*Proc.* Annual Symposium on Research & Industrial Training, 02(2015) 263-268
Department of Electronics – Wayamba University of Sri Lanka

# DESIGN OF AN MP3 PLAYER WITH TIME SCHEDULING

B.M.N.S.K. Basnayake*, W.A.S. Wijesinghe

*Department of Electronics, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka*
*nsk.nandana@gmail.com*

## ABSTRACT

This paper describes the design and implementation of a new MP3 player with time scheduling features. Playing audio files are really important part of many applications. As an example almost all school in Sri Lanka play their school theme song, Observation of five precepts, and National anthem in every morning. But currently those recordings are manually played using a record player. We developed a new system that is capable of playing the recordings according to the schedule. Relevant audio file is played by the system exactly on the preset time, which enables to automate playing audio records in organizations such as schools.

**Keywords**: Decoder Module, Microcontroller, SD Card, Audio, Multilayer PCB

## 1. INTRODUCTION

There are so many Audio players available in the market. However, the main functions of those players are generally same. It can be used to play audio files one by one in the order,as files are stored in the SD card or in its internal memory. In those players, it cannot be changed the playing procedure without changing the order of the files in the SD card because they are starting the playing from the beginning and after that it moves to next file following the stored order in the SD card until reaching the last file. During this process it cannot be done anything other than moving to next or previous file, pause and stop. If anyone wants to play specific audio file it must be moved by pressing next or previous until reach the necessary file.

In this paper we describe the design and development of a new system to solve this above problem. The main feature of this device is time scheduling function. That means it can be scheduled the file playing time with respective audio file. That means this system has the facility to play audio file on specific time. User can select that which file should be played automatically in pre-scheduled time as well as the order. By using this device it can be set

few (Three) timers for playing respective files at a time. The system plays the audio files automatically according to the preset time schedule.This kind of system has many applications where audio recordings need to play on specific time such as in schools.

## 2. EXPERIMENTAL

We have designed and implemented a prototype of new MP3 player with time-scheduling features whose functional block diagram is show in the Figure 1. The main part of the system is a8-bit Atmega microcontroller. Using the set of buttons on the control panel a user can set the time schedule to play audio files stored in the SD card. The MP3 decoder module is used to increase the quality of audio.

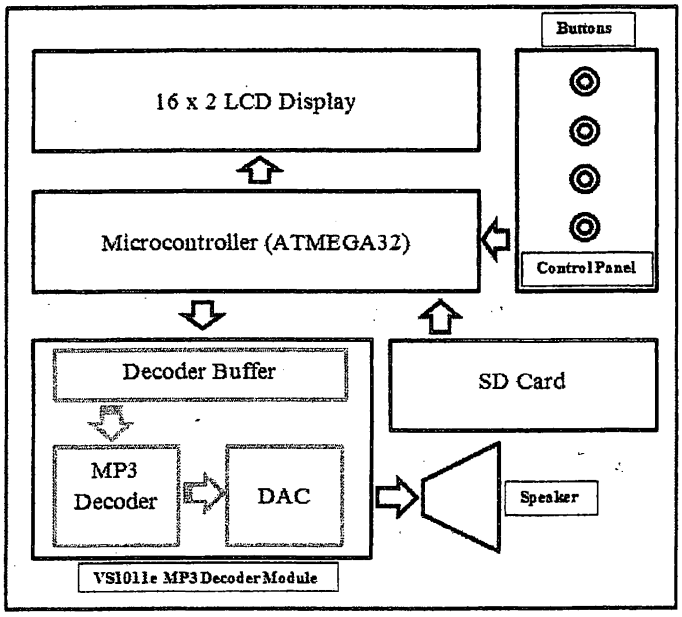


Figure 1: The Block Diagram of the System

### 2.1. PCB Designing

The entire system is built on four-layer Printed Circuit Board (PCB). A simple two-layer PCB is not sufficient to route the connections with proper use of signal integrity. Multilayer boards have many benefits over conventional double layer, singlelayer PCBs. The use of multilayer boards provides several benefits for applications where high levels of consistency in conductor wave impedance are required. In addition, multilayer boards offer superior reductions in distortion and signal propagation in applications where signal integrity and "cross talk" levels are critical[2]. The multilayer PCBs allow for considerable savings on space, allow for the easy, simultaneous shielding of large numbers of components, and cut down on the number of interconnection wiring harnesses that would be needed if separate circuit

boards were used. These interconnections represent a considerable addition to the space a circuit occupies and add substantially to the overall weight of the system also.

The layer stack up of the PCB is given below. The top and the bottom layers are routing layers where all the components are connected. Placing the ground plane and the power plane closed to routing layers minimize unwanted capacitive and inductive effects.

- Layer 1- RoutingPlane
- Layer 2- VCC Plane
- Layer 3- GND Plane
- Layer 4- RoutingPlane

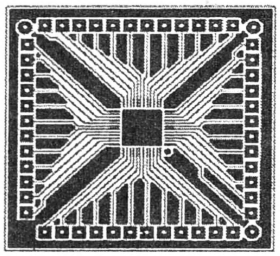

Figure 2: Adaptor

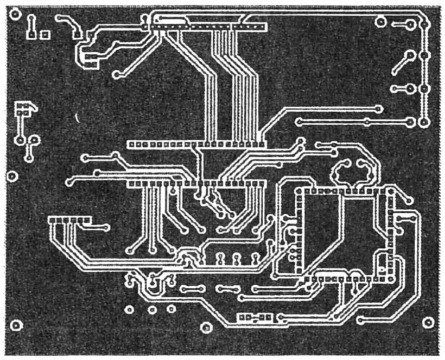

Figure 3 : Bottom View

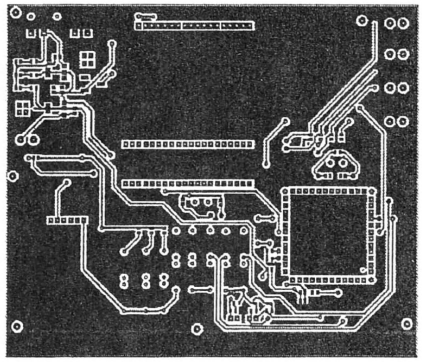

Figure 4: Top View

## 2.2. VS1011E Module

The VS1011 is a basic MP3 decoder chip of VLSI Solution. This module has a reliable and high-quality MP3 and WAV decoding engine with a combination of stereo D/A converter and earphone amplifier. Although intended as slave processor, the VS1011 also has a standalone mode that can be used to play audio files such as mp3, mp1, mp2, wav. Furthermore it Available in two difference packages as well[3, 4].

## 2.3. Decoder Module

The VS1011e device is based on a proprietary digital signal processor. It contains all the codeand data memory needed for MPEG, WAV PCM and WAV IMA ADPCM audio decoding, together with serial interfaces, a stereo audio DAC and analog output amplifiers andfilters[3]. It can play all MPEG 1.0, and 2.0 layer I, II and III files, as well as MPEG 2.5 layer IIIfiles, with all sample rates and bitrates, including variable bitrate (VBR) for layer III. Thatdecoding of layers I and II must be activated separately[4].

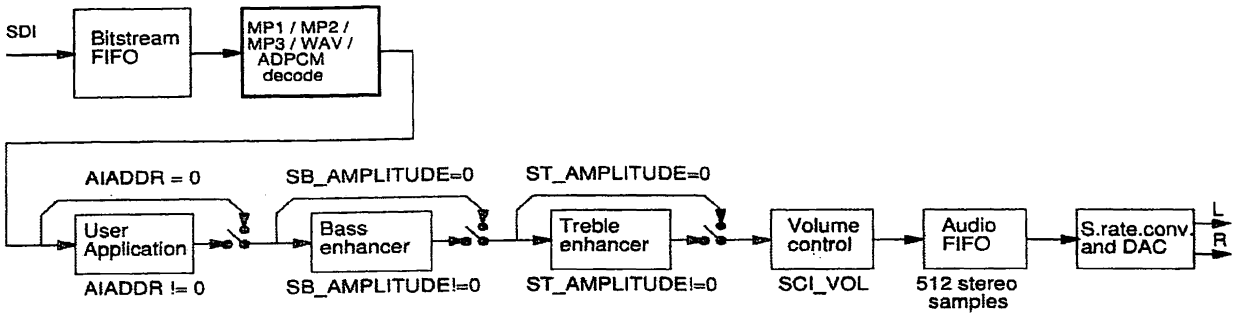


Figure 5: Data Flow of Decoder[4]

First, MPEG or WAV audio data is obtained from SD cardthrough the SDIbus and then the received data is decoded by decode module as shown in above Figure 5.After decoding, if SCI_AIADDR is non-zero, application code is executed from the addresspointed to by that register. Then data may be sent to the Bass and Treble Enhancer depending on the value of SCI_BASS register.After that the signal is fed to the volume control unit, which also copies the data to the AudioFIFO[4].

The Audio FIFO holds the data, which is read by the Audio interrupt and fedto the samplerate converter and DACs. The size of the audio FIFO is 512 stereo (2×16-bit) samples, or 2 KB.The sample rate converter converts all different sample rates and feeds the data tothe DAC, which in order creates a stereo in-phase analog signal[4]. Finally this signal is produced the sound as the result.

## 2.4. ATMEGA32

It is a microcontroller with high-performance, low-power Atmel 8-bit AVR RISC-based microcontroller combines 32KB of programmable flash memory, 2KB SRAM, 1KB EEPROM, an 8-channel 10-bit A/D converter, and a JTAG interface for on-chip debugging. The device supports throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts.

By executing instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed[5]. It has been used to develop this device especially considering the programmable memory.

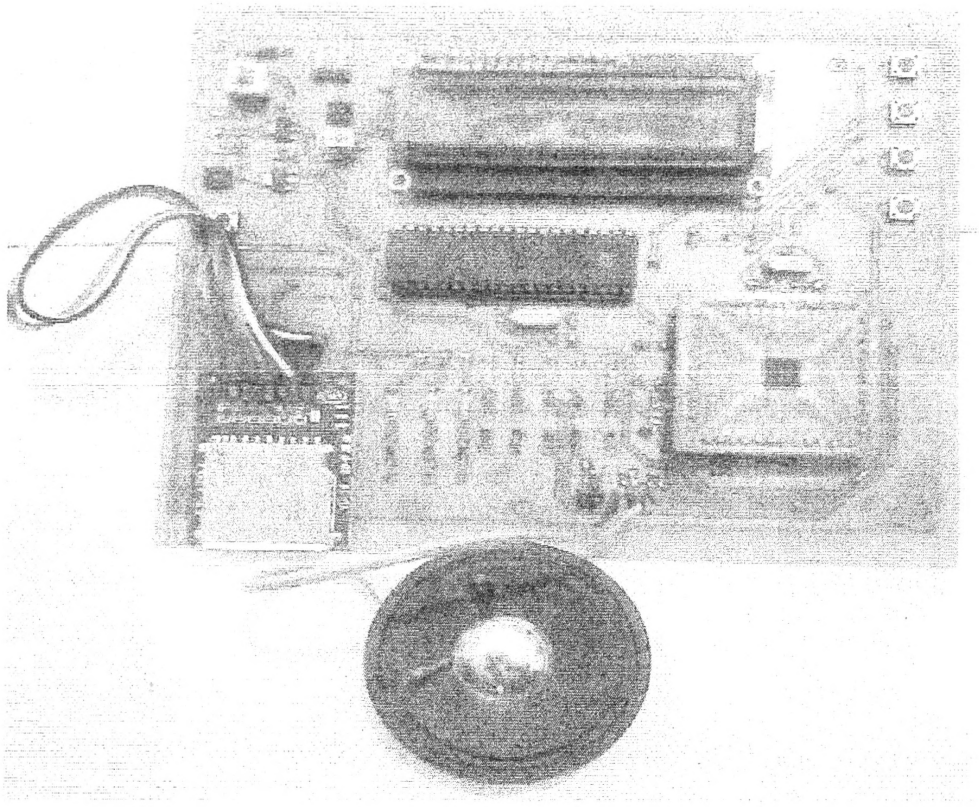

Figure 6: Prototype of the System

## 3. RESULTS AND DISCUSSION

This system can be used in any place where audio files should play easily. It has the feature to make a schedule to play audio file with respective time. So user should not be worried about the storing order and other things and it is easy to use anyone. SD card can be filled with mp3 or whatever audio files by using a PC.

At the beginning of this project we tried to play some audio files including mp3 by using microcontroller directly. Initial tests provided some important results.

- It is required higher memory to decode the mp3 and other audio files. Therefore microcontroller program memory is not enough for decoding such a file in a microcontroller.
- By using microcontroller program memory it can be play only wav formatted audio files with low quality such as8 bit mono wav files having 22 kHz sampling frequency. That means the quality of that files very low and then the play with some noises.
- By adding external memory it can be done and can be played good quality wav files through microcontrollers. But its cost is somewhat high.

### 3.1. Limitations

There are some limitations of this system. The major problem is, it had to be limited the number of timers used because the memory usage of the Microcontroller. It is required more memory to increase the number of timers and as a future development, it can be increase the number of timers by using another microcontroller with higher memory such as ATMEGA 128, STM32 etc.

There is no any internal power backup system. Therefore, if there is any power failure, all timers will be reset and as the result of that, it must be rescheduled.

## 4. CONCLUSION

We have designed and implemented a new MP3 player with time scheduling features. The system consists of an ATmega microcontroller, which controls the main operations of the system. This system can be used to automate playing audio records at different time of the day. It is especially suitable for schools in which play many recordings during the school time.

## REFERENCES

[1]. Rikte Winkel, *four or more layer pcb design for beginners using eagle*, June 28, 2012

[2]. *Kraig Mitzner, complete pcb design using orcad capture and layout, Newnes,2011*

[3]. VS10XX Application Notes, Version 0.73, 2005-11-25, http://www.vlsi.fi/en/support/software/vs10xxapplications.html

[4]. VS1011E Datasheet, Version: 1.22, 2014-12-19, www.vlsi.fi /fileadmin /datasheets / vs1011.pdf

[5]. ATMEGA32(L) Datasheet, http://www.atmel.com/Images/2503S.pdf

[6]. LucioDi Jasio, *programming 32-bit microcontrollers in c: exploring the PIC32, Newnes,2008*