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DATA RECEPTION TERMINAL OVER FM

Group No: D08

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ABSTRACT

In this project, we have designed a handheld device capable of receiving data (text) from a FM transmitting station and display it on a two line character LCD (liquid crystal display). A large external memory has been provided to store the received data. User can easily read the stored data on LCD display using the four scroll keys located on the device. The scroll keys give the provision for display in both page-wise as well as line-wise mode. The device operates with 9V supply. Tuner in the device gives flexibility to select the desired FM station. Designed hardware demonstrates an efficient data reception.

1. INTRODUCTION

The basic design includes a FM receiver to receive data. The received signal is then converted to digital form using a waveform reshaping circuit made using LM339. The data thus obtained is stored in an external memory (HY6264) of size 8K using a microcontroller. The microcontroller then retrieves the data from memory and parallely outputs it to the input pins of LCD (JHD162A). The LCD used is 16x2 character and has an inbuilt Hitachi HD44780 display controller, which displays the input data. The microcontroller used is AT89C52. Only thirteen address pins (A0-A12) of microcontroller are effectively used for external memory addressing. Two of the unused address pins (A13, A14) are used to provide page-up/page-down interrupts and remaining address pin (A15), is used as a chip select for the external memory. Two switches which provide the line-up/line-down feature are connected to the two external interrupt pins of the microcontroller.

On the transmitter side, the data is sent to RS-232 module using 'HyperTerminal' software which sends data serially on the COM port of PC at a baud rate of 9600. This RS-232 module acts as a buffer for the data coming from the PC. Its main work is to shift the voltage level of data that we are feeding to the transmitter. The transmitter operates at 92.8MHz.

This cheap handheld device can be used in rural areas for providing daily news items and other important information to the users. The data is transmitted by a FM base station giving coverage area depending on the strength of the transmitter.

2. **DESIGN APPROACH**

The project is divided into the following sections:

2.1. Hardware

The hardware of the data transmission – reception system is shown in Figure 1.

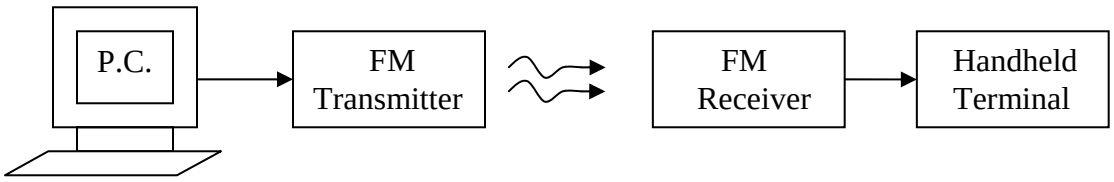

Fig. 1 Block diagram of data transmission – reception system

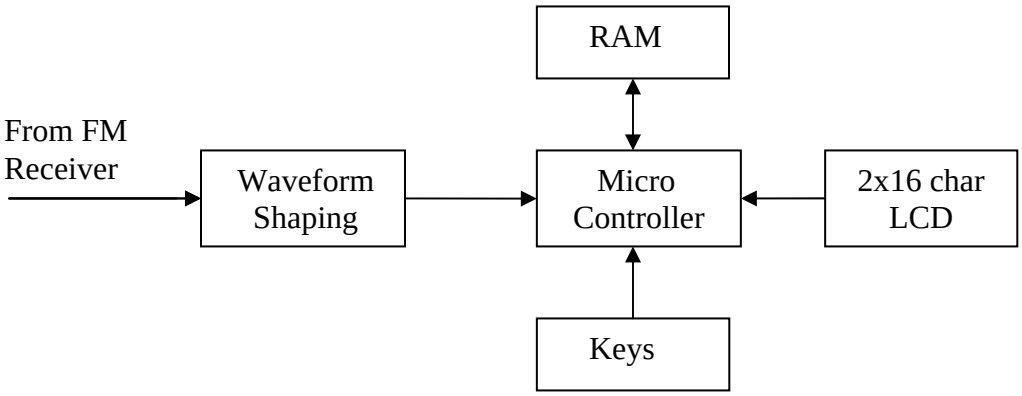

Fig. 2 Block diagram of handheld terminal

2.1.1 FM Transmitter

We are using FM transmitter [2] which was available in the lab to transmit data from PC. The circuit diagram of transmitter is shown in Figure 3. The data is sent from COM port of PC to MAX232 circuit. The on-board RS-232 level shifter ensures correct signal level for FM transmitter. Peak value of input signal fed to the transmitter is 1V. Output of MAX232 is fed to the transmitter which modulates this data to be sent via FM.

When the level of input signal is high (i.e. for bit as 1), higher frequency of carrier is used. On the other hand, when the input signal is low (for bit as 0) the carrier frequency is low. The output frequency of the transmitter is adjustable from 88 to 108MHz (FM band) by varying C3. The frequency of the oscillator is controlled by the LC network L1-C3. C1 ensures that the circuit continues oscillating with changing amplitude of input signal. The output (antenna) of FM transmitter is at the collector of transistor T1. Transmitter operates at 3V. Transmitter was tuned to 92.8MHz to avoid interference with other FM radio stations.

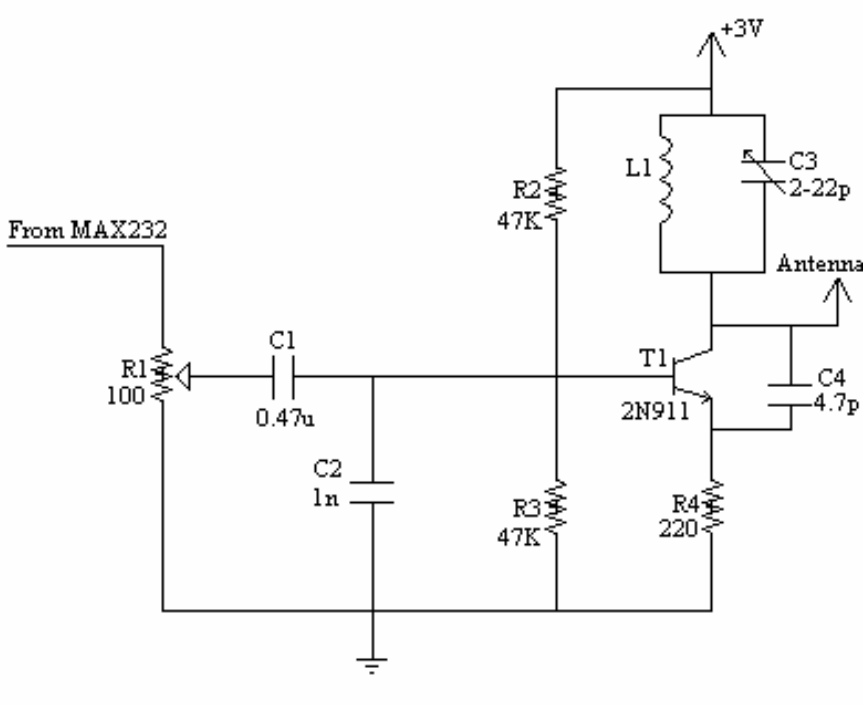

Fig. 3 FM Transmitter circuit [3]

2.1.2 FM Receiver

We are using commercially available TEA5591 [6] based FM Receiver circuit. The signal received from this is fed to the waveform shaping circuit. The FM signal received has peak to peak voltage around 900mV. The FM receiver module operates at 5V supply.

2.1.3 Waveform Shaping

This circuit takes input from FM receiver and modifies the received signal to required logic levels by microcontroller. Received waveform after FM receiver was observed to have a DC

offset. A coupling capacitor C1 is used to remove this offset. Comparator LM 339 compares output from capacitor with a reference voltage of 650mV to digitize the data. Output of this module is sent to serial input pin of microcontroller.

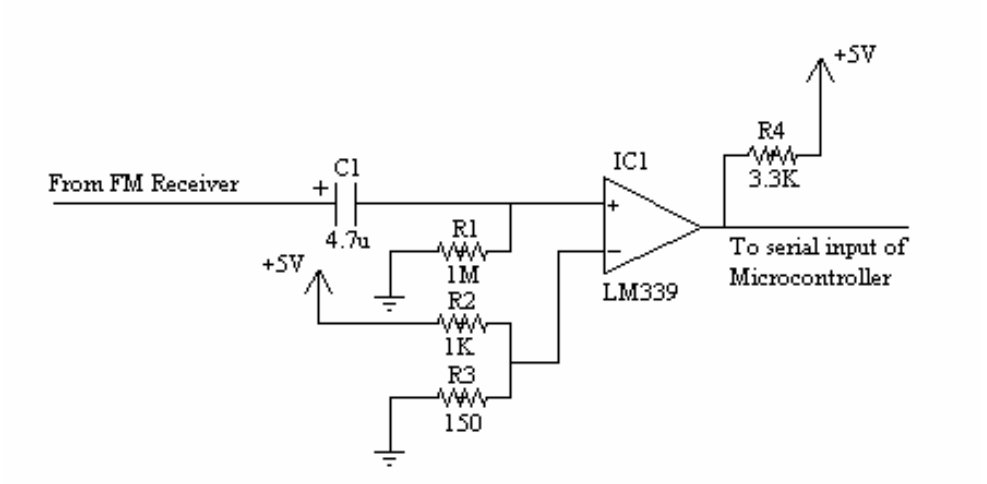

Fig. 4 Circuit diagram for waveform shaping

2.1.4 Handheld Terminal

The hardware of handheld terminal is shown in Figure 5. The entire terminal works at 5V. A steady supply voltage is obtained using a 7805 voltage regulator IC. The hardware consists of the following components.

1) Microcontroller
40-pin AT89C52 microcontroller [3] has been used. It is one of the cheapest available and easy to use microcontrollers. 11.0592 MHz crystal was used to generate precise baud rate. This microcontroller is interfaced to external RAM, control keys and the LCD. Port 0 and Port 2 are used for external memory interfacing. Lower address pins (A0-A7) are fed to the latch for data multiplexing. Higher address pins (A8-A12) are directly connected to RAM. Two of the unused address pins (A13, A14) provide page-up/page-down interrupts and the remaining address pin (A15) is used as a chip select for the external memory. Two switches which provide the line-up/line-down feature are connected to the two external interrupt pins of the microcontroller. Port 1 pins give parallel input data to LCD.

Microcontroller takes serial data from waveform shaping circuit and stores it in external RAM. This data is retrieved from RAM and displayed on LCD, which can be scrolled using four available keys.

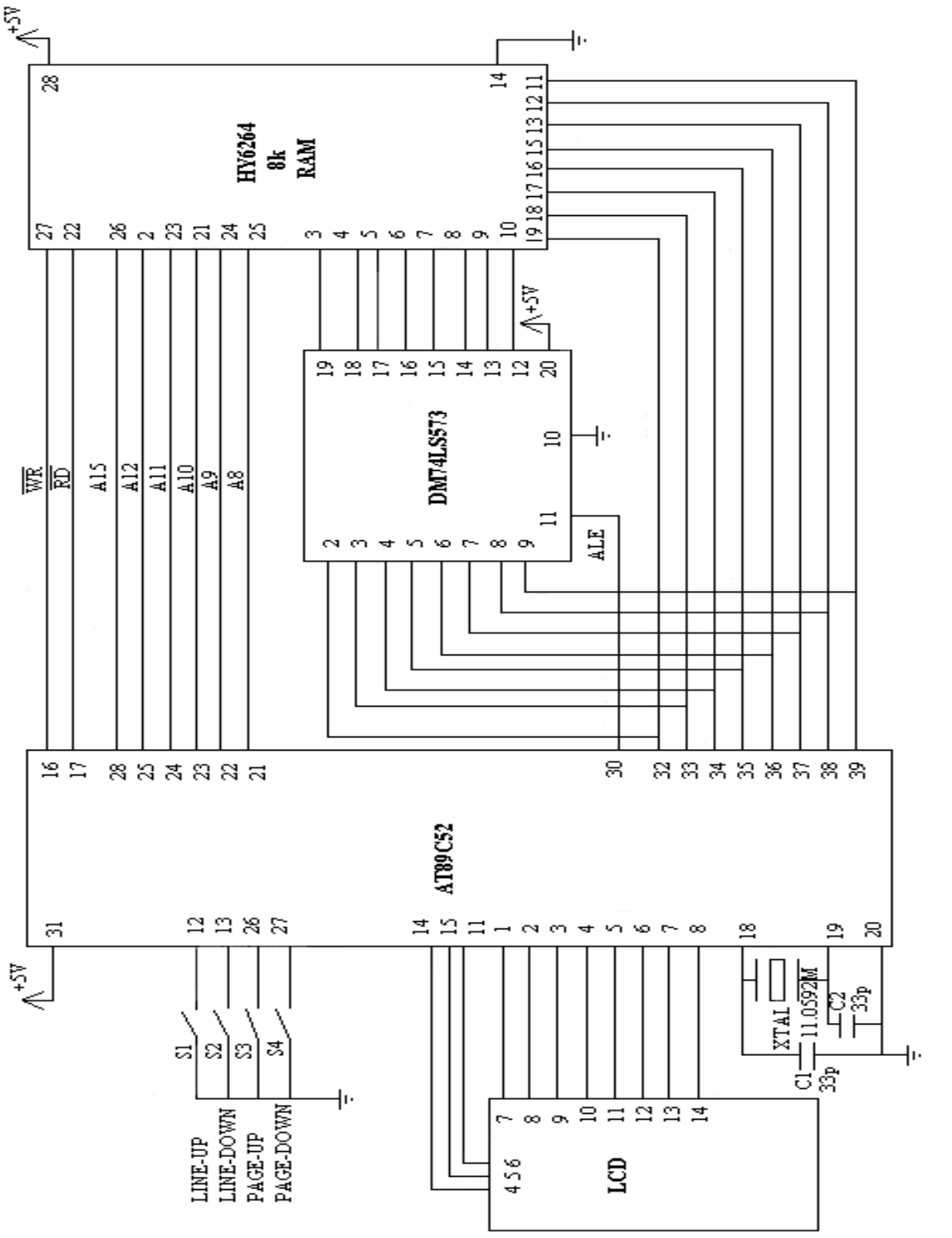

Fig. 5 Circuit diagram of handheld terminal

2) LCD

LCD used is a 16 x 2 character JHD162A [1] capable of text display. It consists of an inbuilt Hitachi HD44780 display controller. Port 1 and Port 3 pins of microcontroller are used by LCD. The display contains two internal byte-wide registers, one for commands (RS=0) and the second for characters to be displayed (RS=1). The pin functions are given in Table 1.

Pin No.	Function	Pin No.	Function	Pin No.	Function
1	Gnd	7	Data0 (LSB)	13	Data6
2	Vcc (5V)	8	Data1	14	Data7 (MSB)
3	Gnd	9	Data2	15	NC
4	RS	10	Data3	16	NC
5	RW	11	Data4		
6	EN	12	Data5		

Table1. Pin function of LCD JHD162A

3) RAM

We are using HY6264A RAM [4] of size 8KB. It is interfaced with the microcontroller through latch DM74LS573 [5]. We selected this latch only because it is very convenient for designing of circuit.

4) Keys

This unit consists of four control keys. These keys are used for scrolling the data displayed on the LCD. The functions of these keys are as following:

a. Page-up - increases dph by 1 and sets dpl to 00.
b. Page-down - decreases dph by 1 and sets dpl to 00.
c. Line-up - increases data pointer by 20.
d. Line-down – decreases data pointer by 20.

2.2 Software

We have described algorithm used, using flowcharts in the following pages. The program has been written using 8052 instruction set. Program has been compiled using keil complier. The algorithm for data receiving and storage is described in Figure 6, where we are storing 8 pages, each of 16 lines. Figure 7 explains the algorithm for display of data from RAM onto LCD. Figure 8 describes the working of scroll keys.

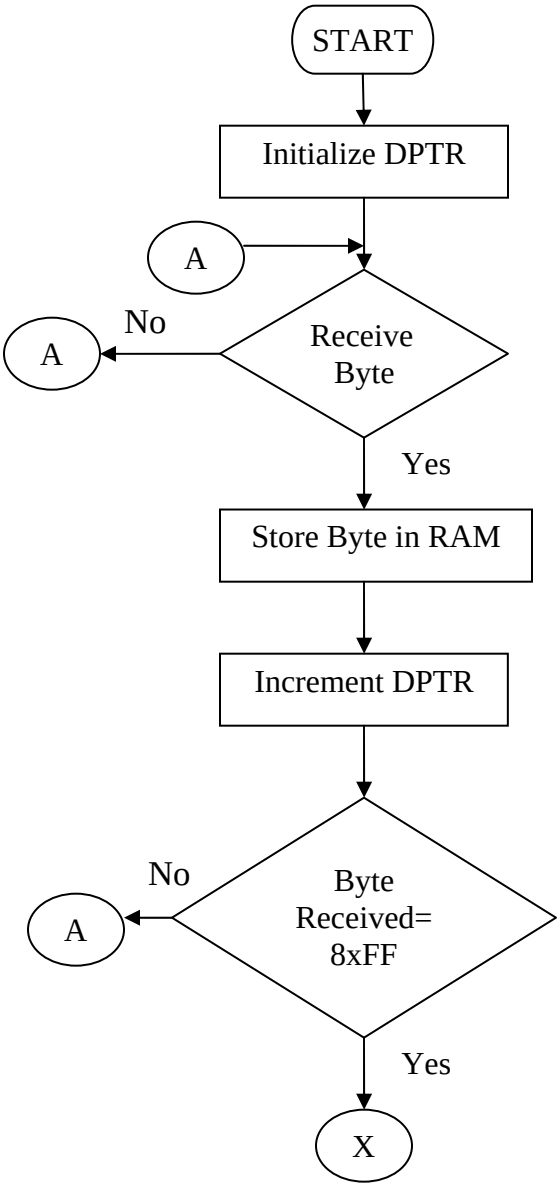

Fig. 6 Flowchart for storing data in RAM

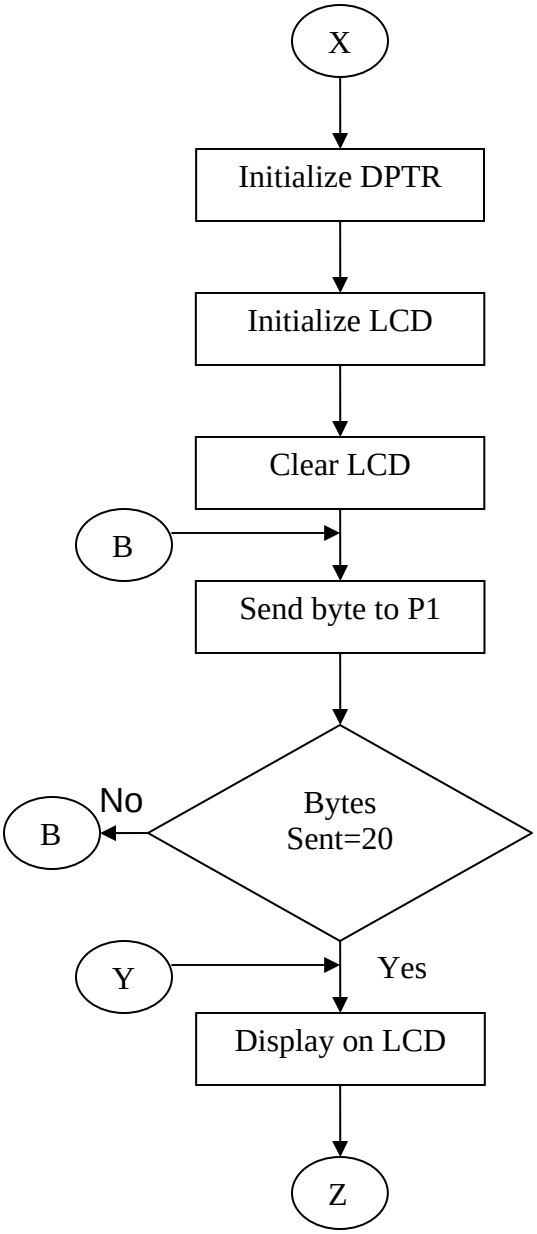

Fig. 7 Flowchart for lcd display from RAM

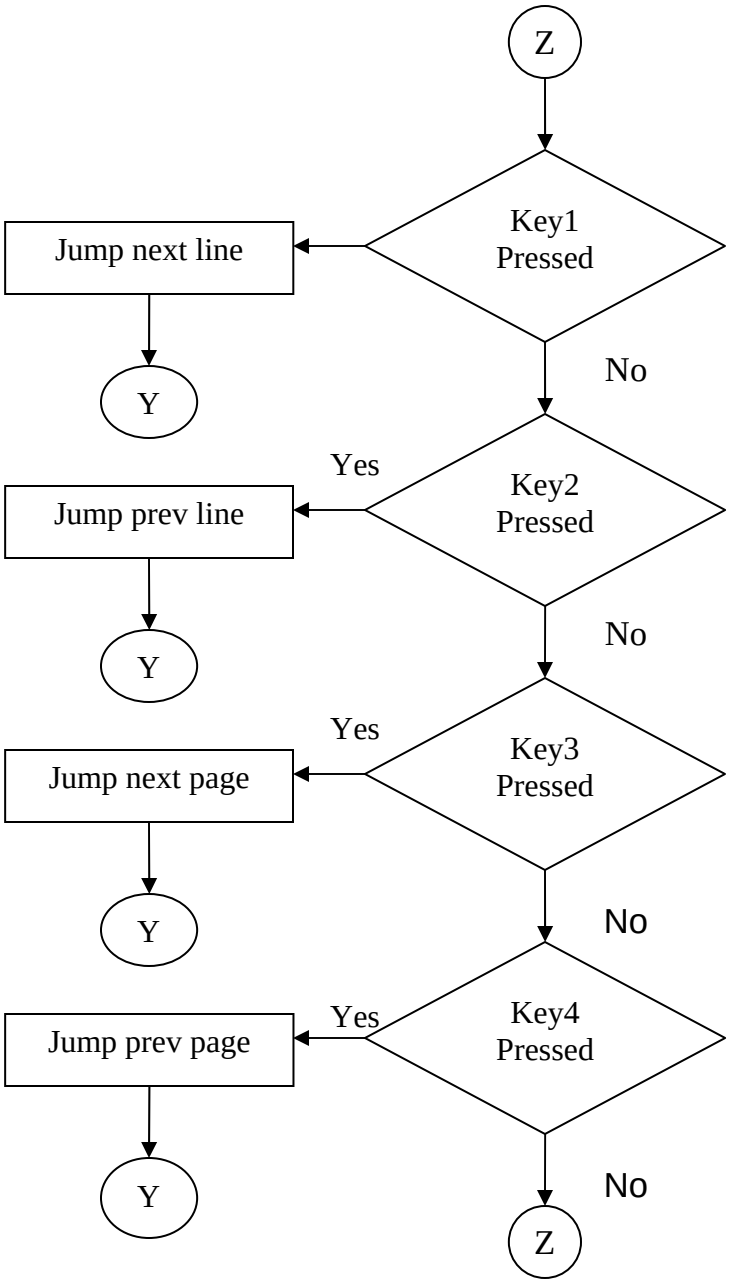

Fig. 8 Flowchart for scroll keys

4. TEST PROCEDURE

1. FM transmitter and receiver circuits were tested separately using DSO to check corresponding output signals. Tuning of FM receiver is also a major difficulty that we encountered.

2. In the first phase, the serial RS-232 module was tested using loop back mode with DB9 connector. For this data was sent through COM port of the computer using HyperTerminal. The data which was sent was echoed to verify successful functioning of this setup.

3. In the second part, large external buffer memory of 8K was tested. The serial data which was received by microcontroller was stored in the SRAM. This data was read back and was then verified using LED's on Port 1.

4. DSO was used to observe and analysis various signal characteristics while interfacing external RAM and microcontroller and also the signals fed to LCD.

5. The assembly codes written were tested using the debugger tool in Keil Compiler.

5. SUMMARY

The external memory was successfully used to provide a large storage space for data with 100% reliability. On giving some external interrupt the data pointer used to jump to some arbitrary position. This happened because of multiple interrupts. To avoid this, a delay is given whenever we give an interrupt. To avoid interference with other FM radio stations, FM transmitter was tuned to 92.8MHz. We are not able to refresh data simultaneously while scrolling. The device designed can serve as a compact and convenient information sharing system. Being cheap, this gadget can find its usage for community based news sharing in rural areas.

6. FUTURE WORK

This device can be further improved by using a Graphical LCD in place of this character LCD. The robustness of the device against the transmission errors can be improved by implementing Manchester coding technique. Significant size reduction can be achieved by integrating the FM receiver module with the designed PCB.

REFERENCES

1. K. J. Ayala, *The 8051 Microcontroller, Architecture, Programming and Application*, Second Edition, Mumbai: Penram International Publishing, 1996

2. "Integrated Circuits", http://www.mikroe.com/en/books/keu/08.htm, Mikroelektronika, Accessed on 10th October 2006.

3. "Data sheet of 8-bit microcontroller AT89C52 with 8k bytes flash memory", ATMEL, http://www.atmel.com/dyn/resources/prod_documents/doc0313.pdf, Accessed on 15th October 2006.

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6. "PDF datasheet TEA5591A: AM/FM radio receiver circuit", Philips Semiconductors, http://pdf1.alldatasheet.com/datasheet-pdf/view/19723/PHILIPS/TEA5591A.html, Accessed on 15th October 2006.

PCB LAYOUT

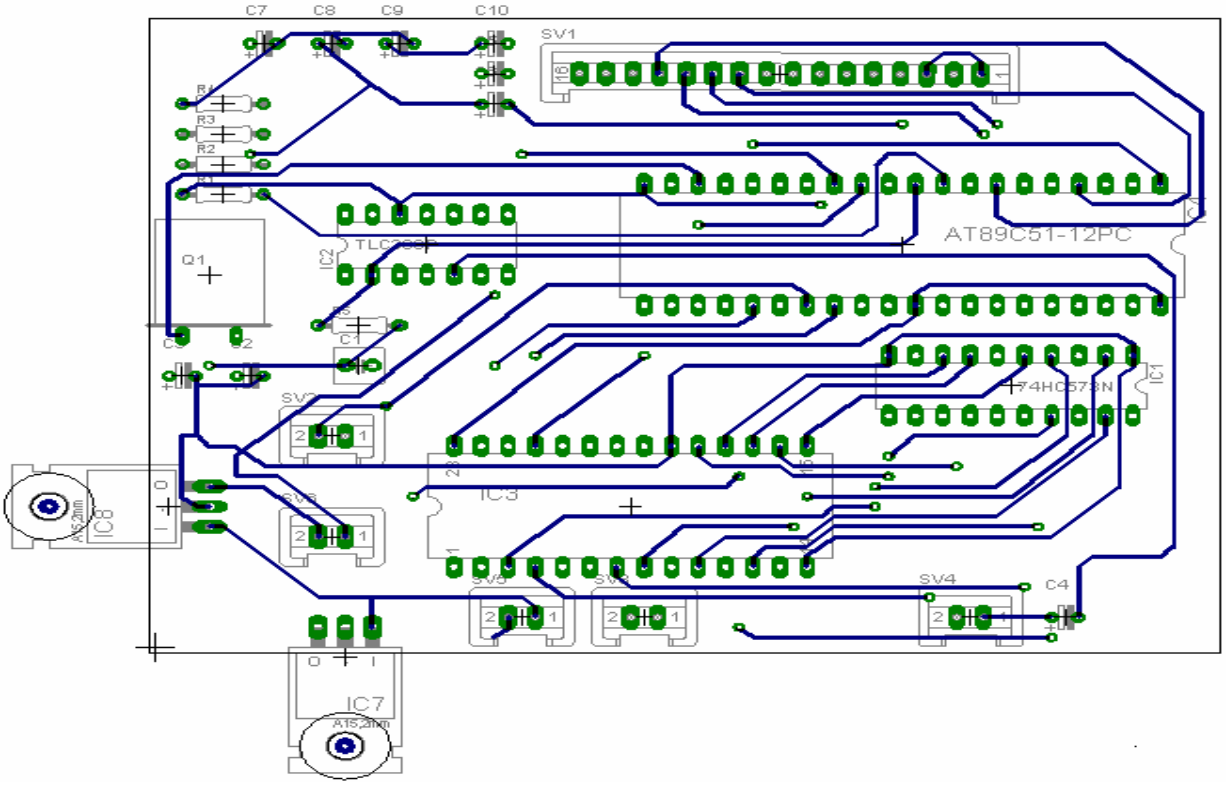

Fig. 9 Bottom layer of PCB layout

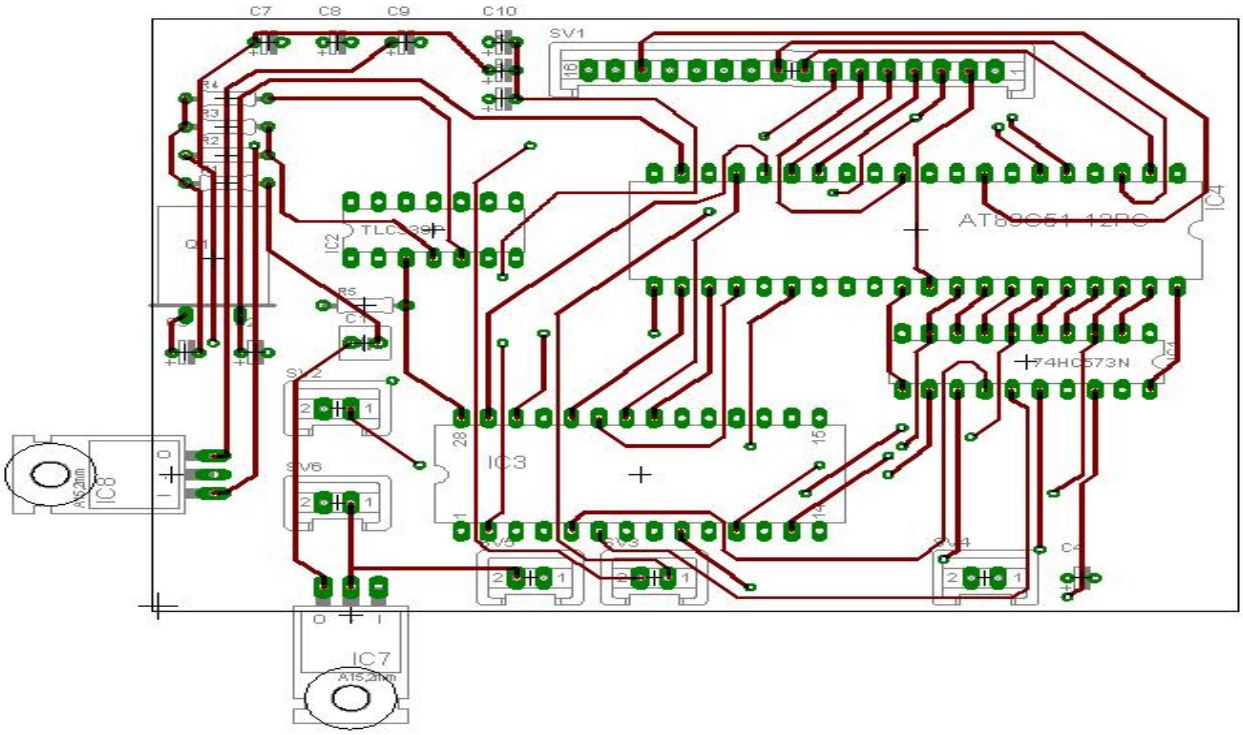

Fig.10 Top layer of PCB layout