DESIGN AND REALIZATION OF MULTICAST ONLINE RADIO APPLICATION WITH RECOMMENDATION FACILITY USING MACHINE LEARNING TECHNIQUE.

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Introduction

Background of the Study

Internet and digital media have profoundly reorganized the radio landscape by given birth to new format and patterns of radio transmission. Nowadays, traditional radio station owners systematically use online platforms to transmit their programs and communicate with their audience.   A lots of research has been carried out in the area of streaming radio online with the aim of achieving an efficient, reliable easy to use and cost effective radio streaming system. Nigeria alone own about 23,506,233 radio station out of which, there are about 300 FM radio station and about 234 of these are online radio stations (

ABSTRACT

In resent time, there has been an upsurge of interest in the field of internet and digital radio. The popularity of live streaming application on the internet is increasing daily with capability to host hundreds of radio channels online. However, the challenges now are difficulties in locating a favorite channel and program of interest, within a short period of time, low coverage, couple with the fact

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that most of the existing application in this area are highly bandwidth intensive and delay sensitive, therefore increase data consumption and bandwidth usage. To alleviate the identified challenges of these existing radio applications, this work seeks to design and develop a novel method of presenting an efficient, cost effective and easy to use means of listening to some selected radio channels online to the users through the development of a multicast online radio application with recommendation facility using Manhattan distance based, K-Nearest neighbor (MD-KNN) Machine leaning techniques. The present work is capable of presenting multiple radio channels to the users using multicast technology with ability to recommend channels and program of interest to the users without expecting them to request for it explicitly, therefore, save time and reduce data consumption. The development of online radio wed application was achieved using HTML 5, CSS 3, and Java Script on note pad ++, for the web application and web service front end implementation where the python programming language version 3.8 was used for the back end implementation of the application. performance evaluation of the present work was carried out and the result demonstrated that the present system is capable of providing an efficient, excellent and cost effective multicast online radio channels, with accurate recommendation to the users and tendency to save time and reduce data consumption.

Keywords: Multicast, Online-Radio, Recommendation, Machine Learning, Manhattan-distance, K-Nearest neighbor

Udomisor 2013). Many more of such online streaming radio still comes up on daily basis.

However, the majority of existing applications in this area are highly delay sensitive, which tends to increase data consumption, because the application uses simulation techniques to allow radio streams through internet services in one location and reassembled on the listeners' end aided by listening via software on a computer or any smart device. More so, being a multichannel application, most of these online radio application suffers setback when it comes to users making a choice of

program and channels to listen to at a particular time. This is generally denoted as information over-loading. Since the choices are numerous. These challenges coupled with the problem of low coverage will be looked into and appropriate solution will be provided.

To alleviate these challenges, this study presents the design and realization of a multicast online radio application with recommendation facility using machine leaning techniques, specifically, the Manhattan distance based K-Nearest neighbor (MD-KNN) Machine learning technique. The study aims of presenting multiple radio station to stream online on a single application using multicast technology with ability to proffer recommendation facility to the users in order to ease navigation on the site, while reducing data consumption. The contribution of this work is in three fold.

First, the study presents the design and development of an online multicast /multichannel software application, that can present hundreds of radio channels both local and internal channels to the users at a time, so as to enable them to have varieties of channels to be selected in order to widen the coverage of their choices.

Second, due to the challenges of making the best choice of channels and programs out of the hundreds of channels and thousands of programs available at a time (information overloading), the present study presents the development of a recommendation module which aimed at delivering a variety of interesting programs and channels to the radio listeners based on their current click stream data, their previous choices and the choice of majority of the users. This is to assist them save time and energy while search for relevant channels and programs on the radio application. This is accomplished by presenting to the user their desired channels and program without them explicitly requesting for it. The recommendation module will overcome the problem of presentation of too many choice (information overloading) and slow searching capability common to many existing radio application, hence reduces search time and data consumption.

Third, this study presents the construction of a multicast radio streaming application software with recommendation capability using collaborative filtering algorithm using an in house application developed with HTML 5, CSC 3, and Java script on notepad++ at the front-end with Python programming language version 3.8 at the back ends.

Performance evaluation of the present online radio application was carried ought in order to justify the rationale behind this study.

Finally, a thorough presentation of the experimental result was carried out. The experimental result shows an excellent performance of the designed system. The entire system will be implemented online and in real time on the Kaduna Polytechnic server.

Review of Related work

This section deals with review of relevant works pertaining to the topic of online radio with a view to provide better understanding of the concept of online radio applications and to explore the contributions of a number of scholars in the field of online radio and its related concepts. Specifically, the review is organized according to the following sub-headings:

Overview of Internet radio

The AM standard radio is quickly becoming antiquated due to poor sound quality and predictable programming, the beginning of the radio era is often equated with the introduction of the FM standard. The goal of radio was to provide listeners with high-quality sound and overall technology reliability. The radio's initial focus was on delivering a range of talk-oriented formats to listeners, as sound quality did not matter as much to listeners as it does now (Bessire & Fisher, 2012). Even while FM receivers could not compete with television in terms of entertainment value, a further drop in price allowed the radio to increase its audience and enhance its technology.

The traditional radio industry was severely harmed by a lack of resources and an economic downturn, which resulted in local marketing agreements that should have allowed the sector to build new programming hubs. The economic downturn at the time gave rise to Internet radio initiatives, which later evolved into streaming services, putting traditional radio to the test (Bessire & Fisher, 2012).

During the 1970s, radio stations began to use the FM standard and switched to free-form stations in order to acquire a larger audience and provide listeners with better sound quality and less restrictions than the AM standard. • Because Internet radio grew popular, after the

Telecommunications Act was passed in 1996, many traditional radio stations were acquired by commercial firms. Today its internet radio.

The Conventional Radio Versus Internet Radio

Traditional radio stations have long been thought of as something that people grew up listening to. We've gotten into the habit of listening to it while cooking and eating breakfast, then turning it off when everyone goes to work. In some ways, traditional radio transmission evokes nostalgia because radio stations were formerly the primary source of new and popular music. Traditional radio became so ingrained in people's lives that we continued to listen to radio stations even after the invention of television. Television slowed people down in certain respects, but conventional radio was always welcome in the morning since it allowed people to listen to the latest news without having to look at anything (Bathgate, 2012). Long driving periods were virtually impossible without radio stations, which were viewed as the primary source of enjoyment. (Bessire & Fisher, 2012).

Even while traditional radio hasn't altered much since then, it continues to be quite popular among a large number of people all over the world. Because the latter did not play only the renowned songs while disregarding other artists and their treasures, the difficulties to secure a huge playlist from one artist became the cornerstone of the conflict between traditional and Internet radio stations. The most significant development in the radio industry was that, with the introduction of Internet radio, inexperienced musicians began to be less concerned about gaining visibility on traditional radio stations. . Internet radio stations nowadays provide exposure to all musicians, not just the well-known ones. We don't have to listen to repetitive tunes that grow less enjoyable after being played at least 10 times every day. (Bathgate, 2012).

A review of Related Radio station streaming applications.

A lot of works has been carried out in the area of streaming Radio online with the intention of achieving an efficient and very reliable ways of streaming audio online. Presented here are some past works review to give room for improvement and limitations observed in them which gave room for further work. Utkarsh et al, (2011). In their research paper, E-Radio: The Electronic Music Service, a computer software application

was developed to stream about 80 stations on line. The application allows audio to be digitized and spilt into small pieces for transmission across the Internet. The Desktop application can run on any windows operating system and need .NET framework installed. The bandwidth used for application was 32kbps which reduces use data rate consumption.

The limitation of the application is that it does not allow for recording when streaming. Jonathan et al, (2011). In their research paper Developed an e-radio: An online Audio Streaming Application. In their research a computer software application was developed which focuses on multimedia streaming specifically on live audio streaming in internet radio, the application allows users to interact with the radio station and other listeners. It provides a feature that promote advertisements and modify of advertisement's information. The application run on Adobe Dream Weaver, MySQL and Apache sever bundled with PHP 5.0. Here the limitation involves cost of implementation of starting a radio station is high, increase in bandwidth is required which means more data rate consumption and need for faster and more efficient computer as servers would come into consideration.

Overview of Related Recommendation System
A Recommendation or Recommender system is a subclass of information filtering system that seeks to predict the rating or preference that a user would give to an item (Ricci et al., 2011). Grundy, a computer based librarian, is believed to have first come up with the idea of automatic recommender system before the introduction of collaborative filtering in the early 1990s (Ekstrand, et al., 2010). Historically, people rely on recommendation and mentions from their peers or advice from experts, such as asking a Librarian to suggest a book in order to support their decisions or discover new materials (Ekstrand, et al., 2010).

The main goal of a recommender system is to generate and present meaningful recommendations to users for items and products of interest. For instance, relevant books are suggested to users on Amazon and relevant movies are suggested on Netflix. Over the last two decades, there has been a good deal of research on how to automatically

recommend things to people and wide varieties of methods have been proposed (Ekstrand, et al., 2010).

Some of the existing recommender system understudied during the course of this study includes the

Online book recommendation system, the FAB Recommender system, E-VZPro etc. some of these systems performed better on their data sets. However, most of them have the disadvantage of being unable to make real-time recommendations based on current user's behavior. The present approach is capable of making a real-time recommendation to the client consistently. Mooney and Roy, (2000),

A review of related machine learning algorithms

Han and Kamber ,(2006); Luca and Paolo,(2013), stated that there are different techniques for data classification in a machine learning system which includes; Decision tree classifier, Bayesian classifier, K-Nearest Neighbor classifier, rule base classifier, J48, ID3 etc. some of some related classifiers are studied during the course of this work: (Hssina, Merbouna, Ezzikouri and Erritali, 2014, Bhosale and Ade, 2014).).

METHODOLOGY

A methodology is an orderly and organized system or methods consists of various, tools and notations. In this chapter the System Design framework was presented highlighting the steps taken to realize the model. The goal of this research is to design and Implement an Internet Radio platform with recommendation facility. This study intends to improve the Quality of Service (QoS) at the end-user level and to retain the overall performance and the user's satisfaction level from the provided services. The performance metrics used in evaluating the model were explained. Finally, the selected method is the form a final research approach for this work. The goal of deciding an appropriate model for the research approach is vital to comprehend and analyze the purpose of the project which provides the basis of the aim and objectives of the research.

This section describes in detail the realization of the multicast online radio application with recommendation facility and presents the application of the propose methodology for analyzing the users' URL address database of the online radio website. It showcases how an

online, real-time recommendation expert system is developed to recommending a unique set of objects that satisfy the need of an active user based on her current click stream.

Data collection

In this study, an experimental online radio station developed was used to collect users' browsing history through the RSS links on the website. The online radio website was developed in such a way that it can be installed on a standalone computer for browsing through various program and stations of interest. But up till the time of this experiment, this website has been unable to identify client navigation pattern or provide a satisfactory real-time response to the user's needs.

A random selection of click logs of 3,754 anonymous users of the experimental online radio application web site who logged into site over a period of 10 weeks was done, from 15/03/2021 to 14/05/2021. This is made up of about 16,445 records extracted from the website's server's URL address database of an anonymous users.

Experimental design

The raw users' URL address database data extracted is cleansed so as to eliminate irrelevant/noisy entry. The data mart of the log data is developed. At the end of the data cleansing operation. The users are then grouped based on similarities in their search behaviors using our propose MD-KNN technique.

The results of this work were stored in a data mart developed and implemented using MySQL DBMS software specifically created for the purpose of the recommendation based online radio. The said online radio wed application was developed using HTML 5, CSS 3, and Java Script on note pad ++, for the web application and web service front end implementation where the python programming language version 3.8 was used for the back end with HTML 5, CSS 3, and Java Script on note pad ++, for the web application and web service front end implementation where the python programming language version 3.8 was used for the back end. The overall architecture of the entire internet radio system is shown in figure 1.

Figure 1. The overall architecture of the entire internet radio system

The Online Radio Application System Design Methodology

The methodology adopted for this project is the Hybrid Agile Approach. The hybrid project management approach is often considered for projects to increase stakeholder feedback and reduce the risk and uncertainties (Archer and Kaufman, 2013; Jaziri et al., 2018). Though we attain numerous benefits from traditional waterfall and agile methodologies, project managers are still facing many challenges while implementing large scale projects (Bohem and Turner, 2004; Salum et al., 2014)

Multicasting and Podcasting applications

Multicast is a way to distribute information, where the number of recipients of this information is assumed to be random. Recipients are divided into individual groups that later are available under a single IP address, a multicast group. Unicast multicast differs from already very essence of the action and its effectiveness. For transmission to *n* listeners in the network transmits the data to a node once in unicast method *n* Times to n clients. In other words, using multiple multicast streaming, sending the same message is avoided. It offers the greatest savings on bandwidth, especially where portions of data are great. While podcasting in the other way is a form of Internet radio broadcasting that is published on the Internet in the form of regularly posted sections using an RSS feed (Really Simple Syndication). Podcasting is also sometimes called offline Radio, because it is possible to download the entire program onto your computer in the form of any audio file like MP3, which allows you to restore it later without having to connect to the network.

The term podcast is a combination of words derived from the words "under," which constitutes an abbreviation for iPod (a popular media player, created in the U.S. by Apple), and "cast" (derived from the word meaning broadcast transmission, or transfer). This term was first formulated by Ben Hammersley, who worked as a journalist in "The Guardian" . In recent years Podcasting has become a very popular way of getting information without having to tediously search multiple websites. The system works through RSS tags, to which surfers subscribe.

Algorithm listing

The Algorithm listing for the ED-KNN Recommendation Model is shown in listing 3.1

Listing 3.1.Algorithm listing for the ED-KNN Recommendation Model.

Let X_i be an input tuple with features ($x_{i1}, x_{i2}, \ldots\ldots, x_{ip}$) simply put, Let $U = \{x_1, x_2, \ldots\ldots x_n\}$

1. Begin
2. Input x of unknown classification
3. Let k= $1 \leq K \leq n$
4. Initialize i=1
5. Do Until(K-Nearest neighbor found)
6.   Compute Manhattan distance from x to x_i
7.   If($i \leq K$) Then
8.   Let x_i be a member of K-Nearest neighbors
9.   Else if(x_i is closer to x than any previous neighbors) Then
10.   Swap x_i for the previous nearest(closest) neighbor i.e. add x_i to the top of members of K-nearest neighbor
11.   End if
12. Increment i by 1
13. End Do Until
14. Determining the majority class in the members of the K-nearest Neighbors
15. If (a tie exists) Then
16.   Add all the distances of neighbors in each class which tied

17. Else(if no tie exists) Then
18.   Classify x in the class of minimum sum of distance
19.   Else
20.   Classify x in the class of last minimum distance found
21. End if
22. Else
23.   Classify x in the majority class
24. Recommend the program and station of the majority class for X
25. End if
26. End if
27. End

IMPLEMENTATION, SYSTEM TESTING AND RESULT

This chapter presents the implementation and Testing of the System. It described the software and hardware that would be needed to be installed for proper implementation. In this project, the html 5, CSS3, JavaScript and xml was used for the web application and web service front end implementation while python version 3.8 was used to implement the front end and back end of the Desktop Application. The system interfaces were also implemented using Python 3.8 programming language.

Implementation Phase

The implementation Phase involves the use of Python 3.8 programming language for the back end and Interface design. The Pycharm 2020 Community Edition was used as the Integrated Development Environment Python is an interpretive and Object Oriented Programming Language. It is used for the coding due to its numerous libraries and availability. It is an Open source language and easy to use. The front end was developed using HTML 5, CSS3 and JavaScript on not pad++.

Technical Implementation

Multicast is a way to distribute information, where the number of recipients of this information is assumed to be random. Recipients are

divided into individual groups that later are available under a single IP address, a multicast group. Unicast multicast differs from already very essence of the action and its effectiveness. For transmission to *n* listeners in the network transmits the data to a node once in unicast method *n* Times to n clients. In other words, using multiple multicast streaming, sending the same message is avoided. It offers the greatest savings on bandwidth, especially where portions of data are great.

The reference is, of course, not only teleconferences, but video transmission and broadcasting of Internet radio. Multicast technology depends on a number of network protocols.

These can include:
i. IGMP - Internet Group Management Protocol, ii. MLD - Multicast Listener Discovery
iii. PIM-SM - Protocol Independent Multicast - Sparse Mode iv. PIM-DM - Protocol Independent Multicast - Dense Mode v, MRD - Multicast Router Discovery.

Result of the Research Work

The project work contains the following:
a. Desktop Front Page , b. Recommendation module

Desktop Front Page: The Desktop Front page is the page that the user can access in order to view the content of the program. This is contained in the Pycharm IDE. The Desktop Front page is shown in figure 2.

Figure 2: Desktop Front page

The Desktop Front Page written in python codes on pycharm 2020 IDE is activated when the codes are run. It contains the following Tabs:

The Menu Tab which has a drop down button for various world stations such as British Broadcasting Corporation (BBC), Voice of America (VOA).

The menu Tab also contain Local Stations in Nigeria and a help button.

The app also has other functional buttons at the Bottom Right Hand of the App, which are:

i.   About: Link to the internet radio web app page

ii.   Podcast: Link to the podcast of various online radio broadcast.

iii.   Stations: Links toss web based internet radio apps all over the world.

iii.   Quit: The Quit button is to close the app.

The recommendation page: This module serves to test the workability of the program. Users are ssbased on the users' current interest by observing her click stream data. After this recommendation are made to the user on similar program and stations, according to her interest. This is in order for the recommendation system not to constitute an intrusive interface to the user. Figure 3 is the screen shot of the serch channels window showing the active users's click stream, presenting his requested programm and station with presention of real-time recommendation to the user based on her current request.

Figure 3: The screen shot of the serch channels window showing the active users's click stream, with presention of real-time recommendation to the user.

SUMMARY, CONCLUSSION AND RECOMMENDATION

Summary of Findings

The radio application has both front-end and back-end design which helps in achieving the desired selected radio stations being stream online with use of data. These various Station which can be run on the application which are categorized as World station, Local Station and Educational Station. It also has the functional buttons at right hand of app which are About, Podcast, Station, Quit. With the recommendation module triggered when the appropriate button is pressed. The results of the experiment was analyzed using the F-Measure technique. The results shows a very high degree of recommendation capability to the users with over 70% degree of accuracy.

Conclusion

The desire to design and implement an internet radio app with recommendation facility was achieved with three world station which are VOA, DW and BBC Hausa, the Local Station are Dalla FM, Freedom FM Kaduna and Freedom FM Kano, with five Educational stations such as Uni Ilorin, Foreign education station, ACE radio, DVC radio and Destiny college radio.

Recommendations for further study

Since the software application developed is a far more efficient mechanism to stream radio stations the following are recommended

i. The software can be made commercial with need legality and require approval to generate money to reduce the cost of implementation.

ii. The software can be basically made for Educational radio station only. Since software like Radio Garden exist which stream more than 8000 stations mostly news and music station.

iii. The software could use as teaching tool on various subject for student like during COVID-19 pandemic.

There is always a room for improvement in any software package, however good an efficient it may be done. But the most important thing, it should be flexible to accept further modification. The thesis work has some limitations that should be improve upon.

- ✓ The radio stations on the application should be increased.
- ✓ The application developed to accommodate other platform like mobile phones.

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