Python code is more clearly defined and visible to the eyes.
- PHP
  It is a server-side scripting language designed primarily for web development but also used as a general-purpose programming language. PHP originally stood for Personal Home Page, but it now stands for the recursive acronym PHP: Hypertext Pre-processor. PHP code is usually processed by a PHP interpreter implemented as a module in the web server or as a Common Gateway Interface (CGI) executable. The web server combines the results of the interpreted and executed PHP code, which may be any type of data, including images, with the generated web page.
- Embedded C
  Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. C compilers are available for almost all embedded devices in use today, and there is a large pool of experienced C programmers. Unlike assembly, C has advantage of processor independence and is not specific to any particular microprocessor/microcontroller or any system. This makes it convenient for a user to develop programs that can run on most of the systems.

VII. MATHEMATICAL MODEL

Mapping



Many users can obtain one result or multiple results.

Set Theory:

$$S = \{s, e, X, Y, \phi\} \quad (1)$$

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s = Start of the program.
1. Log in user.
2. Get the data from sensors or Hardware e = End of the program.
3. Display the captured data on the screen (monitor or mobile).
4. Log out the user.
X = Input of the program.
Input should be sensors data.
Y = Output of the program.
Finally we display the captured data on the screen (monitor or mobile).
X, Y U
Let U be the Set of System.

$$U = \{Client, I, S, H, A, D, R\} \quad (2)$$

Where Client, I, S, H, A, D, R are the elements of the set.
Client=User
I=Input data (sensors data).
S=Sensor.
H=Hardware.
A=Application (Web or Mobile).
D= Display captured data.
R=Result or output
SPACE COMPLEXITY:
The space complexity depends on Presentation and visualization of discovered patterns. More the storage of data more is the space complexity.
TIME COMPLEXITY:
Check No. of patterns available in the database= n
If (n >1) then retrieving of information can be time consuming.
So the time complexity of this algorithm is $O(n^n)$ Above mathematical model is NP-Complete = Failures and Success conditions.
Failures:
Huge database can lead to more time consumption to get the information.
Hardware failure.
Software failure.
Success:
Search the required information from available in Datasets. User gets result very fast according to their needs.

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VIII. ALGORITHM / FLOW

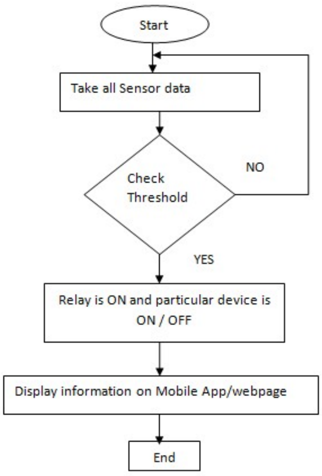

Fig. 2. Sensor information)

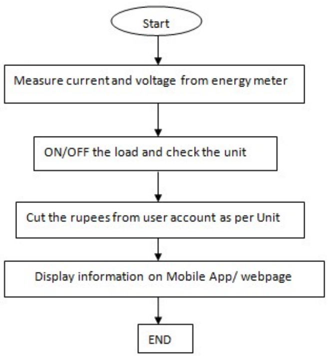

Fig. 3. Billing information)

IX. RESULT

In this project we have connect the four loads of 100W bulb each considering them as one single room so there willbe four different rooms where load is present total load for the system is 400W. On GUI of system we have two modes manual mode and system mode. As well as different options for making load ON/OFF using the buttons form the GUI. In manual mode we apply load to the system manually by the buttons presents on the GUI. As shown in table 5.1 we have divide the 24 hours into different time slots according to the peak enegry usage during those respective hours on which we set the different threshold to do some energy saving during this time slots. Also during high peak we have highest energy charge similarly for different peak different energy charge. After which we apply system mode as shown in table 1 depending on set conditions it

Tables are handled in a similar fashion, but with a few notable differences.

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TABLE I
CONDITION TABLE FOR TIME OF USE AND SET THRESHOLD

Time of use	Peak	Set Threshold	Billing per unit
6am-10am	High	100W	8
10am-6pm	Medium	200W	5
6pm-12am	High	100W	8
12am-6am	Low	300W	2

Checks the time of use and set threshold in which if load do not exceeds the set threshold no action will be then and if load exceeds the set threshold priority based switching is applied from lowest to highest priority. It checks the status of the load whether ON/OFF if its OFF its moves to next load according to given priority and if its ON using PIR sensor it detect human is present or not if present it dim the load or turn OFF the load if human is absent where load is unnecessarily wasting power and goes checking all four loads. Here we are dimming the load just to differentiate between the ON load and the human detected for that load in the room. Now we will see the system output results with the four different thresholds under different conditions in the presense of human detection.

Figure 4, 5 and 6 shows the detailed information of the mobile application use in this system like user registration,

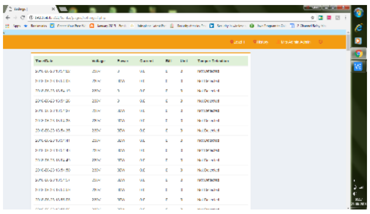

Fig. 4. User registration)

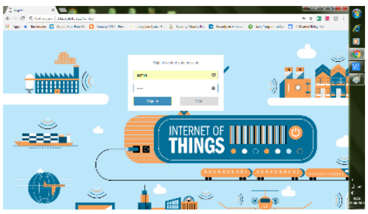

Fig. 5. User login)

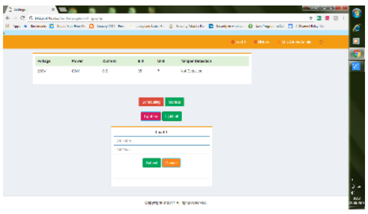

Fig. 6. Details Reading

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user login and details reading respectively.

TABLE II
CONDITION TABLE FOR TIME OF USE AND SET THRESHOLD

parameter	Previous system	Proposed system
Platform	IoT	IoT
Display	Mobile	Mobile/webpage
Energy meter	ZigBee, MC13224	ZigBee, PIC, LCD, SCR
Controlling unit	Kinetis k60, Zigbee	ZigBee, Raspberry pi 3.

X. CONCLUSION

We have presented the architecture, implementation, and a demonstration of the Customer Domain of the smart grid, based on a platform for the IoT that can host a broad range of smart home applications. In this sense, our proposal has unique advantages and elements of novelty with respect to the state of the art: it is customer centric, it minimizes the deployment of specific smart grid infrastructure, and it leverages possibly available smart home applications, sensors, and networks. We intend to find out the daily peak hours of usage levels of electricity and come up with a solution through which it is possible to decrease consumption and improve better usage of already restricted resources at the time of peak hours. We have been measure the parameters such as power and current of home apparatus. And also energy efficiency also reduced. And also we can on/off the home apparatus when you outside the home. Such all information will display on webpage/Mobile App.

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