

The Design and Management of Intelligent Systems in Mechanical Domestic Water Meters

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Abstract

The design and implementation of mechanical domestic water meters in current industrial organization and intellectual properties have been registered as an invention to solve the problems of current meters. The device operation includes inquiry of printing, subscription connection and disconnection in an emergency. This system includes a software and hardware parts on the users and the control center connecting with two-way mobile phone. Central control software sends the message through the wireless telecommunication lines to the user's software, requesting the desired information and also provides the commands needed to be sent through the same. The same information can also be submitted to the control center. Through the same way, some of advantages of this method are as follows: installing on existing meters, cheap cost of inquiry call meter, the possibility of declaring illegal manipulation to the control center, the exchange of information using information encoding, and manipulating digital meters applying minor changes.

Keywords: Intelligent Meters, Mechanization, Mechanical Meters, Meter Management System

1. Introduction

Difficulties of domestic mechanical meters & the cost of management of these meters are some of the users' problem.

Present device has been designed for perfect & intelligent mechanization of domestic water meter. Using it at houses will help to improve families' welfare & speed some related works with high security & carefulness.

Since many years ago humans have had the sense of need to control things around them, this needs fulfill every days with man promotion. Now we'll be able to remote control all the meters completely by inventing this device & installation on the water meters (see **Figure 1**). It will be usable on the other domestic meters by applying the minor changes.

These are main problems about reading meter's number & distribution of subscriber's fiches such as: nobody is at home during the time of reading the meter's number, low speed in reading the meter's number & distribution of subscription fiches & disability of related offices to apply online distribution policy, there is no continuum supervision on the consumption totally there is low speed & accuracy, with waste of time & cost.

This device in the specific periods of time can print



Figure 1. Home water meter.

the amount of fiches in a few minutes & with high security & accuracy without man interference by reading the subscriber's meter number & applying consumption computation formula as online in the office.

Also the device supervise the subscriber's consumption any time or in a period of time that it can provide useful information, as the related offices can gain information about the amount of subscriber's consumption over night, they will be able to apply the distribution policy by doing statistic of subscriber's consumption in

every moment of time.

Another feature of the device is temporary connection or disconnection of subscription. It can connect or disconnect meter without physical attending in the place of meter & without taking cost & human power. Because all of these things work as mechanization completely, they can help to economize the human power & help the offices to apply all the distribution tact. In summary the purpose of this device is economy in human power & cost, also it increase the accuracy & speed by using the perfect & intelligent mechanization as aforesaid.

At the rest of the article, in the second part, at the first time we'll review on the similar works, then in the third part the device structure & how the device will be connected to the control center was explained & in the fourth part the device operation was expressed & in fifth part facilities & advantage of the device in compare of other similar device has been mentioned. Also at the end of the article some consequences & suggestions has been assigned to continue the project.

2. Related Works

In order to overcome disadvantages of the traditional meter reading system some efforts are underway around the world to automation this systems [1-7].

One of the methods to solve the problems was using a camera on the meter. This device had Bluetooth & searched the specific receiver steadily & when it found receiver, it send the meter's identity code & taken picture. In this solution some of people should have a recipient machine & walk on the alleys & streets of the city & if they passed near a meter almost 30 meters distance, the installed device on the meter, will send the number & the recipient machine saves it in the memory, too. Finally it would be surveyed as offline in the related offices some of the disadvantages of the device are: ability of sending information just in 30 meter distances, disability of surveying information as online, there is no another control on the meter such as subscription's connection or disconnection, ..., low security in sending the information by Bluetooth, need to the human power & high cost to walk on the streets. This device just prevents the entrance of agent subscriber's house for reading the meter & just improves the reading of the number by the man's eyes. But has no influence on decreasing the human power & no influence on accuracy & speed of operation actually [1].

The next suggested method to read the meter operates the computer network with electricity cable. A special modem in used in this method that it can use electricity cable to make the computer net with other frequency, then the method was used to read the electricity meter

from far away. In this method there was equipped meter with modem on it, that the modem was connected to the operated net by electricity cable. It sent the meter information. Its main defect was making problem in police walkie-talkie. So the defect caused it was stopped in implementation period. There are other defects such as high cost in each meter & no other controls on the subscriptions meter [2].

In next method, a device installed instead of meter & the number of meter is sent to control center by home number. Some disadvantages of this method are dependency to home phone number for each meters there is no lateral control on the meter need to change the meter (disability of installation on the meters), that it will cause high cost [3].

In the article of this device, has been tried to utilize as much as possible advantages of similar devices & rectify their defects. In fifth part these abilities will be disconnected.

At the rest of the article, how the parts of system connect each other & the structure of present device has been explained.

3. How to Be Connected to the Control Center

The meter management device is connected by mobile system (**Figure 2**). This affair is very important in security of information. As you can see in **Figure 3**, this device includes a hardware that from one way connects to the subscriber's meter & in another way it will connect to GSM modem on the software in control center.

This device sends order to the hardware in definite times by the country's wireless telecommunication substructure then hardware distinguish the order like reading the number, or other necessary information like identity of meter as a code will send to the software in center.

The software after receiving the amount of subscriber's consumption will calculate the price according to the total or special formula for that subscriber & finally pluralize all the information of subscriber's monthly fiche then send to hardware in user's house.

After receiving by hardware it will be observable on LCD. The ability of printing is also predicted on small 4 inch printers.

Solving the technical problems to make a system is the purpose of offered method that this system in one way related to the house's meter & there are some controllers on it to read the meter's number-subscriptions connection or disconnection & print subscriber's fiches.

As **Figure 4** shows. To utilize this device at the first time you should sign on the meter's first number from right side as a colorful sensor, then the hardware on the

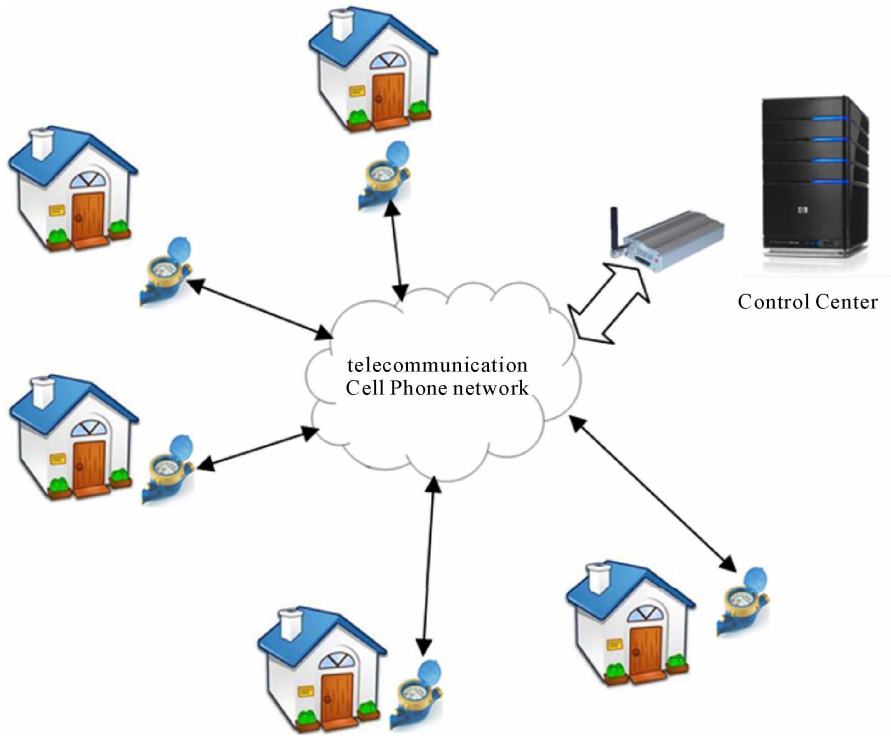


Figure 2. Meter management system communication with control center.

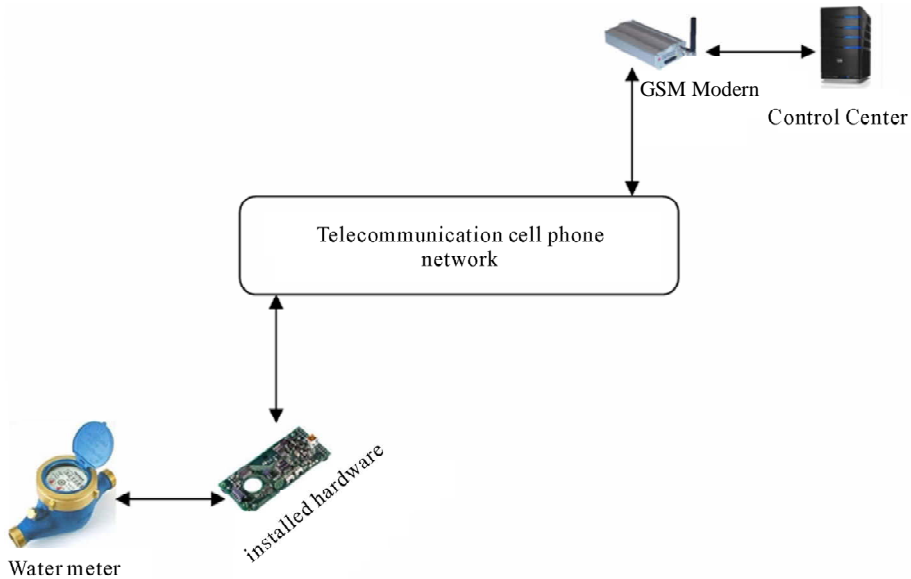


Figure 3. Meter management system structure.

meter can recognize the times of rolling by the colorful sensor on meter's first number, so this device can be installed on the meter without any additional actions (like image processing). The sensor connected to the micro controller's device & sends information to it, this micro controller connected to Relay subscription's connection or disconnection.

As receiving "subscription disconnection" order from

control center, Relay command the "disconnection order" to the special installed valve on the device then subscription's valve will be disconnected.

As you see in picture micro controller is related to telecommunication network by GSM (mentioned before).

When GSM receives the order, it can send the number in definite times (without receiving order from control

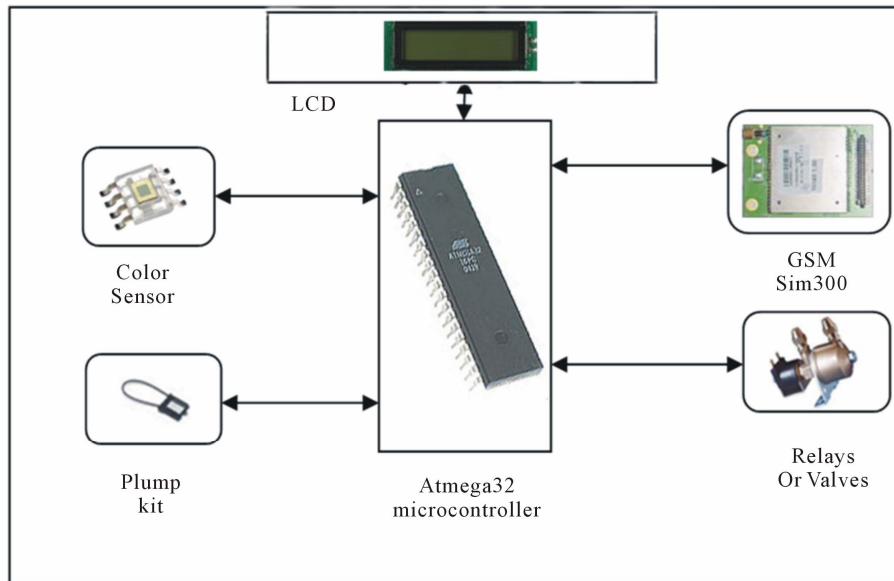


Figure 4. Structure of hardware that installed on meter.

center). This device has been also designed with maximum security, if plump of device was opened illegally, it will inform the center immediately, even if the relation had been disconnected, it will declare the center as soon as connection. Also the micro controller connected to LCD (2×16) numbers that show the meter's number either if need be it can show the wrong numbers.

As you see in **Figure 5**, this device is able to draw each houses consumption diagram, every alley's consumption diagram, every sector or town's consumption diagram... & it can produce the necessary report by statistical data that they've gained from subscribers in different seasons of year & in special definable situation, for example some areas that should never disconnect their water are defined, when facing a problem, it can route high pressure of water to those areas.

In the next part hardware structure has been explained.

4. The Structure of Hardware System

In this device has been used a photo electro sensor TCS230D that it can read the meter's number by knowing the red color, then the sensor helps the received information enter to the micro controller, after it applies some necessary filtering on the entrance numbers, it will be able to recognize the red color. The amount of meter's number has been defined in part of micro EEPROM, it'll never waste. While the electricity disconnected, the number is increasing (is counting) in the memory until the device was utilized mobile telecommunication network to connect the center. For this design a GSM SIM300 was used on the board that it receives & sends the sending & receiving information as SMS.

In each period of time LCD (2×16) was used to show meter's number & the amount of using price.

Also security linkages are contacted to the base of micro that was mentioned as plump board. They cause you know any illegal manipulation & also has been used 12 V Relay that they can connect or disconnect the subscription by the electro valve PE201.

The software of controller part has been written by the Microsoft visual C# software & object oriented technology. That it has ability of doing all the control works & it's extendable, too. So the device has capability to apply probable change & development of software, extremely.

Figure 6 is showing the main page of management of domestic meters software on control center that you can enter the special subscriber's user account by choosing subscription number from subscriber's list. Every noted change is applicable by choosing every item in right column & click on it (in **Figure 6**).

5. System's Facilities

There is no geographical limitation in this design, because the device exchanges the information by country's telecommunication & mobile system. It means subscriber's office & respective meter can be in every point of the world, without making a problem for device. In the other words there is no distance between the meter & the office.

The device can be installed on the usual meters without changing the meter, that it'll be hard work & costly. According to specific working mechanization of the device, it needs low cost than pervious similar devices & its installation is very easy, in the other way device connects

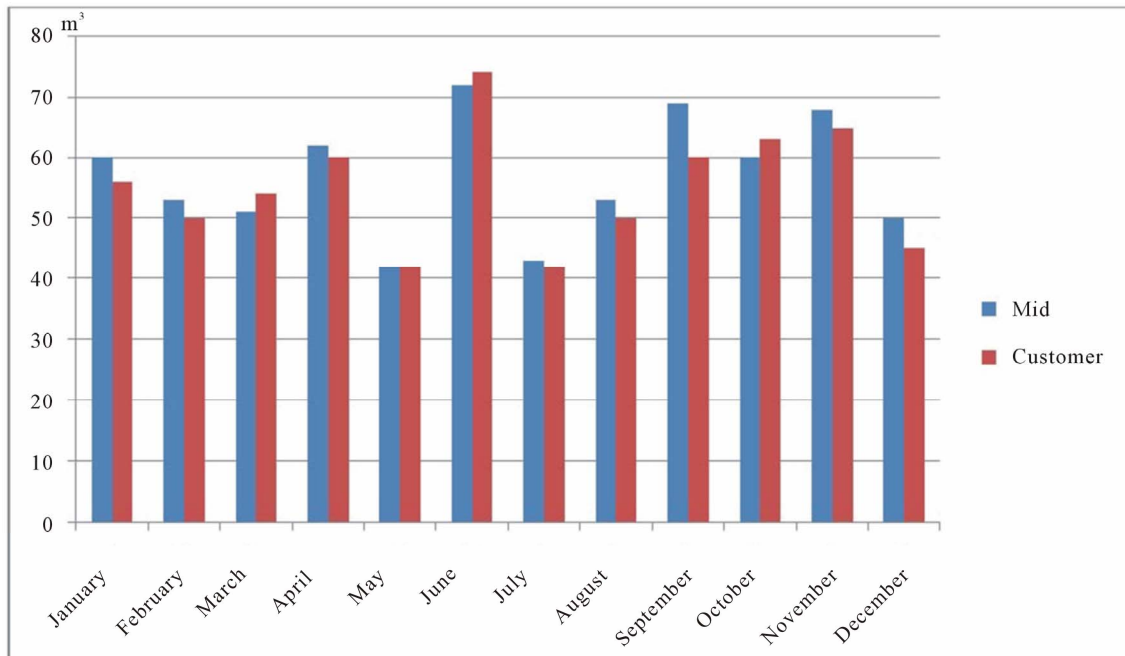


Figure 5. Customer daily usage chart.

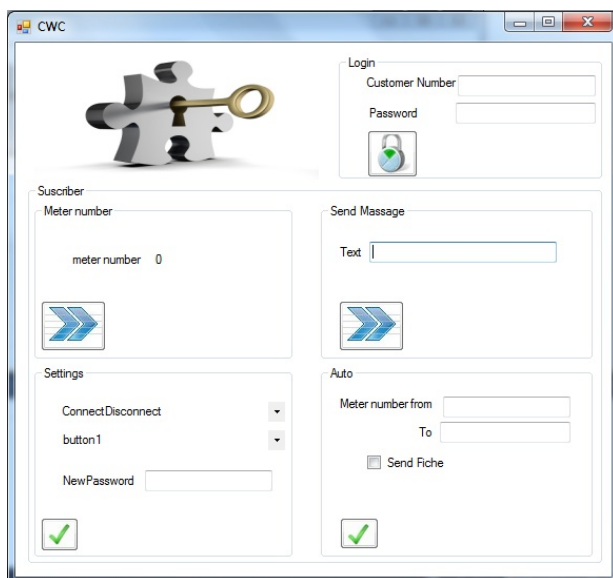


Figure 6. Main page of control center software.

to the subscriber's office as online.

By installed controller, the device can connect or disconnect subscription as online, when receives order from office or even acts as intelligent in incidents time that it hasn't ever seen in other similar works. It acts mechanization & intelligent completely without human power. In the device has been predicted top security scheme, as, any illegal changes on the system will be informed the device immediately. This device can generalize on the other meters (like water meters, electricity meters) just

by applying minor changes.

If electricity disconnected, device can save present information, but if it takes a long time & the battery discharge quite, the relation between center & meter will be disconnected. One of these problems is that it's solvable.

Another facility is possibility of visiting water distribution status in on area or other several cities' sectors.

The main problem in the device is, it can't act actually in every place with no telecommunication covering, because it works by the country's mobile network.

The other defect is colorful sensors using the colorful sensors don't act in darkness. But it can be solved by using other sensors (like metal sensor).

6. Conclusions

This paper studies on the design and management of intelligent systems in mechanical domestic water meters. The advantage of using this device in a city with 500,000 populations is to provide 125,000 units. As such we could normally consider a family consisting 4 people. The price of this device in mass production is about 35\$. Estimated total price for such a city is a nearly $125000 \times 35 = 4375000$ \$. So we need 4375000\$ for installation of the device in the city. Reading, publishing fishes and management of subscriber's meters in the city mentioned, we need 60 people with at least 900\$ monthly salary, so water office pay $60 \times 900 = 54000$ \$ every month.

If water office decides to install this device on the city, it should pay 4375000\$ but this is price of 60 people

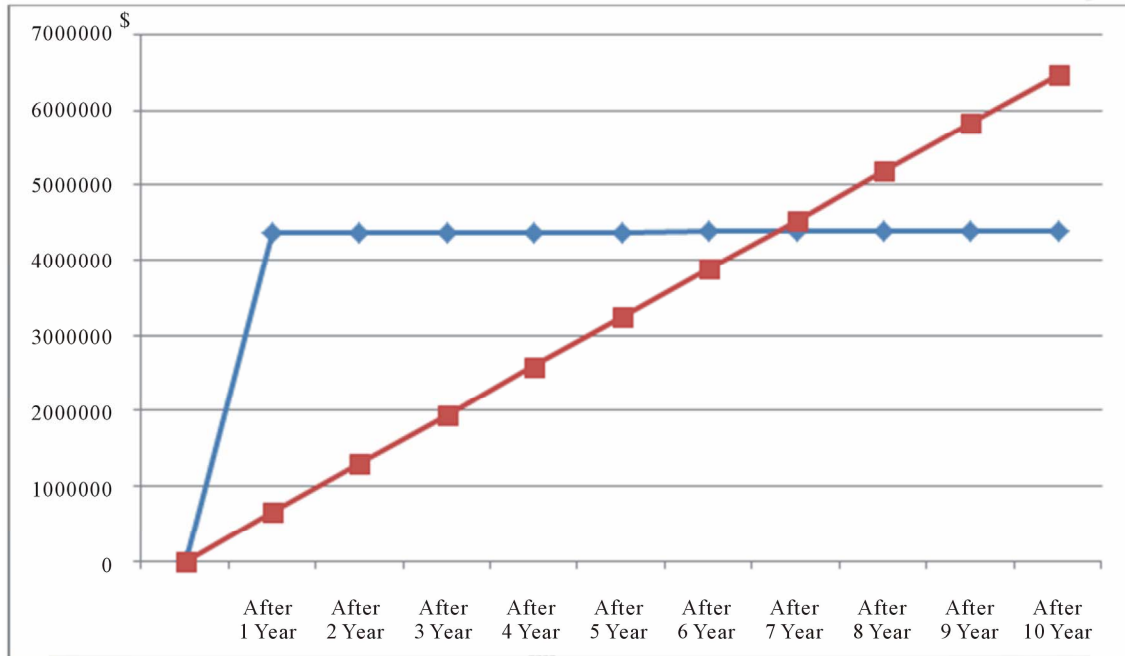


Figure 7. Cost saving after 7 year. Red: without using this device; Blue: with using this device.

working 81 months, namely after 81 months, water office will pay a little money (about 1000\$ per year for maintenance) with fast speed and high performance (Figure 7).

The great advantages of this project are the management of intelligent system in mechanical domestic water meters; easy installation on the usual mechanical domestic water meters and acceptable cost.

This device like other similar devices has some advantages and disadvantages, but its disadvantages comparing to similar devices are soluble.

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