World of Computer Science and Information Technology Journal (WCSIT)
ISSN: 2221-0741
Vol. 3, No. 10, 164-170, 2013

Software Application to Monitor and Control Distributed System Based On Mobile / Networks

Dr. Afif J. Almghawish, Akram Abdel Qader, Mohammad AbuMahfouz
Computer Science department
Al-Zaytoonah University of Jordan
Amman, Jordan.

Abstract—This paper presents a new novel software application system that can be control distributed devices based on mobile/Bluetooth networks. The AT commands where analysed and processed by the application system to manage a distributed multifunction mobile/Bluetooth control system. To evaluate the application system a full home prototype model were built to be used in a real time control system. In this system, a real time data can be accessed worldwide using the proposed application system via a GSM modem. The proposed application system shows a significant results when it used with a GSM (Global System for Mobile)[1]. A distributed multifunction control system were used and tested. The system can also be configured to control an alarm or any other electrical device via a mobile phone using SMS text messaging. The proposed application system can control a home automation from the remote location, determines the real time actions with a feedback from the system. The Cellular Shield will send the signal to the output PIN's which are programmed using Java language to control the devices operation. The concerned authority can control the system through his mobile phone by sending AT Commands to the GSM modem connected to the computer and the proposed application system works with all GSM modem technologies [2] and in turn to main board controller. The application system providing the access to the system for security and automated monitoring and control the system operations remotely.

Keywords- Remote Monitoring &Control; AT Commands Mobile phone; Bluetooth; Home automation; SMS.

I. INTRODUCTION

The growth of using the digital technology, Bluetooth and mobile networks [3], in addition to the production of services all over the world with a lowest cost for global distribution. There has also been much interest in Bluetooth communication [4] in industrial sector for uses in automation as well as to increase the safety and security standards.

Recently, there has been much interest in remote monitoring and control in the field of the industrial automation. There has also been much interest in Bluetooth communication [5] in industrial sector for uses in automation as well as to increase the safety and security standards. There is a great deal of benefits for industries to adopt the Bluetooth communication to control systems. Currently, the common condition of using the Bluetooth remote monitoring and control systems is to use the GSM SMS-based systems. The dominant mobile phone network in the world today is GSM. This network has coverage in most urban areas and offer support for the SMS [6] that allows users to communicate with each other by sending short text messages to each other at minimal cost.

The use of mobile phones has grown exponentially over the years [5]. As the number of mobile phone users increased, the technology and infrastructure to use mobile for control system are also increased. The dominant mobile phone network in the world today is GSM.

The primary aim of this paper is to propose the concept of Development of a Low-Cost Application system SMS-Based Control system for a multi distributed monitoring system. This application system works as a GSM communications module linked by a serial communications port. Using this to control a home monitoring system automation relative to sort text send via SMS.

Remote Monitoring, Control and intelligent maintenance is one of the most important criteria for many remote monitoring control systems. This automation is maximizing production and process availability in deferent fields. Bluetooth media has been undergoing a rapid innovation process in search for a reliable, simple and business-viable technology for fast, easy and inexpensive diagnosis of faults in medical, home and industries. A new growth will come through new technology (Bluetooth/Mobile) [4], production at the lowest cost for global distribution, and fast real time operatios. Afif, Akram and et al. [14] proposed a multi function solution, based on GSM for control of a motor driving circuit. The system provides ideal solution for controlling the direction of motor driving within a specified range of time, two directions where controlled in addition to activated functionality with 5V. They proposed a real time data can that can be accessed worldwide using the GSM network. The system can also be configured to control an alarm or any other electrical device via a mobile phone using SMS text messaging. The proposed system controls the motor direction from the remote location, determines the time duration the motor is in a specified direction and whenever it crosses the Cellular Shield to the SM5100B Module.

Khushwinder Gill [15] proposed a Zigbee based Home Automation System. The system allows home owners to monitor and control connected devices in the home, through a variety of controls, including a ZigBee based remote control, and any Wi-Fi enabled device which supports Java. Additionally, users may remotely monitor and control their home devices using any Internet enabled device with Java support.

In [16] DTMF based Remote Control System is proposed. In this work, the teleremote system has been installed. The system uses DTMF tones. The decoder decodes the DTMF tones generated by the keypad of a commercial landline or mobile set. No PC is required for monitoring when using DTMF technology. However DTMF does not utilize the network resources efficiently as it takes several seconds to send instructions.

A.Alheraish [17] proposed a design of Home Automation System based on GSM. To enable its use in several applications, this design integrates the device to be controlled, the microcontroller, and the GSM module. This paper implements a complete M2M (Machine to machine or man to machine system) over a GSM network. The controller processesthe incoming data from RS-232 by running a visual C++program, and sends data via M2M module to control any connected device. The M2M module GM47 is developed by Sony Ericsson. It is intended for use in 900/1800 and 850/1900MHz GSM bands respectively. The module is used to make a connection to the GSM network and send and receive SMS and GPRS services and to make a voice calls as well.

Wael M El-Medany [18] et. al. proposed a GSM-Based Remote Sensing and Control System using FPGA. The system is based on designing and implementing an FPGA chip that is interfaced with a GSM modem to work together as a remote security and control system at the same time. The hardware of the chip has been designed using VHDL and has been tested using Xilinx FPGA. First a synthesizable VHDL code has been written and simulated using Xilinx ISE 6.2i tools, and then implemented on a Xilinx Spartan 3 FPGA. The design has been successfully simulated and tested for both sensing and controlling purpose sat different frequencies (4800 KHz, 9600 KHz, and 19200KHz). The system works as a remote sensing for the electrical appliances at home to check whether it is on or off, at the same time the user can control the electrical appliances at home by sending SMS. It also works as automatic and immediate reporting to the user in case of emergency for home security. The advantages of using FPGA as a controller is multi inputs/outputs and low cost, where the used FPGA chip has 256inputs/outputs that achieve the multi inputs and outputs. Since many components can be integrated into the FPGA chip that has 200 k Logic Gate, a low cost is also achieved

Finally, the systems in [19] [20] [21] propose Remote Monitoring and control Systems based on GSM. GSM network is a medium for transmitting the remote signal and communication takes place between monitoring centre and remote monitoring station. The central monitoring station performs real time control, alarm and data processing and also manages database. Receiving and sending of the data in the central monitoring station is achieved by using the GSM Bluetooth communications module TC35 in[19] - [21]. TC35 is introduced by SIEMENS which is a dedicated Modem. GSM module is interfaced using RS232 and accessed using AT commands.

II. CONTROL FLOW DIAGRAM

The control follow diagram represents the functional control flow that will be managed and monitor the distributed devices based on a software system. The Bluetooth, SMS messages or (AT commands) will be used in this system. The control flow of all the system is shown in figure 1. It contains the process flow of the monitoring system.

2.1. Functional Block Diagram

The Functional Block diagram of the entire system is as shown in the Figure 2. The block diagram consists of the proposed software application system to work as (GSM modem), PIC Controller, Relays, ULN2803 (to optimized for 6 to 15 volt high level CMOS or PMOS), Resistors, Diodes, Parallel Connectors, Transistor, and LEDs to indicate different electronic devices and a time duration. Figure 3 shows the main board controller that will be connected to computer where the application sys-

tem software implementation processed the incoming messages.

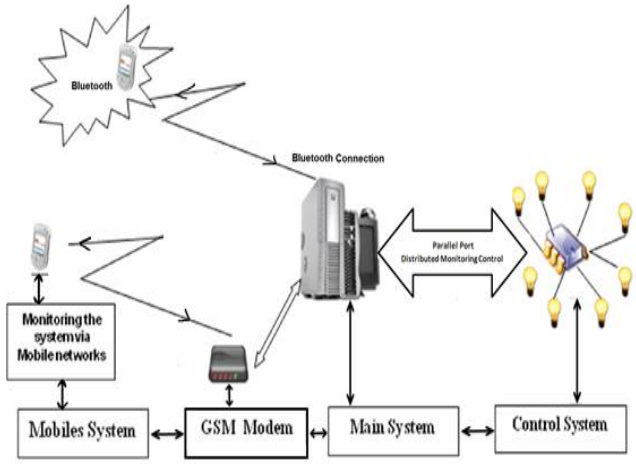

Figure 1. Functional block diagram

The Parallel Port Connectors shown in figure 2 are used to passes the distributed monitoring signals from the computer to the control board and then to control the different devices.

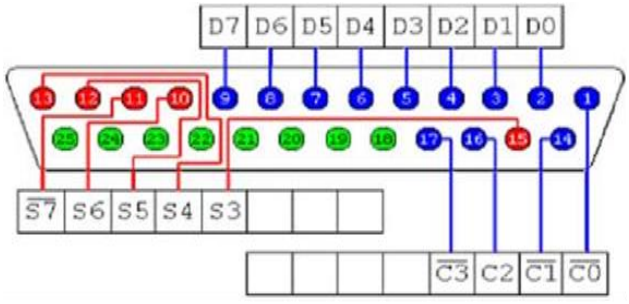

Figure 2. Parallel port connectors

Where the Pins 18,19,20,21,22,23,24 and 25 for ground, Pins 1, 14, 16 and 17 are for control, Pins 2,3,4,5,6,7,8 and 9 are for data, and Pins 10,11,12,13 and 15 are for status.

3.2. Main Board Controller

This circuit used to manage and control eight electronic devices AC voltage (high voltage) by the following components as shown in figure 3.

1. Resistors multi value that increase the transistor base impedance, and protect some elements.
2. Diodes as freewheeling diode
3. Transistor is operates as electronic switch and interfaces the control signal from controller to relay element.
4. AC ports to connect several distributed devices signal from controller.
5. Relays 12V DC to reverse control to the output connected devices.

LED to indicate the control

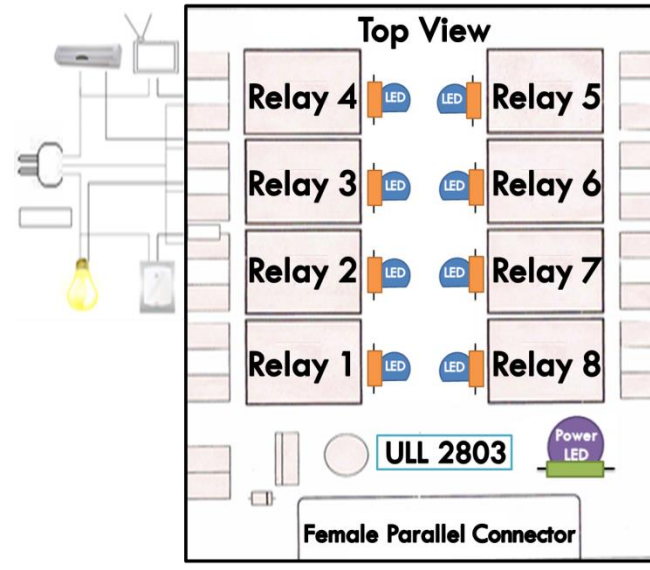

Figure 3. Main board controller functions

III. THE PROPOSED SYSTEM METHODOLOGY

3.1 System Methodology and Application System

The algorithm in figure 4 is describes the methodology of the application system proposed the main contribution:

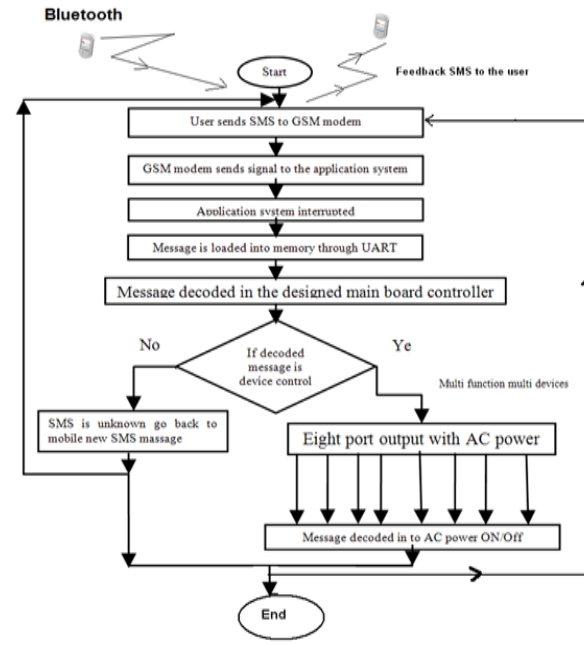

Figure 4. System methodology and application system

3.2. Why the proposed algorithm in a novel method and scalable:

All these systems [7]-[21] are well suited for remote control and monitoring depending upon the requirements. In this system, PC is the remote monitoring station and microcontroller is the controlling device. Although one can monitor and control devices remotely from any part of the world provided internet access is available, this system incurs additional cost due to the requirement of a computer. Special hardware and software installation is required to control the devices. Also in case of power failure, it is difficult to monitor and control the status of devices unless you have a battery backup which is an additional cost.

While the proposed system has many benefits listed below:

- New novel distributed multifunction application system based mobile/Bluetooth networks is proposed.
- Flexibility / modularity in control by the use of the proposed application system.
- Global coverage through the use of the mobile networks.
- Extremely low cost software adaptation for different applications.
- Scalable, Robust and Reliable.
- Provides password security.
- Efficient and cheap means of communication by use of SMS.
- True mobility using mobile phone sets.
- Ideal for monitoring and control deferent monitoring fields.
- The design of the main board controller is the novelty of a distributed multi-function controller. On the other hand, all available monitoring system is used microcontroller for each device.
- The microcontroller of each device must be programmed separately, while the proposed algorithm is multi devices with one controller that managed by a software application algorithm.
- The proposed application system and the control board, made it very efficient to monitor and manage multi devices via SMS from mobile or internet.
- The proposed application system sends an SMS as a feedback to the user phone.

3.3. System Framework

The overall developed system can be configured as shown in figure 5.

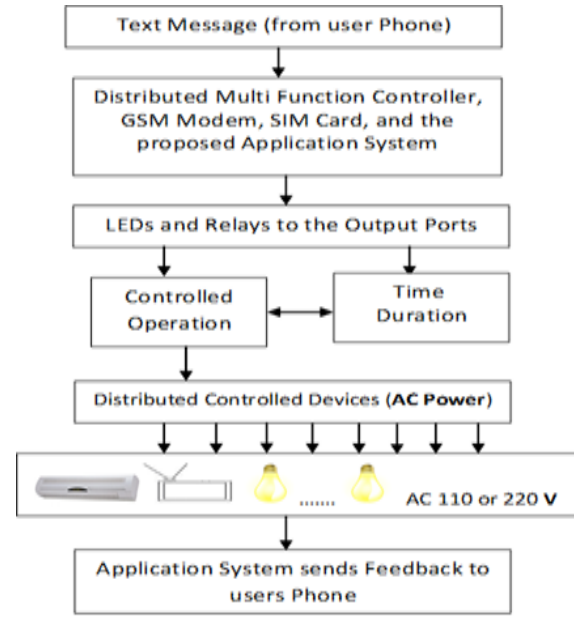

Figure 5 System Framework

IV. System Implementation Functionality

This developed system has been designed to receive a text message from a user via a mobile phone to the GSM modem with a SIM card connected to the main board controller circuit, the parallel connector ports are connected to the parallel computer port, the application programs are programmed to manage their parallel ports as shown in figure1.

The modem is connected to the computer embedded with the SIM card to start receiving the ATM commands.

The following procedure shows how the process of send-receive SMS text message that is accomplished as the following steps:

1. Initialize the library with the numbers of parallel port interface PINs.
   - Decode the required eight pins for Ground (earth) for safety electricity power with high voltage.
   - Decode the required eight pins for Data to get the distributed device.
   - Decode the required four pins for Control.
2. Initialize GSM model serial port for communication.
   - Give time for GSM module to register on network.
   - Set module to send SMS mode to text and to send data to output upon receipt.

3. Specify the LEDs port connected to the specified device to switch ON for
   - Setup the LEDs number of columns and rows as a combination of two digits as 00, 01, 10, 11. to switch (On/Off) the device.
4. If the incoming character from the cellular module read the AT Command,
   Send Feedback to the Phone as
   "Message is received";
   Otherwise;
   Delete the message;

The implementation of proposed procedure above has been programmed using Java programming language.

When the system is in an "active mode" (the power supply is subjected to the controller), the SMS message will be send to distributed controlled device (multi-function operations) through the main board circuit which in turn acts to affect the device monitoring control for a given specified period or scheduled, at the same time this message is send to the user phone as SMS message.

When the system deactivated, all actions are stopped and a related status report is send to the user phone as a warning SMS message.

The proposed prototype operates effectively based on the hardware module comprised it and the software designed. It also allows a remotely control user to manage the devices control by using a Graphical User Interface (GUI) mobile application.

Every message consisting of a sequence of characters starting with an upper case letter followed by lower case letters and ending with a number (to indicate the amount of time) or with # symbol (to stop manually or by sending other message).

To demonstrate the control follow of the incoming SMS messages, we create a database table as a library of coding commands that will be used in the system.

The table 1 shows the standard format of the table attributes that will be used via the system. This table is dynamically updated by the system, in addition this table can be updated by the system administrator to manage the system updating dynamically with a simple DBMS connected to the application system built in Java language.

TABLE1. FORMAT OF SMS MESSAGE

SMS Text	**Actions**	**Time in seconds**
Upper case letter	Sequence of lower case letters	Number or # Symbol (optional)

Every received message from mobile phone consists of an AT commands followed by a sequence of characters starting. Each message must start with upper case letter followed by lower case letters and ending with a number. The last number in the message is to indicate the period of time we want to run this machine (device) then stop. Otherwise, if we need the device always running ON then, the # symbol will be used as the last character of the message. In addition, we can stop the device manually or by sending other message. Farther more, to apply a multi control device we use the "," symbol.

The following list demonstrates the different message sending by the system to control and monitor the different devices. The number of device and the time are controlled by the message as shown in table 2 below.

TABLE 2. SAMPLE OF DIFFERENT MESSAGE SENDING BY THE SYSTEM

SMS Text	Actions	Time in seconds
Room00-1-30	Circuit is operates, and LED number 00 on the board becomes ON, and then the light of the room number 1 is become ON for a duration time of 30 seconds then stop automatically.	30
Room01-1-20	Circuit is operates, and LED number 01 on the board becomes ON, and then the light of the room number 2 is become ON for a duration time of 20 seconds then stop automatically.	20
Room01-1-#	Circuit is operates, and LED number 01 on the board becomes ON and then the light of the room number 2 becomes always ON.	Always ON until manually stopped or by send message
Door10-1-30, Room00-0-	Circuit is operates, and LED number 10 on the board becomes ON and then the door motor is OPEN for 30 seconds then stopped automatically. Room00 light will be turn Off.	30 The second stopped
Off	Circuit will be shut down for all devices.	
Ledon	LED circuit is operated so it is lighting.	
Ledoff	LED circuit is turned off.	

The GSM Modem and Mobile configuration screen snapshot of the proposed (DMCMA) system is shown in figure 6.

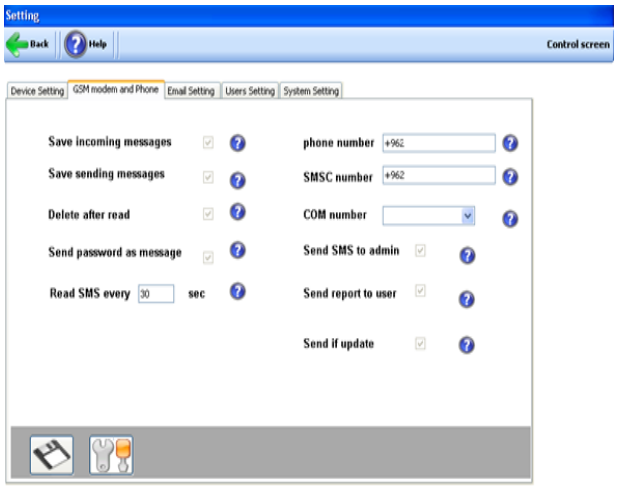

Figure 6. GSM Modem and Mobile configuration screen

The figure 7 below shows the system settings, in addition to the authorization and authentication that will be manage the system security.

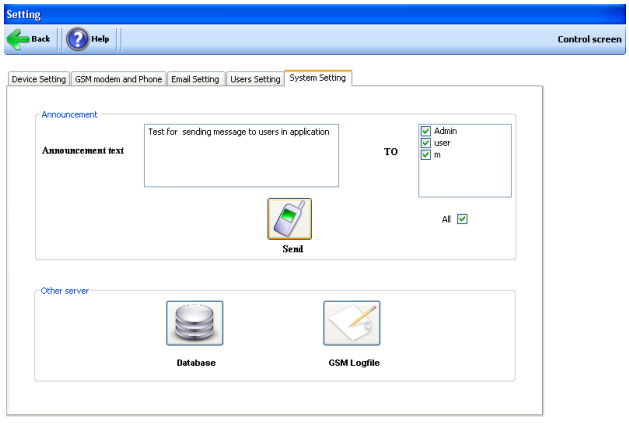

Figure 7. System Settings

The GUI of the mobile side system is shown in figure 8. The devices list menu and message diagram are shown.

The table 3 shows the different SMS AT Commands that can be deal with the proposed system. This format is stored in a database library for the SMS message format used by the proposed system.

TABLE 3 LIBRARY DATABSE FORMAT OF SOME AT COMMANDS

AT Command	Details	Description
AT	Attention Command	Checks the communication between the phone and any accessory. Determines the presence of a phone.
AT+CGSN	Request product serial number	Causes the ME to return one or more lines of AT commands. Note: Only commands available to the user are returned.
ATD	Dial command	Initiates a phone connection, which may be data or voice (phone number terminated by semicolon). The phone number used to establish the connection consists of digits and modifiers or a stored number specification. It is also possible to initiate a phone connection with the use of the alphanumeric field for a phonebook entry location or by the use of the entry location.
AT+CLCC	List current calls	Returns the list of current calls. If command succeeds but no calls are available, no information response is sent to TE.
AT+CPIN	PIN control	The set command sends the password to the ME, which is necessary to make the ME operational (SIM PIN, SIM PUK or PH-SIM). If the PIN is entered twice, the TA will autonomously repeat the PIN. If no PIN request is pending, no action is taken towards the ME and an error message is returned to the TE.
AT+CMGR	Read message	Returns message with location value <index> from preferred message storage <mem1> to the TE. Status of the message and entire message data unit <PDU> is returned. If status of the message is "received unread", status in the storage changes to "received read".
AT+CMGS	Send message	Sends message from a TE to the network (SMS-SUBMIT). Message reference value <MR> is returned to the TE on successful message delivery. Optionally (when AT+CSMS <service> value is 1 and network supports it) <ACK PDU> is returned.
AT+CMGD	Delete message	Deletes message from preferred message

V. CONCLUSION

This paper discussed an application system for a distributed multi-function remote control devices. More than one controlled device in parallel which uses communication networks via a mobile phone based on the designed model included a GSM, SIM card, table or library of accepted SMS messages. The system model can be used in many areas, such home automation, industrials, and many other aspects. As shown by the obtained results this remote control system is low cost, reliable, feasible, and effective.

REFERENCES

[1] Drumea A, Popescu Camelia, Svasta P, GSM Solutions for Low Cost Embedded Systems for Industrial Control, 28th Int. Spring Seminar on Electronics technology, IEEE, 2005, pp. 226-230.

[2] Chen Peijiang Xuehua, "Design and Implementation of Remote Monitoring System Based on GSM", 2008 IEEE Pacific-Asia Workshop on Computational Intelligence and Industrial Application

[3] Ciubotaru-Petrescu B, Chiciudean D, Cioarga R,Stanescu D,"Bluetooth Solutions for Telemetry in Civil Equipment and Infrastructure Monitoring", 3rd Romanian-Hungarian Joint Symposium on Applied Computational Intelligence (SACI) May 25-26, 2006.

[4] Catalin Pancu, Adrian Baraboi, Maricel Adam, Adrian Plesca, GSM Based Solution for Monitoring and Diagnostic of Electrical Equipment, Proceedings of the 13th WSEAS International Conference on CIRCUITS.

[5] Ken Wieland, "Spreading the Word" Telecommunications Magazine International Edition October 2004, Issue Highlights.

[6] Puneet Gupta, SMS: How, what and where, Bluetooth Developer Network

[7] Delgado, A. R., Picking, R., & Grout, V. (2006) Remote-controlled home automation systems with different network technologies. Proceedings of the 6th International Network Conference (INC 2006), University of Plymouth, 11-14 July 2006, pp. 357-366.

[8] Ciubotaru-Petrescu, B., Chiciudean, D., Cioarga, R., & Stanescu, D. (2006). Bluetooth Solutions for Telemetry in Civil Equipment and Infrastructure Monitoring. 3rd Romanian-Hungarian Joint Symposium on Applied Computational Intelligence (SACI) May 25-26, 2006.

[9] Conte, G., & Scaradozzi, D. (2003). Viewing home automat ion systems as multiple agents systems. RoboCUP2003, Padova, Italy.

[10] Alkar, A. Z., & Buhur, U. (2005). An Internet Based Bluetooth Home Automation System for Multifunctional Devices. IEEE Consumer Electronics, 51(4), 1169-1174.

[11] Murthy, M. V. R. (2008). Mobile based primary health care system for rural India. W3C workshop on Roleof Mobile Technologies in Fostering Social Development, Jun 2008

[12] Jawarkar, N. P., Ahmed, V., Ladhake, S. A. & Thakare, R. D. (2008). Micro-controller based Remote

[13] Potamitis, I., Georgila, K., Fakotakis, N., & Kokkinakis, G. (2003). An integrated system for smart-home control of appliances based on remote speech interaction. EUROSPEECH 2003, 8th European Conference on Speech Communication and Technology, pp. 2197-2200, Geneva, Switzerland, Sept. 1-4, 2003.

[14] Afif Mghawish, Akram A. AbdelQader, Mahmoud A. Al-Jezawi, Mohammad AbuMahfouz. Multi Function Control System using GSM modem Based SM5100B Module. ICITST-2012 London, Technical Co-Sponsored by IEEE UK/RI Computer.

[15] Khusvinder Gill, Shuang-Hua Yang, Fang Yao, and Xin Lu; "ZigBee-Based Home Automation System"; IEEE Transactions on Consumer Electronics, 2009, Vol. 55, No.2, pp. 422-430.

[16] Coskun, I.andArdam, H., "A remote controller for homeand office appliances by telephone", IEEE Transactions on Consumer Electronics, vol. 44, pp. 1291-1297, Aug 2002.

[17] A. Alheraish, "Design and implementation of homeautomation system," IEEE Transactions on ConsumerElectronics, vol. 50, pp.1087-1092, Nov. 2004.

[18] Wael M El-Medany and Mahmoud R El-Sabry, "GSM-Based Remote Sensing and Control System Using FPGA", Proceedings of the International Conference on Computerand Communication Engineering 2008, pp 1093-1097, May2008.

[19] Chen Peijiang;Jiang Xuehua; "Design and Implementationof Remote Monitoring System Based on GSM", Pacific-Asia Workshop on Computational Intelligence and Industrial Application, 2008, pp. 678 – 681.

[20] Jifeng Ding, Jiyin Zhao and Biao Ma,"Remote Monitoring System of Temperature andHumidity Based on GSM" 2nd International Conference on Image and Signal Processing, 2009, pp. 1-4.

[21] Li Wei, Yu Min, Cheng Liangliang and Chu Ping, "TheDesign of Intelligent Household Control System Based on Internet and GSM", 2nd International Conference on Networking and Distributed Computing2011, pp. 254-256.