IOT BASED SMART ENEGRY METER FOR EFFICIENT UTILIZATION AND BILLING.

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ABSTRACT

This study has specifically focused to develop a IOT Based Smart Metering System which would be able to address some of the challenges currently available in the regular digital automated metering system in Smart Metering with its unique performance with the Internet of Things (IoT) tend to be an efficient system for electricity management, secure against the intervention by third parties, and reliable for tracking and real-time remote monitoring. Hence, this project work is accomplished by analyzing available functions and journals on the existing design of Smart Metering and discussed on further preferable application. In the currently working system, electricity meter reading for electricity usage and billing is done by human workers from home to home and building to buildings. The purpose of this project is to develop a Smart Electricity meter . This can reduce human errors and helps to retrieve the real time meter value and send it to customers mobile phone through . This also allows electricity board to modify the variable package price in specific duration. The administrator can analyze the customers power consumption data and generate the report from the data online. The prototype will be able to introduce the billing system to the customers, get the power consumption data from smart meter, keep the data in centralized database and generate the report.

1. INTRODUCTION

Electricity is one of the vital requirements for sustainment of contents of life. It should be used very judiciously for its proper utilization. But in our country, we have lot of locality where we have surplus supply for the electricity while many areas do not even have access to it. Our policies of its distribution are also partially responsible for this because we are still not able to correctly estimate our exact requirement and still power theft is prevailing. On the other hand, consumers are also not satisfied with the services of power companies. Most of the time they have complaints regarding statistical errors in the monthly bills. with this we can monitor meter and track if any fault is there or not. In previous meter a circular metal strip rotates and according to that rotation we calculate the consumption. But our meter works on pulse which is created according to consumption and we previously connected an- droid board which monitor the pulse and according to pulse the bill is generated. With the help of this project we are aiming to receive the monthly energy consumption from a remote location directly to centralized office. In this way we can reduce human efforts needed to record the meter readings which are till now recorded by visiting every home individually. Smart energy meter is an electronic device that measures the most accurate amount of electricity consumed by a residence, business or any electricallypowered device. A smart meter is reliable source for most accurate information of consumed energy that reduces the chance of error in the existing billing system to minimal.

The energy consumption can be monitored by using an electric device called energy meter. The cost and the regular usage of Power consumption are informed to the user to overcome high bill usage. The Energy meter shows the amount of units consumed and transfers the data to both the customer and to the electrical board so this helps in reducing man-power. The user can check their Power usage from anywhere and at any time interval. The IoT is used to Turn on/off the household appliances using relay and Arduino interfacing. The objective of this system is to monitor the amount of electricity consumed. The distributer and the consumer both will be benefitted by eventually reducing the total Power consumption.

1.1 PROBLEM STATEMENT

An expansive number of staff is utilized for meter reading and other related assignments like bill payment. Billing errors due to carelessness of meter readers during meter reading and sometime billing estimation.
Consumer has to stand in queue for hours for bill payment. Care less usage of electricity by consumer who is unaware of its cost.

3.1 OBJECTIVES

- To monitor the amount of electricity consumption using smart energy meter.
- Lots of time and power saving for electricity department.
- To make consumers to keep the track of energy usage for the period like 1 day / 1 week / 1 month.
- To provide application for user to refer the generated bill and validity of payment.

1.2 REQUIREMENT SPECIFICATIONS

Requirement specifications are divided into two categories based on the nature. Those are hardware and software requirements. Requirement specification is a description of a software and hardware system to be developed. It lays out functional and non-functional requirements, and may include a set of use cases that describe user interactions that the software must provide. The requirements of the device on which the application will be running. The application runs on both the Android and IOS devices.

Software Requirements

Operating system	:	Windows XP.
Front End Coding Language	:	Java , XML
Back End Coding Language	:	PHP,JSON
Database	:	MYSQL
Server	:	000webhost

Hardware Requirements
LCD
Relay
Smart Meter
Arduino controller
Wifi Module :ESP8266
Potential transformer
Power supply circuit
Voltage and Current sensor

2. MODULES

2.1 STUDY AREA AND METHODOLOGY

The Smart energy meter Energy meter used here is clamp energy meter .230V AC mains is the input given to the transformer and AC mains is converted to low voltage. Energy meter measures the live current, voltage and power in terms of KW-h. Microcontroller reads these parameters and send it to the cloud. NodeMCU is a Wi-Fi device which has a microcontroller in it. This connects the local router through IoT. The status of these parameters can be obtained through mobile or laptop. WIFI is used for data communication. WIFI is configured with Arduino. The Data from the Energy meter is sent to Arduino and to WIFI module and it reaches the users mobile phone. In this system the user can switch on/off the mains or home appliances from their Android smart phone app. The WIFI module trans and receives the data from cloud and sends to Arduino and the Arduino controls the relay to switch on and off the circuit of the home .

Client Side

- The Application will be built on Android Studio.
- XML will be used for front end design.
- Java will be used for background processing.

Server Side

- PHP will be used to provide connectivity between the android application and the database(MySql).
- JSON will be used to transmit data from server to application.

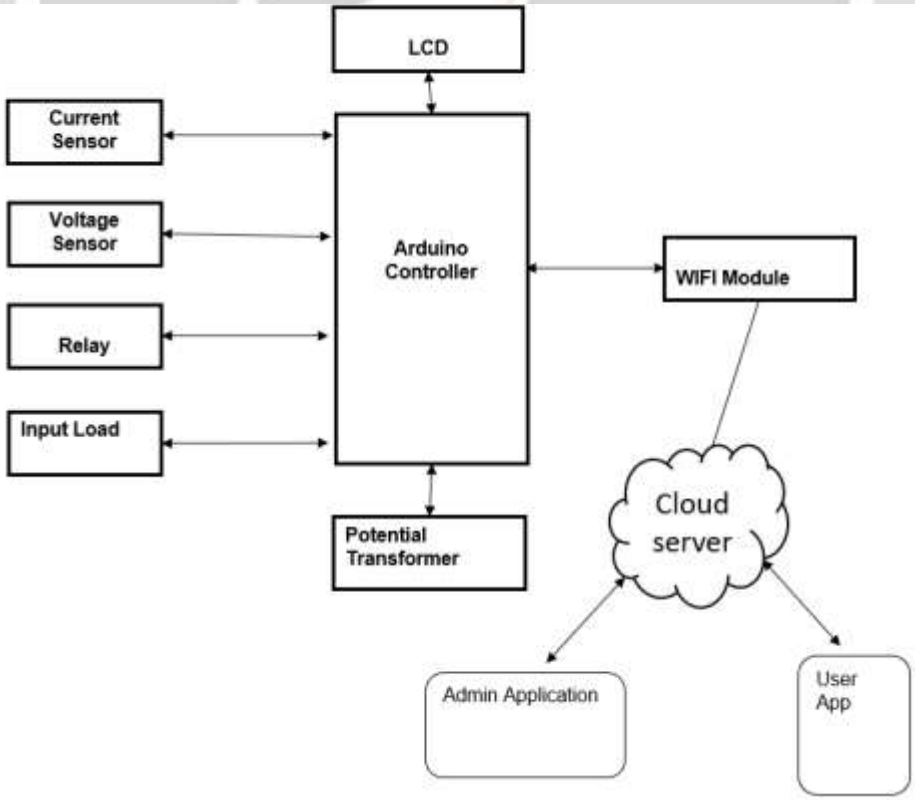

Fig-1 Block diagram

ARDUINO :

Arduino board acts as the heart of the required system. Entire functionality and processes of the system depend on this board. Arduino reacts in response to the 5V supply given by the Opto-coupler and keeps on counting the supply and then calculates the cost and also the power consumed. This data, it continuously stores on the webpage, so that users can visit anytime and can also check their consumption. It even reacts accordingly as per programmed, to the situations like message passing/sending during threshold values etc.

Internet of Things (IOT):

Internet of things has become heart of data transfer and communication. It is a network for inter-linking physical devices or objects with embedded platforms, sensors, actuators to exchange data from any part of the world. The devices which are linked through IOT can be controlled and monitored from anywhere and at any time.

RELAY:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state

POWER SUPPLY:

The ARDUINO and other devices get power supply from AC to DC adapter or from direct AC lines through voltage regulator. The adapter output voltage will be 12V DC non - regulated.

LCD:

An LCD (Liquid Crystal Display) screen is an electronic display module and has a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. This LCD has two registers, namely, Command and Data.

RESISTORS:

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat, may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

3.TESTING

Mobile application testing, a software testing technique exclusively adopted to test the applications that are hosted on web in which the application interfaces and other functionalities are tested.

3.1 Functionality Testing

- The below are some of the checks that are performed but not limited to the below list:
- Verify there is no dead page or invalid redirects.
- First check all the validations on each field.
- Wrong inputs to perform negative testing.
- Verify the workflow of the system.

• Verify the data integrity.

3.2 Usability testing

To verify how the application is easy to use with
• Test the navigation and controls.
• Content checking.
• Check for user intuition.

3.3 Interface testing

Performed to verify the interface and the dataflow from one system to other.

3.4 Compatibility testing

Compatibility testing is performed based on the context of the application.
• Operating system compatibility
• Compatible on various devices

3.5 Performance testing

Performed to verify the server response time and throughput under various load conditions.

• Load testing –

It is the simplest form of testing conducted to understand the behaviour of the system under a specific load. Load testing will result in measuring important business critical transactions and load on the database, application server, etc. are also monitored.

• Stress testing –

It is performed to find the upper limit capacity of the system and also to determine how the system performs if the current load goes well above the expected maximum.

• Soak testing –

Soak Testing also known as endurance testing, is performed to determine the system parameters under continuous expected load. During soak tests the parameters such as memory utilization is monitored to detect memory leaks or other performance issues. The main aim is to discover the system's performance under sustained use.

• Spike testing –

Spike testing is performed by increasing the number of users suddenly by a very large amount and measuring the performance of the system. The main aim is to determine whether the system will be able to sustain the work load.

3.6 Security testing

Performed to verify if the application is secured on web as data theft and unauthorized access are more common issues and below are some of the techniques to verify the security level of the system.
• Broken Authentication and Session Management.
• Insecure Direct Object References.
• Security Misconfiguration.
• Sensitive Data Exposure .
• Missing Function Level Access Control.
• Using Components with Known Vulnerabilities.

4.RESULTS

- This system is used to measure accurate amount of electricity consumed by a residence, business or any electrically powered device.
- A smart meter is reliable source for most accurate information of consumed energy that reduces the chance of error in the existing billing system to minimal.
- This system can be used for activating and deactivating electricity meter when an user payment bill is due.
- With the help of this system we are aiming to receive the monthly energy consumption from a remote location directly to centralized office.

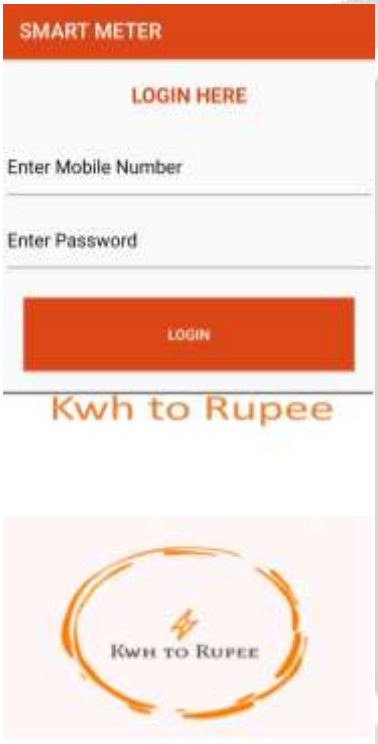

Fig -2 Login Page.

Fig -3 Home Page.

Fig -4 Bill generated Page.

Fig -5 Admin Page.

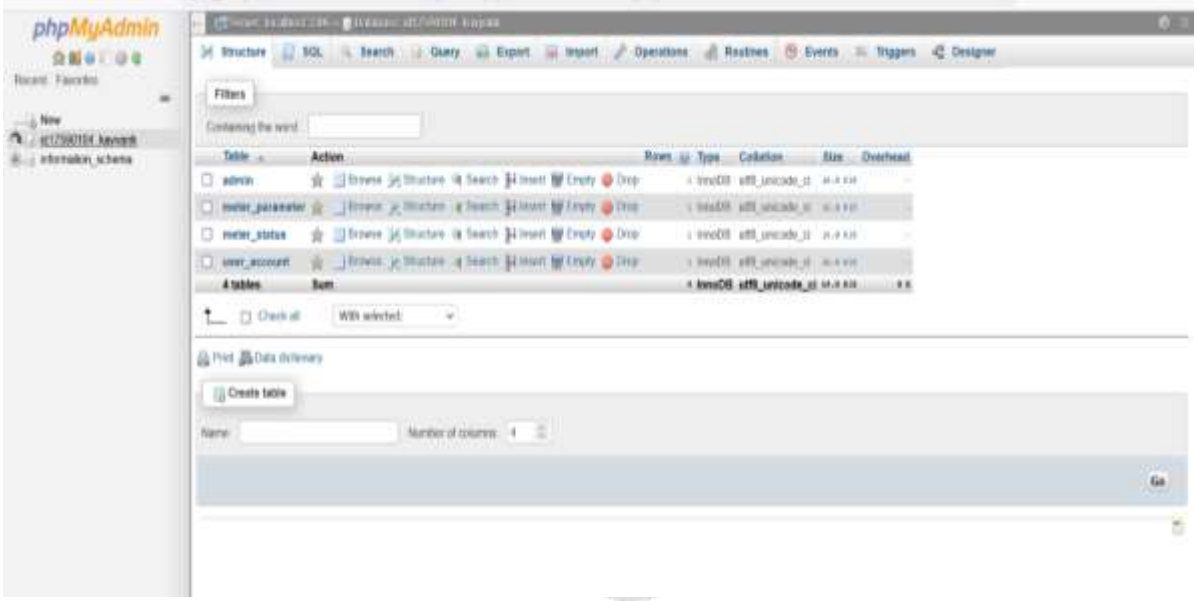

Fig -6 Database Page.

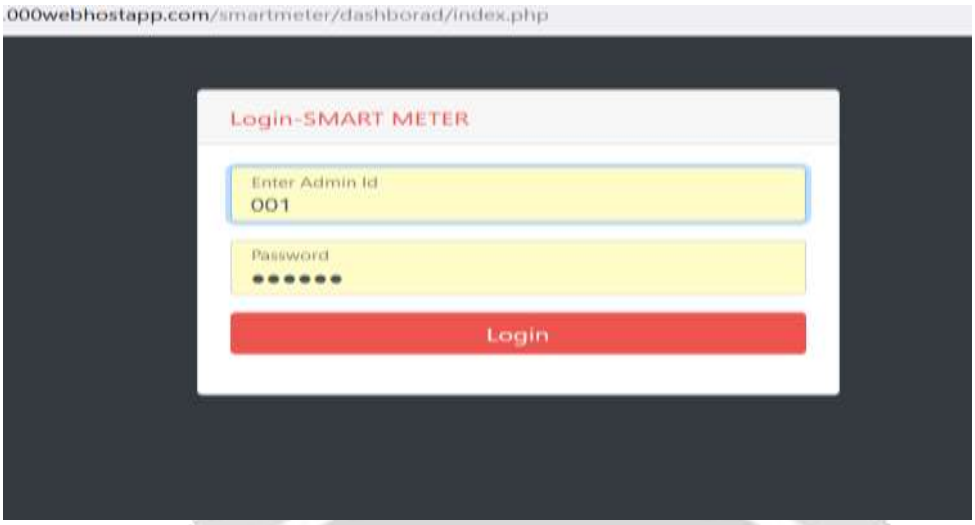

Fig -7 Login at admin Page.

Fig -8 Dashboard Page.

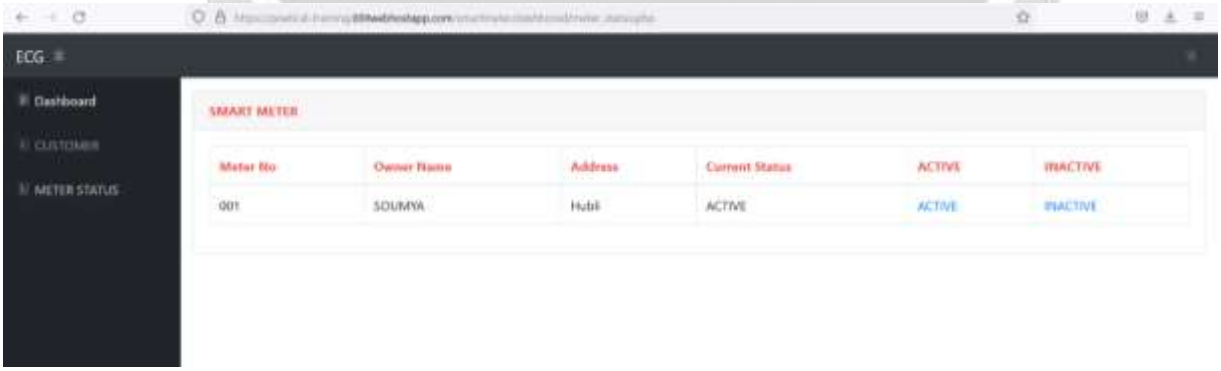

Fig -9 Meter Status at admin Page.

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