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IOT Based Electronic Lehra

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Abstract:
Music plays a very important source of entertainment in each and everyone's life. One of the most important part of music is rhythm or beats. In Indian classical form of music, the beats are given by instruments like Tabla, Mrindangam, etc. In solo tabla, the tabalists need something to guide them know as "Lehra". Conventional Lehras were played by instruments like Harmonium and Sarangi. By replacing the conventional Lehras by an IoT based electronic Lehra, we can make the life of the tabalists much easier as they can control the Lehra from anywhere without anyone's help. A mobile application can be used to send the data and a wifi microcontroller module like ESP 8266 to receive the data and give the desired output.

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I. Introduction

Music plays a very important role in each and everyone's life. It's a great source of entertainment. Throughout our life music is there with us at each and every moment of life. It also plays a very important role in soothing our ears. The Indian Classical Music is well known throughout the world. The beats and the rhythmic patterns of Indian Classical are distinct. The beats and the rhythmic patterns called as "taal" are provided by instruments like Tabla, Mridamgam, Pakhawaj, Khol, etc. When these instruments are played in solo like Tabla Solo or Pakhawaj Solo, they need something for accompaniment called as "Lehra" (a repetitive instrumental melody). Lehra is also used in Indian Classical Dance.

Traditionally, Lehra was played by instruments like Harmonium, Sarangi, etc. Getting Harmonium players anywhere was not easy and also the Tablist had to pay them. This used to create a lot of problems to Tabalists from practicing tabla anywhere and anytime. Even the Lehra players needed to be quite efficient. Due to the advancement of Electronics and the popularity of Internet everywhere, we choose to create an IoT based Electronic Lehra which is portable, needs less human aid and can be operated from anywhere.

The Internet of Things is becoming very popular these. It is a network of physical devices, vehicles, home appliances, industrial unit and other items embedded with electronics connected with the help of internet.[1]. Software plays a huge role in connecting the hardware to the Internet. In order to provide security to our Lehra, we use a authentication code to connect to a smartphone or laptop app. So, the tabalist can only control the Lehra machine. The whole of the work is controlled by ESP 8266 wifi module. It takes input from the user and generates the output in the speaker. The ESP 8266 generates varying tone and frequency with the help of PWM. The user can vary the taal according to his wish and change the tempo as well. Due to IoT the Tabalist can control the Lehra Machine from large distances.

II. Related Works

IoT is quite popular in today's world. IoT based noticeboard is one of the modern developments [1].

In the field of music, Internet of Musical Things are also available in the market [2]. Musical things, such as smart musical instruments or wearables, are connected by an infrastructure that enables multidirectional communication, both locally and remotely.

IoT Based Multi-Room Music System is based on a local server [3]. User is required to use different mobile devices like smart phones, Laptops, Tablets to operate the multi-room sound with the help of UI created on web page.

Self-learning, Context Aware Music Player for IoT is based on a self-learning system that updates itself based on user's preferences(feedback). For which the system needs an initial training period to understand the user's preferences under different conditions. After which the system uses various machine learning techniques to accurately predict a song, given the users state (Activity) [4].

III. Proposed Implementation

A. SOFTWARE REQUIREMENTS:

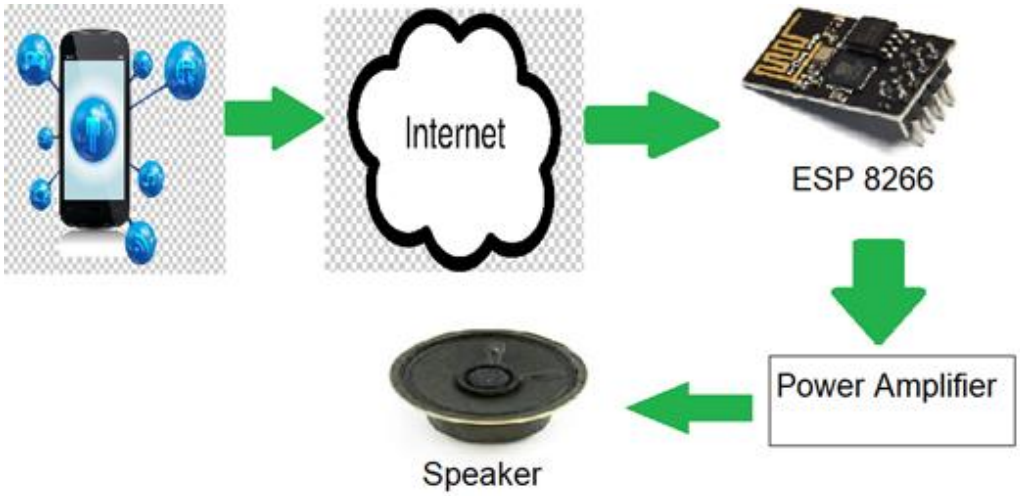
1) Operating system: WINDOWS 10
2) Coding Language: C++
3) IDE: Arduino IDE
4) Musical Note Frequency Converter

B. HARDWARE REQUIREMENTS:

1) ESP 8266 WIFI module
2) Arduino Uno board/FTDI USB to TTL
3) Good Quality Speaker 8ohm or 4ohm
4) Power Supply
5) BD139 Power Transistor

C. METHODOLOGY:

The user's smartphone or a laptop is used as an input for the Lehra Machine. The user logs in using the authentication code. After the log in the user can change the taal and the tempo of the Lehra using the smartphone.



A musical note frequency converter is used to determine the frequency of a particular note.

The coding is done using the Arduino IDE. The code is afterwards uploaded onto the hardware.

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by manufacturer Espressif Systems [5] in Shanghai, China. The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.[6] It is used in our project to connect to the internet cloud.

The code is being uploaded in the WIFI module using an Arduino Uno board or a FTDI USB to TTL converter. The authentication code is also mentioned in the code. The access is allowed only if the user enters the correct authentication code. If he enters the wrong code then he/she will have to again enter the authentication code.

A look up table is created in the code using a note frequency converter application. The frequency of the notes: - C, C#, D, D#, E, F, F#, G, G#, A, A# and B are created using the note frequency converter from the zero octave to eighth octave.

We have chosen the middle octave C Major Scale in order to make our Lehra and tune the tabla or pakhawaj of the C Scale. We have assigned the note and the beat duration according to the notes of the Lehra of a taal and created two different arrays for the note and beat duration. Such array is created for all the taals.

The duty cycle is calculated using the tempo and beat duration.

The tempo of the Lehra would be controlled by the user. Thus, a tone of particular frequency and duty cycle is generated.

A 5V power supply is used to power the Arduino board. The power supply should have good stability as ESP 8266 needs highly stable power supply. A BD139 power transistor is connected at the output pin in order to drive the speaker. A 4ohm or 8ohm speaker is used to convert the PWM signals to sound energy. Better the speaker, better the sound quality.

D. ALGORITHM:

1. Start
2. Login to access of Lehra Machine and verify the authentication code.
3. If the user is valid, go to next step otherwise remain in step 2.
4. Select the taal from the app and vary the tempo.
5. The ESP module receives the information.
6. The Duty cycle is calculated as follows:

   If $frequency <= beat\ array\ size$

   $$Duty\ Cycle = tempo$$

   Otherwise,

   $$Duty\ Cycle = \ tempo\ *\ beats[i]/10$$

7. The Frequency is taken from the array
8. The PWM wave is generated at the output pin
9. Repeat steps 6 to 8 if there is no change in user input
10. If there is change in user input, repeat steps 2 4 to 8
11. Stop.

IV. Results and Discussion

The proposed implementation was successfully tested to demonstrate its effectiveness and feasibility. In this paper an android application is used to control the Lehra machine by connecting to the cloud and the ESP 8266 is used to receive the signals from the cloud. The tempo can be varied by scrolling the slider in the app. The taal can be selected by tapping the taal on the screen of the app.

Figure. 1 The page to select the taal and control the tempo

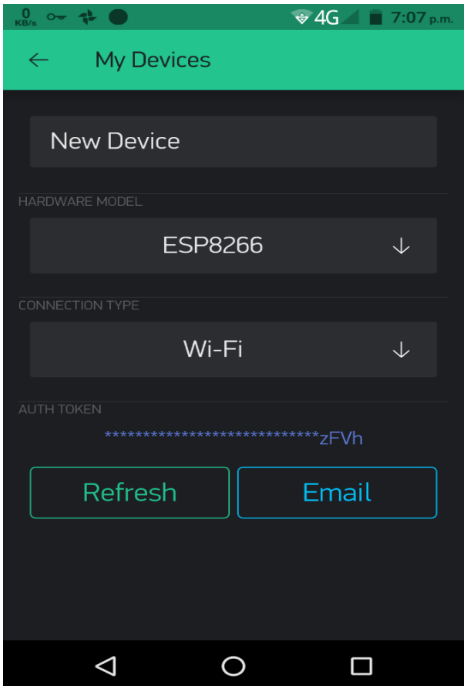


Figure. 2 The page showing Authentication Code

The smartphone connects to the ESP 8266 using the Authentication Code. It verifies the authentication code and then enables to connect with the Lehra.

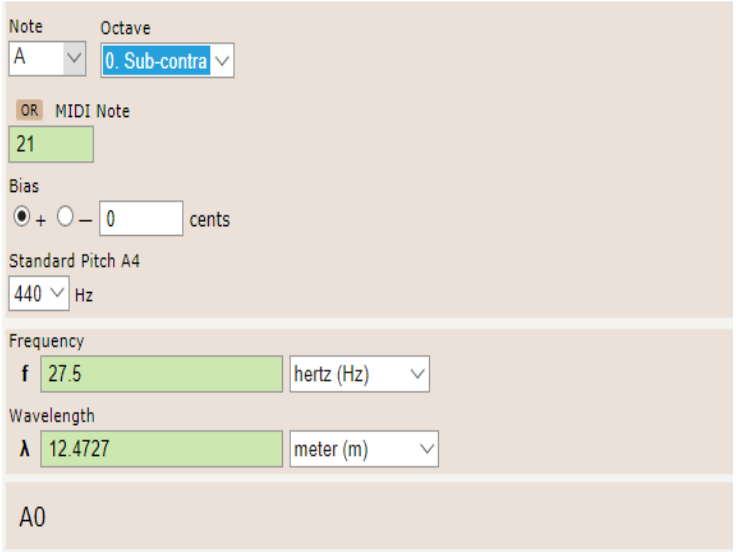


Figure. 3. The Musical Note Frequency Generator App

The Music Frequency Converter App is used to get the frequency of a musical note. Then a lookup table is made in the code in order to use these notes wherever required.

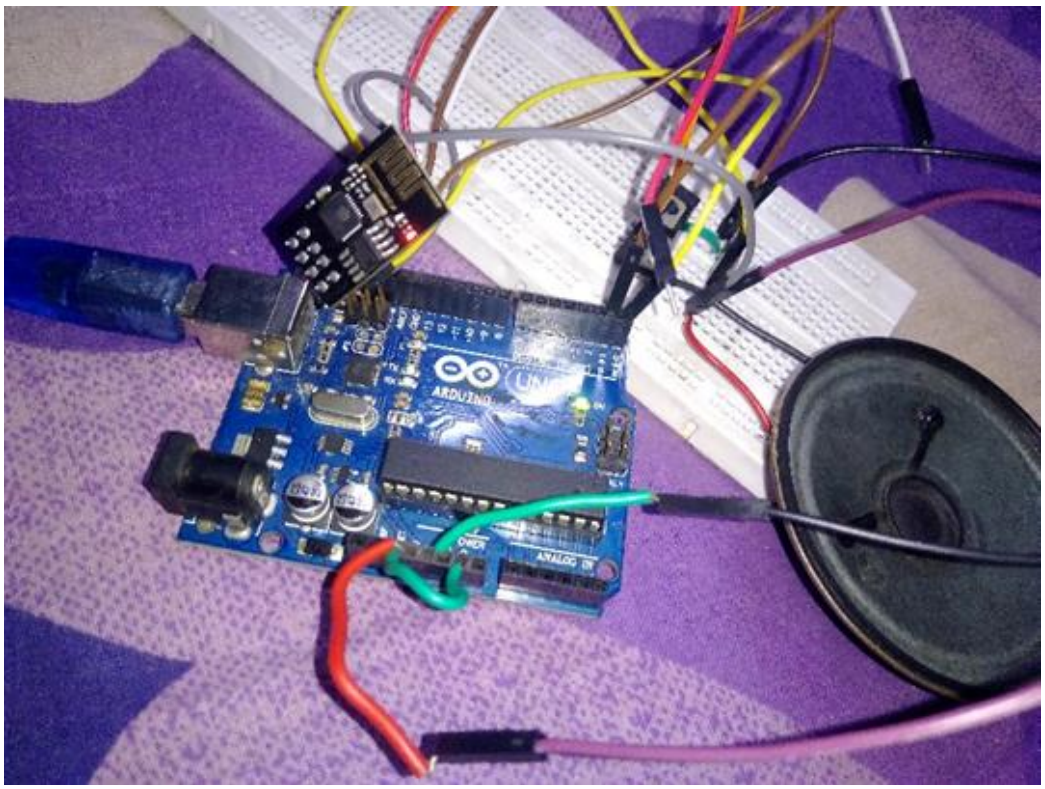


Figure. 4 Lehra Machine at the receiver's side using ESP8266 and Arduino Uno

The ESP 8266 module receives the input from the user and generates the PWM using the frequency and duty cycle. A BD139 power transistor is connected to drive the speaker. Thus, the tabla player can play the tabla with the help of Lehra.

V. Conclusion

This paper presented a vision of how Internet of Things and Electronics can be applied to the field of music. It has shown that how Internet of Musical Things can be implemented.

In addition, the smart musical instruments and their interface with a variety of Musical Things have the potential to greatly impact how music is composed, played, recorded, taught, and experienced.

Such smart instruments would be very useful by the music players and composers for practicing and making the music more symphonic.

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