

Arduino Based Guitar Fretboard for Beginners

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ABSTRACT: In the world of musical symphony, the instrument of guitar plays a very crucial role. A guitar is a popular musical instrument that makes sound by the playing of its six strings with the sound being projected either acoustically or through electrical amplification. In today's age the guitar is widely learned by physically attending music classes which is often a costly affair. It is also a well known fact that this intricate instrument is intimidating for the beginners to play. Also the most frustrating experiences of guitar playing are caused by years of incorrect practicing and sometimes bad guitar instructions. The use of Arduino Uno is one of the technological advances which can provide solution to these problems. The proposed system is a Arduino based guitar fretboard which is a proactive fretboard that helps beginners learn the guitar. Thus this system is an efficient yet cheap alternative to learning the guitar via the present conventional methods

KEYWORDS: Arduino Uno, Guitar.

I. INTRODUCTION

The guitar is a musical instrument classified as a string instrument with usually having 6 strings. The sound is projected either acoustically or through electrical amplification. Guitars are recognized as a primary instrument in genres such as blues, bluegrass, country, flamenco, folk, jazz, jota, mariachi, metal, punk, reggae, rock, soul, and many forms of pop.



Figure Error! No text of specified style in document.-1 Acoustic Guitar

It is typically played by strumming or plucking the strings with the one hand while fretting the strings with the other. The guitar is a type of chordophone, traditionally constructed from wood and strung with gut, nylon or steel strings and distinguished from other chordophones by its construction and tuning. There are three main types of modern acoustic guitar: the classical guitar (nylon-string guitar), the steel-string acoustic guitar, and the archtop guitar. The tone of an acoustic guitar is produced by the vibrations of the strings, which is amplified by the body of the guitar, which acts as a resonating chamber.

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Figure Error! No text of specified style in document.-2 Fretboard

Electric guitars, introduced in the 1930s, use an amplifier that can electronically manipulate and shape the tone. The proposed system consists of the ATmega328 which is the heart of the Arduino Uno. The Arduino is the main component of this system which is connected to the guitar fretboard and informs the player on how he should place his fingers on the fretboard in order to play the various guitar chords. LEDs are connected to this fretboard which light up when it receives its input from the Arduino. The LEDs are placed on every fret and they glow such that they represent a particular guitar chord. The beginner has to place his fingers on the glowing LED positions in order to play the desired chord. Various open chords, bar chords, arpeggios etc, can be programmed into the Arduino and can be changed as and when required which provides flexibility.

II. LITERATURE SURVEY

After studying various technical papers, the overall understanding of the system could be broken down into two steps as follows:

2.1 Data Acquisition

Data acquisition is basically extraction of meaningful data from the gestures. This could be done by finding out all the probabilities of the LEDs that need to glow to learn the finger positioning of a particular chord on the guitar fret board.

2.2 Data Processing

Once the data is stored in the Arduino, it needs to be processed and classified into particular chords with the amount of delay that needs to be given in between chords for the beginner to learn the entire chord progression. Most of the previous projects have been used in ATmega 328.

2.3 Output

After a particular chord is recognized they are shown in the PCB where a particular set of LEDs get high voltage and is recognized by the user in the form of guitar chords. This helps the user to learn the finger positioning of the chords.

III. PROBLEM STATEMENT

To design a Arduino Based Guitar Fretboard for beginners who want to learn the guitar such that they are able to do so without any assistance. To develop a Fretboard that teaches students how to play the various chords on the guitar by highlighting the specific strings to play, with the help of LEDs. The design should be such that it is adaptable to the beginner's choice of chords that he/she wants to play.

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IV. ADOPTED METHODOLOGY

The circuit of the microcontroller based guitar fret board is built around the arduino. The indication of the points where the guitar learner is supposed to place his or her fingers is indicated by the LEDs. In this prototype circuit we use three frets but the by-product would have a total of 18 LEDs since there are six strings.

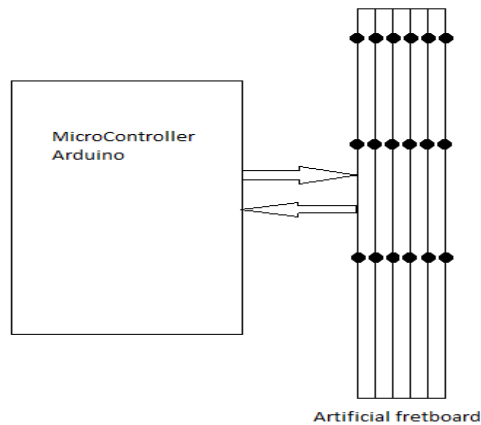


Figure IV-3

The entire electronic fret board is run by the interfacing which is done between the microcontroller and the pins of the LEDs. This interfacing is done by male to female connectors. In this interfacing, we use thirteen digital output pins of the microcontroller and the remaining five for the remaining LEDs are the analog output pins namely from A0 to A5. The microcontroller is fed with the appropriate code. This microcontroller can be powered by an external 5V power supply or can be even auxiliary powered by the laptops USB port. But to make this circuit portable, the external power supply of 5V is preferred over the USB power supply. Finally when the LEDs's are mounted onto the matrix based PCB, it form the shape of an exact guitar fret board.

V. HARDWARE

A. Arduino Uno microcontroller

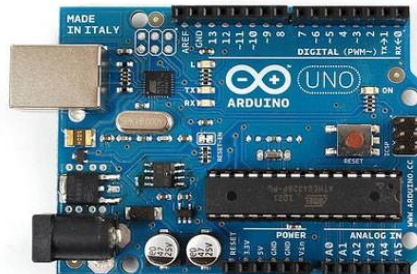


Figure Error! No text of specified style in document.-4 Arduino Board

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs.

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Arduino projects can be stand-alone, or they can be communicated with software running on your computer (e.g. Flash, Processing, MaxMSP). The boards can be assembled by hand or purchased.

B. ATmega328

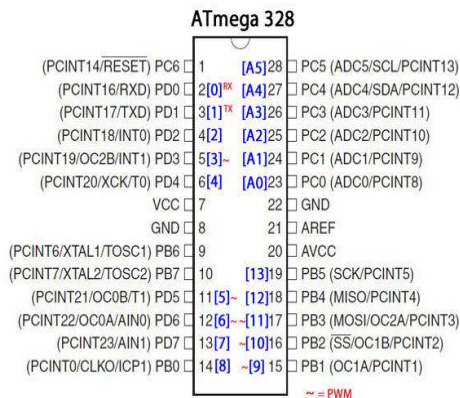


Figure Error! No text of specified style in document.-5 Pin Diagram

1. ATmega328 is the ATMEL Microcontroller on which Arduino UNO is based.
2. The ATmega328 is an 8-bit microcontroller which has 32K of flash memory, 1K of EEPROM. A 2K of internal SRAM is also included.
3. The Atmega328 has 28 pins.
4. It has 14 digital I/O pins, of which 6 can be used as PWM outputs and the other 6 are analog input pins. These I/O pins account for 20 of the pins.
5. The 20 I/O pins can function as input as well as output pins to the circuitry. Whether they are input or output is decided by the software.
6. Two of the pins are for the crystal oscillator. This is to provide a clock pulse for the Atmega chip. A clock pulse is needed for synchronization so that communication can occur in synchrony between the Atmega chip and a device that it is connected.

VI. WORKING

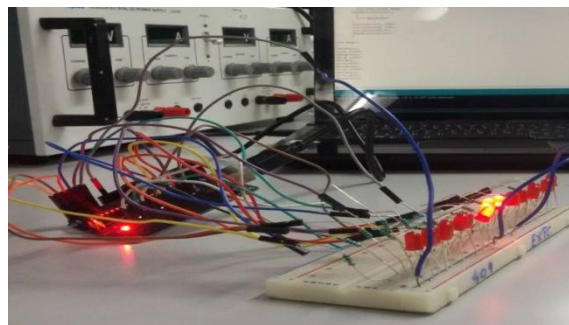


Figure Error! No text of specified style in document.I-6 Working Model

The initial testing stage of the system has been done on a breadboard and the LED's have been lined according to their position on the matrix based PCB. Since each pin of the arduino UNO provides 5V, they are programmed in such a

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way that only those specific LED's glow that signify the shape of a chord. The project model basically consists of LED's that are connected to the resistors that limit the current value passing to the resistors. As we need a certain chord to be played on the guitar, the strings need to be held in a particular position so that a specific chord rings. As the input given to the LED's are with the help of the male connectors and the female end of the connectors are connected to the port pins in the Arduino board. The Arduino board is programmed in such a way that certain ports are given high output while the others are kept low. There is common ground connected to all the LED's that are mounted on the PCB. According to the finger positioning of the chords the particular LED's glow where the learner needs to place his fingers. In the final stage, when the LED's are mounted on to the matrix based PCB and interfaced with the arduino, a particular set of LED's can be given high input which form the shape of a guitar chord and with the help of delay, a particular chord pattern can be given high input of a specific amount of time and the LED's of the next chord pattern can be given high input. Hence, it enables the user to learn the chord pattern with strumming per second of an entire song.

VII. FUTURE SCOPE

A. Remote Controlled Mode of Operation

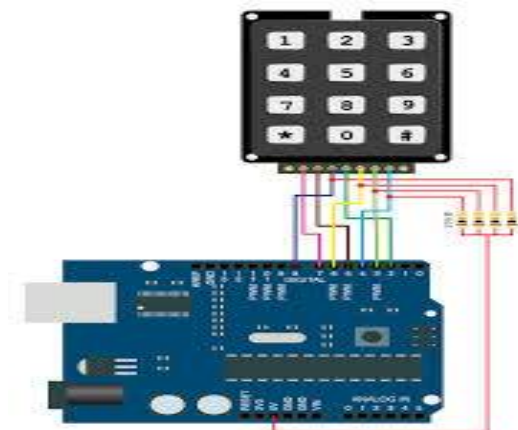


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The circuit in its present form can be very versatile. The versatility in this circuit can be indicated by the very fact that different musical notes can be entered with ease by making minor changes in the program. These changes might include the change of a single code or the change of the entire pattern, to suite ones musical requirements and his or her musical capabilities. The only disadvantage in the present form of this circuit is its inability to make changes in the codes on the go i.e., without using a computer or a laptop.

Hence, the present scope of improvement in the circuit would be to add an external keyboard to enter a certain note. This external keyboard would make the circuit more versatile and portable. Any changes in the present code can be made anywhere without the help of a PC or a laptop. Hence the particular pattern of chords of a song can be fed in a particular number on the keyboard and the user can choose any particular chord progression of a song that he/she would like to learn.

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VIII. RESULT

LED (FRET NO, STRING NO)	CHORD PLAYED
(2,2) + (2,3) + (2,4)	A
(3,5) + (2,4) + (1,2)	C
(2,3) + (3,2) + (2,1)	D
(3,1) + (2,5)+(3,6)	G
(2,5) + (2,4) + (1,3)	E
(3,4) + (2,3) + (1,2) + (1,1)	F
(4,4) + (4,3) + (4,2) + (2,1)	B

Table VIII-1

The above table represents the LED positions on the PCB that glow to represent the corresponding chord. The player has to place his fingers in these positions to play the desired chord.

IX. CONCLUSION

This guitar fretboard system simplifies the very approach of the learner by indicating the position of the strings, the playing on which, will receive a melodious output. The complication is associated with this system is that it consists of lot of wires in the circuit. One has to be very cautious while doing the connections, as a single wrong connection might entangle the entire synchronization. As indicated very elaborately in all the above points, it is a highlighted fact that this circuit is very cost effective and simple. This being a very indigenous idea, all the planning, research and development was done independently. The underlining fact at the end which needs to be highlighted is that this simple circuit makes learning the intricate, complex and sophisticated instrument of guitar simple.

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