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Telemetry Over SMS-Based GSM Wireless Communication System

Noha Kamal, Sherine S. Ismail, Hala Abd ElKader and Mohamed Sharaf

***Abstract*— this study was performed to implement a modern wireless communication system for data collection and communication by using GSM Communication Network as a platform based on SMS. The system depends on EasyPIC5 microcontroller development board as a modern digital communication system together with a smartg100 (GSM) development boards; both development boards are developed and manufactured by mikroElektronika.**

This system is used to measure the water level in a field, and implement telemetry over wireless communication network system which Present a solution for irrigation system as an application. In this research a Pressure Sensor (E-Tape Million Pressure sensor) and handmade sensor are used to measure water level value, and calibrating the results. Water level measurement system includes a control center (Base station), a GSM modems, and a telemetry unit (Sub Station), on the other hand the author developed friendly user interface for the wireless telemetry by means of Visual Basic which connect the base station with substations, and create a data base to save a historical data of measured water level. In this Research the author developed an alarm system by using buzzer and flashing leds to warn if there are any errors at any station. Compared to other telemetry systems, in this system the measured data does not sent continuously but it is only sent when the data value is changed, so it provides a minimum size of data reserved in the room service and reduce the cost, on the other hand the other systems send measured data continuously so it reserve the channel all the time and increase the cost. On the other hand in this system we have two way actions, and alarm system which determine the error, where, and how to fix.

***Keywords*— Telemetry, GSM Communication Network, Easypic5, SmartG100**

I. INTRODUCTION

Traditionally, telemetry systems have been used for remote data acquisition and control. System devices are usually placed on different remote locations away from a control center. To connect individual elements of the system, wired or wireless communication links are used. There are many distributed control systems suitable for wireless telemetry such as automated systems in factories, building access, remote monitoring, security and alarm systems, health, care applications and inventory management systems. For a reliable and secure communication between distributed measurement and control devices and a centralized control center, professional digital communication system offers adequate solution. Water level measurement circuit by using GSM communication network is used to be one of professional digital communication system that offers adequate solution. Compared to wired telemetry, wireless telemetry has several advantages such as improved mobility, simple installation, easier extension and reconfiguration. Data processing is typically handled by a centralized data acquisition and control application, which leads to the fact that the telemetry units are less complicated and consequently cheaper. This is especially important for systems with great number of telemetry stations. Besides that, elements of wireless telemetry system can be implemented also in moving vehicles.

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II. TELEMETRY SYSTEM TYPES

A. Meteor-Burst Communication System

Meteor burst telemetry uses the billions of dust-size meteors that enter the earth's atmosphere daily. As each particle enters the atmosphere, it burns, producing an ionized trail of gasses in a zone 80 to 120 km above the earth's surface. These trails diffuse rapidly, usually disappearing within seconds. During their brief existence, however, they will either reflect or reradiate radio signals, particularly those in the low end of the VHF range, from 40 to 100 MHz. The height of these trails allows radio communications from a transmitter to be received as far as 1920 km from the source.

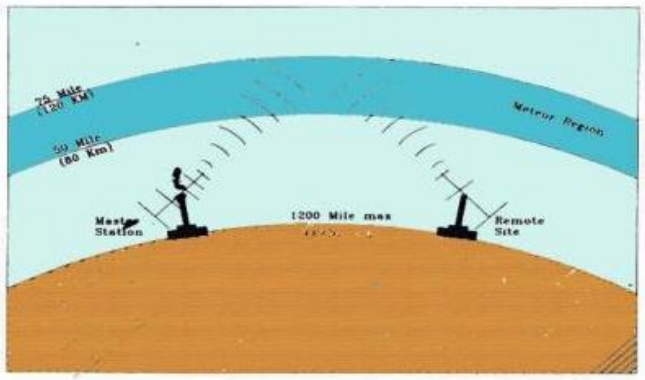

Fig (1) METEOR- BURST Communication System

The main advantage of this system is the long distances coverage. Using the Meteor-Burst communication allows to cover distances up to 1600km without repeaters or any additional link. The system is considered to be less expensive than other communication media with respect to implementation operation and maintenance Meteor-Burst Master Station Meteor-Burst Data collection Platform (DCP).This system was used in Ministry of Water and Irrigation in Egypt but for their disadvantages, which are: it is not a Real-Time communication system.

The message may take 20-40 minutes to be sent from the remote site to the Master (or Sub-Master) station; consequently, it is not convenient for Voice Communication or the appliance of automatic control from a control room.

Fig (2) Meteor- Burst Sub And Base Station

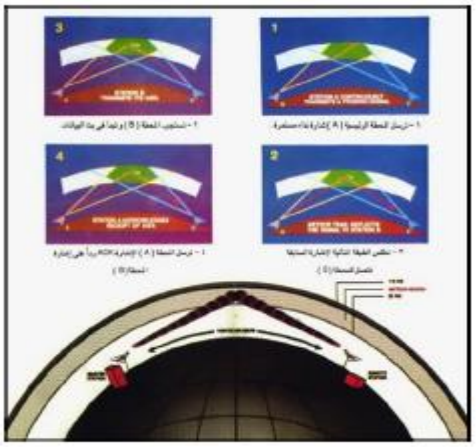

Fig (3) Meteor-Burst Communication System

B. Voice and Data Commumcation System Vdcs

The Voice and Data Communication System (VDCS) is a VHF radio based system with capability to provide voice communication, remote data collection. It consists of 630 remote data collection units, 21 sub master stations and one master station located in Delta Barrage.

Fig (4) Spatial Distribution of the Meteor Burst and the Voice Data Communication Systems in Egypt

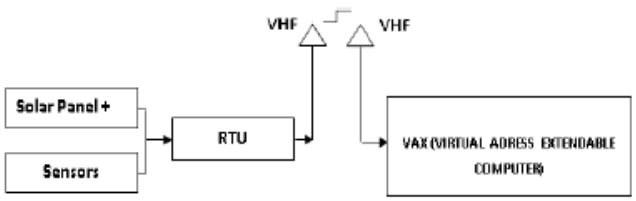

Fig (5) Block Diagram of the Voice and Data Communication Systems in Egypt.

The main advantage of VDCS is the Real-Time communication, which allows Voice Communication and the applying of the automatic control from a central room.

On the other hand, it is considered to be an expensive system in implementation, operation, and maintenance; that is because it depends on 19 repeater stations to cover the whole domain, and also leased telephone lines to link these repeaters to the Master and Sub-Master Station. These leased lines are expensive and not fully reliable.

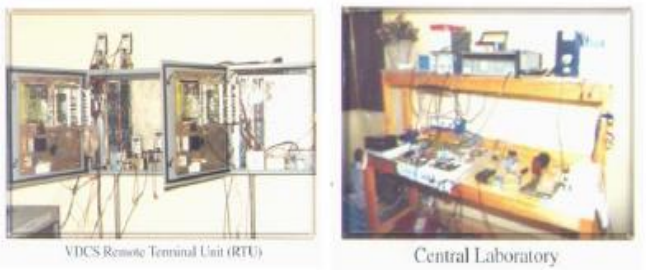

Fig (6) Voice and Data Commumcation System Vdcs

C. Telemetry over GSM Wireless Communication System

This study was performed to implement a modern wireless communication system for data collection and communication by using GSM Communication Network as a platform based on SMS. The system depends on EasyPIC5 microcontroller development board as a modern digital communication system together with a smartg100 (GSM) development boards; both development boards are developed and manufactured by mikroElektronika.

The System Block Diagram

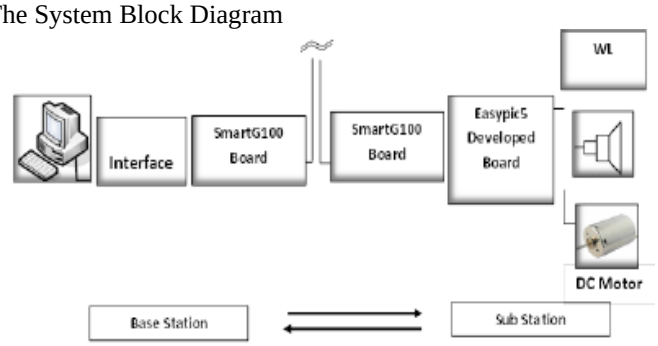

Fig (7) Block Diagram for water level measurement System

III. THE CONSTRUCTION

The system was constructed using an EasyPIC 5 microcontroller development board, together with a Smart GSM (smartg100) development board. Both development boards are developed and manufactured by mikroElektronika. EasyPIC 5, shown in Figure (8), is a popular, highly versatile, and general-purpose.

Fig (8) EASYPIC5 microcontroller development Board

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A SMARTG100 GSM development board, shown in Figure (9), was used to provide the modem functionalities. This board offers support for GSM modems, SIM card holder, antenna holder, audio amplifier and audio interface with microphone and speaker.

Fig (9) Smart-G100 Module

Water Level Sensors

a. E-Tape Sensor

The e-Tape sensor is a solid state, continuous (multi-level) fluid level sensor for measuring levels in water, non-corrosive water based liquids and dry fluids (powders). The e-Tape sensor is manufactured using printed electronic technologies which employ additive direct printing processes to produce functional circuits. The e-Tape sensor's envelope is compressed by hydrostatic pressure of the fluid in which it is immersed resulting in a change in resistance which corresponds to the distance from the top of the sensor to the fluid surface. The e-Tape sensor provides a resistive output that is inversely proportional to the level of the liquid: the lower the liquid level, the higher the output resistance; the higher the liquid level, the lower the output resistance.

Fig (9) E-Tape Sensor

b. Hand Made Sensor

Here the sensor used is the two conductors placed in the field. If there is water then the conduction occurs between the two conductors, which closes a circuit to the microcontroller and microcontroller detects the intensity of water in the field. If there is conduction microcontroller detects that water is in the field. If there is no conduction microcontroller detects absence of water.

Fig (10) Handmade Sensor

The AT Commands

The AT commands are used to control the operations of modems. These commands were first developed for the Hayes Smart modem 300 in late 1970s. An AT command consists of the letters "AT", followed by a number of characters specifying the command tail. Some commands are used to set the configuration of modems, some are used to interrogate modems and get their configurations, while some other commands are used to dial numbers, send SMS messages and so on. In addition to the standard AT command set, the SmartG100 GSM/GPRS modem supports commands to configure the modem and send SMS messages. Table 1 gives a list of the important AT commands available for sending an SMS message.

Table 1: SMARTG100 modem SMS commands

AT Command	SMS Function
AT+CMGF	Select SMS message format
AT+CMCS	Select SMS character set
AT+CSCA	SMS service centre address
AT+CMGS	Send SMS message
AT+CSMP	Set SMS text mode parameters

Developed Telemetry Program

The telemetry program was developed by the author with the intention to communicate the base station with each substation (sites); the program was developed by means of the Visual Basic language representing a flexible interface that operates with 2 way operations.

The telemetry program flow chart is shown with the following figure (11) which describes the settings for each sites, sensors properties, and database for readings history.

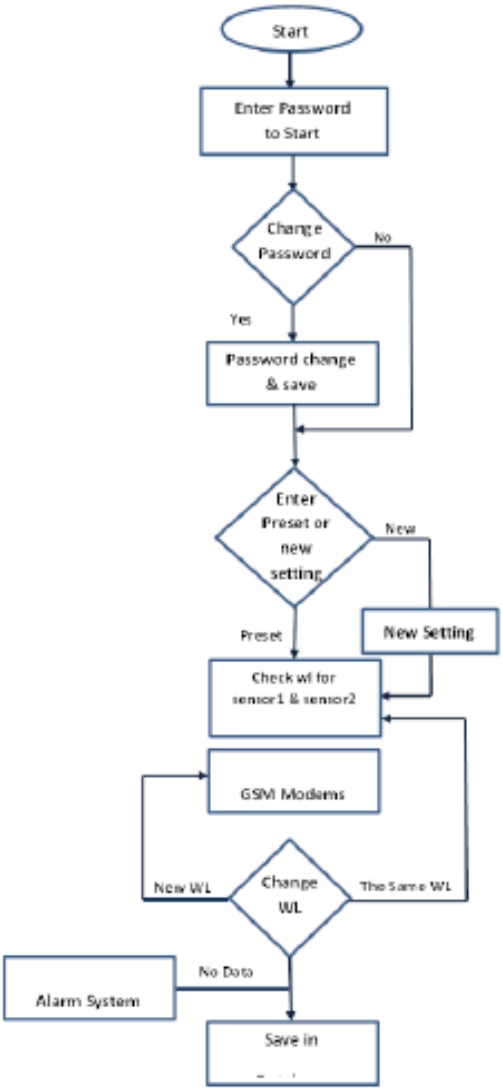

Fig (11) flow chart for telemetry program

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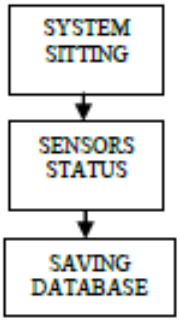

Fig (12) Block Diagram of Telemetry Program

a. Settings:

In the setting of the system, it shows the settings for each site, user should enter the data for each sensor in each site to have an action, this action here is (open the gate) which implied here by DC motor.

b. Check Sensors:

In Check sensors, check sensors through progress bar to show water level, and there is a message Areas for error that may be happen in substations.

c. View History:

In the view history, the program shows the history of the measured water level in each site which saved in database.

Alarm System

The purpose of Alarm operation is to create an alarm to alert that there is an error happens in site, show what is the error and where it is, and how we can fix that error. In our system alarm is applied by sound get out from buzzer, when error applied to sensor in substation ,then the substation send SMS to base station to confirm that there is an error and inform the type of error and how to fix.

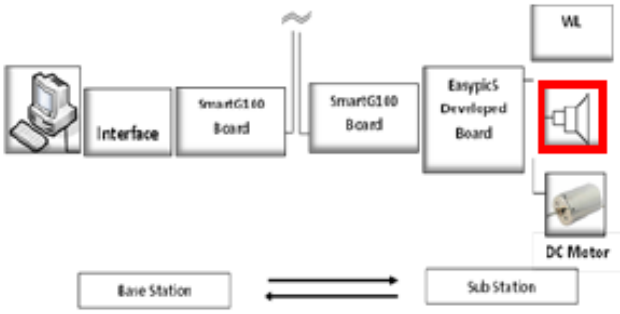

Fig (13) Alarm System in telemetry

IV. 0SUMMARY AND CONCLUSIONS

This study was performed to implement a modern wireless communication system for data collection and communication by using GSM Communication Network as a platform. The system depends on EasyPIC5 microcontroller development board as a modern digital communication system together with a smartg100 (GSM) development boards; both development boards are developed and manufactured by mikroElektronika. This system is used to measure the water level in a field, and implement telemetry over wireless communication network system which Present a solution for irrigation system as an application. In this research a Pressure Sensor (E-Tape Million Pressure sensor) and handmade sensor are used to measure water level value, and calibrating the results. Water level measurement system includes a control center (Base station), a GSM modems, and a telemetry unit (Sub Station), on the other hand the author developed friendly user interface for the wireless telemetry by means of Visual Basic which connect the base station with substations, and create a data base to save a historical data of measured water level. In this Research the author developed an alarm system by using buzzer and flashing leds to warn if there are any errors at any station.

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