

OPEN SOURCE AUDIO SYNTHESIS



WPI

An Interactive Qualifying Project Report
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by

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Abstract

With the development of music technology software, traditional musical instruments and analog synthesizers are being supplanted by Virtual Studio Technologies (VST), powerful software-based tools that provide a wide variety of sounds and sound manipulation options to composers and producers. VSTs, however, are very expensive. This Interactive Qualifying Project aimed to develop a prototype of a free, open source VST library that could be used and enriched by musicians and producers. A survey method was used to test the prototype's viability as a useful studio tool. The results obtained from the survey concluded that the prototype satisfied the users in terms of the effectiveness and simplicity of the software while providing them the accessibility and freedom of an open source project. Based on this survey data, additional features and revisions were implemented within the prototype.

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1. INTRODUCTION

According to the earliest records of human civilization, people have been making instruments and music. In ceremonies and rituals of every kind, every known society has had some way of embracing music within their culture. Today, changes in technology have radically changes the way music is composed and experienced.

Similarly, instruments and the art of instrument building has always played an important role in human culture. Early instruments like the harp and drums are simple in design. With each time period, the innovations that emerged influenced the types of instruments being manufactured. During the industrial revolution, for example, the harpsichord was modified by the innovation of hammers and pulley systems to help the modern day piano emerge as a prominent instrument.

Today, electronic technology continues to influence the creation of new musical instruments. The sampler, for example, is an instrument that plays back pre-recorded sounds stored on tapes. The sounds used in samplers were recorded in a studio or created synthetically to by manipulating audio generation components. The sounds were then stored on tapes and played back when performers corresponding pressed keys on the sampler.

In recent years, the storage of music has migrated from older physical medias to a virtual environment. Cassettes and vinyl used to be the storage and distribution platforms of choice. In 1990, the rise of the personal computer and the development of the Moving Picture Experts Group-1, Layer 3 (MP3) contributed to the popularization of computers as a medium for storing music.

As a result of this, production methods have been shifting from analog to digital. It was soon discovered that computers allow a large flexibility in term of sound texture and are much easier to use and to learn than a single instrument with a single sound. Aspiring musicians can now produce and mix their own music; they do not need the support of a record company or even a real instrument! Unfortunately, professional music tools are expensive, and while it is not a problem for a big-budget recording studio, the cost can prohibitive for a single user.

Given the vast number of artists who produce electronic music using computers, it is surprising that there is not yet a large open-source movement for the purpose of providing the ability to produce professional sounding music for free. Some free music creation programs are available, but they often lack quality sound samples and the ability to produce professional quality music resulting in compositions that sound inorganic and amateurish.

Given this problem, we came to the conclusion that one of the current needs of the bedroom musician community was access to a collection of sounds that are royalty-free. An ideal way of doing that would be providing an interface embedded in music production software that anyone can contribute to in term of sound samples or interface capabilities. Our project's purpose is to provide access and the ability to contribute to a shared collection of instrument samples for free. We developed a prototype of an application that would give access to this sample library, and surveyed music students in order to assess the effectiveness of this type of prototype as a viable music studio application. The project is open-source which means anyone can contribute to the application or can contribute a collection of samples for an instrument. Our priorities were to make the interface convenient and conducive to creativity.

2. BACKGROUND

Music has been a hobby, a passion or a profession for millions of people over centuries. As the technology developed, new instruments and techniques emerged including Virtual Studio Technology (VST). This technology allows musicians to include musical instruments in their recording using large libraries of prerecorded instrument samples instead of the traditional mechanism of hiring performers to record compositions in a studio. These VST technologies have been widely used since the 1990s. One drawback to relying on VSTs is the price point: new technologies that update every few months require very high budgets and many people are not able to afford them.

There are many VST options to the composers and artists who creating music in an electronic environment. Due to the excessively high prices of professional VSTs and supplementary software, many people who are not funded by record labels or big-budget studios cannot afford access to such programs.

There is a free VST market that provides options to bedroom producers, but due to the fact that they do not cost money, they do not provide what the expensive programs are able to do in terms of technical support and compatibility, robust sound solutions and instrument libraries, scheduled updates, and so on.

In this chapter, we will discuss the current situation of the free and paid music production software and common attributes among these products.

2.2 Computers in Music Production

Creating music with computers has become an integral part of the music industry. The first computer to generate some sort of music was built by two Australian scientists Trevor Pearcey and Maston Beard in 1950, called "CSIRAC"¹. The limitations with this were that the machine only played the standard repertoire and was not used for creative purposes. One year after the performance of CSIRAC, the music program that was written

¹ Zara, Tony. "CSIRAC: Our First Computer." Melbourne School of Engineering, 29 June 2009.

by Christopher Strachey performed the oldest known recordings of computer generated music².

1950s were great years in terms of new ideas and progress in computer involvements in music production. In 1957, American engineer Max Mathews developed the MUSIC I program, the first computer program for generating digital audio waveforms through direct synthesis. Mathews and many other scientists worked on later versions of the MUSIC program but the problem with the early versions of this program was the fact that they were not running in real time. The process would take hours or days by million dollar computers that no everyday user can access and the output would be only few minutes of generated sounds³. This problem was going to be overcome by the introduction of microprocessors that allows creating hybrid systems and the most noticeable early example of microprocessor based analog synthesizer will be Roland MC-8 Micro-composer that was produced in 1978. Finally in early 1990s, it was possible to use simpler and user-friendly programs and algorithms with these microprocessor based computers.⁴

Since the invention generating sounds with computers, electronic environments have been a big part of the music production. People were realizing the power of these machines built up of circuits, and had the urge to push their limits and discover new ways of creating sounds. During such a fast developing time interval, the intervention of the computers and computer-based production in 1978 was the first spark. The company called Soundstream introduced the first DAW, The digital Editing System, in 1978.

² Fildes, Jonathan. "'Oldest' Computer Music Unveiled." BBC News. BBC, 17 June 2008. <<http://news.bbc.co.uk/2/hi/technology/7458479.stm>>.

³ Cattermole, Tannith. "Farseeing Inventor Pioneered Computer Music." Farseeing Inventor Pioneered Computer Music. N.p., 9 May 2011. Web.<<http://www.gizmag.com/computer-music-pioneer-max-mathews/18530/>>.

⁴ Dean, R. T. The Oxford Handbook of Computer Music. Oxford: Oxford UP, 2009. Print.

2.3 Digital Audio Workstation

Digital Audio Workstations, also called DAW, are basically computer-controlled systems that makes it possible to create, record, process, edit and replay sounds in digital environments. In addition to these innovative functions, the later versions of DAWs provided MIDI information processing from the same control surface⁵.

The involvement of DAWs in everyday usage didn't happen immediately after their discovery. This was mainly because most of the consumer level computers in early and mid-80s were only able to process MIDI data, not audio. Towards the end of the 80's few companies such as Apple Macintosh started to release consumer level computers that were able to process these two together. Once this new technology was reaching out to the everyday consumers, companies started to focus on improving other things such as better visual feedback futures. Until then, all the focus was on Macintosh machines, but in 1992the



Figure 1 A complex workflow screen from an earlier version of Cubase from 2000⁶

⁵ Lambert, Mel. "History Files: Inside The Development Of What We Know As Digital Audio Workstations - Pro Sound Web." Prosoundweb. N.p., 7 Feb. 2011.

<http://www.prosoundweb.com/article/inside_the_development_we_now_know_as_digital_audio_workstations/>.

first Windows based DAWs started to emerge. At this point, the entire production system was built around dedicated hardware. Each one of these box shaped hardware systems were serving for a different purpose and had different ways of altering the sound. The problem was that everything was hardware based. The consumers needed to physically switch between different hardware and replace them with new equipment when a newer version was released. The release of the software-only product Samplitude Studio for Windows based computers in 1993 was innovative in this manner, but the next big thing wasn't out there yet. A German company called "Steinberg" would introduce the real innovation. In 1996, Steinberg releases Cubase VST software, which was able to record, and playback up to 32 tracks of digital audio without the need of any of the previously used bulky hardware. In such a short amount of time, Cubase changed the DAW industry entirely, both in what it provides to the users and in the prices. Even today, most of the DAWs are using Cubase as a basis.

There are many options of DAWs in the market today. But just like any other software, all these options differ from each other in ways such as easiness to learn, compatibility etc. But most of them meet in one common point: They are expensive. These DAWs are mostly used for business purposes such as music production, thus companies keep the prices high. Even though this does not affect label-supported artists, the price is still a big issue for most amateur producers. In the table below, the advantages and disadvantages of using different digital audio workstations that are leading the electronic music production market today.

DAW NAME	PROS	CONS
Ableton	<ul style="list-style-type: none"> ● Loop oriented session view ● Live Performance ability ● Max for live ● Good customer support ● Push Controller 	<ul style="list-style-type: none"> ● Expensive ● UI hard to learn ● Limited amount of midi and audio tracks
Fl Studio	<ul style="list-style-type: none"> ● Easy to pick up for beginners ● Many options of plugins ● New performance mode 	<ul style="list-style-type: none"> ● Bad default samples

⁶ Walker, Martin. "Steinberg Cubase VST5.0." SoundonSound. SoundonSound, Sept. 2000. Web. 28 Apr. 2015. <<http://www.soundonsound.com/sos/sep00/articles/steinbergcubase.htm>>.

	similar to Ableton Live	
Logic	<ul style="list-style-type: none"> ● Score Editor and chord grid library ● Designer drums ● Logic remote 	<ul style="list-style-type: none"> ● Only available in Mac OS
Pro Tools	<ul style="list-style-type: none"> ● Designed for professional studios and studio equipment 	<ul style="list-style-type: none"> ● Hard to pick up for beginners ● Expensive ● Lack of supported operating systems
Reason	<ul style="list-style-type: none"> ● Emulates a physical audio workstation ● Low CPU usage 	<ul style="list-style-type: none"> ● Timing issues when used with VSTs ● Lack of plugin support
Reaper	<ul style="list-style-type: none"> ● Cheap price ● Easy to customize ● Open source ● Many plug-ins ● Low CPU usage ● Unlimited midi and audio track availability 	<ul style="list-style-type: none"> ● Hard to pick up UI ● Does not contain default samples
Steinberg Cubase	<ul style="list-style-type: none"> ● Easy to use ● Many amount of midi and audio track availability 	<ul style="list-style-type: none"> ● Bad latency on Mac OS ● Bugs that are not fixed ● Bad customer support

Table 1 Comparison of current Digital Audio Workstations in the market⁷

2.4 Virtual Studio Technology

Even though these computers were introduced to the music industry as standalone production elements, the first examples were missing something. The fact that they were great inventions for the industry cannot be denied, but still they were not enough by alone. The music industry was full of people craving for mediums that they can reflect their creativity and their brilliant ideas, but these first examples of DAWs had limited capacity, they were not offering more than what the company provides in the package. At this point, software interfaces called Virtual Studio Technology, VST, emerge as the savior of the producers who wants to experiment new technologies.

⁷ The MusicRadar Team. "The 19 Best DAW Software Apps in the World Today." Music Radar. N.p., 24 Sept. 2014. Web.<<http://www.musicradar.com/us/tuition/tech/the-19-best-daw-software-apps-in-the-world-today-238905>>.

VSTs provide a link between synthesizers and effect plugins with an audio editing and recording system. The purpose of this is to mimic the functionality of hardware music production equipment in software. This way, numerous bulky hardware equipment will be avoided and the money spent will decrease drastically. In 1996, a German company called *Steinberg* released two great innovations, the first known VST interface specifications and their new DAW software Cubase 3.02. These first versions of VSTs were limited to plug-ins such as reverb, echo and auto panner.⁸ These VSTs were not able to process MIDI data in the beginning. When Steinberg released the second version of VSTs, these third party applications made it possible to work with MIDI data in real time effect modules.

Even though first examples of VSTs were limited, this wasn't a problem at all. What was important was the release of SDK, which gives the flexibility and the power to the consumers' hands and provides them with a universal medium to work with on and develop and even create VSTs from their houses. Once people started using these SDKs and other coding sources, the number of free options in the market increased drastically.

Since the SDK sources were provided to the public, the number of different alternatives for VSTs is extraordinary. There are companies, individuals and amateur programming groups who are all working on different VSTs. When this is the case, it is not expected that all of the VSTs on the market are top tier and flawless. This is the point that distinguishes the current VSTs in the market: price vs. professionalism.

2.5 Comparison of Free and Paid VSTs:

	FREE VSTs	PAID VSTs
Pros	<ul style="list-style-type: none"> • Free • Usually open source • Tended to fulfill everyday user needs 	<ul style="list-style-type: none"> • Professionally engineered • Massive sound libraries
Cons	<ul style="list-style-type: none"> • Lack of gigantic sound libraries • Less professional feeling 	<ul style="list-style-type: none"> • Might be complicated to pick up for beginners • Expensive for bedroom producers

Table 2: Comparison of Free and Paid Virtual Studio Technology

⁸Johson, Derek, and Debbie Poyser. "Steinberg Cubase VST." SoundonSound. SoundonSound, July 1996. Web. 28 Apr. 2015. <http://www.soundonsound.com/sos/1996_articles/jul96/steinbergcubase3.html>.

The table above is the starting point for most of the goals we determined for our project in general. As a group, we decided to maintain the pros of free and paid VSTs and try to avoid the cons that we decided for both types of softwares. As a result, the prototype we were going to come up with must be open source, easy to operate, and provide a sense of professionalism to the users.

Even though we separated VSTs into free and paid categories, the invention of these third party applications made the effect machines and samplers more affordable compared to when the only option was hardware machines. But still the price is a major issue in the industry where the users' budgets are ranging from a student budget to a multi billionaire record company salary. The issue with the pricing caused a big controversy among the producers with the highest salary when producers like Avicii and Martin Garrix were seen using pirated copies of VST plug-in with their studio setup.⁹



Figure 2 An example of a free VST, SC Pro-One. This VST is a sequential Circuits Pro-One virtual emulator¹⁰

⁹Van Der Sar, Ernesto. "Avicii and Other DJs Produce Hits Using Pirated Software | TorrentFreak." TorrentFreak RSS. TorrentFreak, 23 Feb. 2015. Web. 28 Apr. 2015. <<https://torrentfreak.com/avicii-and-other-djs-produce-hits-using-pirated-software-150223/>>.

¹⁰"EFM Releases Pro-1 V0.6 VSTi - Rekkerd.org." Rekkerd.org. N.p., 21 Dec. 2006. Web. 28 Apr. 2015. <<http://rekkerd.org/efm-releases-pro-1-v06-vsti/>>.

¹¹"NI Massive VSTi Dubstep Bass Tutorial." YouTube. YouTube, 7 Dec. 2011. Web. 28 Apr. 2015. <<https://www.youtube.com/watch?v=dSX08czskpw>>.



Figure 3 An example of one of the most expensive VSTs, massive by Native Instruments, a leading electronic company based in Germany¹¹

2.6 What makes a VST successful?

There are different criteria that distinguish the successful and unsuccessful VSTs from each other. These specific criteria are called the Measurable Key Performance Indicators (KPI) and they apply for both hardware and software VSTs.

Measurable Key Performance Indicators (KPI)

- Low warm-up time
- Low time to switch between instruments, banks, patches, presets
- Low audio latency (less than 5 ms)
- Good sound quality (sample rate, low signal to noise, etc.)
- Low CPU use
- Sufficient memory capacity¹²

The criteria listed above are sufficient ways to determine the performance of a VST running on a computer. Besides these features, we have decided that there are two other criteria that apply when one decides whether a VST project is successful or not. These criteria that we came up with are the price and the open source adaptability. As stated in the previous section, the price is an important determining factor when a small budget

¹² "Steinberg Releases VST 3 SDK." KVR:. N.p., 17 Jan. 2008. Web. <http://www.kvraudio.com/news/steinberg_releases_vst_3_sdk_8522>.

producer is purchasing a software. Without the assistance of a multi-billion music label company, it is very unlikely that these producers can pay hundreds of dollars for VST sample libraries such as Native Instruments Komplete. On the other hand, these softwares are purchased once and used for many years. In a dynamic industry like music production, producers are always seeking for new sounds and techniques to improve their products. Sometimes the original producers of the softwares cannot be responsive enough to meet these new needs of their customers, which makes the open source feature highly beneficial since it gives the control to the users and they can decide which add-ons they will add to their repertoire. In this manner, we decided to make our VST an open source software where the users can record an upload sound files to the shared library online and any user can preview these sound files and add them to their personal copies of the VST.

3 METHODOLOGY

We created a prototype of a VST Library using the JUCE framework, and used Logic Pro to create samples for the application's sound libraries. In order to assess the potential for this application as a viable studio option for musicians, a survey has been prepared to obtain feedback from a target group of musicians. Relevant documents and a survey were sent to the target group, which consisting of students who are taking electronic music courses in their undergraduate program.

In this methodology section, the steps that were followed during the design of the prototype will be provided. The methodology was evolving throughout the process of preparing the prototype and kept updated by the team members. After the information about the preparation of the prototype, the survey procedure will be explained and in the upcoming sections, the results obtained from the survey will be discussed.

3.1 Collecting Samples

The prototype that we were intending to create was a VST sound library that can be expanded according to the users' preferences so that they will not be limited with the abilities of the original synthesizer in the original product. For testing purposes, a set of sample sounds needed for the prototypes and as a group we decided to collect our own

samples through existing VST synthesizers. The VST we decided to use was Apple’s Logic Pro’s virtual analogue synth ES2. The reason why we picked to use this particular VST is the flexibility it provides to the users and amount of features we can adjust for any given sound.

During the process of collecting samples, Logic Pro DAW software has been used. For the prototype, 12 notes (ranging from C to B) from the same octave with 6 different velocities were needed. The MIDI values for each velocity value were obtained from the templates in the DAW that has been selected. The results are listed below:

Velocity	MIDI Value
fff	127
ff	120
f	98
mf	76
mp	54
p	32
pp	10

Table 3: MIDI values used during the process of collecting samples for each velocity category.

Once the velocity MIDI values were determined, next step was deciding on the sound that will be used. In the group meetings, it has been determined to use keyboard sounds. Through research in the sound library provided in the DAW, a keyboard sound has been chosen. The parameters set for the sound used for the demo can be seen in the diagram (4) below. After the parameters were set and the sounds to be used were agreed on, 12 notes were recorded in the same velocity (fff) for 4 beat. After collecting the first set of sounds for fff velocity, the set copied six more times and the velocity values for each set got entered. The values used can be seen in Table (2).

In the table below, the parameters used for the sample data can be seen. While deciding on the sounds that will be used for the sample sound library, we paid attention to the attractiveness and variety of the sounds we chose. Since the software will be first used with the default library that comes with the original product, it was important to attract the user in first try. For this purpose, we stayed away from generic instrumental samples such as generic piano and guitar sounds, and created the Hybrid Electric Piano samples that can be seen in the figure below.



Figure 3 Parameters used in the VST for the keyboard

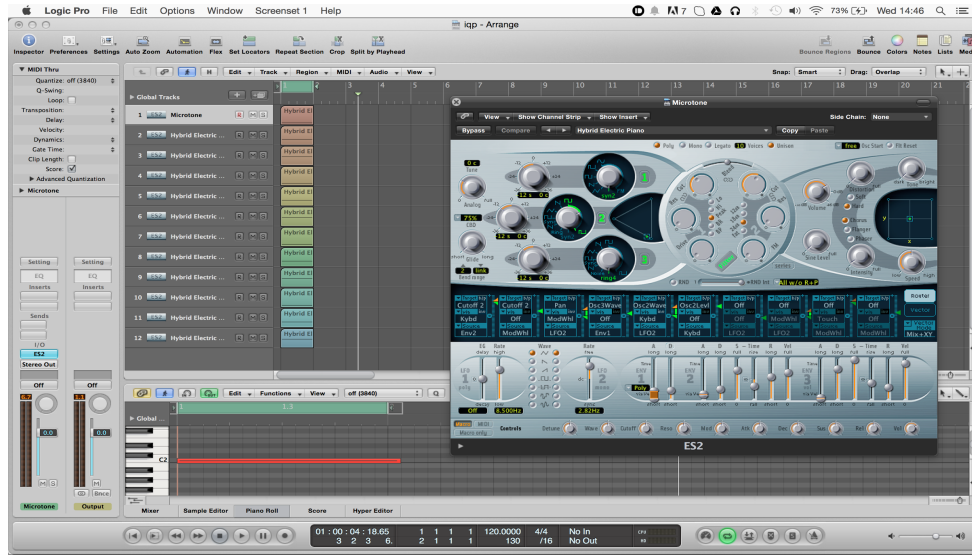


Figure 4 Workflow during the process of collecting the samples

In the Figure above, the workflow of the sample collection process can be seen. As stated before, the DAW software that has been used for the samples was Apple Logic Pro (the window for the software can be seen in the background). Each one of the tracks are dedicated to 12 different notes in an octave and color coded for easier visual feedback.

3.2 Finding an appropriate framework

VSTi are traditionally built using the Steinberg VST Software Development Kit (SDK), but initial research revealed that VSTs could be built by other means using different tools. The first option was to simply use the Steinberg SDK, but digging deeper in the documentation revealed that the API was disorganized and many claimed it was also outdated. While the other options depended on the VST SDK, they did not use the native API and instead mapped it to their own API to make it more user-friendly. Another option was to use the Audio Plugin Generator (APG) with MATLAB. Since MATLAB is proprietary, APG has a licensing fee and our VSTi is open source, we felt it would be better to get an open source solution. JUCE is an open source application framework for audio-visual applications, there is a licensing fee but if the library is used for an open source project, the library is licensed as GPL. JUCE allows the creation of VSTs using the Steinberg SDK and also comes with a tool named the Introjucer, which allows manual creation of a user interface using drag and drop direct manipulation. Additionally, JUCE is cross platform

available on Windows, Mac OSX and Linux and generates the necessary build files for all platforms.

3.3 Dividing the components

Since our project involved real time audio and latency inducing components such as networking, parts of the project had to be in different environments. This is to avoid performance issues when real time performance is critical, like when recording an instrument. For this reason the first separation was of the real time audio processing and the distribution of the audio samples via Internet. The main components are the sound processing module and the graphical interface. The basic JUCE VST architecture lends itself well to this kind of separation.

As mentioned before, it is important for VSTs to be latency free and perform well. For this reason, while the JUCE framework has networking abilities, our team chose to deal with the distribution of samples outside of the VST. A well-supported revision control system such as Git seemed like a viable option.

A fork of Git named git-media¹³ was first evaluated. Git-media allows for the transfer of large files without storing the files in git itself, which is perfect for media files like audio or video files. Unfortunately, this extension depends on the Ruby virtual machine and it was deemed that this was too encumbering of a dependency. Another derivative of Git that was evaluated was git-annex¹⁴. Git-annex is similar to git-media as it does not store the files themselves in git, which makes it appropriate for large files. Additionally, git-annex allows having a git repository distributed across machines. It works by storing in a key value hash a key representing a file in the repository and storing as the value which clone of the repository the file is stored into. Unfortunately, similarly to git-media, git-annex has a pretty heavy dependency on Haskell and it was judged by our team that the Windows version was not stable enough to be integrated in the project. We encourage future teams developing this project to consider these options in the future, as they are both in development and might improve their performance. For this first version of the project, our team settled on regular git with each collection of samples in their own git repository and a

¹³ Chacon, Scott. "Git-media." GitHub. N.p., 2009. Web. <<https://github.com/alebedev/git-media>>.

¹⁴ <https://git-annex.branchable.com/>

master git repository with references to the sample collections. Since our VST only uses short samples, uploading the entire file to git was not a considerable performance issue. This will help ensure that our team's VSTi satisfies the KPI requirements for hardware and software VST. Currently the user has to use git to manage the sample library and decide which sample library will be downloaded to the host.

3.4 User Interface

The user interface (UI) was a really important component in our prototype since this was the medium that we were actually communicating the users. As stated in the background section, the target groups we are trying to reach are ranging from beginners to advanced users. This situation leads us to create a UI that does not involve very advanced and complex parameters at first sight in order to prevent the beginner users to get intimidated in the first sight. In order to achieve this, we used a simple layout for the main part, with a keyboard located in the middle and a velocity slider on the top of it. The left side of the screen was assigned for the sound library drop down menu, where the users can access the sounds files that they have created before, or the files that they have been downloading from the open source library. Since we gathered samples for each seven velocity groups, a slider was implemented to give the ability to determine the velocity in case if the user is not using a velocity sensitive equipment or using the regular computer keyboard.

The color selection of the user interface was based on the color scheme of the well-known VST Massive. The reason for using this specific tones of grey was to avoid any distraction in the software page and make sure it will blend into any DAW program that is running through since gray is a very neutral color and will match with any other DAW design.

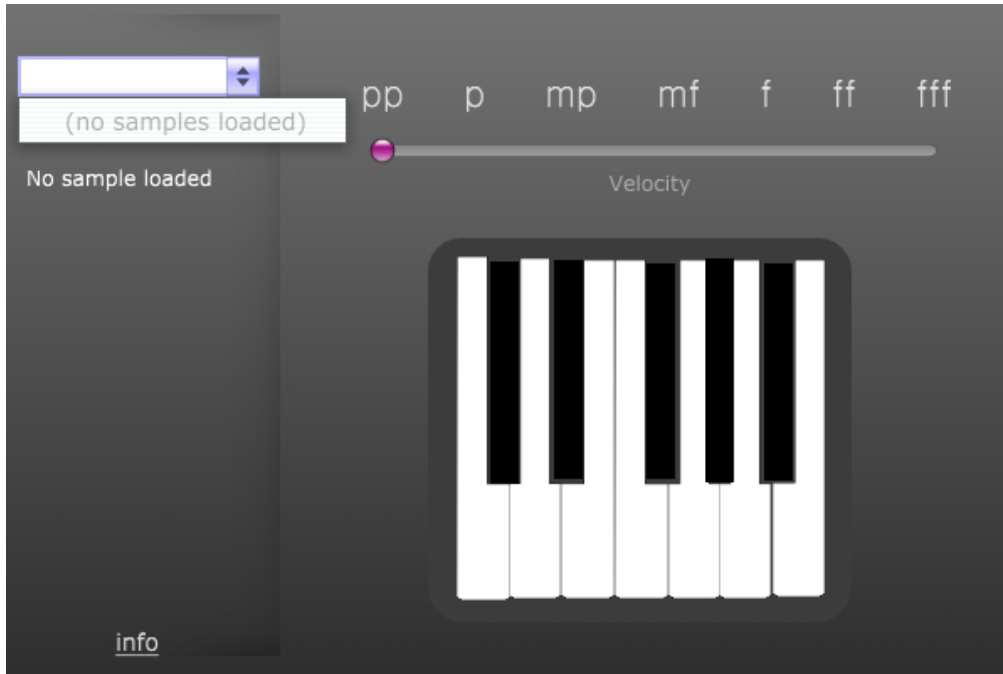


Figure 5 User Interface Templates

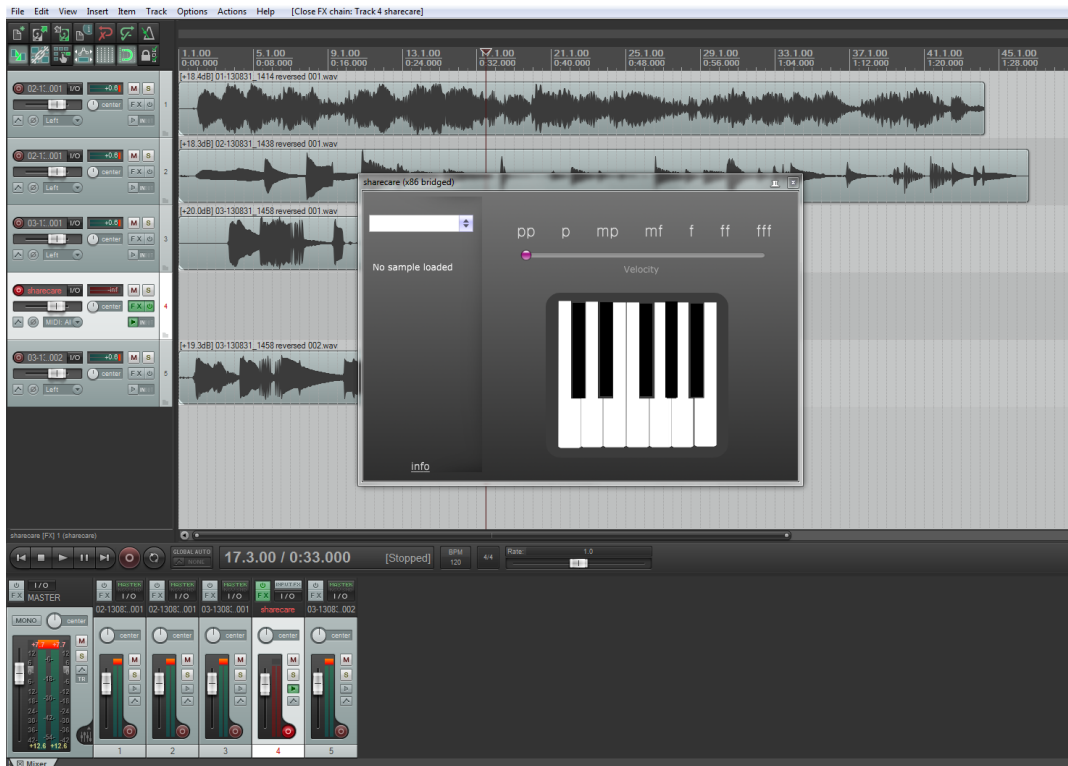


Figure 6 The VSTi bridged inside a DAW

3.5 Research Survey

Once a working prototype of the VST library was created, it was decided to create a survey to collect information from a group of student who are attending electronic music classes in Worcester Polytechnic Institute. This group of students was best fit for our research since they are interested in electronic music technologies and able to comprehend the concept of our prototype and provide valuable feedback. The questions prepared were aiming to get feedback related to the easiness of the user interface, the professionalism of the VST, and possible improvements that can be done in order to meet the expectations of the users. Once the questions were decided with the partners, the IRB Form was filled out and sent to the commission in order to get approval to start our survey. After the approval arrived, we decided to reach our target group through their instructors for their current music courses. With the help of Professor Frederick Bianchi and Professor Vincent Manzo, our team reached around 50 students to examine the screenshots taken from the working VST prototype and asked to answer the survey that was created. The purpose of the survey was not only to get feedback for the prototype we created, but also possible guidelines for the future work in case of a group working on the project in the upcoming years. A copy of the survey can be found in the Appendix.

Our primary goal for this project was creating an open source VST sound library that is suitable for every kind of users ranging from professionals to amateurs. In order to determine the strongest and weakest features of our prototype, we asked the participants to determine the strongest and weakest features they spot in first sight for us. They were given the chance to determine and explain the reason for these two questions, instead of picking an answer from given multiple choices. The reason for giving the target group this option is to not limit them to the features that we can think of and give them the chance to identify the points that we are unable to see.

Since we are trying to reach out to producers from every experience level, it is important to be able to communicate with them clearly. The medium that provides us this opportunity is the user interface. In order to determine how much we managed to achieve in terms of reaching out to the users, we asked them to rate the user interface of our prototype. This question was more focused on the visual aspects of the user interface and

was aiming to get feedback about the design of our interface such as the layout and formatting of the texts included.

Next question of our survey was related to the easiness of the software to operate. One of our goals was making our VST understandable for all kinds of producers, that is why we wanted feedback about the clarity of the directions and features of our prototype. The multiple-choice options given to the target group ranging from 1-Hard to operate and 5-Easy to operate.

As stated before, the free VSTs in the market these days are lacking the sense of professionalism, which makes them less preferable options. This was the emerging point of one of our goals in the project. We wanted to make sure our prototype is providing a sense of professionalism, which will make it more appealing to the higher-level producers. Question 5 was decided on measuring the professionalism of the prototype and the multiple choice options given to the target group ranging from 1-Hard to operate and 5-Easy to operate.

Last question of the survey was designed to get ideas for the recommendations that we can provide to the groups that will be working on the project in the upcoming years. Similar to the first and second question, this last question also is giving the chance of explaining their thoughts and ideas in a more detailed way.

3.6 Naming the Prototype

Throughout the project, the members of our team and our advisor came up with a few names for the VSTi. Eventually, we settled for *Sharecare* because “sharing is caring”.

4 Data and Analysis

Once we finished developing the working prototype taking into the goals we determined into consideration, which are easy to operate, professional and open source, we created a survey. The survey created in order to measure how much we managed to meet our goals and receive verbal feedback from the participants who are knowledgeable and experienced with electronic music production. We reached our target group with the help of the professors from the music department in WPI.

4.1 Research Survey Results

The survey created to collect feedback from students was answered by 11 students in total. The answers collected are highly important to see the strong and weak points of our prototype and provide guidelines for the groups that will be working on this project. The questions were focusing on the how does the user interface communicate with the .In this section, the raw data collected from the survey will be presented.

4.1.1 Question 1

The first question of the survey was asking for the strongest feature that the users can identify in the first sight before going into details of the prototype. This question was important in terms of identifying the most appealing feature of our prototype and pay attention to keep those features in the later versions. The raw data obtained from the users are listed below.

I liked how traditional dynamic notation is used for the velocity
Piano keyboard
It looks sleek and intuitive
Attractive interface with easily understandable text and instructions
The design is simple and attractive (the color scheme works well). The design makes me want to experiment with the different features.
The design is extremely clean and looks very simple to use.
simple, looks easy to use
It looks very intuitive for musicians.
ability for samples to be loaded into the piece

Table 4 Answers to the question- "What is the strongest aspect of the software that attracted you in the first look?"

4.1.2 Question 2

The second question of the survey was asking for the weakest feature that the users can identify in the first sight before going into details of the prototype. This question was important in terms of identifying the most appealing feature of our prototype and pay attention to keep those features in the later versions. The raw data obtained from the users are listed below.

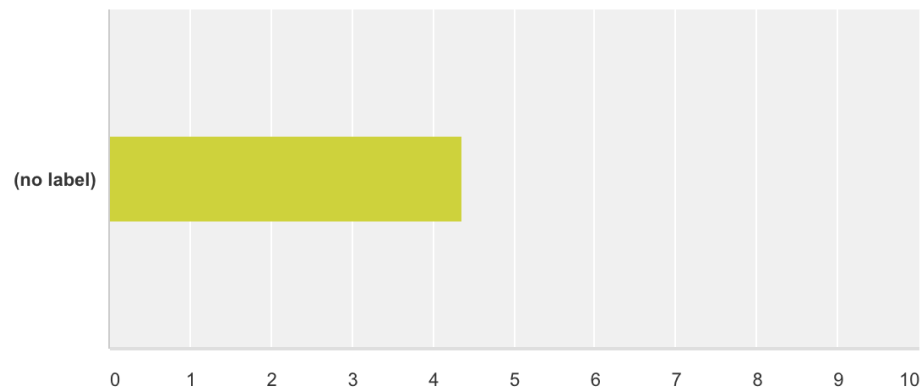
Only one octave of keys
The letters on the upper level
I have no idea what it does
The white text boxes look out of place as they are so close to the velocity slider
The keyboard seems a bit small considering the amount of space it is given. The Velocity label

may be more clear above the meter used to adjust it.
Looks very unpopulated and like it is missing some things.
a velocity slider seems sorta unconventional, why not just use midi velocity data?
I didn't know how to change the octave of the small piano
no way to see what your playing

Table 5: Answers to the question- "What is the weakest aspect of the software that attracted you in the first look?"

4.1.3 Question 3

The third question of the survey was asking the participants to rate the user interface. The results were ranging from moderately easy to very easy to operate. While 27.27% of the people who was involved in the survey thought it was moderately easy to understand the VSTi, 9.09% of the users thought it was easy, and 63.64% of the participants decided it was very easy to understand the user interface of the prototype. The raw data obtained from the users are listed below.



	1 (Hard to understand)	2	3	4	5 (Easy to understand)	Total	Weighted Average
(no label)	0.00% 0	0.00% 0	27.27% 3	9.09% 1	63.64% 7	11	4.36

Figure 7 Answer to the question- "Please rate the user interface"

4.1.4 Question 4

The fourth question of the survey was asking the participants to rate the easiness to operate the VSTi prototype. The results were ranging from moderately easy to very easy to operate. While 18.18% of the people who was involved in the survey thought it was moderately easy to operate the VSTi, 27.27% of the users thought it was easy, and 54.55% of the participants decided it was very easy to understand the operation of the prototype. The raw data obtained from the users are listed below.

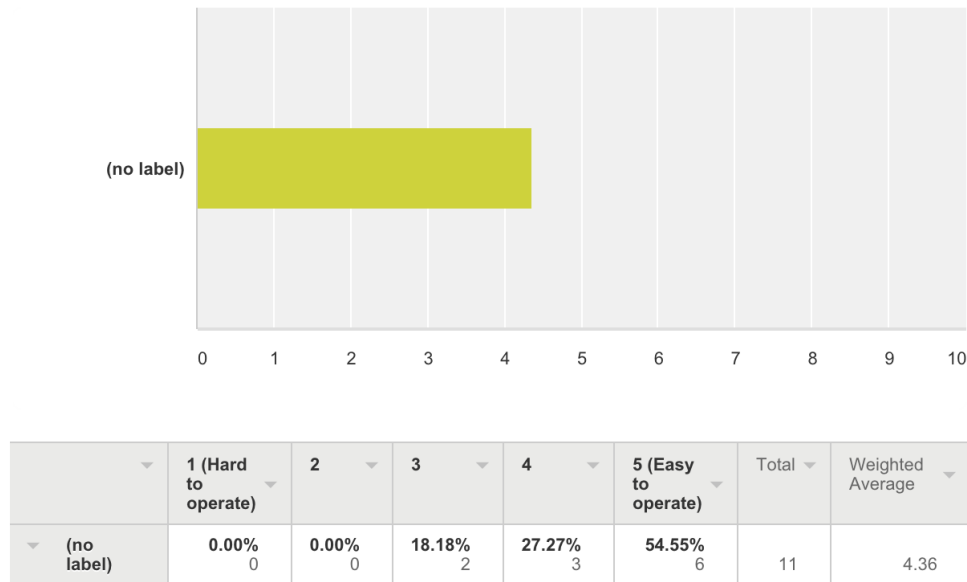
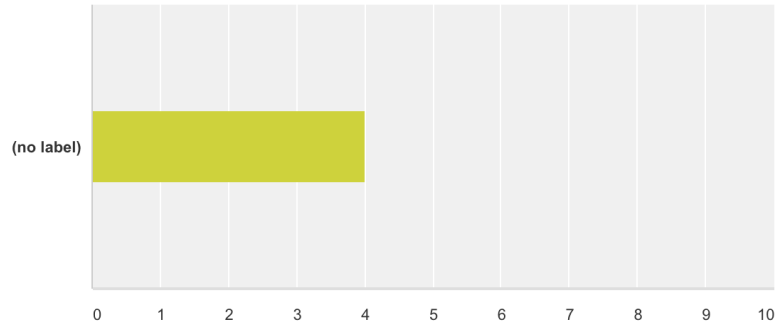


Figure 8 Answers to the question- "Please rate the easiness to operate the software"

4.1.5 Question 5

The fifth question of the survey was asking the participants to rate the sense of professionalism they were getting from the prototype.. The results were ranging from moderately professional to very professional. While 27.27% of the people who was involved in the survey thought it was moderately professional the VSTi, 45.45% of the users thought it was professional, and 27.27% of the participants decided the prototype was very professional. The raw data obtained from the users are listed below.



	1 (Not professional)	2	3	4	5 (Highly professional)	Total	Weighted Average
(no label)	0.00% 0	0.00% 0	27.27% 3	45.45% 5	27.27% 3	11	4.00

Figure 10: Answers to the question- “Please rate the professionalism of the software”

4.1.6 Question 6

The sixth and last question of the survey was asking what would the participants change in the prototype if they were given the chance. This question was useful for the upcoming groups that will be working on the VSTi. The raw data obtained from the users are listed below.

At least two octaves worth of keys
I have no idea... I'd really have to try a working copy of it to tell you.
I would increase the size of the keyboard to match the length of the velocity meter and maybe provide some more information about the velocity in addition to the labels. (e.g. "Softer" or "Louder")
More things populating the screen.
maybe add another octave to the on-screen keyboard. usually it's common for vst libraries to have at least 2 octaves, unless it's a pitch shift/vocal tuning vst or something dunno what kind of vst you're going for, but seeing as it's sample based, adding an adsr envelope on there would seem like a useful feature to have, and probably wouldn't be to difficult to implement either. if you're going for a sampler, time-stretching would be pretty cool, and maybe some granular synthesis capabilities
I would include an area that displayed some sort of notation of what was produced.
I know it is your prototype, but I feel there needs to be more controls for the sounds, from the look I don't see how anything is being controlled. I would have loved to get to use it and just mess around with it. There is only so much we can discuss from a picture.

Table 6: Answers to the question- “What would you change, if you had the chance, about the software”

5 CONCLUSION AND RECOMMENDATIONS

Our objective for the IQP project was to create a prototype of a VST sound library that is free and open source, and obtain some feedback from other musicians regarding its potential as a studio tool. In the electronic music production market today, it is very hard to find a free sound library that is available to provide an open source feature. For this reason, we created a prototype of a VST sound library that includes an open source library that can be expanded by the users themselves. Once we created the prototype, we reached the target group with the help of Worcester Polytechnic Institute professors and collected survey data that will be helpful for our future work and recommendations. In this section, the results of the survey questions will be discussed as well as the recommendations that will be useful for the groups that will be working on this project in the future.

5.1 Conclusion

5.1.1 Survey Feedback

The main point of most of the survey results was the easiness of the user interface. The simple layout and color scheme was attracting the user without overwhelming them and avoiding providing many complex features that are highly confusing to understand in the first look. At the same time, lack of more advanced features such as oscillators, effects

and such were weak points of the prototype. This issue can be solved by adding the features available for the user, but keep them in an organized manner with categories and explanations hinting the usage of the grouped features in order to provide brief information to the beginner users.

5.1.2 Easiness/Accessibility

It was important to communicate the users without overwhelming them since we are trying to reach users from every expertise level. Questions 3 and 4 in the survey were useful to collect information in this manner. The results gathered from these certain questions show us that people were able to understand the concept of the prototype and are not overwhelmed by the features provided. Additionally, there were valuable information provided in the answers given to the question 1. The answer “The design is simple and attractive (the color scheme works well). The design makes me want to experiment with the different features.” clearly signifies that the interface design that we came up with is working well towards our primary goal, which was communicating users from every experience level.

5.1.3 Professionalism

While we were trying to reach both beginner and advanced producers, we wanted to provide a professional medium to work to the users. The method we wanted to achieve this goal was through the features we provide to the users and the user interface we create. According to the comments about the user interface, it is clear that our simple design is effective in order to draw attention of the users but in terms of the features that it provides, we are lacking couple effects that could have provide more control to the users. This situation can be seen in the answers given to the question 6, such as “... but I feel there needs to be more controls for the sounds, from the look I don't see how anything is being controlled.”. This critic can be addressed by making changes in our prototype features and the user interface that the users interact with. Series of improvements we can implement on the prototype can be seen in the recommendations section.

5.1.4 Completeness

Even though the product we created was a prototype, we wanted it to have a sense of completeness. In the beginning, we decided the prototype to be a professional, free open source VSTi that everyone will be able to use. The prototype that we have created is able to be accessed by users and its library can be expanded by following the certain instructions., such as using the git.

5.2 Recommendations

5.2.1 Prototype

The base architecture for this prototype has proven to function well for an audio plugin. As mentioned before in the methodology, our team would like to encourage future teams working on the project to reevaluate git-annex and git-media. Either of them would have been an elegant solution for this project, unfortunately neither of them seemed stable enough across platforms to be deployed. As of right now, a user has to have knowledge of git if he wishes to contribute a collection of samples to the project. An interface, which allows users to easily download or upload a sample library, would be a desirable future expansion of the project. Simply from the feedback on the interface, it was felt that the lack of features made the VSTi feel unprofessional. The addition of filters or modulation effects on the samples might also be a desirable amelioration.

5.2.2 User Interface

After reviewing the survey results, our team came up with a draft of a new user interface, which takes into account the suggested improvements. We hope that this draft design will give future teams a direction and implementation ideas.



Figure 11 New user interface template designed after the survey. This particular view is for the effects screen

The figure above is the new design we have come up with after reviewing the results from the survey we created. All the short answer questions were very useful to see the weak spots of our prototype.

One of the most common complain about the user interface was the lack of octaves in the screen. In order to fix this situation, we added an extra octave to the visible section, and allowed users to switch octaves with the octave switch buttons. This way we did not have to keep the user interface crowded, in order to keep the simplistic theme preserved. The addition of the knobs above the octaves were added after couple complains about how the prototype was missing something. After discussing this situation with the group partners, we have decided to add effects options the user interface in order to give the users a complete freedom where they will not have to bridge another effects VST to manipulate the sounds they generate from the VSTi we have created.



Figure 12 Timbre screen for the new user interface



Figure 13 Looper screen for the new user interface

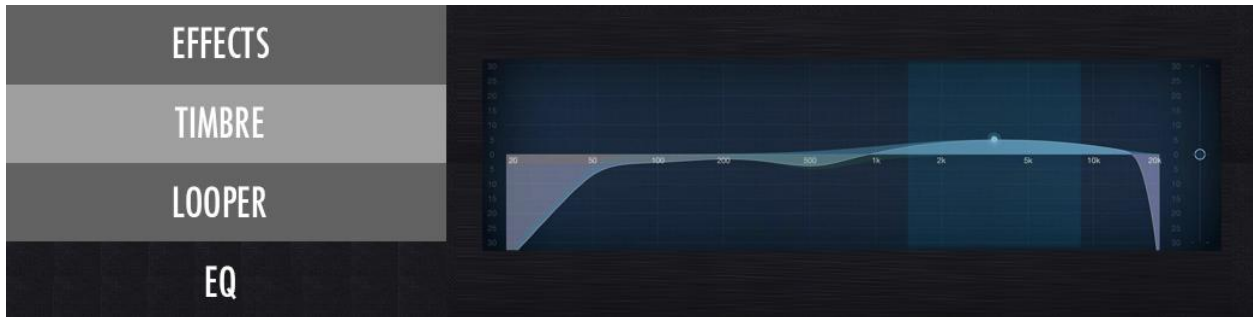


Figure 14 Equalizer screen for the new user interface

With the addition of different features, such as timbre, looper and equalizer control, we have decided that the user interface was satisfying the needs of the users as we have interpreted from the survey results. We kept a few features from the original prototype, such as the color scheme, since it was really appreciated by the testers, and the drop-down menu for different instrument selections right on the main screen in order to provide easy access to any sound the users are willing to access at any moment.

This project will be developed in the upcoming years by future students in Professor Manzo's HU3910 Practicum. Throughout the process of preparing the prototype, the relevant documents were kept in Git library and this Git repo is currently live. The addresses for this repo are

<http://vjlab.wpi.edu/VSTSampleInstrument/VSTIApplication.git>

<http://vjlab.wpi.edu/VSTSampleInstrument/DefaultInstrument.git>

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APPENDIX A

APPENDIX 1-Survey

1. What is the strongest aspect of the software that attracted you in the first look?

2. What is the weakest aspect of the software that you notice in the first look?

3. Please rate the user interface

1 (Hard to
understand)

2

3

4

5 (Easy to
understand)

1 (Hard to understand)	2	3	4	5 (Easy to understand)
------------------------	---	---	---	------------------------

4. Please rate the easiness to operate the software

1 (Hard to operate)	2	3	4	5 (Easy to operate)
---------------------	---	---	---	---------------------

1 (Hard to operate)	2	3	4	5 (Easy to operate)
---------------------	---	---	---	---------------------

5. Please rate the professionalism of the software.

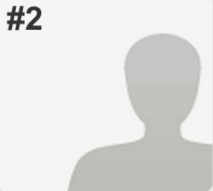
1 (Not professional)	2	3	4	5 (Highly professional)
----------------------	---	---	---	-------------------------

1 (Not professional)	2	3	4	5 (Highly professional)
----------------------	---	---	---	-------------------------

6. What would you change if you had the chance about the software?

APPENDIX 2-Raw data collected from the survey for each question can be seen below.

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 **Collector:** Web Link 1 (Web Link)
Started: Thursday, March 26, 2015 2:06:06 PM
Last Modified: Thursday, March 26, 2015 2:14:06 PM
Time Spent: 00:08:00
IP Address: 130.215.66.19

PAGE 1

Q1: What is the strongest aspect of the software that attracted you in the first look?

ability for samples to be loaded into the piece

Q2: What is the weakest aspect of the software that you notice in the first look?

no way to see what your playing

Q3: Please rate the user interface

(no label) 3

Q4: Please rate the easiness to operate the software

(no label) 3

Q5: Please rate the professionalism of the software.

(no label) 3

Q6: What would you change if you had the chance about the software?

I know it is your prototype, but I feel there needs to be more controls for the sounds, from the look I don't see how anything is being controlled. I would have loved to get to use it and just mess around with it. There is only so much we can discuss from a picture.

#3



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Time Spent: 00:05:18

IP Address: 130.215.218.134

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PAGE 1

Q1: What is the strongest aspect of the software that attracted you in the first look?

It looks very intuitive for musicians.

Q2: What is the weakest aspect of the software that you notice in the first look?

I didn't know how to change the octave of the small piano

Q3: Please rate the user interface

(no label)

5 (Easy to understand)

Q4: Please rate the easiness to operate the software

(no label)

4

Q5: Please rate the professionalism of the software.

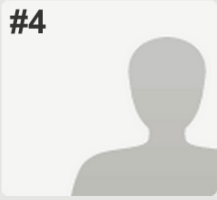
(no label)

4

Q6: What would you change if you had the chance about the software?

I would include an area that displayed some sort of notation of what was produced.

#4



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Time Spent: 00:16:09

IP Address: 130.215.226.233

PAGE 1

Q1: What is the strongest aspect of the software that attracted you in the first look?

simple, looks easy to use

Q2: What is the weakest aspect of the software that you notice in the first look?

a velocity slider seems sorta unconventional, why not just use midi velocity data?

Q3: Please rate the user interface

(no label)

4

Q4: Please rate the easiness to operate the software

SurveyMonkey Analyze - VSTi Feedback

(no label)

5 (Easy to operate)

Q5: Please rate the professionalism of the software.

(no label)

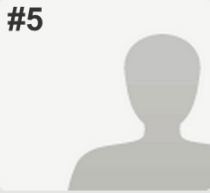
3

Q6: What would you change if you had the chance about the software?

maybe add another octave to the on-screen keyboard. usually it's common for vst libraries to have at least 2 octaves, unless it's a pitch shift/vocal tuning vst or something

dunno what kind of vst you're going for, but seeing as it's sample based, adding an adsr envelope on there would seem like a useful feature to have, and probably wouldn't be too difficult to implement either. if you're going for a sampler, time-stretching would be pretty cool, and maybe some granular synthesis capabilities

#5



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IP Address: 130.215.14.215

PAGE 1

Q1: What is the strongest aspect of the software that attracted you in the first look?

The design is extremely clean and looks very simple to use.

Q2: What is the weakest aspect of the software that you notice in the first look?

Looks very unpopulated and like it is missing some things.

Q3: Please rate the user interface

(no label)

5 (Easy to understand)

Q4: Please rate the easiness to operate the software

(no label)

5 (Easy to operate)

Q5: Please rate the professionalism of the software.

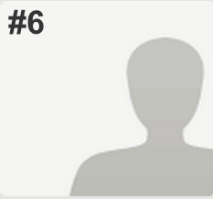
(no label)

5 (Highly professional)

Q6: What would you change if you had the chance about the software?

More things populating the screen.

#6



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Time Spent: 00:10:22

IP Address: 130.215.250.183

PAGE 1

Q1: What is the strongest aspect of the software that attracted you in the first look?

The design is simple and attractive (the color scheme works well). The design makes me want to experiment with the different features.

Q2: What is the weakest aspect of the software that you notice in the first look?

The keyboard seems a bit small considering the amount of space it is given. The Velocity label may be more clear above the meter used to adjust it.

Q3: Please rate the user interface

(no label)

3

Q4: Please rate the easiness to operate the software

(no label)

4

Q5: Please rate the professionalism of the software.

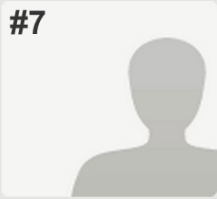
(no label)

4

Q6: What would you change if you had the chance about the software?

I would increase the size of the keyboard to match the length of the velocity meter and maybe provide some more information about the velocity in addition to the labels. (e.g. "Softer" or "Louder")

#7



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Time Spent: 00:03:32

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PAGE 1

Q1: What is the strongest aspect of the software that attracted you in the first look?

Attractive interface with easily understandable text and instructions

Q2: What is the weakest aspect of the software that you notice in the first look?

The white text boxes look out of place as they are so close to the velocity slider

Q3: Please rate the user interface

(no label)

5 (Easy to understand)

Q4: Please rate the easiness to operate the software

(no label)

5 (Easy to operate)

Q5: Please rate the professionalism of the software.

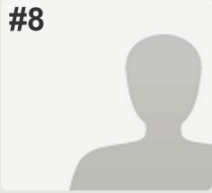
(no label)

3

Q6: What would you change if you had the chance about the software?

Respondent skipped this question

#8



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Time Spent: 00:03:07

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PAGE 1

Q1: What is the strongest aspect of the software that attracted you in the first look?

It looks sleek and intuitive

Q2: What is the weakest aspect of the software that you notice in the first look?

I have no idea what it does

Q3: Please rate the user interface

(no label)

5 (Easy to understand)

Q4: Please rate the easiness to operate the software

(no label)

3

Q5: Please rate the professionalism of the software.

(no label)

4

Q6: What would you change if you had the chance about the software?

I have no idea... I'd really have to try a working copy of it to tell you.

#9



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PAGE 1

Q1: What is the strongest aspect of the software that attracted you in the first look?

Piano keyboard

Q2: What is the weakest aspect of the software that you notice in the first look?

The letters on the upper level

Q3: Please rate the user interface

(no label) 3

Q4: Please rate the easiness to operate the software

(no label) 4

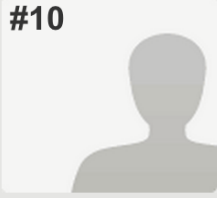
Q5: Please rate the professionalism of the software.

(no label) 4

Q6: What would you change if you had the chance about the software?

Respondent skipped this question

#10



COMPLETE

Edit

Delete

Export

Collector: Web Link 1 (Web Link)

Started: Sunday, March 29, 2015 2:57:29 PM

Last Modified: Sunday, March 29, 2015 3:00:14 PM

Time Spent: 00:02:44

IP Address: 75.143.36.48

PAGE 1

Q1: What is the strongest aspect of the software that attracted you in the first look?

I liked how traditional dynamic notation is used for the velocity

Q2: What is the weakest aspect of the software that you notice in the first look?

Only one octave of keys

Q3: Please rate the user interface

(no label)

5 (Easy to understand)

Q4: Please rate the easiness to operate the software

(no label)

5 (Easy to operate)

Q5: Please rate the professionalism of the software.

(no label)

4

Q6: What would you change if you had the chance about the software?

At least two octaves worth of keys

APPENDIX 3-IRB Form



WORCESTER POLYTECHNIC INSTITUTE
 Institutional Review Board
 Application for Exemption from IRB Review for
 Survey or Interview Research Involving Minimal or No Risk

WPI IRB use only
IRB #
Date:

This application is specifically intended for projects in which students are expected to conduct interviews, surveys or focus groups. Use of this application is recommended for most student project research involving minimal risk. Proposed research meets the definition of "minimal risk" when the risks to research subjects are not greater than those ordinarily encountered in daily life.

RESET FORM

Project Faculty Advisor(s):

Name: Vincent J. Manzo	Tel No:	E-Mail Address: vj@wpi.edu
Department: Humanities and Arts		

Name:	Tel No:	E-Mail Address:
Department:		

Project Faculty Instructor:

Name:	Tel No:	E-Mail Address:
Department:		

Student Investigator(s): *ALL student investigators must be listed.*

Name: Etienne-Alexandre Scraire	Tel No: 5088739437	E-Mail Address: escaire@wpi.edu
Name: Ali Yalaz	Tel No: 3145416014	E-Mail Address: ayalaz@wpi.edu
Name:	Tel No:	E-Mail Address:
Name:	Tel No:	E-Mail Address:
Name:	Tel No:	E-Mail Address:

Project Title: Open-source VST Sample & Synthesis Sound Library Plug-in

Project Location and Time Frame:

Worcester, MA September 2014-May 2015

**WPI IRB Application for Exemption from IRB Review for
Survey or Interview Research Involving Minimal or No Risk**

Expected Research Subjects: (e.g. museum visitors under the age of 12)

College students over the age of 18

Project Mission Statement and Objectives

Creating an open-source VSTi that will operate in popular digital audio workstations, which will allow users to contribute to the sound library.

Brief Methods Listing: (e.g. “Survey of public to ascertain knowledge and opinions about climate change” or “Interviews of professionals working on climate change regarding effective city climate change program”)

Survey of students to ascertain opinions about the plug-in prototype.

Appendix 1: Attach the draft methodology chapter or statement of research methods.

Appendix 2: Attach a draft of surveys and/or a list of questions to be used for interviews or focus groups. If sample questions are included in Appendix 1, Methodology Chapter, indicate page numbers here.

1. Is the proposed research sponsored or supported by a US federal agency or by US government funding? If so, identify sources. No Yes
2. Is the proposed research funded by a corporation or foundation? If so, identify sources. No Yes
3. Does the proposed research involve vulnerable research subjects? (e.g. children, prisoners, students, persons with mental or physical disabilities, pregnant women) No Yes
4. Does the research involve human subjects in ways other than as participants in interviews, focus groups, or surveys? (e.g. observation of public behavior, use of archived data or experimental procedures) If yes, explain. No Yes
5. Will the researchers collect information that can be used to identify the subjects? No Yes
6. Could the disclosure of a human subject’s identity and responses place the subject at risk of criminal or civil liability or be damaging to the subjects’ financial standing, employability or reputation? No Yes
7. Will the researchers disclose the identity or the individual responses of any human subjects? (e.g. by quoting an individual, whether or not identified by name or title) No Yes

**WPI IRB Application for Exemption from IRB Review for
Survey or Interview Research Involving Minimal or No Risk**

IF you answered yes to question 6 or 7, answer these questions:

A. What is the potential risk to human subjects?

There are no potential risk to human subjects

B. How will you eliminate or reduce said risk to an acceptable level?

Not Available

Please Print Form Before Signing Below

By signing below, all participants in this research project are agreeing to abide by the following instructions:

1. You agree to inform subjects orally or in writing that:
 - Participation in the research is voluntary.
 - Participants may end their participation at any time.
 - Participants need not answer every question in an interview or survey.
2. If your research is **anonymous**, you also inform subjects that you are not collecting names or any identifying information from them.
3. If your research is **confidential**, you inform subjects that no identifying information will be disclosed with individual responses.
4. If your research is **NOT** completely anonymous and confidential, you must obtain each subject's permission to publicly disclose his or her identity and/or responses. All requests for anonymity and confidentiality must be honored. The subject must be offered the opportunity to pre-approve the publication of any quoted material

Signature of Faculty Advisor  Date 2/27/15

Print Full Name and Title Vincent Joseph Manzo, Assist. Prof Music

*Please return a signed hard or electronic copy of this application to the WPI IRB c/o Ruth McKeogh,
2nd floor Project Center or irb@wpi.edu.
If you have any questions, please call (508) 831-6699.*

APPENDIX 4-IRB Approval Letter

WORCESTER POLYTECHNIC INSTITUTE

Worcester Polytechnic Institute IRB# 1
HHS IRB # 00007374

10 March 2015
File:15-055

**Re: IRB Application for Exemption #15-055 "Open-source VST Sample & Synthesis
Sound Library Plug-in"**

Dear Prof. Manzo,

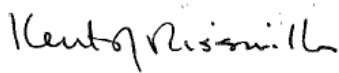
The WPI Institutional Review Committee (IRB) has reviewed the materials submitted in regards to the above mentioned study and has determined that this research is exempt from further IRB review and supervision under 45 CFR 46.101(b): (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

This exemption covers any research and data collected under your protocol from 10 March 2015 for one year, unless terminated sooner (in writing) by yourself or the WPI IRB. Amendments or changes to the research that might alter this specific exemption must be submitted to the WPI IRB for review and may require a full IRB application in order for the research to continue.

Please contact the undersigned if you have any questions about the terms of this exemption.

Thank you for your cooperation with the WPI IRB.

Sincerely,



Kent Rissmiller
WPI IRB Chair

APPENDIX 5-E-mail to the professors

Professor Bianchi,

My name is Ali Yalaz, and with my partner Etienne Scraire we are working on a VST Library IQP project with Professor Manzo. For research purposes we prepared a quick survey regarding the usage of the prototype we prepared and thought your students are really fitting our target group. We will highly appreciate if you can forward this email to your students.

Kind Regards,
Ali Yalaz

Hi Everyone,

Me and my partner Etienne are working on an open source VST Library as our IQP. We prepared a prototype of the software that we would like people who are interested in electronic music production to take a look and give us their valuable feedbacks. The email contains the screenshot image of the prototype and a survey that won't take you more than 2 minutes to complete.

We will highly appreciate if you can spare a quick moment to check the software and fill out the survey.

Link to the survey: <https://www.surveymonkey.com/s/R8TVG9F>

Thank you,
Ali Yalaz

Professor Manzo,

Here is the email you can forward to your students.

Kind regards,
Ali Yalaz

Hi Everyone,

Me and my partner Etienne are working on an open source VST Library as our IQP. We prepared a prototype of the software that we would like people who are interested in electronic music production to take a look and give us their valuable feedbacks. The email contains the

screenshot image of the prototype and a survey that won't take you more than 2 minutes to complete.

We will highly appreciate if you can spare a quick moment to check the software and fill out the survey.

Link to the survey: <https://www.surveymonkey.com/s/R8TVG9F>

Thank you,
Ali Yalaz