

A Review on an Integrated Mobile System for Improving Efficiency in Water Meter Reading – A Case of Arusha Tanzania

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Abstract

Technology has shown tremendous growth in recent years, which has led to the evolution of mobile phone development. A mobile phone is a wireless handheld device that allows users to make calls and send text messages, among other features. A water meter is a device which collects and registers information on the volume of water used over a period of time at a particular location. Due to the fact that the current process of recording water consumption in Arusha, Tanzania is inefficient as it is still done manually, this paper shows different best studies made in perfecting water meter reading system via mobile system. It further proposes the best way of recording water consumption which can match with the environment of Tanzania after reviewing different studies made by others.

Keywords: Mobile phone, Water meter, SMS, USSD, Data logger

1. Introduction

The fast development of mobile phone technologies nowadays offers exciting opportunities in other life changing sectors causing the spread of mobile phones across the developing world to be one of the most remarkable technology stories of the past decade [14]. Mobile phone is an electronic telecommunication device that has the same basic capabilities of conventional fixed-line telephone except that, it can be carried anywhere (portable) and no need to be connected to the telephone network by wire (wireless). [1] Contend that new technology that comes along the development of mobile technology is an SMS Gateway. SMS gateway is a telecommunications network facility for sending or receiving (SMS) transmissions to or from a telecommunications network that supports SMS. Most messages are eventually routed into the mobile phone networks [2].

Smart metering is a topic that has attracted much attention in recent years. Traditional water, meters display a number that must be physically read by a meter reader, another person then enters such numbers into the billing systems manually [15]. A water meter is a device which collects and registers information on the volume of water used over a period of time at a particular location according to [3]. Nowadays providing efficient and effective services is vital in every economic sector. Most of the time automation of processes increases efficiency when compared to manual processes [1]. Moreover, manual processes can lead to risks of human errors.

1.2 Water meter reading system in Arusha Tanzania

Water meter reading system in Tanzania is still a big challenge. Water meter reading system is still done

manually and it brings many challenges that lead to suspicious water bills. The current process of recording water consumption is inefficient. Normally, meter readings is carried out once per month for each customer. These records are eventually used to prepare monthly water bills. The printed bills are distributed to the customer through hand delivery and post mail or sometimes through SMS. Fundamentally this process involves the manual system which requires the water meter reader to record the readings on paper and then manually recapitulated in the computer by the billing officer. This process takes a lot of time and have a high risk of errors that officer repeatedly checks to reduce the risk of error; this reduces the performance of the officer [1].

Another method that was used for water meter reading was reading the water meter by using data logger. Data loggers are portable electronic machine (equipment) mainly meant for capturing data at sites. They are used for the same purpose to download data into the system after reading for the purpose of preparing customer bills. Although the introduction of data logger aimed at improving efficiency in water meter reading but still it was the same as the manual system which requires the water meter reader to deliver the device (data logger) to the office in order to download data taken from the site.



Figure 1: Data logger

Although the introduction of a data logger focused to improve efficiency of water meter reading but has failed due to lack of stability of this device (data logger). The drawbacks of this device (data logger) are; its battery doesn't last longer which can cause data loss. Also when used for some period of time like five to seven years the device memory gets corrupted and starts producing errors, that results in records that are not the same as the first recorded one. The one introduced in Arusha, Tanzania lasted for only nine years; introduced in 2004 and dropped in 2013. Due to these kinds of deficiency of the device, the water authority abandoned the device and continued with the old system of using paper while seeking other solutions.

This paper proposes the solution of using mobile system in water meter reading. So in this paper, we are reviewing on the role of mobile system (application) in improving efficiency in water meter reading.

[4] Concluded that a mobile application, most commonly referred to as an app, is a type of application software designed to run on a mobile device, such as mobile phone, a Smartphone or tablet computer. Mobile telephone has been the most visible and fastest growing media technology in Tanzania in recent years. Mobile applications frequently serve to provide users with similar services to those accessed on PCs. Apps are generally small, individual software units with limited function [5]

1.3 Literature review

From review of related work and published literature, it is observed that many researchers have tried to deal with water meter reading by using windows mobile platform and some other mechanisms. We will see also the work that have been given much effort to support the overall process of water meter recording to simplify the whole process and make the process more automated compared to what it is.

It has been described by [1] that, the process of recording the amount of customer water consumption that are done manually have a higher risk of error. In addition, the study proposed the use of mobile application for

recording water meter readings and automatically sends the consumption data directly to the computer server for billing. The technology proposed is embedded on a mobile phone for recording water gauge data. This mobile application records all the necessary information such as the officer, the water meter, the customer, the recording date, and the name of the photo files when doing the documentation. The overview of the proposed system is shown in the Figure 2 below:

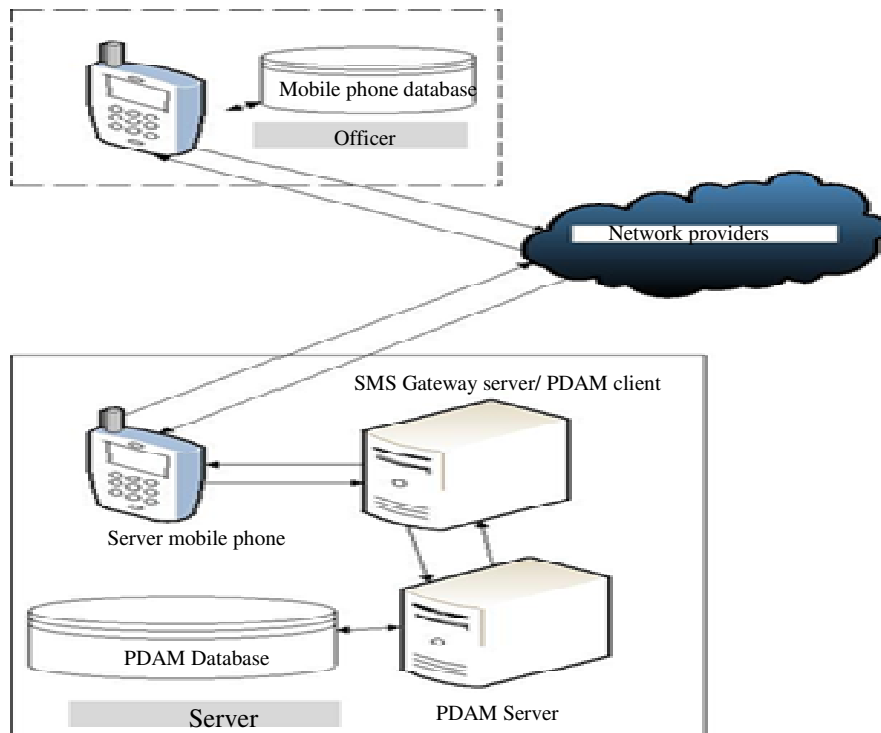


Figure 2: Overview of mobile application in recording water meter. [1]

In addition, Quick Response (QR) code application proposed by [6] can be combined with the Smartphone technology. From this application information of the customer identity is modified into QR code form. Moreover, by utilizing the camera feature on the Smartphone, the customer identity recognition in the water meter recording process can be done easily. At the end, the QR code reading result which includes the customer identity will be connected directly with the water meter recording process. QR code generator and reader mobile application is capable to do data generating process into QR code form and QR code reading to gain information that is suitable with the database in the system. Furthermore, it can save QR code results both from generating and reading process into database that exists in the mobile phone. QR code reading process is directly connected to the water meter recording process. The overview of the system that has been proposed is shown in Figure 3 below:

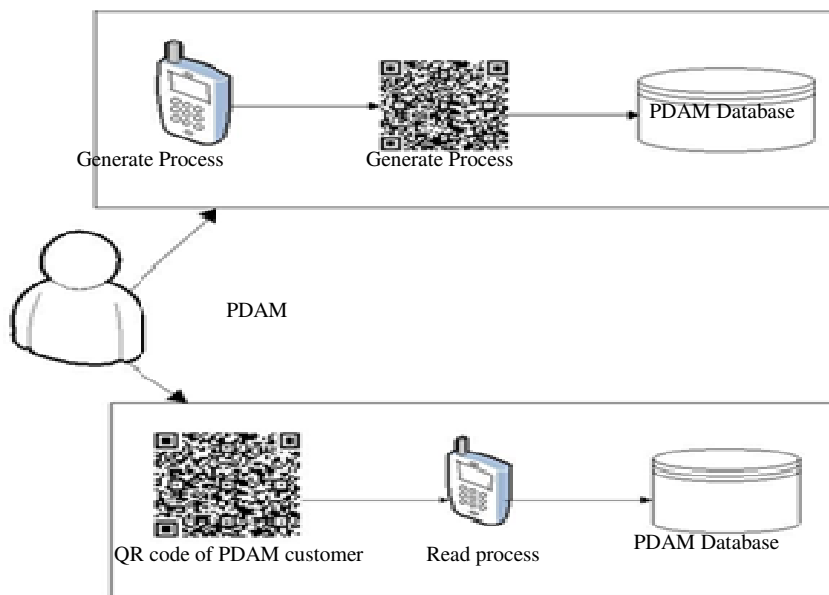


Fig 3: Overview of the system [6]

Another study by [7] shows some challenges that arise when using manual water meter recording. From his study, the previous meter reading system wanted the water meter reader to go physically to the head office for updating the readings. The study added that specific problems encountered by readers would be noted on scraps of paper and handed in at head office. Due to the age and lack of flexibility of the previous system it was difficult to record information. This in turn affected the ability to serve customers. To this end, the study suggests use of handheld mobile devices with customized software. The system proposed uses Web Services for communications, an Embedded SQL Server database for storage and Microsoft Mobile 5 for the operating system. How the system works, the device connects to Microsoft Outlook, which enables the meter reading schedules to be sent directly from head office to the meter readers via email. The meter readers can then key in readings and send them back straight from the field. According to his study, the advantage of this technology is its ability to receive and complete reading rounds in the field has led to increased efficiency, accuracy and cost savings.

Another mechanism presented by [8]. They presented an embedded system implementation of a wireless water meter system. The system uses the existing GSM network, where water meter system can send its readings directly to a server application using a GSM modem. The application itself can notify subscribers of their bills using SMS messages as well. The system for water billing and consumption management based on an embedded system implementation of the water meter that is capable of reporting readings over the GSM network to a server application capable of billing and of controlling the meter itself.

The approach presented by [9] designed reconfiguration of analog water meter to provide remote access to user water consumption and billing records, payments, and meter device monitoring using photo-encoding as the detecting method for water consumption, using microcontroller for data processing, and SMS (short message service) technology for data transportation. For this, in order to validate the system design, an analog water meter was converted into a digital equivalent and interfaced to the cellular network to transmit parameters of the meter to-and-from a consolidation server (CS).

An invention done by [10] proposes method and apparatus for obtaining information from a utility meter. The method comprising of a digital camera to take a digital image of information displayed on the utility meter, passing the digital image to a computing means and using the computing means to obtain information from the image. The information may be displayed on the meter as numbers, letters, words, barcodes, shapes or colours and the computing means can extract, interpret and store the information from the image. According to them, the digital camera is preferably a handheld device that can enable an operator to carry it easily from meter to meter and to enable the operator to take a clear picture of the information displayed on the meter. The computing

means may be a portable computer such as the so-called “laptop” or handheld computer. Such a computing means may also be carried around by an operator and connected to the digital camera so that as digital images are taken by the camera, the image is passed directly to the computing means and the relevant information extracted from the image. The relevant information can then be extracted from all of the stored images. The digital image may be passed from the camera to the computing means by a various methods, like the digital camera may be in communication with the computing means by an electrical cable or by a Wireless link, using for example an infra-red link or a mobile phone.

1.4 Overview of water meter

A water meter is a device which collects and registers information on the volume of water used over a period of time at a particular location. The subsequent information which is the volume of water used since the installation of the meter is used to calculate the amount charged by the water utility company to the customer for water usage at that location for that billing period [3].



Fig 3: Water meter [11]

1.4.1 Importance of metering

Water meters are important component of a local drinking water utility for a number of reasons. In one hand they allow the utility to: (a) charge customers for the volume of water used, (b) monitor the total amount of water produced and sent to the distribution system, and (c) detect and fix leakages in the distribution system. On the other hand they allow the customer to: (a) monitor the volume of water they are using, (b) have some control over their water bill, (c) detect and fix leakages at their location, and (d) take measures to conserve water [11].

1.4.2 Benefits of using mobile in meter reading

Improved meter reading efficiency: centralized monitoring increases frequency and accuracy of meter reads and reduces operational expenses. Improved billing accuracy: eliminates estimated meter reading, improving revenue collection and avoiding suspicious billing for customers.

Increased efficiencies of field workers: the ability to access schedules, GIS data, and other critical information reduces trips to the central office and speeds repair time.

Improved customer service: customer portals into the usage date allow customer monitoring of real time usage and consumption trends, encouraging water use awareness and conservation.

Reduces operating costs; eliminates manual reading, improves operational efficiency and faster response to incidents [12].

1.5 Observation and discussion

These reviews discuss on the use of GSM network whereby they presented an embedded system implementation

of a wireless water meter system. Also the use of windows mobile platform (smartphone technology) as a means of improving the efficiency in water meter reading. Generally, these ideas are good although due to the context level of Arusha, Tanzania they are difficult to implement. Commonly ministerial budget are not enough compared to other countries that we have seen from these reviews. It requires a lot of investments to establish those things while the aim of this paper is to find a solution which can be cheap and solve this problem. Furthermore, due to the dependability of electricity, the idea of GSM network for water meter reading is difficult to implement because electricity is unreliable making it to access and retrieve data from the meter. Likewise, use of smartphone technology requires reliable internet access but in Tanzania especially in rural areas still there is 2g network (which provides edge service for internet) which is not reliable in terms of internet service as we know that 2g is not reliable in internet services. Similarly, use of this technology needs to have smartphones which have limitations in terms of battery life, so it will be difficult for the water meter readers to read many sites. In regard to this, it is proposed to use another method which will cover the context of Tanzania. Essentially, use of USSD technology seems to be a good solution that will cover this problem of inefficacy in water meter reading.

[13] defines Unstructured Supplementary Service Data (USSD) as a communication protocol used to send text messages between a mobile phone and applications running on the network. It is a messaging service used in Global System for Mobile Communications (GSM) networks similar to SMS. However, unlike SMS; USSD provides session-based connections. Because of its real-time and instant messaging service capability, USSD service offers a better performance and is much cheaper than SMS for two-way transactions. This service is unique and only available to GSM networks. USSD communication is initiated by dialling a special code. USSD codes consist of asterisk (*), followed by a combination of digits (0 to 9) and a hash (#) an example of USSD code is *149*01#. The * and # codes are used to signify the beginning and end of the request.

1.6 Conclusion

A review of various methods on the role of mobile application (system) in improving water meter reading is done in this study. Various methods are presented aiming to remove inefficiency in water meter reading. Although, some of methods offered are good but are difficult to implement in the Tanzania environment, it is therefore proposed to introduce another method that can match with the Tanzania environment of course, this will be considered as a future work to be done. The method proposed is the use of USSD code as a mobile application (system) for water meter reading. USSD code doesn't need internet services to access it, so it can be used even in rural areas.

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