Memo Clock for Classrooms

Group No :**D2**

Arun Aggarwal 05d07033 arun_aggarwal@iitb.ac.in

Abhishek Mittal 05d07034 mittalabhishek@iitb.ac.in

Kamlesh Meena 05d07009 kamleshm@iitb.ac.in

Under the supervison of:

Abhay Karandikar

Dipankar Chaudhary

Abstract:

The project was undertaken to automate the announcement of lectures in a lecture hall as per a pre-decided time-table. This can be of great use in a multiple lecture hall setting where students must move from hall to hall for different classes. The audio alarm can be used both within and outside the class for the same. Within the class, it can serve as a “bell” for the class and on the outside it can serve as a guide to the next class being held in the hall. The approach to this has been to find a compact way to store audio messages that can be played back at a later time as per the time-table that can be specified by the user. We have used a data flash for this which can be extended as per user needs. The design would need the time table to be specified at the beginning of every day and the lecture timings feeded in and the messages recorded orally. The individual components of the circuit are working fine and can be integrated. The output circuit for playback of recorded messages is noisy and seems to be a spot of bother.

Contents

Introduction:

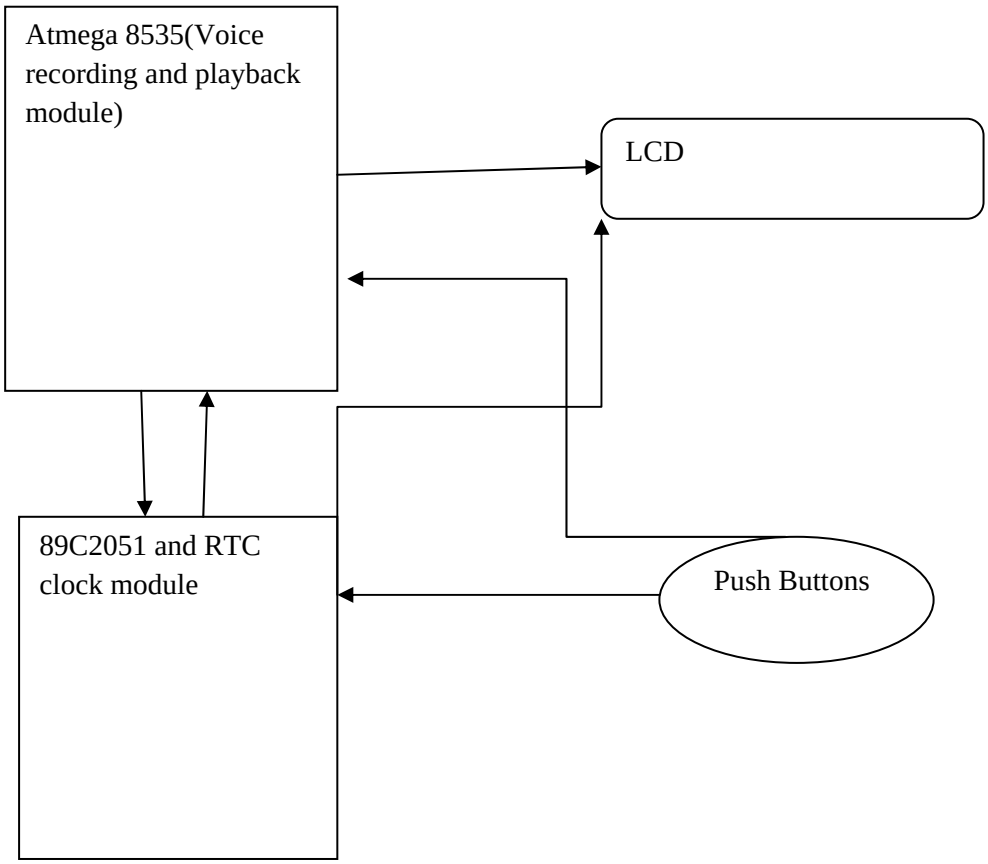
The project was undertaken to automate the announcement of lectures in a lecture hall as per a pre-decided time-table. This can be of great use in a multiple lecture hall setting where students must move from hall to hall for different classes. The audio alarm can be used both within and outside the class for the same. Within the class, it can serve as a “bell” for the class and on the outside it can serve as a guide to the next class being held in the hall. The approach to this has been to find a compact way to store audio messages that can be played back at a later time as per the time-table that can be specified by the user. We have used a data flash for this which can be extended as per user needs. The design would need the time table to be specified at the beginning of every day and the lecture timings feeded in and the messages recorded orally.

Design Approach:

The design approach has been to break the problem into 2 major parts and attempt to work on them separately and allow for integration later. The first being the clock and the alarm circuit and the second being the voice recorder cum playback circuit.

The clock and alarm circuit has been built to allow for multiple alarm setting and deletion at any given time for the duration of the day.

The voice recorder circuit allows the user to record the audio messages as he may deem fit. This when coordinated with the above alarm timings will serve the specified purpose.



We have been successful in implementing a single alarm circuit in EDL-1. This has been updated to include multiple alarms for the duration of the day. Although the RTC has an internal calendar system which could have been used;we did not see any need for exploiting that given the current usage of the device as an classroom memo clock.

An advantage of this is that work on the two separate modules can proceed without hindering work on the other. This was envisaged because in EDL 1 work could not progress beyond the 1st module as it was not moving forward.

Design Considerations:

The use of a 89c2051 was because of ease of coding and since it is one of the most commonly available chips in the market

The data flash used was dictated by a couple of reasons: the amount of data that it could store and also just as importantly,the maximum rate of data transfer that can be effectively carried out between the data flash and the external circuitry. As we needed to record voice

samples, a min sampling rate of around 8k was seen necessary ;so the buffer sizes of the data flash needed to be able to support such data movement.

The choice of Atmega 8535 in the recorder cum playback circuit was motivated by a greater ease of operations as PWM operations are built into the processor and do not have to be implemented externally.

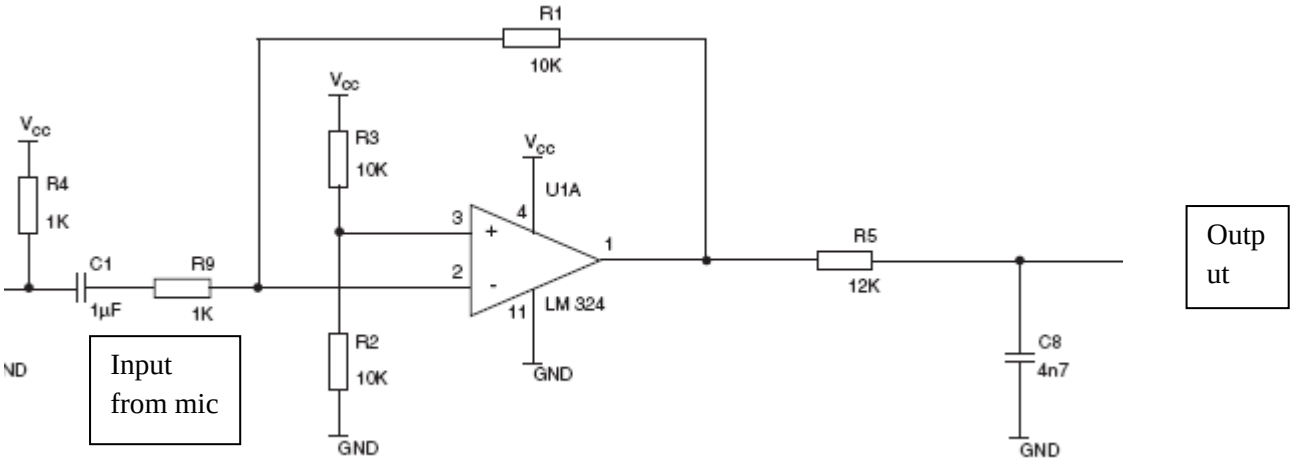
Design Circuits:

The microphone amplifier is a simple inverting amplifier. The gain is set to 10. R5 and C8 form a simple first order low-pass filter. In addition R5 protects the amplifier from any damage if the output is shortcircuited.

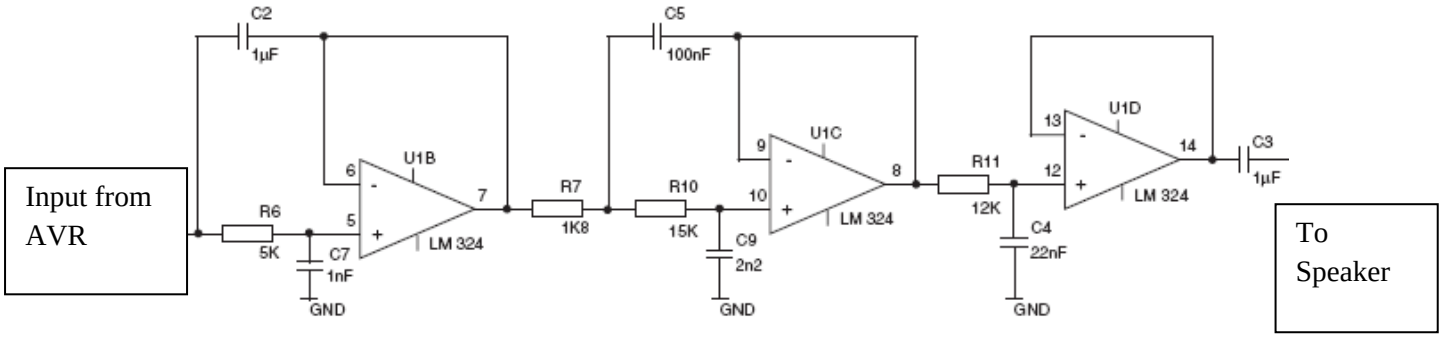
The speaker circuit consists of a 5th-order, low-pass Chebychev filter and a unary-gain amplifier. The filter is made up by two stagger-tuned, 2nd-order Chebychev filters and a passive 1st-order filter. The cut-off frequencies of these three filters are slightly shifted against each other to limit passband ripple of the whole filter circuit. The overall cut-off frequency is set to 4000 Hz, which is roughly one-quarter of the PWM frequency (15,686 Hz). The unary-gain amplifier prevents the circuit from getting feedback from the output.

For the AVR module we can control the sound system with three pushbuttons, called “Erase”, “Record” and “Playback”.. Pushing a button pulls the input line to GND.
As feedback for the user, an LED indicates the status of the system. The Data Flash is directly connected to the AVR microcontroller using the SPI bus.

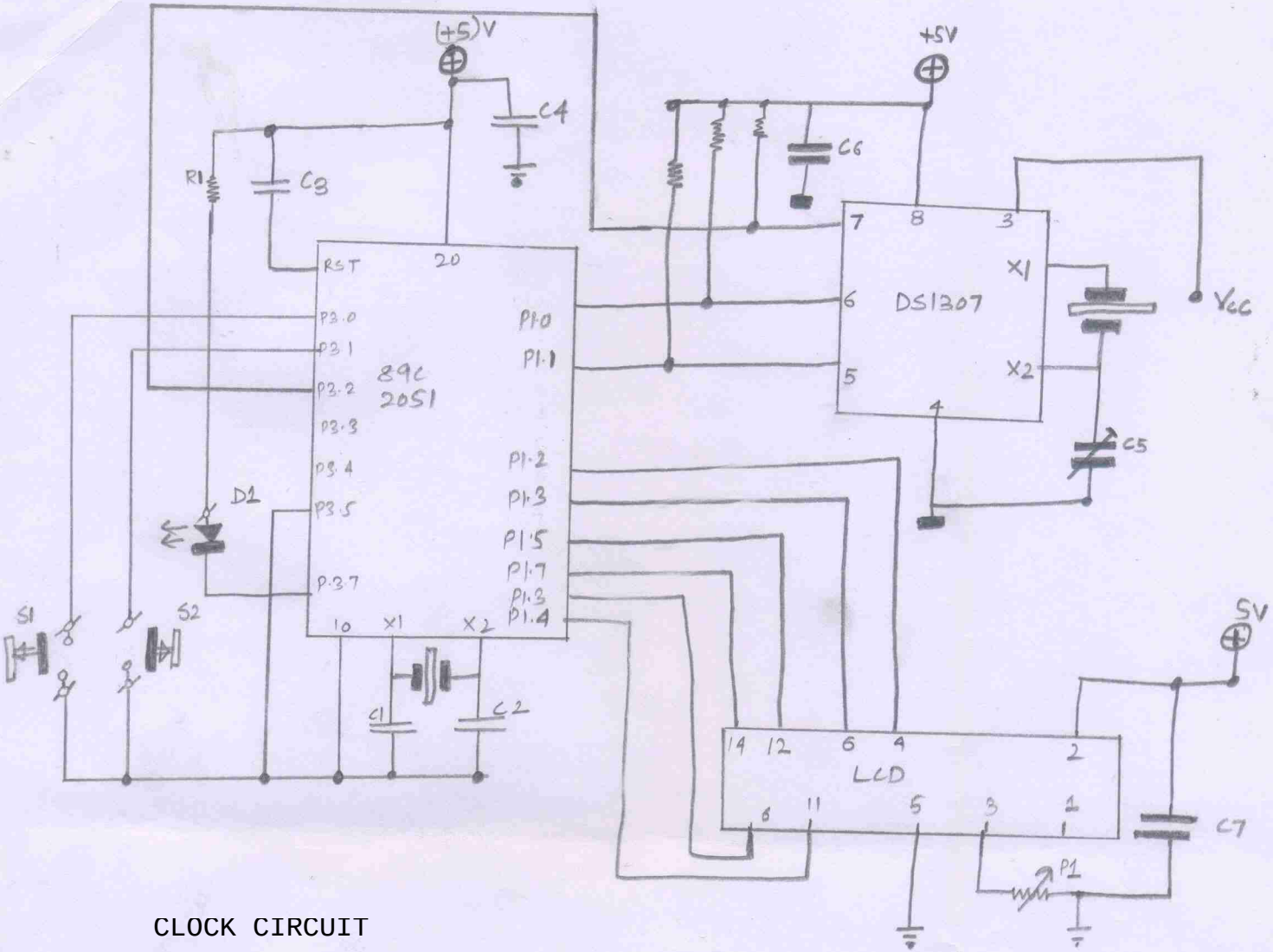
The oscillator crystal(8 Mhz) with two decoupling capacitors generates the system clock.



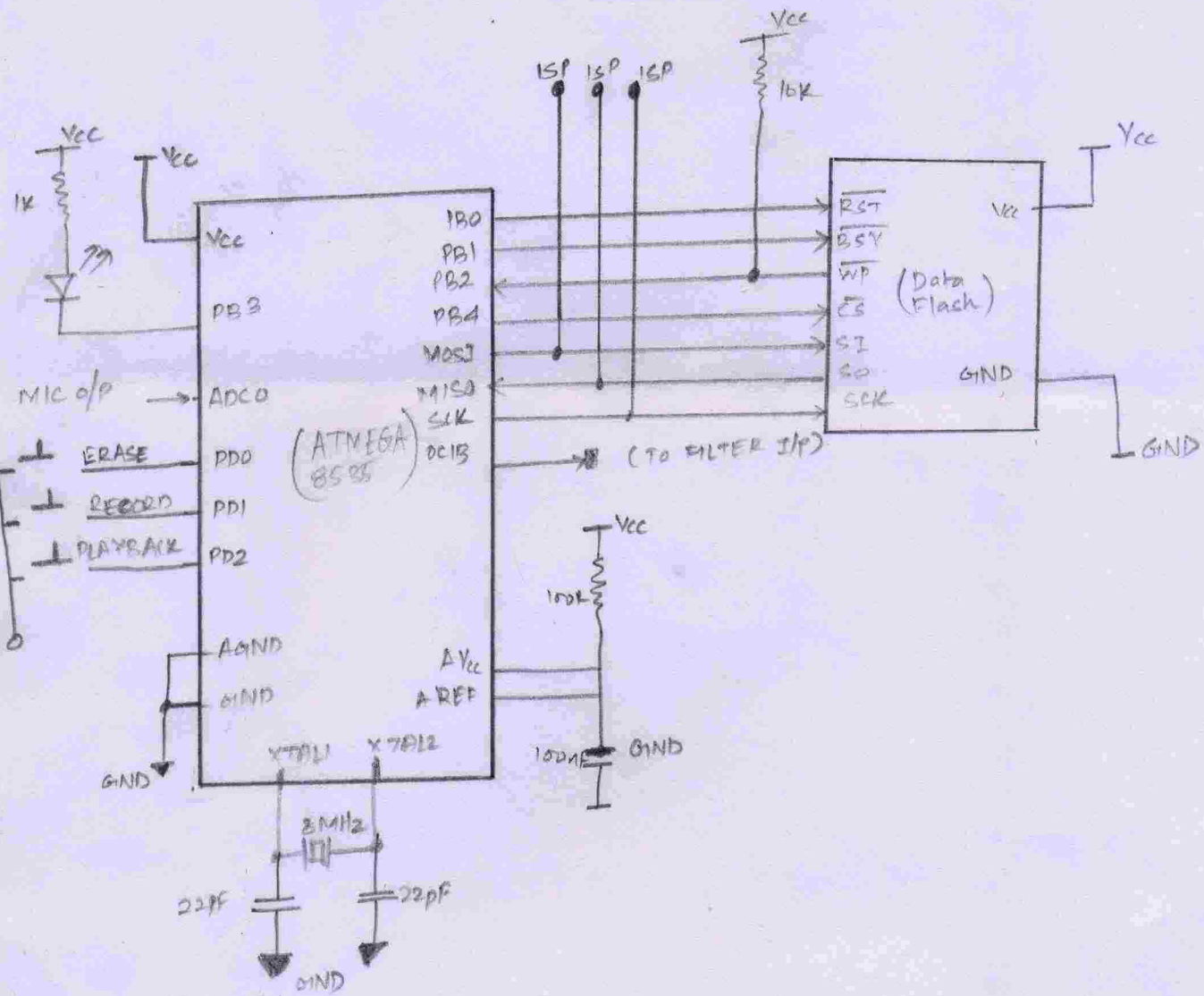
MICROPHONE CIRCUIT



FILTERS for speaker



CLOCK CIRCUIT



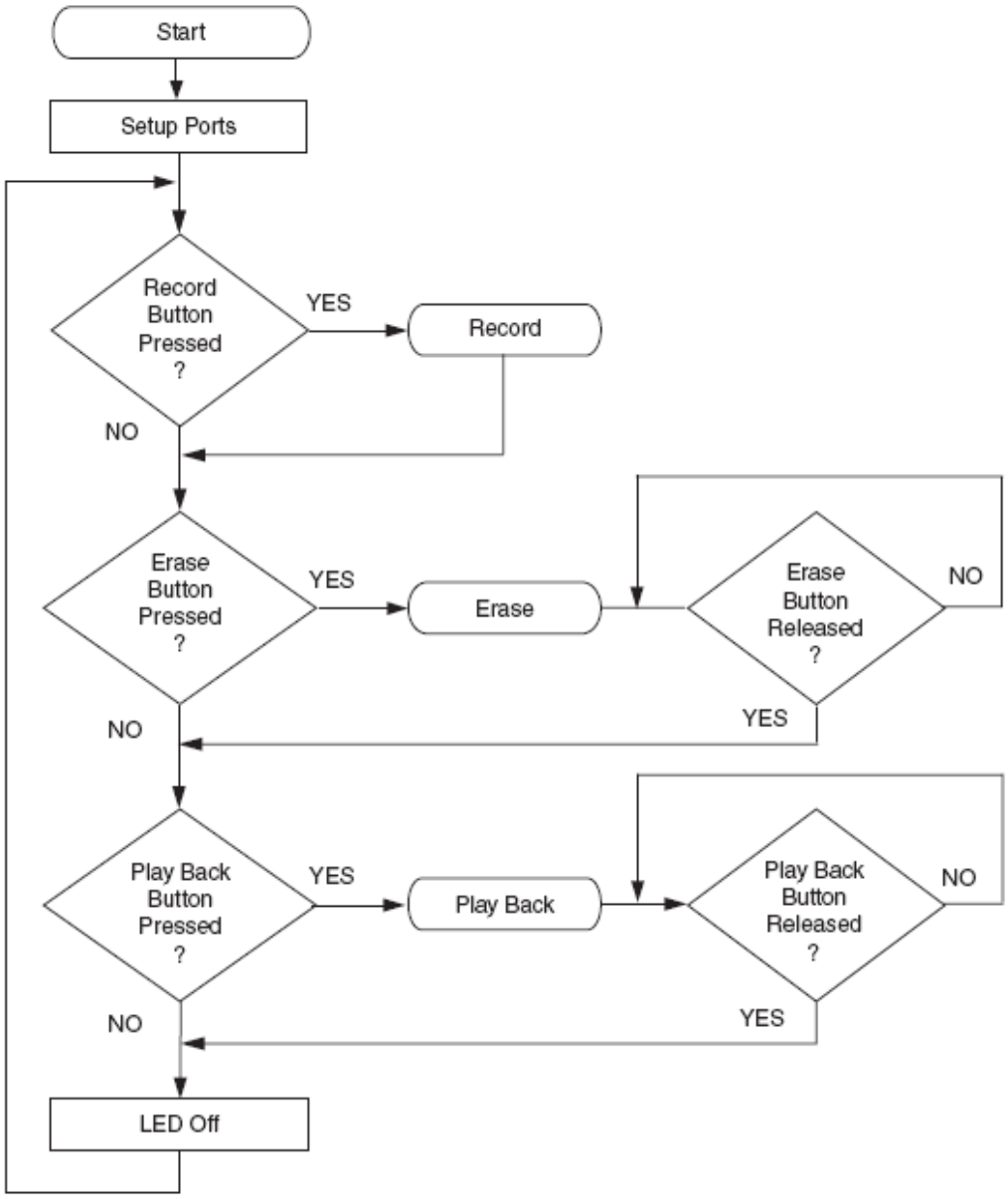
Voice Recorder and Playback using Atmega 8535

Algorithms and Flow Diagrams:

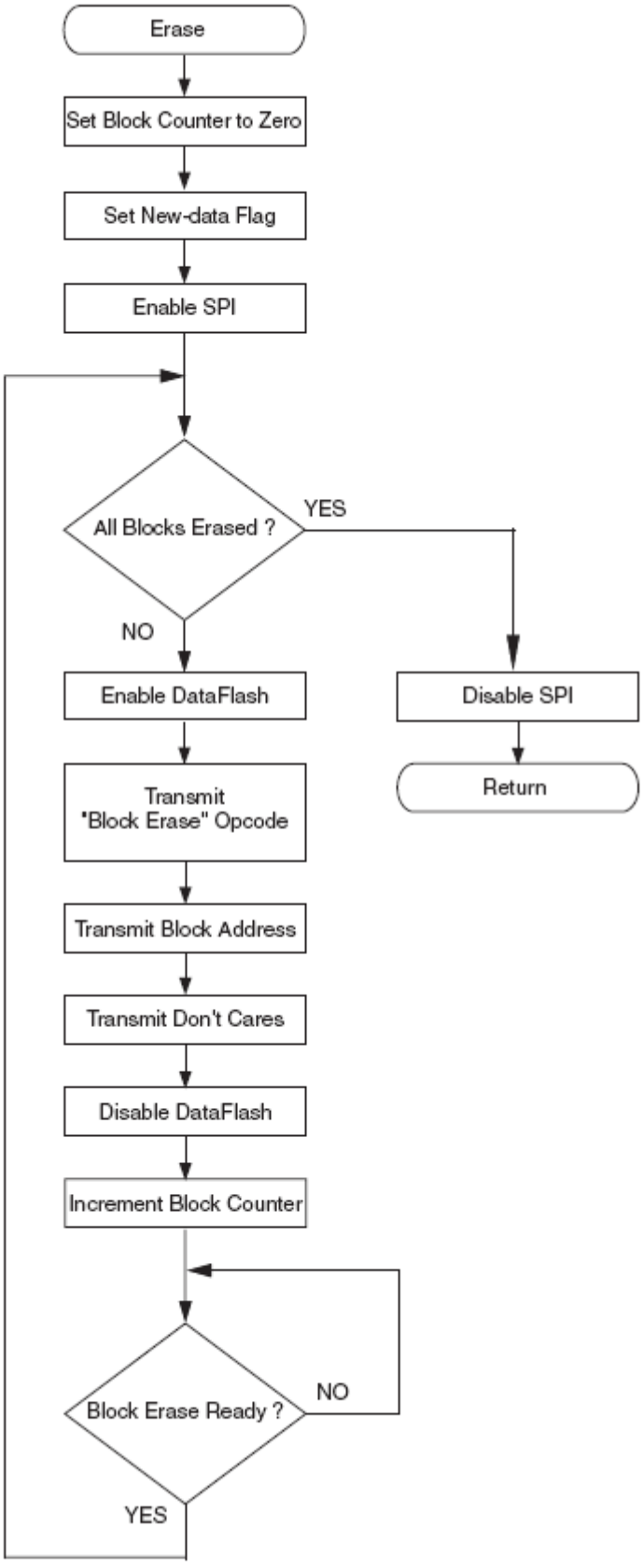
In the program, the three pushbuttons are scanned. If one of them is pressed, the LED is turned on to show that the system is busy and the corresponding subroutine is called.. During the main loop, the LED is turned off to indicate that the system is running idle.

AVR MODULE:

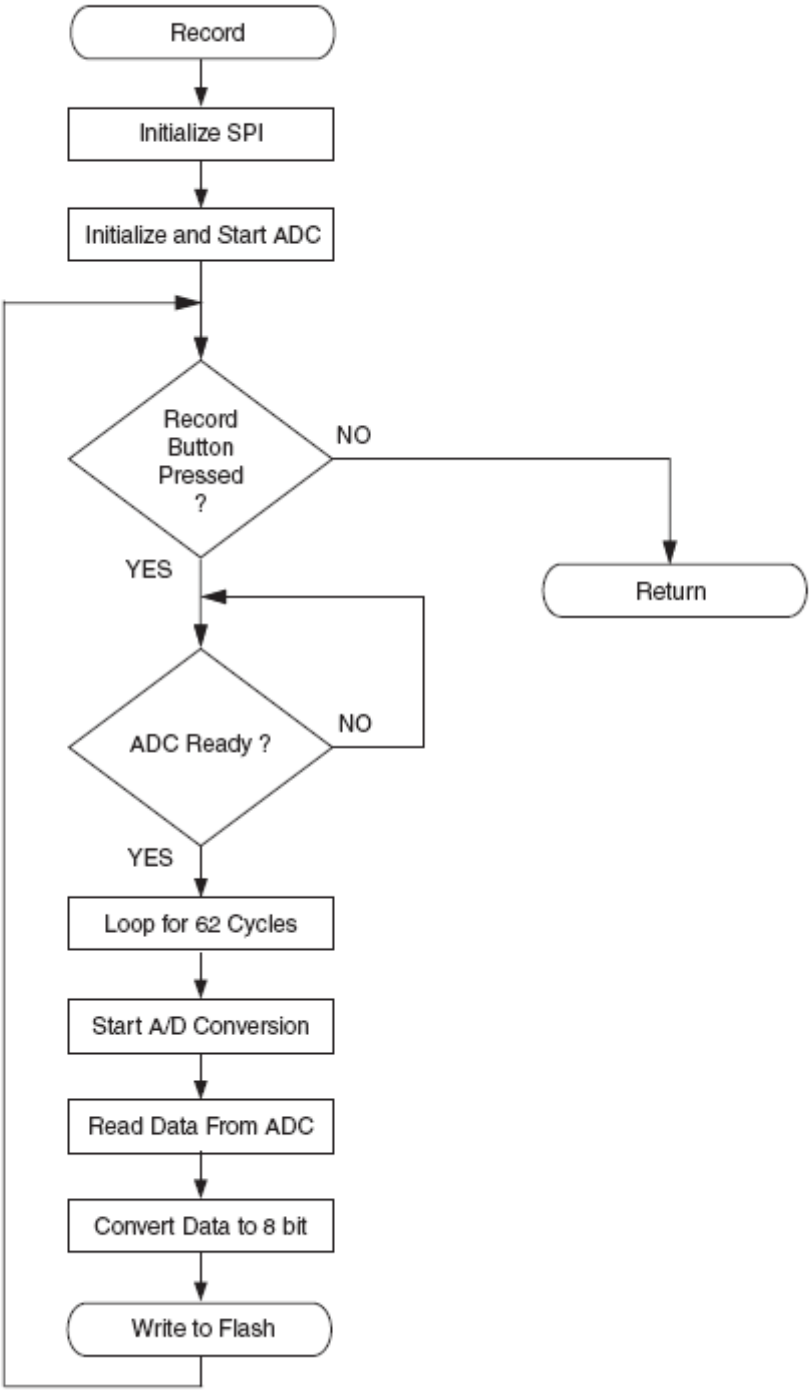
Basic flowchart:



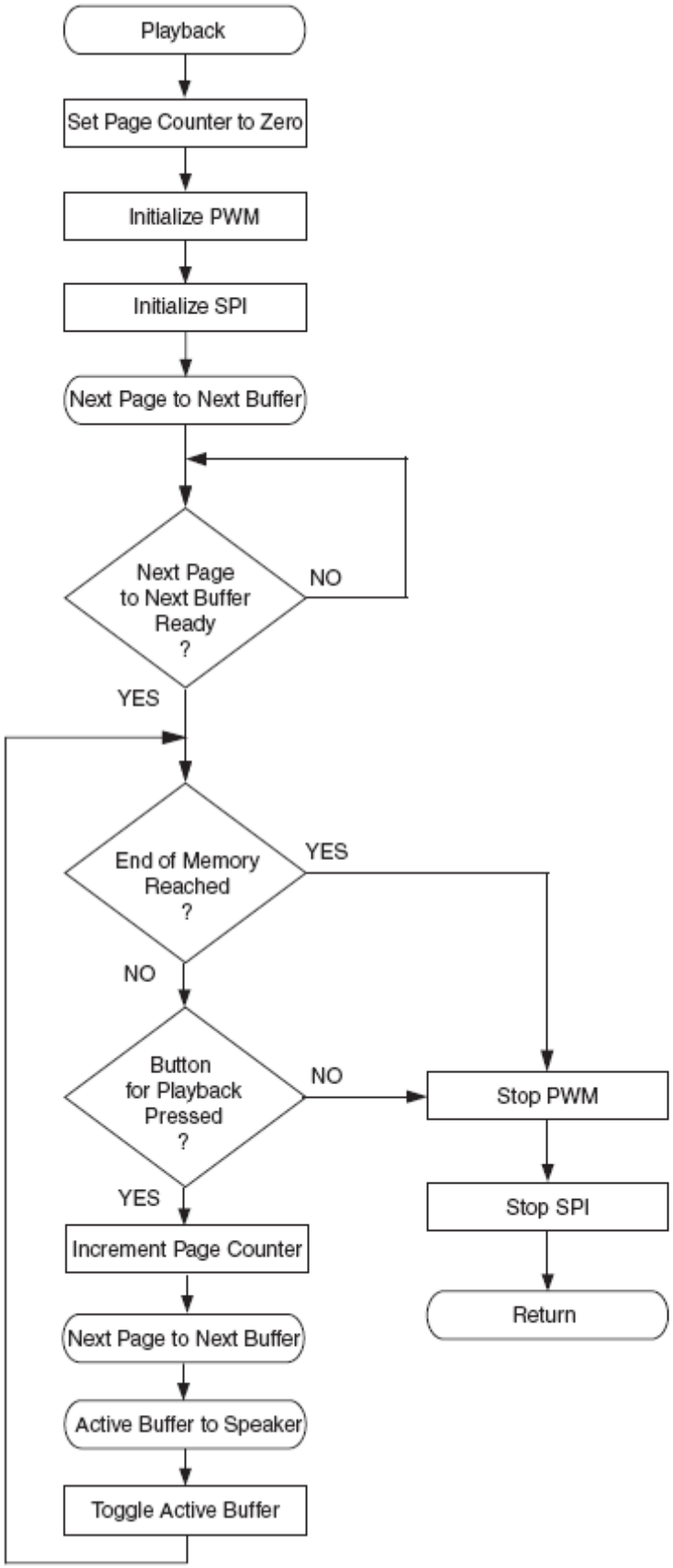
Erase


Erase
Set Block Counter to Zero
Set New-data Flag
Enable SPI
All Blocks Erased ?
YES
NO
Enable DataFlash
Transmit
"Block Erase" Opcode
Transmit Block Address
Transmit Don't Cares
Disable DataFlash
Increment Block Counter
Block Erase Ready ?
NO
YES
Disable SPI
Return

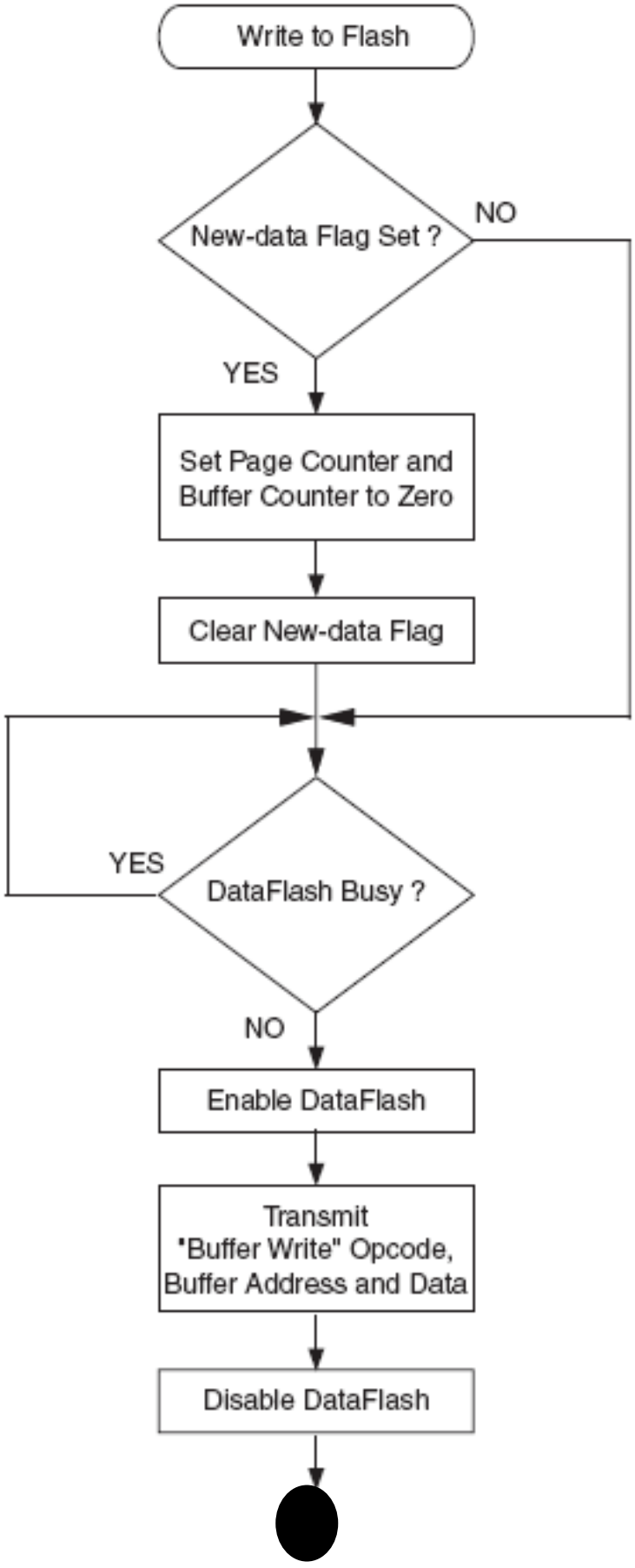
. Record

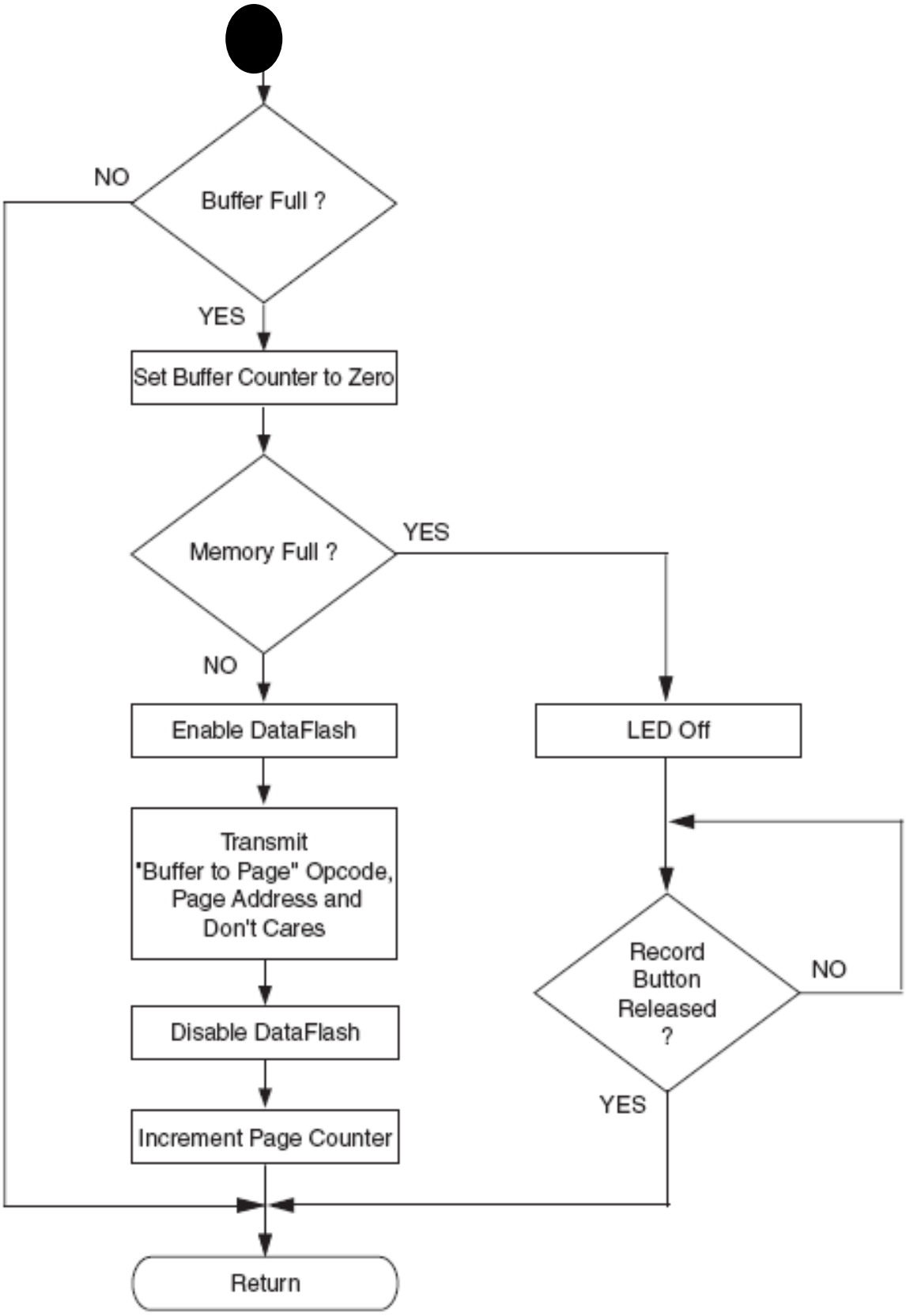

Record
Initialize SPI
Initialize and Start ADC
Record Button Pressed ?
NO
YES
Return
ADC Ready ?
NO
YES
Loop for 62 Cycles
Start A/D Conversion
Read Data From ADC
Convert Data to 8 bit
Write to Flash

Playback


Playback
Set Page Counter to Zero
Initialize PWM
Initialize SPI
Next Page to Next Buffer
Next Page to Next Buffer Ready ?
NO
YES
End of Memory Reached ?
YES
NO
Button for Playback Pressed ?
NO
YES
Stop PWM
Stop SPI
Return
Increment Page Counter
Next Page to Next Buffer
Active Buffer to Speaker
Toggle Active Buffer

Write to DataFlash




Buffer Full ?
NO
YES
Set Buffer Counter to Zero
Memory Full ?
YES
NO
Enable DataFlash
Transmit
"Buffer to Page" Opcode,
Page Address and
Don't Cares
Disable DataFlash
Increment Page Counter
LED Off
Record
Button
Released
?
NO
YES
Return

Suggestions and Further Modifications possible:

1) The device may be expanded so that it can receive the next day's time table via a wireless network (internet or wi-fi).
2) It may also be used in place of traditional announcement systems in school if it can catch signals off the air.
3) The clock timings may be synchronized to a central clock (of the school) or even to the world standard via the internet as it will provide unparalleled accuracy.
4) The length of the voice signals that can restored may be improved by compression algorithms.
5) It may be built with a self sustaining power feature if a small solar panel can be effectively harnessed and realized on the device itself.

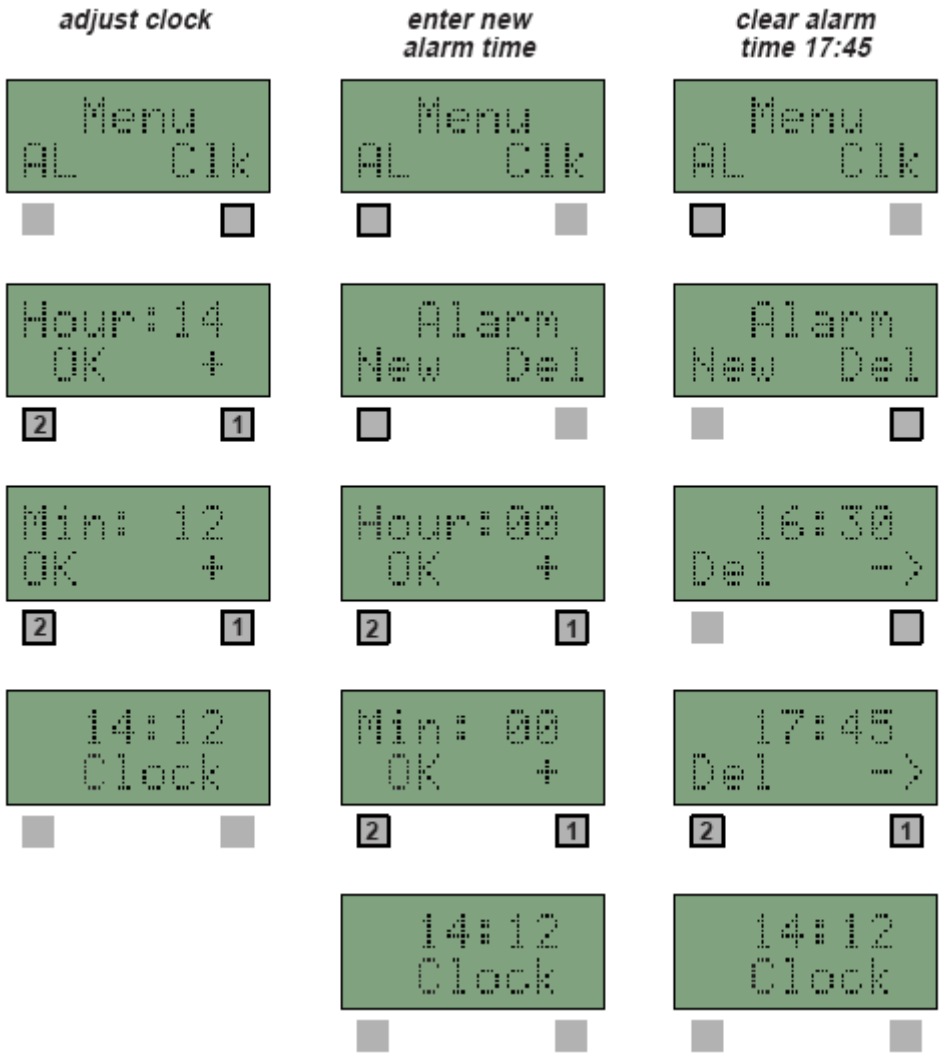
References:

1. Proakis, J.G. and Manolakis, D.G. (1992)
Digital Signal Processing: Principles, Algorithms, and Applications
Second Edition
2. Datasheets:
Atmega8535
Atmel AT45D321D DataFlash

User’s manual:

The alarm clock uses a very convenient user input format that is self intuitive as it uses directional entries. All user settings are guided by the in-built menu and entered using the two pushbuttons. The menu is entered by keeping one of the pushbuttons pressed for about one second. Within the menu, the items to define invariably have two options, which are displayed in the lower of the two display lines. The desired option is selected by pressing

the pushbutton below the relevant text on the display (i.e., left or right).The three main functions, clock adjust, alarm adjust and alarm clear, are shown pictorially below.



The three button setup of the recorder cum playback module is as follows.The operation to be carried out must have its corresponding switch pressed as long as the opeartion is under flow.