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# Location Aware Audio Tour using nRF

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***Abstract***— Tourism plays an important role in the economies of many countries. It is important to provide correct and relevant information to the tourist. Visitors are not always given a guided tour at the museums and other places of importance. It is infeasible to provide personal human guides to each visitor due to shortage of personnel and language constraints. Not just in tourism, providing location guidance is important in many areas like schools, colleges, companies, hospitals, exhibitions to guide people and provide them with relevant information. Audio tours using handheld devices is a solution to this problem. But traditional audio tour devices are time based, where information is displayed based on time and user has to pause and play accordingly; or they are interactive devices where users have to choose the current location to receive relevant information. This lead to development of location aware audio tour systems. But these systems rely on GPS signals for location information which is highly unreliable in indoor locations as GPS signals does not pierce through the solid walls or structures. The proposed system uses Radio Frequency Identification (RFID) which relies on radio waves. Each location or artefact is embedded with an NRF24L01 module, which is a radio frequency transceiver with limited range, that acts as a transmitter and the handheld unit given to the user also has an NRF24L01 module that acts as our receiver. Based on the signal received by the receiver unit relevant information is given via text, images and audio.

***Keywords***— Location Aware, nRF, Raspberry Pi (RPi), Arduino, Radio Waves.

## I. INTRODUCTION

Tour guides lead visitors through tourist attractions and give information about the attractions' natural and cultural significance. Often, they also act as interpreters for travelers who do not speak the local language. Tour operators often hire guides to lead tourist groups. Automated systems like audio tours are sometimes substituted for human tour guides. An audio tour or audio guide provides a recorded spoken commentary, normally through a handheld device, to a visitor attraction such as a museum. They are also available for self-guided tours of outdoor locations, or as a part of an organized tour. It provides background, context, and information on the things being viewed. Location awareness refers to devices that can passively or actively determine their location. It is any technology that is able to detect its current location and then manipulate this data to control events and information. It is a component of presence technology that delivers information about a device's physical location to another user or application. Location-aware technology includes sensors and methods for detecting or calculating the geographical position of a person, a mobile device or other moving objects. The most common location-aware technologies [1] are GPS, assisted GPS (A-GPS), Wi-Fi, Enhanced Observed Time Difference (E-OTD), Enhanced GPS (E-GPS) and RFID-Based systems. RFID is the use of radio waves to read and capture information stored on a tag attached to an object. A tag can be read from up to several feet away and does not need to be within direct line-of-sight of the reader to be tracked. The nRF24L01 (nRF - Near Radio Frequency) is a highly integrated [2], ultra-low power (ULP) 2Mbps RF transceiver IC for the 2.4GHz ISM (Industrial, Scientific and Medical) band.

Rest of the paper is organized as follows, Section I contains the introduction of location aware audio tours, Section II contain the related work on audio tours, Section III contains the problem statement, Section IV contains the system design, Section V deals with the requirements, Section VI describes implementation with algorithm and flowchart, Section VII describes the results and Section VIII concludes research work with future directions.

 

## II. RELATED WORK

### A. Smart Audio Tour Guide System using TTS

The global positioning system (GPS)-enabled mobile phones provide the location-based tourist guide applications for indoor or outdoor environment. KiBeom Kang [3] developed the location-based audio tour guide system using speech synthesis provided by the server-based text-to-speech (TTS) engine as shown in Fig-1. The mobile audio guide travel application provides real-time tour information in multilingual versions at the major tourist attractions. The developed audio tour guide system consists of the tour guide service system, the wiki-based tourist information collection system, the tour information DB, the server-based TTS engine, and Android and IOS mobile apps. The developed tourist guide system is very helpful for tourists and enhancing self-guided tours of outdoor locations. The audio tour guide services also provide safe and comfortable route and path guidance for pedestrians and handicapped or elderly people.

### B. IoT Based Smart Museum using Bluetooth Low Energy (BLE)

In today's world everything is becoming smarter through the development of heterogeneous technologies. To match this smartness, the environment needs to become smarter through a technology that is called Internet of Things [4]. Nowadays, people are switched to follow the ancient culture. Craftsmanship and culture have constantly assumed an imperative part in people's lives. Museum is one of the place where ancient culture and cultural heritage exist. It is hard to characterize ahead of time a visit for every one of the guests, since interests may fluctuate from individual to individual. Hence it is considered to make a smart museum. To get the attention of the visitor in a museum, it is being proposed as IoT based smart museum environment which will automatically provide the information about artwork without any user intervention. K Somalatha [5] proposed an IoT based system where smart museum relies on a wearable device (Raspberry Pi) that will capture the user's movement, does the background subtraction algorithm to perform image processing and it gets the localization information from a Bluetooth Low Energy (BLE) which is fixed in the museum. Hence, this wearable device will increase the performance of the whole system by sending only matched frame to cloud processing center. To start with, all the artwork and related multimedia contents need to be uploaded to cloud. Finally, everyone can easily access the arts profile and history through smart phone by using the mobile application.

### C. Smart Guide – an approach to the Smart Museum using Android

Android application recognizes the article which displays the information by scanning QR code near to the statue either in image, audio, video or in text format. Nowadays, museums are available with QR codes to improve visitor's ability to access the information by scanning QR code with their own smart phone. Sagar Patil [6], developed the 'Smart Guide' to override the problems prevailing in the practicing manual systems. This system eliminates and reduces the hardships faced by existing system. Moreover this system is designed for the particular need of Museum to carry out operations in a smooth and effective manner. This application reduces errors while entering data. It is a user friendly system.

## III. METHODOLOGY

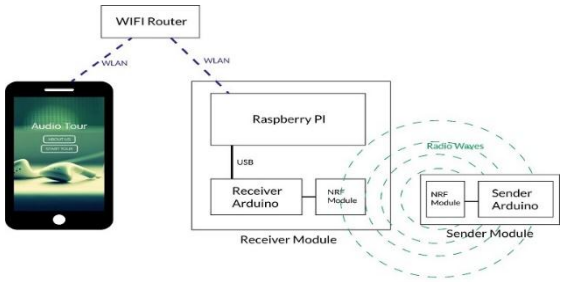


Figure 1. System Architecture

Figure 1 shows the architecture of the overall system. The system contains a receiver and transmitters. The receiver consists of a raspberry pi (RPi) to which an arduino soldered with a nRF is connected via a USB cable. Mobile device is connected to the RPi via WiFi. The transmitter consists of an arduino soldered with a nRF. The transmitters are placed at different points. The transmitters keep emitting radio signals. In the above figure, the receiver is considered to be within the range of transmitter 2 and not transmitter 1. Even though the transmitter 1 emits radio signals, it is not received by the receiver because it is not within the range of the nRF. The receiver receives the signals from transmitter 2 and appropriate actions take place, i.e., the receiver arduino sends a message to the RPi and the RPi send the relevant data to the mobile device. The mobile device displays the corresponding data to the users.

The nRFs are soldered to arduino boards and are placed at different locations which acts as the transmitters. The nRF soldered to arduino is connected to the RPi via a USB cable which acts as the receiver. The RPi has a server running on it and contains a SD card which contains all the audio files. The user connects his/her mobile device to the RPi using WiFi. Every nRF has a unique ID. Once mobile device is connected to the internet, start the navigation. When within the range of a nRF module, the ID of the transmitting nRF is identified and the corresponding webpage is loaded and the

 

audio starts playing in the background. The mobile device is used for viewing the images and the description related to a particular location. Once the tour is completed, disconnect the mobile device. A flask app is created to provide the web UI.

### *A. Algorithm*

Step 1: Start
Step 2: Connect phone to RPi server using the browser
Step 3: Start tour
Step 4: while not end tour
4.1 **if** signal received
4.2 **if** signal same as previous
stay in the same page
**else**
reload page and play new audio
**else**
display error page
goto step 4
Step 5: Tour completed
Step 6: Stop

## IV. RESULTS AND DISCUSSION

Unit testing was performed to ensure that all the individual components were working perfectly. The sender and the receiver modules were tested separately using the spare arduino. Integration testing was performed by combining the sender and the receiver modules. Finally, the system testing was performed by connecting the phone to the RPi server. It was observed that when the hand-held device was moved between artefacts (different locations), appropriate pages were rendered and the correct audio was playing in the background.

Figure 2 shows the different webpages rendered on the mobile device during the audio tour.


Figure 2. Webpages Rendered

## V. CONCLUSION AND FUTURE SCOPE

The proposed system provides a RFID based location aware audio tour which overcomes the problems of existing GPS based system. The proposed system is easily customizable and can be installed easily in any location with minimum effort. Additional language support can be added to the system by recording more languages and allowing the user to choose from the available languages.

The current implementation requires the user to carry a bulky handheld unit consisting of the Raspberry pi and the Arduino along with the NRF24L01 module. But this could be improved by designing a mod, inspired by Motorola Mods designed for their Moto-Z smart phones which consisted of a magnetic case that allowed users to connect better lenses or speakers to their phone. The proposed mod should consist of a NRF transceiver that receives RF signals from the transmitter NRF and sends it to the phone using NFC or Bluetooth. The phone can then ping the ID of the received signal to the Raspberry Pi server. Then the relevant information can be relayed onto the users' mobile.

Another improvement to the current system could be applying analytics to analyse user patterns to assess the amount of time spent at each artefact/location to identify the most popular artefacts/locations so that they could be moved to a more prominent location. This could help in improving the revenue of the museum or the gallery.

## REFERENCES

[1] Neeraj Chhabra, "*Comparative Analysis of different Wireless Technologies*", International Journal of Scientific Research in Network Security and Communication, Vol. 1, No. 5, 2013.

[2] M.V.Moreno, J.L.Hernandez, and A.F.Skarmeta, "*A New LocationAware Authorization Mechanism for Indoor Environments*", In the Proceedings of the 2014 28th International Conference on Advanced Information Networking and Applications, Victoria, pp.791 – 796,2014.

[3] KiBeom Kang, JeongWoo Jwa and SangDon Earl Park, "*Smart Audio Tour Guide System using TTS*", International Journal of Applied Engineering Research, Vol. 12, No. 20, pp. 9846-9852, 2017.

[4] B.H.S. Jaleleddine, "*Advance remote control home appliance switching system using radio frequency and Bluetooth*", International Journal of Scientific Research in Computer Science and Engineering, Vol.5, No.4, pp.60-62, 2017.

[5] K.Somalatha and V.R.Kavitha, "*IoT Based Smart Museum using Bluetooth Low Energy*" In 2017 3rd International Conference on Advances in Electrical. Electronics, Information, Communication and Bio_Informatics.

[6] Mr.Sagar Patil, Ms.Shraddha Limbekar, Ms.Amruta Mane and Ms.Netra Ponis, "*Smart Guide – an approach to the Smart Museum using Android*", International Research Journal of Engineering and Technology, Vol. 5, 2018.

 

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