DEVELOPMENT AND IMPLEMENTATION OF A PC-BASED HOME AUTOMATION SYSTEM USING USB PROTOCOL

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Abstract-
In our day to day life every electrical appliance is to be controlled manually or automatically. For example, an electric fan needs a regulatory system to control its speed or a switch to turn it ON or OFF as required. In such circumstances, one may forget to turn it OFF which could lead to wastage of electricity since the control of such appliance or device is manual. The problem can be solved using PC control technique where the user can get to know the status of each appliance whether OFF/ON as well as switching operation using Home Automation Technique. This Paper therefore presents, 'the Development and Implementation of a PC-Based Automation System' with the use of the Computer's USB Port Protocol. This design is divided into two parts; the first part is the Hardware development where all the electronic components used are built around the Microcontroller which is the main controlling component. The second part is based on the Visual Basic programming to operate all the hardware structure. The Objective of this design is to design and implement a system that will interface pre-existing home appliances with the PC's USB Port using simple Graphical User Interface (G.U.I) which is provided on the Visual Basic Platform. The interfaces are easy to use and provide the user with a more accessible interface. The devices are also very easy to integrate into existing applications and require only a little knowledge of computer to install. Since this development is limited to a PC based home automation via USB protocol however, it is recommended that the design be modified to incorporate voice recognition and other wireless networked systems.

Index Terms-- *Automation, USB, Protocol, Microcontroller, Electrical Appliances.*

INTRODUCTION

Home automation refers to the use of computer and information technology to control home appliances and features (such as doors, lighting etc). Home automation is adopted for reasons of ease, security and energy efficiency (Harper et al., 2003, Gerhart 1999). The first smart house was coined by the American Association of House builders in 1984 (Anogianakis, 1997). A web server based home gateway was also developed however, the use of power lines as the communication medium limits the positioning of devices within the home to areas in close proximity to power sockets (Saito, et al. 2000). Other type of PC-based, time and speech method was developed using VB 6.0 language and for voice recognition the Microsoft voice engine tools was used. However, the parallel ports were used in order to transfer data from computer to specific device which is to be controlled. (Haque,.et al 2006).

A Cell phone based home appliance control system was presented using the J2ME language to program the client cell phone. Here, Opto-coupler and static power switch (TRAIC) is used to interface the devices between the PIC and the home appliances (Nasr, 2009). Other types of home automation systems include, blue-tooth based system (Srskanthan, et al. 2002), Wifi and Zigbee systems (Kushiro, et al., 2003), (Hwang et al. 2009). The disadvantages of these systems are the user must be with the PC to send messages. booting time, high power rating, short distance communication with the electrical appliances (khusvinder, et al., 2009.

METHODOLOGY

This Paper focuses on developing an automation system with the use of a computer's USB port which is controlled and connected to a microcontroller. It is divided into two parts namely; the hardware part where all electronic components used are connected around a microcontroller. The second part is based on software programming; the Visual Basic (Graphical User Interface) to operate all the hardware architecture.

The Hardware Development

The hardware is divided into three units (see Figure 1):

i) USB Protocol

Universal Serial Bus (USB) defines the cables, connectors and communications protocols used in a bus for connection, communication, and power supply between computers and electrical appliances.

Basic Operation of USB

When a USB device is first connected to a USB host, the USB device enumeration process is started. The enumeration starts by sending a reset signal to the USB device. The data rate of the USB device is determined during the reset signaling. After reset, the USB device's information is read by the host and the device is assigned a unique 7-bit address. If the device is supported by the host, the device drivers needed for communicating with the device are loaded and the device is set to a configured state. If the USB host is restarted, the enumeration process is repeated for all connected devices.

The host controller directs traffic flow to devices, so no USB device can transfer any data on the bus without an explicit request from the host controller. In USB 2.0, the host controller polls the bus for traffic, usually in a round-robin fashion. The throughput of each USB port is determined by the slower speed of either the USB port or the USB device connected to the port.

FT232RL

The FT232RL provides true CMOS Drive Outputs and TTL level Inputs. It was used to convert signals from a USB port to serial signals suitable for use in TTL. The device operating supply current has been reduced to 15mA, and the suspend current has been reduced to around 70µA. This allows greater margin for peripheral designs to meet the USB suspend current limit of 500µA. It operates over an extended temperature range of -40º to +85º C thus allowing the device to be used in automotive and industrial applications. Previous generations of the chip required 5V supply on the VCC pin. The FT232R will work with a Vcc supply in the range 3.3V - 5.25V. Bus powered designs would still take their supply from the 5V on the USB bus, but for self-powered designs where only 3.3V is available and there is no 5V supply there is no longer any need for an additional external regulator. It has internally generated clock (6MHz, 12MHz, 24MHz, and 48MHz) which can be brought out of the device and use to drive a microcontroller or external logic.

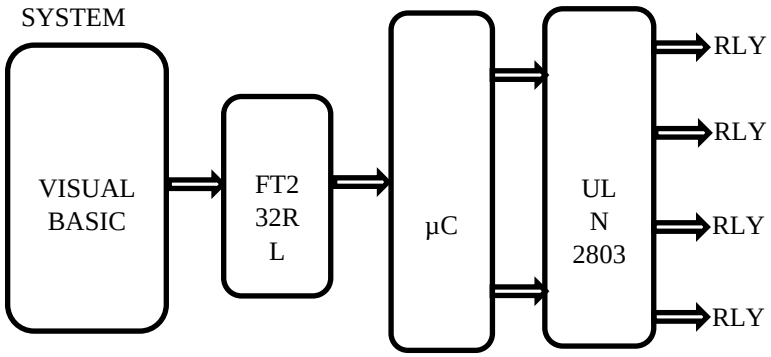

Figure 1: Block Diagram of A PC Based Home Automation Using USB Protocol

The Software Development

(i) The design's Flow Chart (see Figure 2)

(ii) Installing Visual Basic (Graphical User Interface)

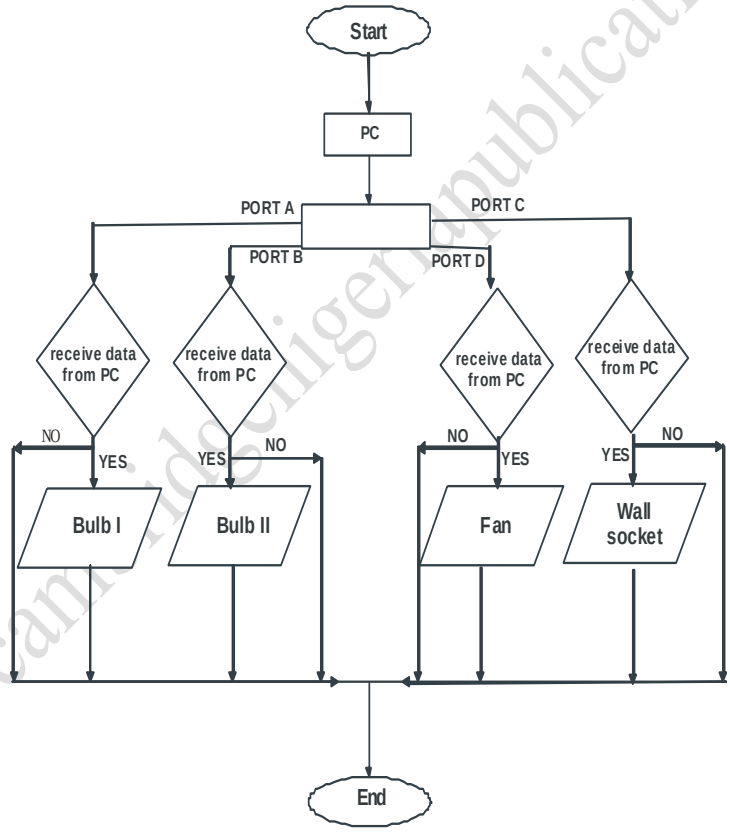

Figure 2: Flowchart of the Operation

Controller Code Used

```
load1equ     p2.0
load2equ     p2.1
load3equ     p2.2
load4equ     p2.3
;.....mainprog.....
org 0000h
main:            mov a,#0
mov p2,a
go:        call serial_init
callreciev_byte
call compare
ajmp go


compare:    cjne a,#'A',go1
setb load1ret
go1: cjne a,#'B',go2
setb load2ret
go2:cjne a,#'C',go3
setb load3ret
go3:cjne a,#'D',go4
setb load4ret
go4: cjne a,#'E',go5

clr load1ret
go5: cjne a,#
'F',go6clr load2ret
go6: cjne a,#'G',go7
clr load3ret
go7: cjne a,#'H',go8
clr load4
go8:ret
end
```

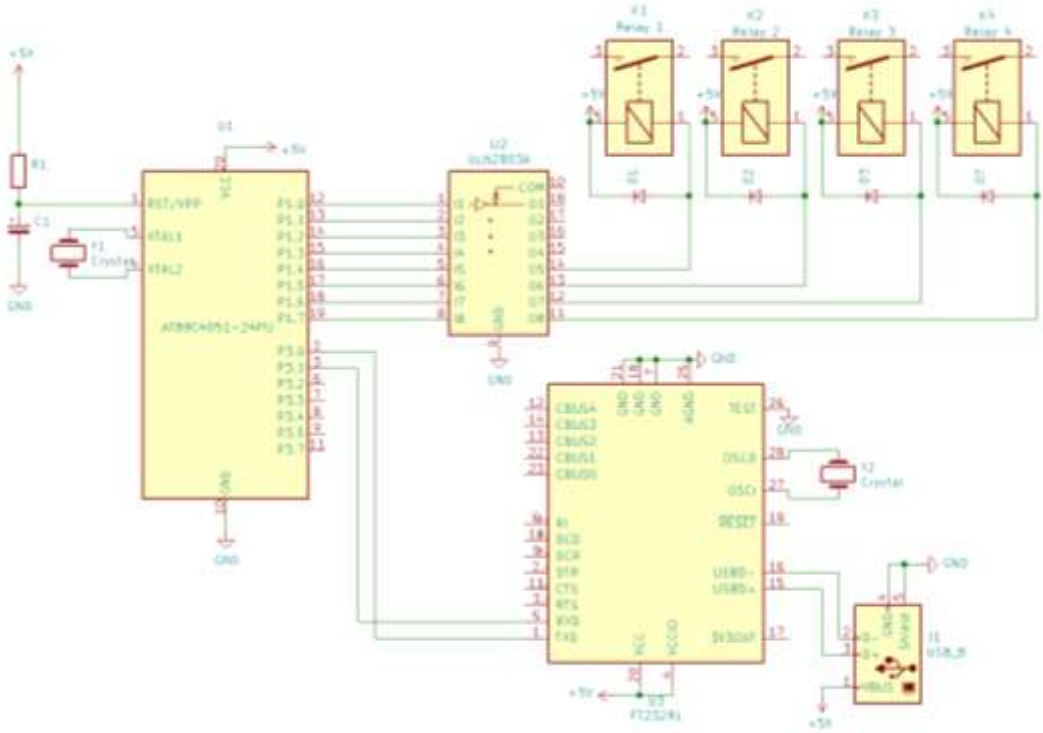

Figure 3: Circuit Diagram of PC Based Home Automation System Using USB Protocol

MODE OF OPERATION

The Visual basic application installed on the PC allows remote it to display user interfaces. It uses the visual basic (VB) to transmit the user interface to the remote device (PC).

The basic operation is stated and explained below:

Then the USB cable of the circuit is connected to the computer system and when it is recognized by the computer system, G.U.I (VB software) is launched which makes the circuit to communicate with the computer system serially.

Figure 4: The G.U.I Interface

The G.U.I (VB software) brings out the interface (see Figure 4). Then the

user is allowed to log in. and a welcome message observed.

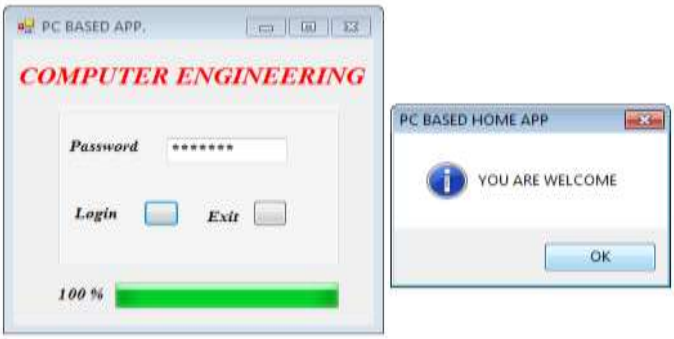

Figure 5: Welcome Message Interface

A dialog box will appear that shows the control interface where all the electrical appliances can be controlled. The user can also know the status of these appliances either ON/OFF (see Figure 6).

Figure 6: Control Button Interface

IV. TESTING AND DISCUSSION

(i) Testing for and Electric FAN

When the ON button of the FAN is clicked; a message will pop-up to display its status (either ON or OFF).. It is shown in the Figure 7.

Figure 7: Message displayed When Fan is switched ON

When the OFF button of the FAN is clicked; a message will pop-up to display the result (see Figure 8).

Figure 8: Message displayed When Fan is switched OFF

(ii) Testing for RADIO

When the ON button of the RADIO is clicked; a message will pop-up to display the result (see Figure 9).

Figure 9: Message displayed When RADIO is switched ON

When the OFF button of the RADIO is clicked; a message will pop-up to display the result (see Figure 10)

Figure 10: Message displayed When RADIO is switched OFF

Once the user is through with the operation, the "EXIT" on the interface is clicked to close the Interface.

CONCLUSION AND RECOMMENDATIONS

This Paper presents the development implementation of a sPC-based home automation system using the USB Protocol. It easily interfaces the pre-existing home appliances with the PC's USB Port.

This Paper therefore successfully designed a system that communicates with a PC via a USB port/cable. The design worked according to specifications. It is however recommended that a wireless or a voice recognition system be incorporated into the circuit to serve longer range distances and facilitate high performances.

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