Automation System Using Embedded IP and Radio Frequency

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CERTIFICATE

This is to certify that the work entitled, "Device Automation using Embedded IP and Radio Frequency" submitted by Anshul Agrawal, Ashish Sharma, Neeraj Kohli in partial fulfillment for the award of degree of Bachelor of Technology, of Jaypee University of Information Technology, in 2007 has been carried out under my supervision.

This work has not been submitted partially or wholly to any other university or institute of award of this or any other degree or diploma.

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ACKNOWLEDGEMENT

TELL ME AND I WILL FORGET

TEACH ME AND I WILL REMEMBER

INVOLVE ME AND I WILL LEARN

We would like to express our gratitude to all those who gave us the support and guidance to complete this project. We express our gratitude to Prof. Sunil V Bhooshan HOD, Department of Electronics and Communication, JUIT for his help, support, interest and valuable suggestions during the project designing and building stage.

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Anshul Agrawal **Ashish Sharma** **Neeraj Kohli**

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LIST OF ABBREVIATIONS

AC	Alternating Current
ALE	Address Latch Enable
DC	Direct Current
EA	External Access Enable
FCC	Federal Communications Commission
GND	Ground
IC	Integrated Circuit
LED	Light Emitting Diode
MOV	Move
NC	Normally Closed
NO	Normally Open
PSEN	Program Store Enable
RAM	Random Access Memory
RST	Reset

ABSTRACT

Remote control based automation system is being considered more and more useful in many applications today. Similarly control of devices online using internet or intranet is a field of interest in the growing technology. This work of ours deals with the implementation of functions, based on the usage of radio control frequencies as well as the powerful tool of networks for the control of automation systems. We have included a system that can control devices effectively and in a non cost prohibitive manner. This work was divided into two modules. In module 1 we developed an embedded application to control the devices in module 1. This utilizes sending commands via internet through DNS server and through TELNET in local area networks. These commands are then processed by an independent microcontroller which results in the desired control. In module 2 we developed the complete system for our application using 35MHz of permitted frequency. This module controls four devices as of now and we have used Atmel's 8051 microcontroller for the overall management.

The biggest feature of our work is that it is highly compatible with the existing technologies as well as can be restructured and updated for future technologies. Secondly, it is a very low cost application. Thirdly, since both the modules are independent but interrelated so this offers a flexible use.

MODULE I

CHAPTER 1: OVERVIEW – MODULE I

1.1 INTRODUCTION

If we're looking for the next new Internet thing or want to surf the latest Web technology wave, or start a dot-com and become a multimillionaire without getting hitched on TV, then we have one word for us: appliances.

Most of the people thought of controlling appliances and other things like bulbs tubes and switches etc using an IR remote or a wired things running from our computer to switch board, but what if we are not at and suddenly we feel that we have left something on but we are not sure and we can't even go back..

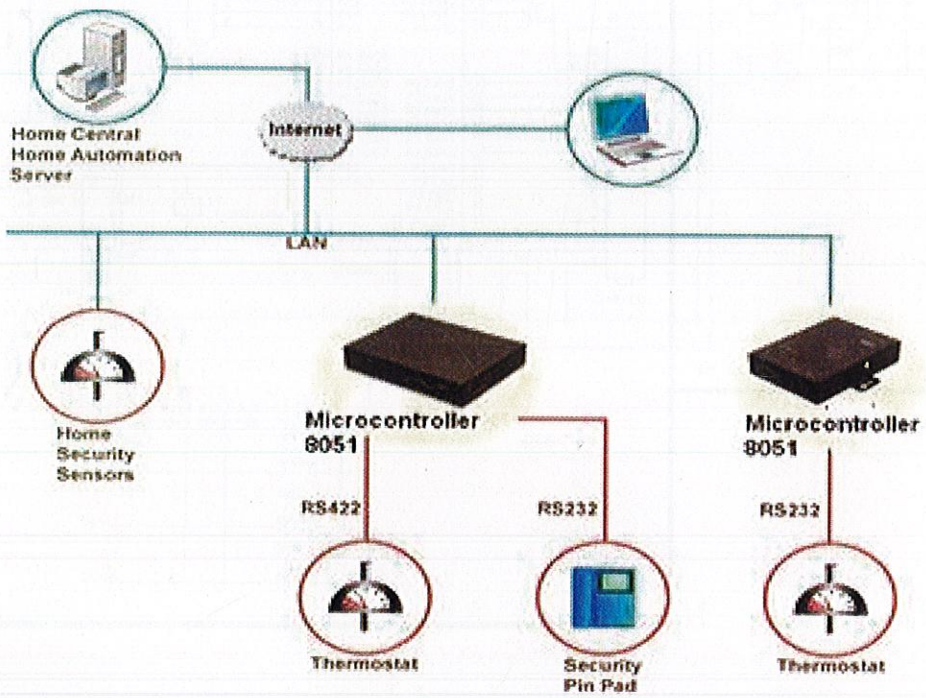


Figure 1: General Block Diagram (module I)

So discussion about the main thing that we can say the backbone of this project is the automation SERVER. The software will help us to emulate our serial communication over a very famous remote access utility called TELNET.

1.2 BASIC OVERVIEW

We have divided the project into two major sections:

1) The hardware section

2) The software section

1.2.1 THE HARDWARE SECTION

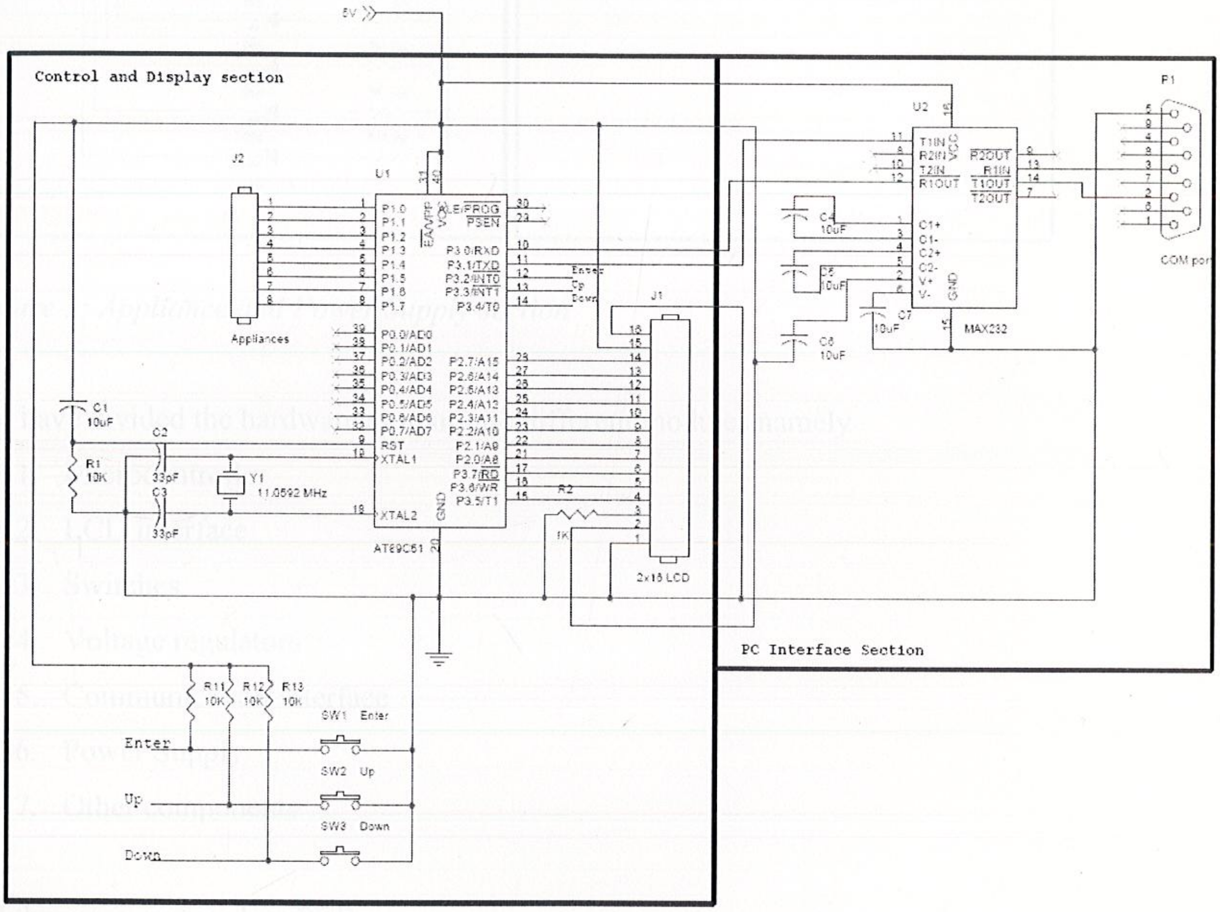


Figure 2: Control, Display and PC interface section

As per the program; the tubes are connected at P1.0 and P1.1; Bulbs are connected at P1.2, P1.3 and P1.4; and switched are connected at P1.5, P1.6 and P1.7. The LCD (16x2 LCD) is connected at P2; and three switches which are used to read the messages i.e. P3.2 for read message, P3.3 for next message and P3.4 for Previous Message. Because of the lack of RAM we can only support maximum of three messages. Control lines are connected with port 3 of the microcontroller. The contrast of the LCD is controlled by 10K variable resistor. Common line is given at +5V. The other lines can be connected with port 2 of microcontroller. The Com port is connected using MAX232 chip.

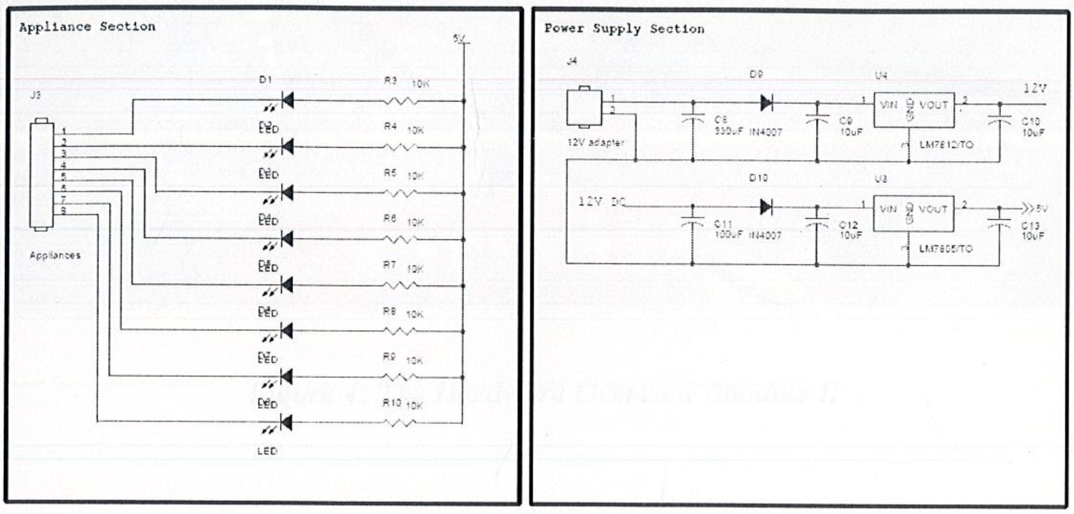


Figure 3: Appliance and Power Supply section

We have divided the hardware system into different modules namely

1. Microcontroller
2. LCD interface
3. Switches
4. Voltage regulators
5. Communication interface
6. Power Supply
7. Other components

All these are mounted on PCB

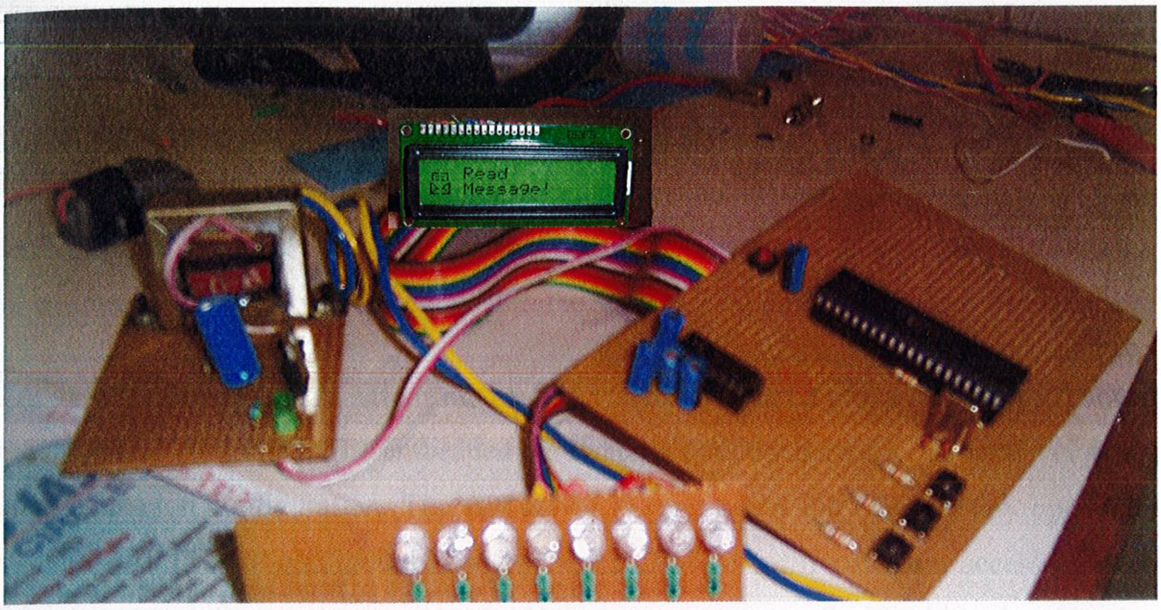


Figure 4: The Hardware Overview (module I)

1.2.2 THE SOFTWARE SECTION

The backbone of this project is the automation SERVER. The software will be help us to emulate our serial communication over a very famous remote access utility called TELNET. So basically a telnet server is created at our host PC.

A screen shot of the working software is shown below.

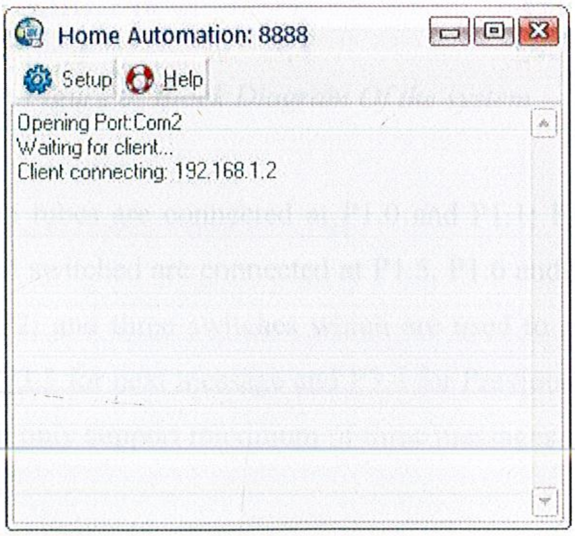


Figure 5: Automation Server Software

We have switches and appliances that are to be controlled. The embedded hardware is then connected to the Computer via serial communication configuration. The HA server is running on the computer with any operating system, with Computer's IP configured. We can use a DNS server if we want access all over the internet and if we are using it on LAN then we can have a fix IP within that domain. So using the telnet command with the IP address of the server we can connect to the server.

Figure 2 shows a block diagram of the full system. We have switches and appliances that are to be controlled. The embedded hardware is then connected to your PC via serial communication configuration. The HA server is running on the PC with any operating system, with PC's IP configured. You can use a DNS server if you want access all over the internet and if you are using it on LAN then you can have a fix IP within that domain. So using the telnet command with the IP address of the server you can connect to the server.

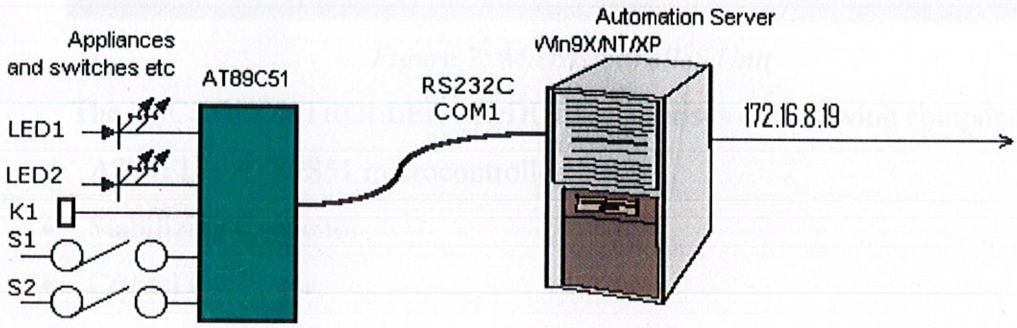


Figure 6: Block Diagram Of the system

As per the program, the tubes are connected at P1.0 and P1.1; Bulbs are connected at P1.2, P1.3 and P1.4; and switched are connected at P1.5, P1.6 and P1.7. The LCD (16x2 LCD) is connected at P2; and three switches which are used to read the messages i.e. P3.2 for read message, P3.3 for next message and P3.4 for Previous Message. Because of the lack of RAM we can only support maximum of three messages.

CHAPTER 2: HARDWARE DISCRIPTION – MODULE I

2.1 MICROCONTROLLER UNIT

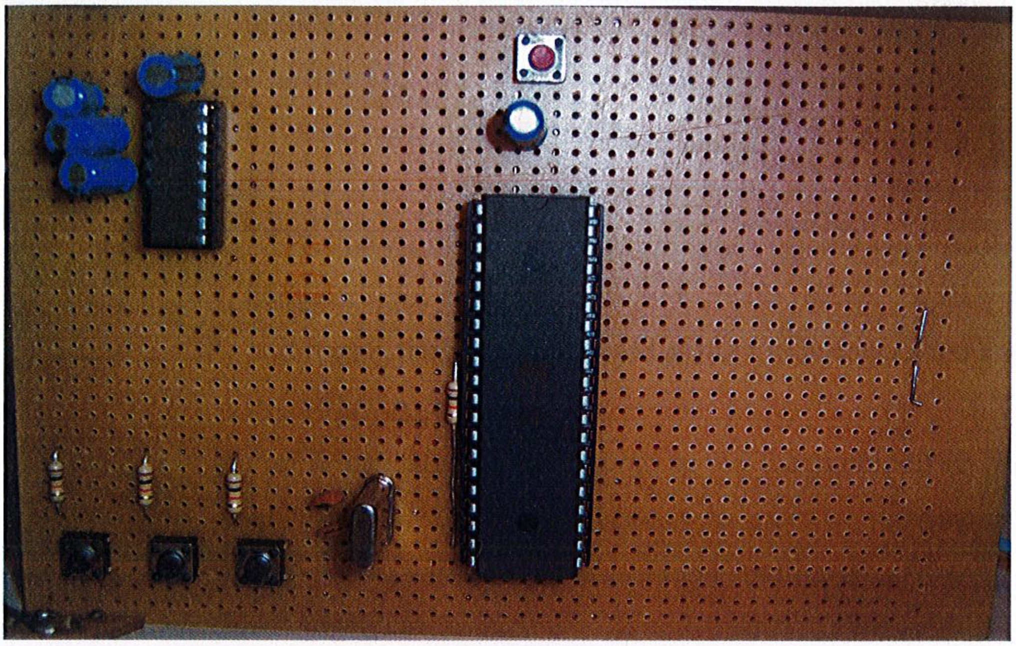


Figure 7: Microcontroller Unit

The MICROCONTROLLER MODULE comprises of following components:

- ATMEL's AT89S51 microcontroller
- Stabilizing Capacitor
- Crystal Oscillator

2.1.1 MICROCONTROLLER

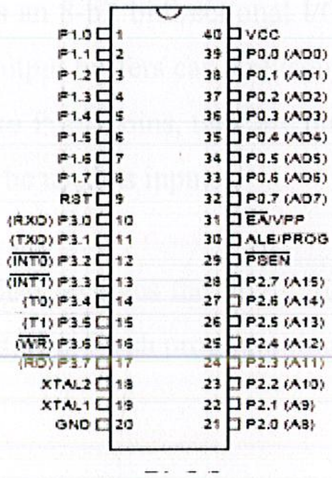


Figure 8: The AT89S51 Pin configuration

Pin Description

VCC:	Supply voltage.
GND:	Ground
Port 0:	Port 0 is an 8-bit open drain bidirectional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high-impedance inputs. Port 0 can also be configured to be the multiplexed low-order address/data bus during accesses to external program and data memory. In this mode, P0 has internal pull-ups.
Port 1:	Port 1 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups.
Port 2	Port 2 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the internal pull-ups and can be used as inputs. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.
RST	Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device.

ALE/PROG	Address Latch Enable (ALE) is an output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation, ALE is emitted at a constant rate of 1/6 the oscillator frequency and may be used for external timing or clocking purposes.
PSEN	Program Store Enable (PSEN) is the read strobe to external program memory.
EA/VPP	External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH.
XTAL1	Input to the inverting oscillator amplifier and input to the internal clock operating circuit.
XTAL2	Output from the inverting oscillator amplifier.

2.1.1.1 Programming the Flash

The AT89C51 is normally shipped with the on-chip Flash memory array in the erased state (that is, contents = FFH) and ready to be programmed. The programming interface accepts either a high-voltage (12-volt) or a low-voltage (VCC) program enable signal. The low-voltage programming mode provides a convenient way to program the AT89C51 inside the user's system, while the high-voltage programming mode is compatible with conventional third-party Flash or EPROM programmers. The AT89C51 is shipped with either the high-voltage or low-voltage programming mode enabled.

2.1.1.2 Memory Organization

Program Memory

The AT89C Microcontroller has separate address spaces for program memory and data memory. The program memory can be up to 64K bytes long. The lower addresses may reside on-chip

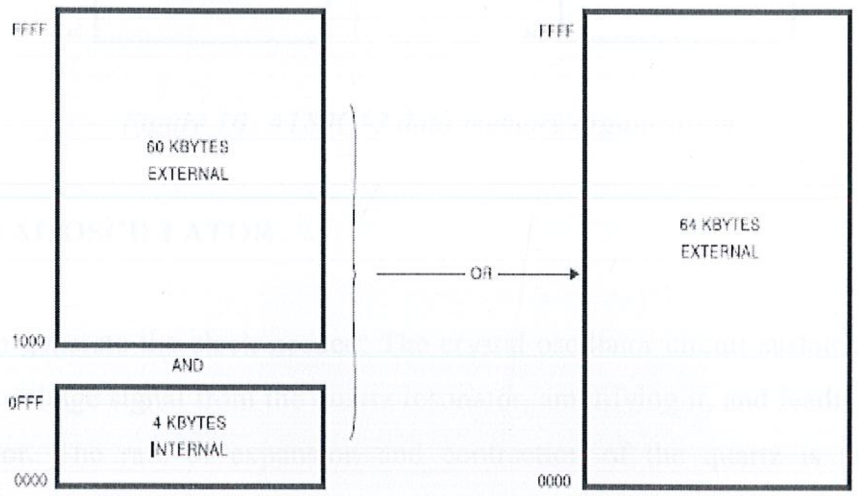


Figure 9: Program Memory

Data Memory

The AT89C can directly address up to 64K bytes of data memory external to the chip. The MOVX instruction accesses the external data memory. The AT89C51 has 128 bytes of on-chip RAM (256 bytes in the AT89C52) plus a number of Special Function Registers (SFRs). The lower 128 bytes of RAM can be accessed either by direct addressing (MOV data addr) or by indirect addressing

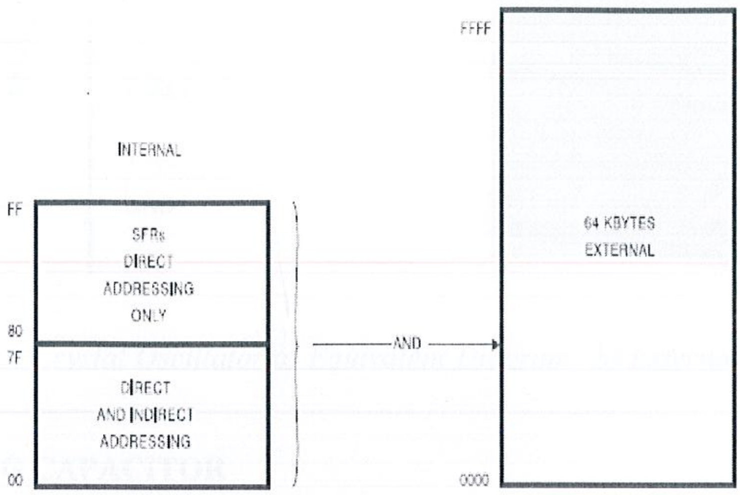
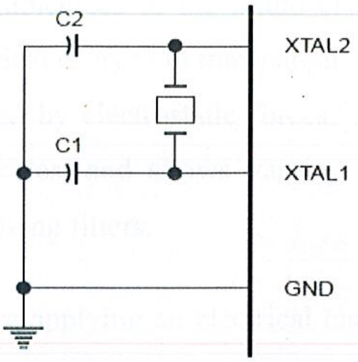


Figure 10: AT89C52 data memory organization

2.2 CRYSTAL OSCILLATOR

It is used to generate the clock needed. The crystal oscillator circuit sustains oscillation by taking a voltage signal from the quartz resonator, amplifying it, and feeding it back to the resonator. The rate of expansion and contraction of the quartz is the resonant frequency, and is determined by the cut and size of the crystal. Fig: Crystal oscillator

A regular timing crystal contains two electrically conductive plates, with a slice or tuning fork of quartz crystal sandwiched between them. During startup, the circuit around the crystal applies a random noise AC signal to it, and purely by chance, a tiny fraction of the noise will be at the resonant frequency of the crystal. The crystal will therefore start oscillating in synchrony with that signal. As the oscillator amplifies the signals coming out of the crystal, the crystal's frequency will become stronger, eventually dominating the output of the oscillator. Quartz crystal filters out all the unwanted frequencies.



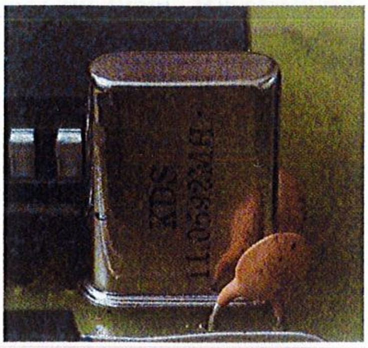


Figure 11: Crystal Oscillator a) Equivalent Diagram b) External view

2.3 STABLIZING CAPACITOR

The role of this capacitor is to normalize the fluctuating voltage.

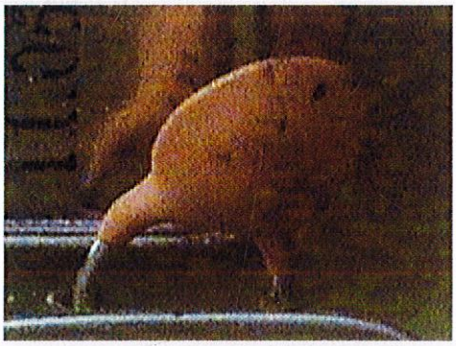


Figure 12: Stabilizing capacitor

2.4 LIQUID CRYSTAL DISPLAY

A **Liquid Crystal Display (LCD)** is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. It is prized by engineers because it uses very small amounts of electric power, and is therefore suitable for use in battery-powered electronic devices.

Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

The molecules of the liquid crystal have electric charges on them. By applying small electrical charges to transparent electrodes over each pixel or sub pixel, the molecules are twisted by electrostatic forces. This changes the twist of the light passing through the molecules, and allows varying degrees of light to pass (or not to pass) through the polarizing filters.

Before applying an electrical charge, the liquid crystal molecules are in a relaxed state. Charges on the molecules cause these molecules to align themselves in a helical structure, or twist (the "crystal"). In some LCDs, the electrode may have a chemical surface that seeds the crystal, so it crystallizes at the needed angle. Light passing through one filter is rotated as it passes through the liquid crystal, allowing it to pass through the second polarized filter. A small amount of light is absorbed by the polarizing filters, but otherwise the entire assembly is transparent.

When an electrical charge is applied to the electrodes, the molecules of the liquid crystal align themselves parallel to the electric field, thus limiting the rotation of entering light. If the liquid crystals are completely untwisted, light passing through them will be polarized perpendicular to the second filter, and thus be completely blocked. The pixel will appear unlit. By controlling the twist of the liquid crystals in each pixel, light can be allowed to pass though in varying amounts, correspondingly illuminating the pixel. Many LCDs are driven to darkness by an alternating current, which disrupts the twisting effect, and become faint or transparent when no current is applied.

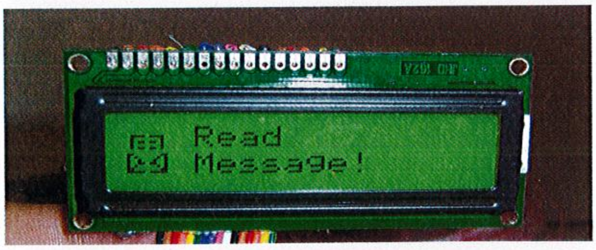


Figure 13: Liquid Crystal Display

2.5 COMMUNICATION INTERFACE

2.5.1 General Description

The MAX220–MAX249 family of line drivers/receivers is intended for all EIA/TIA-232E and V.28/V.24 communications interfaces, particularly applications where ±12V is not available.

These parts are especially useful in battery-powered systems, since their low-power shutdown mode reduces power dissipation to less than 5μW. The MAX225, MAX233, MAX235, and MAX245/MAX246/MAX247 use no external components and are recommended for applications where printed circuit board space is critical.

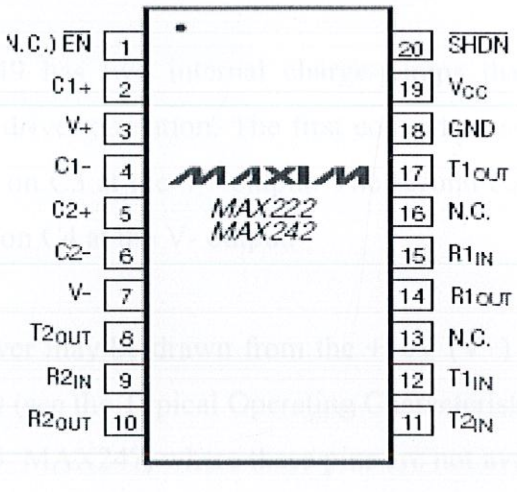


Figure 14: Communication link

2.5.2 APPLICATIONS

- Portable Computers
- Low-Power Modems
- Interface Translation
- Battery-Powered RS-232 Systems
- Multidrop RS-232 Networks
- Drivers/Receivers

2.5.3 FEATURES

- Superior to Bipolar
- Operate from Single +5V Power Supply (+5V and +12V—MAX231/MAX239)

- Low-Power Receive Mode in Shutdown
- Multiple Drivers and Receivers
- 3-State Driver and Receiver Outputs

2.5.4 DESCRIPTION

The MAX220–MAX249 contains four sections:

a) Dual Charge-pump DC-DC voltage converters

b) RS-232 drivers and receivers

c) Receiver and transmitter enable control inputs

d) Dual Charge-Pump Voltage Converter

The MAX220–MAX249 has two internal charge-pumps that convert +5V to ±10V (unloaded) for RS-232 driver operation. The first converter uses capacitor C1 to double the +5V input to +10V on C3 at the V+ output. The second converter uses capacitor C2 to invert +10V to -10V on C4 at the V- output.

A small amount of power may be drawn from the +10V (V+) and -10V (V-) outputs to power external circuitry (see the Typical Operating Characteristics section), except on the MAX225 and MAX245–MAX247, where these pins are not available. V+ and V- are not regulated, so the output voltage drops with increasing load current.

Input thresholds are both TTL and CMOS compatible. The inputs of unused drivers can be left unconnected since 400kO input pull-up resistors to VCC are built in (except for the MAX220). The pull-up resistors force the outputs of unused drivers low because all drivers invert. The internal input pull-up resistors typically source 12μA, except in shutdown mode where the pull-ups are disabled. Driver outputs turn off and enter a high-impedance state—where leakage current is typically microamperes (maximum 25μA)—when in shutdown mode, in three-state mode, or when device power is removed. Outputs can be driven to ±15V. The power-supply current typically drops to 8μA in shutdown mode. The MAX220 does not have pull-up resistors to force the outputs of the unused drivers low. Connect unused inputs to GND or VCC.

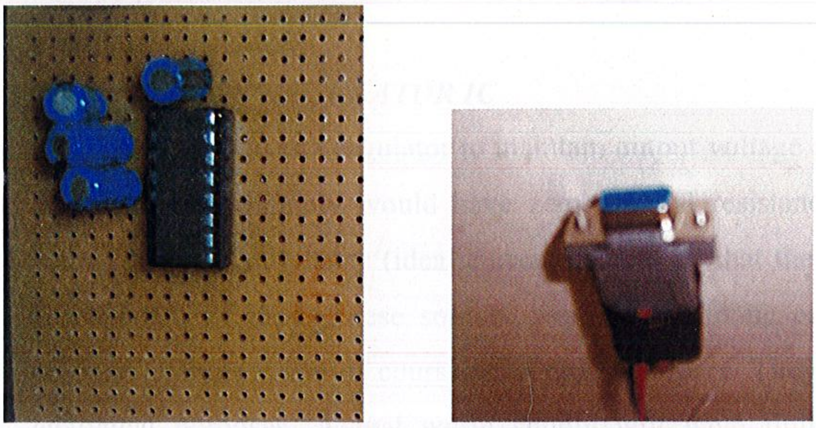


Figure 15: Communication link – MAX 232

2.6 SWITCHES

This switch is used to reset the values. In other words these initialize the value.

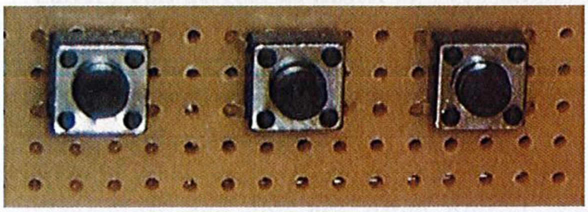


Figure 16: Switches

These three switches control the set point.

- One of them is used for setting the set point
- Other for incrementing
- The third one for decrementing

2.7 VOLTAGE REGULATOR

This module consists of

- Voltage regulator
- Filter capacitors
- Diodes

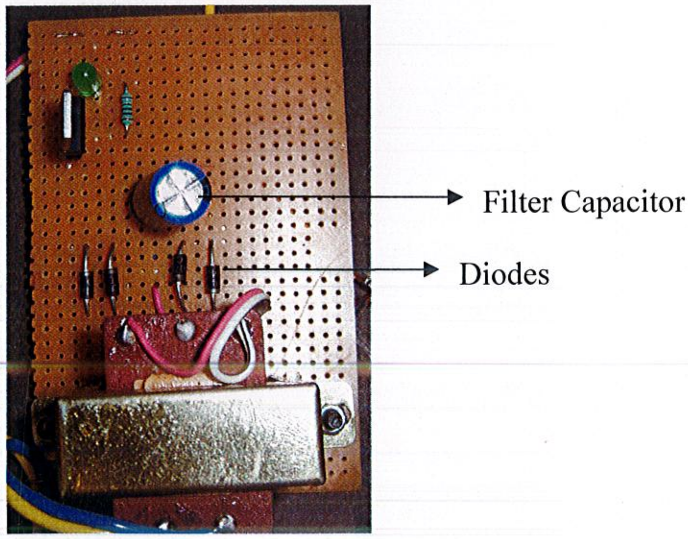


Figure 17: Voltage regulator

2.7.1 VOLTAGE REGULATOR IC

A power supply uses a regulator to maintain output voltage or current at specified limits. An ideal power supply would have zero internal resistance (ideal voltage source) or infinite internal resistance (ideal current source) so that the output voltage or current is independent of load. These sources would have to be capable of supplying infinite amounts of power and of course exist only in theory. They are used in engineering for analytical purposes. A real world supply will have finite internal impedance. This impedance may vary with the load on the supply. The maximum current a voltage source can deliver into a short circuit or the maximum voltage a current source can deliver across a load can sometimes be quite high. As an example, a common 12 Volt automobile battery can deliver as much as 1000 amps.

2.7.2 FILTER CAPACITORS

Capacitors can and are often placed across the regulator output terminals to reduce residual ripple and to ensure low output impedance, but be aware that capacitive loads may cause problems with loop stability.

Also, if the input voltage falls below the output voltage due to a short or component failure, or sudden removal of the input voltage, this capacitor can discharge back into the regulator, possibly damaging the pass transistor emitter-base junction due to reverse over voltage. A protection diode is often added across the pass transistor to guard against this type of fault.

CHAPTER 3: PROGRAM – MODULE I

3.1 COMMANDS

Following are the commands which are used in our project.

COMMAND	DESCRIPTION
stat	To get the status of all the appliances connected to the controller.
tube	To switch ON/OFF the tubes. Selecting any one out of two.
Bulb	To switch ON/OFF the bulbs, selecting any one out of the three bulbs.
swch	To switch ON/OFF the switches connected to the controller, selecting anyone out of three switches.
msg	To leave a message. Maximum of three messages and each containing maximum 28 characters.
?	To display help menu.

Figure 18: Table showing commands used

3.2 ALGORITHM

Automation()
Step 1: Initialize serial port
Step 2: Initialize the LCD
Step 3: Display the welcome text on the LCD
Step 4: Monitor the connection for incoming messages or commands
Step 5: Repeat step 4 until the connection is not terminated
Step 6: End

Send_Status()
Step 1: Initialize the status pointers
Step 2: Check for status of all connected devices
Step 3: repeat step 2 until all device's status are checked
Step 4: compile the status of all the connected devices
Step 5: send the report back to the administrator
Step 6: End

Tube()
Step 1: Initializing the status pointers
Step 2: Get status of all tubes at the administrator
Step 3: Administrator is prompted to change status of any of the tubes
Step 4: End

Bulb()
Step 1: Initializing the status pointers
Step 2: Get status of all bulbs at the administrator
Step 3: Administrator is prompted to change status of any of the bulbs
Step 4: End

Switches()
Step 1: Initializing the status pointers
Step 2: Get status of all switches at the administrator
Step 3: Administrator is prompted to change status of any of the switches
Step 4: End

Help()
Step 1: Displays help message at the administrator
Step 2: End

3.3 FLOWCHART

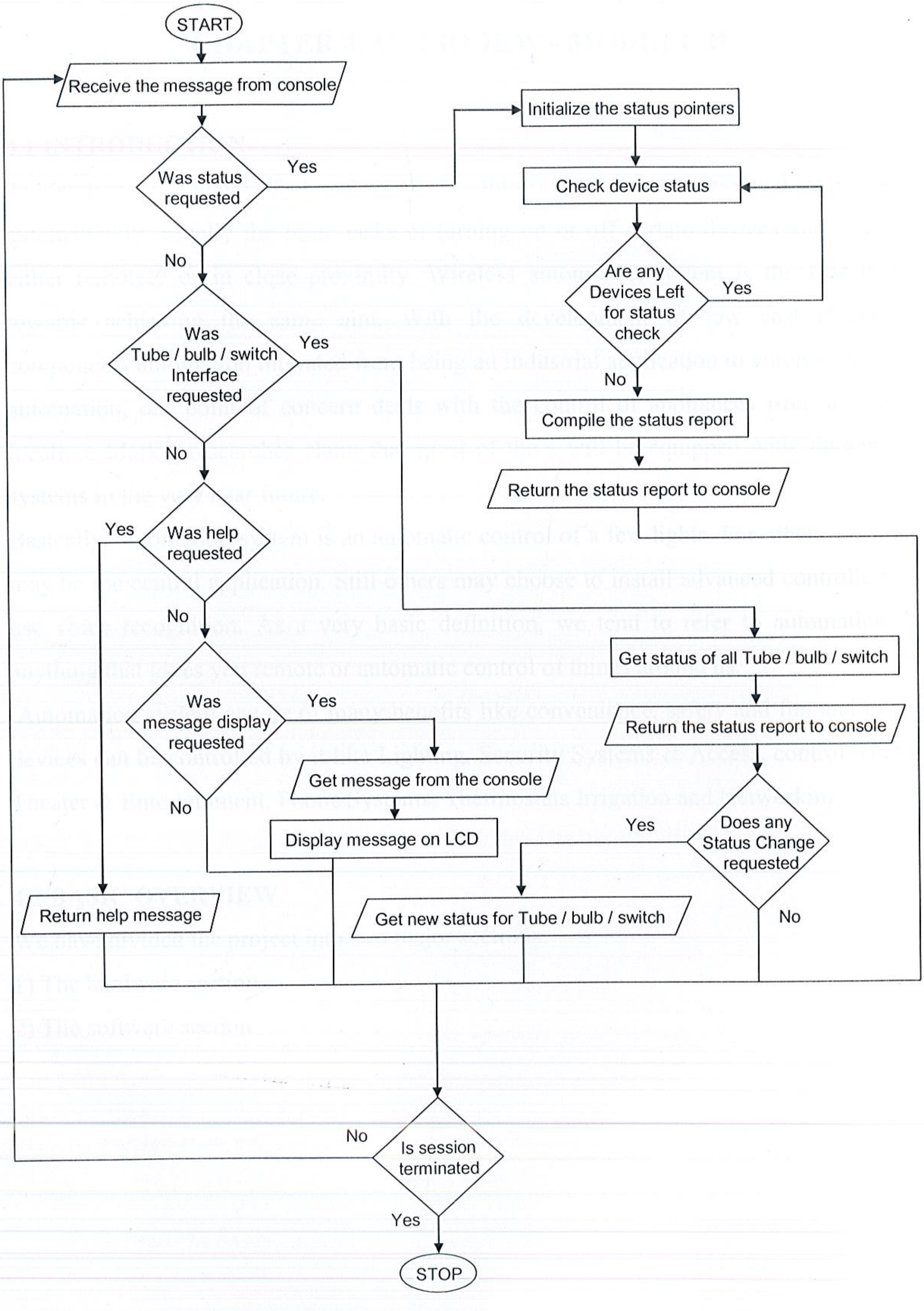


Figure 19: Flowchart of automation system (module I)

MODULE II

CHAPTER 4: OVERVIEW - MODULE II

4.1 INTRODUCTION

Automation is today's fact, where more things are being completed every day automatically, usually the basic tasks of turning on or off certain devices and beyond, either remotely or in close proximity. Wireless automation system is the first move towards achieving the same aim. With the development of low cost electronic components automation migrated from being an industrial application to automation. The automation, our point of concern deals with the control of appliances from a central location. Market researches claim that most of the s will be equipped with automation systems in the very near future.

Basically, automation system is an automatic control of a few lights. For others, security may be the central application. Still others may choose to install advanced controllers or use voice recognition. As a very basic definition, we tend to refer to automation as anything that gives you remote or automatic control of things around us.

Automation system can be of many benefits like convenience, safety and fun and many devices can be controlled by it like Lighting, Security Systems & Access, control, Home Theater & Entertainment, Phone Systems, Thermostats Irrigation and Networking.

4.2 BASIC OVERVIEW

We have divided the project into two major sections:

1) The hardware section

2) The software section

4.2.1 HARD WARE SECTION

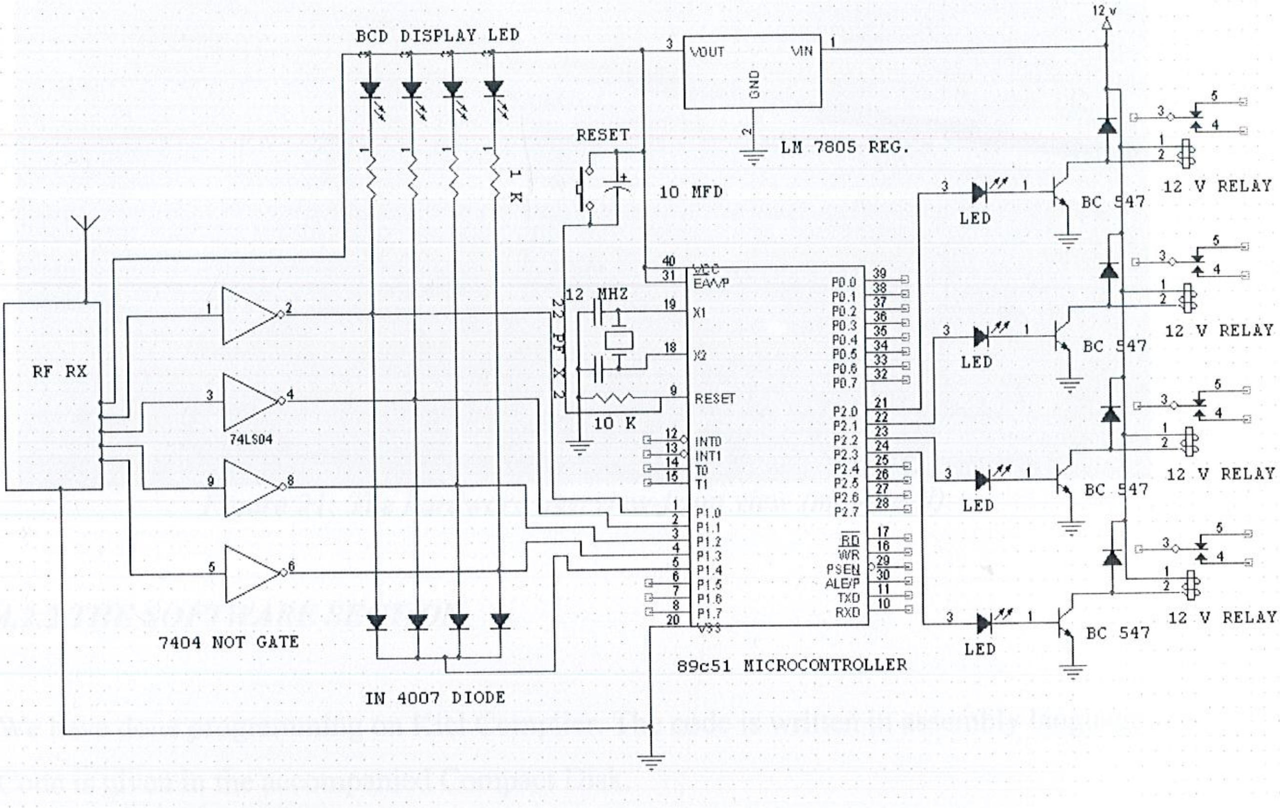


Figure 20: Circuit Diagram of complete hardware module II

Here p1 port is taking the inputs and p2 port is driving the outputs. Such that when input at p1.0 is triggered then port at p2.0 excites the relay trigger it and switch on/off the corresponding appliance connected to it.

We have divided the hardware system into different modules namely

8. Microcontroller
9. LCD interface
10. Switches
11. Voltage regulators
12. Communication interface
13. Power Supply
14. Other components

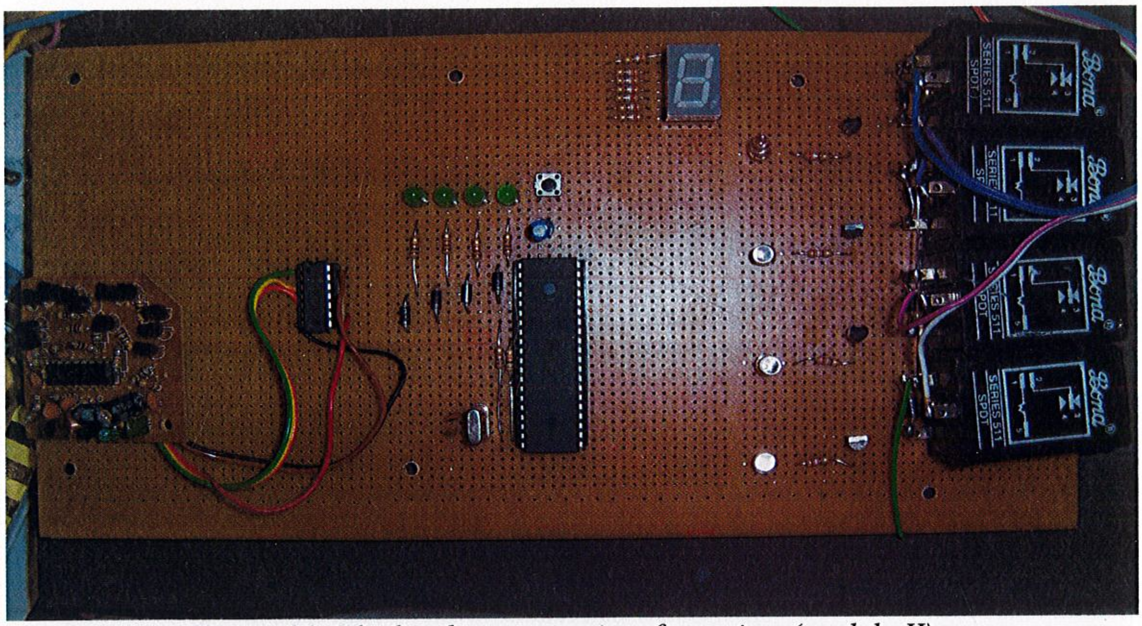


Figure 21: The hardware overview-front view (module II)

4.2.2 THE SOFTWARE SECTION

We have done programming on Kiel Compiler. The code is written in assembly language. Code is given in the accompanied Compact Disk.

4.3 WORKING OF THE HARDWARE

The circuit designed uses a transmitter and a receiver section. The transmitter sends a signal over a frequency to the receiver. The transmitter has a power source that provides the power for the controls and transmission of the signal. This module operates at 35 MHz. This frequency has been allocated by the FCC for basic consumer items. This transmitter sends bursts of radio waves that oscillate with a frequency of 35,000,000 cycles per second (35 MHz) as pulse modulation. The receiver is constantly monitoring the assigned frequency for a signal. When the receiver receives the radio bursts from the transmitter, it sends the signal to a filter that blocks out any signals picked up by the antenna other than 35 MHz. The remaining signal is converted back into an electrical pulse sequence. The pulse sequence is sent to the IC, which decodes the sequence and servers as input to the microcontroller unit for further action.

CHAPTER 5: HARDWARE DISCRIPTION – MODULE II

5.1 MICROCONTROLLER UNIT

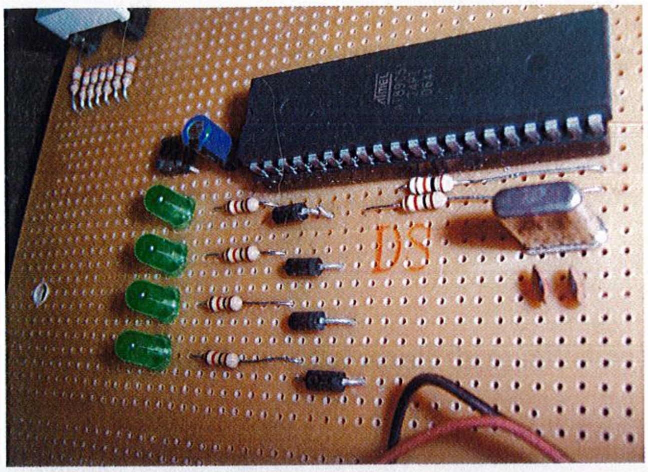


Figure 22: Microcontroller Unit (module II)

The MICROCONTROLLER MODULE comprises of following components:

- AT Mel's AT89S51 microcontroller
- Stabilizing Capacitor
- Crystal Oscillator

The details have been discussed in MODULE I.

5.2 SEVEN SEGMENT DISPLAY

A **seven-segment display** is a form of display device that is an alternative to the more complex dot-matrix displays. Seven-segment displays are commonly used in electronics as a method of displaying decimal numeric feedback on the internal operations of devices. In our project, it shows the device number which is being operated by radio frequency.

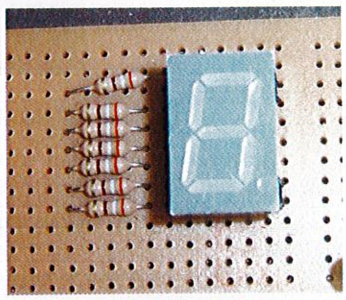
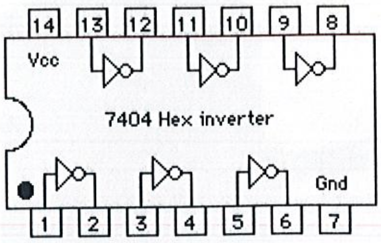


Figure 23: Seven segment display

5.3 NOT GATE IC 7404



$Y = \overline{A}$

Inputs	Output
A	Y
L	H
H	L

H = High Logic Level
L = Low Logic Level

Figure 24: NOT Gate IC 7404

5.4 SWITCHES

This switch is used to reset the values. In other words these initialize the value.

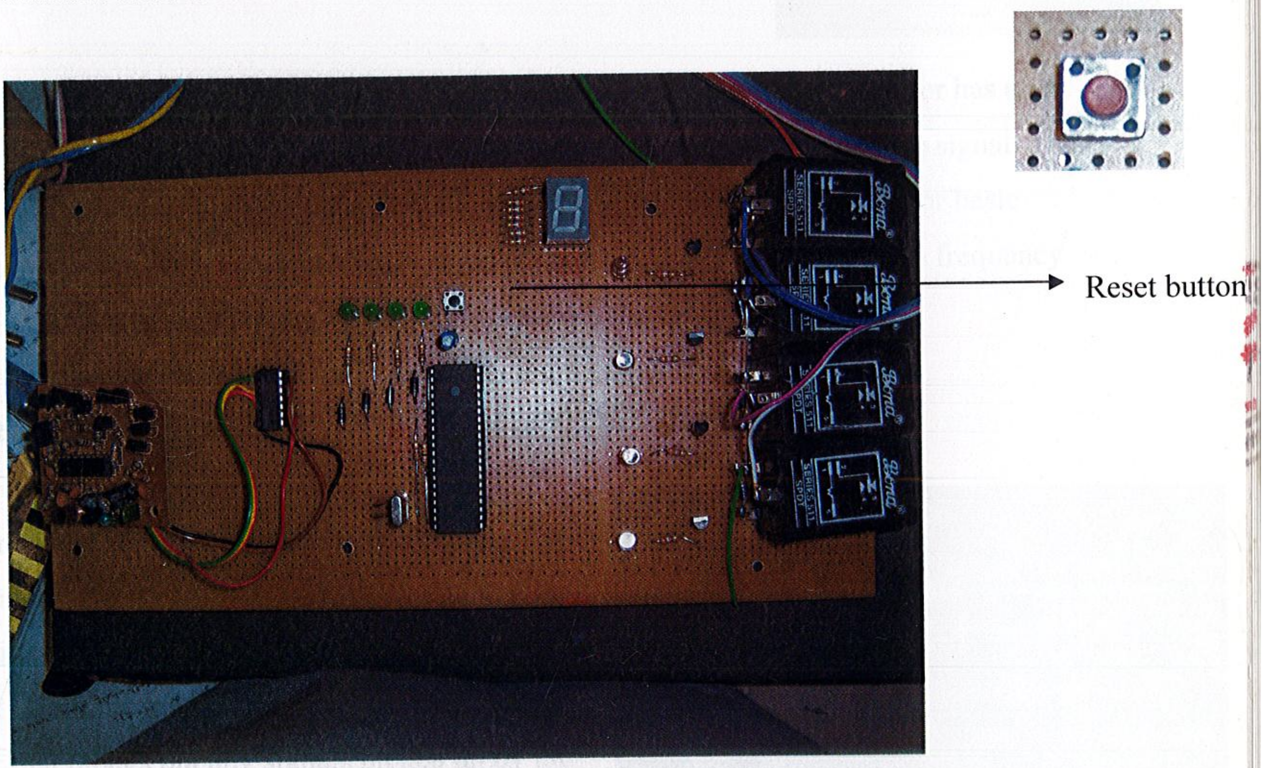
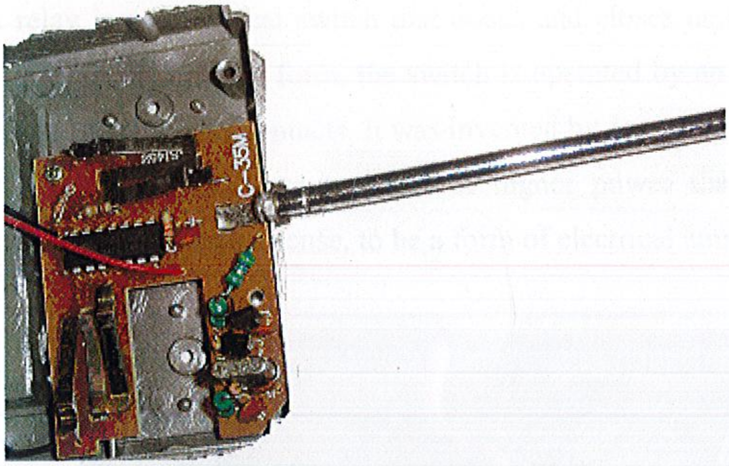


Figure 25: Picture indicating switch button in the module

This one switch servers as reset to the automation system such that each time this is pressed all 4 green LEDs at input port (port 1) glows and all the relays are switched off. This switch connects to the reset state of the microcontroller i.e. pin no 9 which goes high on resetting.

5.5 TRANSMITTER SECTION



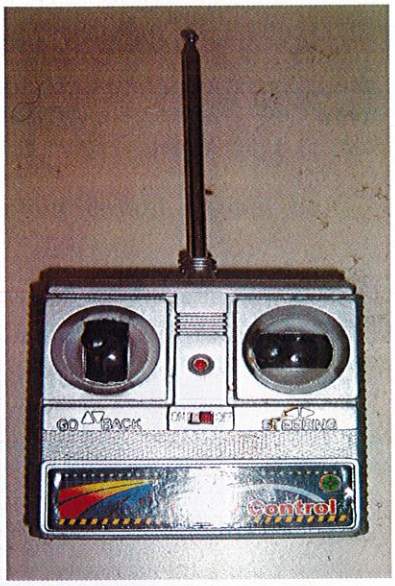


Figure 26: Transmitter module

The transmitter sends a signal over a frequency to the receiver. The transmitter has a power source that provides the power for the controls and transmission of the signal. This module operates at 35 MHz. This frequency has been allocated by the FCC for basic consumer items. This transmitter sends bursts of radio waves that oscillate with a frequency of 35,000,000 cycles per second (35 MHz) as pulse modulation.

5.6 RECEIVER SECTION

The receiver receives the transmitted signal. It is constantly monitoring the assigned frequency for a signal. When the receiver receives the radio bursts from the transmitter, it sends the signal to a filter that blocks out any signals picked up by the antenna other than 35 MHz. The remaining signal is converted back into an electrical pulse sequence. The pulse sequence is sent to the IC, which decodes the sequence and starts the appropriate action to be taken.

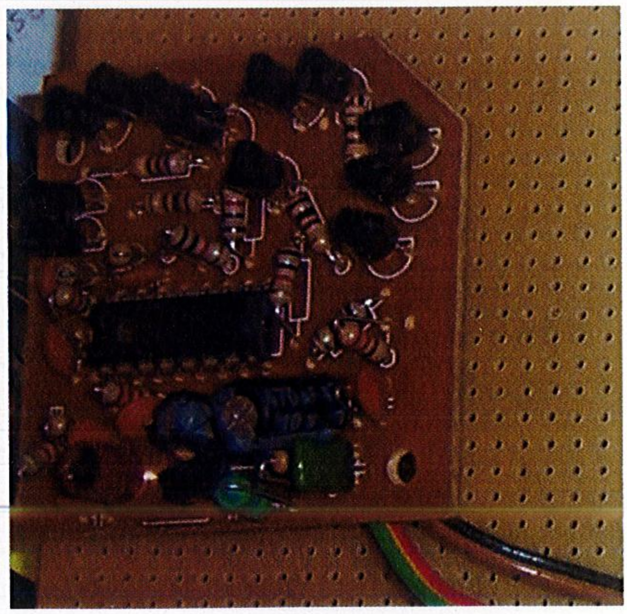


Figure 27: Receiver module

5.7 RELAYS

A relay is an electrical switch that opens and closes under 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. It was invented by Joseph Henry in 1835. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered, in a broad sense, to be a form of electrical amplifier.

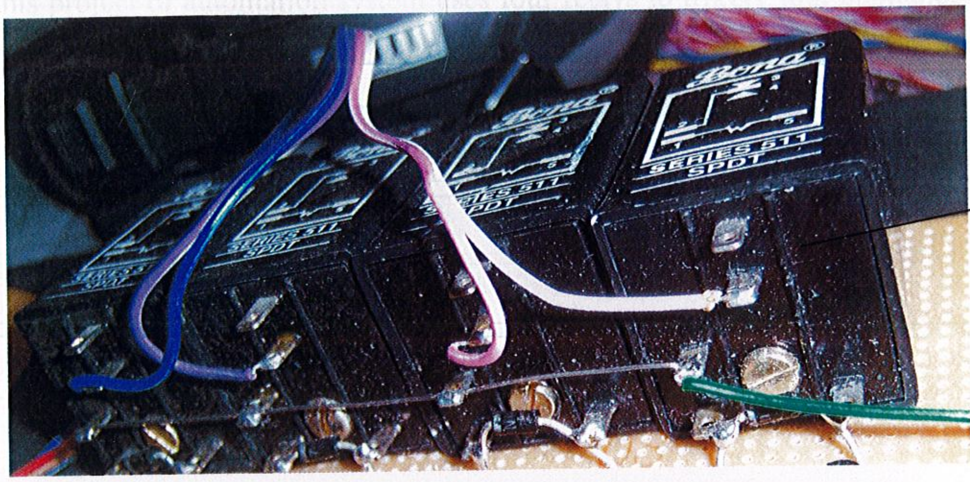


Figure 28: Picture indicating relays in the module

These contacts can be either Normally Open (NO), Normally Closed (NC), or change-over contacts.

- Normally-open contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. It is also called Form A contact or "make" contact. Form A contact is ideal for applications that require to switch a high-current power source from a remote device.
- Normally-closed contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. It is also called Form B contact or "break" contact. Form B contact is ideal for applications that require the circuit to remain closed until the relay is activated.
- Change-over contacts control two circuits: one normally-open contact and one normally-closed contact with a common terminal. It is also called Form C contact.

Uses of relays:

- To control a high-voltage circuit with a low-voltage signal, as in some types of modems,
- To control a high-current circuit with a low-current signal.

This project of automation system uses four relays to trigger four appliances that run on high power. However, many more appliances can be connected to the system using relays.

CHAPTER 6: PROGRAM – MODULE II

6.1 ALGORITHM

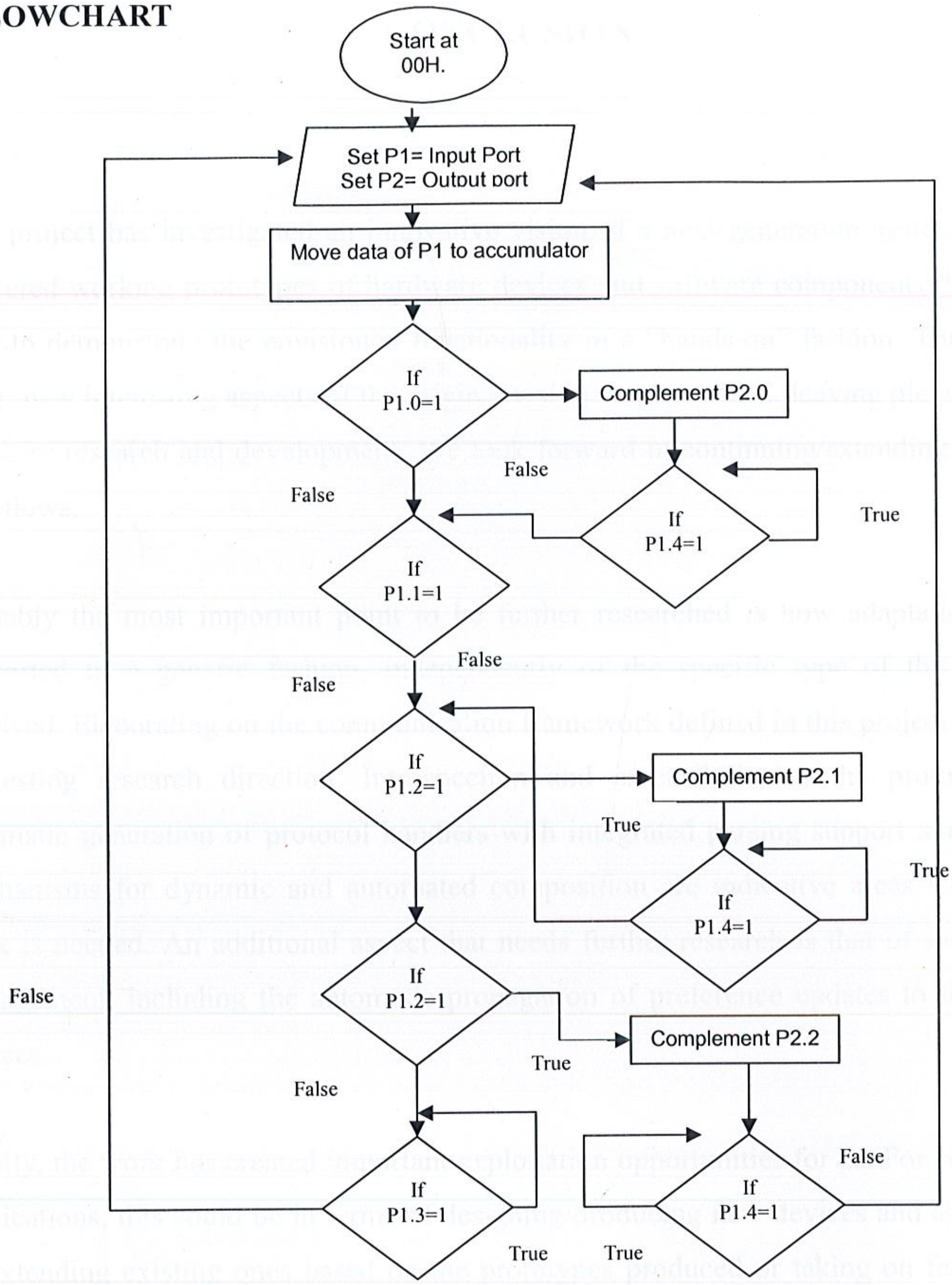
1) Initialize initial location address to #00H.
2) Program port P1 as input port.
3) Set port P2 as an output port
4) Initially move flow of control by moving P1 data to accumulator
5) If P1 .0 = =High then complement P2.0
6) Else If P1 .1 = =High then complement P2.1
7) Else If P1 .2 = =High then complement P2.2
8) Else If P1 .3 = =High then complement P2.3
9) Otherwise go back point 2 and continue

6.2 PSEUDO CODE

```
While (true)

 {

   acc= P1 ;  //acc stands for accumulator while P are the ports

   If(acc = = #f1H)

   {

     P2.0 = not(P2.0);

    while(P1.4 = = 1);

   }

  else If(acc = = #f2H)

  {   P2.1 = not(P2.1);

    while(P1.4 = = 1);
```

```
}

else If(acc = = #f4H)

{     P2.2 = not(P2.2);

      while(P1.4 = = 1);

}

else If(acc = = #f8H)

{     P2.3 = not(P2.3);

      while(P1.4 = = 1);

}

}//end of  while
```

6.3 FLOWCHART



CONCLUSION

This project has investigated an innovative vision of a next-generation system, and has delivered working prototypes of hardware devices and software components that can be used to demonstrate the envisioned functionality in a "hands-on" fashion. Through this work, new interesting aspects of the original vision were revealed, leaving plenty of room for more research and development. We look forward in continuing/extending this work as follows.

Probably the most important point to be further researched is how adaptation can be supported in a generic fashion, independently of the specific type of the resources involved. Elaborating on the communication framework defined in this project is another interesting research direction. Introspection and extensibility at the protocol level, automatic generation of protocol handlers with integrated parsing support and concrete mechanisms for dynamic and automated composition are indicative areas where more work is needed. An additional aspect that needs further research is that of system-wide management, including the automatic propagation of preference updates to the various devices.

Finally, the work has created important exploitation opportunities for us. For commercial applications, this could be in terms of designing/producing new devices and applications or extending existing ones based on the prototypes produced or taking on features that were implemented in this project. Academic and research pursuers can pursue the various research issues, and may use parts of the system prototype and demonstrator in student projects.

BIBLIOGRAPHY

1. 8051 Microcontroller and Embedded Systems by Muhammad Ali Mazidi, Janice Mazidi, Janice Gillispie Mazidi
2. Designing Embedded Internet Devices by Brian DeMuth, Dan Eisenreich
3. Embedded Internet Design by Al Williams

WEB RESOURCES

For circuit Concept

http://electrosofts.com/dtmf/index.html

For datasheets of Components

http://www.alldatasheet.com/

For relay configuration

http://en.wikipedia.org/wiki/Relay

Other important resources

http://www.homeauto.com/main.asp

http://www.smarthome.com

www.google.com

www.electronicsforu.com

www.wikipedia.com