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A Project report On MUSIC INFORMATION RETRIEVAL SYSTEM USING OPENSOURCE TOOLS Submitted By Jagadeesh C (18BCS033) Arun Kumar S M (18BCS013) Anuj C S (18BCS009) Darshan R P (18BCS023) Under the guidance of Dr. Uma Sheshadri

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INDIAN INSTITUTE OF INFORMATION TECHNOLOGY DHARWAD Indian Institute of Information Technology, Dharwad

Indian Institute of Information Technology, Dharwad 1. Introduction While we listen to the excerpts, name as the many of its musical characteristics as we can. But, can you name the genre, tempo, instruments, mood or the time signature or the song structure? The report consists of an overview on how clear a user gets to know about music Information retrieval system literature. The main intention was to make the information in the presentation become user friendly, maximum care has been taken by all four members of the team to make users know the information clearly and have a proper knowledge about music Information retrieval. There is a systematic explanation of each step and each topic with screenshots and python commands. We have been through a perfect flow of Abstract, Introduction, How MIR works and things used in the project, References and Acknowledgement and Conclusion. ▪ Aim and scope The aim of this project is to develop a command line python programming language-based application, which is used to identify a music/song just by listening to a small portion of that song at any point. ▪ What is MIR The main objective of this project is to help the user find the music/song or album just by listening to a small portion of the music. The user mainly uses our product when they don't know the name of the music they have been listening to, like the cases while watching a movie or a random video. Our application helps them to identify the music name just by listening to a portion of that music. Here is a sampling of tasks that found in MIR: ▪ Cover song detection ▪ fingerprinting ▪ recommendation

Indian Institute of Information Technology, Dharwad ▪ genre recognition ▪ instrument recognition ▪ source separation ▪ tempo estimation ▪ pitch tracking ▪ song structure/form ▪ score alignment ▪ query by humming ▪ beat tracking ▪ key detection ▪ Why MIR? ▪ MIR used to discover and organize media collections. ▪ It is used to search ("finding something that sounds like this") songs, speech, loops, sound effects and environmental sounds. ▪ It is used to detect workflows in consumer products by the help of machine hearing. ▪ It is used for the automatic control of mobile devices and software.

Indian Institute of Information Technology, Dharwad 2. About the project ▪ Things used in this project ▪ Python2.7 – is the programming language used in this project. ▪ Python-pip – python package manager used to add or remove packages. ▪ Python-tk – python library used to create GUI (graphical user interface). ▪ ffmpeg – it is a command line tool designed to process video and audio files. ▪ Portaudio – is a library used for recording and audio playbacks. ▪

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Pyaudio - provides Python bindings for PortAudio, With PyAudio, you can easily use Python to record audio and play on a variety of platforms. ▪ Matplotlib – is

a python library used for data visualization and graphical plotting library for Python and its numerical extension NumPy. ▪ Termcolor – it is a python module used for Color formatting for output text in the terminal. ▪ Scipy - Python library used for technical computing and scientific computing. ▪ Pydub – it is a python library used to split, play, edit and merge audio files.

Indian Institute of Information Technology, Dharwad ▪ How MIRS works (brief explanation) MIRS identifies songs based on an "audio fingerprint". ▪ MIRS already has the audio fingerprint of the song/music stored in the database. (audio fingerprint – is like a unique id for each song to be able to recognize it, which is created using an audio files frequency with respect to time and other criteria for the whole song, music or audio) ▪ For every new song, album, music released MIRS requires

to create audio fingerprint of those songs and store it in the database. (It's the work of the product owner or the people maintaining the MIRS to create fingerprint of the newly released song, album and music in order for the user to find them.) ▪ It tags a song for 5-10 seconds and the application creates an audio fingerprint for a particular song. ▪ For any user wants to use the application, it'll uses their computer or smartphone's built-in microphone to gather/collect a brief sample of audio being played. ▪ MIRS works by analyzing the captured sound and seeking/finding a match based on an audio fingerprint in the database of millions of songs. ▪ If it finds a match, it sends/returns information such as the artist, song title, and album back to the user. ▪ For our application it'll send/return the song name.

Indian Institute of Information Technology, Dharwad ▪ How MIRS works Music information retrieval system is a command line python application which returns the name of the song just by listening to a small portion of that song. ▪ Python2 reset-database.py "reset-database.py" is a python script used to reset the database containing audio fingerprints. Generally used to clear the previous songs audio fingerprints.

Indian Institute of Information Technology, Dharwad ▪ python2 collect-fingerprints-of-songs.py "collect-fingerprits-of-songs.py" is a python script used to create fingerprints of .mp3 of songs stored in mp3 folder. This application will look for .mp3 songs stored in the folder named mp3 which is located in the same directory as our application and creates fingerprint of those songs and store them in the database, so that if anyone using our application would be able to find the song just by playing a small portion of those songs.

Indian Institute of Information Technology, Dharwad ▪ python2 get-database-stat.py "get-database-stat.py" is a python script used to get the list of names of the songs whose fingerprint has been created and stored in the database using "collect-fingerprints-of-songs.py" python script. ▪ python2 recognize-from-microphone.py −s n "recognize-from-microphone.py" is a python script the user use to find the music. "recognize-from-microphone.py" will use user's mobile phone or computer's internal microphone to gather brief sample of audio as input and returns the name of the song being played. Options: -s - defines how many seconds we want the script to listen n − takes an integer value, defines how many seconds the application will listen for an audio. Example: python2 recognize-from-microphone.py -s 10 will listen for 10 seconds

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Note: Any user only uses this application when he/she doesn't know the name of a particular song/music, and our application helps them to find it. Just for the demonstration, We mentioned the name of the song in the beginning itself, so that we could verify the application detects the song correctly.

Indian Institute of Information Technology, Dharwad ▪ Previously developed MIR applications

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MIR is a small but growing field of research with many real-world applications.

There are several apps/applications developed on the idea of MIRS. like, ▪ Shazam Shazam is an application that can identify music, advertising, movies and television shows, based on a short sample audio played and using the microphone on the device. It was created by London-based Shazam Entertainment, and has been owned by Apple Inc. since 2018. Link: https://play.google.com/store/apps/details?id=com.shazam.android &hl=en_IN&gl=US ▪ SoundHound SoundHound Inc. is an audio and speech recognition company founded in 2005. It develops speech recognition, natural language understanding, sound recognition and search technologies. Link: https://play.google.com/store/apps/details?id=com.melodis.midomi MusicIdentifier.freemium&hl=en_IN&gl=US

Indian Institute of Information Technology, Dharwad ▪ Audiggle ▪ Audio Tag And many more. ▪ Open-source algorithms There are more than 198 open source algorithms are developed for MIRS. Like, ▪

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Essentia C++ library for audio and music analysis, description and synthesis, including Python bindings. http://essentia.

upf.edu/ ▪ Musicinformationretrieval.com Instructional notebooks on music information retrieval. http://musicinformationretrieval.com/ ▪ Meyda Audio feature extraction for JavaScript. https://github.com/meyda/meyda ▪ Madmom Python audio and music signal processing library https://madmom.readthedocs.io/ ▪ Strugatzki Algorithms for matching audio file similarities

Indian Institute of Information Technology, Dharwad https://github.com/Sciss/Strugatzki ▪ Audio-fingerprint-python project Fingerprint audio files & identify what's playing https://github.com/itspoma/audio-fingerprint-identifying-python Links for more – https://awesomeopensource.com/projects/music- information-retrieval For our project we are using the "Audio-fingerprint-python" project https://

55%	MATCHING BLOCK 6/13	W	https://github.com/itspoma/audio-fingerprint-i …

github.com/itspoma/audio-fingerprint-identifying-python This project is shazam-similar app, that identifies song using audio

fingerprinting.

Indian Institute of Information Technology, Dharwad 3. Review of literature ▪ Music Information Retrieval: Recent Developments and Applications

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Music Information Retrieval: Recent Developments and applications is a literature written by Markus Schedl (Johannes Kepler University Linz, Austria) Emilia Gómez (Universitat Pompeu Fabra, Barcelona, Spain) Julián Urbano (Universitat Pompeu Fabra, Barcelona, Spain)

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survey of the field of MIRS, paying attention to the developments made lately, similar as the auto-tagging and the semantic and the user centric retrieval approaches. First written on well-established and the proven styles for feature extraction and

the music indexing, from both the contextual data sources and the audio signals about the music, similar as cooperative/collaborative tags or the web sites.

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These in turn enable the wide kinds of music retrieval tasks, similar as music identification ("query by illustration") or semantic music hunt/search. And they reviewed current work on modeling in the environment/context of music recommendation and

user analysis

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and retrieval, addressing the recent trend towards user- centric and adaptive approaches and systems. And it follows the

discussion about how different/various Music Information retrieval approaches to different problems are compared and evaluated/estimated.

Indian Institute of Information Technology, Dharwad 4. Report on the present investigation

Indian Institute of Information Technology, Dharwad 5. Summary and Conclusions There has been a lot of discussions on music Information retrieval system till date but not that much researches have been done on the same. There are only a

few numbers of algorithms which are developed for music Information retrieval system. We got an idea of what kind of music being listened by what kind of age groups in a particular situation or environment through these online resources or pdfs, and have studied the algorithms that have been given in the article. We got to know about the working of a MIR on detecting a song and providing information on it. There has been a systematic explanation about each and every steps involved in detection of a song, we studied the fingerprint matching algorithm and have used the same algorithm in our project. Music Information Retrieval is a young but the established multidisciplinary field of research. Even the though the origin of the Music Information Retrieval system (

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MIR) can be tracked back to the 1960, the first International Conference on the Music Information Retrieval system, started in 2000

and has exerted on the sense of belongingness to the

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research community. Although the field is constantly evolving, there already exists a set of techniques that have become

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standard in certain applications. In this report, we provided an introduction to MIRS and detailed

overview of how to use our provided application. A great variety of different methods for searching in the audio data and music scores has been proposed and implemented in the research prototypes and commercial systems. Besides the limited and well-defined tasks of the identifying recordings, for which the audio fingerprinting techniques works well, it is hard to tell that which methods should be further pursued. User studies have been identified as the key components of music information research.

Indian Institute of Information Technology, Dharwad While the existing work has been provided the valuable findings and the recommendations for future MIRS development, expanded research attention will be required to provide a comprehensive picture of music information use.

Indian Institute of Information Technology, Dharwad 6. References https://musicinformationretrieval.com/index.html https://github.com/itspoma/audio-fingerprint-identifying-python https://aclanthology.org/L16-1312.pdf https://www.researchgate.net/publication/220722985_User_studies_in_th e_Music_Information_Retrieval_Literature https://link.springer.com/article/10.1007%252Fs10844-013-0247-6 https://www.sciencedirect.com/topics/computer- science/music- information-retrieval https://julian-urbano.info/files/publications/059-music-information- retrieval- recent-developments-applications.pdf

Indian Institute of Information Technology, Dharwad 7. Acknowledgment We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Pyaudio - provides Python bindings for PortAudio, With PyAudio, you can easily use Python to record audio and play on a variety of platforms. ▪ Matplotlib – is

PyAudio provides Python bindings for PortAudio, the cross-platform audio I/O library. With PyAudio, you can easily use Python to play and record audio on a variety of platforms. PyAudio is

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W   https://en.wikipedia.org/wiki/Music_information_retrieval

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Essentia C++ library for audio and music analysis, description and synthesis, including Python bindings. http://essentia.

essentia - C++ library for audio and music analysis, description and synthesis, including Python bindings • • • • • • Jupyter Essentia

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github.com/itspoma/audio-fingerprint-identifying-python This project is shazam-similar app, that identifies song using audio

GitHub - itspoma/audio-fingerprint-identifying-python: The Shazam-similar app, that identify the song using audio

W https://github.com/itspoma/audio-fingerprint-identifying-python

7/13	SUBMITTED TEXT	37 WORDS	65%	MATCHING TEXT	37 WORDS

Music Information Retrieval: Recent Developments and applications is a literature written by Markus Schedl (Johannes Kepler University Linz, Austria) Emilia Gómez (Universitat Pompeu Fabra, Barcelona, Spain) Julián Urbano (Universitat Pompeu Fabra, Barcelona, Spain)

Music Information Retrieval: Recent Developments and Applications Markus Schedl Johannes Kepler University Linz, Austria markus.schedl@jku.at Emilia Gómez Universitat Pompeu Fabra, Barcelona, Spain emilia.gomez@upf.edu Julián Urbano Universitat Pompeu Fabra, Barcelona, Spain

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survey of the field of MIRS, paying attention to the developments made lately, similar as the auto-tagging and the semantic and the user centric retrieval approaches. First written on well-established and the proven styles for feature extraction and

survey of the field of Music Information Retrieval (MIR), in particular paying attention to latest developments, such as seman- tic auto-tagging and user-centric retrieval and recommendation ap- proaches. We first elaborate on well-established and proven methods for feature extraction and

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These in turn enable the wide kinds of music retrieval tasks, similar as music identification ("query by illustration") or semantic music hunt/search. And they reviewed current work on modeling in the environment/context of music recommendation and

These in turn enable a wide variety of music retrieval tasks, such as semantic music search or music identification ("query by example"). Subsequently, we review current work on user analysis and modeling in the context of music recommendation and

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research community. Although the field is constantly evolving, there already exists a set of techniques that have become

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