

Overview of Automation Systems and Home Appliances Control using PC and Microcontroller

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Abstract: *In the fast growing world today it is necessary to control the home from remote locations. Every home is different, and just like you have to instruct your maid in the operation of your home, you have to instruct your PC in your personal preferences. Also, we know the importance of saving electricity, with the advancement of technology things are becoming simpler and easier for us. The main aim of the automation system is to on/off the device at the specified time by using desktop, which can be placed even in other room. The on/off system can be programmed well in advance and there is no need to perform the operation at that particular time. The proposed work has been done experimentally and responded successfully, which verifies the feasibility of this system's theory and concept. Automatic systems are being preferred over manual system. The main reason to develop this system is to save time and man power along with maintaining security and convenience.*

Keywords: Automation, 8951 micro controller, relays, dallas timer, Keil cross compiler.

1. Introduction

In this paper, the main point that is discussed is regarding the automatic control of home appliances (On/Off) with the help of computer and microcontroller(8951). This is a wired system and every appliance must be connected with the help of cables. The other modules which are used in order to accomplish our desired goal are Dallas Timer, Relays, ULN, MAX232, Keil cross compiler, flash magic and power supply circuit. This paper presents the design and implementation of APPLIANCES CONTROLLING USING PC module. Simply by using this home automation we can save time, money, man power. And also we can have command, security and convenience on controlling appliances.

2. What is Home Automation?

Home/office automation is the control of any or all Electrical devices in our home or office, whether we are there or away. Home/office automation is one of the most exciting developments in technology for the home that has come along in decades. There are hundreds of products available today that allow us control over the devices automatically, either by remote control or even by voice command.

3. Other Types of Home Automations

Apart from the home appliance control using computer and microcontroller which will be further discussed in this paper later, there are many other different ways by which we can control the home appliances and each and every system will have its own pros and cons.

3.1 Home Appliances Control Using A Remote Control

The lights, fans can be automatically turned on/off with the help of a remote where there will be a sensor instead of going near to a switch board and putting on/off the switch. Companies like Legrand and Gold Medal already started these kinds of control system and they are at present available in the market.

3.2 Home Appliances Control Using DTMF

In this method, the control of home appliances can be done even though when we are elsewhere just by using the DTMF tone generated when the user pushes mobile phone keypad buttons or when connected to a remote mobile.

3.3 Home Appliance Control Using Free Hand Gesture

This is a type of home appliance control system where the person must be present in sight to the appliance that is needed to be controlled and a predefined gesture must be used to turn on the device and another gesture must be used by us to turn off the device. The performance of the proposed system is done with a hardware embedded in that particular device.

3.4 Home Appliance Control Using Internet And Radio Connection

In this system, the control of home appliances can be done from a remote are with an option from a local server, using the Internet and radio connection. This system is accomplished by personal computers, interface cards, radio transmitters and receivers, microprocessors, ac phase control circuits, along with window-type software and microprocessor control software.

3.5 Home Appliance Control Using Speech Recognition in Wireless Network Environment

The main aim of this system is to establish a wireless connection between a client computer and a server in a real application. Via the wireless communication system, this system utilizes the remote voice recognition system server to translate the voice input received from a serviced client computer into a symbolic data file to be processed by the client's computer. The Wi-Fi network and the computer server utilize the GUI manager for implementing the speech recognition system.

3.6 Home Appliance Control Using Power Line Communication Technology

One of the technologies used by domestics to connect the home controller with the appliances is using the Power-Line Communication (PLC) protocol for data transmission. Power-line is a special media, which transport not only the AC power to devices, but also the multimedia or control data to and from the device; the benefits of using this media are the availability and quantity of electrical outlets in a house and no new wiring necessary for building the network

3.7 Home Appliance Control Using Bluetooth

The main part of the system is the multimedia gateway with the HTTP server inside. In the system there are also personal communication assistants (PCA), a special kind of remote control with the Bluetooth protocol applied to them. The PCA is used to communicate between user and multimedia gateway. The aim of the system is centralization of services in the multimedia gateway.

4. Development of Idea for this System of Automation using PC and Microcontroller

The idea to this project has been developed after studying the technique that is involved in the home automation system control using power line communication technology which is already an existing paper. In this, the person must operate the desktop at that particular time when he wants the appliance to be turned off. They mentioned that on computer screen the list of devices will be displayed and we should select the particular device (say for example-fan1). Now, if we want fan1 to be stopped in the room and so on the desktop screen after selecting fan1, choose the option stop, that particular fan will be stopped in the room. We wanted a system, where we can operate the desktop anytime before the time the device must be switched off.

In fact, this was even mentioned under the future scope of the paper that was mentioned earlier (using PLC). For example, i need to stop the fan1 in the room at 4 p.m, i can program this in the desktop on 9 a.m. The fan will automatically off at 4p.m.

Similarly we can operate as many devices as we wish but we should increase the number of ports and if the maximum limit of ports exceeds, we should use another port. So, before studying about the procedure involved in this project and the circuit diagrams, we should look at the over view of the components that are used in this project and then the usage of these components in this system.

5. Description Regarding Components

5.1 8951 Microcontroller

The P89V51RD2 is an 80C51 microcontroller with 64 kB Flash and 1024 bytes of Data RAM. The AT89C51 is a low-power, high-performance The P89V51RD2 is also In-Application Programmable (IAP), allowing the Flash Program memory to be reconfigured even while the application is running. Its features are 80C51 Central Processing Unit, 5 V Operating voltage from 0 to 40 MHz, 64 KB of on-chip Flash program memory with ISP (In-System Programming) and IAP (In-Application Programming). It supports 12-clock (default) or 6-clock mode selection via software or ISP, SPI (Serial Peripheral Interface) and enhanced UART PCA (Programmable Counter Array) with PWM and Capture/Compare functions, four 8-bit I/O ports with three high-current Port 1 pins (16 mA each), three 16-bit timers/counters Programmable Watchdog timer (WDT), eight interrupt sources with four priority level, second DPTR register, low EMI mode (ALE inhibit), TTL- and CMOS-compatible logic levels.

5.2 Max 232 IC

The MAX232 has two sets of line drivers for transferring and receiving data. The line drivers used for TXD are called T1 and T2, While the line drivers for RXD are designated as R1 and r2. In many of applications only one each used. For example T1 and R1 are used together for TXD and RXD of the 8051, and the second left unused. Notice in MAX232 that the T1 line driver has designation of T1 in and T1 out on pin numbers 11 and 14, respectively. The T1 in pin is the TTL of the microcontroller, while T1 out is the RS232 side that is connected to the RXD pin of the RS232 DB connector. The R1 line driver has a designation of R1 in and R1 out on pin numbers 13 and 12 respectively. The R1 in is the RS232 side that is connected to the TXD pin of the RS232 DB connector, and R1 out is the TTL side that is connected to the RXD pin of the microcontroller.

5.3 Relays

A **relay** is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts.

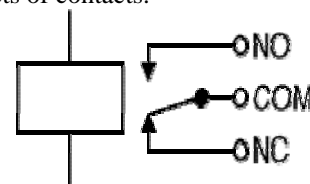


Figure 1. Circuit diagram of relay

5.4 Dallas Timer

The DS12887 Real Time Clock plus RAM is designed to be a direct replacement for the DS1287. The DS12887 is identical in form, fit, and function to the DS1287, and has an additional 64 bytes of general purpose RAM. Access to this additional RAM space is determined by the logic level presented on AD6 during the address portion of an access cycle. A lithium energy source, quartz crystal, and write-protection circuitry are contained within a 24-pin dual in-line package. As such, the DS12887 is a complete subsystem replacing 16 components in a typical application. The functions include a nonvolatile time-of-day clock, an alarm, a one-hundred-year calendar, programmable

interrupt, square wave generator, and 114 bytes of nonvolatile static RAM. The real time clock is distinctive in that time-of-day and memory are maintained even in the absence of power.

5.5 Transformer

The potential transformer will step down the power supply voltage from (0-230V) to (0-24V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op-amp. The advantages of using precision rectifier are it will give peak voltage output as DC, then that 24v D.C is given to the 7812 regulator to get the 12v output, and then from 12v it is given to the 7805 regulator to get the required 5v D.C.

5.6 ULN 2003

The ULN2003 is a high voltage, high current Darlington arrays each containing seven open collector Darlington pairs with common emitters. Each channel rated at 500mA and can withstand peak currents of 600mA. Suppression diodes are included for inductive load driving and the inputs are pinned opposite the outputs to simplify board layout.

These versatile devices are useful for driving a wide range of loads including solenoids, relays DC motors, LED displays filament lamps, thermal print heads and high power buffers. The 2003A is supplied in 16 pin plastic DIP packages with a copper lead frame to reduce thermal resistance. They are available also in small outline package (SO-16) as 2003D.

6. Block Diagram

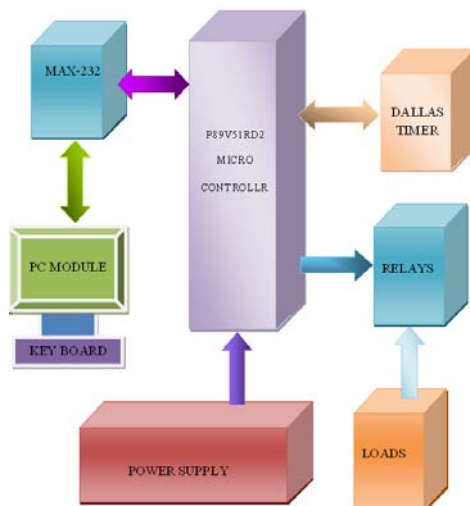


Figure 2. Block diagram of system.

7. Circuit Diagram

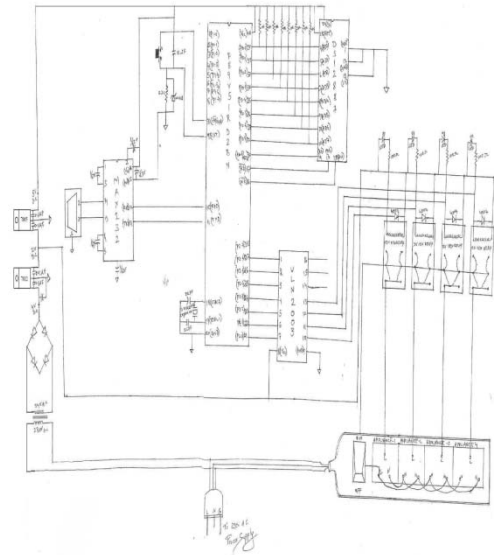


Figure 3. Circuit diagram of the system.

8. Software Used

8.1 Keil Cross Compiler

This is used for the purpose of writing the program and for simulation.

8.2 Flash Magic

When we simulate the program in the Keil cross compiler, a window will be generated and this will be used for dumping the program into the microcontroller.

9. Steps Involved In The Automation Kit

- i. The written program that deals with the devices that are to be stopped and that are to be on at the desired time will be written and simulated in keil cross compiler and by using flash magic 4.64, we will dump the program into the micro controller.
- ii. The connection between the computer and the kit will be made through the RS 232 cable which is used to allow compatibility among data communication.
- iii. The output that is been generated from the RS 232 cable is in the form of TTL logic (Analog) and this particular type of output is not accepted by microcontroller(8951)
- iv. So, we will use the MAX232 IC to convert into the voltage that is accepted by the microcontroller and then the data is send to microcontroller. One advantage of the MAX232 is that it uses a +5v power source which is the same as the source voltage for the 8051. In other words, with a single +5v power supply we can power both the 8051 and MAX232, with no need for the dual power supplies that are common in many older systems.
- v. The kit must be supplied with the power supply, where generally in India, a 240V A.C will be produced from switch boards.
- vi. We use a step down transformer in this kit and so, the voltage of 240 A.C will be step down to 5v and then it will be passed to a rectifier which maintains a stable voltage and also converts A.C to D.C.

- vii. As a result, a constant 5V will be produced and it will be given to the microcontroller(8951) and this 5v is also needed by MAX232 IC.
- viii. The ULN 2003 is the one which consists of an array of Darlington pairs and it is used to drive the relays.
- ix. The Dallas timer will be present and it is a real time clock and we can on and off the appliance according to the time mentioned in the program.
- x. A relay is the one in which we can use as the on/off device which acts similar to that of a switch, when the data reaches the relay and according to the data the relay will be on or off.
- xi. We should place one relay for one appliance and so we placed four relays in the kit because we used only 4 ports in the kit.
- xii. As a result each relay will control the each appliance based on the code given and we use the dallas timer to know the time and to stop or start the device in a particular point of time and the aim of home automation has been achieved.

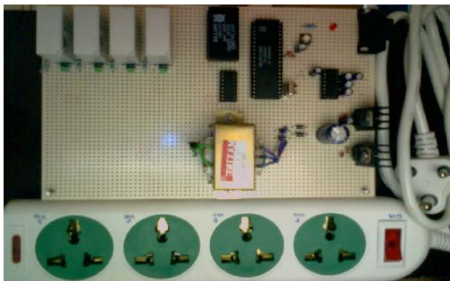


Figure 4. The kit which we used for home automation

10. Algorithms used in the Program

- i. In order to receive the data to the microcontroller, we should enable the receive flag.
- ii. From microcontroller to relay, we should enable the transmit flag.
- iii. We should provide different codes for different operations for security reasons which will be discussed in the next section.
- iv. Give instructions for operations directly.
- v. Give instructions for timer setting(Dallas timer)
- vi. Give instructions for date settings(Dallas Timer)
- vii. Give instructions for operate commands with regard to time and date.
- viii. Give instructions for on/off at the given time in step7.

11. Security Aspects

The main advantage in this design of home automation is the security because any one cannot access the appliance control because we will predefine the code in the program for the control of the appliances which is described below.

12. Code For Appliance Control

Let us consider for example in the register buffer 1, we defined 'C1' as the first byte in such a manner that

CASE1:IF INPUT GIVEN FROM PC IS

```
C1 01 FF 00 00 00 00 00
02 FF/00
03 FF/00
04 FF/00
```

This code states that we should off the appliance which is connected to port1.

The second byte can be given from (01 or 02 or 03 or 04) which indicates the PORT1,PORT2,PORT3,PORT4 respectively.

The third byte indicates 00-On that particular device FF-Off that particular device

CASE2: IF INPUT GIVEN FROM PC IS

```
C2 00 00 00 00 00 00 00
```

The timer which is set in the computer will be initiated in the Dallas timer.

CASE3: IF INPUT GIVEN FROM PC IS

```
C3 00 00 00 00 00 00 00
```

The date which is present in the computer will be initiated in the Dallas timer.

CASE4: IF INPUT GIVEN FROM PC IS

```
C4 HH MM SS 00 00 00 00
```

The particular time when we wish a change in the state of appliance will be known to the system.

CASE5: IF INPUT GIVEN FROM PC IS

```
C5 (1st appliance state) (2nd appliance state) (3rd appliance state) (4th appliance state) (5th appliance state) (6th appliance state) (7th appliance state)
```

Where 00 indicates On the device FF indicates OFF the device

For example:

```
1. C5 00 00 FF FF 00 00 00
```

The above code indicates that APPLIANCES-1,2,5,6,7 must be switch ON (at the particular time) and

APPLIANCES-3,4 must be switch OFF (at the particular time)

NOTE:Particular time must be mentioned in CASE 4, that means after following CASE-4 only we should come to CASE-5.

CASE4 and CASE5 are interdependent on each other

13. Advantages

- i. We can save electricity whenever there is no need.
- ii. Full security because we require specific codes in order to access the appliances.
- iii. Control of appliances can be done from anywhere.
- iv. A predefined time when to On/Off the appliance can be given well in advance.

- v. We can control different appliances at different pre defined times.

14. Disadvantages

- i. Wired system
- ii. If the output ports are more than 8, we should require combining of 2 microcontrollers.
- iii. NOTE:With the above programming structure, only 7 ports can be accessed at at one time.
- iv. The program is lengthy.

15. Conclusions

These kinds of home automation systems are required because humans can make mistakes and forgot to switch off the appliances when there is no use and in this case, they are useful in order to utilize the power effectively and also in a secured manner.

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