

Smart Metering System

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Abstract: In the recent state of affairs, electricity-saving has become a key factor in every household because of the raising awareness about the need for reducing excess consumption of energy. In the current scenario, a designated person from the electrical department visits every house in a region, assesses the meter board, takes the reading, and generates a true copy of the electricity bill for the customer. This whole process is tedious and involves much time and human power. We have come up with a solution for developing an IoT-based smart energy meter which is based on Energy Tracking and Bill Estimation System. In our proposed system, the energy meter is connected to the MCU which takes the reading from the meter and updates it on the GUI system which is connected through a Wi-Fi module. The reading of consumption is updated frequently in stipulated time. Here the customer gets notified about the energy consumption.

Keywords: Smart meter, Smart grid, AMI, ZigBee.

1. Introduction

The existing billing system employs a guide invoice technology technique that consumes a full-size amount of manpower. It reasons a big wide variety of calculation mistakes and flaws. The modern-day device additionally lacks the capability of informing a consumer about his energy use on a day-by-day foundation, leaving the person surprised when he gets a massive electricity bill at the end of the month. The item outlines the task, which is depending on a "Smart Electricity Meter", which makes a specialty of delivering information approximately his day-by-day electricity usage and fee via a user interface, in addition to predicting his bill so that one can be organized at the stop of the month. After one has efficaciously logged in to the portal with the use of accurate statistics, all of his statistics can be viewed or is displayed on his dashboard.

Even though the user does now not test his account on the portal, the gadget will ship him an SMS informing him about his consumption when a threshold quantity is reached.

2. Internet of Things

The brand-new technology of the Internet of Things (IoT) cited uniquely identifiable objects represented in a "network-like" shape. IoT has been playing a principal role in our daily existence in terms of intelligence and automation of traditional objects. By developing connectivity, IoT, as a wise machine, join things like a conventional worldwide impartial community. [5]. Implementation of this device is the use of the idea of IoT

assumes that the scope of the consequences is studied in real-time from everywhere inside the global who has the handiest restrictions and who has the ideal credentials and net access. It also additionally allows for a simple layout and the implementation of additional functions inside the proposed device.

3. Electricity Monitoring System

A smart city is primarily based on a smart grid that permits intelligently manipulating the strength grid. Smart Grids can be one of the areas good ways to be more stylish in research applied to networks and extra. but what it is, because its miles spoke and how it's far a part of the contemporary search for the sustainability of the power, manufacturing, and social sectors. A smart meter can speak with different smart meters in some instances [7]. Smart meters have a spread of potential benefits from the standpoint of the customer; for example, customers may forecast bills based on the amassed records and thereby manage their electricity consumption to lower their electric payments. [8]

4. The Smart Meter Environment

The electricity utilization cycle and stakeholder facts are based on the country-wide Institute of standards and era (NIST) type [10]. In addition, the critical thing is the latest push closer to the mixing and coupling of a couple of structures and components within the smart grid and the information on the fee of interoperability of such systems and components. it is suitable that multiple systems and additives are interoperable under the 3 aspects of organizational, informational, and technical.

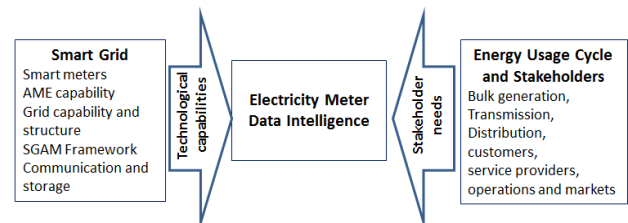


Fig. 1. The environment for smart meter data intelligence [10]

5. A Framework for Smart Metering

A high-level view of the framework is presented in fig. 2. where the relationships to the environment and the key

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components are highlighted. [10]

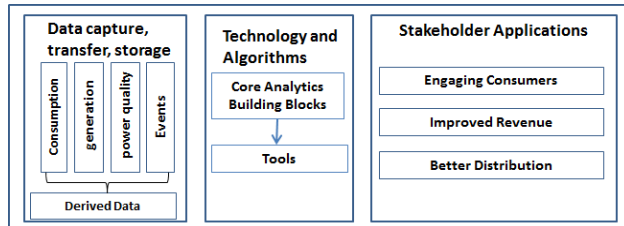


Fig. 2. Smart meter data intelligence framework [10]

Those statistics kinds can be used as aggregates or mixed with outside records including temperature to derive facts for evaluation. capturing correct and applicable records in a timely way is crucial for smart metering, which incorporates the collection, switch, and garage (accumulation). smart meters have led to a massive increase in the quantity in addition to forms of records generated and accumulated, main to many potentials possibilities for generating value from such statistics. As cited under the metering procedure, there are numerous forms of records generated measurement or consumption records, generation statistics, power quality, and occasions statistics. consumption records are the extra predictable and ordinary consumption statistics. It becomes vital that data analytics technologies need to maintain pace with these changing surroundings.

6. Smart Meters

The term Smart Meter initially referred to the functionality of measuring the electricity used and/or generated and the ability to remotely control the supply and cut it off when necessary [10]. It was called Automated Meter Reading (AMR) which used one-way communication and has the ability of automated monthly reads, one-way interruption, tamper detection, and simple load profiling. Over time the AMR capability was extended into the short-term interval (hourly or less) data capture, on-demand reads, and linking into and reading other commodities. A major upgrade of functionality occurred after the integration of the meters with two-way communication technology which has been called Advanced Metering Integrated (AMI). The upgrade included the incorporation of service switching, time-based rates, remote programming, power quality measure, and a dashboard-type user interface for real-time usage monitoring into the AMR. [10] Therefore, in the current metering environment, a meter is expected to Real-time or near real-time capture electricity usage and possibly distributed generation.

- Providing the possibility of remote and local reading of the meter.
- Remote controllability of the meter enabling control and even cut off of supply.
- Possibility of linking to other commodity supplies (gas, water).
- Ability to capture events such as device status (device measured by smart meter), power quality including voltage.

The smart meter is the dimension and facts capture device and, frequently, related to a communicate device referred to as a smart meter gateway to establish an at ease power statistics network. The gateway ought to receive and speak actual-time information from the supplier, be a point of management for home equipment, begin and forestall electricity supply, and many others. it may have a user interface referred to as the 'in a domestic show (IHD) which shows electricity intake, cost, tariffs with actual-time updates, and so forth. The smart meter may be linked to the smart meter gateway which in flip communicates with unique home equipment (washing gadgets, fridge, and so on), neighbourhood technology as well as heating, ventilation, and air conditioning (HVAC).

The measurements and records captured employing the smart meter are displayed through the IHD. The smart meter could without delay communicate the consumption information with the software but the gateway communicates with the following level gateway in the smart grid infrastructure to pass records for aggregation, demand reaction activities as well as utilities. As such the device consists of the smart meter, the gateway, and the IHD communicating in actual time with appliances. [10].

7. Types of System Being Used

Various meters have been in use since the time electricity was employed in day-to-day life.

The classification of the smart meters is as follows:

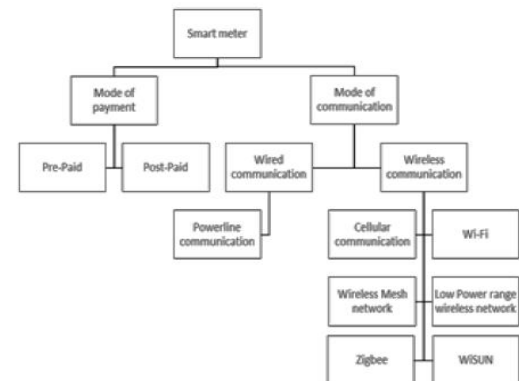


Fig. 3. Classification of smart meters based on payment and communication [4]

A. Mode of Payment

Prepaid Meter much like pay as you go cell services, power bill bills can also be made via pay as you go mode. month-to-month or termly invoice generation is not required, as and when the deposited quantity is going under the marginal degrees, the consumer is alerted and the required amount may be recharged [4].

Postpaid Meter The postpaid device is similar to the traditional technique, wherein the consumer can pay for the amount of strength consumed after a hard and fast length of time [4].

B. Mode of Communication

1) Wired Communication

a) Power line communication

The electricity line conversation used for smart meters is

bidirectional. The information from the home meter is transmitted to the official board through the power line connection. The hazards related to this form of communication consist of the noisy nature of the interface between the speaking modules, it happens because of interference. [4].

2) *Wireless communication*

- a) *Cellular Communication:* Cellular conversation entails the use of GPRS offerings. The GPRS serves as a hyperlink between the energy board and the consumer. that is extensively utilized for the cause of delivery of generated payments to the customers. [4]
- b) *Wi-Fi:* Here the system provides the user the facility to monitor the personal usage of electricity consumption in watts from a webpage. The user is usually provided a unique user id and password to the web portal. [4]
- c) *Wireless mesh network:* The wireless mesh community includes radio nodes organized in a mesh topology. A mesh is usually regarded for its sturdy interconnection among the taking part devices or nodes. [4]
- d) *Low power range wireless transmission:* Low energy variety Wi-Fi transmission is otherwise called as LoRa. The use of LoRa the strength grid's quit device that is the electricity meter sends the power requirement of the specific residence. [4]
- e) *ZigBee:* ZigBee is nowadays favored for its advantages over conventional technology. Its miles comparatively decrease in value, energy consumption, and records quotes. excessive pace statistics costs aren't vital for ZigBee. [4]

8. Advantages and Disadvantages of the Different Types of Techniques

The reading of the modern-day power intake is accomplished manually by shifting to the patron locations. This calls for a large variety of people and long hours to complete the venture. also tends to wander off. For the past years, smart (pay as you go) electricity Meter has been proposed as the modern solution geared toward making affordability less difficult and lowering utility fees. This mechanism essentially requires customers to pay for the power earlier than it's far used, on this way the consumers have a credit score and then use the electricity until the credit is used up while the available credit score is used up then the strength deliver it will shorten by using one relay. [2]

Other than making readings the use of GSM communicate, the billing system is had to be made prepaid to avoid useless usage of strength. using prepaid strength Meters is still controversial. On the only hand, people who help the diffusion of pay as you go meters declare that they advantage each customer and utilities because they assist users to eat extra successfully and enhance the management of their budget, at the same time as permitting corporations to reduce monetary expenses. alternatively, those who are towards the pay as you go meters argue that their adoption is high priced for companies and volatile for low-earnings clients.

9. Different Communication Systems Used

1) *Blynk*

Blynk android application is the IoT cloud interface with both control unit and monitors unit built-in. It was preferred as it has a variety of predesigned widgets for building control units and monitor units. [1]

2) *GSM*

The worldwide system for Cell Communications (GSM) is fashionable to explain the protocols for 2nd-generation (2G) virtual mobile networks utilized by mobile gadgets which include mobile phones and tablets. In a mesh community, the SMs trade messages with a coordinator node that gives a link with the EPCs through GSM. [9]

3) *IEEE 802.15.4*

IEEE 802.15.4 is a low-price, low-statistics-rate wireless gets entry to technology for devices that are operated or paintings on batteries. This describes how low-rate wireless non-public location networks (LR-WPANs) are characteristic.

4) *ZigBee*

ZigBee is a Wi-Fi generation developed as an open international well known to cope with the precise desires of low-fee, low-energy wireless IoT networks. To obtain bidirectional communication between the smart meter and electric strength businesses, a communication community Infrastructure (CNI) is vital. A CNI can be provided through numerous wireless protocols, such as IEEE 802.15.4, and ZigBee. [9]

10. Problems that have been Analyzed

With the fast development of the social financial system, the power consumption of industries and residents will increase regularly. [6] The smart meters are prolonged swiftly for the available and correct size and the popularization rate reaches a hundred%, however, increasingly problems approximately smart meters reveal with the development of power intake facts acquisition device and deepen utility of smart meter consisting of, show fault, communicate failure, error out of tolerance, bizarre dimension records, clock unusual.

these issues are mainly on account of the issue's usual overall performance and affect the character of a smart meter or dimension accuracy. This paper simply analyzes the problem of uncommon measurement records, through the metering principle, fault type, element ordinary performance, and experiments, the give-up result suggests that the battery beneath Neath voltage, component failure and power failure purpose the uncommon size together.

11. Conclusion

Workers from the electricity board visit each consumer's home to take the readings for consumption and also visit again to deliver the bill. The smart meter will eliminate this requirement of manpower and will be able to generate the bills more conveniently.

Consumers also consume a lot of energy unknowingly, therefore the smart meter will enable users to track their consumption daily which will help them reduce their

consumption also, they will be notified via mobile SMS, APP, or website after a threshold value of energy consumed is reached.

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