

Integrated Geographic Information System for Customers Water Meter Recording Using Google Map

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Abstract

This research developed a smart water meter recording technology for Local State Water Company. This smart technology consisted by the client side application and the server side application. The client side application is a moving application that is embedded on a smart phone, which is carried by the water meter clerk when recording the customer's consumption numbers that shown on the water meter. The server side application is running on the server computer that its main task is to serve the client applications.

On the client side application consists: the recording of customer's coordinates, introduction/searching customers with QR Code and GPS coordinates, the recording of customers' water meter, sending water consumption data via SMS, water meter clerk's GPS location tracking, the clerk's guidance to the customers' location through the Google MAP, and customers GPS coordinates errors correction module. While the application servers provide services against client applications, controlling the water meter clerk's visit to the customers, and management information systems for the Water Company.

Keywords: Water Company Smart Technology, QRCode, GPS, SMS, GPS Coordinates Error Correction

1 Introduction

The reading of water meters is one of the main activities which the Water Company used to know the customer's water usage. The recording of water consumption on the water meters is a vital part in the business of the company because this is the biggest (main) income to this company. Personnel or operators are required to conduct regular visits every month to each customer to record water usage values are listed on customer water meters. Various problems arise here, ranging from collecting data, data entry into the system, as well as the discipline of the officer in recording meters water customers each month. The water meter clerks often don't really visit customers to perform the recording, but just doing the interpretation of the water usage based on the customers' usage months earlier. Supervision is very difficult to do because of the number of customers of the water company which reach tens of thousands of customers as well as the wide customers' distribution.

An integrated geographic information system can overcome the problems that have been mentioned above. So the reading customers' water meter is done digitally. It takes a smart phone application as a client side used by the water meter clerks to record customers' water meter, the application is able to record the coordinates of the position of the water meter clerks now and the position of the customers on GPS. Not only that, the smart phone side of application is capable of transferring logging results data which has been done by the clerk to a server-side application for the updates of customers' water meter logging data in order to make it easier for the water meter the clerks so as to save costs. Then, the server-side application is needed to store the logging data results of the recording meter water as well as monitoring the recording of the customers' water meter. The monitoring acts which mentioned are the GPS location tracking for clerks and customers, tracking the movement of the recording activity of the water meter clerks, as well as see the distribution of either all or half of the Water Company's customers on Google Map.

On research [2] a technology/application is built to record the value of the water usage on the customers' water meter on smart phone with windows phone platform where the water consumption data sent digitally via SMS transmission. This application does not support QRCode yet, customers' GPS coordinates recording, water meter clerk tracking and still use the windows phone OS platform.

On research [4] developed a technology to do the reading of the water meters automatically. This technology was built to overcome various obstacles in the reading of water meters manually through direct visits to each customer. There are three main sections in the generated technology, encoder, RTU and Services. This technology provides accurate information against use of water customers without

having to use the human resources to do the reading water meter at each customers. The downside of this sophisticated technology is a relatively large investment costs include the cost of an SMS when dealing with a number of customers TAPS a relatively large, since the base of the tool at each customer.

Research [5] applying the QRCode to identity customer identity for customer water meter recording application on smart phones on the windows phone platform. This application has not been recording customer's GPS coordinates and water meter clerks tracking and still using the windows phone OS platform.

In the paper [6] an application is built which combines geographic information systems and GPS technology to help management and empowerment of the forests in Nepal. GPS uses on the applications used for mapping the boundaries of the forest, the forest area on the block division, mapping of natural resources found in the forest, as well as knowing the less care and attention area in the forest. The data collecting process involves some government-owned forestry institutions, members of the forest empowerment independent organizations as well the general public civilians by using a high accuracy GPS Unit.

There is a geographic information system application which is discussed in the paper [7] which is used to help the management of the social environment of society in India. Geographic information system displays information about the environmental situation of the settlements, the condition of the local communities, the distribution of water in every environment, as well the areas that require special attention. The recording was done on computers at the civil branch offices in any area which is connected to a central server so that the collected data can be seen in every branch office. The thing which becomes a drawback in this application is the recording of the data by the record clerk requires the computer to record the results of logging so that less practical and convinient.

Research [8] built a technology that uses GPS utilization. This technology besides utilize the location as reminder service, also utilizing the location to provide information of a place or a dynamic tracking service in accordance on traffic conditions. This technology is built on a smart phone and using GPS on smart phones to provide location information of its users.

In the paper [9] a geographic information system application is built which combined with GPS technology to help research on the urban planning of the city of Rounen as well as tracking for some sample pedestrians and several groups of tourists to know some point that becomes their favorite.

This system is built on two applications running on different sides (client and server). Client side application running on smart phone with Android platform and used by the water meter clerks to record customers' water meter in their visit to the place of the customer. This client side application has some supporting facilities in its use of which are scanning QR Code customer water meter as well as water meter recording data delivery via SMS. Some customer data (10 – 15 customers) can be sent with a single SMS so that will save costs. Server-side applications running on a

server computer which is used as a illustrator the result of the water meter logging and customers record in the client side application customers into Map. On the Map can be seen the spread of customers coordinates, mapping and tracking customer visits of water meter clerks.

2 Methods and Overview System

Smart Water Meter Recording Technology consists of 2 major system i.e. system at the client side and the server-side system. Figure 1 illustrates how the whole system works (client side applications and server-side applications).

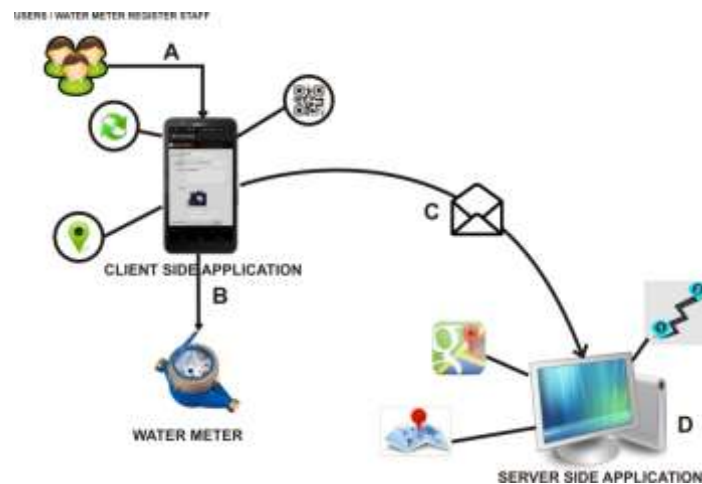


Figure 1. General system overview

These are the following description of the image: (A) the water meter clerk login to client side application that resides on a smart phone. (B) the water meter clerk records his responsible customers' water meter with client side application with multiple features within such as; The synchronization of data from the server, GPS coordinates records of the clerk meters and customers, QR Code Scanning. (C) the results data of the customers' water meter recording sent via SMS to the Server. (D) server-side application receive data which has sent and visualize the results of the recording into the Google Map such as; distribution customers' coordinate, visits mapping, meter clerk's tracking.

3 Results and Analysis

Water Meter Recording on the Client Side Application



Figure 2. Client side water meter record module interface

This module is used to record water meter so can figure out the water usage (m^3) since in the first time becoming customer and use of water (m^3) per month. The meter clerks can see the list of customers that they signed, find and choose the customers to record their water meter. The meter clerks can be facilitated with QR Code scanning at each customer water meter so they don't trouble navigating much customer data since each registrar handles up to hundreds of customers. The clerk is obligated to fill a photo of water meters at the time of the recording as evidence has been conducted a visits to customers. Customers GPS coordinates automatically populated after the taking of the photograph. In addition, the officer must also provide the status of the water meter so that can immediately handle the customers with water meter at fault or the customer with the condition of the house is not uninhabited. In this module there are facilities for guessing the water usage. The value is obtained from the mean of the water usage from previous months. The figures above shows the display of the meter recording module on the client side application

Customers Meter Data Transmission through SMS on Client side Applications

Customers meter data which have been recorded could be sent to the server using SMS by the meter clerks. Earlier, the meter clerks filled the server number which found in the server settings section of the system. The application can allow clerks choose customer data which will be sent to a central server. 10 – 15 customer data can be sent with just a single SMS, so that it can save the cost of the SMS. Like, as if there were 40,000 customer data, then it can be sent over 4,000 SMS which only requires-Rp. 400,000 or equivalent-US \$ 35. The application can also monitor the status of the SMS sending data so as to prevent the SMS sent twice.

SMS to the server is sent through a specific format. The format is "CTM *customer account number*, the letter " a "as the separator, *the status code/condition of the meter, the meter's water usage value*". As an illustration, this is one of the SMS which sent on July 2015:

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"CTM 53059aD 46635a289 47370aW 47371aD 46737aMa906 43469a1252
44527a152 46259a103 46260a611 46261aW 46262aW 46263a564 46264aD
46265a501 48667a1353"
```

In this example there are 15 customers data sent in one SMS. For example, "53059aD" means customer with account number 53059 has water meters with the condition of "empty house" which is represented by the letter D so that water meters could not be read and meter value is unknown. While "46635a289" means the customer with account 46635 has water meter with normal status with water usage value of 289.

Customer's Coordinate Mapping on Server Side Application

This module displays the coordinates of the customers in the Google Map on the server-side application. The coordinates which displayed are obtained based on the results of the meter clerks recording on client side applications. Customer's coordinate is represented with a circle with the letter corresponds to the customers' group. In addition, this module can be used to see the details of the customer based on the recording on client side application (description of the identity, address, coordinates, up to the boundaries of the customers place based on the direction of the wind). In addition, this module facilitated with distance counter between one point with one other point on the Map (in meters), Road indication facility from the meter clerks coordinates into customers coordinates who will be recorded and direct locating on the coordinates of the selected customers. The picture below describes the appearance of a Map on the server-side application.



Figure 4. Customer's coordinate distribution view with colored dots as its classifier

Customer Visits Mapping on Server Side Application

This module is used to view the meter recording visits at the customer's place. Data obtained on this module is derived from meter recording data and clerk's GPS

coordinate recording on client side applications. There are recording status (📍) or (❌) on the map to find out whether the listed customers had been visited and their water meter had been recorded by the clerks. Recording status usually will appear near the coordinates based on the customer GPS record on the Smartphone that turned on at the time of the recording. The status will become check if the recording is already carried out and data already inputted. Status logging will become a cross if it is not done or logging data has not been inputted. The picture below describes the display of the clerks mapping visits to customers.



Figure 5. Clerks visits mapping display on Map on the Server Side Application

The following table shows the results of the calculation of the margin error between the coordinates of some customers with the coordinates of the recording which is done by the clerks at the same customers on April using the Haversine.

Table 1. Customers coordinate margin error calculation results

Opp	Custmr	Custmr.LAT	Custmr.LNG	Record.LAT	Record.LNG	Margin
Ardika	27786	-8.559285	115.148015	-8.5595	115.148	23.96373622
Ardika	7527	-8.558935	115.145615	-8.55944	115.1460317	72.47235543
Ardika	7095	-8.559363333	115.1503183	-8.55952	115.151	76.95143238
Ardika	7096	-8.559996667	115.1537783	-8.56048	115.153	101.0584908
Ardika	6984	-8.559285	115.148015	-8.55915	115.148	15.10165316
Ardika	42064	-8.562521667	115.1572333	-8.56261	115.157	27.47219016
Ardika	44272	-8.563228333	115.15637	-8.562885	115.1563133	38.68204403
Ardika	7040	-8.55986	115.1453	-8.559705	115.14545	23.855534
Ardika	30522	-8.562631667	115.1565517	-8.56253	115.157	50.57634171
Ardika	45301	-8.55933	115.1496567	-8.55934	115.14966	1.170798426
Ardika	35688	-8.560638333	115.145725	-8.560696667	115.1456667	9.122156578
Ardika	30749	-8.558536667	115.14725	-8.558568333	115.1472083	5.77832736
Ardika	28706	-8.558453333	115.1476383	-8.55858	115.148	42.18822657
Ardika	48333	-8.559156667	115.146225	-8.559246667	115.1461833	11.00641919

From the results of the calculation above, the valid data found on the line that has the small margin error, it would be nice if the margin < 100. The following table shows the validity of the results of the margin error calculation above.

Table 2. Data validity

Opp	Account	Margin	Status
Ardika	27786	23.96373622	Valid
Ardika	7527	72.47235543	Valid
Ardika	7095	76.95143238	Valid
Ardika	7096	101.0584908	Not Valid
Ardika	6984	15.10165316	Valid
Ardika	42064	27.47219016	Valid
Ardika	44272	38.68204403	Valid
Ardika	7040	23.855534	Valid
Ardika	30522	50.57634171	Valid
Ardika	45301	1.170798426	Valid
Ardika	35688	9.122156578	Valid
Ardika	30749	5.77832736	Valid
Ardika	28706	42.18822657	Valid
Ardika	48333	11.00641919	Valid

4 Conclusions

This system is built to monitor and manage water meter recording activities by meter clerks to customers on a water company. This system consists of two large systems which support each other on the two different sides, i.e. the client side and the server side. Client side applications running on smart phone with Android platform used by the meter clerks to record customers, record the indicated water usage on water meters and server-side applications as the center of all recording meter data, distribution of coordinates visualization and the results of the visit on the Map. Some interesting things that support the functions of the supervisory act of the clerk's visits on this system are mapping customer visits to find out if the officer already visiting and doing a recording on a water meter and tracking customer visits to find out the area of movement of the clerks in conducting visits. In addition, this system on the client side application can send recording data results to server-side application through SMS. This delivery via SMS can save costs because it can transmit some of customers data (10-15) with a single SMS.

The drawback in this system is the lack of accuracy of tracking and mapping customer coordinates on the Map because of the low accuracy of the GPS unit which is running on clerk's smart phone.

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