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Microcontroller based Power Consumption Observing and Bill Supervision using Raspberry Pi

R. Krishnaveni (M.E)[1], N.Revathi (M.E)[2], Lithesh. R[3], Hemanth Kumar. S[4], Poovarasan.M[5]

[1,2]Assistant Professor, Department of Electronics and Communication Engineering, Panimalar Institute of Technology, Chennai, India.
[3-5]Student, Department of Electronics and Communication Engineering, Panimalar Institute of Technology, Chennai, India

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Abstract - *In this paper, a new procedure is followed based on MICROCONTROLLER (Raspberry pi) to detect and monitor the power consumption, faults, loss. Data will be sent automatically to the utility central server through the IOT module. Here Automatic meter reading can be Proposed in the System along with Cloud data analysis and Money Management with Energy meter report and Billing Displayed in web page.*

Key Words: IOT Module, Cloud, WiFi, Current Sensor, Voltage sensor, Python.

1. INTRODUCTION

Electronic metering technology greatly reduces man power and time and also makes it easy for remote area people to pay the bill. It also reduces the non-payment of the bill and avoids the mistake due to manual calculation. Power theft is one of the greatest problems that our country is facing and with the help of this AME power theft can be greatly reduced. Considering a complicated power system network, it is very usual to get faults in every branch of the network. In this system all the loads will be monitored and examined through online using IOT. In case of losses also can be determined by this system by comparing the past values or normal values with present value. If there is any variation occurring can be intimidated by this system.

1.1 IOT Consideration, Requirements and Architecture for Smart Buildings- Energy Optimization and Next Generation Building Management.

The concept of Smart City is emerging in multiple continents, where enhanced Street lighting control, Infrastructure monitoring, public safety and surveillance Physical Security, gun shot detection, meter reading and transportation analysis and optimization system are being deployed on a city wide scale. A related and cost effective user-level. IOT application is the support of IOT enabled Smart building. Commercial space has substantial requirements in terms of comfort, usability security and Energy Management. Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

1.2 The Applied Research on Power Telecommunications Identifier Management System Based on QR Code.

Establishes a telecommunication Identifier data base management mode and develops a telecommunication identifier management system based on QR Code technology, which can guarantee the site date and system database synchronization. The major work of this paper including the background of the power company identifier management introduction the QR code technology and designing a power telecommunication tag based on QR code designing and implementing the power telecommunication identifier management system, finally introducing the system security mechanism.

1.3 Smart Energy Meter.

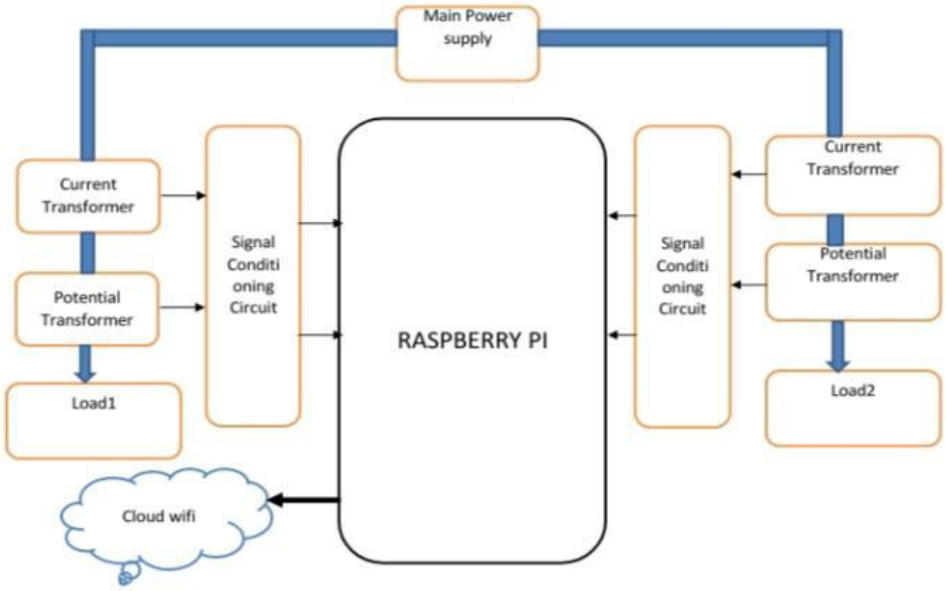
In the current working system, electricity meter reading for electricity usage and billing is done by human workers from home to home and building to building. The purpose of this project is to build a smart electricity meter using GSM, This can reduce human error and help to retrieve the real time meter value via GSM and send it to the Customers mobile phone through GSM. This also allows the electricity board to modify the variable package price in specific duration. The administrator can analyse the customer power consumption data and generate the report from the data online. The

prototype will be able to introduce a billing system to the customer, get the power consumption data from the smart meter, keep the data I'm centralized database and generate the report.

2. PROPOSED SYSTEM

A smart energy meter works on communication directly with wireless data protocol, so there will be precise reading. Smart energy meters can operate in divergent ways with iot Module. The proposed system consists of a digital energy meter, a Raspberry pi (microcontroller). The data from the energy meter by the help of current and potential transformers will be transmitted to the cloud by the iot module. The stored data can be recognized by authorized persons. Terms like power loss, over power usage, instantaneous power, total energy usage, faulty loads, can be recognised by this system. Every branch in the power system can be monitored in every instant of time.

3. BLOCK DIAGRAM



3.1 Working

There are two branches of loads. For those branches separate voltage and current transformer pairs are added each will continuously monitor the instantaneous power. Whenever loss occurs the value of the dataset will be compared with present values and the fault will be determined, fault in a particular branch can also be determined so that it will be easy for regulating those faults. If any fault occurred it can be determined by regular check-up, also faulty loads can be found through this system.

3.2 Signal Conditioning Circuit :

Voltage transformer is a normal transformer which converts high voltage to a particular voltage comfortable for us. Here the microcontroller work in 5 voltage or less than that so by using potential transformer we have to convert (0-230) volt to (0-5) voltage, for that conversion we are using signal conditioning circuit .In case of current transformers also we are converting current value to a proportional voltage value comfortable to microcontroller.

4. MODULES

4.1 Raspberry pi 3 :

Raspberry Pi is a small board Computer. Raspberry pi is a Controller and Controlled by all sensors. The heart of the Raspberry Pi is a BroadCom System on Chip (SOC), which includes ARM Compatible CPU and on Chip graphic processing unit. The all Sensor interfacing into Raspberry Pi and the Raspberry Pi is used for controlling all sensors. The Raspberry Pi 3 model is the third generation Raspberry Pi. This power credit card size board computer can be used for many applications and supersedes the original Raspberry Pi model and Raspberry Pi 2 , maintaining the popular board format

the Raspberry Pi 3 model brings a more powerful processor, 10x faster than the first generation raspberry pi. Additionally it adds Wireless LAN and Bluetooth connectivity making it the ideal solution for power connected design.

Specifications :

- **Processor :**

Broadcom BCM 2387 chipset.

1.2 Ghz Quad-Core ARM Cortex-A53.

802.11 b/g/n Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE).

- **GPU :**

Dual core Videocore IV Multimedia Co-Processor provides open GL ES 2.0, hardware accelerated open VG and 1080p 30 H. 264 high profile decode.

Capable of 1G pixels, 1.5 texels or 24 GFLOPs with texture filtering and DMA infrastructure.

- **Memory :**

1GB LPDDR2.

- **Operating System :**

Boots from Micro SD card, running a version of the Linux operating system or windows 10IOT.

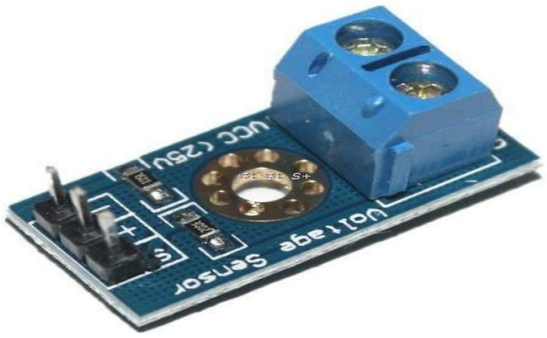
- **Dimension :**

85x56x17mm

- **Power Micro :**

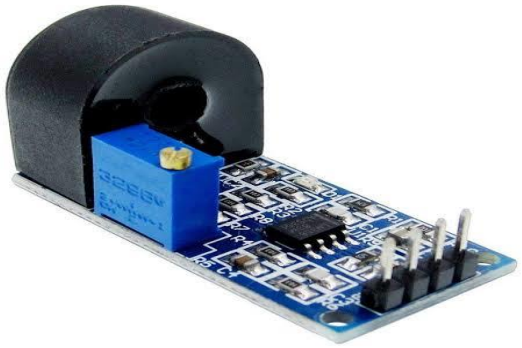
USB Socket 5V1, 2.5A.

4.2 Voltage Sensor :



Voltage sensors are used to measure or monitor the voltage on transmission lines and to isolate the metering equipment from the lines.The voltage level from the energy meter by the help of the current transformer will be transmitted to the cloud by an IoT module.

4.3 Current Sensor :



Current sensors is used to measure or monitor the current in transmission lines and to isolate the metering equipment and relay connected to secondary side.The current level from energy meter by the help of current sensor will be transmitted to cloud by IoT module

4.4 Cloud :

The entire data collections from the Current sensors and Voltage sensors are stored in the cloud. These stored data are highly secured. The stored data can be recognized by authorized persons.

A cloud service has three distinct characteristics that differentiate it from traditional web hosting. It is sold on demand, typically by the minute or the hour; it is elastic -- a user can have as much or as little of a service as they want at any given time; and the service is fully managed by the provider (the consumer needs nothing but a personal computer and Internet access). Significant innovations in virtualization and distributed computing, as well as improved access to high-speed Internet, have accelerated interest in cloud computing.

A cloud can be private or public. A public cloud sells services to anyone on the Internet. (Currently, Amazon Web Services is the largest public cloud provider.) A private cloud is a proprietary network or a data center that supplies hosted services to a limited number of people. Private or public, the goal of cloud computing is to provide easy, scalable access to computing resources and IT services.

MQTT PROTOCOL :

Multiple clients connect to a broker and subscribe to topics that they are interested in. Clients connect to the broker and publish messages to topics. Topics are treated as a hierarchy, using a slash (/) as a separator.

Terms like power loss, over power usage, instantaneous power, total energy usage, faulty loads, can be recognised by those authorized persons.

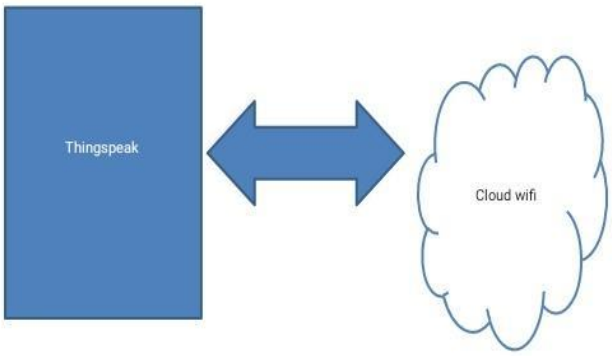
5. SOFTWARE DESCRIPTION

1. Thing Speak Cloud web page.
2. Python platform for Raspberry Pi.

5.1 Raspberry pi software

This chapter introduces the devices and software which are used in this bachelor's thesis. The chapter also contains a short introduction to the Linux operating system which is used in this thesis.

MONITORING SECTION BLOCK DIAGRAM :



- **LINUX :**

Linux is a free open source operating system and it belongs to the Unix operating systems. Actually Linux means the kernel itself which is the heart of the operating system and handles the communication between the user and hardware. Normally Linux is used to refer to the whole Linux distribution. (Upton, E. & Halfacree, G. 2012, 28.)

Linux distribution is a collection of software based on the Linux Kernel. It consists of the GNU-project's components and applications. Because Linux is an open source project, anyone can modify and distribute it. That is the reason why there 66 are many variations of Linux distributions. Most popular distributions are Ubuntu, Red Hat Linux, Debian GNU/Linux and SuSe Linux. (Kuutti, W. & Rantala, A. 2007, 2.)

Raspberry Pi doesn't come with an operating system. This is not a weakness, 68 however, rather a wide variety of OSs, each of which can be flashed to an SD card (or microSD card for the Raspberry Pi B+) in a few simple steps. Here's how to get a new OS installed and running on your Pi – and how to clone your perfect setup for quick disaster recovery. Operating systems such as the recommended Raspbian, ArchLinux, Risc OS and even Android come ready to run on your Raspberry Pi. I'll show you the two main ways to add an operating system – and once you've got your Pi set up how you want it, we'll look at how to clone the card so that it can be restored following errors (or for temporary reuse of your SD card). The following tutorials assume that you have a basic Raspberry Pi package and Windows to manage your SD card writing and cloning. Flash An OS To SD And Boot YourRaspberry Pi. Whichever operating system you download for your Raspberry Pi, the process of writing it to an SD card is the same. However, there are some differences in SD card writing between desktop operating systems. You'll also need to ensure that your card is blank and formatted, and at least 2 GB.

5.2 Python Platform for Raspberry Pi :

Python programming language was developed in the late 1980s at the National Research Institute by Guido van Rossum. Python has grown in popularity, and it is widely used commercially. (Upton, E. & Halfacree, G. 2012, 152.)

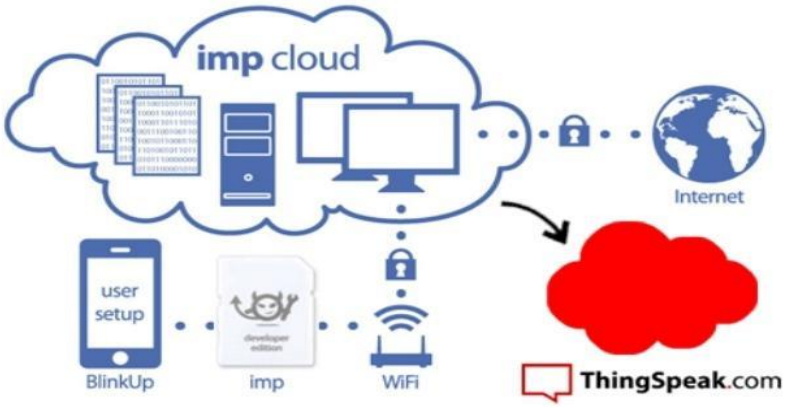
Python is a flexible and powerful programming language but still it is easy to learn and follow. The clear syntax of Python makes it a valuable tool for users who want to learn programming. This is one of the reasons why it is recommended by the Raspberry Pi Foundation. Python is published under an open-source license and it is available for different operating systems. Python runs on Linux, OS X and Windows computer systems. (Upton, E. & Halfacree, G. 2012, 152.)

Cross-platform support guarantees that the programs which are written in Python are also compatible in other platforms. There are few exceptions where the programs are not compatible. For instance, when the Python is addressed to use the specific hardware such like Raspberry Pi's GPIO. (Upton, E. & Halfacree, G. 2012, 152.)

Python can be used to create standalone programs, but the language can also be used to create programs that communicate with the outside world over a computer's network connection. This next example, written by TomHudson, offers a brief glimpse of these possibilities with a tool for monitoring the users connected to an Internet Relay Chat(IRC) channel.

5.3 USING THE GPIO PORT IN PYTHON

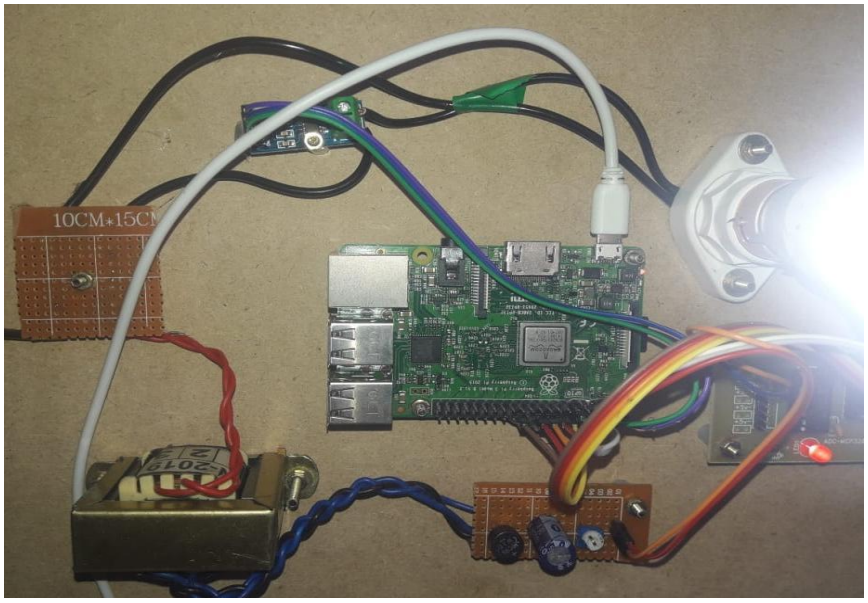
Python is a friendly yet powerful programming language. It's not, however, the perfect choice for every scenario. Although it works fine for the simple circuits you'll be creating in this chapter, it does not offer what is known as deterministic real-time operation.



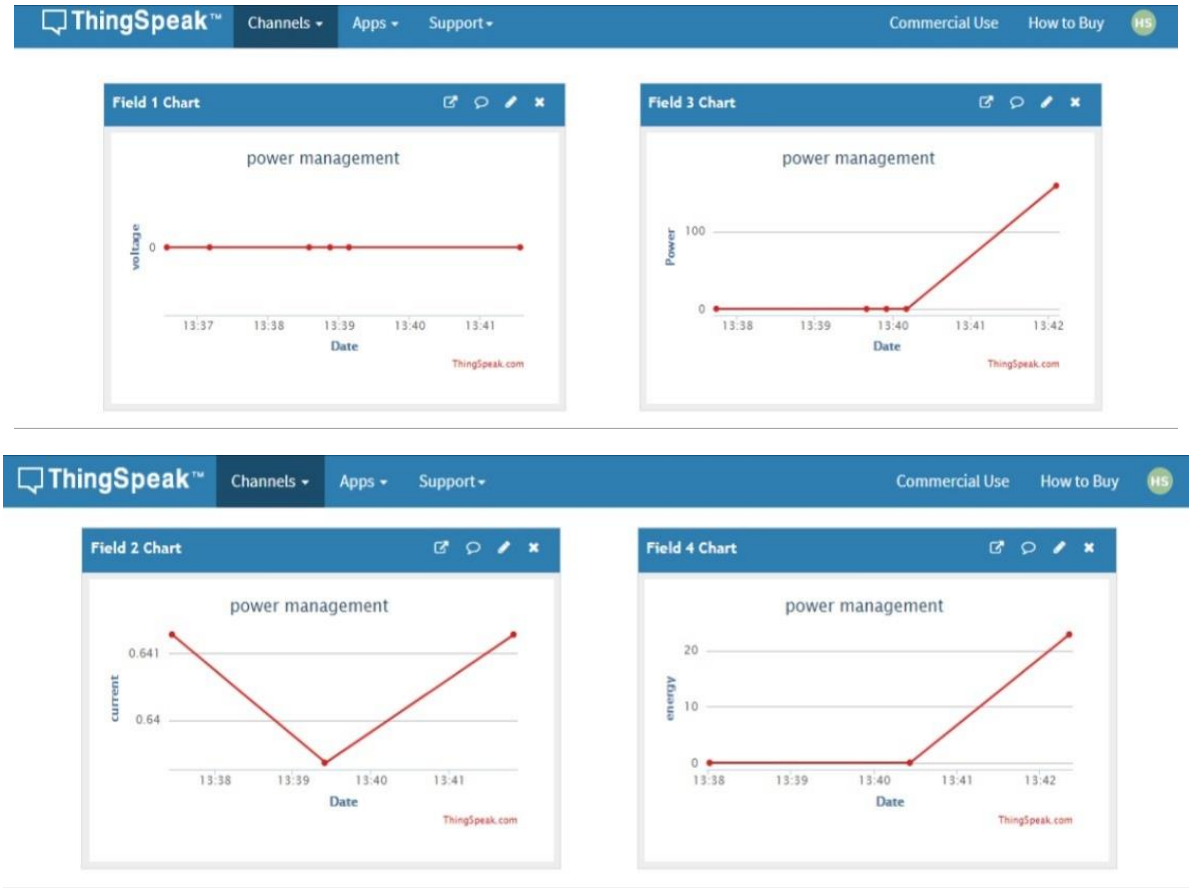
For the majority of users, this doesn't matter; if you're planning on using thePi at the heart of a nuclear reactor or a complex robotics platform, however, you may want to investigate a lower-level language such as C++ or even assembler running on a dedicated real-time microcontroller.

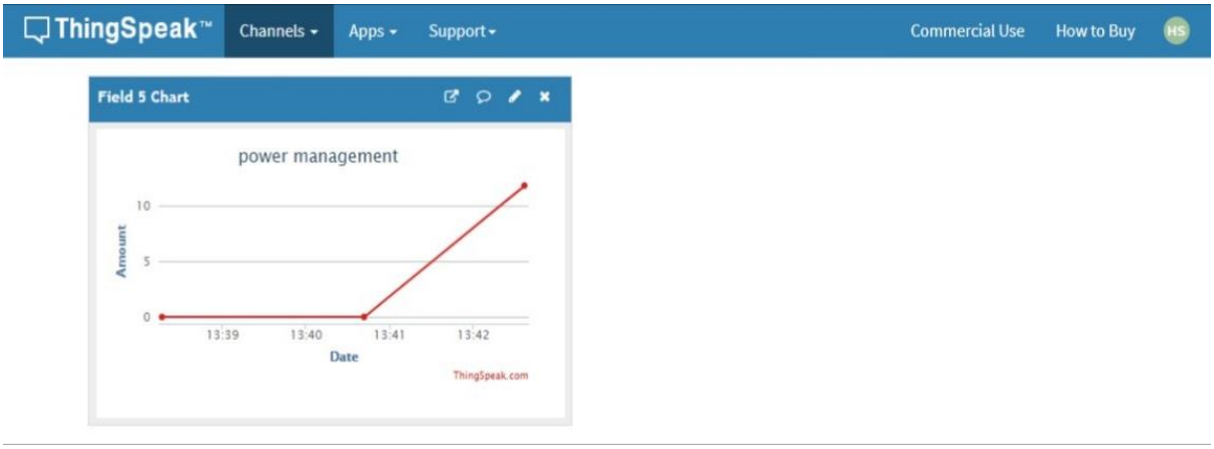
If true real-time operation is required for your project, the Pi may be a bad choice. Instead, consider using a microcontroller platform such as the popular open-source Arduino, or one of the MSP430 family of microcontrollers from Texas Instruments. Both of these devices can interface with the Pi either through the GPIO header or over USB, and provide a specialised real-time environment for control and sensing.

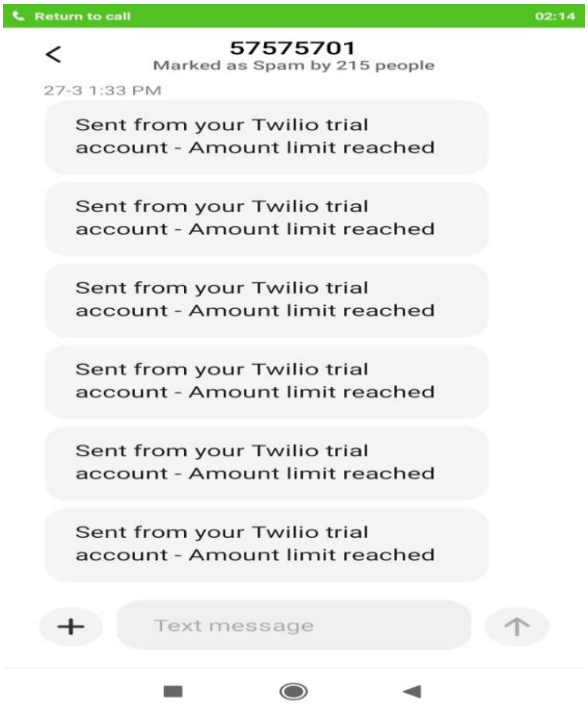
6. RESULTS :



Output :







CONCLUSION :

This paper is the combined hardware advantage for both utility and the customer. Raspberry pi, SSR, and IoT stationed Energy Meter for smart metering,is built which is able to read and send data via wireless protocol using IoT technology through IoTmodule, capable of managing and controlling the supply. In the case of faults, losses, and faulty loads, Power consumption, power quality, and its accuracy can be monitored by the consumers directly.

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