

PREPAID WATER SYSTEM USING GSM BASED CONTROL PLATFORM

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ABSTRACT - The theory of GSM Based Control System has existed for years already. This paper will present a solution platform of enhancing this kind of monitoring system to a very specific application that will be very helpful to households and businesses to track and monitor their water consumption.

CHAPTER 1 The Problem and Its Background

1. INTRODUCTION

The new era of technology has redefined communication. Most people nowadays have access to Internet and GSM technology. At any given time, an individual can be contacted through laptop, pads or mobile phone. The applications of mobile phone were not just restricted in calls (starting conversations) or in sending SMS (short service message or commonly called text message ^[1]). New innovations and ideas can be generated from it that can further enhance its capabilities. Recent advancement in these technologies has eased our life and the way we live. In recent years, remote management or controlling remotely of electronic devices is a subject of growing interest.

These days, apart from supporting voice calls a mobile phone can be used to send text messages as well as multimedia messages (that may contain pictures, graphics, animations, videos, etc) or even browsing the Internet. Sending written text messages is very popular among mobile phone users especially in the Philippines. Text Message, as Filipinos also know it, allows quick transmission of short messages that allow an individual to relay information. This very concept will be used to design a system that acts a control platform to send text messages which in fact are commands

sent to control different devices connected to the control platform and to receive text messages which are also commands received to know the status of the monitored electronic device ^[2]. This system is based on the GSM technology that will effectively allow control from a remote area to the desired location. The application of this suggested system is immense in the ever-changing technological world. It allows a greater degree of freedom to an individual whether to control or monitor any electronic device and the need to be physically present in order to control or monitor those electronic devices will be eliminated.

Remotely the system allows the user to effectively monitor and control Prepaid Water System using the proposed Web Enabled GSM Based Control Platform by sending and receiving commands in the form of SMS messages.

2. STATEMENT OF THE PROBLEM

Technology has advanced so much in the last decade or two that it has made life more efficient and comfortable. The comfort of being able to take control of devices from one particular location has become imperative as it saves a lot of time and effort. Therefore there arises a need to do so in a systematic manner that we have tried to implement with our system. The system we have proposed is an extended approach to automating a control system.

With the advancement and breakthroughs in technology over the years, the lives of people have become more complicated and thus they have become busier than before. With this situation a demand in time-saving and cost-saving devices are on the top of the list of researchers. With the adoption of this system, we can gain control over certain

things that required attention to save cost, time, energy and resources.

The application of this system comes in handy when people want to save cost especially in their water consumption. The present way of billing water consumption is post-paid, meaning households or business pay their water consumption based on the water volume they used on the previous month or week. With this new application, the idea is simple – the activation and use of water supply will be initiated and consumed through loading credits exactly like the way like prepaid SIM cards are used in mobile phones. This new system could potentially be a hassle because there's the danger that water supply is cut off as soon you run out of credits, but for those living on a tight budget or those who wants to save then this can be a practical way of managing their expenses.

It's a totally different system from what we are used to, but the fact that the user controls the distribution and consumption of water makes it a potential solution to the chronic case of unknown fees laid on our bills by water suppliers. While the system may have its risks, it gives us customers a valuable power: FLEXIBILITY.

4. SIGNIFICANCE OF THE STUDY

“Prepaid Water System using GSM Based Control Platform” is aimed to construct a tracking and control system to be used in our water supply meters. General objectives of the project are defined as;

- To Control and Monitor remotely located Water Supply Meter through Short Message Service.
- To monitor the water-load or water-credit of every household or businesses being monitored
- To effectively receive and transmit data via Short Message Service using Microcontroller based GSM Modem.
- To implement web based GUI and Database showing the water-load or water-credit of any consumer.
- In supplier's point of view - To eliminate the need of being physically present in any location to check or read the water consumed by the consumer.
- Overall - To minimize Cost, Time, Energy and Resources wastage.

CHAPTER 2

Review of Related Literature and Studies

5. RELATED LITERATURE

- Alkar and Buhur (2005) [6] propose an Internet Based Wireless Home Automation System for Multifunctional Devices. This paper proposes a low cost and flexible web-based solution but this system has some limitations such as the range and power failure.
- Ciubotaru-Petrescu et al. (2006) [7] present a design and implementation of SMS based control for monitoring systems. The paper has three modules involving sensing unit for monitoring the complex applications. A processing unit that is microcontroller and a communication module that uses GPRS modem or cell phone via serial port RS-232. The SMS is used for status reporting such as power failure.
- Malik et al. (2009) [8] focuses on the controlling of home appliances remotely and providing security when the user is away from the place. The system is SMS based and uses wireless technology to revolutionize the standards of living. This system provides ideal solution to the problems faced by homeowners in daily life. The system is wireless therefore more adaptable and cost-effective. The system uses GSM technology thus providing ubiquitous access to the system for security and automated appliance control.
- GSM / Mobile / Cell Phone Based Device Monitoring and Control System: The purpose of this system is to Monitor and Control any Digital or Analog devices from your Cell Phone. This system can be used to control up to 16 electrical devices. With this circuit you can switch-ON , OFF or Restart some Linux servers, ADSL modems, Printers, Door with electric lock, Irrigation Pump, Garage door, House lights, Water pumps, electric sunshade, Block the engine of your car or your motorcycle, at the steel case and much more. The purpose of this circuit is to make the human life better and easier.
- GSM Based Automatic Irrigation Water Controller System: The purpose of this

project is to get SMS alerts whenever the electrical power status changes to ON or OFF. Use your mobile phone to switch on/off the water pump from any location in the world.

- Mobile technology (GSM) based remote monitoring and control of digital Energy meter: Useful for Electricity Department personnel for remote meter reading. Also useful to disconnect the power supply to consumer incase of non-payment of electric bill. This is also used to exchange messages like power cut timings with the consumers.
- GSM based Highway vehicle traffic monitoring system: The purpose of this project is to monitor the vehicles moving on highways at remote locations. This project uses infrared/laser sensor system to count the number of vehicles passing in both the directions. The vehicle count is logged by the microcontroller. Vehicle information will be transmitted to the user over GSM modem. The information can be sent to the user periodically or can be sent on demand by sending a missed call or SMS.

CHAPTER 3 Project Methodology

6. PROJECT DESIGN

The objective of this project is to develop a system that gives users the flexibility in water consumption. In supplier's point of view, it will monitor multiple consumer water-credits through a web based user interface and database. This system will be a powerful and flexible tool that will offer this service at any time, and from anywhere with the constraints of the technologies being applied. The proposed approach for designing this system is to implement a Prepaid Water System using GSM Based Control Module that transmits and receives commands using GSM modem over the GSM network.

a. BLOCK DIAGRAM

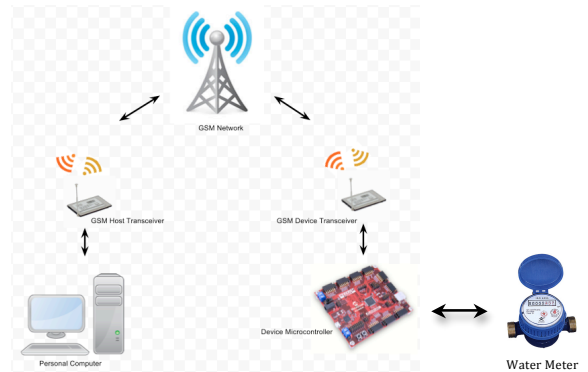


Figure 1: Single Controlled Water Meter Device Communication Concept

b. DESCRIPTION

Figure 1 shows a simple concept of the project. It is a simple illustration of how we wanted to implement the project and the various parts involved in it. The project will use (i) internet connected personal computer, (ii) GSM Host Transceiver, (iii) GSM Network, (iv) Single GSM Device Transceiver or Multiple GSM Device Transceiver, (v) Microcontroller PCB Assembly for each and (vi) Water Meter.

The Internet connected personal computer has access to the Web GUI, Database and Software Program. The Software Program will encode information for sending and will decode receive information.

The GSM Host Transceiver and GSM Device Transceiver is basically same device. For the sake of naming convention, GSM Host Transceiver is the modem that is connected to the computer while the GSM Device Transceiver is the modem that is connected to the device.

GSM (Global System for Mobile Communications), is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second

generation (2G) digital cellular networks used by mobile phones. GSM is a cellular network, which means that cell phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in a number of different carrier frequency ranges with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Short Message Service (SMS) is a text messaging service component of phone, web, or mobile communication systems, using standardized communications protocols that allow the exchange of short text messages between fixed line or mobile phone devices. SMS as used on modern handsets originated from radiotelegraphy in radio memo pagers using standardized phone protocols and later defined as part of the Global System for Mobile Communications (GSM) series of standards in 1985.

The Device Microcontroller will decode the set of codes received and will perform the specific task as indicated in the codes. This microcontroller has I/O's; (i) TTL I/O's (ii) USB or (iii) RS232. This is where the water meter will be connected. It is also responsible in encoding information and will send that information in the form of codes back to Internet connected personal computer.

c. SYSTEM OPERATION FLOW DIAGRAM

Assuming that the control unit is powered and operating properly, the process of controlling and monitoring a device will proceed through the following steps;

i. SENDING PROTOCOL

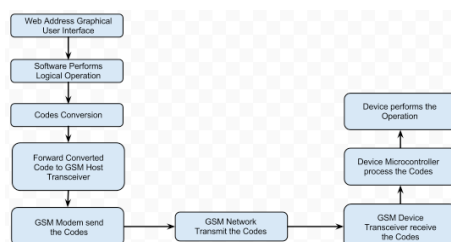


Figure 2 : Sending System Flow

Figure 2 shows the System Flow when sending commands to the Controlled Device or Monitored Process. The Web GUI awaits the user's command of what task to do. After the user press the dedicated graphical button, the software will perform checking if the press is valid or just a glitch. If the press is valid, the software will then perform conversion of that information to set of codes. The codes contain the address (SIM Identification Number) of the Device Microcontroller, the specific Device Microcontroller Port Address and the task to do. The codes will be forwarded to GSM Host Transceiver and will be sent as Short Message Service (SMS) through GSM Networks. The GSM network will route the communication to the correct Device Microcontroller as indicated in the codes. The GSM Device Transceiver will forward the receive codes to the Microcontroller PCB Assembly where it will be decoded. The Microcontroller PCB Assembly will forward the task to the specific device or sensor – in our case “water supply meter”.

ii. RECEIVING PROTOCOL

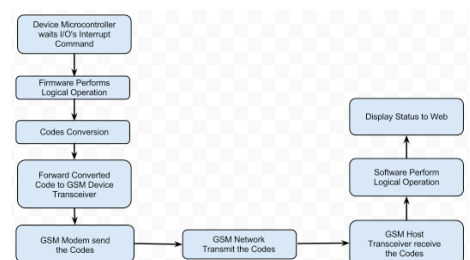


Figure 3 : Receiving System Flow

Figure 3 shows the System Flow when receiving information from Device Microcontroller. Using sensors – “water supply meter”, the Device Microcontroller will monitor the status of any device or process. Any change in the sensor state – “water supply meter” (depends how it is configured) will be processed in the Device Microcontroller. If found

out that the change in sensor state is valid, the information will be encoded into set of codes that contains the address (SIM Identification Number) of the GSM Host Transceiver, the specific Device Microcontroller Port Address and the status. This set of codes will be converted to Web Readable codes and the Web will then display the information to the User.

8. REFERENCES

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APPENDIX

GSM (Global System for Mobile Communications): It is a cellular communication standard.

SMS (Short Message Service): It is a service available on most digital mobile phones that permit the sending of short messages (also known as text messaging service) [3].

Firmware: Firmware is software that is embedded in a piece of hardware. You can think of firmware simply as "software for hardware."

Software: The programs and other operating information used by a computer. Software is a generic term for organized collections of computer data and instructions, often broken into two major categories: system software that provides the basic non-task-specific functions of the

computer, and application software which is used by users to accomplish specific tasks.

that is connected to the Device Microcontroller.

GUI (Graphical User Interface): A *graphical user interface* (GUI) is a *human-computer interface* that uses *windows, icons* and *menus* and which can be manipulated by a mouse (and often to a limited extent by a keyboard as well). In computing, a graphical user interface is a type of user interface that allows users to interact with electronic devices using images rather than text commands.

SIM Card (Subscriber Identity Module): A SIM card, also known as a subscriber identity module, is a smart card that stores data for GSM cellular telephone subscribers. Such data includes user identity, location and phone number, network authorization data, personal security keys, contact lists and stored text messages. Security features include authentication and encryption to protect data and prevent eavesdropping.

GSM Networks: GSM is a TDMA based wireless network technology developed in Europe that is used throughout most of the world. Also known as: "Global System for Mobile Communications", "Groupe Special Mobile". Currently GSM networks operate on the 850MHz, 900MHz, 1800MHz, and 1900MHz frequency bands.

Magnetic Ball Levitator: It's an educational project that will teach you all about closed-loop control systems as you build it.

GSM Host Transceiver: Is a simple GSM Modem. For naming convention in this proposed project, "GSM Host Transceiver" will be for the name of the GSM Modem that is connected to the Computer.

GSM Device Transceiver: Is another simple GSM Modem. For naming convention in this proposed project, "GSM Device Transceiver" will be for the name of the GSM Modem