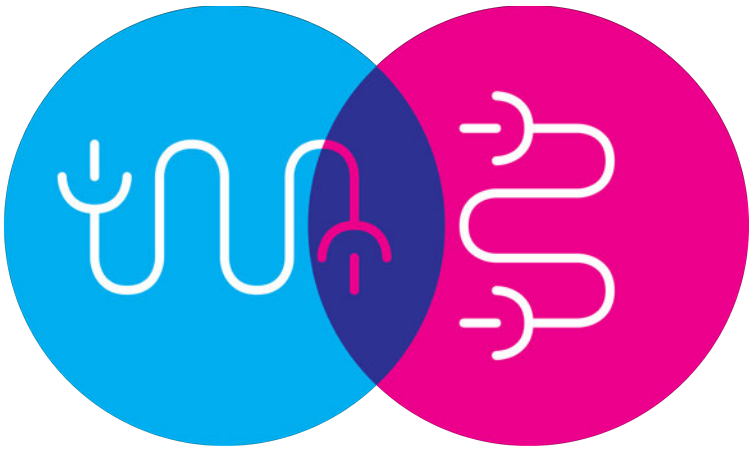

Project Acronym: **MusicBricks**

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D7.3 Results from the Market Testbed

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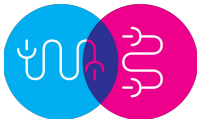

The #MusicBricks project consortium is composed of:

SO	Sigma Orionis (until Month 15)	France
STROMATOLITE	Stromatolite Ltd	UK
IRCAM	Institut de Recherche et de Coordination Acoustique Musique	France
UPF	Universitat Pompeu Fabra - Music technology Group	Spain
Fraunhofer	Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung E.V	Germany
TU WIEN	Technische Universitaet Wien	Austria

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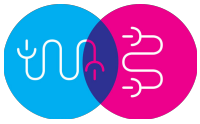

Revision Control

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0.2	Hugues Vinet (IRCAM)	21 June 2016	Extension of initial draft
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1.0	Michela Magas (Stromatolite)	1 July 2016	Submission to the EC

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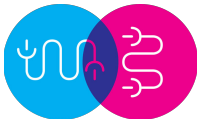

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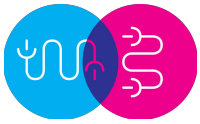

Executive Summary

The present document is a deliverable of the #MusicBricks project, funded by the European Commission's Directorate-General for Communications Networks, Content & Technology (DG CONNECT), under its Horizon 2020 research and innovation programme.

The Final Market Showcase was the 10th and largest event hosted by partner Stromatolite's Music Tech Fest and was specifically designed to provide a range of ways in which #MusicBricks teams could be integrated with industry in order to maximise the market opportunities for products and for the #MusicBricks platform itself. Incubated teams not only pitched their finished projects to investors and industry insiders, but significantly developed their networks, their skills and their products through integration with intensive artistic performance development and innovation, feedback from early adopters and festival attendees, and exploration of new and sometimes unanticipated exploitation opportunities.

Following the Market Testbed, the impact of the toolkit as a whole has been established, and there has been significant interest within both industry and partner research organisations to extend the project as a commercial entity beyond the life of the funded activities because of the opportunities inherent not just in the toolkit in its current form, but in the entire #MusicBricks methodological approach and resulting Innovation Ecosystem.

As well as the opportunities inherent in the combination of interoperable components, there has been significant impact made by each individual tool within the #MusicBricks toolkit. Most notably, the R-IoT board has been the Tangible User Interface (TUI) that has been driving a great deal of innovation, and it is to a large extent this tool that has encouraged the expansion of the toolkit as third party organisations see the opportunities inherent in partnering their technologies with a powerful, small gestural and internet connected device.

A significant factor in the success of #MusicBricks has been the role of mentorship throughout the life of the project, led by the Innovation Coordinator, and by the Innovation Exploitation Manager in WP7 during the market testbed. This ongoing process, culminating in intensive mentorship by partners at the Market Testbed Final Event has contributed to the high level of impact achieved by the #MusicBricks projects, the individual tools, and the #MusicBricks toolkit as a whole.

The knowledge transfer that resulted from this approach has led to tangible results, including 11 product prototypes, two new companies being formed, the filing of a patent, significant contributions of knowledge and innovation to the open source community, and a range of interventions focusing on societal impact, particularly in the realm of accessibility.

Through this process, seven distinct exploitation layers and business models have been identified, made possible by the Innovation Ecosystem and methodological approach: exploitation of the research; exploitation of the tools themselves; expansion of the toolkit by third parties; toolkit as

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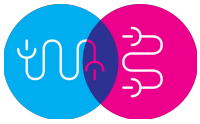

innovation ecosystem; business startups resulting from the testbeds; product as platform; and creative content for those platforms.

At the end of 18 months of the project duration, the partners, incubatees and the wider Innovation Ecosystem that has gathered around the #MusicBricks toolkit are able to report significant real and tangible impacts not only on industry and market innovation, but also on the arts, research, IP and policy. As a model for the entire Innovation Ecosystems Value Chain, the #MusicBricks methodology provides a successful template for deployment in transversal large scale experiments across industry verticals.

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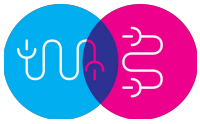

1. Introduction

This report introduces the final market testbed and showcase for the #MusicBricks project. It outlines the key components of the Music Tech Fest event in Berlin that were specially created to showcase the #MusicBricks incubatees, and outlines the event's focus on industry inclusion, startup pitches, integration of hack challenges that were large industry focused (e.g. societal challenges and IoT industry horizontal crossovers) and the inclusion of polished professional performances.

Deliverables D7.1 and D7.2 outline a business strategy for the incubated music technologies and their innovation value chain. Case studies have outlined the experiences offered through a growing network of external partners. This deliverable now presents the results from the market testbed which include engagement with key music technology partners, pitches to investors, as well as a range of different market interventions with target markets that include academia, hackathons themselves and performance contexts as well as customers purchasing consumer electronics.

This report also describes the results of the #MusicBricks technologies and the way in which they are being brought to market, both individually and as a collective and interoperable toolkit. It also outlines new IP integrations from third party commercial entities willing to commit their own proprietary technology to the suite of #MusicBricks tools in order for creative developers to innovate using their technologies along with the others.

The report goes into depth on the achievements and results of a comprehensive portfolio of products created with the #MusicBricks toolkit, following the Market Testbed. It concludes with a section on the wide and comprehensive range of impacts enabled by the #MusicBricks Innovation Ecosystem.

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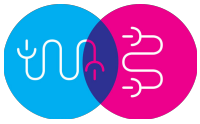

2. The Final Market Showcase

Music Tech Fest Berlin was conceived as a market testbed for music technology innovation in general and for #MusicBricks specifically. The event took place at Funkhaus - the former GDR broadcasting facility which boasts the largest recording hall in the world. The central 3-day festival of #MTFBerlin took place from the 27th to the 29th of May. The festival was preceded by a week of performance and innovation in #MTFLabs that included projects to address accessibility in performance, extend the creative and expressive capabilities of the human body and develop open innovation for Blockchain music technology. These workshops ran from the 23rd to the 27th, with results showcased on the main festival stage and in other areas of the festival. In addition, the #MTFResearch Symposium took place on the Monday following the festival (30th May) which brought together top academics and researchers to discuss ideas and discoveries made during the festival weekend, and to establish new interdisciplinary research collaborations. Topics for the symposium included metadata, transhumanism and music as a site for cross-disciplinary work.

The event was set up as a market testbed so that the #MusicBricks products, including #MusicBricks tools such as the popular R-IoT board, could be embedded within the broader MTF innovation ecosystem as well as interact with industry and the market. Where previous Music Tech Fest events had been established to focus on creative seeding of ideas, #MTFBerlin was more about bringing market practices and reflecting the state of the market for music technologies and music innovation. As a result, this iteration of the festival focused more on industry inclusion, startup pitches, integration of hack challenges that were large industry focused (e.g. societal challenges and IoT industry horizontal crossovers) and included polished professional performances. This gathered a larger crowd of early adopters, industry representatives and potential customers for the innovative SMEs and creative developers represented in the #MusicBricks project. SoundCloud, Native Instruments and other large music technology companies were represented and engaged with the #MusicBricks tools and outcomes. The hack camp - by far the largest in the 10-event history of the festival - was sponsored by element14, the world's largest manufacturer and distributor of componentry.

The market for #MusicBricks is not simply 'customers' for the products that emerge from the project. There are clear ancillary markets for #MusicBricks tools and innovations. The tools do not simply go into hackathons in order to generate new applications: hackathons are themselves a market for #MusicBricks products, projects and tools. In particular, the R-IoT board acts as a tangible development environment for physical hack projects to be built upon. #MTFBerlin provided

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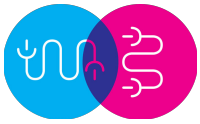

a perfect test case for this proposition as it took place without the active encouragement and incentive of an incubation resulting from development using the tools. Most of the winning entries in the #MTFBerlin element14 hack camp used #MusicBricks as part of their projects.

One outcome of #MusicBricks tools being part of the hack camp at the market testbed event was a synergy between two key European projects: #MusicBricks and Giant Steps. Giant Steps is a Research and Innovation Action creating new interfaces for music interaction, and the project recognises the potential on offer by the #MusicBricks toolkit to enable research into new interfaces for musical expression. Giant Steps became a sponsoring partner for a hack challenge in the #MTFBerlin hack camp and awarded their prize to a project that used #MusicBricks technology. In this way, the festival event was able to provide the context for the synergy between an RIA and an Innovation Action. In so doing, #MusicBricks was able to feed into the research component of Giant Steps; researchers are themselves a market for #MusicBricks as they use and buy tools for their university to do research.

Attendance at the festival included a great many invited guests, press, presenters and performers. Over 500 active participants from 29 countries included hackers, performers, installation artists, industry representatives, researchers, startups, investors, press and VIPs, on each day of the festival. 137 performed on the festival stage, 91 participated in the Hack Camp, 79 participated in the performance, blockchain, vocal and audience laboratories, the rest contributed to a variety of industry, startup, arts, kids, and teens events.

The Music Tech Fest event was majority match funded from sponsorship. The following were the areas that were set up to facilitate exposure and impact of the #MusicBricks tools, projects and products:

2.1.#MTFAmplifier

#MTFAmplifier was an exclusive networking event for business, investors and industry insiders, with a sneak peak at new projects, startup ideas and incubated #MusicBricks prototypes for the future of the music industry. The event included a drinks reception for VIP guests, and startup pitches and presentations by each of the #MusicBricks teams. Industry representatives - including those from SoundCloud, Native Instruments and element14 all expressed a great deal of interest in the #MusicBricks projects.

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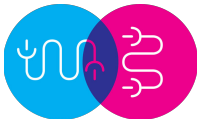

2.2. Startup Soundpit

#MTFBerlin included a dedicated area for startups, including the innovative projects incubated by the #MusicBricks project, where festival attendees could meet the teams, try out and learn about the products and prototypes. This area was adjacent to the main festival stage - a placement which resulted in a large amount of foot traffic. Interaction between startups and and #MusicBricks incubated teams was encouraged to enable transfer of experience and knowledge to the teams.

2.3. #MTFLabs: Performance

The transhumanism performance lab at #MTFBerlin ran in the week leading up to the festival, culminating in a series of public performances in the Absorption Chamber. The lab brought together musicians, technologists, makers, designers, wearable tech experts, videographers, jewellery makers, neuroscientists, composers, stylists, visual artists and lighting specialists to create new performance concepts centred around 'bionic artist' and accessibility champion Viktoria Modesta. #MusicBricks teams GIRD and #FindingSomethingBondingSound along with Stromatolite's #MusicBricks expert engineer Cyril Laurier participated in evolving technologies for stage-wearable prosthetics. The team's products and prototypes were used in the final performance, which is being further developed for Viktoria Modesta's forthcoming stage and video projects. This enabled the teams to collaborate in a real performance industry scenario, providing real world experience and links to the music business and world-class performers, and an opportunity to embed their tools in a professional context.

2.4. On stage performances

Following the latest business assessment of the market potential of the #MusicBricks incubated projects, Airstrument, GIRD and #FindingSomethingBondingSound (FSBS) were selected to showcase in performance and demo presentations on the main festival stage at #MTFBerlin. The performances and demonstrations were at a high level of professionalism, utilising the teams' recent experience of presentations at major global events, such as SXSW in Austin Texas and the Forbes' Top 30 Under 30 Innovators event in Israel. FSBS also gained experience in advance of showcasing at the Ars Electronica Festival as a result of being awarded the Ars Electronica STARTS Prize Honourable Mention. To external stakeholders, this was a fitting addition to a programme that included award-winning artists and internationally renowned performers. More than simply startup pitches to investors, these performances were direct to a market of discerning audiences.

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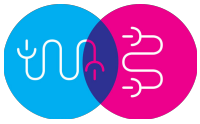

2.5.#MTFHacks: Innovator and Early Adopter Testbed

The Hack Camp at Music Tech Fest Berlin was sponsored by element14, the largest global distributor of electronic developer tools, and the manufacturer of the Raspberry Pi, as the headline sponsor. Many other significant players in the music technology scene set up challenges for the developers, including MOD and the EU RIA project Giant Steps. A challenge was specifically set to developers to use #MusicBricks tools to create an innovative new musical performance.
With over 80 hackers in the element14 hack camp, there were a lot of projects, many of which used a variety of tools and processes - from APIs and software to sponsors' products, including the element14 components such as Raspberry Pi and BeagleBone Black Boards. However, a majority of hack projects - including all of the major winners of the hack challenges awarded on stage - used #MusicBricks tools, thereby demonstrating their appeal and market fit within the hackathon environment.

There were over 25 hack projects created at #MTFBerlin by teams ranging from individual creators to groups of 9 artists, makers, developers and designers (many of which have been documented and archived at http://muzhack.com). However, some projects stood out and won more than one category of award. Each of the multiple-category winners selected by the international panel of expert judges integrated #MusicBricks technologies, and in each case, that included the R-IoT board.

Even though there was a large selection of tools available from the main supporting partner and several contributing partners of the #MTFHacks, the #MTFBerlin element14 Hack Camp most winners used the #MsuicBricks R-IoT:

The Transhumanism Challenge: Electronic Jungle

The Transhumanism Challenge encouraged participants to consider a theme that had been explored through the performance lab in the week leading up to the festival. The Electronic Jungle team created a performance that both enhanced the human capabilities of the participants through wearable technologies and created communication between performers through responsive light, visuals and musical performance, while at the same time evoking ancient animalistic ritual through the use of masks.

Music As Extension of the Human Body: Hackie

The Extension of the Human Body Challenge invited participants to create musical interaction and performance that went beyond the performers themselves. Gadi Sassoon's

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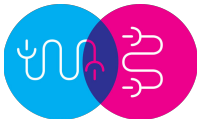

ingenious response was to build R-IoT board sensor/controllers into rubber stress balls that could be waved, shaken, bounced and thrown away from the performer, while the devices remain connected by wifi to computer-generated sound generation. The Hackie (or 'Jazz Balls' as they became known) were used to trigger piano performance that responded to the way in which the balls moved, fell, impacted or rolled.

The Giant Steps Challenge: To Be Remembered

The To Be Remembered team integrated research-led technologies from the European Giant Steps project with #MusicBricks tools and components as well as piano strings and hammers mounted onto the branch of a tree, triggered by Dada Machines-activated solenoids. It also integrated vocal samples as well as live performance by Mercury-nominated artist Eska. The hand-made instrument responded to light falling through the leaves of a tree to create a unique musical performance.

Hack the Bus Challenge: Muze Box

A challenge to create a musical installation in the festival shuttle-bus brought together two #MusicBricks incubatees: Matan Berkowitz of Airstrument and Rojan Gharibpour of Dolphin, along with designer Marzie Tangestani. The project was significant and gathered a good deal of press interest (see deliverable D2.3) as it brought together an Israeli with two Iranians to work in partnership.

MOD Devices Challenge: Simon Goff

Festival sponsors MOD Devices (http://moddevices.com/) provided their own effect pedal technology and challenged hackers and musicians to create a musical response. The presentation on stage took the form of an extended jam session between 15 musicians and makers, and violinist Simon Goff took the prize.

#MusicBricks Challenge: Hackie

Gadi Sassoon also won the challenge for best integration of #MusicBricks tools into market-ready projects or performances. Within a week, he had performed live on stage in a sellout concert at Electric Brixton in London (capacity 1700) using the Hackies in his performance, playing support for international recording artist Amon Tobin.

IoT Crossover Challenge: To Be Remembered

With the support of SoundCloud, hackers were challenged to think of ways in which music

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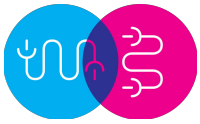

and creativity could cross over to other industry verticals such as transportation, telecommunication, health, agriculture, etc. The To Be Remembered project was a clear winner in its integration of the use of localised meteorological conditions in natural surroundings as a source of data and physical feedback for musical performance.

element14 prize for Best Overall Hack: Electronic Jungle

Hack camp sponsors element14 selected Electronic Jungle as the most ambitious and fully realised creation and performance using their components, along with #MusicBricks tools, paired with choreography, wearable technology and responsive sound and light. The team has been awarded $2500 worth of element14 components to further develop their concept and bring their performance project to market - and in doing so, will also bring #MusicBricks integration with them.

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3. Results for the #MusicBricks Toolkit

3.1. #MusicBricks Toolkit as a growing Innovation Ecosystem

An important and often raised question by potential industry partners addressed the ongoing sustainability of the #MusicBricks project after the official EC-funded project ends. Both large and small stakeholders showed great interest in innovation ecosystem communities and the emerging ideas and projects. This environment provided them a testbed and effective knowledge transfer without the effort and expense of building their own infrastructure. They also saw a clear benefit from access to ideas, which are normally outside of their knowledge vertical. Once they established a relationship of trust with the #MusicBricks project, stakeholders sought to ensure that this initiative would continue to offer value in return for their support.

Prompted by requests from several industry stakeholders, #MusicBricks was incorporated as a legal entity in January 2016. The aim was to provide potential partners a legal framework to enable legal partnership agreements in view of growing the toolkit and developing the related innovation ecosystem.

In order to justify partner investment and ensure long-term results the #MusicBricks ecosystem and its valuable outputs have to be maintained beyond the end of the official EC-funded project. As a valuable investment for the future, all project partners agreed to keep their tools within the #MusicBricks ecosystem based on the conditions agreed in the Consortium Agreement.

For continued presence, it is essential to keep #MusicBricks' web presence and social media channels alive, as well as the required maintenance and administration. The establishment of the #MusicBricks legal entity ensures that the project is able to continue to communicate, and keep stakeholders informed.

3.2. Multiple Open Innovation business models

The #MusicBricks toolkit has provided a valuable insight into the layers of business models possible within an Innovation Ecosystem:

1. Exploitation of the knowledge generated within European research institutions;
2. Exploitation of the #MusicBricks tools themselves;
3. The addition of new bricks to the toolkit from external third parties;

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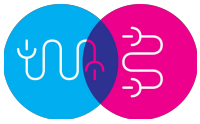

4. Exploitation of the toolkit as a commercially exploitable innovation ecosystem;
5. Exploitation of the 11 innovative startup product ideas;
6. Implementation of those products as platforms in themselves; and
7. Exploitation of the Creative Content generated for those platforms.

More about these business models is described in Section 2 of the D2.4 Exploitation Plan.

The newly formed startup company Sojaner and its project Dolphin offered a useful case study for multiple layers of business models based on Open Innovation:

1. In the use of the board, Rojan Gharibpour was supported by Emmanuel Flety (IRCAM) and Cyril Laurier (Stromatolite) who assisted him with developing with the R-IoT board. The product was thus enabled by direct knowledge transfer.
2. Dolphin creates an interface that can navigate menus and act as a control mechanism. As such, it can be implemented as a product in particular industry user case scenarios to drive machinery. The clear distinction between Research and Innovation APIs in the Consortium Agreement allowed this particular product application to file for patent immediately after the prototype was completed.
3. The roadmap for Dolphin includes deployment for gaming, where it becomes a product platform for gaming content. As a platform, it requires particular technical features in order for other developers to use it as a platform, including its own API that the gaming community can use to build content for it.
4. In order to be successful in the gaming market, such a product platform needs to create its own gaming ecosystem, with gaming developers using the platform's API to create content.
5. In addition the Dolphin product represents exploitation of the #MusicBricks toolkit directly, because every instance of its deployment provides new opportunities for the deployment of the R-IoT to a different industry sector.

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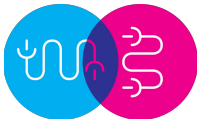

4. Results for individual #MusicBricks tools

During the Market Testbed, the #MusicBricks consortium was asked by industry stakeholders to make the toolkit available for use in their internal development. The comprehensive dissemination online and at the Music Tech Fest events, as well as the communication of a toolkit as a comprehensive package, made this proposition attractive not only to the developer community but also to manufacturers in the music technology sector. Companies like the Berlin-based SoundCloud, Ableton and Native Instruments, actively joined the event as sponsors and brought in their experience with the creative and hacking communities. Aside from the Soundcloud API and the Ableton's Max for Live set being used very often within the projects, Native Instruments is considering the integration of one of their well known products - the Reaktor sound machine - as a #MusicBricks API as well.

The biggest success for the #MusicBricks toolkit is presented by the announcement by a global electronic tools manufacturer (under NDA) of a long-term partnership both in terms of manufacturing and ecosystem building at Music Tech Fest events. The partner aims to use the toolkit to develop new ideas, starting this open innovation process at the next Music Tech Fest. Of course this will also be a big step towards further exploitation for the providers of the tools, and the use of #MusicBricks commercially. In this way empowering the creative community will continue by offering them new technology in an open environment.

4.1.#MusicBricks from Ilmenau by Fraunhofer IDMT

In the beginning of the project Fraunhofer IDMT contributed two of the very stable APIs as bricks to the project:

- The #MusicBricks Transcriber offers transcription of the main melody, chords and bass line of a given audio file, and the estimation the beat times, the key, and the average tempo.
- The Real-time Pitch Detection allows the estimation of the predominant melody notes (monophonic) or multiple notes (polyphonic) from consecutive audio sample blocks.

Both tools were not requested that much during the hackathons at the Music Tech Fest in Barcelona, Ljubljana and Umea, especially when compared to the popular hardware like the R-IoT sensor. But the feedback from the incubated teams and other developers using these #MusicBricks was very valuable. The test with new hardware and other software APIs, i.e. with Hue SDK (Philips) by the LightBeat team has displayed some issues which were fixed within the

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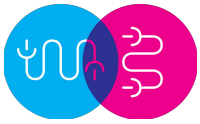

incubation period. The most important influence for the internal process was the pressure for a clean interface and perfect documentation, which was provided to the developers and of course this helps with future implementation and exploitation for customers.

Based on a variety of feedback, the Fraunhofer team also found that another tool could be very useful to be implemented as an additional brick. This prompted the development of a real-time pitch shifting library, which allows the changing of pitch of audio material while keeping the tempo. This feature is often a missing link in some hacks.

The tests on a broader user range raised the overall quality, something which was stressed as being extremely important, and the maintenance list for customer libraries was prioritised by the following demands:

- fast reaction to user feedback, quick changes and testing;
- more flexibility and configuration, better documentation, clean UI.

This process brought back a valuable experience to the Fraunhofer institute and prompted their own hack competition with Fraunhofer tools in partnership with the famous Audiolabs from the University of Erlangen. The institute is very happy with both:

- the new process to motivate researchers and engineers internally; and,
- creating new ideas for external use.

One of these ideas has been included as Fraunhofer's fourth contribution to the #MusicBricks toolkit: The Goatify tool provided is an executable library, that automatically replaces the main melody in a song with a given sample. The main melody is extracted and removed from the song, and the sample is placed and pitched to match the melody.

4.2.#MusicBricks from Vienna by TU Wien

The TU Wien teams received very valuable feedback to the #RhythmTimbre tool, which was mainly used in the two initial Creative Testbeds: #MTFScandi and #MHDBarcelona. The feedback led to supporting different audio input formats (flac, m4a, 24 bit wav audio etc.) which greatly extends the user base, particularly in the music production domain, where 24 bit audio is the

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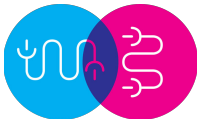

preference. On the feature side, #RhythmTimbre received a whole new layer: the recognition and classification of high-level concepts such as genres or moods, which was added by the new rp_classify library. Thus, the impact of being part of #MusicBricks and exposed to developers, creatives and performance artists has led not only to higher stability, but also to a much larger target audience, due to the aforementioned features. Moreover, the company Musimap has decided to utilise TU Wien's open-source tools for some of their music categorisation endeavours.

On the other hand, the two new additions from TU Wien and former startup Spectralmind to #MusicBricks - Search by Sound and Sonarflow - received less tremendous feedback, in part because they originated from a company (startup) environment, meaning that the two software libraries were already much more mature and market-oriented from the beginning, but also because they are also quite use case oriented already, which resulted in less flexibility in adapting to new use cases that people invented at the Creative Testbeds. For this reason, they also saw much less uptake, with people seeing a much higher barrier to integration of these tools given the flexibility they require in the invention process. However, useful feedback pointed to cloud services and public APIs being preferred over static libraries to be integrated. This is an insight that can lead Search by Sound and Sonarflow to evolve in ways that make their utilization easier, online.

The exposure this broad portfolio of tools has had - tools that can cover nearly any needs in terms of audio analysis and processing - has been very positive and beneficial. TU Wien wants to support the #MusicBricks project in future and stay involved with this successful collection of tools.

4.3.#MusicBricks from Barcelona by UPF / MTG

UPF contributed to the #MusicBricks toolkit with mainly two technologies: Essentia and Freesound. These technologies can be further disseminated after the end of the project under the #MusicBricks toolkit umbrella, as an additional vehicle for reaching new users beyond the UPF academic communication channels.

For an academic research lab such as UPF, the experience of #MusicBricks has shown again the importance of having a close connection with creative users. The research tools need to go out of the lab, and the UPF is specially interested in outreach activities, for example initiating and leading the MusicHackDay in Barcelona (2011-2015). This year 2016, the UPF together with the Sonar+D Festival has reformulated the MusicHackDay and started a new activity called Sonar Innovation Challenge SIC (http://sic.upf.edu/) with collaboration of international brands and music tech

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companies (e.g. Absolut and Deezer). Next editions of the SIC will definitely represent a continuation of the spirit of #MusicBricks, and how academic research results can be used by creative users.

A common piece of feedback gathered throughout the #MusicBricks project was the importance of offering tools that work in real-time. In hackathons and events alike, the sense of “immediacy" is crucial in order to be attractive. To this end, the UPF included a real-time version of the Essentia Library (EssentiaRT~). For the #MusicBricks project only a subset of algorithms were available as real-time modules. However the Essentia Library is a strategic long-run project at UPF and is being further developed and used in multiple projects (e.g. GiantSteps, AudioCommons) and other Industrial projects. Porting more algorithms to real-time operation will enable more users to build new prototypes with Essentia, using the wrappers for MaxMSP and PureData.

In a similar vein, the experience of #MusicBricks has brought valuable feedback for the Freesound API included in the #MusicBricks technology portfolio. In this case, currently the API offered 'text query' to retrieve sounds from the online repository. UPF received multiple requests by users to use also audio-query, i.e. using an input sound as a reference to find similar sounds in the repository. In terms of research, these new features are aligned with the topics of Detection and Classification of Acoustic Scenes and Events, which are getting attention in the 'machine listening' community. In the coming years, the research results of some current Master and PhD students in audio classification will be incorporated in the Freesound API.

4.4.#MusicBricks from Paris by IRCAM

Before #MusicBricks, IRCAM had already developed closed and structured relationships with users of its technologies in the framework of its internal artistic production, collaborative R&D projects, tech licenses with industrial actors, dedicated product lines and through the IRCAM forumnet (forumnet.ircam.fr, 5000+ mainly professional users). Although IRCAM’s contribution to #MusicBricks was focused on one specific piece of technology (the R-IoT gesture sensing hardware and associated software), the project enabled it to experiment with new and complementary dimensions for its tech transfer :

- the delivery and test of a prototype hardware piece, whereas most of its experience with external users was based on software only; a lot of feedback was gathered from users in real performance conditions and this information provided valuable insight for future implementations;

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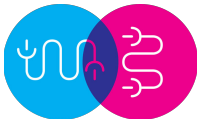

- hackathons, through several occurrences of Music Tech Fest sessions, as the main framework of initial delivery and exchange with users, which was rather new for IRCAM beyond isolated experiences. The big success encountered (most selected teams/ winners of various prizes used the R-IoT package despite the additional complexity of hardware-based prototyping over pure software) clearly assessed the relevance of this framework for a fast adoption of this kind of technologies and provided a clear view of the skills to mobilize in order to ensure a successful training and integration process;

- the MTF framework was also an opportunity for IRCAM to reach new categories of users, in particular neophytes in mainstream experimental music technologies such as Max/MSP (whereas most of its external forumnet users are professional and already trained in these technologies), and hardware/DIY music technology hackers : reflections are currently ongoing at IRCAM for developing new offers specifically dedicated to these user targets as part of extensions of its Forumnet;

- Most of the incubated teams also developed prototypes using the R-IoT technology and future business and scientific collaboration opportunities have been identified with them;

- A direct consequence of these contacts is a decision taken by IRCAM on the productization and distribution of a new version of the R-IoT hardware, which is subject of ongoing discussions with several hardware manufacturers;

These products will provide in particular a good basis for a future distribution of the technology as part of a #MusicBricks package to be agreed after the project execution between concerned project partners.

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4.5.Individual #MusicBricks

Individual APIs and Graphical User Interfaces (GUIs) are being made available to developers as open innovation and #MusicBricks Tangible User Interfaces (TUIs) now exist as batch-tested hardware ready for development into large scale production. Some of the content in this section is repeated from the original description of the tools in deliverables D3.3 and D4.3, but combines them and develops them here as a series of exploitable tools, both individual and interoperable, for the marketplace. These are the APIs, GUIs and TUIs that make up the #MusicBricks tool kit and collectively form the basis for the innovation framework from which the prototype products and startup ideas are built, and from which others can be created in future.

4.5.1. Gesture Sensors for Music Performance

The R-IoT sensor module is a postage stamp sized microboard that embeds a 9 axis sensor with 3 accelerometers, 3 gyroscopes and 3 magnetometers, all in 16 bit. It tracks 3D acceleration, 3-axis angular velocity and absolute orientation at a framerate of 200 Hz over WiFi. The core of the board is a Texas Instrument WiFi module with a 32 bit Cortex ARM processor that executes the program and deals with the Ethernet / WAN stack. It is compatible with TI's Code Composer and with Energia, a port of the Arduino environment for TI processors.The sensor module is completed with a series of analysis MaxMSP modules that facilitates its use, based on the MuBu & Co Max library. This collection of analysis tools allows for: filtering and analyzing, computing scalar intensity from accelerometer or gyroscope, kick detection, Mdetection motion patterns such as "freefall", spinning, shaking, and slow motion.

4.5.2. Freesound API

Freesound is a state-of-the-art online collaborative audio database that contains over 200K Creative Commons licensed sound samples. The sounds are annotated with user-provided free-form tags and textual descriptions that enable text-based retrieval. Content-based audio features are also extracted from sound samples to provide sound similarity search. Users can browse, search, and retrieve information about the sounds, locate similar sounds to a given target (based on content analysis) and retrieve automatically extracted features from audio files; as well as perform advanced queries

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combining content analysis features and other metadata.

4.5.3. Rhythm and Timbre Analysis

This is a library that processes audio data as input and analyzes the spectral rhythmic and timbral information in the audio to describe its acoustic content. It captures rhythmic and timbral features which can be stored or directly processed to compute acoustic similarity between two audio segments, find similar sounding songs (or song segments), create playlists of music of a certain style, detect the genre of a song, make music recommendations and much more. Depending on the needs, a range of audio features is available: Rhythm Patterns, Rhythm Histograms (i.e. a rough BPM peak histogram), Spectrum Descriptors and more. The library is available for Python, Matlab and Java.

4.5.4. Search by Sound Music Similarity

The Search by Sound online system is based on the Rhythm and Timbre Analysis (above) and provides a system which can be used via a REST Web API (called SMINT API) to upload, find and match acoustically similar songs in terms of rhythm and timbre – without the need to install any prerequisite or run the analysis on your own. It can be used with your own custom music dataset or the readily available content from freemusicarchive.org that has already been pre-analyzed by rhythm and timbre, in order to find music that matches a particular rhythm or timbre from that archive.

4.5.5. Real-time Pitch Detection

The real-time pitch detection enables the estimatation of the predominant melody notes (monophonic) or multiple notes (polyphonic) from consecutive audio sample blocks. This allows transcription of the currently played / sung note pitches from a recorded instrument / vocal performance. The monophonic version also estimates the exact fundamental frequency values. Typical applications are music games and music learning applications. Fraunhofer IDMT provides a C++ library as well as sample projects

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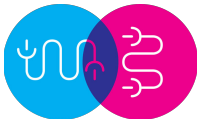

that show how to include the functionality.

4.5.6. Melody Extraction

This module includes a number of pitch tracking and melody transcription algorithms implemented in the Essentia library. Applications include visualization of predominant melody, pitch tracking, tuning rating, source separation.

4.5.7. Real-time Onset description

This module enables the detection of onsets in real-time and provide s a number of audio descriptors. It is part of essentiaRT~, a real-time subset of Essentia (MTG's open-source C++ library for audio analysis and audio-based music information retrieval) implemented as an external for Pd and Max/MSP. As such, the current version does not yet include all of Essentia's algorithms, but a number of features to slice and provide on-the-fly descriptors for classification of audio in real-time. A number of extractors analyse instantaneous features like the onset strength, the spectral centroid and the MFCC's over a fixed-size window of 2048 points, after an onset is reported. Furthermore, essentiaRT~ is able to perform estimations on larger time-frames of user-defined lengths, and to report finer descriptions in terms of noisiness, f0, temporal centroid and loudness.

4.5.8. #MusicBricks Transcriber

(Melody & Bass Transcription + Beat & Key & Tempo Estimation) The #MusicBricks Transcriber provided by Fraunhofer IDMT is an executable that enables the transcription of the main melody and bass line of a given audio file. Also, the beat times, the key, and the average tempo are estimated. The results can be provided as MIDI, MusicXML, or plain XML files. In addition, a Python wrapper is included to further process the analysis results.

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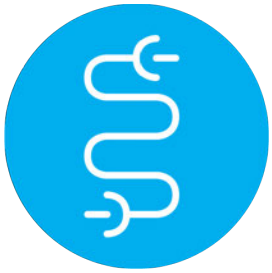
As outlined in deliverable D3.3, two additional APIs were later added to the #MusicBricks toolkit by partner Fraunhofer:

4.5.9. Goatify



The Goatify tool provided by Fraunhofer IDMT is an executable that automatically replaces the main melody in a song with a given sample. Therefore the main melody is extracted and removed from the song. Then the sample is placed and pitched according to the melody notes in the song. For proper pitching of the sample, the pitch of the sample itself is extracted beforehand. The tool is delivered with free sound samples (goat, etc.) from www.freesound.org for direct use.

4.5.10. Real-time Pitch-Shifting and Time-Stretching

The real-time pitch shifting library allows users to change the pitch of audio material while keeping the tempo. It allows enabled changing the tempo without changing its pitch. Typical applications are music games and music learning applications as well real time performances. Fraunhofer IDMT provides a C++ library as well as sample projects that show how to include the functionality.

In addition to the above core #MusicBricks tools, five more 'bricks' have been added to the toolkit through partnership with industry third parties, enabling creative developers to have a broader range of interoperable components, interfaces, databases and algorithms bundled as the APIs, GUIs and TUIs of #MusicBricks to expand the capabilities of the toolkit. Integration with these tools not only enhances the #MusicBricks offering, but also connects the toolkit with significant innovation partners both during the life of the funded project, and beyond into commercial exploitation of the platform. The toolkit expansion is not only an indicator of how valuable the tools suite is, but also of the importance of federating different players and building a culture of exchange and cooperation. The new bricks and the advantages for their creators to join the suite are presented hereafter.

An additional component of the toolkit, while not yet resulting in an actual brick is the addition of the #MusicBricks industry partner SoundCloud as the official cloud hosting platform for projects created with the toolkit.

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4.5.11. Syncjams

SyncJams is an open source standard to allow wireless inter-music app synchronisation and communication of key/scale between players in a 'mobile orchestra'. The programme is authored by Chris McCormick in collaboration with Matt Black of Ninja Tune. Conceived as a "Zero-configuration network, synchronised metronome and state dictionary for music" application, the standard currently supports Pure Data and Python.

4.5.12. POF

A combination of Puredata (Pd) + OpenFrameworks, providing openGL multithreaded rendering and advanced multitouch events management. A recent addition to #MusicBricks by Antoine Rousseau, in collaboration with Matt Black of Ninja Tune, it makes making PD music apps much easier including cross platform applications.

4.5.13. Sonarflow

Created by Spectralmind, Sonarflow is a GUI for browsing music by zooming into a colourful world of bubbles which represent genres, artists or moods which allows to discover new music online from various sources. It is available for iOS and Android, with APIs connecting to 7digital, last.fm, Youtube, Spotify, etc. Demo app in Google Play Store.

4.5.14. Musimap

Musimap's algorithm applies fifty-five weighted variables to each music unit (e.g tracks, genres, labels) so as to model the world's discography as a multi-layered system of cross-matched influences based on a musicological, lexicological and socio-psychological approach. The granular and proprietary database includes over 3B data points, 2B relations, and soon counting 50M songs. Its neural music network is the result of a unique combination of in-depth human curation and the latest AI technologies to engineer a multi-

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layered system.

4.5.15. Synaesthesia

A mobile application and GUI that turns colour into sound and music. Using the phone's camera, the app scans and recognises a colour block - for instance, the colour of your friend's t-shirt - to find a musical loop or sound. The app allows users to perform collaboratively, lock sounds to loop, shake to create beats and tilt to change pitch. Synaesthesia is a colour detection tool triggering and controlling audio. Based on OpenCV it includes a colour detection engine and object tracking algorithm to control music and sound using plain colours or coloured objects. Using the camera it can trigger musical events. It includes an example app with a dedicated GUI. It is available for OSX and iOS.

Originally created by Stromatolite for the Music Tech Fest, and winner of the NEM Art Prize for "Art Meets Science" (Istanbul, 2012), the tool has been opened and released on Github as open innovation and integrated into the #MusicBricks toolkit.

4.5.16. SoundCloud

Not itself a 'brick', but the official cloud hosting platform for the #MusicBricks project. Stromatolite is working closely with audio platform and champion European creative SME SoundCloud and plans for the service to function as the host and repository for musical creativity created by anyone using any #MusicBricks products or projects. Through integration with SoundCloud's own API, music created using products built with #MusicBricks may automatically be uploaded to SoundCloud, allowing products and tools to integrate with the hosting platform.

"#MusicBricks is exactly the sort of open and collaborative music creation SoundCloud is about. It opens up new options for makers and musicians to be creative and we're excited to support it and see what amazing creations are born."

*- **Matt Fenby Taylor, VP Creator Product, SoundCloud***

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5. Market Testbed: Incubatee mentoring and outcomes

As an outcome of the industry testbed in WP6, **10 out of 11 projects** were guided towards a business plan, after they presented their results from incubation (see D6.2). These were **taken forward to the #MusicBricks Market Testbed** between **January** and **May 2016** and offered **intensive consulting** that supported the projects with:

- Consulting on product/project USPs
- Defining the basics for a potential minimum viable product (MVP)
- Coordinating a standard business plan questionnaire
- Directing business and project ideas to potential partners and providing their feedback to the teams
- Discussing market potential and risks

5.1. MusicBricks projects in the market testbed

The following table lists:

- the projects;
- the Creative Testbed where they seeded their project idea;
- the number of team members and their home country;
- potential partners or advisors;
- product or market ideas; and
- their Market Testbed mentors.

Incubated Project	Nominated from Creative Testbed	# of Incubatees & country origin	Partner or advisors	Product or market ideas	Mentors
Airstrument	#MTFScandi	3 from Israel	Nagual Sounds, Musimap	Musical education (new approach) and rehabilitation	Steffen Holly (Fraunhofer), Hugues Vinet (IRCAM), Michela Magas (Stromatolite), Thomas Lidy (TU Wien)

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Dolphin	#MTFScandi	2 from Sweden	3 partners currently in talks and one investment group (confidential)	AR- & VR-Applications, Industry applications (new approach “hands free”, sensor driven)	Hugues Vinet (IRCAM), Michela Magas (Stromatolite)
Enboard	#MHD Barcelona	2 from Spain / Colombia		Consumer monitoring, VR- and AR applications (new approach neuro science & entertainment)	Hugues Vinet (IRCAM), Michela Magas (Stromatolite)
FindingSomething BondingSounding	#MTFScandi	3 from Portugal & Hungary	Nagual Sounds	Musical interaction and production (new approach)	Steffen Holly (Fraunhofer), Hugues Vinet (IRCAM), Michela Magas (Stromatolite), Thomas Lidy (TU Wien)
GIRD - Interactive Remix Dance Floor	#MTFCentral	2 from Austria / Australia	Nagual Sounds	Musical interaction and production (new approach)	Steffen Holly (Fraunhofer), Hugues Vinet (IRCAM), Michela Magas (Stromatolite), Thomas Lidy (TU Wien)
Hi Note	#MHD Barcelona	2 from UK and Spain	Rolf Gehlhaar	Human interface for sensor inputs (new approach for barrier-free access to creativity & productivity)	Hugues Vinet (IRCAM), Michela Magas (Stromatolite)
Interactive Cube	#MTFScandi	2 from UK and Sweden	Warner Music, Abbey Road	1. Connected living (new approach for light & music stand alone) or 2. Musical interaction (new approach for production, performance)	Steffen Holly (Fraunhofer), Hugues Vinet (IRCAM), Michela Magas (Stromatolite)
LightBeat	#MHD Vienna	2 from Austria	Spotify, Deezer, Musimap	Connected living (new approach for light & music in music services)	Steffen Holly (Fraunhofer), Thomas Lidy (TU Wien), Michela Magas (Stromatolite)

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Manuphonia	#MTFCentral	6 from Slovenia, Bulgaria, Finland, Germany	Nagual Sounds, Plug&Play	Musical education and interaction (new approach for children)	Steffen Holly (Fraunhofer), Hugues Vinet (IRCAM), Michela Magas (Stromatolite), Thomas Lidy (TU Wien)
The Snitch (The Eear)	#MHD Barcelona	4 from Spain	Giant Steps	Project as Open Source, Services and add-On products based on specialist expertise	Steffen Holly (Fraunhofer), Michela Magas (Stromatolite), Thomas Lidy (TU Wien)
Sound in Translation	#MHD Barcelona	3 from Germany and Spain	Jamahook, Native Instruments	Intelligent music production & performance (new approach instant/ real-time similarity)	Steffen Holly (Fraunhofer), Michela Magas (Stromatolite), Thomas Lidy (TU Wien)

The ongoing consulting process and mentoring period has been discussed within the #MusicBricks consortium either via email, Slack, Skype demo or project meetings. **Almost all projects (10 out of 11)** were able to follow the product consulting within the Market Testbed, and only the team of Enboard stopped development, due to technical barriers to deployment.

In the following subsections, each project's achievements and results are presented after the Market Testbed period.

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5.2.Dolphin

Team: **Rojan Gharibpour, Marzieh Tangestanigholami (Sweden)**

#MusicBricks used: **R-IoT gesture sensors**

New company website, project website

5.2.1. Prototype Features

Dolphin is a new generation of wearable interactive devices for user control through head movement and audio rendering. This device is screenless and portable and interacts with the user through 3D sound. It recognises the user's head and body gestures, and reacts to them. Dolphin is presented in the form of an advanced pair of headphones which are equipped with required computer hardware, motion detection sensors, several microphones, and surround sound earphones. The software framework developed for Dolphin includes many audio generation and manipulation features and a complete set of tools for body and head gesture detection. This software framework offers an Open API for developers to write applications which could be installed, loaded and run by Dolphin's Operating System, just like applications for smartphones. The motion detection and gesturing features of Dolphin's framework in combination with the audio generation algorithms, creates a powerful toolset for developing audio-only games and applications which can also be played and used everywhere by everyone including visually impaired people.

Another unique feature of Dolphin is the ability of combining the environmental and artificial sounds. This feature is named SpacelessAudio, and is a powerful tool when designing virtual-reality applications. It also gives users the possibility to listen to their environment even when their ears are covered by the headphones.

One of the important hardware components of the Dolphin is the wireless communication equipment. These components enable the device to connect to one or more other similar devices. Communication among Dolphin devices, provides the possibility of designing group activities like group games or group music performances. The communication features can also be used to connect the Dolphin to other gaming consoles like Nintendo Wii, Sony PS4 and Microsoft Xbox as a game controller. Using the Dolphin as a controller for gaming consoles provides more flexibility and freedom for game design to game developers. More users can play Xbox games compared to when they are playing the same games using the Kinect and they will also feel more natural moving and jumping around.

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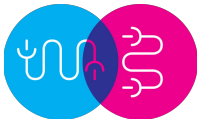

5.2.2. IP management

A patent has been submitted on a broad range of used technologies. The patent information is currently under embargo until the 11th of November 2017.

5.2.3. Communication and dissemination actions

Due to the confidentiality of the patenting process, public dissemination about this project has been kept low and focus shifted to meetings with large organisations and private investors. The project has been presented with successful business follow-ups to stakeholders from the gaming industry, the heavy machinery industries, national research institutes working with large industry clients from Nordic Countries, and top private regional investors.

5.2.4. Target market(s) and positioning

Dolphin covers a wide range of uses, which vary from a simple wireless headphone set to expert gaming equipment. Six different potential markets that can benefit from Dolphin's technologies have been identified, including **healthcare, gaming industry, simulation industry, training equipment, heavy machinery industry and cinema industry**. The market with most potential among the mentioned markets is the Gaming Industry which is the main market that the company is targeting. The inherent risk of entering the game/VR market with a product including specific hardware is well identified by the company.

The majority of today's computer games are played while seated. The lack of physical activity and staring at screens for too long have a very negative effect on the user's health. Dolphin offers a great solution for this problem. It is a screenless and embodied interactive device. While interacting with the device, users have their eyes and hands free. They just have to move their head or body to interact with the device. This means more physical activity and less staring at the screens. Compared to regular gaming controllers, Dolphin is easier to learn, and it feels more natural and entertaining to use. It can also easily be used by visually impaired people. The other important issue that current portable devices have, is the problem of isolation, especially in the use of Smartphones. Dolphin on the other hand is more entertaining and fun to be used when together with other Dolphin users. The devices can get connected and users can play a game all together. This way, they are not isolated and are encouraged to do more physical activities.

5.2.5. Future implementation plan

The Sojaner company has been set up in Sweden for implementing the project development with the project leader, Rojan Gharibpour, as CEO. The main target market is games and VR/AR and will require the design of a product combining hardware and software and an offer for game and

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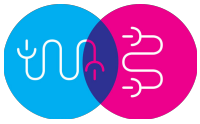

interactive applications developers, as the Dolphin Framework's API will include connectivity APIs for iOS, Android and Window Phone. The software part is already advanced.

The company identity has already been developed by the project partner Marzieh Tangestanigholami, and the company website has been set up on http://sojaner.com.

In the short term and as a first stage, the development of AR applications for heavy industry which recently started with Swedish partners, will enable further elaboration of the technology for relevant use cases.

License agreements for the use of #MusicBricks technologies, and particularly IRCAM's R-IoT board, which has been an integral part of the development of the product so far, will be available to the company when it starts to engage in commercial activities.

Beyond the #MusicBricks technologies, the company could also benefit from binaural rendering technologies including head movement compensation and management of inter-individual differences developed by some of the project partners including IRCAM.

5.2.6. Key Outcome Summary

- mature prototype finished
- Sojaner startup founded by team leaders
- patent filed
- entered talks with large industry players
- first AR applications for heavy industry in Sweden ongoing
- target product for VR/AR/games including an already advanced API for various platforms

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5.3.#FindingSomethingBondingSound

Team: **Francisco Teixeira (Portugal), Horácio Tomé-Marques (Portugal), Fanni Fazakas (Hungary)**

#MusicBricks used: **R-IoT gesture sensors, Onset Description**

Project website, Project video

5.3.1. Artwork and Prototype Features

#FindingSomethingBondingSound (FSBS) has been initially designed as an interactive artwork based on an advanced technology setup for the interactive generation of music and video from the combination of two human performance inputs: brain activity analysis and gestural control. Beyond its artistic and aesthetic value, is has been further developed as a software and hardware framework for audio-visual performances based on brain to brain and brain to computer interfaces. The team usually works with DJs, dancers, musicians, painters, designers and writers to give them a new means of communicating their emotions and intentions. They have the ambition to apply a neurofeedback model and a shared physiology framework to the performative arts in a way that can maximise the experience of events such as: fashion catwalks; DJ performances; dance performances; AV performances and so on.

5.3.2. Communication and dissemination actions

The initial artwork was selected for the Ars Electronica STARTS Prize 2016.

The team contributed to the Transhumanism Performance Lab show with Viktoria Modesta at Music Tech Fest Berlin, 28 May 2016, with coverage by Wired Germany. Several other public presentations of new artworks/installations implementing elements of the developed technology (including for instance gestural control of spatial sound diffusion) are already planned in the near future in venues such as festivals in Moscow, Rotterdam and Amsterdam fashion week.

5.3.3. Target market(s) and positioning

Art, media and entertainment industry sectors; fashion industry; music industry

There is currently no equivalent product on offer and the team possesses the necessary complementary skills (artistic, technical and neuroscience research) for the implementation.

5.3.4. Future implementation plan

The implementation plan will be based on the already existing MuArts company. The targeted product is a digital ecosystem for artists to use live Brain-Computer-Interactions in their performances: DJs; VJs; dancers; audiovisual artists; fashion designers. More precisely, the

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ambition of the group as a main innovative outcome of the project is to set up, through the MuArts company, an unprecedented online platform that will give access to various state-of-the-art BCI interfaces and data analysis pieces of software and data (phenotypes) and will provide the digital media artistic community with a unified and plug&play interface to these data through the OSC protocol. This platform will act as an out-of-box digital ecosystem with a user-friendly interface, presets and modular connections so the artists can easily link their brains to any kind of third party system.

Other categories of users including clinicians may also be considered with potentially paying access to BCI databases of phenotypes.

In parallel, the production of several artworks based on the technology is already planned in several international venues including festivals in Moscow, Rotterdam and the Amsterdam Fashion Week.

5.3.5. Key Outcome Summary:

- major recognition through the Ars Electronica STARTS Prize
- project now integrated in company MuArts
- several public presentations of produced artworks already done and others planned
- main targeted product : open platform offering a unified access of various BCIs to media artists, supported by the MuArts company

5.4.Hi Note

Team: **Vahakn Matossian (UK), Rolf Gehlhaar (UK), Pere Calopa Piedra (Spain)**

#MusicBricks used: **R-IoT**

Project website, Project video

5.4.1. Prototype Features

The designed prototypes are based on a dedicated head mounted hardware piece produced by 3D printing and integrating the R-IoT board, which can sense the head movements and breath control.

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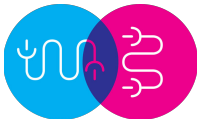

They are in particular dedicated to physically disabled users, including tetraplegic. Several music performance scenarios have been designed based on this control interface and tested by disabled musicians, in private and public performances. Hi Note uses breath control to create dynamics, movement and alter the speed of tones, and head movements to change notes and timbres in an intuitive way.

5.4.2. Communication and dissemination actions

Several music performances have already been produced on the basis of the technology, with the British Para Orchestra. The project has featured in major broadcasting and news media, including BBC World Service, the Guardian Newspaper, Portuguese National Television and Radio Eins in Germany. A major performance was organised for the Portuguese Setubal Festival on the 27th of May 2016.

5.4.3. Target market(s) and positioning

Accessibility market for education, music performance and gaming.

The company is well positioned in the UK with already many collaborations with representative structures of target users, including regular collborations with composer Rolf Gehlhaar and the British Para Orchestra. Moreover, the music skills of the founders are of high standard and yield to relevant use cases.

5.4.4. Future implementation plan

All the development is carried on through the Human Instruments company founded in 2013, which creates new musical instrument interfaces, for either composing and playing through accessible use of commercial industry computer music software, or for interfacing with mechanical instruments. All the designs are accessible to players with physical disabilities, and can also be playable by anyone.

The next development stage aims at designing a plug-and-play instrument with the same hardware control interface based on head movement and breath control, with extended features, including modules for Max for Live and Unity (electronic performance, games and VR). The goal is to propose a real instrument, not necessarily easy to play at first, which will imply learning and will enable musical expressivity. As for hardware, it will be based on current and future commercial versions of the R-IoT board, with a continued collaboration with IRCAM. The funding scheme of the company is to fund various development stages through grants obtained by the company. Hi Note will enable it to go beyond a service offer towards its first product offer.

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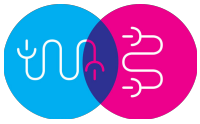

5.4.5. Key Outcome Summary

- a wireless hands-free music controller instrument with accessibility in mind
- product design foreseen based on current prototype
- it takes the company Human Instruments (founded 2013) to the next level
- significant media exposure

5.5. Airstrument

Initial Team: **Ariel Angel (Israel), Matan Berkowitz (Israel), Rani Dar (Israel).**

Final team : **Matan Berkowitz (Israel), Ronen Peri (Israel)**

#MusicBricks used: **R-IoT, Transcriber (MelodyExtraction), initially also RhythmTimbre**

New project website, Project video

5.5.1. Prototype Features

- An intuitive, motion based, wearable device for playing & learning music
- Built in sounds and instruments in a stand-alone app
- Lessons that make music accessible and fun to practice, based on a spatial approach
- A market place of tracks to jam along to - both 'real' tunes by big artists and user generated content

Airstrument is a wireless, wearable instrument with its own standalone app that makes music intuitive to learn and play. It aims to be a real instrument that can be learned, practiced and help improve music playing skills, while at the same time being intuitive and accessible.

A wristband on one or two arms uses the R-IoT sensor to track movements and create a new, intuitive musical UX. The software flow allows the user to ‘upload’ a song / audio file, process it using the #MusicBricks API and tools and play along, always in tune with the harmony, rhythm and melody of the original piece. Other use cases enable the triggering of different sounds based on the arm position, either in solo mode or using a loop re-recording system.

5.5.2. Communication and dissemination actions

In addition to the various Music Tech Fest sessions where the project was designed and further presented until MTF Berlin, The founder Matan Berkowitz presented his actions and demonstrated the prototypes in many public shows and through private exchanges all over the world, including

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Re:publica 2016 in Berlin, Forbes 30 Under The 30 in Jerusalem, the NAMM show, LA, in January 2016, in private exchanges with Google at the CES Trade show, and with various actors in the Silicon Valley.

5.5.3. Target market(s) and positioning

New musical instruments for non-musicians and musicians; rehabilitation and accessibility; VR-AR.

Working in the nexus of music technology and the special needs population, the founder sees the Airstrument's potential to become a powerful tool for education, rehabilitation and accessibility. Developing a model for a dedicated market place based on both song licensing and user generated content is a core part of his business plan.

The existing prototypes, already demonstrated at several venues, considered relevant user scenarios targeting both non-musicians and musicians. The main competitive advantage of the product lies in the existing status of development as a working prototype that enables anyone to play music using intuitive hand movements. Through being selected for three elite groups of game changers - Forbes 30 Under 30, ROI Community and the Generational Ambassadors Program - the founder has access to partners, funding and media.

5.5.4. Future implementation plan

Two options are currently being considered:

- Start up company backed by VCs / angel investor(s)
- Innovation lab developing the project to both hand it off to relevant buyers and apply it for maximum impact in a given field (rehabilitation, for example) - backed by angel investors and strategic partners

The first case is related to the design of an end user product including hardware (gesture capture on the wrist) and software parts. Setting up a company and elaborating a product line on that basis will require the targeting of more specific use cases and further elaboration of the technology, application design, content production and community management/marketing for UGC related features. IRCAM is ready to collaborate on a license of his gesture sensing technology for this purpose.

The second case is more straightforward and can be managed on a project basis, according to the obtained supports. It can rely on an extension of the Shift company already funded by the owner. The hardware part can rely on IRCAM's R-IoT and its future commercial implementations. A scientific collaboration has also been proposed with IRCAM on gesture/sound-based rehabilitation,

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a subject on which Frédéric Bevilacqua has coordinated several research projects.

5.5.5. Key Outcome Summary

- solid prototype
- good international media exposure
- high-level network of partners and potential investors
- developed by an existing company which specialises in “positive impact of technology”
- two main routes for development: as an end-user product, or as an innovation research project

5.6. GIRD - Gesture-based Interactive Remix Dance Floor

Team: **Tracy Redhead (Austria / Australia), Jonathan Rutherford (Austria / Australia)**

#MusicBricks used: **R-IoT, Essentia~RT code (from The Snitch)**

Project website, Video

5.6.1. Prototype Features

- glove-based interactive system to control sound and lights
- integration with Max for Live to address artistic environments
- programmable light fixtures for dance environments

5.6.2. Communication and dissemination actions

The project has been featured in leading media including Wired Germany and has also been presented at the MiXD Integra Lab Symposium at Birmingham Conservatoire. A performance with the prototype was chosen for the main festival stage at #MTFBerlin. A conference paper abstract has been accepted for The Art of Record Production in Denmark 4-6 December 2016.

5.6.3. Target market(s) and positioning

Entertainment industry, lifestyle products, retail environments.

During the Industry Testbed four possible outcomes were identified for project GIRD:

- a consumer goods manufacturer for the "GIRD – Interactive Dance Floor – the Product"
- an app developer for "GIRD App - Interactive Mobile Apps for artists"
- a content licensing system / provider with "GIRD music service - Interactive Music Service"
- an agency for "GIRD event and concert service”

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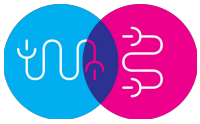

All these very different approaches demand different skills, address very different markets and deal with very different business models. The advice given was to concentrate on a very first “minimum viable product” (MVP). The Innovation Exploitation Manager discussed some hypotheses and comments on the four different approaches:

- becoming a consumer goods manufacturer based on the R-IOT sensor is the most expensive and most risky business, because of the risk in developing hardware
- being an app developer is less expensive, but it depends on the right resources to produce a prototype or wireframe very fast, and it is important to consider that creative people (musicians/Artists) are a niche target group
- becoming a content licensing system or provider is not recommended, because all formats have failed in the past and such models require big catalogues to support the licensing platform
- doing business as an agency is a realistic approach, but it requires a particular set of skills

The Innovation Exploitation Manager matched the team with one of its volunteer start ups, to exchange thoughts, in this case with Nagual Sounds, who won the startup competition after the #MusicBricks pitch event at Music Tech Fest Berlin.

This match has been made because:

- they could be a potential competitor to GIRD
- they have struggled with all the pivots GIRD would have to go through as well
- they are trying to establish the idea of an interactive music or remix format
- they are a technology driven start up with a patent and a platform strategy (first Kinect & PC, then X-Box, then iOS tbc.)

5.6.4. Future implementation plan

The most important action for the team is market research. The the Innovation Exploitation Manager recommended they look at an existing system from the Berlin software manufacturer MAGIX AG, which is doing business with their Music Maker Jam (iOS & Android), as a kind of competition and a product model GIRD needs to disrupt somehow. The next step based on this research and the decisions that come out of it will be re-defining the market and the specific needs they are going to have to tackle. Gathering artist testimonials for marketing and promotion is recommended after the proof of concept has been proven to work well. The MVP can follow the

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general trends observed in this creative market environment. The team may require a special sales force to negotiate with rights holders in case the market reacts well to the product.

5.6.5. Key Outcome Summary

- solid working prototype
- demonstrated in several public performances and events
- presented in academic research environments
- a great deal of positive user feedback

5.7. The Snitch

Team: **Cárthach Ó Nuanáin, Ángel Faraldo, Martin Hermant, Daniel Gómez (Spain)**

#MusicBricks used: **Essentia**

Project website, Github, Video

5.7.1. Prototype Features

- fully functional Android app
- reliable recognition from chord or key from environment
- stable connector to Audio workstation on desktop
- communication over standard OSC protocol with a multitude of digital instruments
- positioning as an open source project (Code published on GitHub)
- presentation at International Society of Music Information Retrieval Conference

5.7.2. IP management

The team decided to hand over the complete source code to the community as open source, available through GitHub. The strategy of expanding the business is based on services on top of the knowledge and the produced features and code.

5.7.3. Communication and dissemination actions

The Snitch was presented as a live demo at the International Society of Music Information Retrieval Conference (ISMIR), Oct 2015, Malaga, Spain along with a paper. It was presented at #MTFScandi, #MTFCentral and #MTFBerlin, and also disseminated via GitHub. An Android app has been launched.

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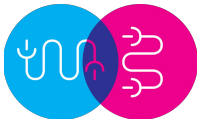

5.7.4. Target market(s) and positioning

Performing arts, prosumers.

The main feature of the project is real-time music information retrieval for prosumers and performing artists with features including real-time chord detection and key analysis, and featuring a transmission protocol on top of the OSC common standard. In the discussion with the Innovation Exploitation Manager it transpired that most creative people do not have enough training or knowledge of music theory, to generate music collaboratively. Experienced musicians in Jazz or Pop have trained to do this, but most need a little help to see what kind of chords are played and how the structure of the harmonies changes over time.

There are some competitive tools available for this market, such as Uberchord from Hamburg (Germany). Musical equipment manufacturers such as KORG or TC Electronic are market leaders for tuners for all kinds of instruments and would consider this concept attractive, providing it was proven to be commercially viable. In the initial stages of product development, instead of entering the market with big competition and risk, it is a smart step to offer the basic technology as Open Source, so that the community can create new tools, not only for music recognition, but more focused on user case scenarios which can increase the speed of creation or the quality of collaboration. The decision to offer a service of development based on specific knowledge is a very realistic plan, and has potential to survive in the long run.

The project has benefitted from integration into the Giant Steps EU H2020 project to further its research. Its GitHub Open Source code has already been used by #MusicBricks projects GIRD and Manuphonia to enhance their products.

5.7.5. Future implementation plan

The Snitch basics can enable plug&play for musical instruments and lower barriers to entry based on degrees of music training or theory. There are also synergies with other #MusicBricks teams such as Manuphonia which have tested the functionality of The Snitch in conjunction with their product. Offering a service based on Open Source, to develop apps which use information from The Snitch 's basic analysis, is a useful model for further business development in the future.

5.7.6. Key Outcome Summary

- Android app published
- GitHub Open Source repository
- already used by other projects (GIRD, Manuphonia) to enhance their products

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5.8. LightBeat

Team: **Stefan Salcher, Adrian Jandl (Austria)**

#MusicBricks used: **originally Transcriber, adapted for use online APIs, Essentia via AcousticBrainz**

Company website, Video

5.8.1. Prototype Features

- Android app created
- uses two online APIs (The Echo Nest and MusicBrainz) for beat detection and light visualisation
- a platform that extends easily to further music APIs and/or light devices
- part of startup company Phono music (in-app purchase as preferred business model)

5.8.2. Communication and dissemination actions

The team has been connected to some of the music service providers in Europe:

- direct contact to Stefan Zilch Spotify GAS by the Innovation Exploitation Manager and the German Bitkom association to check API condition and cooperations about possible monetisation (LightBeat business model in app purchase or advertisements)
- direct contact to Manuel Moussallam (Head of R&D) or Michael Krause (General Manager Central & East Europe) by partnerTU Wien and the Innovation Exploitation Manager to check API condition and cooperations about possible monetisation (LightBeat business model in app purchase or advertisements)

An android app is being launched.

5.8.3. Target market(s) and positioning

Entertainment and hospitality industries.

The project has a well defined target group since the challenge of playlisting during parties or events has not yet been addressed adequately in the market. The LightBeat team has a very clear view as to milestones and a roadmap. The developed feature can be offered as an in-app-purchase to the users and the monetisation through advertisements is also possible.

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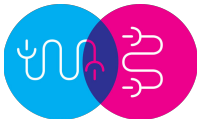

This project has a big advantage over the other existing products, even though it is a software based idea: the team released their Phono Music for Android in the Google Play Store at the end of May and “LightBeat” is planned to enhance this initial application with a "connected light feature". While they rely on the use of APIs from large content providers, the team’s biggest risk is also their biggest opportunity. The risk is that music streaming services (Spotify, Deezer) could change their API conditions in order to prevent apps like Phono Music / LightBeat from doing business. The risk is also that these large music services could implement a similar functionality in their offer, but this seems unlikely, and the opportunity is in developing a system which would appeal to them.

5.8.4. Future implementation plan

Partners have agreed to analyse the results of marketing the Phono App release in Austria in June and July 2016. YouTube promotion is being monitored for initial input from the target group of young music lovers. Giving further incentives to users at parties is an option which is being considered. The team plan is to build on a very good basic knowledge of the market and the two team members are well placed to execute this ambition. As the business grows, the team is advised to hire strong contributors on the business side, or join an accelerator program such as Plug&Play from AxelSpringer SE.

5.8.5. Key Outcome Summary

- Android app created
- integrated with major commercial music APIs
- created links with major music streaming services
- product marketing launched
- takes the startup Phono to the next level

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5.9.Manuphonia

Team: **Maya Lekova (Bulgaria), Terhi Marttila (Germany / Finland), Kristjan Sešek, Rok Milošič, Adrijana Bundalo, Ernest Beličič (all from Slovenia)**

#MusicBricks used: **R-IoT**

New project website, Github, Video

5.9.1. Prototype Features

- Android application allowing users to record their own gestures, to bind these gestures to predefined samples and to create music.
- 3D printed encasing for the sensor that can be worn on various body parts

5.9.2. Communication and dissemination actions

Manuphonia has been presented at Make Munich Fest in January 2016, as well as #MTFCentral and #MTFBerlin, and also disseminated via GitHub. An Android app has been created and a promotional campaign is in development.

5.9.3. Target market(s) and positioning

Lifestyle products, amateur or professional performance.

This diverse team coming from several countries, is a perfect example of how Open Innovation can bring together a variety of minds with different expertise and interests into a space for common understanding. Once this team was assembled around a Hack Camp challenge at Music Tech Fest Central in Ljubljana, Slovenia, the members move ahead with a common objective, great motivation and a fantastic team spirit. Even if the resulting prototype has been less technically evolved than some of the other #MusicBricks projects, the general outcome as well as the communication established between the team members has proven very valuable to the consortium.

In view of the above, the team was guided to consider further technical challenges in order to generate music based on gestures independently from a smartphone with the R-IOT device:

- adding musical content to existing tracks based on the gestures requires real-time analysis of the users' content from a device, which would require addition of other #MusicBricks tools such as Essentia or Transcriber
- detecting or analysing musical content in real-time at a performance or event may require

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collaboration with expert #MusicBricks teams such as The Snitch, which released an open source package of key, chord, and mode detection

- an unique selling point could be a multi-player experience which present its own technical challenges

5.9.4. Future implementation plan

Manuphonia requires a Unique Selling Proposition because a similar working principle has been developed with the use of the R-IoT by #MusicBricks teams like Airstrument, by the winning hacker entry “Jazz Balls” at Music Tech Fest Berlin, or by Ircam’s own research teams. The first challenge for the team is defining the right target group. Based on the ease of use of the prototype, a market of children of a particular defined age group is recommended. Detailed market research is therefore required, not only into hardware (toys) but also into mobile applications. Even if the team is working with a stand-alone sensor like the R-IoT, they have to keep an eye on the sensor equipped smartphone market as well. For this reason the team has been connected to the Berlin startup Nagual Sounds, who have experience of that market. Following market definition, the product features can be defined, together with a clear message for the market communication.

During their initial market research, the team discovered that enabling people to make music without a traditional instrument is currently a global trend. Easy access to music-making tools is fun and entertaining, and therefore has more in common with developing a game, rather than evolve from classic music production or music education. Since the team has integrated a perfect culture of communication they have interdisciplinary competence to adopt this new multidisciplinary approach.

5.9.5. Key Outcome Summary :

- Android app created
- GitHub repository published
- project website created
- project featured in major events
- group dynamic successfully developed

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5.10.Interactive Cube

Team: **Balandino Di Donato (UK), Per-Olov Jernberg (Sweden)**

#MusicBricks used: **R-IoT gesture sensors**

Project website, Github, Video

5.10.1. Prototype Features

- performance/lifestyle product
- GitHub open source instructions to build as DIY kit

5.10.2. IP management

The team decided to provide an open source DIY building kit, available through GitHub, which allows developers to build an Interactive Cube and customise it. In this way the Interactive Cube can be a way to learn to assemble electronic products; it can appeal to DIY enthusiasts; and it allows creative developers to take the product further.

5.10.3. Communication and dissemination actions

The Interactive Cube received a great deal of interest from the music industry already at early prototype stage. Joshua Saunders from Warner Music UK and John Eades from Abbey Road Studios both followed the project closely and mentored the team. The project results have been disseminated via GitHub and through a dedicated Facebook page. Aside from presentations on stage at #MTFScandi and #MTFCentral, the project was chosen to be showcased at the #MTFAmplifier during the Market Showcase at #MTFBerlin.

5.10.4. Target market(s) and positioning

After the first Creative Testbed the product was an LED cube showing light effects based on the surrounding music. This was a simple but very easily understandable product which was very clear and easy to communicate, and the team received many requests for their product during the testbed events. With integration of the Raspberry Pi, allowing the control of light programming e.g. by a smartphone app this product would have been ideally placed to launch a Kickstarter campaign. At the end of the Industry Testbed incubation period the product came closer to a step sequencer, manipulating sounds based on the movements of the cube processed by the implemented R-IoT sensor. This also presented a unique approach, though it addressed a niche market, and had fewer affordances than a professional step sequencer. The Innovation Coordinator arranged for the sequencer version to be tested by the #MusicBricks advisor, well-

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known beatboxer Shlomo, though the geographical distance and work engagements at Spotify by one of the team members prevented this test to be implemented. The team progress would have benefitted from such feedback and a similar test is still recommended. Finally the team uploaded a DIY instruction kit on GitHub. This ingenious way of disseminating the Interactive Cube, allows for multiple interpretations of the product by users and is highly recommended. It allows the Interactive Cube to be an aid in learning how to assemble electronic products; it can appeal to DIY enthusiasts; and it allows creative developers to take the product further.

5.10.5. Future implementation plan

The target group indicates that a crowdfounding campaign may be a suitable way forward for the product as a means of further testing the market. The prototype of the sequencing cube should be given to DJs and performers for testing, as it has already been attempted with Shlomo. The DIY kit on GitHub is an ingenious way to both test and expand the market. It creates multiple possible avenues for the product and builds its own ecosystem.

5.10.6. Key Outcome Summary

- two product prototype options created
- GitHub repository created
- DIY Open Source concept evolved
- dedicated project page with followers on Facebook

5.11.Sound in Translation

Team: **Timothy Schmele (Germany), Juan José Bosch (Spain), Andrés Bucci (Spain)**

#MusicBricks used: **RhythmTimbre, Transcriber**

Project website, Video

5.11.1. Prototype Features

- solid prototype of controller for interactive loop retrieval
- extension from initial limited controller board to larger range of possible controllers
- convincing demo, already shown in live performances on stage at several events

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5.11.2. Communication and dissemination actions

Sound in Translation was featured on the world-renowned Ben Heck Show. Presentations of this project have taken place at the BLE & MUSIC: Barcelona Loves Entrepreneurs event and Algorave, HORIZONTAL (Barcelona) as well as #MTFCentral and #MTFBerlin.

5.11.3. Target market(s) and positioning

Performance arts, entertainment industry.

In the current market of production tools there is a real need to improve methods of music creation and remixing, and algorithms for similarity search, automatic segmentation, and sampling in real time. However the business model for such tools remains a challenge. Three possible ways forward have been identified:

- concentrate on a standalone plugin and the SDK - that should be the preferred model, but there are certain requirements
- custom license to companies, who will implement the functionality into their products - working with one partner on a reference implementation is recommended (see market / positioning below)
- selling a Max for Live integration - that could only work as a proof of concept

5.11.4. Future implementation plan

Sound in Translation can become a unique core feature of a third party product. Positioning it as an exclusive feature of a product would makes the product more desirable. Leaders in music technology software, such as Steinberg (Yamaha), Ableton, Native Instruments and Logic (Apple), offer large libraries of sounds, loops and samples for users to play with. These brands are already deploying intelligent music search systems which place matching samples at the user 's fingertips.

The most common way to integrate this type of application with large music libraries is through a database of tagged sounds. A challenge for manufacturers and industry brands is how to integrate the users' own untagged libraries and untagged global collections. The team has been advised to research possible solutions to this problem in products such as the Maschine (Native Instruments) and LIVE (Ableton). In order to find solutions to this challenge the Innovation Exploitation Manager has connected the team to the startup Jamahook from Switzerland, who have been working on resolving such issues for their online service based on Fraunhofer licensed technologies such as Transcriber and Annotation. This connection is synergetic as Sound in Translation offers features which can help to grow the acceptance of the Jamahook service.

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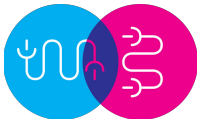

An important component of raising awareness about Sound in Translation are testimonials from DJs and bedroom producers, who are the principle ambassadors for such a concept while the product is in beta. So far the extent of the market research was underestimated by the team, and was just based on a small group of performing artists and technology experts. However in order to have a successful product the team needs to gather a great deal of additional feedback from this target group.

5.11.5. Key Outcome Summary

- demonstrated and performed at several major events
- dedicated project website created
- dedicated project page with followers on Facebook

5.12. Enboard

Team: **Juan Felipe Gómez (Spain/Colombia), Steven Bolaños (Spain/Colombia)**

#MusicBricks used: **R-IoT**

Project website, Video

5.12.1. Prototype Features

- skateboard recording sounds and creating audio-visual output
- enclosure for the R-IoT board t be affixed to skateboard

5.12.2. Communication and dissemination actions

The Enboard team created a project website and demonstration video. Enboard was presented as a live audio-visual skateboarding demo at the grand hall at Universitat Pompeu Fabra - (UPF) Barcelona, Spain, in Nov 2015, as well as at #MTFCentral.

5.12.3. Target market(s) and positioning

Extreme sports, performance, entertainment industries.

The Enboard team members have a strong artistic background, and have focused on providing a showcase and performance, with a loose technical setup of a contact microphone and R-IoT board gyro sensor, focusing on an output of generative audio-visual art. The first showcase demonstrated

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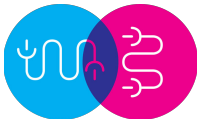

a very new approach and interesting product concept, though it lacked in technical implementation. Aa great deal of mentorship was offered to the team during the course of development, though this was hindered by the fact the team had to leave Spain to return to their native Colombia. As the team did not have sufficient technical experience to bring the concept to the next level, the #MusicBricks consortium consecutively advised the team to extend by enlisting technology experts, as well as to include a professional skateboarder to work on developing the concept further. Even though the prototype had been completed and demonstrated in a public performance, the above reasons prevented the consortium from recommending the project for the Market Testbed.

The #MusicBricks consortium still believes that the idea that Enboard created has great potential and should be developed with a focus on a concrete use case scenario and target audience. Recent talks have taken place with Hamburg-based company Mellow-Boards, producer of electric skateboard drives, which has solved the technical issues around the difficulty of mounting sustainable cases on a board. On the audio-visual side, this project requires an entrepreneurial drive in order to make this promising idea become a real market product.

5.12.4. Key Outcome Summary :

- first prototype completed
- demonstrated in public
- original idea with great potential

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6. Impacts at Month 18 of the project

At the end of 18 months of the project partners, incubatees and the wider Innovation Ecosystem which has gathered around the #MusicBricks toolkit can measure the following tangible impacts on industry, the arts, research, IP and policy.

6.1. Awards

Project FindingSomething BondingSound received the **Ars Electronica STARTS Prize Honourable Mention** and has been listed in this year's State of the Art for achievements at the crossover between science and art.

6.2. Patents

A patent was filed by newly formed Swedish company Sojaner AB on the 11th of May 2016:

Swedish Patent Application No. 1650637-0 filed - "Headphone system"

The patent information is confidential under embargo until 11th November 2017.

6.3. Newly formed companies

Authors of the #MusicBricks Dolphin Project registered **Sojaner AB** as a Swedish company on the 29th of December 2015:

Juridiskt namn: Sojaner AB
Organisationsnummer: 559043-9195
Bolagsform: Aktiebolag
Bolaget registrerat: 2015-12-29

MusicBricks LTD was registered as UK Limited Company on the 13th of January 2016 with Stromatolite LTD as primary shareholder. This makes MusicBricks LTD a sister company to Music Tech Fest LTD, which has the same primary shareholder, and which was registered as the result of the FP7 MIReS CSA.

Music Tech Fest LTD was invited to open an office in Umeå, Sweden, following the success of the first Creative Testbed which was held there.

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CERTIFICATE OF INCORPORATION
OF A
PRIVATE LIMITED COMPANY

Company Number **9949460**

The Registrar of Companies for England and Wales, hereby certifies that

MUSICBRICKS LTD.

is this day incorporated under the Companies Act 2006 as a private company, that the company is limited by shares, and the situation of its registered office is in England and Wales.

Given at Companies House, Cardiff, on **13th January 2016**.

The above information was communicated by electronic means and authenticated by the Registrar of Companies under section 1115 of the Companies Act 2006

Companies House

THE OFFICIAL SEAL OF THE REGISTRAR OF COMPANIES

Figure 1: Certificate of Incorporation of MusicBricks LTD

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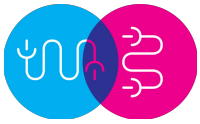

6.4. Tools in the #MusicBricks toolkit

The number of tools in the #MusicBricks toolkit has increased **from the 8 tools originally planned to 15.**

- 1 tool is a TUI
- 2 tools are GUIs
- 12 tools are APIs
- 5 tools have been added by industry partners
- 1 tool has been batch tested for commercial production (TUI)
- the tools are supported by the official cloud platform SoundCloud

6.5. Products

11 #MusicBricks product prototypes were completed:

- 11 product ideas were taken to market
- 10 product prototypes were showcased in the Market Testbed
- 8 products are tools for performance
- 3 products target the gaming industry in their roadmap
- 1 product is currently in development for the heavy machinery industry
- 1 product targets extreme sports entertainment
- 1 product is being considered for the health sector
- 5 products are being used as testbeds for scientific research
- 3 products have been released as Android apps
- 3 products are presented as Open Source software on GitHub
- 2 products are being developed as tools for education
- 1 product is targeting children's education
- 1 product is SaaS
- 1 product idea has been filed for patenting (see above)

6.6. Exploitation opportunities

Several layers of exploitation opportunities have been identified:

1. Exploitation of the knowledge generated within European research institutions;
2. Exploitation of the #MusicBricks tools themselves;
3. The addition of new bricks to the toolkit from external third parties;
4. Exploitation of the toolkit as a commercially exploitable Innovation Ecosystem;
5. Exploitation of the 11 innovative startup product ideas;
6. Implementation of those products as platforms in themselves; and
7. Exploitation of the Creative Content generated for those platforms.

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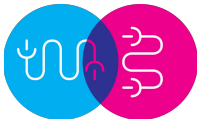

6.8. Social media

The hashtag #MusicBricks registered **5,5 million impacts** in Month 18 of the project on Twitter. On Facebook the project has so far received **1249 likes**.

6.9. Presentations and performances

The project has so far featured in **68 public presentations and performances**:

- 27 by project partners
- 41 by incubatees

6.10. Scientific papers

The project has been published / accepted for publication in 5 peer-reviewed papers:

1) A two-page publication (in English) about #MusicBricks was published in *ERCIM News 101* by partner TU Wien in collaboration with partner Stromatolite, entitled: "***MusicBricks: Connecting Digital Creators to the Internet of Music Things***"

Available printed: http://ercim-news.ercim.eu/en101/special/musicbricks-connecting-digital-creators-to-the-internet-of-music-things; and online: http://ercim-news.ercim.eu/images/stories/EN101/EN101-web.pdf

2) A two-page publication (in German) about MusicBricks in the OCG Journal (Journal of the Austrian Computer Society) was published by partner TU WIien, entitled ***"Kligende Bausteine für die Industrie"***

Available printed: https://www.ocg.at/de/2015; and online: http://www.ocg.at/sites/ocg.at/files/medien/pdfs/OCG-Journal1502.pdf - pages 17-18

3) #MusicBricks is mentioned in the context of ***"Technology, Citizens and Social Change in the Framework of European Research and Innovation Programmes: Towards a Paradigm Shift"*** by Marta Arniani of partner Sigma (forthcoming).

4) #MusicBricks features in "***The Eear: Building a Real-Time MIR-based Instrument From a Hack"*** by Cárthach Ó Nuanáin, Martin Hermant, Angel Faraldo and Daniel Gomez http://ismir2015.uma.es/LBD/LBD29.pdf.

5) G.Dubus, E. Flety, R. Borghesi, F. Bevilacqua, ***"A tutorial on motion data processing for real-time expressive interaction with media using Inertial Measurement Units"***

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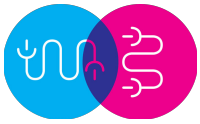

6.11.Book chapters

The project has generated **2 book chapters**:

1) Andrew Dubber of partner Stromatolite has written a book chapter which specifically discusses #MusicBricks for the book '*Business Innovation and Disruption in the Music Industry'* which is one in a series of books addressing '*Business Innovation and Disruption in the Creative Industries'*.

Dubber, A . 2016. ***You have 24 hours to invent the future of music: music hacks, playful research and creative innovation***. In: Wikström, P. & DeFillippi, R. eds., Business Innovation and Disruption in the Music Industry. Cheltenham: Edward Elgar Publishing. pp 211-228

2) Book Chapter for The Routledge *'Companion to Embodied Music Interaction'* SECTION VII. *'Music interaction technologies and applications'*

F. Bevilacqua, N.Schnell, J.Françoise, E. Boyer, D. Schwarz, B. Caramiaux, ***"Designing Action–Sound Metaphors using Motion Sensing and Descriptor- based Synthesis of Recorded Sound Materials"*** (Accepted with minor revisions)

6.12.IP guidelines

The project created new guidelines for IP, by means of introducing **the new layer of Innovation IP** into the #MusicBricks Consortium Agreement. This document can now be provided as reference for other EU IAs.

6.13.Policy guidelines

The project introduced new policy guidelines for **Market Adoption Readiness Levels (MARLs)** and **Innovation Ecosystems**:

1) Market Adoption Readiness Levels (MARLs) were developed for CAF recommendations for H2020 Programme 2016/17 from Section 2.1.2 of the #MusicBricks project proposal.

2) MARLs were adopted in the set of EU recommendations by the Innovation Ecosystems Work Group of the Alliance of Internet of Things Innovation in January 2016.

3) MARLs feature as the top 3 recommendations for Innovation in the CAF recommendations for the H2020 Programme 2018-2020. (See Open Innovation potential defined in D7.1)

4) #MusicBricks Innovation Methodologies feature in multiple CAF recommendations of the Innovation Working Group for the H2020 Programme 2018-2020.

5) #MusicBricks is referenced as best practice in 11 EU presentation documents.

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7. Conclusion

At the Market Testbed, it was apparent that #MusicBricks is more than a methodology for creating market-ready products and prototypes: as an Innovation Ecosystem it opens up a wide range of possibilities for the market. The example of the #MusicBricks Dolphin project demonstrates a range of different market opportunities emerging from one patent filed. The project's roadmap includes two major unrelated industry sectors, and deployment of the product as a gesture-driven system, an competitive solution for existing controller systems, and as a platform for driving content.

Results of the Final Market Showcase include a number of new and ongoing commercial relationships, new market opportunities for the incubatees, new third-party tools joining the suite of #MusicBricks tools as well as the establishment of the #MusicBricks themselves as a product and innovation platform. Following requests from a number of major external industry partners to extend the #MusicBricks toolkit beyond the project end, #MusicBricks is launching as a commercial organisation to further develop these relationships and opportunities.

A comprehensive range of commercial opportunities is evident also from the result of each product which has been taken into the #MusicBricks Market Testbed. Products range from SaaS and gesture-driven applications to performance tools and lifestyle products. They are being deployed across the creative industries, education, health, scientific research and heavy industries. The level of professionalism and achievement by the #MusicBricks teams has resulted in new registered companies, a patent pending, a major international award, several scientific publications, and a range of methods and guidelines for use in law and policy.

The response from the wider, growing #MusicBricks Innovation Ecosystem is evident in the millions of social media impacts. By looking at the overall project impacts it becomes apparent that this Innovation Ecosystem has grown from a few intelligent tools and seed ideas, to a whole that is greater than the sum of its parts. Perhaps the greatest challenge will be testing the successful #MusicBricks methodology as a model for Innovation Ecosystems in Large Scale Industry Pilots. We have demonstrated that placing music technology and creativity at the core of an Innovation Ecosystem can radically impact a full range of industry verticals.

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