Bluetooth Based Home Automation and Security System Using ARM9

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Abstract:-Today we are living in 21st century where automation is playing important role in human life. Home automation allows us to control household appliances like light, door, fan, AC etc. It also provides home security and emergency system to be activated. Home automation not only refers to reduce human efforts but also energy saving and time efficiency. The main objective of home automation and security is to help handicapped and old aged people who will enable them to control home appliances and alert them in critical situations.

This paper put forwards the design of home automation and security system using ARM7 LPC2148 board. The design is based on a standalone embedded system board ARM7 LPC2148 at home. Home appliances are connected to the ARM7 and communication is established between the ARM7 and ARM9 with Bluetooth device. The home appliances are connected to the input / output ports of the embedded system board and their status is passed to the ARM7. We would develop an authentication to the system for authorized person to access home appliances. The device with low cost and scalable to less modification to the core is much important. It presents the design and implementation of automation system that can monitor and control home appliances via ARM9 S3C2440A board.

I. INTRODUCTION

The "Home Automation" concept has existed for many years. The terms "Smart Home", "Intelligent Home" followed and has been used to introduce the concept of networking appliances and devices in the house. Home automation Systems (HASs) represents a great research opportunity in creating new fields in engineering, architecture and computing (Huidobro and Millan, 2004). HASs becoming popular nowadays and enter quickly in this emerging market. However, end users, especially the disabled and old aged due to their complexity and cost, do not always accept these systems. Due to the advancement of wireless technology, there are several different of connections are introduced such as GSM, WIFI, ZIGBEE, and Bluetooth. Each of the connection has their own unique specifications and applications. Among the four popular wireless connections that often implemented in HAS project, Bluetooth is being chosen with its suitable capability. Bluetooth with globally available frequencies of 2400Hz is able to provide connectivity up to 100 meters at speed of up to 3Mbps depending on the Bluetooth device class [1]. In addition, a Bluetooth master device is able to connect up to 7 devices in a

"Piconet" [2]. This paper will describe the approach which we are implementing to control various home appliances with ARM7 processor.

From the overall papers reviews, HAS according to [3-10] never mentioned about the existing physical electrical switches in their system. Without the switches on the wall, the designed system limited the control only at the GUI. This issue brings inconvenient to the people in the house. This designed system remains the physical switches with the modified low voltage activating method, in order to provide safer physical control to the user compared to the conventional high voltage switches. The Bluetooth connection in this system is established by Bluetooth module that directly receives/ transmits commands from/to ARM9/ARM7.

II. IMPLEMENTATION
A. Wince6.0

For this home automation and security system we are targeting ARM9 S3C2440A platform since it has huge market and open source. Wince6.0 is a operating system which is used for ARM9 devices that includes middleware and key applications. The Wince6.0 OS is based on WindowsCE.net 5.0Standard. The ARM9 provides the tools and APIs necessary to begin developing applications on the Wince6.0 platform.
B. Software Design

As discussed earlier we are developing graphical user interface(GUI) application by using visual basics .net. The application consists of main function like light controlling, Door controlling, etc. When the application starts user is first authenticated, if user is authorized he will be navigated to main screen. The main screen has a list of all functions among which user can select any one function which he want to control. After selecting a function he would be able to see a current status of a particular device. If user wishes, he can enable or disable intended device.

The system is programmed to auto on/off lights during late night hours. If room temperature goes very high or low user can manually adjust fan/AC as per user requirement.

C. MDK-ARM

The MDK(microcontroller Development Kit)-ARM is a complete software development environment for ARM7™ and ARM9™ processor-based devices. MDK-ARM is specifically designed for microcontroller applications, it is easy to learn and use, yet powerful enough for the most demanding embedded applications. MDK-ARM is available in four editions: MDK-Lite, MDK-Basic, MDK-Standard, and MDK-Professional. All editions provide a complete C/C++ development environment and MDK-Professional includes extensive middleware libraries.
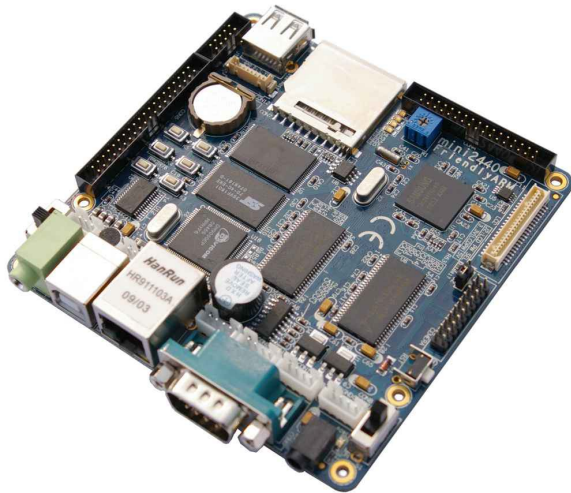
Figure 1 ARM7 LPC2148 kit

Figure 2ARM9 S3C440A kit

The Kiel MDK board provides input and output pins that you can implement through the use of attachments called "shields". With an Micro controller devices and the 'ARM MDK', you can use whatever sensors and actuators you require to create your own accessories. This may include a LED outputs, and temperature and light sensors.

III. BLOCK DIAGRAM
Micro controller Device - It is the device through which application interacts with home applians.

USB Connector - It is the hardware port in the kit through which the USB device is attached to the embedded kit.

Embedded Device - It consists of individual embedded kits along with respective home appliance.

In this project we are implementing ARM9 Wince6.0 based device control with the help of blue tooth. For this one ARM9 is required in the transmitter section. In the receiver section two devices are interfaced to microcontroller with Bluetooth module. User responsibility is to develop one application software(GUI) in ARM9 with VB.net which is used to send the commands

with the help of Bluetooth. In the receiver side Bluetooth module is interfaced to the controller to transreceive the data from the ARM9 processor. Based on that data microcontroller will decide the devices operation like on/off the devices and lock/unlock the door.
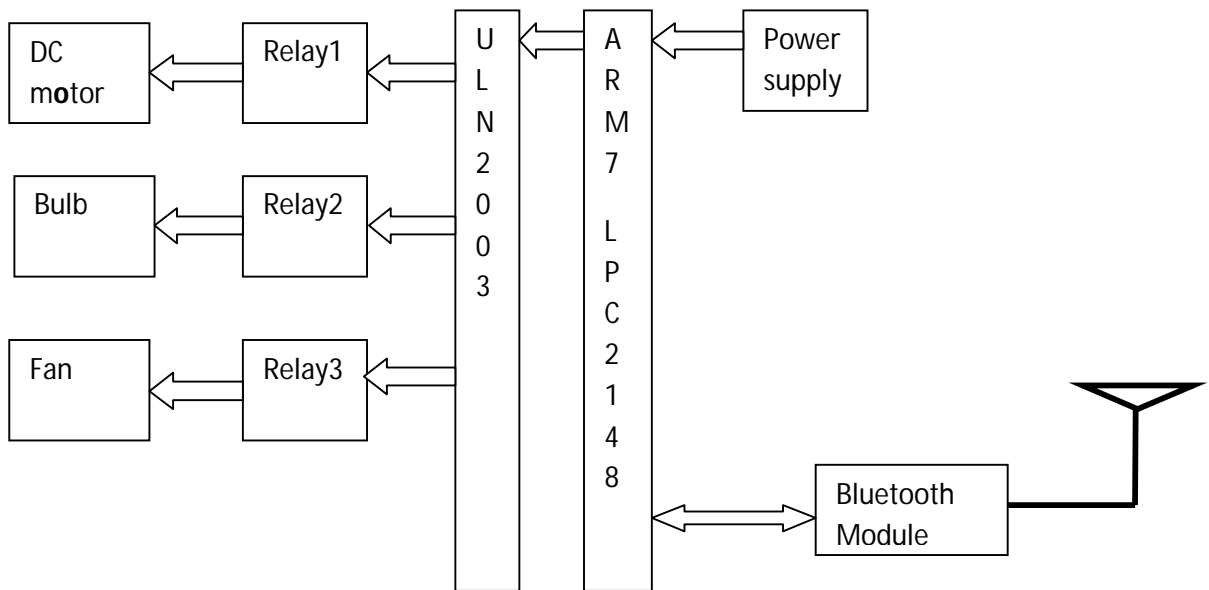
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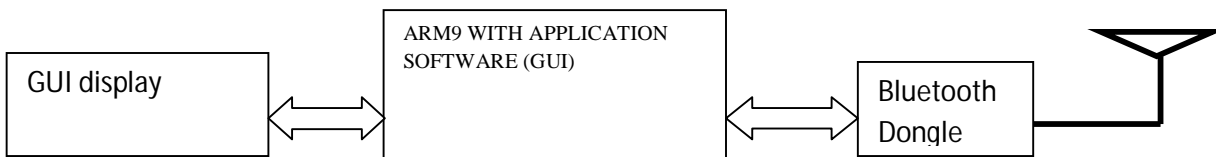
RECIEVER:

Figure 3:Block diagram of Bluetooth Based Home Automation and Security System Using ARM9

IV.SOFTWARE DEVELOPMENT

A.Graphical User Interface (GUI) Module

The most important feature of our application is to hide several processes from

the user while allowing some degree of interaction with the application. By using the GUI package, we were able to customize the application to include a variety of user interface elements such as text boxes, choice groups, alert messages, lists and command buttons. Figure 3 illustrates some designs for the graphical user interface.

Figure 4:ARM9 GUI for controlling home appliances

B.Communication Module

The Serial Port Profile (SPP) is the Bluetooth profile that realizes the RFCOMM connection between two devices. The RFCOMM protocol is an emulation of the RS-232 2011 IEEE 15th International Symposium on Consumer Electronics 978-1-61284-842-6/11/$26.00©2011 IEEE

C.The Program Flow chart

Upon the execution of the program, it first checks if Bluetooth is already enabled on the ARM9. If Bluetooth is enabled, the device and service discovery process will run. The software will check if there are already predefined devices stored in the ARM9s memory. 2011 IEEE 15th International Symposium on Consumer Electronics 978-1-61284-842-6/11/$26.00©2011 IEEE

If they do exist, they will be listed down for the user to select one. The program then checks to see if the selected device is in range. It will then verify if the device is a Bluetooth transceiver (ARM7-MDK board). Now if there are no devices stored in memory, the program will search for Bluetooth-enabled devices within the area. Once discovered, these devices will be displayed on the screen and also stored in memory. Once it is confirmed that the device is indeed a transceiver, the software will store the unique addresses of all the controller modules connected to it, in this case ARM7-MDK. If the address of a controller module has not been saved, then it will be designated a number i.e.MDK-LAMP. Otherwise, it will be given its saved name and will prompt the user to enter the pairing password for ARM7-MDK board. Upon entering the correct password, the program stores all connected controller modules names inside the ARM9 memory, then only the Main Menu user interface will be displayed.

The Main Menu displays three options: Options, List of Lamps and Exit. A List of Lamps is a combination of one or more lights which have been preset to a certain status or state. These states are either ON or OFF. There are two options to choose from in the List of Lamps interface: they are either LAMP ON or LAMP OFF. When the certain instruction has been chosen, the software will send data to the ARM7-MDK transceiver, which in turn will send the data to the controller modules.

The List of Lamps option in the Main Menu will display the entire controller modules saved in memory. The user can modify the lights status from here. Options will display instructions on how to use the software. Lastly, Exit will let the user end the program.
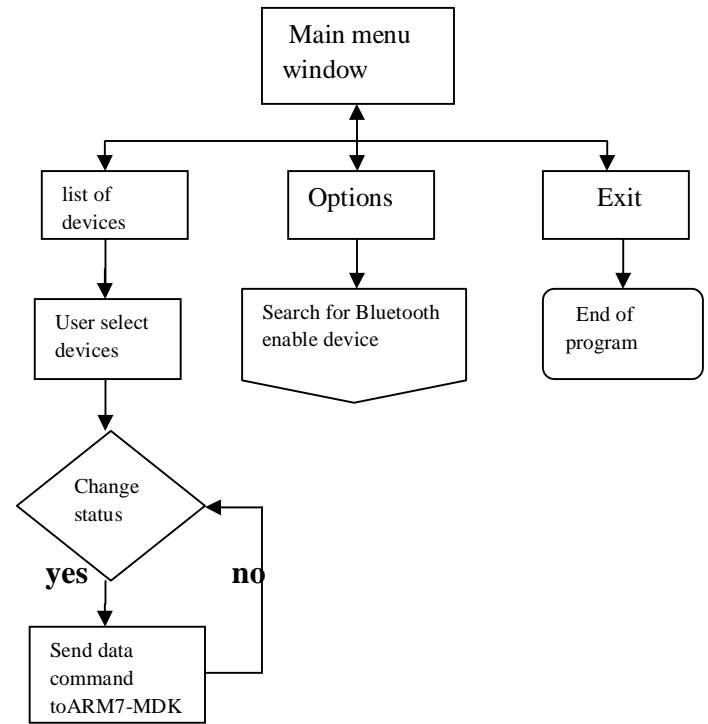

Figure 5. Program Flowchart for Main Menu Window of the GUI.

V. CONCLUSION

In conclusion, this low cost system is designed to improve the standard living in home. The remote control function by ARM9 provides help and assistance especially to disabled and elderly. In order to provide safety protection to the user, a low voltage activating switches is replaced current electrical switches. Moreover, implementation of wireless Bluetooth connection in control board allows the system installation in more simple way. The control board is directly installed beside the electrical switches thereby the switching connection is controlled by relay. Furthermore, flexible types of connections are designed as backup connections to the system. The connected GUIs are synchronized to the control board. They

indicate the real-time switches status. The system is designed in user-friendly interface. The easy to use interface on Window and wince6.0 GUI provides simple control by the elderly and disabled people. For future work, the Window GUI will be implemented with speech recognition voice control. The wince6.0 GUI will be implemented as a remote Bluetooth microphone to the Window GUI. All the voice signal inputs to the ARM9 will be transmitted to the Window GUI for signal processing. Also, the push buttons implemented in low voltage activating switches will be replaced by capacitive sensing switches. All the future work is expected without spend extra cost, even one cent from the current system.

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