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IOT BASED THRESHOLD POWER CUTOFF – SMART ENERGY METER

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ABSTRACT

Electricity is the fundamental requirement of human beings, which is most common in almost all the sectors. India is the third most country in energy consumption. The electricity board uses a manual process to get the information of each house by visiting and clicking the photo of meters. This process has lots of drawbacks, and thus the concept of Smart Energy Meter (SEM) came across. The Smart Energy Meter can help to stop working manually and it will count the energy consumption by using sensors, Sensors will help us to count the intensity utilization charges and help to manage the use of electricity for an individual according to their comfort.

Keywords: Digital Meter, Iot, Sensor, Threshold, Cloud Server, Energy Consumption, Alert Message, Smart Meter.

I. INTRODUCTION

Electricity is one of the fundamental requirements for adherence of contents of life. It should be used very sensibly for its proper utilization. With the rapid developments in the Wireless communication technology using microcontrollers, there are many improvements in automating various industrial aspects for reducing manual task. Smart Energy Meter is an automated, two-way system for remote reading and management of meters [1]. The process of meter reading and management are free from human involvement. Accuracy, speed, efficiency, and cost-effectiveness are the expected benefits achievable using the Smart Energy Meter. Now-a-days the numbers of electricity consumers are increasing very rapidly. The traditional system consists of manual meter reading process which was not suitable for longer operating purposes, as it spends much human and material resource. It brings additional problems in calculation while billing it manually. Keeping records of the consumption of electricity and tracking of bill payment of increasing consumers manually is getting hectic which can result in wrong reading and more time consumption. Smart Energy Meters reduces the work pressure headache and manual work and make this process automatic.

The digital implementation caused the rapid utilization of devices such as computers and telecommunication devices. Communication media like the internet, GSM networks, Zigbee exists everywhere. SEM puts more control into the hands of consumers by giving them more detailed information about power consumption. That information is sent to the base station regularly using Zigbee and in case of power theft an SMS is sent to local operator from base station using GSM. As there is no human intervention in the entire process, there is no chance of human error and corruption.

II. LITERATURE REVIEW

J. Zhang discussed the estimation of voltage winding by understanding meter data to develop a dynamic model for upgrading volt-var control [1], and what's more watching blockage and quality in a power grandstand. Metering data can be similarly used to develop the learning of the influence streams at and near the low voltage end of the course composes with the objective that the stacking and adversities of the framework can be known simply more wonderfully. This can athwart over-troubling modules (transformers and lines) and to avoid control quality varieties from the standard. Bayesian and Hidden Markov Model systems are being utilized in a collection of discerning metering applications, for example, stack disaggregation [2], machine perceiving vindication and supply request examination. Future applications will result in a more wide degree of necessities which will see a consistently growing number of frameworks related and interestingly fitted for stunning metering to accomplish more enormous inclinations.

Saxena [3] proposed a fused affirmation tradition for splendid systems. The recommendation uses disproportionate and symmetric key cryptography to stay the correspondence with the electric organization. Regardless of the way that the makers think of it as a lightweight tradition, the suggestion uses hash and open key exercises, which are not prescribed for utilize with everything taken into account IoT contraptions. A couple of makers proposed threatening to adjusting methodologies to recognize some specific damages of SM and to make reprobation. S.Senthil Arumugam and S.Prabakaran [4] presents an understanding survey of sharp power meters and their usage focused on a seeing piece of the metering technique, phenomenal accomplice's interests, and the advances used to meet the essentials for accessory interests. Other than they give an exceptional piece of issues and also conditions developing conclusively to the nearness of colossal information and the party point of fact appreciated of cloud conditions

III. PROBLEM ANALYSIS

Smart Energy Meter challenges and issues discussed by various researchers. The Smart Energy Meter Use Cases group discusses the different use case scenarios and related requirements that may exist in Smart Energy Meter. They consider use cases from different perspectives including customers, developers and security engineers. Investigation showed the laborious task related to adopting Smart Energy Meter that may lead more time consumption and difficult to handle situations [1]. A lot of current meters were designed not to be replaced or removed. That makes replacing them sometimes difficult as they were installed in either hard to reach places or without much thought to future technology innovations. A smart meter sends your meter readings to your energy supplier automatically, so in principle your bills should be more accurate than when they rely on you submitting manual readings [2].

IV. PROPOSED WORK

In the proposed work two modules will simultaneously work depending upon hardware and software functionality. The aim of proposed module is to provide automated system and the implementation of this will be done by using sensors which will collect the data, further the processing will be carried out on cloud server by using REST API, all this functionality will be done with the help of IoT by using threshold for power cut without human efforts. Threshold value setting and sending of notification is the additional task that we are going to proposed. The proposed work is used to develop the smart meter which can automatically work, which provide the electricity to the customer with some limit, and within a month we have to consume the electricity within the limit and can pay bill online by using PayPal.

Admin panel will be able to track the live data of each customer and their energy consumption. Admin can also Shut down and shut on the electricity of each customer if the limit is reached. If the threshold limit is reached or if the customer didn't pay the bill then admin will shut down the electricity until the bill is not paid. Once the bill is paid the system will automatically switch on the electricity. According to the phase the threshold value is set. If there is a single unit phase the threshold is set to 300 units, if the phase is double then the value is set on 2000 unit and if there are 3 phases then the threshold is set at 10,000 unit per month respectively. These are reserved threshold.

In this work an Arduino Uno microcontroller is used to read the input data, once the data is read, the GSM module will save the data to the server. The sensor is used which will collect the data from the load and a Relay will trigger if the data has reached its limit. Here load are the appliances from the house which consumes electricity.

V. SYSTEM DESIGN

- **Technology Used**

1. HTML

HTML Stands for "Hypertext Markup Language." **HTML** is the language used to create webpages. "Hypertext" refers to the hyperlinks that an **HTML** page may contain. "Markup language" refers to the way tags are used to define the page layout and elements within the page. **HTML** is the code that is **used** to structure a web page and its content. For example, content could be structured within a set of paragraphs, a list of bulleted points, or using images and data tables.

2. CSS

CSS (Cascading Style Sheets) is the core technologies for building Web pages. HTML provides the structure of the page, **CSS** the (visual and aural) layout, for a variety of devices. **CSS** plays an important role, by using CSS you simply got to specify a repeated style for element once & use it multiple times as because CSS will automatically apply the required styles. The main advantage of CSS is that style is applied consistently across variety of sites

3. JavaScript

JavaScript is a text-based programming language used both on the client-side and server-side that allows you to make web pages interactive. Where HTML and CSS are languages that give structure and style to web pages, JavaScript gives web pages interactive elements that engage a user

4. JOuery

JQuery is an open source JavaScript library that reduces to bare bones the interactions between an HTML/CSS document, or more specifically the Document Object Model (DOM), and JavaScript. Particularizing, JQuery simplifies HTML document negotiating and management, browser event handling, DOM animations, Ajax interactions, and cross-browser JavaScript development. It is incredibly popular, which is to say it has a large community of users and a healthy number of contributors who participate as developers and evangelists. It normalizes the differences between web browsers so that you don't have to. Its repository of plugins is massive and has seen steady growth since jQuery's release. It is friendly, which is to say it provides helpful ways to avoid conflicts with other JavaScript libraries.

5. AJAX

The AJAX method makes Internet applications minor, quicker and extra user-friendly. AJAX is a technology, which breaks the standard of page refill and protects a percentage of bandwidth. It can lead and recover the data deprived of refilling the web page, significance, that gone are the days where for each data repossession, we needed to refill the whole web page.

6. PHP

PHP is a server-side scripting language intended for web development and it can also be used as a general-purpose programming language. PHP is a language that is precisely designed for web programming with built-in combination with the most widespread open source database MySQL. PHP code could be embedded into HTML code, or it can also be used in combination with various web template systems, web current management system and web frameworks. PHP code is typically sort out by a PHP interpreter implemented as a module in the web server or as a Common Gateway Interface (CGI) executable.

7. MySQL

MySQL is the popular database choice which can be used for systems and its central component widely use LAMP which is a open source software stack and the other one is 'AMP' stack. Free software open source project that require a full featured database management system often used MySQL. MySQL is a relational database management system, and ships with no GUI tools to administrator MySQL database for manage data contained with the databases. The official set of MySQL front-end tools, MySQL work bench is actively developed by Oracle, and is freely available for use.

8. Bootstrap

Bootstrap is a potent front-end framework used to create modern websites and web apps. It's open-source and free to use, yet features numerous HTML and CSS templates for UI interface elements such as buttons and forms. Bootstrap also supports JavaScript extensions.

- **Algorithm and Methods:**

Otsu's Thresholding Algorithm, Decision Making Algorithm are use in this project.

In digital image processing, thresholding is the simplest method of segmenting images. From a grayscale image, thresholding can be used to create binary images.

The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity $I_{i,j}$ is less than some fixed constant T (that is, $I_{i,j} < T$), or a white pixel if the image intensity is greater than that constant. In the example image on the right, this results in the dark tree becoming completely black, and the white snow becoming completely white.

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OTSU'S THRESHOLDING CONCEPT

Automatic global thresholding algorithms usually have following steps.

1. Process the input image
2. Obtain image histogram (distribution of pixels)
3. Compute the threshold value T
4. Replace image pixels into white in those regions, where saturation is greater than T and into the black in the opposite cases.

VI. IMPLEMENTATION

The figure 1 shows the System Structure of proposed work, in this system Arduino Uno microcontroller is used, to read the inputs from the system, such as light on sensor, finger on a button, activating the device or internet and so on. The modem is used to send the data by using Wi-Fi and at the same time it processed the data too. The ACS712 is a fully integrated, hall effect-based linear current sensor with 2.1kVRMS voltage isolation and a integrated low-resistance current conductor. Technical terms aside, it's simply put forth as a current sensor that uses its conductor to calculate and measure the amount of current applied.

The data of applied current will be remotely converting data to a remote network by using GSM module. The GSM module is a combination of TDMA, FDMA and frequency hopping. Initially GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot.

The Arduino uno operates on a 5V, and it cannot directly control higher voltage device, so to control higher voltage device a two-channel relay is used. Relay module control the AC mains and Arduino to control the relay. A relay is an electromagnetic switch operated by a relatively small current that can control much larger current. Initially the first circuit is switched off and no current flows through it until something (either a sensor or switch closing) turns it on. The second circuit is also switched off. When a small current flow through the first circuit, it activates the electromagnet, which generates a magnetic field all around it. The energized electromagnet attracts a contact in the second circuit toward it, closing the switch and allowing a much bigger current to flow through the second circuit. When the current stops flowing, the contact goes back up to its original position, switching the second circuit off again.

The current consume through load is measured by relay and the data is send or record by using GSM module.

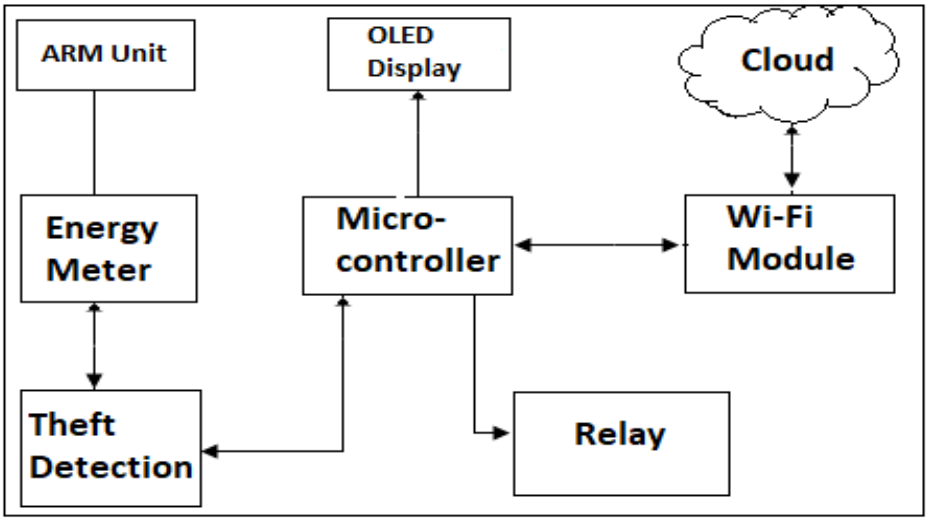

Figure 1: Structure of Smart Energy Meter

VII. RESULT

Figure 2 shows the system hardware implementation where microcontroller, sensor, GSM module, relay and load are interconnected to each other. Once the data get collected from these devices, it will be displayed on the admin panel which is shown in figure 5. But before this admin have to login to the system and the login is shown in figure 3, where admin have to login through its authenticated mail id and password.

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And the user has to first sign-up with their valid credentials and then they can login and in their login page they can see the consume data and can pay the bill. The signup page for the user is shown in figure 3. In the Admin Panel admin can be able to view the consumer name, bill number, Threshold unit, consumed unit, amount to be paid. All the unit and payment detail will be shown in the admin panel which is shown in figure 5.

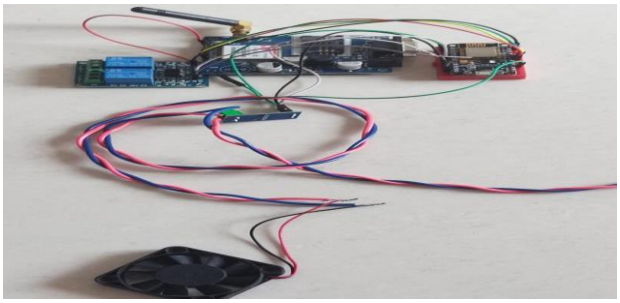

Figure 2: Hardware Implementation

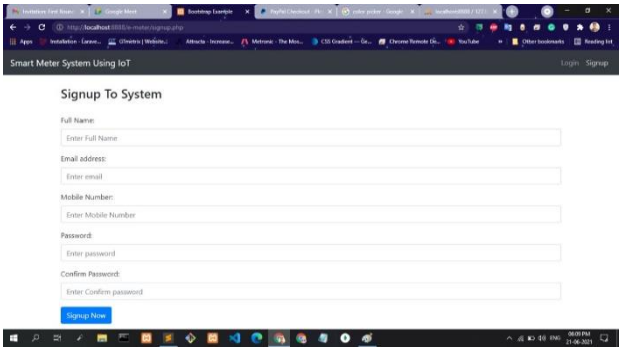

Figure 3: System Sign-up

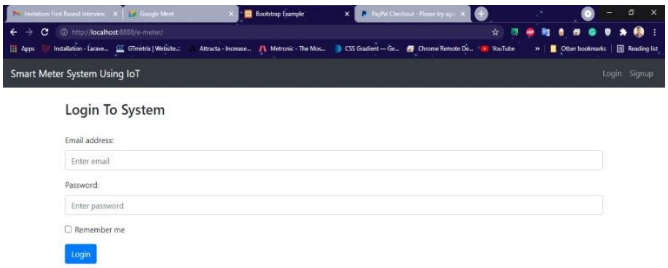

Figure 4: Admin Login

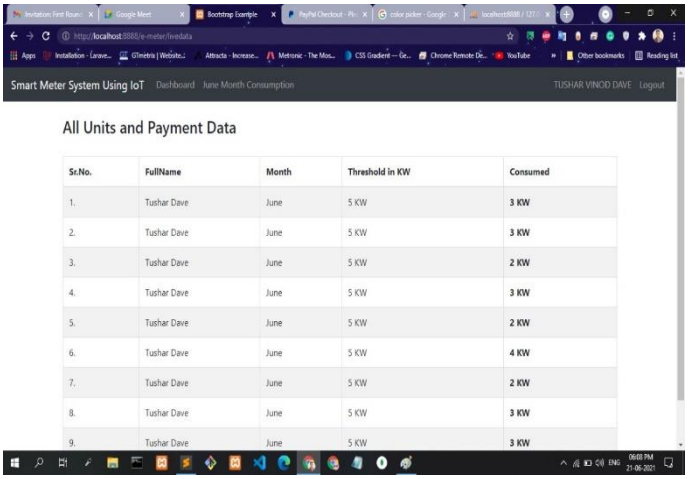

Figure 5: Consumer Data

VIII. CONCLUSION

In our research we did a deep study on the smart energy meter to identify the root causes and key participating dimensions in such security issues/problems discussed by the previous work. This will help better to understand the problem and deliver solutions. And the solution could be the use of threshold power cut off, which will help the people to understand the importance of Electricity, and since it is an automated process there will be less corruption or errors which are unfortunately cause by human interference. thus, the automated meter reading and management process will provide accuracy, speed, cost effective and more efficient by using IoT and Machine Learning.

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