Automation System Using Radio Frequency

By
ASHISH GUPTA -031022
ASHISH SHARMA-031037
NEERAJ KOHLI-031049

MAY – 2007

Submitted in partial fulfillment of the Degree of Bachelor of Technology

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY
WAKNAGHAT

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY
(Established by H.P. State Legislative vide Act No. 14 of 2002)
Waknaghat, P.O. Dumehar Bani, Kandaghat, Distt. Solan - 173215 (H.P.) INDIA
Website : www.juit.ac.in
Phone No. (91) 01792-257999 (30 Lines).
Fax: (91) 01792 245362

CERTIFICATE

This is to certify that the work entitled, "Device Automation using Radio Frequency" submitted by Ashish Gupta, 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.

Supervisor:

Tapas Chakarvarty
Professor
Department of Electronics and Communication Engineering,
Jaypee University of Information Technology,
Waknaghat, Solan, H.P.
INDIA

ACKNOWLEDGEMENT

"TELL ME AND I WILL FORGET
TEACH ME AND I WILL REMEMBER
INVOLVE ME AND I WILL LEARN"

No research endeavor is a sole exercise; various individuals in their own capacity at some point or other contributed in bringing of fruition of the research endeavor, in acknowledging their guidance, support and assistance, we humbly thank them.

We would like to express our sincere thanks and gratitude to **Mr.** Tapas Chakarvarty, Department of Electronics and Communication Engineering, under whose able guidance we managed to give our endeavor the desired shape, his help, stimulating suggestions and constant encouragement helped us at every phase of the project. His enthusiasm and the view of producing quality substance has casted a deep and a long lasting impression on us.

Finally, we thank all our colleagues for their constant support and encouragement. Their unobtrusive support and suggestions bolstered our confidence as usual. Their inspiring words will be a guiding force in all our endeavors to attain greater heights.

Ashish Gupta Ashish Sharma Neeraj Kohli

LIST OF FIGURES

LIST OF ABBREVATIONS

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

The aim of automation is to control devices from a central control point. In this project, we present the design and implementation of a low cost but yet flexible RF based automation system. The communication between the devices is wireless. The project is designed for simple in the design is enhanced to be suitable for most of the appliances. The system is designed to be low cost and flexible with the increasing variety of devices to be controlled.

TABLE OF CONTENTS

CHAPTER 3: EMBEDDED PROGRAM

CHAPTER 1
OVERVIEW TO THE PROJECT

1.1 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 home automation system is the first move towards achieving the same aim. With the development of low cost electronic components home automation migrated from being an industrial application to home automation. The home automation, our point of concern deals with the control of home appliances from a central location. Market researches claim that most of the homes will be equipped with home automation systems in the very near future.

Basically, home 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 home automation as anything that gives you remote or automatic control of things around the home.

Home 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, Networking.

1.2 BASIC OVERVIEW

We have divided the project into two major sections:

1) The hardware section

2) The software section

1.2.1 HARD WARE SECTION

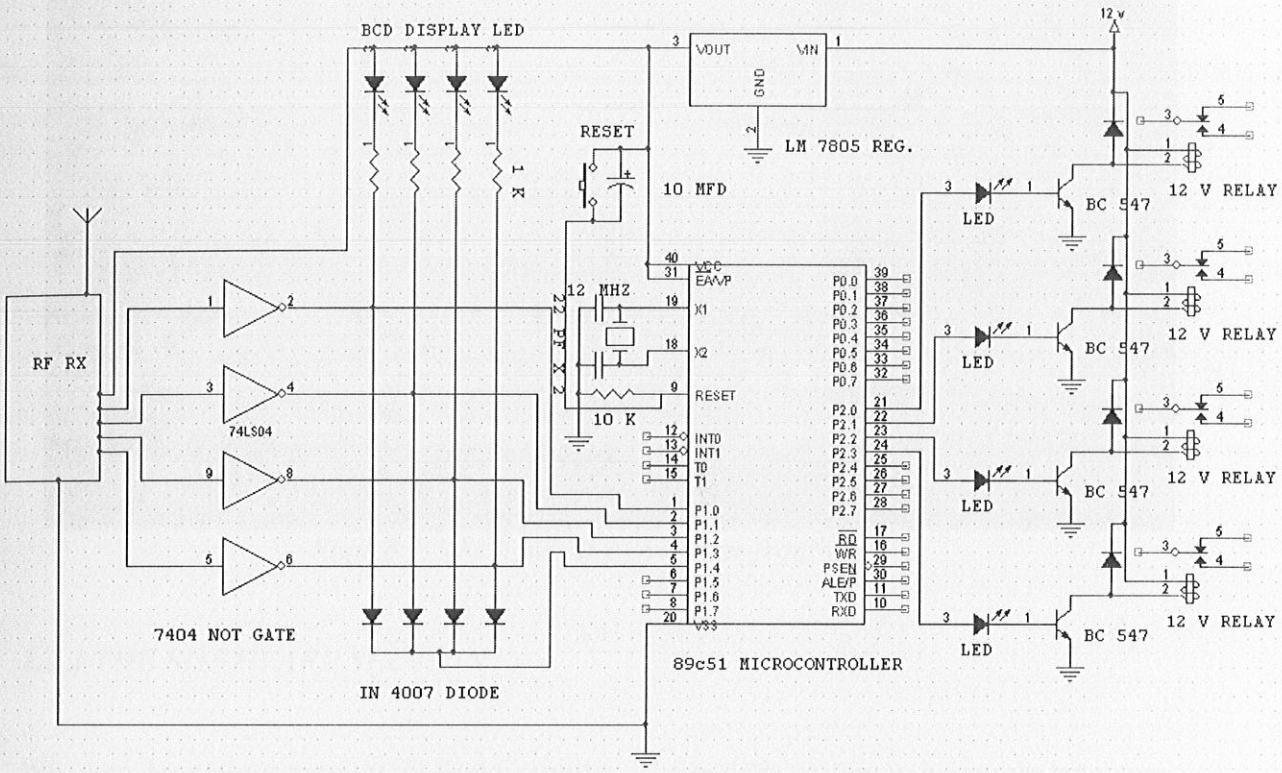


Figure 1: Circuit Diagram of complete hardware module

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

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

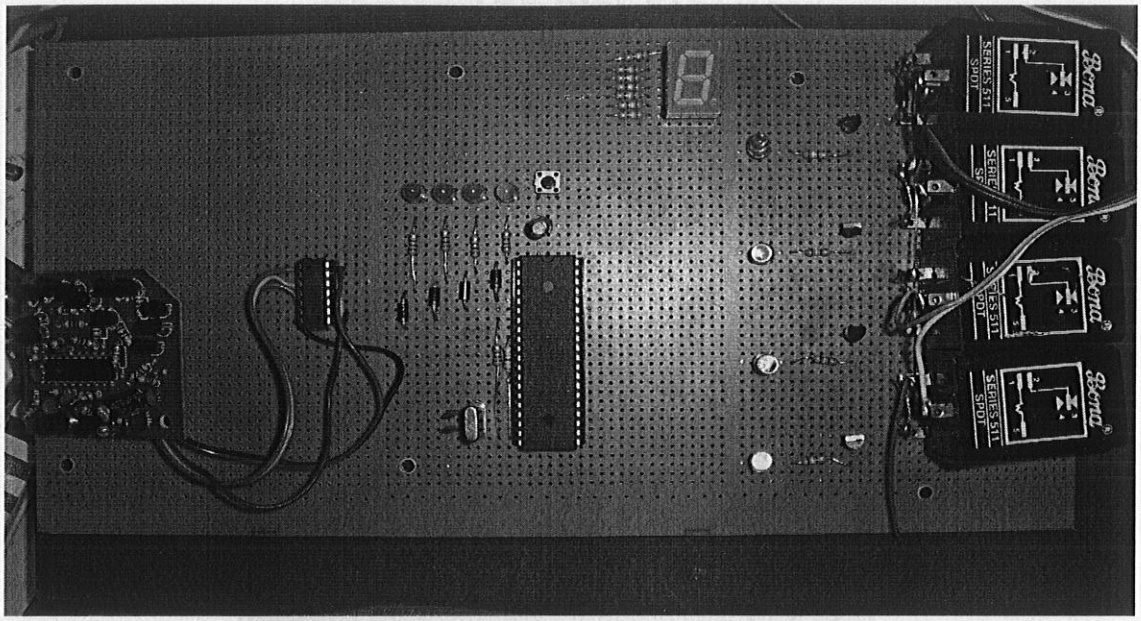


Figure 2: The hardware overview-front view

1.2.2 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.

1.3 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 2

HARDWARE DISCRIPTION

2.1 MICROCONTROLLER UNIT

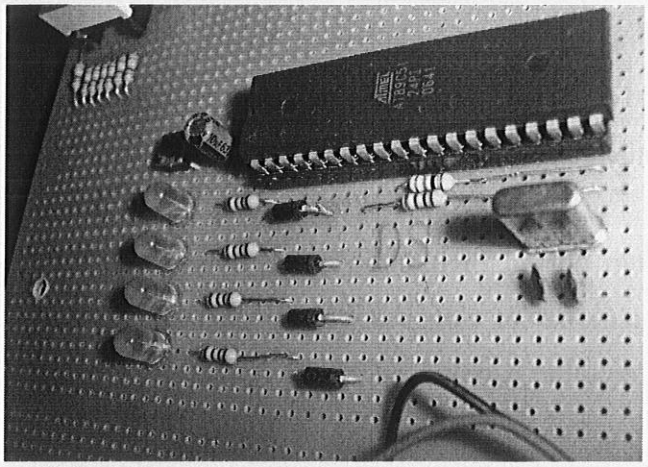


Figure 3: Microcontroller Unit

The MICROCONTROLLER MODULE comprises of following components:

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

2.1.1 MICROCONTROLLER

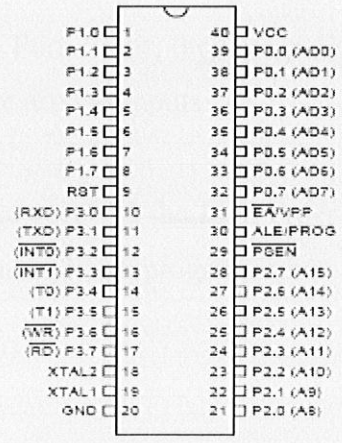


Figure 4: The AT89S51 Pin configuration

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

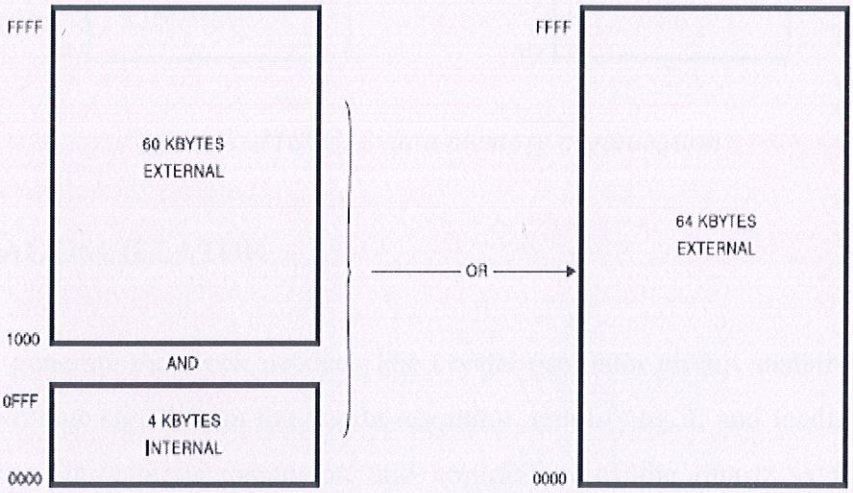


Figure 5: Program Memory

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

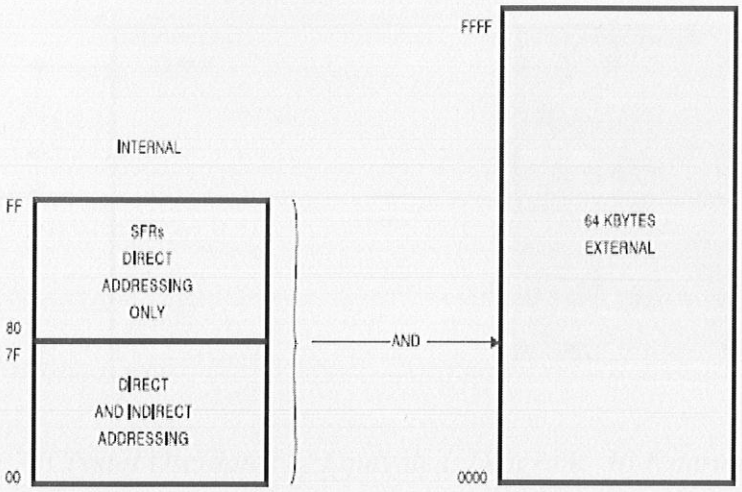


Figure 6: AT89C52 data memory organization

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 7: Crystal Oscillator a) Equivalent Diagram b) External view

2.3 STABLIZING CAPACITOR

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

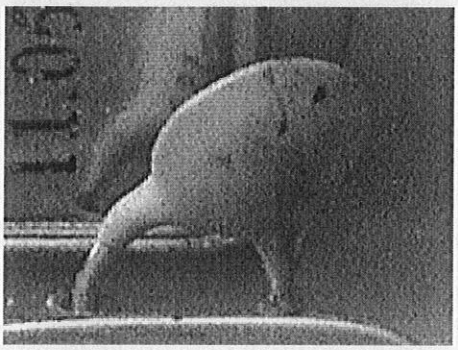


Figure 8: Stabilizing capacitor

2.4 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.

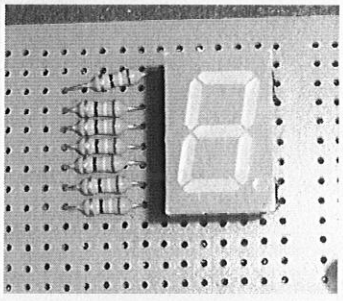
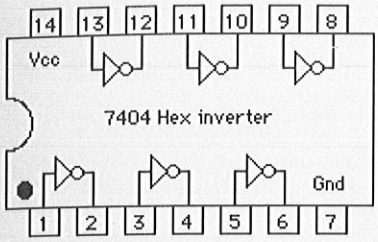


Figure 9: Seven segment display

2.5 NOT GATE IC 7404



$Y = \overline{A}$

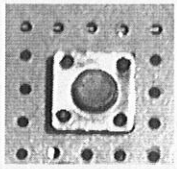
Inputs	Output
A	Y
L	H
H	L

H = High Logic Level
L = Low Logic Level

Figure 10: NOT Gate IC 7404

2.6 SWITCHES

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



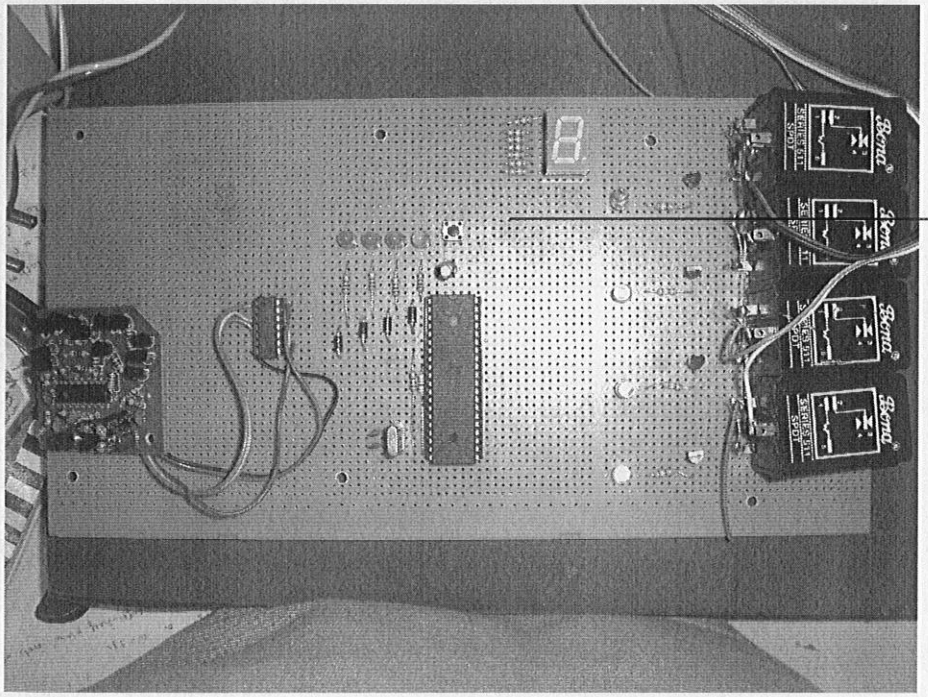


Figure 11: Picture indicating switch button in the module

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.

2.7 VOLTAGE REGULATOR

This module consists of

- Diodes
- Voltage regulator IC
- Bridge rectifier
- Transformer

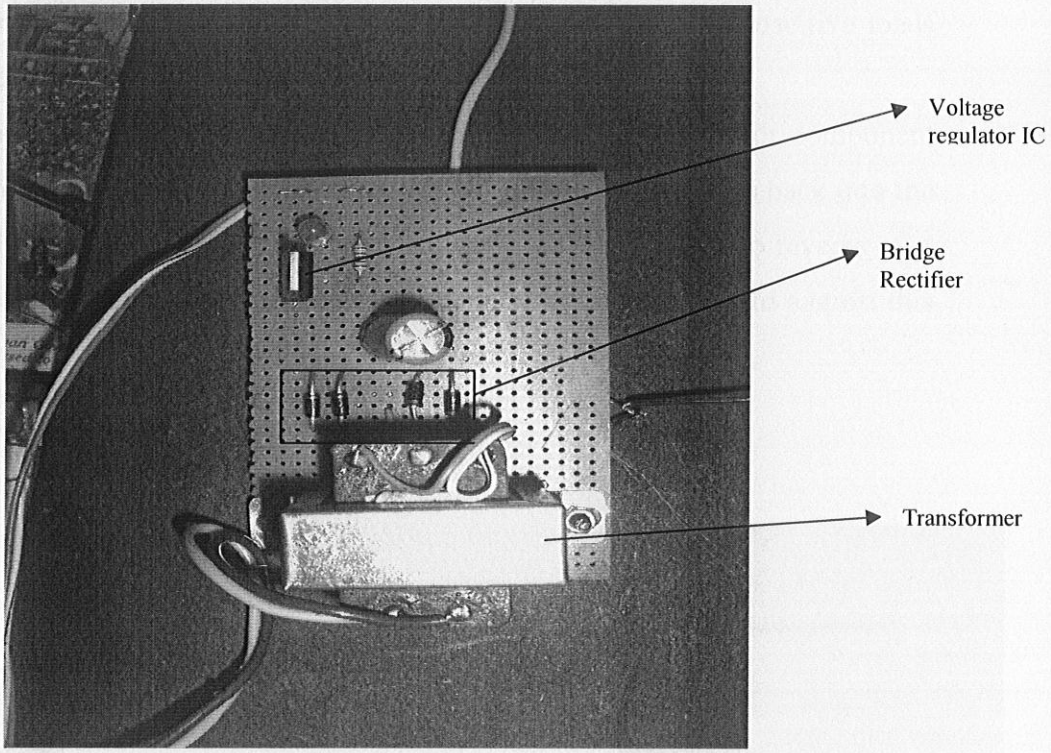


Figure 12: Voltage Regulator

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.

2.8 TRANSMITTER SECTION

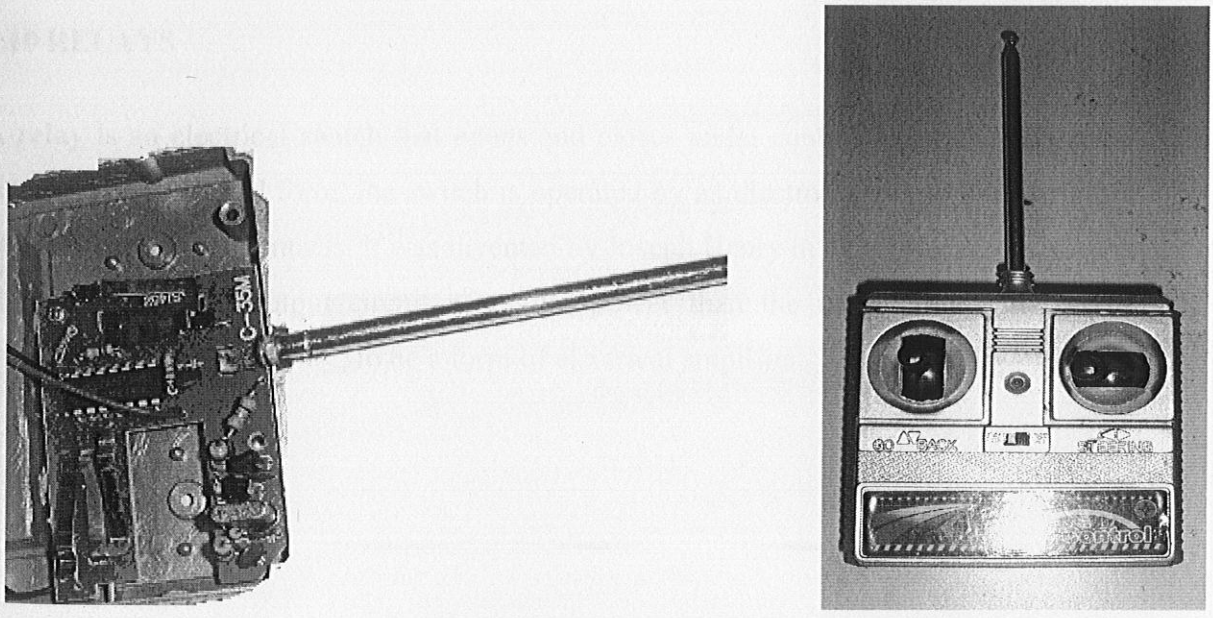


Figure 13: Transmitter module

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.

2.9 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.

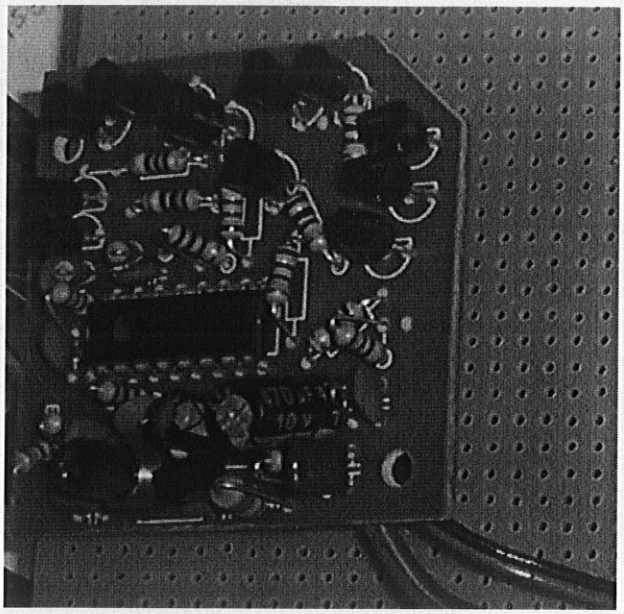


Figure 14: Receiver module

2.10 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.

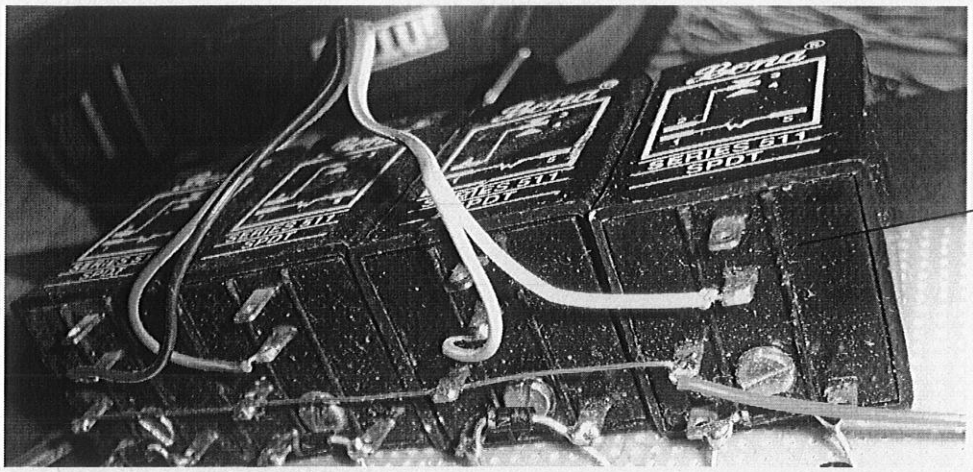


Figure 15: Picture indicating relays in the module

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 home automation system uses 4 relays to trigger 4 home appliances that run on high power. However, many more home appliances can be connected to the system using relays.

CHAPTER 3

EMBEDDED PROGRAM

3.1 ALGORITHM

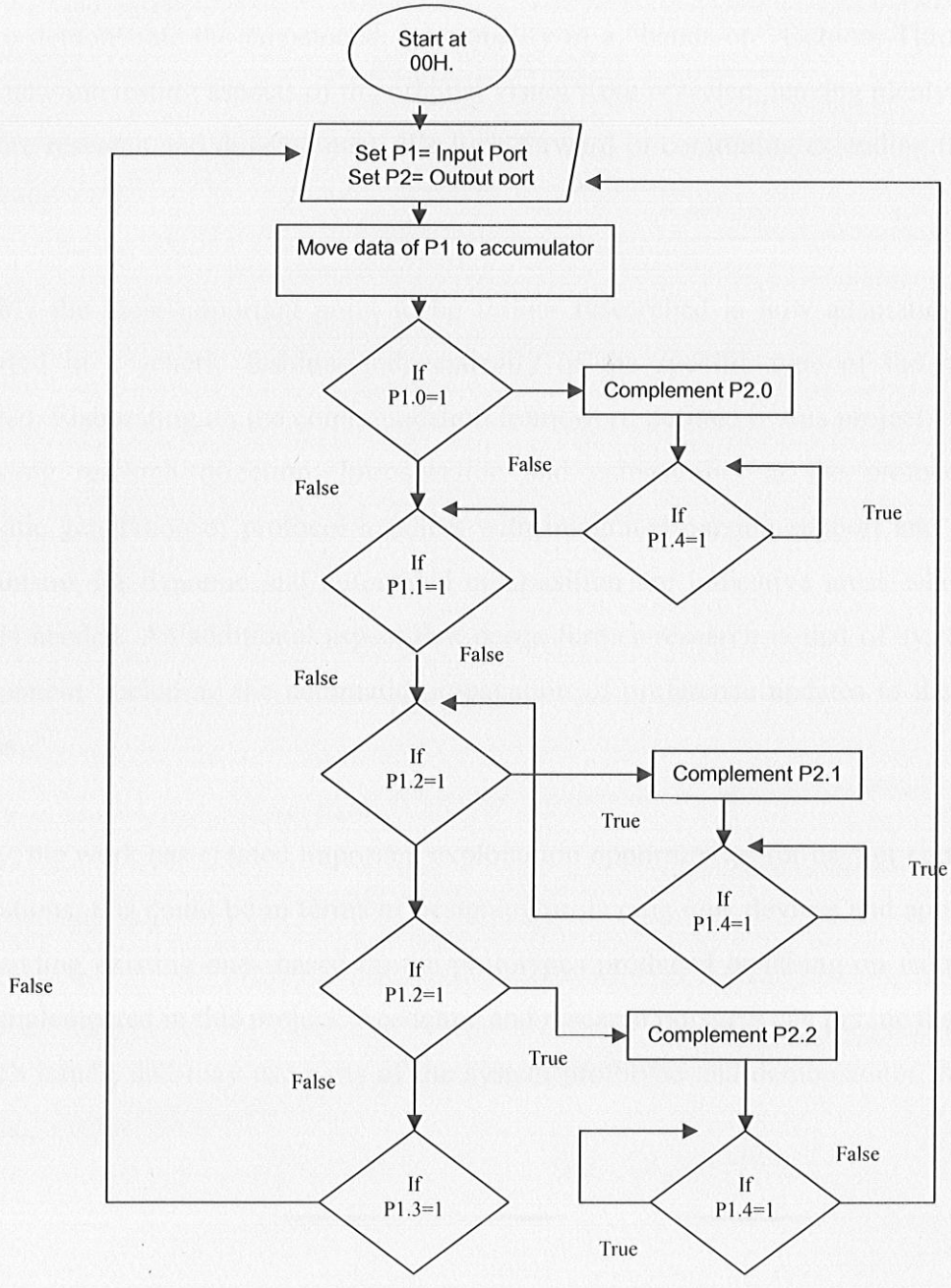
1) Initialize initial location address to #00H.
2) Program port P1 as input port.
3) Set port P2 as an output port
4) Initially move flow of control by moving P1 data to accumulator
5) If P1 .0 = =High then complement P2.0
6) Else If P1 .1 = =High then complement P2.1
7) Else If P1 .2 = =High then complement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

3.2 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
```

3.4 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

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