

Computational Musicology perspective to Indian Music

Xavier Serra
Music Technology Group
Universitat Pompeu Fabra, Barcelona

Music Technology Group

- 40 researchers (+ 20 Master students/year)
- Research topics:
 - Audio signal processing
 - Machine learning
 - Human computer interaction
 - Music information retrieval
 - Computational musicology



The screenshot shows a user interface for a sound library. At the top, there's a navigation bar with links for Home, Sounds, Forums, People, and Help. A search bar is prominently displayed. Below the navigation, a title 'Instruments > Santur.wav' is shown, followed by a 5-star rating and the number '(4)'. The main content area features a large waveform visualization of the sound file. Below the waveform, the file was uploaded by 'xeerra' on July 26th, 2011. It has been downloaded 82 times. There are 'Download' and 'Creative Commons' license links. The file type is listed as 'Wave (.wav)' with a duration of '01:30:694', a file size of '15.3 MB', a sample rate of '44100.0 Hz', a bit depth of '16 bit', and 'Stereo' channels. A 'Comments' section is also visible.



Computational Musicology

- **Object of study:** music data
- **Methodology:** Statistics, Signal Processing, Natural Language Processing, Machine Learning, ...
- **Goal:** understand music

.... different from Music Information Retrieval

Digital music objects

- Digital objects are composed of data, metadata and (ideally) an identifier.
- The data is the actual object. The metadata is textual information describing it.
- Main types of objects:
 - digital audio recordings of musical performances
 - machine-readable music scores
 - machine-readable music-related texts

Research topics (1 of 3)

- **Data processing:** audio signal processing; symbolic music processing; metadata, tags, linked data, and semantic web; lyrics and other textual data, web mining, and natural language processing; multimodality; machine learning.
- **Musical features:** melody; harmony, chords and tonality; rhythm, beat, tempo; structure, segmentation and form; timbre, instrumentation and voice; musical style and genre; musical affect, emotion and mood; expression and performative aspects of music.

Research topics (2 of 3)

- **Music processing:** sound source separation; music transcription and annotation; optical music recognition; alignment, synchronization and score following; music summarization; music synthesis and transformation; fingerprinting; automatic classification; indexing and querying; pattern matching and detection; similarity metrics.
- **User-centered processing:** user behavior and modeling; human-computer interaction and interfaces; personalization; user-centered evaluation; legal, social and ethical issues.

Research topics (3 of 3)

- **Applications:** digital libraries and archives; music retrieval systems; music recommendation and playlist generation; music and health, well-being and therapy; music training and education; music composition, performance and production; gaming; business and marketing.
- **Evaluation and Methodology:** philosophical and methodological foundations; evaluation methodology and reproducibility; statistical methods for evaluation; datasets and annotation protocols; evaluation metrics.

[HOME](#)

[DESCRIPTION](#)

[TEAM](#)

[PUBLICATIONS](#)

[CORPORA](#)

[SOFTWARE](#)

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LATEST NEWS

[MOOC on North Indian Classical Music
by the MTG on the Kadenze platform](#)

16/03/2018 - 15:36

The MTG, in collaboration with RagaspHERE and on the Kadenze on-line...

[Xavier Serra invited to talk at the University of Rochester in New York](#)

01/03/2018 - 00:24

Xavier Serra gives two seminars at the

HOME

English



CompMusic is a research project funded by the European Research Council from 2011 to 2017 and coordinated by Xavier Serra from the Music Technology Group of the Universitat Pompeu Fabra in Barcelona (Spain). It aims to advance in the automatic description of music by emphasizing cultural specificity, carrying research within the field of music information processing with a domain knowledge approach. The project focuses on five music traditions of the world: Hindustani (North India), Carnatic (South India), Turkish-makam (Turkey), Arab-Andalusian (Maghreb), and Beijing Opera (China).

dunya.compmusic.upf.edu



[Info](#) [Legal](#) [xserra](#) [Logout](#)

Dunya comprises the music corpora and related software tools that have been developed as part of the CompMusic project. These corpora have been created with the aim of studying particular music traditions and they include audio recordings plus complementary information that describes the recordings. Each corpus has specific characteristics and the developed software tools allow to process the available information in order to study and explore the characteristics of each musical repertoire.

Explore our collections



Carnatic



Hindustani



Makam



Jingju



Andalusian

LATEST BLOGS

[Interviews published in a Chinese Wechat Official Account](#) 04/09/2017

WeChat Official Accounts can be understood as the WeChat equivalent of a Facebook page. They are drawing a lot of interest these days, as WeChat has risen to dominate the Chinese social media space (Chinese users spend ½ of their smartphone time...)

[Final Report](#) 24/08/2017

CompMusic has finished, and our funding agency, ERC, asked us to write a brief report. Here is it. Achievements along the main objectives/activities The CompMusic project has been a big and long project with many achievements...

[Technology and Multiculturality](#)

17/04/2016

[Article published in the daily newspaper La Vanguardia on Sunday 17th 2016. English translation of the original text written in catalan.] The violin, typewriter or mobile are examples of technological devices that were born in certain contexts...

Music traditions studied



CompMusic team





MusicBrainz

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Dunya Hindustani

— Public collection by compmusic (See all of compmusic's public collections)

Overview

Page 1 of 5

Releases

Release	Artist	Format	Tracks	Date	Country	Label	Catalog
All India Radio	Vishayt Hussain Khan	CD	2	1966	IN	T-Series	SVCCD 126
Archival Release Vol.1	Jasraj	CD	4	1982	IN	Swarashree Enterprises	P0001
Echoes of a Golden Voice	Jasraj	CD	2	1984	IN	Saregama	CDNF150641ADX
A Life in Music	Amir Khan	CD	3	1987	IN	Rhythm House	CD 240361
An Undying Passion Vol. 1	Omkarnath Thakur	CD	2	1987	IN	Rhythm House	CD 240367
The Sanctity of Perampara	Manik Bhide	CD	2	1987	IN	Rhythm House	CD 240368
Tribute To Myan Tansen Vol-1	Veena Sahasrabuddhe	CD	2	1987	IN	Rhythm House	CD 240369
Tribute To Myan Tansen Vol-2	Veena Sahasrabuddhe	CD	2	1987	IN	Rhythm House	CD 240370
An Undying Perampara Vol. 2	Omkarnath	CD	3	1988	IN	Rhythm House	CD 240374
An Undying Perampara Vol. 3	Omkarnath	CD	3	1989	IN	Rhythm House	CD 240381



Signal processing

Machine learning

Semantic analysis

Melodic patterns

Rhythmic patterns

Semantic relationships

Exploring music data · Demographic

ARTIST

- Artist
- Concept
- Instrument
- Language
- Notes

RAAGA

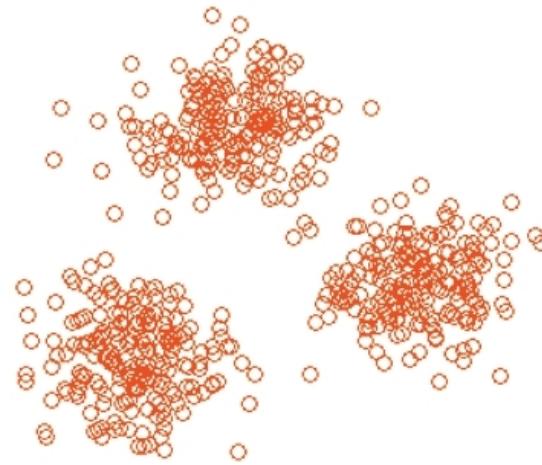
- Concept
- Instrument
- Language
- Notes

Some items from our collection:

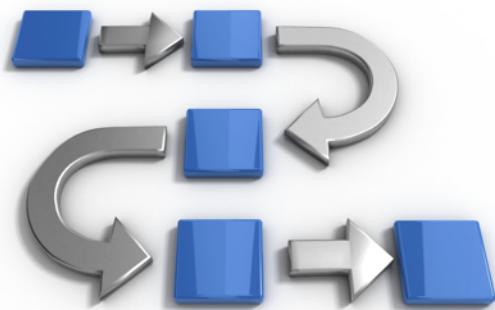
- U. M. Bhattacharya
- Vocal
- Thumri
- A Centennial Retrospective



Problem



Data



Methodology



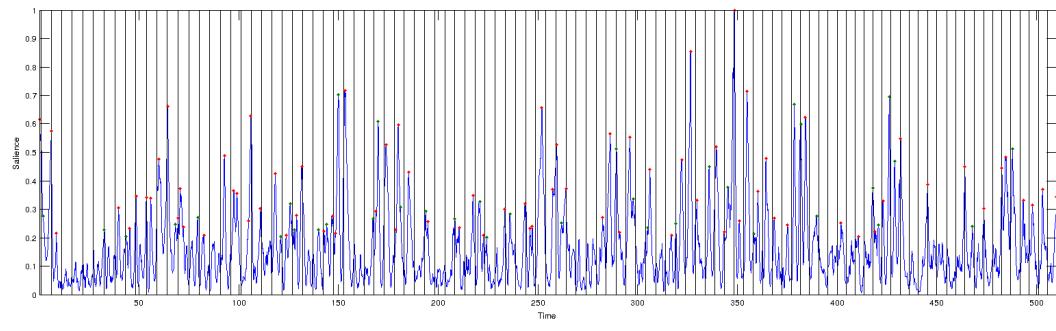
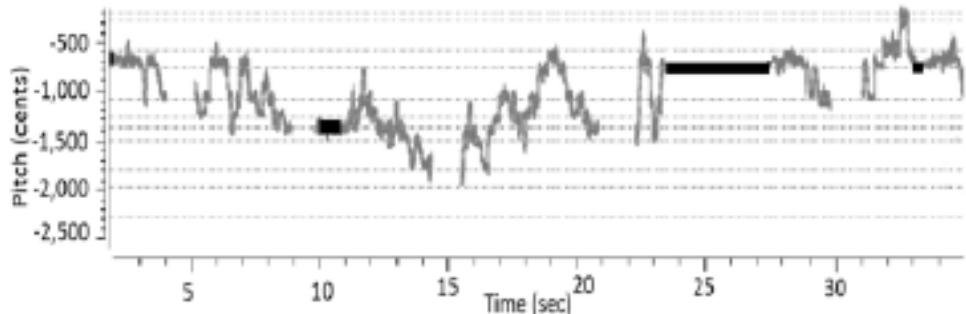
Evaluation



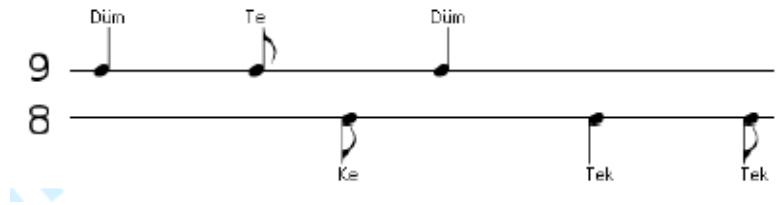
Problem

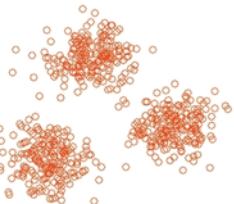


Melody

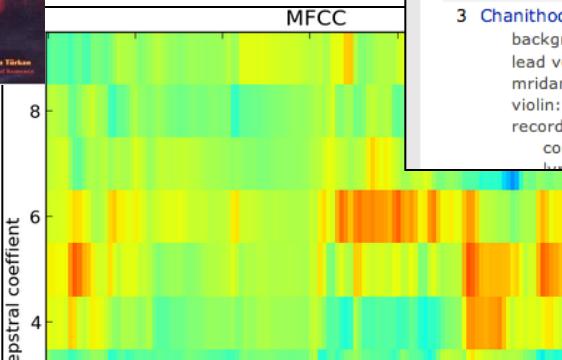


Rhythm





Data



T.M. Krishna

Vocal

[ARTIST'S WEBSITE](#)

[ARTIST'S FACEBOOK](#)

[ARTIST'S TWITTER](#)

[ARTIST'S YOUTUBE](#)

T.M. Krishna is at the forefront of classical vocalists in India today and is known in the musical world as a classicist. His tremendous stage presence, his awe inspiring voice, his great scholarship and his ability to transcend cultural borders makes him the greatest ambassador of Carnatic classical music. He contributes to Carnatic music in numerous ways other than performing. He has started and is involved in many organisations whose work spreads across the whole spectrum of Carnatic music including research, archival and documentations, taking Carnatic music to various parts of society and to smaller towns and villages, conducting festivals focused at the youth, supporting artists from rural south India who need opportunities to widen their horizons and spotting youth talent and giving them opportunities. He conducts creativity workshops for corporates and has lectured in various organisations like IIM Bangalore, IIT Madras, CII, and Harvard university. He is an author who has co authored 'Voices within' a book dedicated to some of the greats of Carnatic music and contributes regularly to various journals and newspapers. He has also always been in the forefront to raise very many sensitive issues that affects Carnatic music over many years. A multifaceted personality.

CD 1

1 Tharunam Eedamma - D.K.Jayaraman

background vocals: Sukanya Sankararaman, Balaji Shankar
lead vocals: D. K. Jayaraman
mridangam: J Vaidyanathan
violin: R. K. Shriramkumar
recording of: Tarunam Edamma
composer: Syama Sastri
lyricist: Syama Sastri

2 Parvathi Pathim

background vocals: Sukanya Sankararaman, Balaji Shankar
lead vocals: D. K. Jayaraman
mridangam: J Vaidyanathan
violin: R. K. Shriramkumar
recording of: Parvathi Pathim
composer: Muthuswamy Dikshitar
lyricist: Muthuswamy Dikshitar

3 Chanithodi Theve

background vocals: Sukanya Sankararaman, Balaji Shankar
lead vocals: D. K. Jayaraman
mridangam: J Vaidyanathan
violin: R. K. Shriramkumar
recording of: Tarunam Edamma
composer: Syama Sastri
lyricist: Syama Sastri

قدام الأصبهان

توشية الميزان

32

الصنعة 1 . شقل - اصبهان . زجل
يا كوكب الأخلاق قلبي هوak

"توشية"

هوak يا فنان

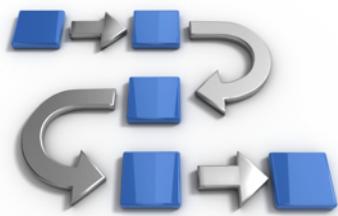
فذ حير الأذهان

بالله يا سلطان

رفقا بمن هوak وذع جفاك

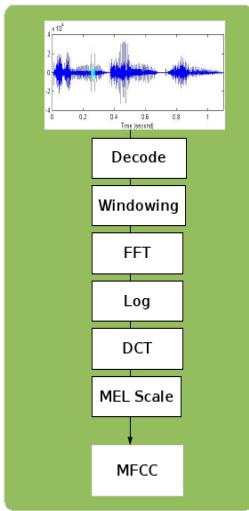
الصنعة 2²⁴⁹ . اصبهان . توشيه

سقط الدموع جاري من مقلتي سقط
كالذر في انحطاط لوز كان ينقط
من دمعي يا تأثر الثنائي الفريد
بمقلة وزيد يا مُثيبة الغزال
يا غيد كل غيد كالفتني شنط
مني على شنط يا جنتي وئاري
مذ بـ بالنقار

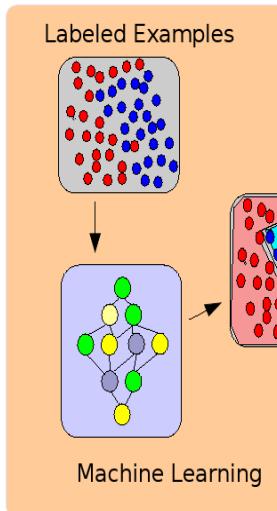


Methodology

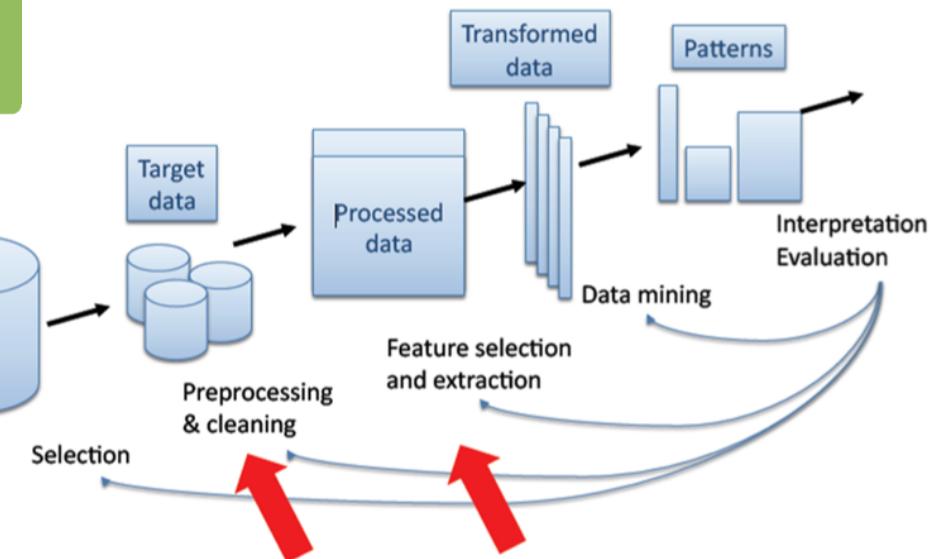
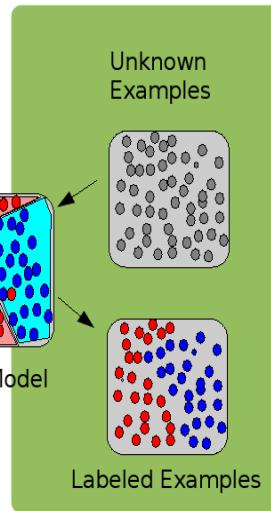
Feature Extraction



Training



Classifying



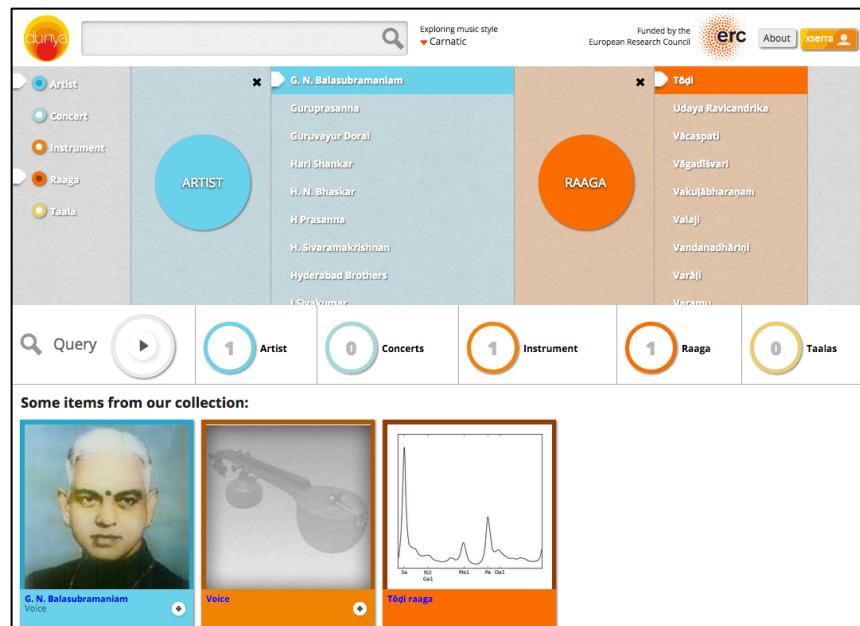


Evaluation

	Algo.	f_b	$AML_{t,b}$	\mathfrak{I}_b Bits	f_s	Tempo CML	Tāla AML	Tāla %
CMR	HMM ₀	0.718	0.722	1.44	0.440	0.718	0.938	64
	AMPF ₀	0.825	0.906	2.17	0.574	0.802	1.000	68
HMR _s	HMM ₀	0.759	0.698	1.21	0.551	0.533	0.721	60
	AMPF ₀	0.828	0.834	1.54	0.569	0.714	0.946	63
HMR _I	HMM ₀	0.338	0.225	0.77	0.280	0.119	0.350	37
	AMPF ₀	0.390	0.427	1.35	0.268	0.350	0.740	27
Blm.	HMM ₀	0.853	0.910	2.52	0.666	0.755	0.988	91
	AMPF ₀	0.813	0.850	2.15	0.529	0.709	0.957	89

quantitative (algorithms)

qualitative (systems)



Results: data processing methods

- Prominent pitch detection (Atlı et al. 2015)
- Tonic detection and pitch representations (Gulati et al. 2014)
- Structural analysis (Sarala and Murthy 2013)
- Melodic/rhythm pattern detection (Gulati, 2016; Srinivasamurthy 2016)
- Lyrics to audio alignment (Dzhambazov et al. 2016)
- Score to audio alignment (Şentürk 2016)

Results: musicology

- Hindustani and Carnatic
 - Comparison of intonation characteristics (Serrà et al. 2011)
 - Raga grammar in improvisations (Ganguli et al., 2016)
 - Raga identification through the characteristic motives (Gulati et al., 2016)
- Turkish-makam
 - Metrical contradiction in *usuls* (Holzapfel and Bozkurt, 2012)
 - *Makam* characterization through their *seyir* (Bozkurt, 2015)
- Jingju
 - Linguistic tones and pitch contours relationships (Zhang et al., 2015)
 - Characterization of schools of *dan* role-types (Caro Repetto et al., 2015)

Publications



compmusic

Computational models for the discovery of the World's Music



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PUBLICATIONS

CORPORA

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LATEST NEWS

Presentation of CompMusic at IMS 2007
16/03/2017 - 12:10

Xavier Serra will present the CompMusic project at the International...
Gopala K. Koduri and Sertan Şentürk defend their PhD thesis
06/02/2017 - 12:10

On February 22nd 2017, Gopala K. Koduri and Sertan Şentürk defend their...
CompMusic Seminar
01/02/2017 - 12:35

PUBLICATIONS

English 

- S. Şentürk. **Computational Analysis of Audio Recordings and Music Scores for the Description and Discovery of Ottoman-Turkish Makam Music.** PhD Thesis, Universitat Pompeu Fabra, Barcelona (Spain). 2016.
- G. K. Koduri. **Towards a multimodal knowledge base for Indian art music: A case study with melodic intonation.** PhD Thesis, Universitat Pompeu Fabra, Barcelona (Spain). 2016.
- A. Srinivasamurthy. **A Data-driven Bayesian Approach to Automatic Rhythm Analysis of Indian Art Music.** PhD Thesis, Universitat Pompeu Fabra, Barcelona (Spain). 2016.
- S. Gulati. **Computational Approaches for Melodic Description in Indian Art Music Corpora.** PhD Thesis, Universitat Pompeu Fabra, Barcelona (Spain). 2016.
- K. K. Ganguli and P. Rao. **"Perceptual Anchor or attractor: How do Musicians perceive Raga Phrases?"** 22nd Frontiers of Research on Speech and Music (FRSM 2016), November 11-12, 2016, Baripada (India).
- A. Lele, S. Pinjani, K. K. Ganguli, and P. Rao. **"Improved Melodic Sequence Matching for Query Based Searching in Indian Classical Music".** 22nd Frontiers of Research on Speech and Music (FRSM 2016), November 11-12, 2016, Baripada (India).
- Y. Yang. **Structure Analysis of Beijing Opera Arias.** Master Thesis, Universitat Pompeu Fabra, Barcelona (Spain). 2016.
- R. Caro Repetto and X. Serra. **"NACTA: construyendo el futuro de la tradición del jingju".** XIV congreso de la Sociedad de Etnomusicología, IX congreso de IASPM España. October 20th-22nd 2016, Madrid (Spain).
- B. Uyar. **Türk Makam Müziği Usulleri İçin İnteraktif Eğitim Aracı.** Master Thesis, Bahçeşehir University, İstanbul (Turkey). 2016
- B. M. Atıcı. **Makam Müzikleri İçin Etkileşimli Eğitim Sistemi.** Master Thesis, Bahçeşehir University, İstanbul (Turkey). 2016
- H. S. Atlı. **Türk Makam Müziği'nin Ezgisel Boyutuna Yönelik İnteraktif Eğitim Programı.** Master Thesis, Bahçeşehir University, İstanbul (Turkey). 2016
- S. Şentürk and X. Serra. **"Composition Identification in Ottoman-Turkish Makam Music Using Transposition-Invariant Partial Audio-Score Alignment".** 13th

LATEST BLOGS

Technology and Multiculturality 17/04/2016 [Article published in the daily newspaper La Vanguardia on Sunday 17th 2016. English translation of the original text written in catalan.] The violin, typewriter or mobile are examples of technological devices that were born in certain contexts...

Two evenings of Chinese traditional music 27/01/2016 Last December (2015), Barcelona's Conservatori Municipal de Música hosted two sessions of Chinese traditional music, the first one devoted to the silk and bamboo music genre and the second one to jingju (Beijing opera). For this...

Nila Saṅgīta - An evening of Indian Classical Music and Dance 30/06/2015 Saṅgītarasikā, with the support of CompMusic organized a concert titled "Nila Saṅgīta": An evening of Indian Classical Music and Dance, at Arts Santa Mònica, La Rambla 7, Barcelona on the 25th June, 2015. The ensemble included N...

Tools: data + software



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Dunya comprises the music corpora and related software tools that have been developed as part of the CompMusic project. These corpora have been created with the aim of studying particular music traditions and they include audio recordings plus complementary information that describes the recordings. Each corpus has specific characteristics and the developed software tools allow to process the available information in order to study and explore the characteristics of each musical repertoire.

Explore our collections



Carnatic



Hindustani



Makam



Jingju



Andalusian

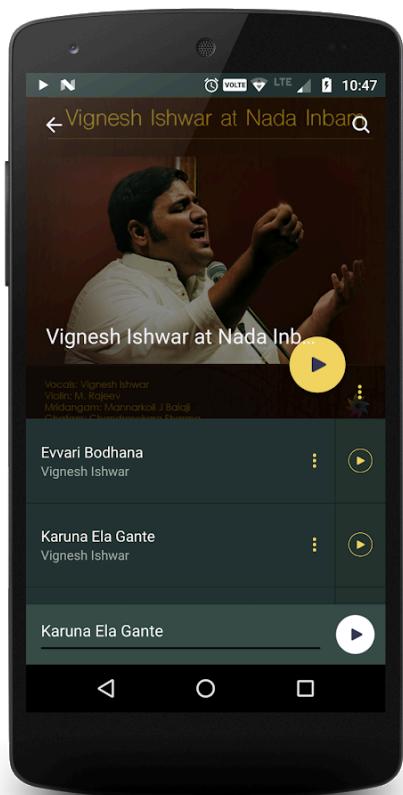
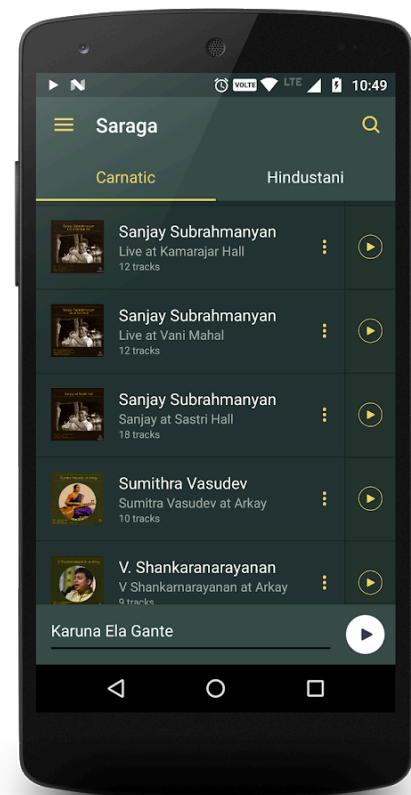
Applications: Dunya Desktop

The screenshot displays three main windows of the Dunya Desktop application:

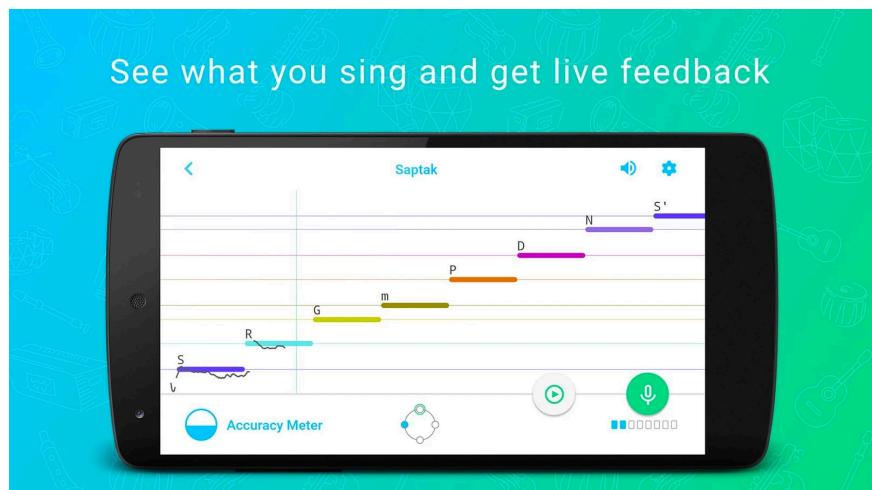
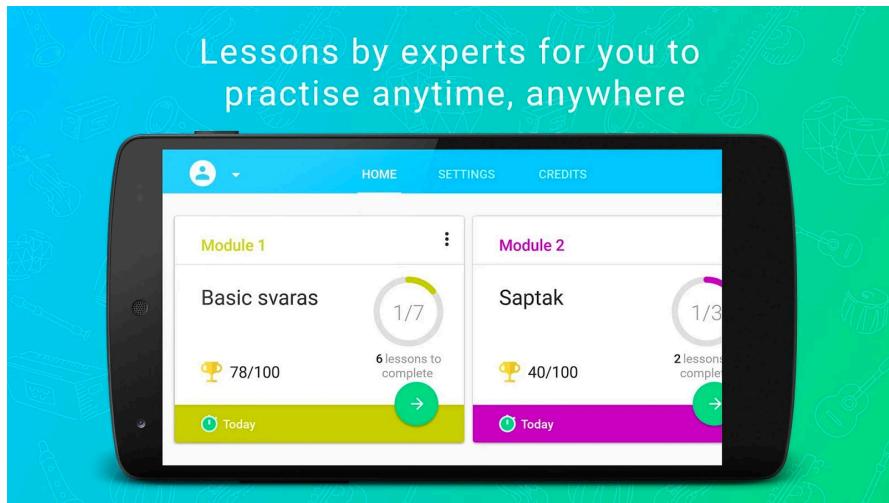
- Dunya Desktop (Left Window):** Shows the "Ottoman-Turkish Makam Music Corpus". It includes a "COLLECTIONS" sidebar with "MainCollection" and "ussak" selected. A "FILTERING" section allows filtering by "Acem" (selected), "Form" (Form), and "Composer" (Performer). A search bar says "Type here to filter the results...". Below is a table of songs with columns "Status" and "Title".

Status	Title
✓	Uşşak Saz Semâisi
✓	Kudümün Rahmet Ü Zevk U Safadır Ya Rasullah
✓	Acem Pesrev
20/22	Acem Pesrev
+ Downloading...	İtibarım Varsa Sendendir
+	Saba ki Dest ura Ol Zülfe Müşkinab Kokar
- mainui_makam.py (Top Right Window):** An audio analysis interface. On the left, a tree view shows "Features" like "audioanalysis", "jointanalysis", and "notes" (selected). On the right, a spectrogram titled "3-HANE-D1" shows "Usşak Sazsemâisi". Below it is a "Time Series" plot with "Frequency (Hz)" on the y-axis (0-600) and "Time" on the x-axis. A red vertical line marks a specific event.
- mainui_makam.py (Bottom Right Window):** A musical score viewer. It displays two staves of music. The top staff is labeled "1. HANE" and the bottom staff is labeled "MÜLÂZİME". The music consists of sixteenth-note patterns in common time (indicated by a "10" over the staff).

Applications: Saraga



Applications: Riyaz



Applications: Music Critic

The screenshot shows a course page on the kadenze platform. At the top, there's a navigation bar with links for Courses, Programs, Membership, Gallery, and a sign-up/login area. The main content area features the UPF logo and the title "North Indian Classical Music I: Fundamental Elements". Below the title is a large image of hands playing a instrument. A play button icon is overlaid on the image. To the right of the image is a card with course details:

- Open For Enrollment (In Development)
- This course is also part of the program: [North Indian Classical Music](#)
- ENROLL button
- Length: 3 Sessions
- Price: Audit (Free) Certificate (Incl. w/ Premium Program (\$300 USD))
- Institution: Universitat Pompeu Fabra
- Subject: Music Performance
- Skill Level: Beginner
- Video Transcripts
- Topics: Hindustani Classical Music, Raga, Rhythm, Tala

Below the card are three circular profile pictures.

The screenshot shows an external assignment interface on the kadenze platform. The left sidebar includes links for Switch Course, Dashboard, Syllabus, Sessions, Coursework, Gradebook, Announcements, Resources, and Connect. The main content area is titled "External Assignment: Session 1 Assignment 3" under the heading "Fundamental Elements of North Indian Classical Music".

The assignment interface includes a "Record exercise" section with the following options:

- Listen to Reference (orange button with play icon)
- Recording (gray button with microphone icon)
- Take 2 (gray button with plus icon) - No recordings
- Take 3 (gray button with plus icon) - No recordings

Instructions at the bottom of the exercise section:

- Click on "Start Exercise" to listen to the reference. Then click on each take to record.
- Remember to use headphones while recording!

A "Submit" button is located at the bottom right.

References

- MTG: <https://www.upf.edu/web/mtg/>
- CompMusic: <http://compmusic.upf.edu>