California Institute of the Arts

# Recontextualizing Persian Music in Electronic Music

by

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# Abstract

Iranian music is one of oldest music traditions in the world. This music has been preserved and evolved over millennia despite numerus murderous and inhuman foreign invasions. Since 1960s there have been efforts to combine this music with other styles of music such as Jazz, Pop and Rock.

This thesis looks at surrounding issues in combining elements of Persian music with Electronic Bass music to create something new and unique. This thesis asks how can melodic concepts, scales and tuning systems used in Iranian music inspire the creation of Electronic music? This research presents new compositional approaches and tools based on the theory and practice of Persian music.

The primary contributions of this work include (1) a new software tool that facilitates creating harmonies and contrapuntal lines in Persian tuning systems in electronic and/or digital music production; and (2) an expressive software instrument/step sequencer that uses physical modeling to recreate the sound of the Iranian Instrument called the Barbat. A physical synthesizer that facilitates the use of microtonal ornamentations in performance. Discussion is provided detailing the affordances provided by these new tools, in the effort to provide electronic bass musicians the ability to think creatively outside of traditional equal temperament and western musical paradigms.

Furthermore, this thesis examines ways in which we can expand on the practical theory of Persian music using digital technology. This includes creating new approaches in polyphony.

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# Chapter 1

# Introduction

## 1.1 Introduction

Archeological records from Elam Civilization 5000 BC and Oxus shows that the history of music in Iran dates back thousands of years. Iranian traditional music can be categorized as classical music and Maqami music. Maqami music has been preserved over millennia through heart to heart teaching traditions. The classical music on the other hand is newer and is essentially a cohesive compilation of Maqams from different regions of Iran. This thesis will focus primarily on Iranian Classical music.

This music can be an enormous source of inspiration for contemporary electronic music.
This thesis discusses how electronic music can be inspired by Iranian music concepts and how technology can facilitate this.

## 1.2 Defining Electronic Music

The term Electronic music has been used liberally by different people over the years to describe many different musical styles, genre, and artistic practices. The intent of this thesis is not to present a broad historical context around the term and how it has been used over the years. Rather, in the context of this thesis, the term Electronic Music will be used to refer specifically to the genres/styles in question, namely Drum and Bass, Neurofunk and Glitch. In this thesis modern Metal that has a lot of processed sounds is also considered Electronic music. What all these styles of music have in common with Persian music is the use of Modal and Middle Eastern sounding scales.

This thesis looks at approaches to using Iranian Music's scales and tuning systems in Electronic music.

## 1.3 Combining Electronic music with Iranian music

Electronic music, as defined in this thesis, is concerned with perfection and precision. Music producers often spend a great deal of time creating musical content to be used in their compositions. These contents can be samples, synth patches, etc. Some even develop custom software using music synthesis languages such as Max/MSP, Csound and ChucK. So much effort is put into creative sound design and producers always try new approaches for creating fresh sounds. However, there is not as much effort put into coming up with new melodic and harmonic techniques. This thesis looks at various ways we can take inspiration from Iranian musical concepts, particularity melody and harmony.

This thesis inquires at different ways we can apply rules and concepts of Persian music to Electronic music production. The first approach that comes to mind is sampling, which is something people have been doing for a long time. But how can we do more? How can we use the concept of Dastgah, a systematic framework for composition and imprecision found in Persian music, in our productions? (For more information on Dastgahs please refer to The Dastgah Concept in Persian Music book by Hormoz Farhat)

## 1.4 Extending Persian Music beyond tradition

### 1.4.1 Harmony

Creating chords and harmonies are a great way to expand Iranian music. European classical music has been built around equal temperament which is nowadays the tuning used in most music. In order to create Iranian sounding harmony new harmonies that based on Iranian tuning systems are necessary.

## 1.5 Contributions

The pieces of software presented in this thesis are developed to surmount limitations of commercially available DAWs, synths and samplers. The first Max for live device is a physical model of the Barbat, an Ancient Persian instrument. It combines the timbre and playing vocabulary of the instrument with the practicality of a step sequencer. The second device is a harmonizer which allows for easy and effective harmonization of Persian Pitch sets in a Dastgah. Finally a physical synthesizer capable of playing in any tuning system and suitable for Persian music is presented.

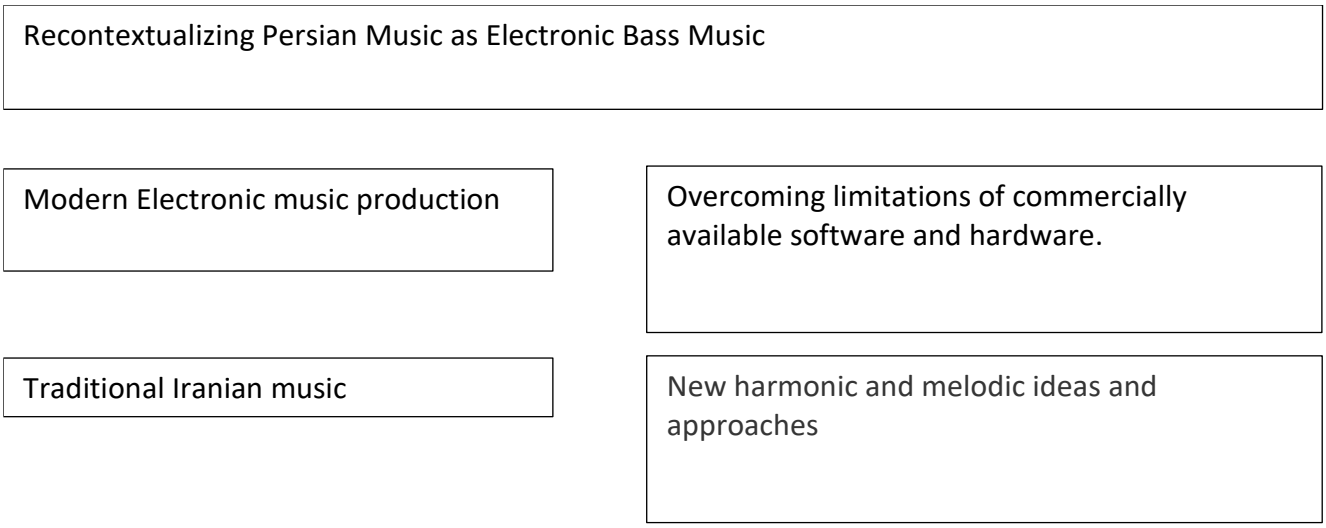


**Figure 1.1: Overview of Thesis**

**Figure 1.2 elamite man playing a lute  5000 B.C**

**Figure 1.3 Bronze cup with a musician's depiction, Lorestan, 9th century B.C., Lyon Art Palace**

# Chapter 2

# Background and Motivation

## 2.1 Iranian Classical Music

While Persian classical music is highly improvisatory, it is built around a rich set of musical rules that give it it's unique musicality. While the framework allows for the musician or performer a potentially endless arena in which to explore their creativity, it is these specific rules, born from what many believe to be the oldest music known to man and codified nationally 500 years ago, that make the music and performance authentic. In order to understand these rules, we need first understand the concept of Radif. Radif consists of Dastgahs and Avazes. A Dastgah can be thought of as a framework for improvisation and composition. This framework consists of a succession of several Goushes. The transition from one Goushe to the next sounds very pleasing. A Goushe can be thought of as a melodic motif or rhythmic motive with a certain set of pitches. Goushes are more like a template and don't have to be followed exactly. The performer can improvise using this template. Throughout a performance in a Dastgah the musician plays a number of Goushes. The first Goushe in a Dastgah is called Daramad and it lays out the initial pitch set of the Dastgah. Daramad is always in a lower register. As the player plays through the Goushes in Dastgah he gets to higher registers until he reaches a Goushe often called Ouj which means the highest part or the highlight. From there the performer plays Goushes at lower register until he reaches a Goushe called Foroud. A lot of Goushes emphasize one of the notes of the scale in their melodic pattern and at the end of the phrase resolve to the tonic.

The concept of Dastgah is only a few hundred years old but it has it's roots in very old times. All these Goushes have existed for a very long time. The invention of dastgah was mainly to preserve

all the ancient maqams[1] that in a systematic way so they aren't lost and forgotten. We have 7 Dastgahs in total and 5 Âvâzes. Âvâzes are similar to Dastgahs but they are more limited and don't have as many goushes. These 7 Dastgahs and goushes make the Radif.

## 2.2 Combining Persian Music and Western Music

Artists have employed different approaches to combine western music and Iranian music.
Some have used western and Iranian instruments in their instrumentation. Others have sampled recordings of Persian music. Some noteworthy artists are discussed in this section.

### 2.2.1 Oriental jazz

Lloyd miller is an ethnomusicologist and multi-instrumentalist who has done a lot of research on Middle Eastern music. Miller moved to Iran after his father got a job to set up a business school in Tehran. In Iran he became really interested in Persian music. He stayed there for a year, but he realized there isn't really a Jazz scene in Tehran. So, he left Iran for Paris to find a Jazz scene and become famous. In Paris he met Dr.Dariush Safvat and took Santour lessons with him at Santour de tout de music oriental. In 1960s he started playing Santour with a Jazz trio and started Oriental Jazz. In 1970 he received the Fulbright scholarship and went to Tehran to finish his doctoral dissertation. In Tehran he studied with Dr.Safvat at the center for preservation and propagation of Persian music where Safvat was training 12 of the best instrumentalists in the University of Tehran's music Department.

Lloyd miller was the first who combined jazz with Iranian music. One of his noteworthy pieces is his jazz arrangement of Gol E Gandom.

[1] Maqams are melodic templates used for improvisation across Middle East

Miller once said, "In order to sound Persian, you need to think Persian "it is obvious from his Piano playing that he really does "think" Persian. He tunes the Piano to a Dastgah's pitch sets and plays Santour picking techniques on the Piano which makes the Piano sound like a Santour.

Other artists such as Masood Shoari and Mahan Mir Arab have also created Iranian Jazz music influenced by Lloyd miller's work.


**Figure 2.1: Lyon Miller Playing the Santour**

### 2.2.2 Kahtmayan

Kahtmayan is one of the first Iranian Metal bands formed by Guitar virtuoso Homayoun Majdzadeh. Majdzadeh always had a fascination with Iranian regional music. Over the years he has tried to use elements of Persian music in Kahtmayans music. He is interested in Middle Eastern scales rhythmic cycles and melodic motifs. Kahtmayan has influenced many Iranian Metal Artists such as Master of Persia also my project Vivanghat. I had the pleasure of taking Guitar lessons with him in Iran.


**Figure 2.2 Homayoun Majdzadeh**


**Figure 2.3 Kahtmayan Drum recording**

### 2.2.3 Orchestral Music:

Morteza Hannane is an Iranian composer who spent most of his life developing a concept called even harmony. He wrote a book called Even Harmony, but he never released it. He suggests harmonizing melodies with Persian scales using mostly voicings in 4ths and 6ths. His reasoning for this is that in Persian music going from 4 to 1 is a lot more common than 5 to 1 cadence.

**Figure 2.4 Morteza Hannane conducting Tehran symphony orchestra**

How can Persian music vocabulary be used in the context of Electronic music though? Are there custom tools that can improve music production workflow? What are solutions to the limitations enforced by software tools that are quantized to equal temperament? The next three chapters answer these questions and provide solutions to these problems. Two software tools and one hardware tool are presented that help bring the two worlds of Persian and Electronic music together.

# Chapter 3

# Homa

Homa is a digital model of the Persian Barbat built in Max/MSP. This virtual instrument can play all the ornaments and scales that the real instrument can play. It also has more range than the real Barbat. Homa consists of a 32 beat step sequencer and an impulse loader.

**Figure 2.1 Persian Barbat**

## 3.1 Physical modeling

Sample libraries have become very popular among music producers Especially for instruments that are percussive. For string instruments that aren't percussive they might not be the best approach because of all the different ornamentation that this instrument can play. For this instruments Physical modeling can be a better approach of getting more realistic ornaments. Homa uses a Karplus Strong model implemented in MSP

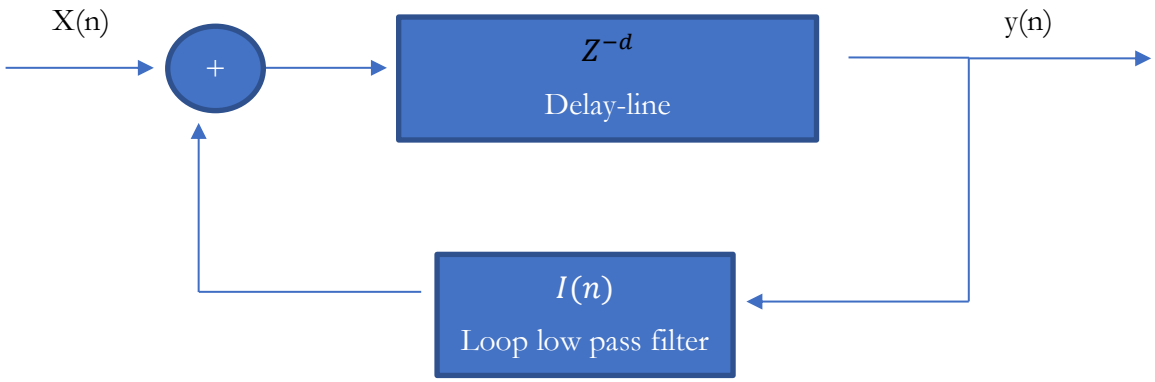


**Figure 3.2 The Karplus-Strong plucked string algorithm**

Karplus Strong only models the strings and not the body. In order to model the body of the instrument the sound needs to be convolved with an impulse response of an instrument's body. HISSTools Impulse response Toolbox v2.0 is used for convolution.

## 3.2 The sequencer

Step sequencers have been an important tool in electronic music for decades Especially in west coast synthesis. More recently musicians have become more used to built in piano rolls in DAWs. Using the roll can be great for programming realistic acoustic drums or rhythm synth lines. When it comes to Middle Eastern instruments though it can be very difficult and time consuming to program realistic and authentic sounding lines with proper ornaments.

So how can this problem be solved? Is there a way to program these ornaments more easily and more effectively?

Homa's Sequencer attempts to solve this by having a probability section with a range of 0 to 100. With it you can sequence pitches, whether a note plays or not and the ornaments as shown in fig 3.1.

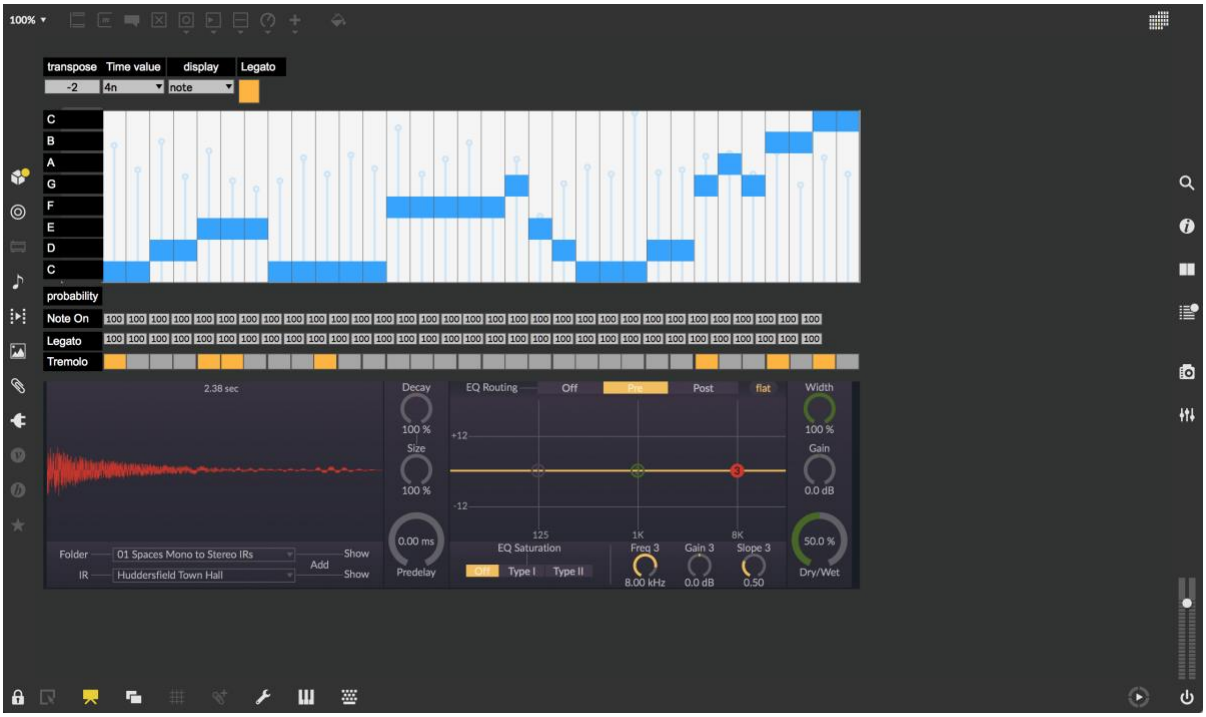


**Figure 3.3 Homa Max Patch**

# Chapter 4

# Sepanta

Sepanta is a Max for Live device that takes the idea of combining Persian and Electronic music further by creating four voice polyphonic microtonal harmony. Persian music normally is monophonic but some composers such as Morteza Hanane came up with ways to create polyphony based on rules of Radif.
Microtonal harmony can be challenging to write and can sound unmusical and jarring if not done right. Inspired by the work of Hanane, Sepanta lets the user create harmonies which are based on Dastgahs.

## 4.1 The sequencers

There are four voices and there is a sequencer per voice. Since a traditional Western score can't represent the pitches used in Persian music accurately[2], the GUI is designed so you can see the melody line for each voice similar to an orchestral score. Every step on the sequencer can be thought of as a voice in a chord voicing so the user can create long and complex chord progressions.

## 4.2 composition possibilities

In fig 4.2 you can see the melodic line for each voice and see how it relates to the other lines. With this device because you can visually see the different contrapuntal lines it's easier to come up with independent melodic lines and achieve better voice leading.
The user can work on each voice individually and mute the ones he is not working on.

[2] It is common to use half sharps and half flats but even those accidentals are not adequate because in Persian music the microtonal pitches aren't necessarily exactly a quarter step sharp or flat.

## 4.3 Synthesis

This device takes in either the incoming audio or uses the internal white noise oscillator and creates pitches using tuned comb filters. There is one comb filter per voice. The user can mix between the dry and wet signals. The pitches that are played back are determined by the sequencers.

There are two options for enveloping. There is an envelope follower that detects the amplitude variation of the incoming signal and applies an envelope to the output based on it. Alternatively, there is the option of having an Attack/decay envelope per step.

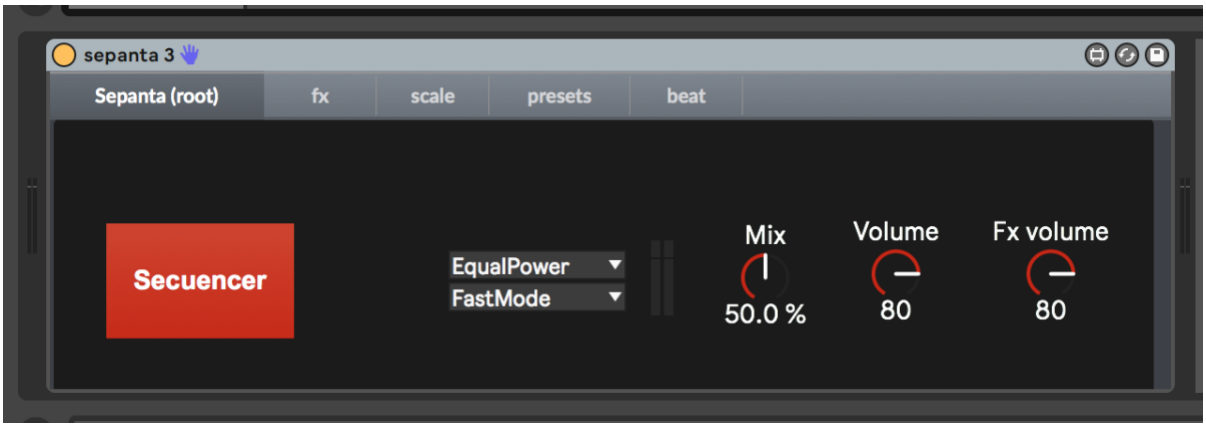


**Figure 4.1 Sepanta Max for Live Device**

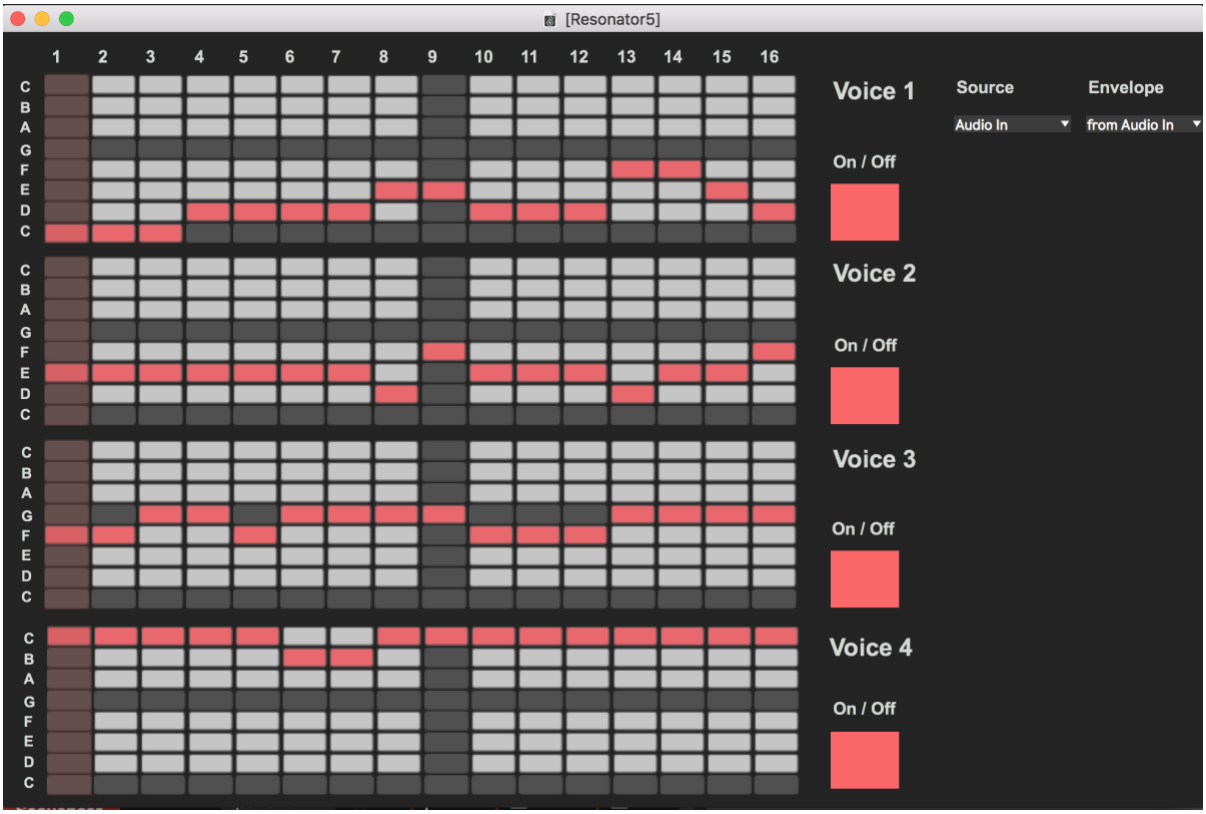


**Figure 4.2 Sepanta Sequencer**

# Chapter 5

# Shahbaz

This chapter describes the Shahbaz Synth, the process for creating it and the inspiration behind it. Shahbaz allows for microtonal glissandos on a customized hardware device. The idea for its design stemmed from frustration over the limitations of most MIDI controllers and instruments. With these controllers, the performer is limited by pitch quantization or the controller's playability. Shahbaz allows for more expressivity and flexibility in performance.

## 5.1 The Instrument

Shahbaz allows the performer to play in any tuning system. It also allows for techniques and nuances that are specific to stringed instruments. Seven linear FSR sensors are used to represent the range of a seven-string guitar. Each pair of sensors is tuned in increasing octaves to an A and a D, with the final sensor tuned to an A. The sensors emulate strings on a fretless instrument. As the performer applies pressure to the sensors and moves their hand horizontally the pitch rises. The names of the non-accidental equal tempered notes are marked on sensors as reference but there is no quantization so you can play in between the pitches. As the performer applies pressure to the sensors, they can move their hand horizontally to adjust the pitch. For reference, the pitches found in C Ionian are listed on the sensors. Non-diatonic notes, including those not traditionally found in Western tuning systems, can be produced by slight movements of the hand.

There are a number of instruments that allow for further expressivity and microtonal possibilities such as the Roli Seaboard, Buchla Thunder and the Continuum Keyboard. However, they are represented as keyboards. This can be a problem for string players who are used to seeing notes on a fretboard.

The exceptions to this are the Moforte GeoShred and XT Synth—both of which are definitely inspirations to Shahbaz.

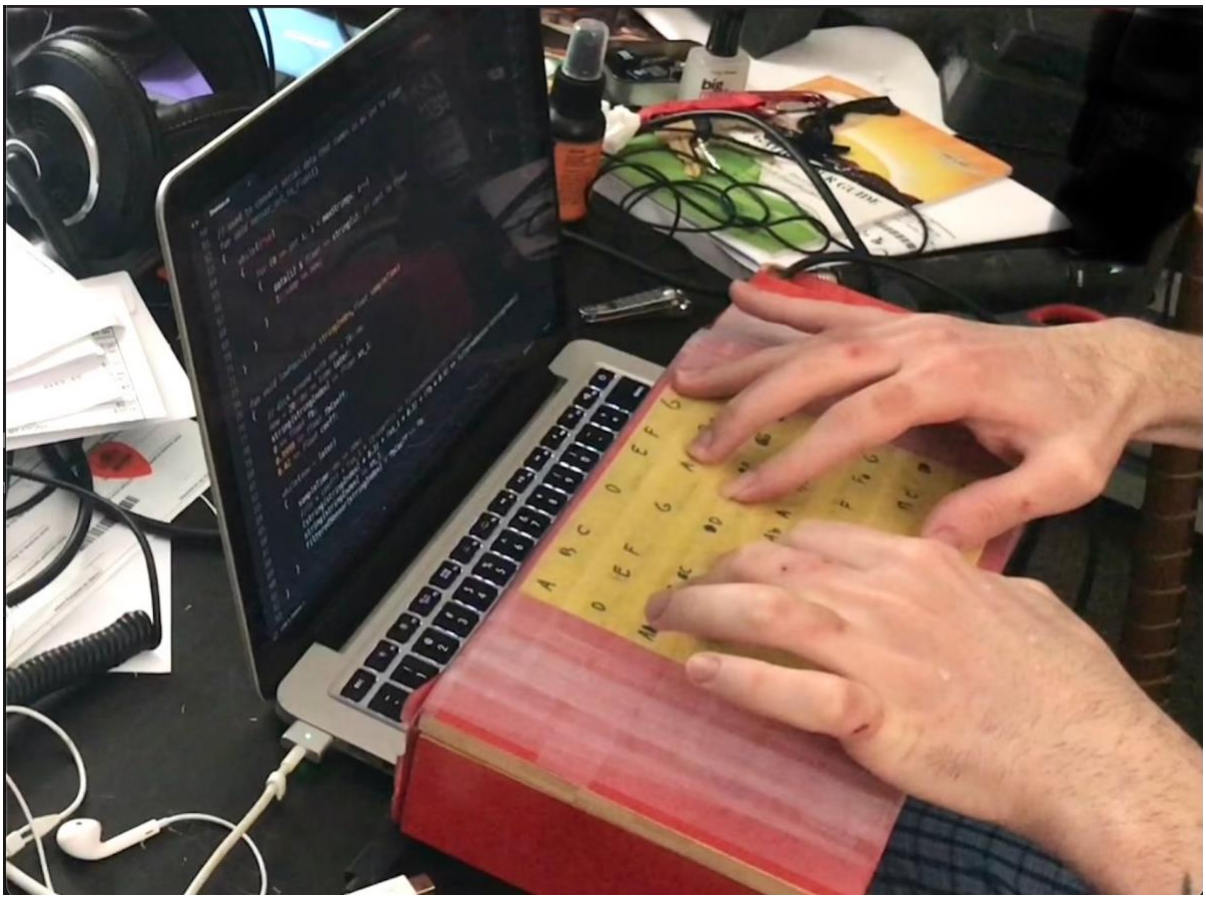

**Figure 5.1 Shahbaz**

## 5.2 Performance Possibilities

Shahbaz makes it very easy to play lines inspired by fretless Middle Eastern instruments such as the Persian kamancheh and Indian Sarangi. Techniques used in Indian music such as murki and meend, which are a form of glissando, can be performed on Shahbaz. Microtonal pitches, like those found in Persian Music, can also be played on Shahbaz and there is nothing stopping the performer from mixing the two styles together.

Another possibility is playing microtonal chords. Often composers who use microtonality have to find ways around the limitations of commercially available instruments to produce the desired pitches. Some composers use two instances of the same audio plugin with one tuned a quarter tone sharper in order to play microtonal intervals; others use custom instruments. With Shahbaz, the user can play and voice lead chords more fluidly, thanks to the visual nature of the instrument. Shahbaz is designed to work with ChucK as opposed to soft synth audio plugins. The reason for this is many soft synths don't support MIDI notes with a decimal point e.g. 65.3 therefore, they can't produce microtonal pitches. Synthesis programming environments like ChucK and Max/MSP are very powerful and flexible for this kind of work.

## 5.3 Implementation

Serial data is sent from an Arduino Mega to ChucK as integers. In order to be able to perform a natural sounding vibrato and glissando without noticeable artifacts an averaging filter with feedback is implemented in ChucK.

Here is the equation used:
(n * coeff) + (xn_1 * (1-coeff)) + (feedback * coeff)

The output from soft potentiometers is linear. In order for the output to be in a usable range, it needs to be converted to an exponential scale.

Here is the equation for doing so:

Frequency = pow(2.0,(sensorData[i]))

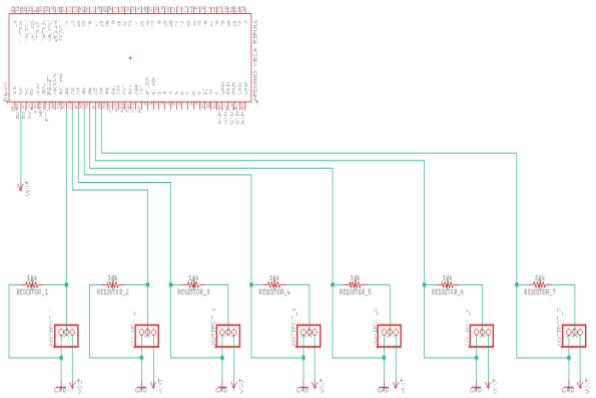

**Figure 5.2 Schematic**

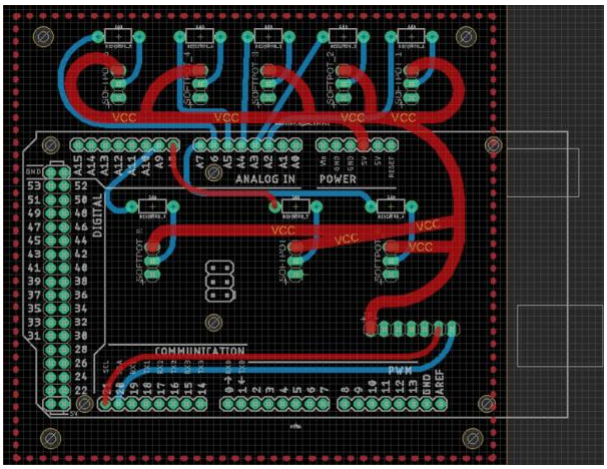


**Figure 5.3 The PCB**

# Chapter 6

# Conclusion

Many musicians have combined Western and Eastern music together in various different ways. Most of their work though has been done in an organic band context. The work presented here is built on top of the work of other great musicians but is focused on highly produced electronic music. This thesis focuses on Iranian music and investigates how this music might be used to inspire creation of electronic music specifically. This is accomplished by development of 3 tools for music performance, production and composition. Shahbaz, a physical instrument that facilitates playing in microtonal Persian scales. Sepanta a tool for creating harmonies in Persian tuning systems. Homa a software instrument/step sequencer emulating the Barbat instrument.

In future versions of Homa and Sepanta, some exciting new effects will be implemented. On a Setar, a surface transducer will be installed. The Setar can be tuned to an open tuning with characteristic notes of a Goushe or a Dastgah to function like sympathetic strings. This sound can be blended in sparingly with the existing body emulation to achieve a more realistic sound, or it can be blended in not so sparingly and heavily compressed as an interesting effect.

Shahbaz will feature an accelerometer in the future iteration, which means the instrument has to be slightly smaller so that it can be held in one hand while being played with the other. This allows the player to effortlessly move and tilt the instrument to achieve different effects.

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