International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

IJIEMR Transactions, online available on 12th Dec 2024. Link

https://ijiemr.org/downloads.php?vol=Volume-13&issue= Issue12

DOI:10.48047/IJIEMR/V13/ISSUE12/11

Title: " PREPAID WATER METER USING SMART CARD"

Volume 13, ISSUE 12, Pages: 93- 99

Paper Authors
Boya Yella Naidu, Jukuntla Pavan Kumar, Thunga Chandu, Peddagolla Srinivas, Dr Prasad Janga

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

PREPAID WATER METER USING SMART CARD

Boya Yella Naidu[1], Jukuntla Pavan Kumar[2], Thunga Chandu[3], Peddagolla Srinivas[4], Dr Prasad Janga[5]
[1,2,3,4]UG Scholar, Department of ECE, CMR Institute of Technology Hyderabad, Telangana
[5]Professor, Department of ECE, CMR Institute of Technology Hyderabad, Telangana
Correspondence mail: yellanaidu129@gmail.com

Abstract

Indonesian population has grown rapidly, as shown in Central Statistics Agency report that in 2018, Indonesia's population reached 265 million. Along with the increasing number of populations, water for daily needs is in high demand. A good monitoring and water management is needed to oversee the water usage efficiently. Currently, local water company still implements post-paid payment system that is time and human resources inefficient. In this study, we proposed the implementation of internet of things (IoT) in designing prepaid water meter card for real time water usage monitoring. The card could also be used to directly purchase water quota online via website. The proposed water meter used air vent valve system combined with the water flow sensor to measure the amount of user's water usage. Result shows that the proposed system could work properly with the error value of 2.84% measured from the difference between water flows read in conventional water meter with the measured value in our proposed water meter. The purchased quota will be directly deducted based on the amount of measured water usage. The process was done in real time environment and the data will be automatically stored in server. When user is running out of quota, solenoid valve embedded in the proposed water meter system will be automatically closed such that user have no access to water source.

1.Introduction

The increasing rate of Indonesian population in each year [1] caused the high demand in water consumption [2,3]. In 2018 where the population of Indonesia reached 265 million [1] caused the increasing number of water company customer up to 5% in each district compared to 2017 number of customer [3–6]. On the other hand, the number of water loss rate is also increasing and the company suffer greater loss. During 2015 – 2018 period, the number of water loss in Malang water company is increasing around 1% each year, from 18.33 until 20.31%. One of the major reason behind water loss rate is the traditional monitoring and customer management system [7]. Good monitoring and management such as increased security, service stability, resilience to disruptions and high performance are needed to reduce losses to the company [8,9].

Traditional water usage readings cause losses to companies and users due to frequent occurrence of misreadings. Customers also often neglect to pay the water bill such that many arrears occur. Users could not control water usage so the amount of monthly payment cannot be predicted. Moreover, current payment system, post paid payment is considered ineffective. Along with the rapid technology development such as Internet of Things (IoT), these problems could be overcome.

IoT is a scenario where an object has the ability to transfer data through a network without requiring human-to-human or human-computer interaction. IoT have been and still could be developed to be implemented in many aspects in daily life to make human life easier [10]. This paper proposed a prepaid water meter card based on internet of things to overcome the problems raised in water management system. In this system, customer could monitor their water consumption and directly paid the appropriate amount using pre-paid system. On the other hand, water company could be able to real time monitor the water usage in each customer, remote controlling the water meter in customer house, reduce inefficient reading method, thus increasing their efficiency. Previous works about digital water meter in Rafik A and Yuniarto [11] implements pre-paid system, but failed to solve the existence of air in the valve that increasing the value of measured water consumption. Marais J M, et all [12] elaborated the topologies in implementing water meter applied in wireless sensor network, a scheme that is relatively small scale compared to the IoT. Instead of implementing IoT, proposed system in Thang V C [13] transmit the data using GPRS network. However, GPRS has lower data speed transfer and capacity compared to the IoT. Congestion would happen if there are many nodes transmit data simultaneously. On the other hand, our proposed system implements IoT that could allow many nodes could transmit data simultaneously. Cahyati C, et all only implemented water monitoring system without the payment method [14]. Wildani A N implements MCU ESP8266 to set up a prepaid water meter, however, the system still used code as prepaid voucher code which is inefficient and less secure [15]. Instead of changing the meter into fully digital by embedding sensor, Yang F, et al implement convolutional neural network to read data in analog meter then sent the data to sensor [16]. However, this method required high computational time and process for the system. Our proposed method implements water flow sensor to calculate water usage instead of the traditional one. Air vent valve was embedded to remove excess air in the water.

2.Literature Survey

Managing massive electric power data is a typical big data application because electric power systems generate millions or billions of status, debugging, and error records every single day. To guarantee the safety and sustainability of electric power systems, massive electric power data need to be processed and analyzed quickly to make real-time decisions. Traditional solutions typically use relational databases to manage electric power data. However, relational databases cannot efficiently process and analyze massive electric power data when the data size increases significantly. In this paper, we show how electric power data can be managed by using HBase, a distributed database maintained by Apache. Our system consists of clients, HBase database, status monitors, data migration modules, and data fragmentation modules. We evaluate the performance of our system through a series of experiments. We also show how HBase's parameters can be tuned to improve the efficiency of our system. Electric power systems are essential to modern society. As a core subsystem, the Power Dispatching Automation System (PDAS) processes runtime information and makes real-time control decisions, which guarantees the safety and substantiality of electric power systems[1]. With the increasing scale of PDAS, system-generated data, including status, debugging, and errors, have increased dramatically in recent years. For example, a city-tier PDAS generates millions of

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

records every day, while a province-tier PDAS needs to collect data from tens of city-tier PDASs, and make global decisions in real time. The electric power data processed by PDAS are typical 4Vs which are difficult to process, query, and analyze within a tolerable time. Recently, the fast development of electric power systems has significantly increased the size of electric power data. According to a report from IBM "going from one meter reading a month to smart meter readings every 15 minutes works out to 96 million reads per day for every million meters. The result is a 3000-fold increase in data that can be overwhelming if not properly managed." Traditionally, electric power data are stored in relational databases, where maintenance costs can explode due to the increasing data sizes and requirements of real-time processing. To address this problem, companies like IBM, Oracle, and General Electric, have brought their big-data projects to the power industry. Scientists have also proposed a series of techniques including optimization and data mining to efficiently analyze, process, and visualize electric power data. Cloud computing is one of the key solutions to process massive electric power data[2, 3]. With cloud computing, distributed file systems and data management technologies such as Google File System[4], Hadoop Distributed File System (HDFS)[5] , Big Table[6], and Apache HBase[7] can be used to store large amounts of electric power data. Parallel processing technologies, such as MapReduce[8] and Spark[9, 10], make real-time processing of electric power data possible. On the basis of cloud computing, many emerging scalable and distributed architectures and frameworks have been proposed in the power grid area. The Tennessee Valley Authority built a power grid information processing architecture using MapReduce and Hadoop to detect power grid anomalies, creating power grid maps and evaluating power consumption history. In Japan, Kyushu Electric Power Company has developed a big data platform to meet the requirements of rapid analysis of vast amounts of power consumption data collected from residences, offices, factories, and other sectors in a power grid[11]. This big data platform is based on a Hadoop cluster and is deployed in a cloud computing environment that utilizes server visualization technology. An open-source project based on Hadoop, which contains a set of applications for processing streaming time-series data from power management units. Overall, most existing information systems are based on Hadoop for batch processing electric power data offline. However, as a batch processing system, Hadoop would not work for real-time queries. To address this problem, we propose a big data platform that uses Apache HBase distributed database to store and query electric power data. HBase is an open source, non-relational, distributed database running on top of HDFS and providing Big Table-like capabilities for Hadoop. Unlike Hadoop, HBase is well-suited for faster read and write operations on large datasets with high throughput and low input/output latency . This paper is organized as follows: We first introduce the basic concepts of HBase. We then show the architecture of our system and we present the data storage model of electric power data when considering the characteristics of power system data. we evaluate the factors that affect HBase performance and propose optimization techniques for tuning HBase for electric power data. We show the related works and conclude the paper. The aim of the paper is to minimize the queue at the electricity billing and to restrict the usage of electricity automatically, if the bill is not paid. The work system adopts a totally new concept of "Prepaid Electricity Card". This technology holds good for all companies and home. The meter is important in making the consumer having sense about his/her energy consumption. This paper is aimed at developing a prototype of a management system for an energy meter. The designed energy meter consists of an RFID reader, a microcontroller, a LCD and an IoT. An RFID reader is used to read the Customer's information. The LCD display will display the Energy and the amount for the Energy. The IoT technology is used to send the information about the consumption of power (in watts) to the server page and during the month end, it would automatically alert the consumer to pay the amount. If the customer didn't pay the bill before due date the connection cut through IOT from EB Office. Also the payment can be done using the prepaid RFID Given to the user and also it will give alert when the amount in the card reduce to the cutoff level. The implementation of this paper will help in better energy management, conservation of energy and also 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. In the present billing system the distribution companies are unable to keep track of the changing maximum demand of consumers. The consumer is facing problems like receiving due bills for bills that have already been paid as well as poor reliability of electricity supply and quality even if bills are paid regularly. The remedy for all these problems is to keep track of the consumers load on timely basis, which will held to assure accurate billing, track maximum demand and to detect threshold value. These are all the features to be taken into account for designing an efficient energy billing system. The present project "IoT Based Smart Energy Meter" addresses the problems faced by both the consumers and the distribution companies.

3.Block Diagram

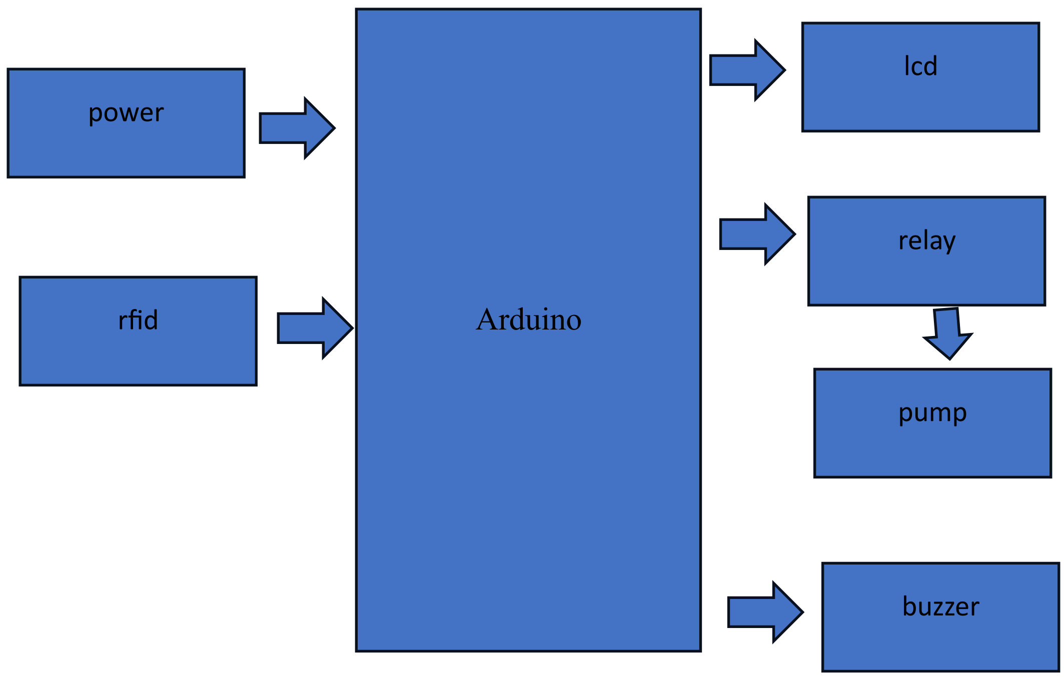

Fig 1 Design Flow

3.1 Ardino

The Arduino is a family of microcontroller boards to simplify electronic design, prototyping and experimenting for artists, hackers, hobbyists, but also many professionals. People use it as

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

brains for their robots, to build new digital music instruments, or to build a system that lets your house plants tweet you when they're dry. Arduinos (we use the standard Arduino Uno) are built around an ATmega microcontroller — essentially a complete computer with CPU, RAM, Flash memory, and input/output pins, all on a single chip. Unlike, say, a Raspberry Pi, it's designed to attach all kinds of sensors, LEDs, small motors and speakers, servos, etc.

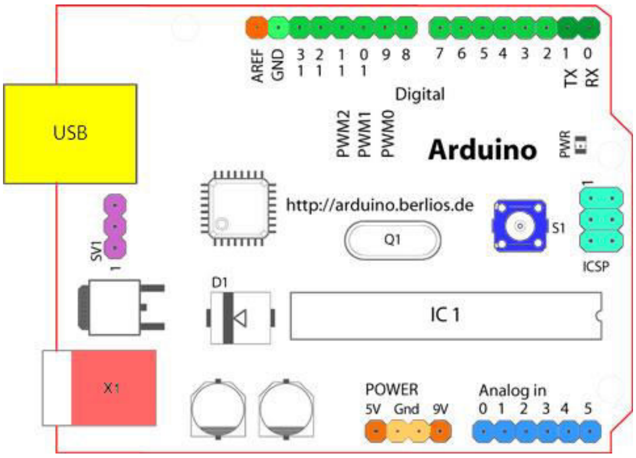

Fig 2 Structure of ardino

3.2 Voltage Regulator

A voltage regulator (also called a 'regulator') with only three terminals appears to be a simple device, but it is in fact a very complex integrated circuit. It converts a varying input voltage into a constant 'regulated' output voltage. Voltage Regulators are available in a variety of outputs like 5V, 6V, 9V, 12V and 15V.

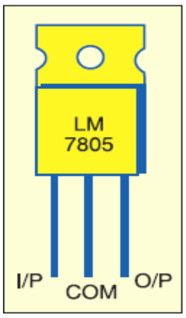

Fig 3 Voltage Regulator

PROCESS

The structure of the LED light is completely different than that of the light bulb. Amazingly, the LED has a simple and strong structure. The light-emitting semiconductor material is what determines the LED's color. The LED is based on the semiconductor diode.

When a diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is usually small in area (less than 1 mm2), and integrated optical components are used to shape its radiation pattern and assist in

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

reflection. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. However, they are relatively expensive and require more precise current and heat management than traditional light sources. Current LED products for general lighting are more expensive to buy than fluorescent lamp sources of comparable output. They also enjoy use in applications as diverse as replacements for traditional light sources in automotive lighting (particularly indicators) and in traffic signals. The compact size of LEDs has allowed new text and video displays and sensors to be developed, while their high switching rates are useful in advanced communications technology.

4.Result

A prepaid water meter using a smart card is a system that allows users to manage and control their water consumption in a way similar to how prepaid mobile phone plans work. The system typically uses a smart card to track water usage and facilitate payment. Here's how it generally works and the results. A prepaid water meter using a smart card system offers a smart, efficient way for both consumers and water providers to manage water consumption and payments. It helps to prevent overuse, ensures timely payments, and encourages water conservation, all while providing a reliable, user-friendly platform for monitoring and controlling water usage.

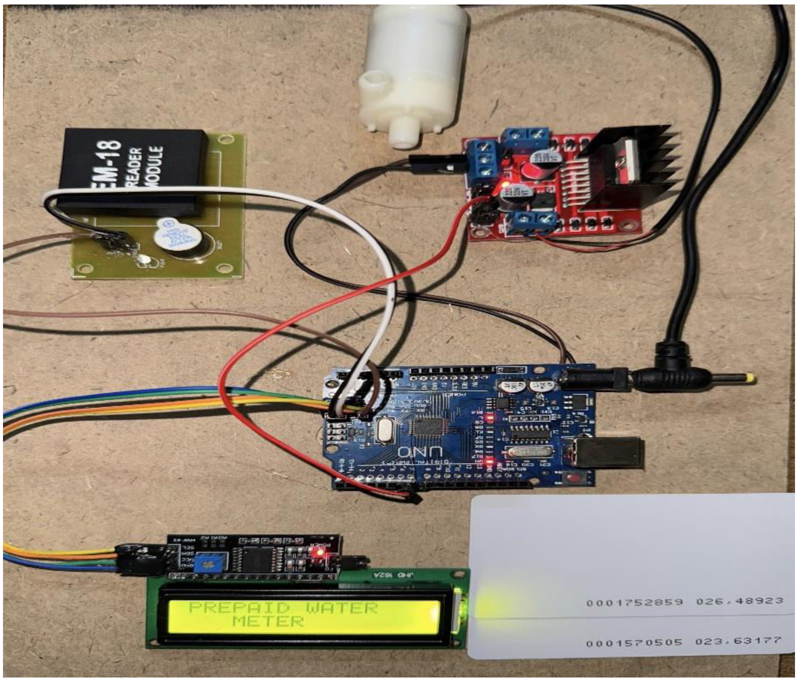

Fig 4 Experiment Kit

5.Conclusion

Our proposed system, prepaid water meter card based on internet of things has been designed successfully. The card is used to check user ID and remaining water quota that could be successfully reload directly from website. Air vent valve is implemented to remove the excess air in the water that flows through the pipes in order to obtain a more accurate result on water flow sensor. Results shows that the installed air vent valve is feasible to use since it could successfully remove the excess air in the water. Water flow sensor is used to detect the volume of water that flow through the pipes. With the error of 0.82%, it proved that the implemented water flow sensor is accurate. Overall results show that our proposed system could work properly and ready to be implemented in daily life to help creating better water management system. Initial Installation Cost ,Potential for Service Interruptions, Limited Access to Recharging Points, Meter Malfunctions or Errors ,Maintenance and Support ,Risk of Fraud or Theft, Consumer Resistance, Limited Flexibility in Water Usage.

6.Reference

[1] Badan Perencanaan Pembangunan Nasional, Badan Pusat Statistik and United Nations Population Fund 2013 Proyeksi Penduduk Indonesia

[2] Badan Peningkatan Penyelenggaraan Sistem Penyediaan Air Minum Kementrian PUPR 2017 Buku Kinerja PDAM 2017

[3] Badan Peningkatan Penyelenggaraan Sistem Penyediaan Air Minum Kementrian PUPR 2018 Kinerja PDAM 2018 Wilayah II

[4] Badan Peningkatan Penyelenggaraan Sistem Penyediaan Air Minum Kementrian PUPR 2018 Kinerja PDAM 2018 Wilayah IV

[5] Badan Peningkatan Penyelenggaraan Sistem Penyediaan Air Minum Kementrian PUPR 2018 Kinerja PDAM 2018 Wilayah I

[6] PDAM Kota Malang Statistik

[7] Suresh M, Muthukumar U and Chandapillai J 2017 A Novel Smart Water-Meter based on IoT and Smartphone App for City Distribution Management 2017 IEEE Region 10 Symposium (TENSYMP)

[8] Moahloli A, Marnewick A and Pretorius J H C 2019 Domestic water meter optimal replacement period to minimize water revenue loss Water SA 45 165–73

[9] Babu B S, Ramanjaneyulu T, Narayana I L and Srikanth K 2017 Trends of IoT Int. J. Eng. Trends Technol. 43 185–8

[10] Rafik A and Yuniarto 2014 Aplikasi Smart Card pada Meteran Air Digital Prabayar berbasis Arduino Mega 2560 GEMA Teknol. 18 35–40

[11] Marais J M, Malekian R, Ye N and Wang R 2016 A Review of the Topologies Used in Smart