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Pimpri Chinchwad Polytechnic

Department of Computer Engineering

Institute	Department
Vision	***Vision***
The Institute envisages to be one among first top ten Institutions and an autonomous Institute in the state of Maharashtra offering demand driven skill development program inclusive of Diploma in Engineering and consistent high degree of professional development of students leading to successful career.	Excellence in Computer Engineering Education for providing services to the Industry and society.
Mission	***Mission***
• To educate and train students in Engineering and Technology domains. • To prepare them for successful employment in industry / business, self-enterprise. • Higher education by providing quality system based teaching and learning processes. • To identify themselves as good individuals, professionals and responsible citizens.	• To develop technically sound Computer Engineers with Lifelong learning skills • To encourage students for higher education, self-employment and entrepreneurship. • To provide excellent teaching and learning systems and facilities. • To nurture them as good individuals, professionals and responsible citizens
Program Educational Objectives (PEOs)	
PEO1:-Pursue higher education or entrepreneurship. **PEO2**:-Excel in professional career and apply the principles of Computer Engineering to identify and solve real world problems. **PEO3**:-Develop a positive attitude towards lifelong learning with ethics and soft skills.	
Program Specific Objective (PSOs)	
PSO1: Computer Software and Hardware Usage: Use state-of-the-art technologies of computer software and hardware. **PSO2: Computer Engineering Maintenance:** Maintain state-of-the-art computer engineering systems and peripherals.	

A PROJECT REPORT ON

PREPAID ELECTRICITY METER

SUBMITTED BY

Om S. Bahirat
Vedant M.Jawalekar
Onkar S. Dokhe
Sourabh D. Tagad

UNDER THE GUIDANCE
OF
PROF. S. S. JOGDAND

DEPARTMENT OF COMPUTER ENGINEERING PIMPRI-CHINCHWAD
POLYTECHNIC AKURDI, PUNE-411044.
(2021-2022)

A PROJECT REPORT
ON

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A Dissertation submitted in partial fulfillment

DIPLOMA IN COMPUTER ENGINEERING

AFFILIATED TO MSBTE

Submitted by

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DEPARTMENT OF COMPUTER ENGINEERING PRADHIKARAN, AKURDI, PUNE-411044.

C E R T I F I C A T E

This is to certify that the end term
Project report entitled

PREPAID ELECTRICITY METER

Has been completed successfully by-

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ABSTRACT

The aim of the project is to minimize the queue at the energy meter billing counters and to restrict the usage of energy meter automatically if the bill is not paid. The project also aims at proposing a system that will reduce the loss of power and revenue due to power thefts and other illegal activities. The work system adopts a totally new concept of "Prepaid Energy Meter". The ARDUINO IDE technology is used so that the consumer would receive messages about the consumption of power (in watts) and if it reaches the minimum amount, it will automatically alert the consumer to recharge.

This technology holds good for all electricity distribution companies, private communities, IT parks andself-containing housing projects. The implementation of this project will help in better energy management, conservation of energy and in doing away with the unnecessary hassles over incorrect billing. The automated billing system will keep track of the real time consumption and will leave little scope for disagreement on consumption and billing. It is observed that one of the faulty subsystems contributing to the huge revenue loss in Nigerian Power Sector is the metering and billing system.

Errors get introduced at every stage of energy billing, like errors with electro-mechanical meters, humanerrors while noting down the meter reading; and error while processing the paid bills and the due bills.

The remedy for this drawback is a prepaid energy billing. There are clear results from many countries, where prepaid system has reduced the revenue loss by a large amount. A ARDUINO IDE-based EnergyRecharge Interface which contains a prepaid card equivalent .

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CHAPTER 1:

INTRODUCTION AND BACKGROUND OF THE INDUSTRY OR USER BASED PROBLEM

CHAPTER 1

INTRODUCTION AND BACKGROUND OF THE INDUSTRYOR USER BASED PROBLEM

1.1 Motivation

In India a decade ago. Various factors have led to the genesis of Prepayment Metering concept in Indiakeeping in view the benefits that's going to accrue to all involved in the concept and its acceptance Prepayment or pay as you go system is receiving more and more attention worldwide as utilities are looking at ways to improve customer service, improve their cash flow and minimize their risks. The concept of prepaid remains the same but there is going to be a paradigm shift in the application.It's altogether a new arena in Metering India which is likely to be important to revenue and energy management. This will in the days to come, open up new vistas for investment and deployment of infrastructure for better customer services. There will be immense benefits, which will be reaped by the State Electricity Boards (SEBs), private utilities and citizens of India. The objective of the paper is to share the details of Prepayment Metering system as a concept and highlight the role to be played by all stakeholders in getting the concept effectively implemented forthe overall benefit of the Indian Power Sector

1.2 Background

Prepayment metering system is very simple. The consumer has a new kind of meter installed in his house which has an inbuilt disconnecting device. The customer buys electricity in advance by paying at any of the Vending office. Once the amount is exhausted the meter automatically disconnects the supply after providing an alarm. The consumer can reconnect himself by buying more electricity and recharging the meter.

Historically, prepayment metering system dates back to over 100 years. The first prepayment meters were manufactured by GE in the year 1899 which were coin operated similar to the coin operated telephone booths. Technological advancement saw new generation of Prepayment Meters using Magnetic cards and then Smart cards. The latest generation of Prepayment Meters uses Keypad technology, wherein there is a telephone like keypad on the meter for recharging. Geographically, prepayment meters have been deployed across the globe. South Africa and UK have deployed this system in huge volumes and with considerable success. Other countries who have adopted the system include Brunei, Argentina, USA, Poland, New Zealand, Malaysia, Israel, Zimbabwe, Nigeria, Kuwait, France, Bangladesh and India

1.3 Need

Power utilities in India have been striving hard to extend best possible support to customers by improving revenue collection efficiency. Meter reading, preparation of bills its distribution and collection of payments takes away a considerable amount of time and efforts for the utility which can be eliminated by the prepayment metering system Interestingly electricity supply is one of the only commodity at present which is after it is consumed, everything else we use in life (cooking gas, prepay mobiles, grocery, clothes etc.) is paid for before it's used. Demand side management, quality of supply along with high customer satisfaction has resulted in acceptance of the new system by utilities everywhere

CHAPTER 2:

LITERATURE SURVEY FOR PROBLEM IDENTIFICATION AND SPECIFICATION

CHAPTER 2

LITERATURE SURVEY FOR PROBLEM IDENTIFICATION AND SPECIFICATION

2.1 Existing System

A prepaid meter is a static meter with an inbuilt load control device. Prepayment meters are of thefollowing types:

- Keypad meters – Keys are provided on the meter or separate in-house unit to enter thecoupon/voucher number that contains various details related with energy to be used
- Smart card meters – When inserted 20 digit number, it stores the various details
- Token or card meters – A token is provided by distribution licensee, which contains the details.

In prepaid meters installed in our country, there are four components (i) main meter, (ii) in house displayunit, (iii) vending system for issue of coupon/token and iv) a token carrier for the vending code.

With number coding is given to consumer for the amount of energy he/she intends to use, the token that isspecific to a meter contains various codes for total energy, total amount, amount and energy exhausted etc. The display of balance left and the energy consumed are available on the meter as well as on the display unit. Offline (stand alone) systems are being used in India. BIS marked prepaid meters are available in the market. Key pad meters will have key buttons marked with numbers/letters for entering the coupon code. Displays that shall be available on press of keys are stated hereafter

2.2 Description

The prepaid meter has a number of advantages over conventional static meters. It is being used by as manyas 17 utilities in India. Some of the countries where prepaid meters are predominant are South Africa, UK and Bangladesh.

Prepaid meters can play a major role in reducing AT&C losses – as collection efficiency is 100%. Somestates have already introduced prepaid metering in the domestic and commercial sector, and some have proposed to introduce it.

Prepaid metering will facilitate the distribution licensee in enhancing its revenues, saving of energy andmanpower. It will give consumer flexibility in frequency and amount of recharge. He/she will adjust his/her consumption according to his/her affordability, a kind of DSM approach. From the point of viewof distribution licensees, it will reduce bad debt.

2.3 Advantages

A) Up front payment for electricity:

Energy is paid for before it is consumed. This is in contrast to the current arrangement of paying for themafter use. The benefits will lie in earlier cash flow for Utility.

B) No unpaid bill:

Because energy is prepaid the problem of collection of arrears and unpaid bills will be no more.

C) No meter readings:

The problems associated with the logistics of meter reading will be eliminated, providing a substantialsaving to Utility.

D) Lower overheads:

As there is no meter reading, no billing, no bill generation, there is a gradual decrease in the overheads.This manpower of Utility can be put for some further value added jobs like vigilance etc.

E) No incorrect bills:

Because no bills are sent, incorrect billing as a result of inaccurate meter readings is no longer a problem

2.4 Disadvantage

1. The unit rates tend to be more expensive.
2. You have to keep an eye on the balance Color backgrounds can lead to malfunctioning.
3. Limited amount of tariffs to choose from

CHAPTER 3:

PROPOSED DETAILED METHODOLOGY OF SOLVING THE IDENTIFIED PROBLEM WITH ACTION PLAN

CHAPTER 3

DETAILED METHODOLOLY OF SOLVING THE IDENTIFIED PROBLEM WITH ACTION PLAN

3.1 Project Modules:

Fig 3.1:- The Basic Block Diagram of the System:

Below are the modules:

1. Arduino:

Arduino is **an open-source electronics platform based on easy-to-use hardware and software**. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message and turn it into an output - activating a motor, turning on an LED, publishing something online.

2. **16x2 LCD:**

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.

3. **Relay:**

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof..

4. **Electric energy meter:**

An electric meter, or energy meter, is **a device that measures the amount of electric energy consumed by a building, tenant space, or electrically powered equipment**. Electric utilities use electric meters installed at customers' premises to measure electric energy delivered to their customers for billing purposes..

3.2 Input and Output:

Input:

Current in volts entered by the user is used as a input here.

Output:

The current is shown on the lcd and after reaching the entered current limit the flow of electric current is stoped .

3.3 System Architecture

3.4 UML Designs

a. Data Flow Diagram [DFD]

i) DFD 0

Fig 3.3:- DFD Level 0 Diagram

ii) DFD 1

Figure 1. Block diagram。

a. Use Case

Fig 3.5:- Use Case Diagram

b. Class Diagram

-+

Fig 3.6:- Class Diagram

c. Activity Diagram

Fig 3.7:- Activity Flow Diagram

3.5 Project Schedule

Fig 3.8:- Project Schedule Diagram

CHAPTER 4:

METHODOLGY

CHAPTER 4:

METHODOLOGY

4.1 Methodology: SDLC Activities

SDLC provides a series of steps to be followed to design and develop a software product efficiently. SDLC framework includes the following step:

Fig 4.1:- SDLC Diagram

1. **Requirement Gathering:**

This step onwards the software development team works to carry on the project. The team holds discussions with various stakeholders from problem domain and tries to bring out as much information as possible on their requirements. The requirements are contemplated and segregated into user requirements, system requirements and functional requirements. The requirements are collected using a number of practices as given -

- studying the existing or obsolete system and software,
- conducting interviews of users and developers,
- referring to the database or collecting answers from the questionnaires.

2. Feasibility Study:

After requirement gathering, the team comes up with a rough plan of software process. At this step the team analyze if a software can be made to fulfill all requirements of the user and if there is any possibility of software being no more useful. It is found out, if the project is financially, practically and technologically feasible for the organization to take up. There are many algorithms available, which help the developers to conclude the feasibility of a software project.

3. System Analysis:

At this step the developers decide a roadmap of their plan and try to bring up the best software model suitable for the project. System analysis includes Understanding of software product limitations, learning system related problems or changes to be done in existing systems beforehand, identifying and addressing the impact of project on organization and personnel etc. The project team analyze the scope of the project and plans the schedule and resources accordingly.

4. Software Design:

Next step is to bring down whole knowledge of requirements and analysis on the desk and design the software product. The inputs from users and information gathered in requirement gathering phase are the inputs of this step. The output of this step comes in the form of two designs; logical design and physical design. Engineers produce meta-data and data dictionaries, logical diagrams, data-flow diagrams and in some cases pseudo codes.

5. Coding:

This step is also known as programming phase. The implementation of software design starts in terms of writing program code in the suitable programming language and developing error-free executable programs efficiently.

6. **Testing:**

An estimate says that 50% of whole software development process should be tested. Errors may ruin the software from critical level to its own removal. Software testing is done while coding by the developers and thorough testing is conducted by testing experts at various levels of code such as module testing, program testing, product testing, in-house testing and testing the product at user's end. Early discovery of errors and their remedy is the key to reliable software.

7. **Integration:**

Software may need to be integrated with the libraries, databases and other program(s). This stage of SDLC is involved in the integration of software with outer world entities.

8. **Implementation:**

This means installing the software on user machines. At times, software needs post-installation configurations at user end. Software is tested for portability and adaptability and integration related issues are solved during implementation.

9. **Operation and Maintenance:**

This phase confirms the software operation in terms of more efficiency and less errors. If required, the users are trained on, or aided with the documentation on how to operate the software and how to keep the software operational. The software is maintained timely by updating the code according to the changes taking place in user end environment or technology. This phase may face challenges from hidden bugs and real-world unidentified problems.

10. **Deployment:**

As time elapses, the software may decline on the performance front. It may go completely obsolete or may need intense upgradation. Hence a pressing need to eliminate a major portion of the system arises. This phase includes archiving data and required software components, closing down the system, planning disposition activity and terminating system at appropriate end-of-system time.

4.2 Risk Management:

Fig 4.2:- Risk Management Diagram

1. Identify Risk:

Risk identification requires knowledge of the organization, the market in which it operates, the legal, social, economic, political, and climatic environment in which it does its business, its financial strengths and weaknesses, its vulnerability to unplanned losses, the manufacturing processes, and the management systems and business mechanism by which it operates. Any failure at this stage to identify risk may cause a major loss for the organization. Risk identification provides the foundation of risk management.

2. Access Risk:

Once risks have been identified, they must then be assessed as to their potential severity of loss and to the probability of occurrence. These quantities can be either simple to measure, in the case of the value of a lost building, or impossible to know for sure in the case of the probability of an unlikely event occurring. Therefore; In the assessment process, it is critical to making the best-educated guesses possible in order.

To properly prioritize the implementation of the risk management plan. The fundamental difficulty in risk assessment is determining the rate of occurrence since

statistical information is not available on all kinds of past incidents. Furthermore Evaluating the severity of the consequences (impact) is often quite difficult for immaterial assets. Asset valuation is another question that needs to be addressed.

3. Control Risk:

Risk can be controlled either by avoidance or by controlling losses. Avoidance implies that either a certain loss exposure is not acquired or an existing one is abandoned. Loss control can be exercised in two ways. Control risk is very important in auditing as it can prevent the misstatement of financial information. However, when the control mechanism fails to detect fraud and error, the financial information is misstated, and investors get the wrong picture about a firm's financial condition.

4. Review Control:

Initial risk management plans will never be perfect. Practice, experience and actual loss results will necessitate changes in the plan and contribute information to allow possible different decisions to be made in dealing with the risks being faced.

Risk analysis results and management plans should be updated periodically. There are two primary reasons for this;

1. To evaluate whether the previously selected security controls are still applicable and effective, and,
2. To evaluate the possible risk level changes in the business environment. For example, information risks are a good example of the rapidly changing business environment.

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AC
SOURCE
CURRENT
SENSOR
ACS712
Gnd
Vcc
RELAY
IN
Vcc
Gnd
Display
LCD
16X2
Module
I2C
Vcc
Gnd
OUT
LOAD
Gnd
A0
Vcc
ARDUINO UNO
12

CHAPTER 5:

DETAILS OF DESIGN WORKING AND PROCESSES

CHAPTER 5

DETAILS OF DESIGNS WORKING AND PROCESSES

5.1 System Overview:

In our project, we attempted to **allow consumers to track their electricity usage in real time**. This can incentivise customers to save money by reducing use of power-guzzling appliances if they feel that their power usage is spiralling out of their household budget..

The code is written in Arduino ide, arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.Their centers are calculated, and the action to be taken is determined based on theirrelative positions.

5.2 Working:

Following are the steps in working of our project:

1. **Arduino ide :**

Arduino MEGA controlling meter circuit **reads the recharge amount and resumes the power supply by switching the relay**. The recharge balance is shown on the LCD panel of the prepaid energy meter.

Arduino UNO is a microcontroller board based on the **ATmega328P**. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

2. **Relay:**

The prepaid electricity meter uses a relay (**an automatic switch**) which disconnects the power when there is no units left. When you top up, the meter balance increases and the relays lets electricity flows again. Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal. Relays were first used in long-distance telegraph circuits as signal repeaters: they refresh the signal coming in from one circuit by transmitting it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

3. ACS 712 SENSOR:

Current Sensor detects the current in a wire or conductor and generates a signal proportional to the detected current either in the form of analog voltage or digital output. 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 features of ACS712 include:

- 80kHz bandwith
- 66 to 185 mV/A output sensitivity
- Low-noise analog signal path
- Device bandwith is set via the new FILTER pin
- 1.2 mΩ internal conductor resistance
- Total output error of 1.5% at TA = 25°C
- Stable output offset voltage.
- Near zero magnetic hysteresis

4. Bread bored:

Breadboards are one of the most fundamental pieces when learning how to build circuits. In this tutorial, you will learn a little bit about what breadboards are, why they are called breadboards, and how to use one. Once you are done you should have a basic understanding of how breadboards work and be able to build a basic circuit on a breadboard.

5. LCD 16×2:

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

6. Circuit Description:

Circuit connections for this Wireless Electricity Meter Reading Project, are shown in the diagram; we have used a Arduino UNO for processing all the things used in project. A liquid crystal display is used for displaying the status of Units and remaining balance. Data pins of LCD namely RS, EN, D4, D5, D6, D7 are connected to Arduino digital pin number 7, 6, 5, 4, 3, 2. And Rx and Tx pins of ACS712 SENSOR module are directly connected to the Tx and Rx pins of Arduino respectively. And ACS712 SENSOR module is powered by using a 12 volt adaptor. A relay is used for switching electricity connection which is connected at pin 12 of Arduino though ULN2003 relay driver.

CHAPTER:6

RESULT AND APPLICATION

CHAPTER 6

RESULT AND APPLICATION

6.1 Results:

Following in the final circuit and full working of prepaid electricity meter:

6.2 Applications:

- By using this system we can easily reduce the billing of our homes.
- By using this system we can reduce the energy losses.
- By using this system we can implement manpower less electricity recharge stations for electric vehicles.
- By using this system we can save the energy from theft.
- By using this system there will be no due's pending towards MSEB.

CHAPTER 7:

CONCLUSION AND FUTURE SCOPE

CHAPTER 7

CONCLUSION AND FUTURE SCOPE

7.1 Conclusion:

The old method of electricity billing is quite cumbersome and tedious. It entails many activities that are energy draining such as preparing the bill and reading energy consumption data from house to house. Accuracy is another issue that was difficult to maintain in the old analog system. With prepaid electricity meters, you can be certain of receiving accurate energy consumption information on a daily basis.

In conclusion, the creation of prepaid electricity meters simplifies the task of monthly electrical billing, even in the odd chance where there is an incorrect energy reading. In short, prepaid metering is beneficial to both the consumer and the energy providers as it enables them to be aware of their energy consumption. It ensures that no guess work is done in the computation of your monthly electric bills.

7.2 Future Scope:

In future, this project can be implemented and validated in remote areas. Future enhancement can be incorporated to suit the system for three phase electric distribution system in India Along with all this new architectural components can be incorporated, so that the system can be completely used foroptimizing the energy consumption. This method will reduce the energy wastage and save a lot of energy for future use Measurement of parameters like power line current and power line voltage has not beenavailable in a satisfactory way to optimize power network management. But due to advancement inpresent technologies we can give better solution to detect the power thief.

CHAPTER 8:

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REFERENCES & BIBLIOGRAPHY

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