From Beat to Bit: Open Music Production in the Underground Scene

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Abstract. *The democratization of technology has made independent music production increasingly accessible. However, the early stages of this journey are often marked by difficulties and disorientation, due to the complexity of the processes involved—from ideation to distribution. Proprietary DAWs (Digital Audio Workstations) such as FL Studio and Ableton Live, while widely known and used in digital audio production, present financial barriers due to their paid licensing models. In contrast, free and open-source DAWs like LMMS (Linux MultiMedia Studio) offer significant potential to support independent artists. Their open project formats allow for transparency, adaptability, and the integration of programming logic and musical theory to automate early creative processes. This research aims to analyze file types generated by open-source DAWs and to develop functional tools to support learning and creation in music production, especially within underground or independent scenes. The manipulation of project files through scripts or web interfaces can facilitate project generation based on genres, BPM, or sonic references—enhancing the workflow and creative autonomy of emerging artists.*

1. Introduction

Contemporary music production is intrinsically linked to technological advancements, and more specifically, to the methods of recording, manipulating, and reproducing sound. Music has come to exist independently of the musician, and this autonomy has paved the way for innovations that have redefined musical practice itself.

In this landscape, Digital Audio Workstations (DAWs) emerge as one of the most significant tools in modern music production. DAWs are digital platforms that provide, within a single environment, all the necessary resources to record, edit, process, synthesize, arrange, and export audio and MIDI. They function as complete recording studios within a computer, replacing or integrating technologies that were once housed in separate physical equipment such as analog synthesizers, effects processors, and mixing consoles.

These software applications have become essential for major studios and independent producers alike, as well as for amateur musicians, film composers, sound designers, and even digital content creators. With a DAW, it is possible to perform tasks ranging from simple podcast editing to the production of a complex musical track with dozens of layers, effects, virtual instruments, and detailed automation.

The importance of DAWs extends beyond mere practicality they have democratized music production. What was once restricted to expensive studios and specialized technicians can now be accomplished at home with a standard computer and basic knowledge. This accessibility has transformed the music industry, enabling new artists to produce, finalize, and release their work without relying on major record labels.

Furthermore, DAWs afford an unprecedented level of creative freedom. It is possible to experiment with ideas rapidly, test effects, rearrange musical sections with just a few clicks, and even simulate instruments that would be physically inaccessible. There are numerous DAWs available on the market, each with its own unique characteristics.

The significance of DAWs in modern music production is immense. These tools can automate processes that were previously manual and time-consuming, thereby facilitating creative experimentation and fostering sonic innovation. This work aims to present the role of DAWs in current music production by exploring their main functionalities and the possibilities for indexing, documenting, manipulating, and (re)using projects created within these tools.

2. LMMS

Among the existing DAWs, this study is based on a tool called LMMS (Linux Multimedia Studio)[1], shown in Figure 1. According to its official website, LMMS is a free, open-source, and cross-platform digital audio workstation [1].

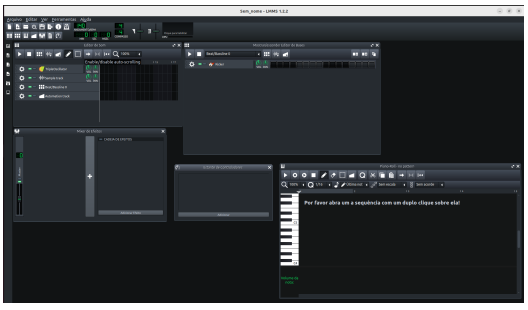

Figure 1: LMMS Workspace

*Supported by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

[1]Available at the website http://lmms.io.

Compatible with Linux, Windows, and macOS, it is a cross-platform tool that can be used for music production following a ”block-based” creation principle, as seen in Figure 2. This aesthetic is similar to proprietary tools used in music production, such as FL Studio.

Figure 2: LMMS Database Editor

For creating and manipulating works within LMMS, several types of tracks are available. Among them are automation tracks, which are responsible for automating the modulation of chosen parameters during the composition process. It is possible to automate volume, panning, and pitch, among numerous other parameters available in the instruments used.

The Beat+Bassline Editor is responsible for storing patterns, which in turn hold the compositional information for each instrument within that pattern. This composition can be done using the block-based concept in the Beat+Bassline Editor, as shown in Figure 2, or through the Piano Roll, seen in Figure 3, where one can compose using musical notes and scales, specifying the duration of each note as well as parameters like volume and panning.

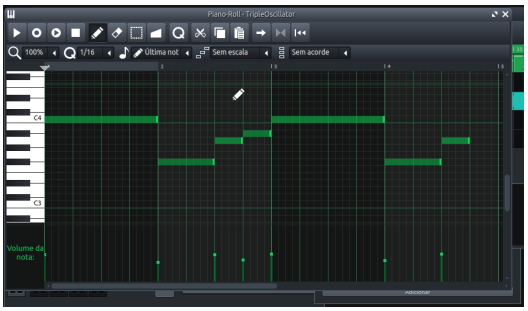

Figure 3: LMMS Piano Roll

Another interesting versatility of this DAW is the ability to use audio tracks for elements such as sample loops or vocals, for example. Figure 8 shows the LMMS workspace. The Song Editor is responsible for containing the work itself. It is where all the sound is arranged and can be considered the global playlist for the project. Patterns, automation tracks, and audio tracks are organized in this space.

For the creation process, LMMS has several native alternatives to suggest uses for its tools. Presets, for example, are saved configurations of instruments or effects, ready for immediate use. In LMMS, you find presets mainly in plugins and synthesizers.

LMMS includes a basic library of samples organized by categories such as Drums (kicks, snares, hi-hats), FX (transition sounds and impacts), and Melodic (instrument loops). It is also possible to import your own samples in formats like WAV and OGG.

Furthermore, LMMS also features several demonstration projects to show how music can be composed with it. These projects serve as excellent practical tutorials.

LMMS comes with several native synthesizers, each with its own characteristics, which offers great flexibility for musical creation.

It is possible to use LADSPA (Linux Audio Developers Simple Plugin API) and VST (Virtual Studio Technology) effect plugins to achieve satisfactory results completely free of charge. The tool is based on creation with samples and synthesizers, and it is possible to export/import plugin presets and audio samples.

There is also a community of users and developers for the tool, which allows for interaction and information exchange on topics such as usability and interface viewpoints, creations, feedback, and other demands present in this community. An official repository [2] for file sharing is available to the community to enable the exchange of experiences and help users find new ways to create music using LMMS. The search function in this repository is based on several parameters, such as searching for presets, samples, and projects, as seen in Figure 4. When searching for projects, the filters shown in Figure 5 are available.

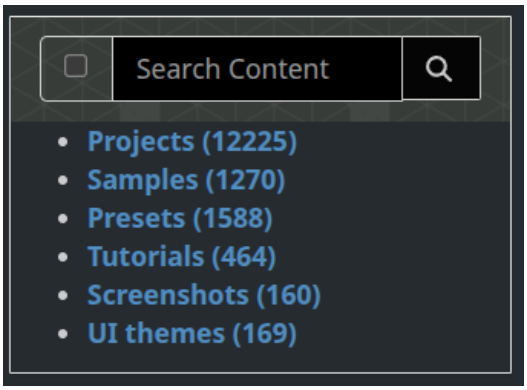

Figure 4: Search filters on the LMMS website.

3. Objectives

The official LMMS repository can serve as a starting point for many enthusiasts and assist both beginners and experienced users in commencing their projects. However, the projects shared in this repository are black boxes, which do not allow a user to understand what a project contains before downloading it to their computer. Furthermore, these projects may have dependencies on external files such as LADSPA plugins, samples, and audio files that are often not shared with the project, making its local execution impossible.

Figure 5: Search filters for projects on the LMMS website.

Given this context, and with the aim of expanding the possibilities for searching within LMMS projects, this work presents tools and opportunities for using projects geared towards musical creation in LMMS. It takes advantage of the tool's open file formats to open the "black boxes" that hide what happens "under the hood." To achieve this, the project delves into the representation of .mmp files, proposing a taxonomy for their structure and enabling alternative ways of understanding a composition within this tool.

The project's objectives also include:

- To understand the LMMS file format.
- To scrutinize the data of a composition.
- To understand how the tool handles external file dependencies.
- To enable alternative methods for indexing and searching LMMS projects.
- To create mechanisms for visualizing collaboration between authors.
- To facilitate the sharing and availability of the tool's projects.
- To allow for greater interoperability between LMMS and other tools.
- To generate new files based on user parameters.
- To foster a collaborative ecosystem for LMMS.

4. Related Work

Just as programmers are assisted by tools like Stack Overflow [3] and Searchcode [4], artists can seek references to aid them during their creative processes.

Tools such as Searchcode, seen in [4], assist with programming questions by using the principle of term-based searching. For example, in Figure 6, the term "print" was used as the search parameter. The result is a diverse set of code snippets where the term appears.

The results can be filtered by the programming language of the files to be searched. It is possible to navigate to the source file of the returned information and

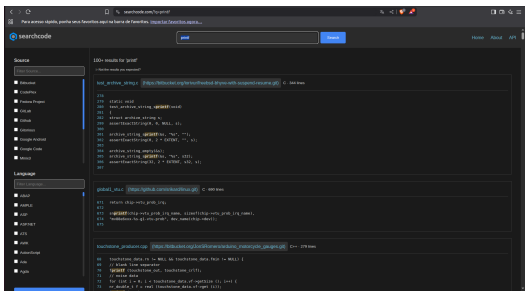

Figure 6: Search for the term "print" in Searchcode.

observe its content. This tool is exceptional for resolving questions about the use of terms in programming languages, the implementation of functions, and finding code snippets to solve problems.

This is similar to Stack Overflow, seen in [3], a go-to resource for countless programmers around the world. It is a forum renowned for providing assistance and having answers to—almost—everything related to programming, a place where we post our errors and search for solutions.

5. Development

In Section 3, the goals of this work were discussed in a broader sense. This section aims to describe, more objectively, the development of the tool [5], as well as to briefly discuss future implementations and potential improvements identified during its development.

5.1. Understanding the LMMS File Format

Due to the ".mmp" file format of LMMS projects, it is possible to analyze and manipulate them as text. Projects can be indexed in sharing repositories.

In digital music production, the file formats used play a central role in how projects are stored, shared, and reused. Open formats, such as XML (Extensible Markup Language) or other standardized languages, offer a series of advantages that directly impact learning, autonomy, and the continuity of creative processes, especially in the context of independent music production.

In the case of LMMS, its project file has the ".mmp" extension. In [6], it is possible to observe how the file is created: "When you save a project in LMMS, the MMP file format is created for that project. This important file allows you to store all project data in one clean and organized location." This extension is commonly used for configuration and project parameter files, just as it is in this DAW.

After some empirical analysis and observation of parameter usage in projects, it was possible to document[2] this file type and formalize its requirements. This document can be seen in [7]. This, in turn, allowed for the validation of the file using an XSD (XML Schema Definition) file, found in [8].

[2]For use within LMMS.

Since LMMS does not have a DTD (Document Type Definition) or an XSD (XML Schema Definition) file to validate its project files, there are some particularities about the developed file and some necessary abstractions regarding mandatory parameters. For example, if a controller is used to manipulate the volume of an instrument in the composition, the instrument's volume tag is not located within the instrument's control structure in the ".mmp" file. Instead, it is found within the controller's structure, using a reference to the instrument.

5.2. Scrutinizing Composition Data

With a repository containing a significant quantity of beats, such as the one seen in [2], it is possible to search for projects that contain concepts, instruments, or harmonic compositions of interest.

We divided the file into parts, which allows us to, for example, save all the settings of a project as a template. It is possible to go even further by saving parameters of a plugin, automations, instruments, or effects as presets. Consequently, we can check all projects that use a specific pattern, oscillator, or automation.

This way, it is possible to analyze each track of the composition that is part of the work. Given that this information is saved in the project file and that the structure of each track type—within this file—has already been documented, the tracks cease to be mere parts of a song. This versatility brings with it the possibility of understanding creative processes through the dissection of compositions.

Another advantage that was identified is the standardization of structures for generating new compositions from predefined tracks. Beyond generation, it is possible to search for projects using this approach, providing greater accessibility for the search to be performed. Similar to Searchcode [4], which locates terms across multiple projects, it is possible to visualize rhythms from all tracks or restrict the view to specific tracks.

5.3. Dealing with External File Dependencies

The scrutiny of the files allows them to be divided into various sectors and enables searches for parameters that have external dependencies, such as audio plugins, samples, SoundFonts, Giga samples, and other synthesizers that use external files. This is a powerful resource for learning in music production.

By detailing these dependencies, the tool not only facilitates the understanding of how a composition was created but also helps solve problems like "where is that sound?" or "why doesn't this project sound as it should?". It would transform the search for musical elements into something much more dynamic and contextualized, going beyond simple genres or rhythms and delving into the sonic architecture of the composition.

However, it is necessary to control how files are uploaded to the platform so that all dependencies are properly allocated on the server and referenced in the project. Only then will the projects function correctly, with all their layers and tracks. This is one of the biggest challenges during the implementation of the tool described in this work. Section 6 provides a more detailed description of the difficulties and successes of this approach.

Nevertheless, in an optimal process, the user will upload the file in a designated area on the website [5]. At the time of upload, the file will be examined, and the path—/src—of each element in every track will be observed. If a path is not a standard LMMS path, such as "drums/clap04.ogg," the site should prompt the user to also upload the files considered external to the DAW. The user's participation ends at this point, with the option to either provide the dependencies or leave them out. The server then takes over, scanning the file and observing its paths. Consequently, it will be necessary to rewrite the paths for the dependencies according to their new location on the server. If the user has not uploaded the dependency files, the project will be displayed with warnings indicating missing dependencies for download.

5.4. Enabling Searches and Indexing

This possibility arose from a need identified during workshops aimed at popularizing the LMMS tool. It was observed that one of the greatest difficulties faced by participants was starting a composition. DAWs offer many possibilities, various buttons, and numerous parameters that can be altered, which is incredible. However, inexperience and a lack of familiarity with these types of tools can lead to the opposite of the desired effect.

These alternatives have many parameters, which can cause confusion for the independent artist when using the tool. For example, this LADSPA equalizer, seen in Figure 7.

Figure 7: LADSPA multiband equalizer.

With the goal of optimizing the experience in LMMS, our tool assists in locating specific parameters for the creation of new compositions. The inclusion of more dynamic search filters—such as detailed rhythms, individualized instruments, or instrument parameters—confers great potential for a deeper understanding and efficient use of the DAW.

But how is it possible to extract information from finished projects, transforming it into learning material for music production, even if their file formats are plain text or pragmatic, like XML (Extensible Markup Language) and its tags? By observing the "blocks" from a more open perspective and bringing it into a computational context, the

discretization of the information contained in the projects opens up several possibilities for indexing, documenting, and formalizing patterns[3]. This allows for the manipulation of projects based on the composer's preferences.

Figures 8 and 9 show the same project, as seen in LMMS (Linux MultiMedia Studio) and in the ".mmp" file[4]. Figure 9 highlights envelope parameters, effects, volume, and panning, in addition to the pattern for the Kicker plugin, seen in Figure 8.

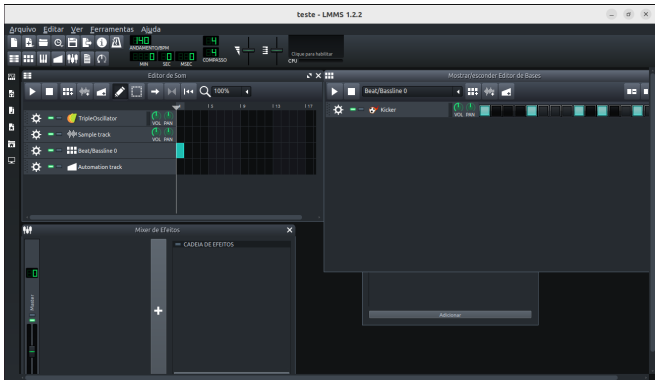

Figure 8: A simple project in LMMS DAW.

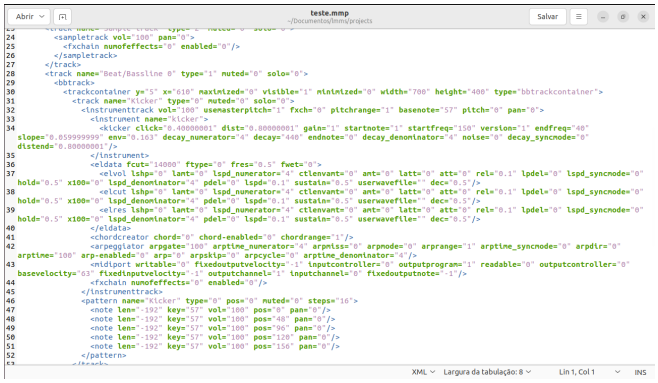

Figure 9: The same simple project presented in MMP XML format.

By analyzing the file, it is possible to observe the markup pattern in the structure where the instrument is stored in the project. This structure reflects the project's presentation in the tool's GUI (Graphical User Interface) but with the added possibility of indexing, classifying, dissecting, and reusing project snippets that could otherwise only be accessed through the graphical interface. Thus, such a representation allows a project to be shared beyond its sonic result, also permitting more direct access to the creative process behind the musical creation.

Another approach that is viewed favorably is searching by project metadata, beyond the parameters in its tracks. This includes searching by the author who created it, the version of the work, the year of creation, and other specifics, such as the version of LMMS that was used, for example.

5.5. Creating Mechanisms to Visualize Collaboration Between Authors

There is a window within LMMS reserved for "project notes," which can be used to store information about the project and its authorship.

Given that LMMS rewrites the file when saving a change made in the DAW, writing something outside the project's scope is not an effective approach to ensure the information remains in the project and is accessible to the average user—without them needing to open the file with a text editor to see its content. By pressing the F10 key in the application, the "project notes" are displayed—or hidden—on the screen, as shown in Figure 10.

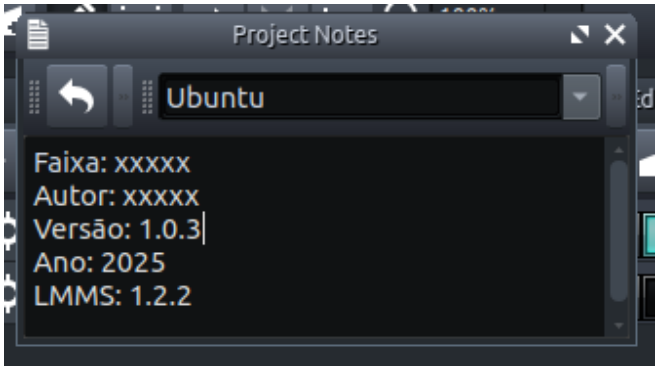

Figure 10: LMMS project notes.

However, when information is inserted into the area reserved for project notes, LMMS does not overwrite it upon saving. Therefore, what is written in this part of the file can persist[5], contributing to the standardization of this information and enabling searches based on these types of parameters as well.

This approach is used to ensure history, auditing, and feedback for authors regarding their works and the modifications made after being downloaded from our tool. It transforms this information into a search parameter, making it possible to view all projects made by a specific author, year, track name, or by versions of the same project.

5.6. Enabling Greater Interoperability between LMMS and Other Tools

The ability to transform LMMS projects into scripts for other platforms, such as Sonic Pi, Hydrogen, or other tools, expands interoperability and creative potential for users. This goes beyond the idea of simply importing or exporting files it is about allowing the structure and musical ideas conceived in the DAW to be "translated" into a format that other software can interpret.

Composers could leverage the visual and intuitive interface of LMMS for initial creation and, with a single

[3]These patterns can include percussive instruments and time markings, characteristic instruments, harmonic patterns, among other information that can determine or characterize a musical genre.

[4]This is a file format used by LMMS to store projects.

[5]Assuming the user fills in the information correctly and, consequently, does not delete or overwrite the notes left in the project.

click, migrate to code-based environments for algorithmic experimentation, like Sonic Pi. Or, perhaps, export a detailed drum pattern to Hydrogen, allowing for fine-tuning and integration with that tool's specific percussion kits. Another export format that LMMS provides natively is MIDI (Musical Instrument Digital Interface), a recognized and widely documented protocol, supported by numerous controllers and DAWs.

This interoperability is considered an approach with significant potential for aiding the creative processes of music production. However, it is necessary to consider the limitations between the tools used, as some conversions will be lost. An audio sample that is not related to percussion, for instance, is generally not well-accepted in Hydrogen, but it is completely accepted in LMMS. The same applies to Sonic Pi, which also has its own particularities.

5.7. Creating New Files from User Parameters

Can we create new files by mixing existing ones? If a user only wants a small piece, would it be possible to download it? The straightforward answer is yes.

Imagine a user finds an LMMS project with a perfect bassline but does not need the rest of the song. Or they wish to take the drums from one project, the synthesizer from another, and the melody from a third to create a new, original composition based on the reinterpretation of other works. The ability to create new files by mixing them with existing ones and the option to download just a piece of a project are extremely valuable functionalities. This reinforces the idea that projects can be "dismantled" and their components accessed individually, enabling modular music creation, which is extremely effective for learning music production.

This approach is seen as having great potential because, as previously mentioned in this work, interoperability between DAWs can be a great ally in this case, making it possible to download something like a MIDI file, an audio loop, or even a small script snippet for another DAW.

5.8. Fostering a Collaborative Ecosystem for LMMS

The word ecosystem has Greek origins, formed by the junction of "oikos" (house, inhabited environment) and "systema" (whole, organization). The word was chosen by Arthur George Tansley, a British ecologist (1935), to describe the set of living organisms and the relationships they establish with the physical environment in which they live. But what would a music production ecosystem entail?

Sonic Pi Blender[6] is a web tool for generating code for Sonic Pi based on the "block-based music" concept described in Section 2, which aims to improve accessibility in composition using code-based environments for music production. In the ALICE laboratory, other web tools are being developed, such as a sample recorder, to transform any "noise" into a sample that can be used in a DAW. Additionally, there are MIDI generators based on a musical scale. All these tools are available at [9] and [10].

The democratization of access to information about compositions, modular creation, and search mechanisms facilitate creative processes and learning in music creation in various ways. These tools, organized in a dashboard that can direct users to each one, form an environment conducive to learning and assistance in the creative processes during musical creation and composition. This is how the music production ecosystem is characterized in this work.

6. Results

The use of open file formats allows for the efficient **indexing** of data present in a musical project. Information such as tempo, BPM, track structure, automation parameters, and the use of effects and virtual instruments can be organized into hierarchical structures that are both human- and machine-readable. This facilitates not only the subsequent retrieval of this data but also its integration into search systems, databases, or platforms for music education and analysis.

This work sought to illustrate some possibilities for understanding and manipulating files resulting from music creation and composition projects in free-to-use DAWs, primarily LMMS. This tool is responsible for creating configuration files that contain parameters and information about the projects, which can be indexed and reused for learning in music production. Initially, this approach holds enormous potential for evolution, expanding access to knowledge, and resolving questions during the creative process.

Furthermore, these formats promote detailed **documentation** of the creative process. In collaborative or educational environments, it is crucial that projects can be read and understood by third parties. XML files or similar formats make this possible by exposing the content in a clear, structured, and accessible manner, allowing students, teachers, or collaborators to understand the inner workings of a composition or mix.

Standardization is another important benefit. By adopting widely documented open formats such as XML, MIDI, or project files compatible with free standards, it is possible to ensure greater compatibility between different software and platforms. This reduces dependency on specific proprietary software and extends the longevity of projects, which can be opened and modified even after many years, without the risk of technical obsolescence.

Finally, the **manipulation** of open files favors learning and experimentation. Users with basic knowledge of programming or data analysis can automate tasks, generate project variations, or apply creative transformations directly to the file's code. This possibility opens up space for interdisciplinary pedagogical approaches that unite music, technology, and computational thinking. In this way, collaboration can transcend the barriers of geographical distance, as the platform [5] is available online and can

[6] Available at: `https://alice.ufsj.edu.br/~fls/sonicpi/`.

be accessed from anywhere via its access link. Or even by creating compositions of rhythms and synthesizer plugins through the [5] platform, for example.

MMPSearch [5] emerges as an innovative solution to the challenges of music creation, proposing a detailed search engine for LMMS projects. Unlike current approaches, the tool allows compositions to be searched not just by genre, but by specific parameters such as instruments, plugins, samples, pattern names, and even drawn rhythms, as seen in Figure 11. This ability to ”dissect” projects saves the time spent downloading irrelevant files for one’s needs or watching long video tutorials, offering objective access to elements of interest.

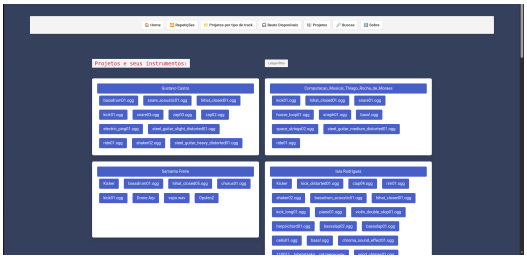

Figure 11: Search by instrument in MMPSearch.

Developed by the author, MMPSearch allows users to listen to the project’s audio, view samples, and search for related projects via tags, as seen in Figure 12. It possesses great potential for interoperability—such as transforming LMMS projects into scripts for Sonic Pi or Hydrogen—and the tool aims to democratize access to knowledge and collaboration in music production. Its distribution to the LMMS developer community, in a more complete and stable version, is viewed favorably.

Although functionalities like the search for drawn rhythms and the uploading of files with external dependencies are still under implementation—requiring real-time validations to ensure project integrity—MMPSearch already proves to be a valuable tool for independent artists and producers at all levels, fostering learning and creation with free software.

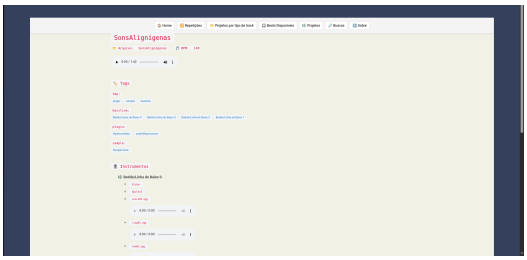

Figure 12: Simple project in MMPSearch.

7. Discussions

The popularization of hardware resulting from increased accessibility to technological tools, such as PCs (Personal Computers), notebooks, or smartphones, brings with it a wide range of possibilities. In the realm of interest for this study, technology is used to empower talents, express feelings, and save lives, in a way that makes creativity a strong ally for generating knowledge and ensures that collaboration fosters the personal development of each artist, enhancing collective gain.

The famous phrase, ”Nothing is created, nothing is lost, everything is transformed,” by the French chemist Antoine-Laurent Lavoisier (1789), is quite popular, and many people adhere to this line of thought. Summarizing it, one could suppose that not all music is created. Much of it is copied. And other parts are transformed. However, it is necessary to consider the intention of each artist and the principle of originality in every composition, arrangement, or post-production process. Here, it is possible to cite Chacrinha, an illustrious Brazilian communicator well-known for his variety shows from the 1950s to the 1980s, who used to say, ”On television, nothing is created, everything is copied.” He was expressing his indignation at the lack of ”creativity” and ”originality” among producers who, upon observing a new trend, would all jump on board and continue producing ”replicas” of one another.

Nevertheless, creation based on reference can be a great ally when it comes to learning and the initial stages of music production. But the options for seeking knowledge in official project repositories can lead to more confusion or a costly effort to retrieve results that are of interest at the moment. Searching for projects in the official LMMS community [2], for example, does not allow for searching by rhythms, instruments, or plugins. Thus, it can become limited for some users at various levels of technological and/or musical knowledge. A more versatile mechanism could be an interesting ally to assist in displaying results that meet the user’s expectations.

Beyond the search functionalities, various scripts are being developed in the ALICE laboratory to automate the generation of MIDI scales for use in tools like Hydrogen or LMMS. Tools for teaching and learning are also under development, such as an environment for delivering and hosting online courses, enabling the dissemination of content through the laboratory’s resources and, going further, by recording and/or live-streaming the music production workshops.

Some of the tool’s functionalities are yet to be implemented, such as searching for rhythms drawn in patterns and generating projects from user-defined patterns. However, its use has already proven to be of great value, showing significant potential to assist independent artists or artists at any skill level in collaborating and learning about music creation using free-to-use tools.

RAP (Rhythm and Poetry) is considered the spoken branch of Hip Hop’s musical expression. It carries with it a feeling of revolt, stemming from discrimination against marginalized peripheral culture, state neglect, and oppression by public security forces. The pain of losing a family member, a friend, or an iconic figure in the neighborhood where one lived. RAP is an instrument capable of changing—and saving—lives. One of the greatest characteristics of RAP is originality, both in the lyrics and in the

beats[7].

However, many RAP beats are the fruit of samples[8] from renowned musicians—or even unknown ones, lost in time—who defined an era. The track by [11] is a notable example of this sampling approach, as a loop from its introduction is used as a reference for the beat in several tracks, such as [12], [13], and [14], for example. Is this considered copying or transformation? This does not mean that RAP beats are not original, nor does it mean they are copies a modification was made by the producer during the finalization of the track. Their point of view and perception were introduced into it.

7.1. Free Software and Music Production

Free software can be defined as software that respects users' freedom, allowing them to run, study, modify, and distribute the program and its modified versions. In music production, this means that users have full control over the tools they use, enabling them to adapt them to their creative, technical, or philosophical needs.

The importance of free software in music production is linked to autonomy and accessibility. In a landscape where proprietary software is often expensive and restrictive, free alternatives allow musicians and producers with limited resources to access powerful tools. Furthermore, open source promotes collaboration and technical learning, which encourages the formation of communities of users and developers.

Unlike proprietary DAWs, free software helps to open the black box of music production. This occurs because the internal workings of the tools are available for analysis and modification. With this, it is possible to understand how sound effects are applied, how synthesis algorithms operate, and how data is processed. This technical transparency is fundamental for developing critical thinking about the technologies used in music creation. Moreover, this transparency is crucial for the development of auxiliary tools that can explore the projects and extract content and resources for learning about music production.

The use of free software in music production goes beyond a technical choice: it is also a political and pedagogical position. It promotes creative freedom, knowledge sharing, and technological autonomy, while also stimulating reflection on the digital media that shape contemporary aesthetics and sonic practices.

7.2. Opening the Black Box

However, DAWs can also be seen as black boxes in music production. This is due to the fact that a large part of the digital processing occurs at levels that are not visible to the common user. The internal functioning of plugins, synthesis algorithms, and audio processing, for example, is often not transparent. This can lead to a dependency on tools whose logic and limitations are not fully understood, which influences both aesthetic outcomes and technical decisions.

[7] The instrumental foundation of the work.

[8] Audio snippets. In this case, they are repetitions of a harmonic or melodic fragment from a specific instrument.

8. Thanks

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