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Internet of Things in Music Industry

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Abstract **—** In this paper we propose to extend the concept of the Internet of Things to the musical domain leading to a subfield coined as the Internet of things in music Industry refers to the network of computing devices embedded in physical objects (Musical Things) dedicated to the production and reception of musical content. Musical Things, such as smart musical instruments or smart devices, are connected by an infrastructure that enables multidirectional communication, both locally and remotely.

The IOT in the music Industry digital ecosystem gathers interoperable devices and services that connect performers and audiences to support performer-performer and audience-performers interactions, not possible beforehand. The paper presents the main concepts IOT in the Music industry and discusses the related implications and challenges.

key related works:- IoT technologies, Digital ecosystems, Networked music performance systems, Smart Instruments, Smart wearables, Virtual reality, augmented reality, and 360◦ videos

INTRODUCTION

The Internet of Things is a well-known concept. For those who know a little about this technology, IoT is a technology that deals with the formation of a network of interconnected devices ranging from computers to home appliances, and vehicles. IoT facilitates us with the efficient operation of these devices with minimal intervention.We all love the experience of listening to music. Our music experience has been enhanced with the help of technology. IoT is one such technology that is helping the music industry to make the user experience even more creative. IoT is a modern technology that has attracted the attention of Artificial Intelligence and Machine Learning. We live in an age where technology dominates. It is amazing how humans have changed their traditional ways of doing things, taking advantage of advances in technology. IoT is an interesting concept in the music industry. Therefore, in this dissertation we will try to reveal the role of IoT in the music industry. We will understand how musicians are taking the help of a state-of-the-art technology. Also, to better understand the scope of technology in this particular industry, we will discuss some of the basics of music production.

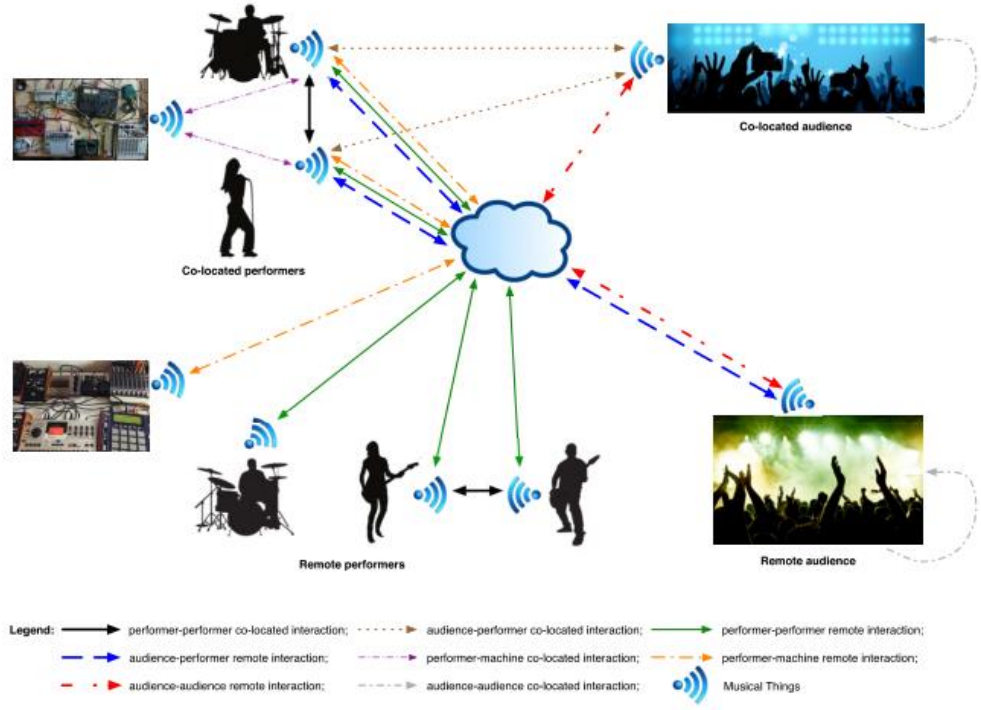

Fig. [1]. Interaction possibilities between musicians, audience members, and machines.

The Internet of Things (IoT) in the Music Industry is a rapidly growing field positioned at the intersection of the net of things new connections for music-powered play look net- worked and things not fixed music human-computer effect on one another through participation in art and artificial intelligence. Applied to music-based contexts. We define an IoT in music Industry as a computing apparatus capable of sensing, getting, processing, or effecting, and exchanging facts giving out to a music-based purpose" and the IoT in Music Industry as a group of connections, approved designs, and pictures of music-related news given that make able services and applications giving out to a music-based purpose based on interactions between humans and musical objects or between musical objects themselves, both physically and numerically, electronic nations Music-related news conveys information regarding facts perceived and processed by a music-based Thing, and exchanged with a human or another musical Thing.

The proposed IoT in the music industry is related in the network of material (Music Objects) dedicated to the production invested in a product, interaction or experience of music content. Musical instruments embed electronics, sensors, data transfer and processing software, and network connections that allow collection and exchange of data for musical purpose. It can take a Music Thing type of Smart Instrument, Smart Wearable, or whatever another clever device used to control, reproduce, or retrieve sponsorship of music content. For example, Smart Wearable can track simple movements, complex touches, and life parameters, but can also provide the answer to assist the senses of perception, touch, and perception.

Literature review

IoT has a multidisciplinary vision to provide its benefit to several domains such as environmental, industrial, public/private, medical, transportation, Music, Video, Entertainment etc.

We all love the experience of listening to music. Our music experience has been enhanced with the help of technology. IoT is one such technology that is helping the music industry to make the user experience even more profile.

With every passing day, IoT and other technologies are finding their use in different sectors. IoT has found its use in the music industry. For example, Google had launched The Universal Orchestra in 2012 and 2013. This was an interactive exhibition at the London Science Museum that allowed physical musical instruments to be played by anyone anywhere via the Google Chrome web browser.

A similar example came from MIT when it launched Patchwerk- a massive modular synthesizer that could be operated online. So, having looked at the examples, we will now understand the application of IoT in music composition, production, and performance.

There are so many networking audio mixers, like Roland VR-3, Behringer X32 Core, Shure SCM820, and others, available in the market but none of them offer remote control via the internet, which can be a great addition. A mixing specialist could then be sat in their studio with a live stream of a show in an alternate area, blending the sound continuously distantly.

Musical Things can include a smart instrument, a musical haptic wearable, a networked speaker system, and smart mixing consoles. There are a number of these devices on the market, like Elk Audio's Sensus Smart Guitar, a guitar augmented with wireless sensors and network technologies.

In an era where musicians are trying to create masterpieces and stand above the rest, IoT can help them in achieving this. The Internet of Things is an extremely captivating and valuable field that will no uncertainty become more conspicuous in all pieces of life sooner rather than later, including inside the music innovation industry.

Problem Definition/ Current Challenges. -:

The IoT in the music industry inherits all the challenges of the general IoT space. In addition, the actual implementation of IOT envisioned in the music industry poses specific technical, artistic, educational, legal, personal and creative data challenges. This section outlines the , which is the main challenge for each of these categories.

1. **TECHNOLOGICAL CHALLENGES-:**
   1) **LOW-LATENCY, HIGH-RELIABILITY,AND SYNCHRONIZATION**
   2) **INTEROPERABILITY AND STANDARDIZATION**
   3) **MUSICAL THINGS DESIGN**
   4) **REPRESENTATION AND ANALYSIS OF MULTIMODAL CONTENT**

2. **ARTISTIC CHALLENGES-:**
   1) **DISTRIBUTED AND SITUATED PERFORMANCES**
   2) **COMPOSING THE NETWORK**
   3) **IOMUST FOR AUGMENTED PERFORMANCE**

3. **PEDAGOGICAL CHALLENGES-:**
   1) **SMART INSTRUMENTS AND SCORES**
   2) **RESHAPING INDIVIDUAL TEACHING AND LEARNING**
   3) **SCALING INSTRUMENTAL MUSIC PEDAGOGY**

4. **PRIVACY, SECURITY, AND LEGAL CHALLENGES-:**

   (I) **Security:** Because Musical Things are wireless devices, they are exposed to the security risks of wireless communication. On the Internet today, encryption is an important aspect of ensuring the information security of the IoT. Therefore, Musical Things should be designed to support strong encryption. This poses the challenge of being powerful enough to support these devices.

   (II) **Privacy:** Given the ubiquitous presence of the IOT in the music industry, the 's transparent privacy mechanism needs to be implemented on the platform that supports them, in addition to a variety of music. Data ownership issue must be addressed in order for Musical Things users to comfortably participate in IOT in music-enabled activities.

   (III) **Legal Issues**: Music IoT raises new legal issues that need to be addressed and a new legal environment specific to Music IoT is expected to emerge. .. For example, we need to develop new legal approaches to protect privacy and copyright. It may be necessary to adapt current copyright and intellectual property laws that give music content owners control over the reproduction, distribution and performance of their works to the future music IoT landscape.

Objective

IoT in the music industry is an interesting concept. So, in this blog, we will try to uncover the role of IoT in the music industry. We will understand how musicians are taking the help of one of the top modern technologies. Also, we will discuss some basics of music production to better understand the scope of technology in this particular industry.

The IOT is a well-known concept to the techies by now. For those who know a little about this technology, IoT is a technology that deals with the formation of a network of interconnected devices ranging from computers to home appliances, and vehicles. IoT facilitates us with the efficient operation of these devices with minimal intervention.

An IoT system consists of sensors/devices which "talk" to the cloud through some kind of connectivity. The data is sent to the cloud and then is processed by the software. The software then passes the command to the device to perform an action such as sending an alert or automatically adjusting the sensors/devices without the need for the user. For example, the geysers can be turned right before you take a shower.

Implemented result -

This is basically how IoT works. There are many such uses of IoT in different areas like the manufacturing industry, disaster management, travel industry, eCommerce, and others. The music industry is an area that requires a lot of electronic devices. So, IoT can come in handy to operate those devices.

Basics of music production

Music production involves some basic steps. However, as everything has evolved over the years, music production has also changed. The only rule that has become prominent is that there are no rules. Record whenever, whatever, and wherever you want and use that as a sample. Although there is a huge scope for experiments with your composition, you would not like to present anything before your listeners. So, to come up with a good sounding track, there are six basic steps, to begin with, let's look at them in brief.

1. Songwriting

It is quite obvious that the production of a song starts with noting down the lyrics or the tunes. Songwriting is all about making the lyrics perfectly work with the music. For a singer, good lyrics set up the platform. The melody (what the singer sings) will fit with the harmony (what the guitars, bass, and synths mostly play) in a way that's pleasing to the ear, using repetition to help the listener get used to the chord progression before transitioning to the next section and a different set of chord progressions. The words in the lyrics provoke emotions both in the singer and the listener.

2. Arranging

Of all the stages of music production, arranging is perhaps the most important stage but unfortunately, it is least understood and most neglected. In simpler terms, the arrangement of a song refers to the selection of instruments, how they are arranged, and also the arrangement of different sections of the song in the larger timeline. When a song has a good beat and melody but gets too repetitive after a while, this is usually a problem of arrangement. It's the arrangement that makes a song interesting.

3. Tracking

This is the stage that brings the gears into the picture. Tracking involves recording the performance of different instruments. Usually, one track is recorded at a time while listening to other recorded tracks. This is called multitracking. Tracking must be distinguished from songwriting because the latter is a different kind of focus than performing.

There is always scope for experiments while writing a song whereas, during the performance, the concentration must be high. The difference can also be understood with the fact that songwriting is done before tracking which means while tracking the performer has to stick to what has been written.

4. Editing

The possibilities of digital editing have made capturing great performances a lot easier than ever. Editing the raw track involves rectifying the mistakes that occurred while tracking. Editing is considered a separate stage for a couple of reasons. The first is that stopping every time to correct a mistake is definitely not handy. The second reason is about avoiding too much reliance on editing to get a good track. Too much editing takes away all the feelings from the track and can make it 'chopped up'.

5. Mixing

For many of the composers, mixing is real fun. As it is mentioned above, tracks are recorded separately. Mixing is the process of combining all the instruments you've recorded into a stereo 2-track mix. A good mix lets you hear all the instruments with clarity and detail. It adds depth and motion whilst adding intensity to the music.

Research Methodology

The background communication technologies of the IOT in Music Industry are **wireless sensor networks (WSN),** Internet of Things **(IoT),** and **tactile Internet.** WSN refers to a network of nodes that can **communicate over a wireless network** for monitoring, communication, **automation,** and **so on.**

The WSN **node is and is** ultimately **an** electronic **device** that can **embed** in any physical object. **Later, the** term Internet of Things **appeared, suggesting** that WSNs could be reached via Internet **Protocol.** Given their high **social** impact, these technologies have been the **subject** of **intensive** research in many disciplines, from electrical engineering to computer science, and both academia and industry (eg). See).

1.0 Digital Ecosystem -:

The Digital Ecosystem is the result of the recent development of a digital network infrastructure that inherits the principles of ecological systems . They are a collaborative environment in which species / agents form coalitions to achieve specific goals. values are created by establishing connections through collective ("swarm intelligence") intelligence and facilitating collaboration. The underlying concepts of the digital ecosystem are in good agreement with the proposed goals of Musical Things Internet , where multiple actors, intelligent devices, and intelligent services interact to enrich the musical experience. increase.

2.0 Networked music performance systems-:

The Networked Music Performance System (NMP) has been proposed to enable collaborative music creation over the computer network and has been the subject of scientific and artistic research. A notable example is the Reac Table. This is a concrete interface consisting of a table that can track objects moving on the surface to control the sound output. ReacTable allows multiple performers to interact with objects located in the same table or in multiple network tables at geographically separated locations. Creation of networked collaborative music can be done over the wide area network (WAN) or local area network (LAN), especially wireless (WLAN), for each of these configurations. Various methods have been proposed. In [9], the author provides a comprehensive overview of the hardware and software technologies that enable NMP, including aspects of low latency codecs, frameworks, protocols, and perceptions .

3.0 Participatory live music performance systems-:

In interactive art, a participatory live music performance (PLMP) system has emerged that uses information and communication technology to actively engage the audience in the music production process. These systems break the traditional one-way musical communication chain from performers to creatively "passive" viewers (see eg). Leveraging 's wide range of media and sensors, from mobile devices to tangible interfaces such as the Lightstick , interaction techniques for technology-based audience participation are proposed (see for overview and classification framework).). Most PLMP systems require the audience to use a single device and application type. Nevertheless, different types of devices can be used simultaneously to provide a wealth of dialogue opportunities for the . Historically, creative audience participation has been primarily based on manual controls or gestures (screen touch, tilt, etc.) using a smartphone. For example, the Pressure Modality uses a device specially designed for this purpose to measure physiological parameters (eg, electrode skin activity, heart rate) at the individual and population level. Or it can be increased by with more complex actions and body gestures to follow. By the public. In addition, the means of interaction in current PLMP systems, , usually relies on auditory or visual modality, but tactile sensation is rarely explored to create a more engaging musical experience.

4.0 Smart Instruments-:

In interactive art, a participatory live music performance (PLMP) system has emerged that uses information and communication technology to actively engage the audience in the music production process. These systems break the traditional one-way musical communication chain from performers to creatively "passive" viewers (see eg). Leveraging 's wide range of media and sensors, from mobile devices to tangible interfaces such as the Lightstick , interaction techniques for technology-based audience participation are proposed (see for overview and classification framework).). Most PLMP systems require the audience to use a single device and application type. Nevertheless, different types of devices can be used simultaneously to provide a wealth of dialogue opportunities for the . Historically, creative audience participation has been primarily based on manual controls or gestures (screen touch, tilt, etc.) using a smartphone. For example, the Pressure Modality uses a device specially designed for this purpose to measure physiological parameters (eg, electrode skin activity, heart rate) at the individual and population level. Or it can be increased by with more complex actions and body gestures to follow. By the public. In addition, the means of interaction in current PLMP systems, , usually relies on auditory or visual modality, but tactile sensation is rarely explored to create a more engaging musical experience.

Analysis & Findings

Thanks to Iot In the Music Industry, live music performance art and music education by providing a technology ecosystem that doubles the potential for interaction between the audience, artists, students, teachers and their instruments and machines. It is possible to reinvent. This could revolutionize the way people experience, compose, learn, and even record music by adding other modality of to audio. In particular, IoMUT has the potential to make NMP and PLMP more attractive and expressive. This is between performers, performers and spectators.

From the traditional music chain (that is, the composer who creates music content for performers to deliver to a unique and "creatively passive" audience) by applying IoT to music. , is expected to move to the possible music web. The interactions are innumerable. We have regular scenarios (co-localized participatory music performances in concert halls) and extreme scenarios (massive open online music that attracts thousands or hundreds of thousands of participants in a virtual environment). Performance) is both assumed.

Block diagram- A block diagram is a diagram of a system in which the principal parts or functions are represented by blocks connected by lines that show the relationships of the blocks.[1] They are heavily used in engineering in hardware design, electronic design, software design, and process flow diagrams.

Block diagrams are typically used for higher level, less detailed descriptions that are intended to clarify overall concepts without concern for the details of implementation. Contrast this with the schematic diagrams and layout diagrams used in electrical engineering, which show the implementation details of electrical components and physical construction.

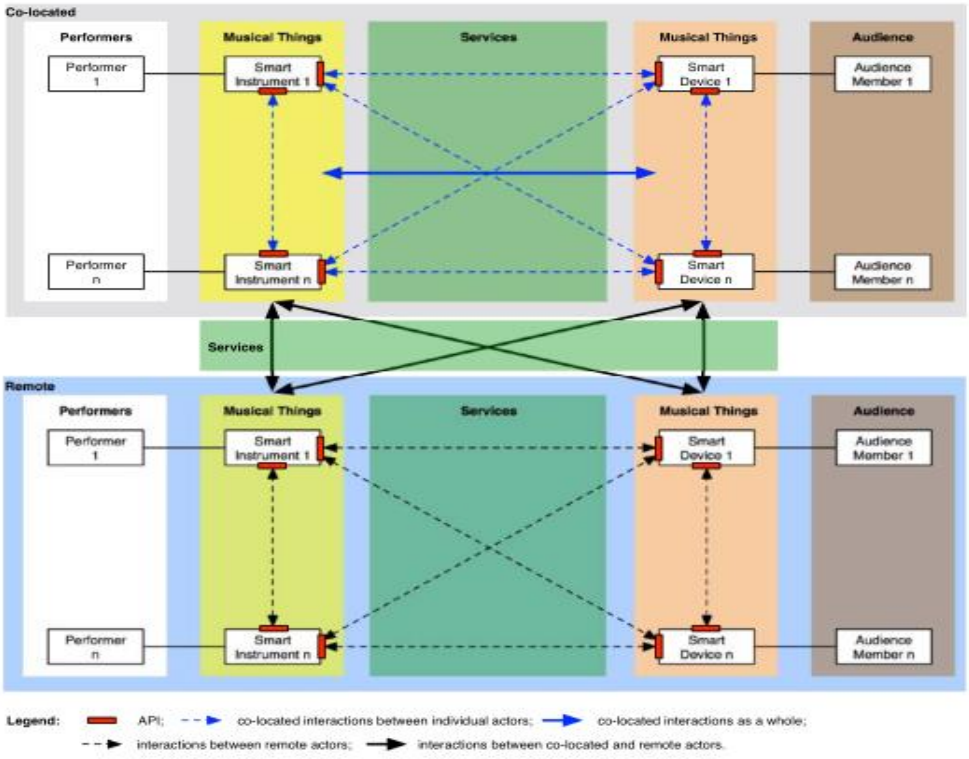

Figure 2 : Block diagram of the IOT in Music ecosystem.

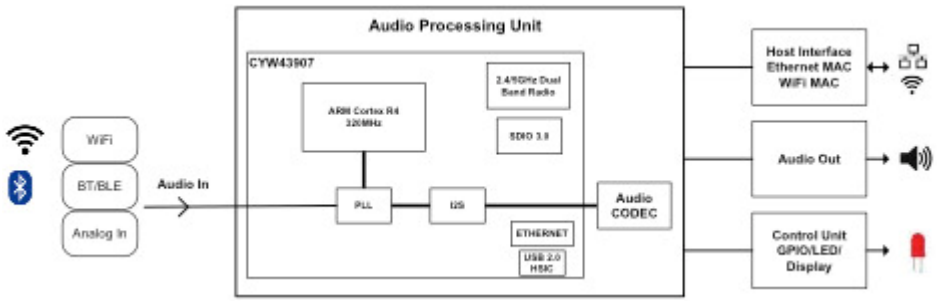

Fig 3- acoustic audio for IoT applications Block Diagram

Examples :- Technological components of an IOT in Musical Industry ecosystem.

Component	Example
Musical Things	Smart instruments, musical haptic wearables; networked speaker systems, intelligent mixing consoles, networked virtual reality headsets
Connectivity	Wireless and wired networks supporting, in both local and remote communications, ultra-low latency, high reliability, high throughput, high quality of audio and multimodal content: standards and protocols for the loMusT (e.g., supporting synchroniza tion mechanisms), antennas specific to loMusT networks; Web of Musical Things; APIs (based on IoMusT API specifications);
Services	Service for connecting smartphones to smart instruments, service for connecting smart instruments to social networks; service for creative content analysis; service for cross-modal mappings between sensed data and control parameters of Musical Things: service for content synchronization between Musical Things:
Applications	For audience members: enhanced concert experiences based on multisensory content provided by Musical Things, remote audience participation in the music creation process during concerts; for musicians: remote rehearsals, interaction with the cloud directly from smart instruments; for audio engineers: intelligent live and studio production supported by smart instruments; for students: enhanced music e-learning with remote teachers, or augmented experiences through mobile apps and mixed reality displays leveraging daia from smart instruments; for music teachers: web-based apps for student assessment, progress monitoring, and individual or group feedback (thanks to the smart instrument capabilities).

CONCLUSION

This paper presented a vision for the emerging research field IoT in the music industry. This stems from many lines of existing research, including the Internet of Things, a new interface for musical expression, a connected music power supply system, ubiquitous music, and artificial intelligence . gen, human-Computer interaction and participatory art. IoMusT refers to the wireless network of the intelligent device for musical purposes, enabling various forms of connection between musicians, sound engineers, listeners , and educators, both spatially and remotely.

The IOT IN Music Industry vision offers an unprecedented number of opportunities, but technical rather than technology, which is expected to be addressed in both academic and industrial research over the next years. We will also present the issues.

Throughout this paper, one of the most demanding technical challenges is the high quality, low latency (generally multimodal) audio stream over both wireless and wired networks. Claimed to be a transmission. The challenge of designing a communication network that can support music services in real-time hours needs to be addressed by developing a radically new technology for low latency and stable message reception speeds.

IOT's vision in the music industry needs to rethink music composition practices that must take into account the diversity of music content, as well as the dispersal of musicians and audiences within the ecosystem . In addition, the interoperability of envisioned intelligent instruments with a variety of music can have a significant impact on the way music is composed, played, recorded, taught and experienced. You need to analyze a framework like IoMusT and what it needs for the artistic and educational agenda . This could pave the way for Audience Acceptance, Interactive Art, Education , and Innovative Studies on Aesthetics.

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