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IOT based smart energy meters for Efficient Distribution Sector.

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Abstract: As we have entered in new Era of Artificial intelligence, automation & advanced infrastructures which also increased the demand for power exponentially over the last century. One of the method through which today's energy crisis can be addressed is through the efficient energy usage in households. That's lead to increased to focus on accurate and economic methods of power measurement and improve revenue collection . The main objective of the project is to develop smart energy meter is not only measure the consumer's power consumption in KWH but also to enable and support real consumption in rupees according to consumer tariff, so meter reader doesn't need to visit each customer for the consumed data collection and to distribute the bills . The smart energy meter which incorporate *Modern* ***technologies, such as the Internet of Things (IoT)*** facilitates two-way communication, allowing consumers to access their energy usage data remotely via mobile applications or web portals. This empowers users to monitor their energy consumption patterns, set energy-saving goals, and receive personalized recommendations for optimizing their energy usage.

Smart energy meters will save money, labor, efforts and time and at the same time it will effectively monitor the electricity consumption, usage and fraud. It is safe and easy to use and user friendly. These devices will be the vital component of smart grid technology, will enhance energy distribution ,consumption efficiency, reliability, and sustainability of which aims to make highly efficient distribution sector .

I. INTRODUCTION

The prime motive of a smart energy meter is to facilitate accurate and detailed information of electricity consumption . in India Even at present the major challenge faced by distribution sector is Commercial losses which are caused by theft and pilferage of power, and lack of metering and poor billing and collection systems.

But this challenge can be overcome by utilization smart meters which have additional characteristics , including two-way communication between user & utility company. which enables both the user and the utility company to have access to real-time energy usage data remotely . Smart energy meters typically have the following features:

1)**Real-time monitoring**: Smart meters provide up-to- date information about electricity consumption. Users can view their energy usage in real-time, enabling them to make informed decisions about their energy consumption habits.

2)**Remote reading**: Utility companies can remotely read the meter data without the need for physical visits to the premises. This eliminates the need for manual meter reading, reducing costs and improving efficiency.

3)**Time-based tariffs**: Smart meters support time-of-use (TOU) pricing, allowing utility companies to charge different rates for electricity consumed during peak and off- peak hours. This encourages users to shift their energy usage to off-peak times when electricity demand is lower, resulting in cost savings.

4)**Energy consumption feedback**: Smart meters provide detailed information on energy consumption patterns, allowing users to identify energy-intensive appliances or behaviors. This feedback empowers consumers to make more informed decisions about their energy usage and find ways to reduce consumption.

5)**Integration with smart home systems**: Smart meters can be integrated with other smart home devices and systems, allowing users to automate energy management. For example, users can set up rules to automatically adjust thermostats or turn off appliances when they are not in use.

6) **Billing accuracy:** Smart meters eliminate estimation errors in energy bills by providing accurate and actual consumption data. This leads to fairer and more precise billing for consumers.

The proposed smart energy meter integrates advanced metering infrastructure (AMI) with IoT sensors, connectivity, and data analytics to enable real-time energy monitoring, intelligent load management, and energy efficiency improvements. The meter collects data on energy consumption, voltage levels, power quality, and other relevant parameters, which are transmitted wirelessly to a central monitoring system. By utilizing IoT connectivity, the smart energy meter facilitates two-way communication, allowing consumers to access their energy usage data remotely via mobile applications or web portals. This empowers users to monitor their energy consumption patterns, set energy-saving goals, and receive personalized recommendations for optimizing their energy usage

II BLOCK DIAGRAM OF IOT BASED SMART ENERGY METER

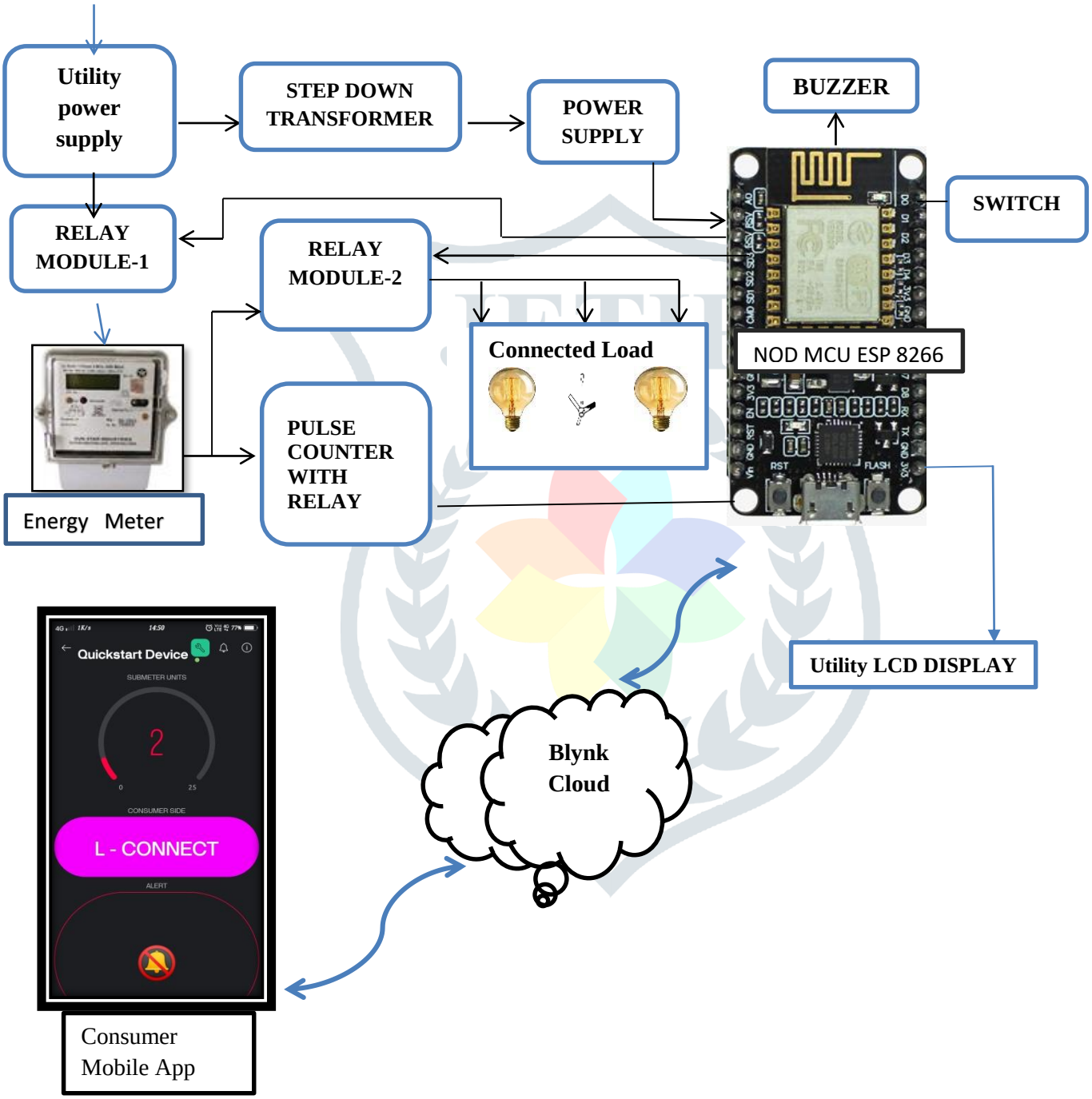

Fig 1 . Block Diagram of IOT Based Smart Energy

III WORKING:

The current model proposes a real-time monitoring system for the energy meter. The presented system provides the consumer with ubiquitous and continuous access to energy consumption by exploiting the advancement of IoT technology.

The proposed system is cost-effective, requiring a simple upgrade on the existing (analog electronic /semi-digital) energy meters rather than a complete replacement. The circuit has been made using all the hardware components like PCB, Energy meter, relays, transformer, AC-DC convertor, load switch, NOD MCU wi-fi module ,pulse generator, buzzer, voltage regulator, LCD display. After this, we can complete the circuit by connecting all the components & programming of NOD MCU WiFi

module and operate it.

When the supply is switched on The blinking LED flashes 3200 times for every 1 unit of measure of electrical energy for simplicity we converted it to 1 pulse to 1 unit with help of the pulse counting relay . The output of this relay is given to the NOD MCU each time the meter LED flashes. The microcontroller utilizes these pulses to compute consumed energy and send it to the cloud using the WiFi module ESP 8266.The consumed energy units will be flashed at both utility center and consumer mobile app .

Evert time the load is put ON The NOD MCU ESP8266 WIFI Module will verify whether sufficient recharge is available at consumer account in terms of units if yes then only the Load & energy meter will be ON through utility controlled relay , If Insufficient unit are balance at consumer account message will be sent to consumer to recharge, buzzer will be on at consumer premises to recharge the units & it will give alert to the consumer on this mobile app also . The alert will come at sufficient units are left so consumer can recharge it at consumer facility center where the units top up can be done. If alert is ignored by consumer & recharged units are consumed by consumer and that become 'zero' the signal is sent to energy meter to stop from NOD MCU waya utility load disconnect Relay and load is disconnect from utility side until next units are top Up.

Again if there is sufficient units are balance and consumer willing to OFF the load that can be done by consumer through mobile app. the key is hit on mobile app as L-disconnect the signal is pass through NOD MCU through cloud and it will provide signal to consumer load disconnect Relay which will off The load from remote location . again if consumer willing to ON the load from remote location that can be done from remote location using mobile app & L-connect key.

Main Components

- Energy Meter Buzzer
- Indicating lamps
- Blink Cloud
- Mobile app to display
- NOD MCU
- Relay Module
- Step down transformer
- LCD Display

IV SYSTEM FLOW CHART:

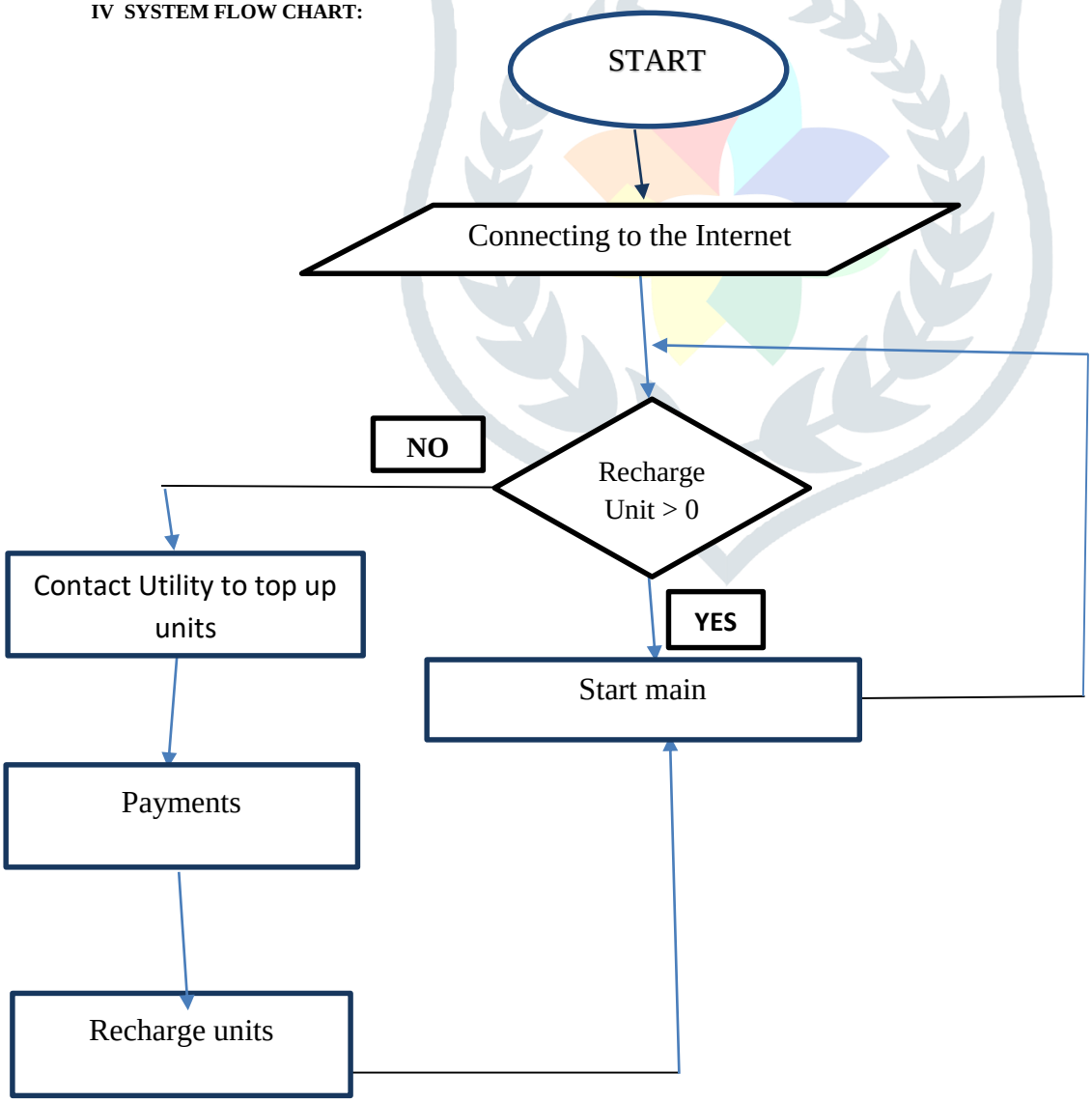

Fig. 3 **System Flow Chart**

Fig:4 **Circuit Connection**

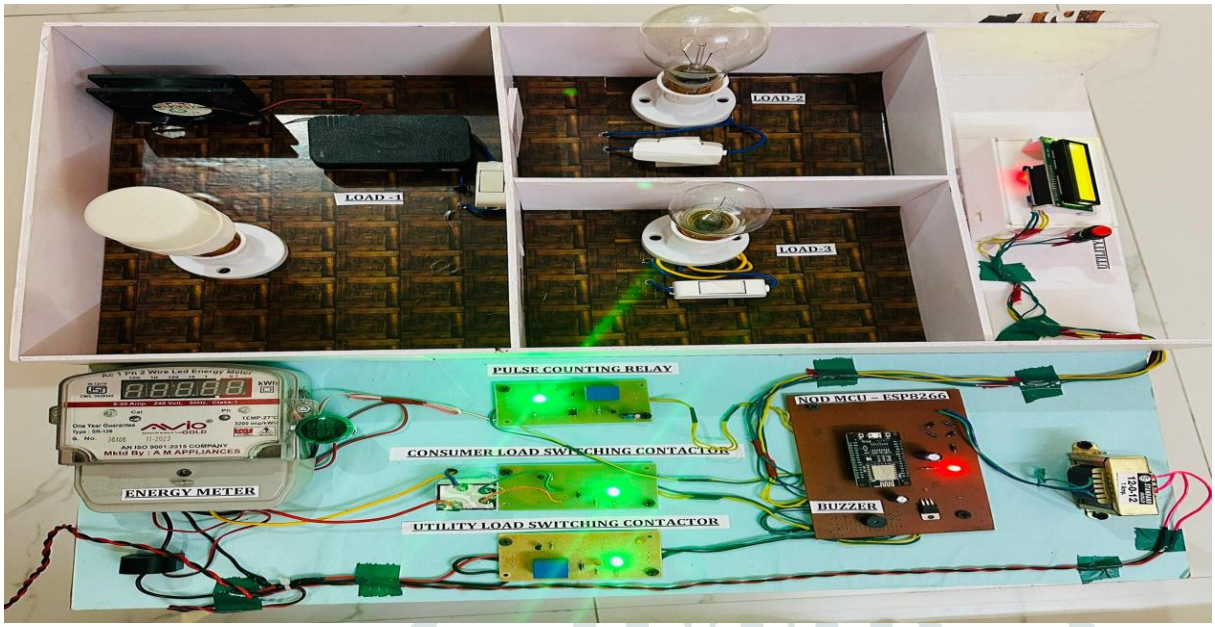

Fig:5 Circuit Connection Working Mode

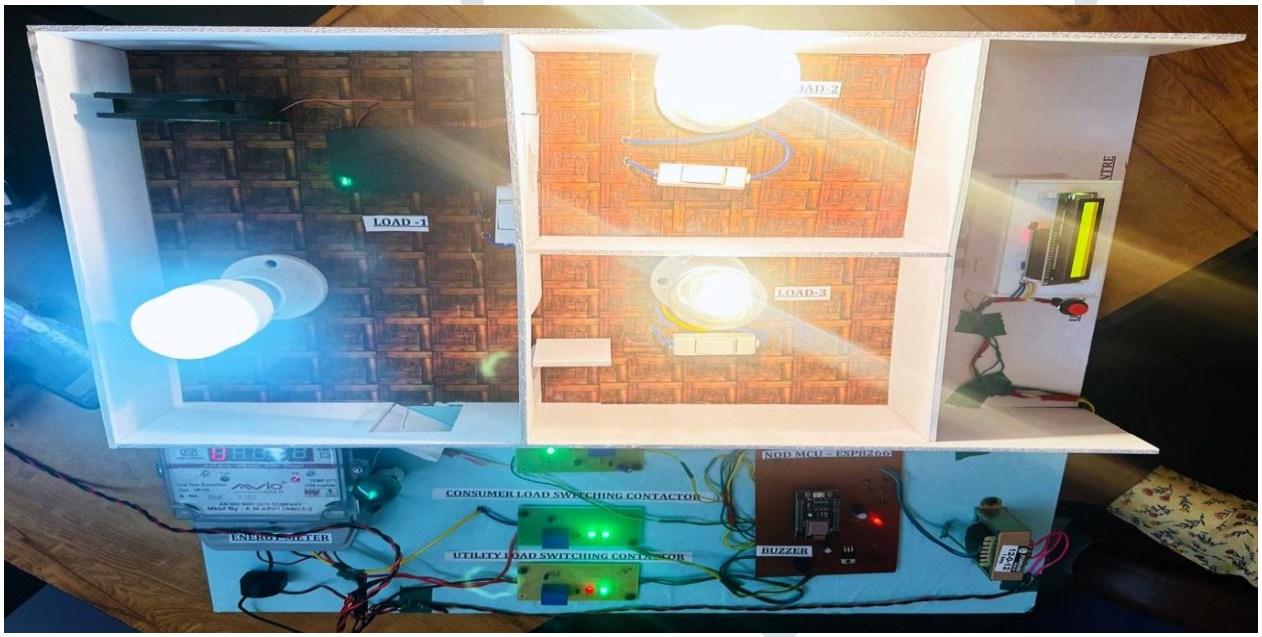

Fig:5 App Display

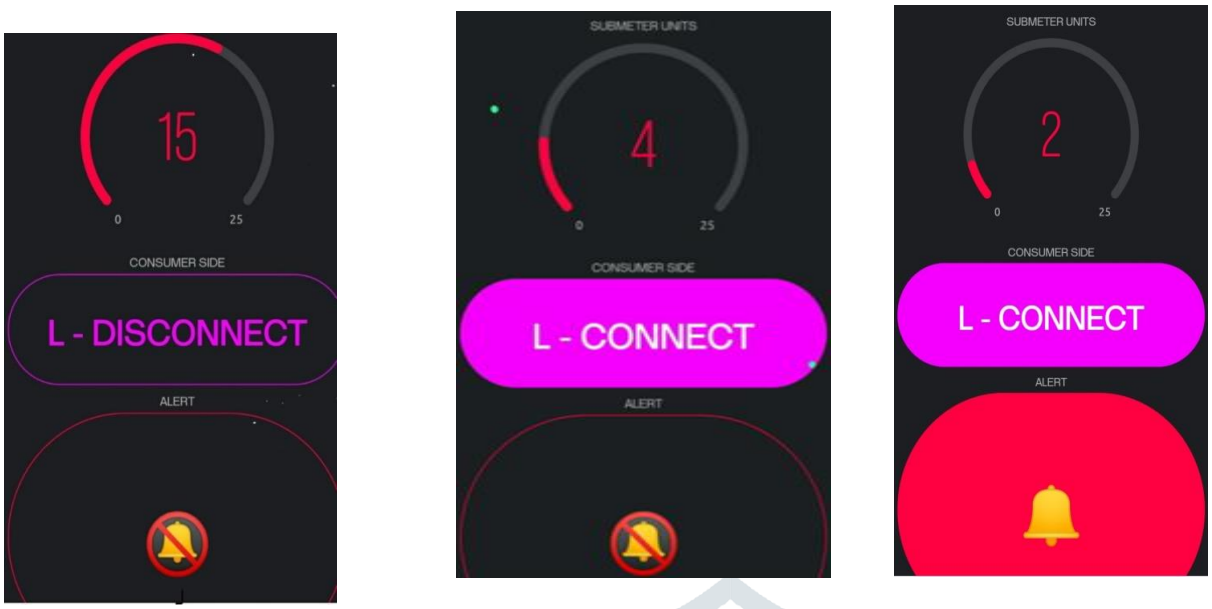

Fig 6.LCD Display

V. RESULTS

Sr.No.	Units Available	Meter status	Load Status	Alert	App DisplayUnits	APP key status	Cut-Off	Remarks
1	12	ON	ON	NO	12	L-CONNECT	NO	
2	10	ON	OFF	NO	10	L-DISCONNECT	YES	Load disconnected by consumer through APP
3	7	ON	ON	NO	7	L-CONNECT	NO	
4	5	ON	OFF	NO	5	L-DISCONNECT	YES	Load disconnected by consumer through APP
5	4	ON	ON	NO	4	L-CONNECT	NO	
6	2	ON	ON	YES	2	L-CONNECT	NO	Alert sent on consumer mobile app
7	1	ON	ON	NO	4	L-CONNECT	NO	
8	0	OFF	OFF	NO	0	L-CONNECT	YES	The load will start after recharge

VI CONCLUSION:

IOT based smart energy meters will not only effectively save money, labor, efforts and but also efficiently monitor the electricity consumption, usage and fraud. It is simple , safe and user friendly. It facilitates ease in taking meter reading, accuracy, detection of fault conditions, calculation of power factor, less operation cost and removal of possible human errors related to meter readings.

The main advantage of the system is that in addition to the display of consumed energy it will also allows consumer to monitor consumption in money & unit terms. Again with this kind of AMR system lot of manpower can be reduced which is beneficial to utility . The system is designed to automatically reads the energy meter and provides home automation through an app developed hence Power management can be achieve through this application. The system will make consumer aware about usage of energy so the corrective actions like recharge of units before time , energy saving and avoid wastage will be su-moto done by consumers. The Proposed system reduces Manual work. & monthly energy consumption can be monitored from any location of the world , Hence it is beneficial to utility & consumers too as there is no need to visit consumer location twice for reading as well as for bill distribution again its substantially reduces bill processing charges as well as human efforts. The utilities will be upgraded with application of this system as there will be financial stability and efforts to take only to maintain of supply .

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