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Audio Digital Signal Processing

Winter 2020/21 ARP A

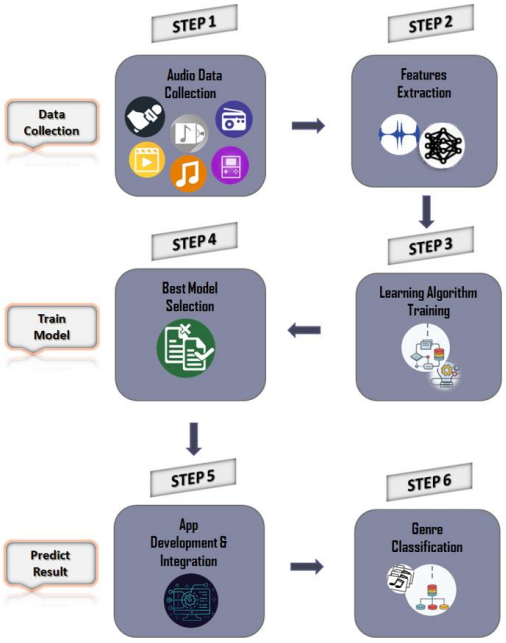
Problem Statement

A digital audio can be classified into many forms like speech, music, natural sounds, artificial sounds, and noise. Therefore, in this project our main aim is on music, identifying the music genre. The term "genre" is a category of art and there are various ways in which music can be divided into different genres, though ten genres are at the top of the music industry right now.
As a large volume of music being released daily on internet platforms, thus it's hard to classify which genre it is and also time-consuming work. Nowadays classification of the genre is an important task for a variety of reasons, including management of large music collections.

Related Work

- A Deep Learning Framework for Classifying Sounds of Mysticete Whales: A marine mammal audio signal processing for identify different whale spices. [1]

Solution/Experiment/Design



Implementation

First, audio data are collected of different genres then understanding different feature extractions in order to use it in learning algorithms. By using Python notebook in Google Colab, extracted features with the help of Librosa Library (a python library mainly used for audio data extraction). Collected feature data from audio files then used in various machine leaning and deep learning algorithms. After obtaining various accuracy outcome selecting the best result. Later integration of the best model with application and classifying an audio genre in real-time.

Evaluation

The accuracy achieved from the RNN-LSTM deep learning model was the best. Even though the accuracy was between 60% to 70% but it was giving results with reduced overfitting issue and for training the model less features were needed. The test results of this can be highly trusted from among all the other model implemented.

Outlook

There are some limitations like cultural songs cannot be identify into any genre. The application can have a better user interface, On the other hand in future, same methodologies can be implemented to other audio related classifications such as instrument classification, speech recognition, noise detection etc.

References

1. Stavros Ntalampiras (2017), Chapter 22: A Deep Learning Framework for Classifying Sounds of Mysticete Whales, Book: Handbook of Neural Computation. Available at: https://www.sciencedirect.com/science/article/pii/B9780128113189000223

Easy Termin - A Web-based Appointment Booking System for International Students

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Applied Research Project A, Winter 2020/21
Information Engineering and Computer Science, M. Sc.

Problem Statement

Every year thousands of international students are coming to Germany for higher education. After coming here, they face various problems. One of them is to get an appointment from the city immigration office. So it is essential to address the international students' issues that they face to get an appointment from the city immigration office (Ausländerbehörde) for city registration, visa extension, and other issues.

Objectives

Providing a centralized web-based platform from where the international students will get help related to issues they face and a timely appointment without waiting longer.

Analysis

We surveyed international students from different universities located in different cities to gather our proposed system's requirements. We found out that almost 90% (Figure 1) of students faced appointment-related issues in the city immigration office. Among them, nearly in total, 50% faced problems during city registration and visa extension (Figure 2). In most of the cities, students used email platform for booking an appointment, and most of them got a reply after a month (68%) (Figure 3). However, the majority did not get an appointment as per their expectation or urgency. They got an appointment one month later (51%) or sometimes more than a month (34%) (Figure 4). As a result, more than 90% faced other issues for not getting the appointment (Figure 5) and around 50% are not satisfied with the current booking system of his/her current city and surprisingly no one responded that he-she is very happy (Figure 6).

Figures

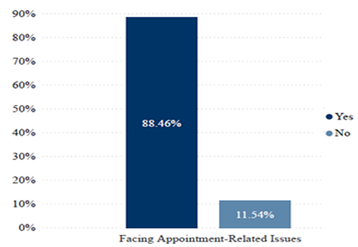

Figure 1

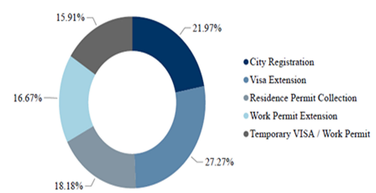

Figure 2

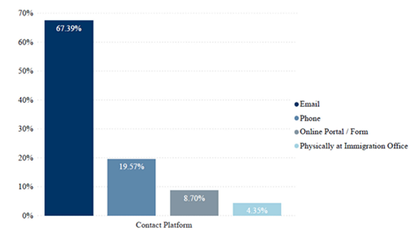

Figure 3

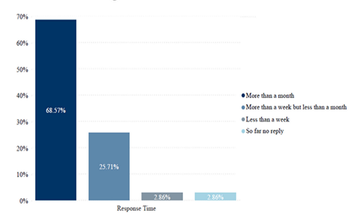

Figure 4

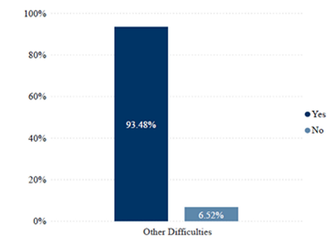

Figure 5

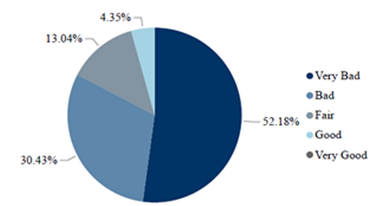

Figure 6

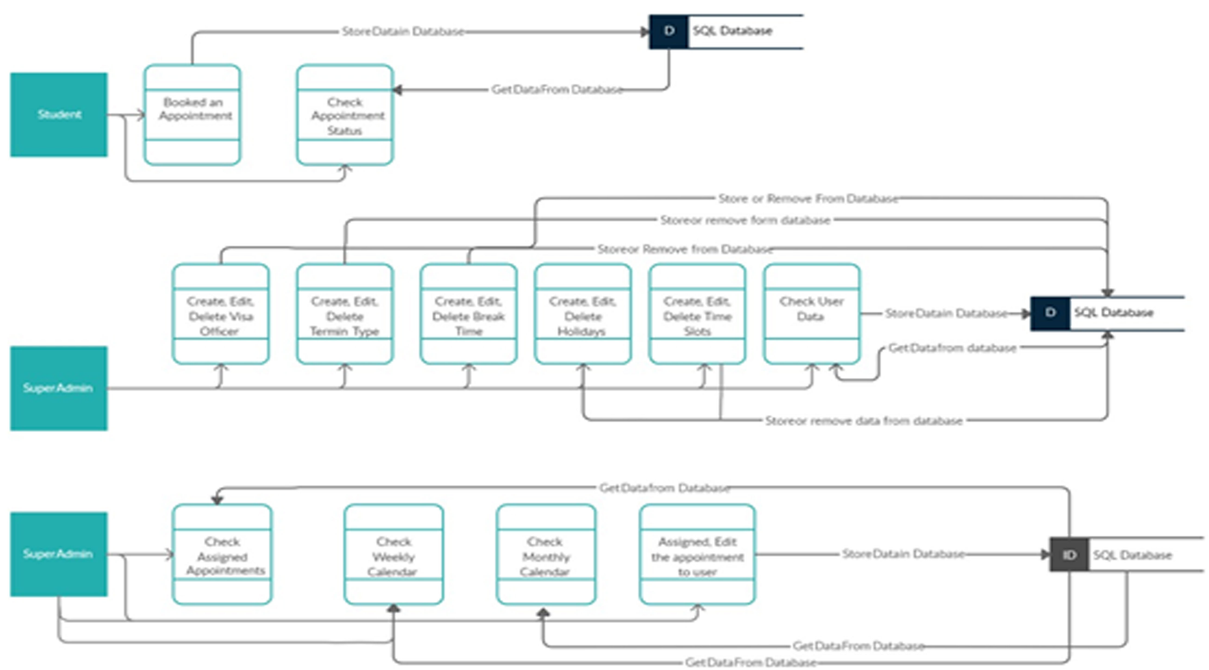

Figure 7

Implementation

We used ASP. NET 3.0 frameworks, Entity framework, and Microsoft SQL as backend teachnology for implementing this system. Figure 7 shows the Data Flow Diagram at Level 1of our proposed system. Before implementing the system, we performed functional and non-functional requirements analysis and created use cases for identifying and clarifying our system requirements.

Discussion

Getting a timely appointment from the city immigration office for city registration and visa extension is a big issue for the international students. During the COVID-19 pandemic situation, the situation is even worse. We implemented the system based on the survey data, and generated an algorithm that depends on the students' visa or residence permit's expiration date. The system can assign appointment requests, both automatically and manually. We could implement more logics for our automatic appointment assigning features if we could gather information from the city immigration of.fices. This is the main drawback of our project. But there are future scops to improve this.

Outlook

Our developed system will help the international students with booking appointments in different city immigration offices in Germany. The authorities can also use this system to book appointments for the students and solve the problems related to the appointments requests.

References

1. Alaa Qaffas, & Trevor Barker (2012). Online Appointment Management System.
2. Bashir Omolaran Bello (2016). Student-Teacher Online Booking Appointment System in Academic Institutions (Vol. 9)

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HOCHSCHULE RHEIN-WAAL
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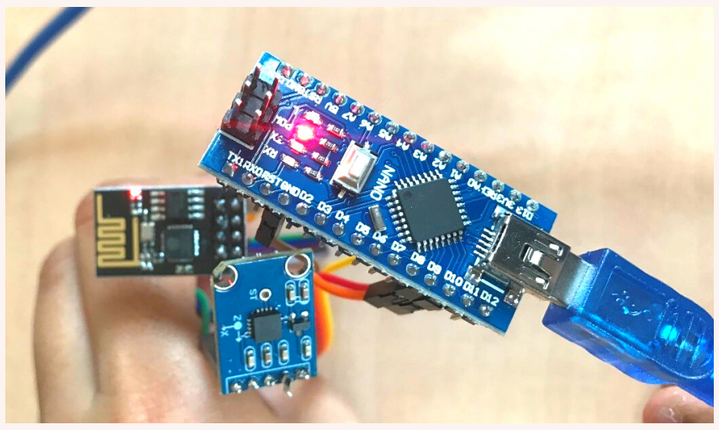
IoT based Physical Rehabilitation Monitor

Problem Statement

In the current scenario of physical rehabilitation therapy one-third of the patients affected fail to continue the rehabilitation exercise regularly and patients continue to prefer game-based therapy activities.Therapists can easily assign rehabilitation motions accompanied with corresponding hardware to patients to meet different goals of therapy, and stroke patients can play any rehab-compatibility games they like during rehabilitation.

Implementation

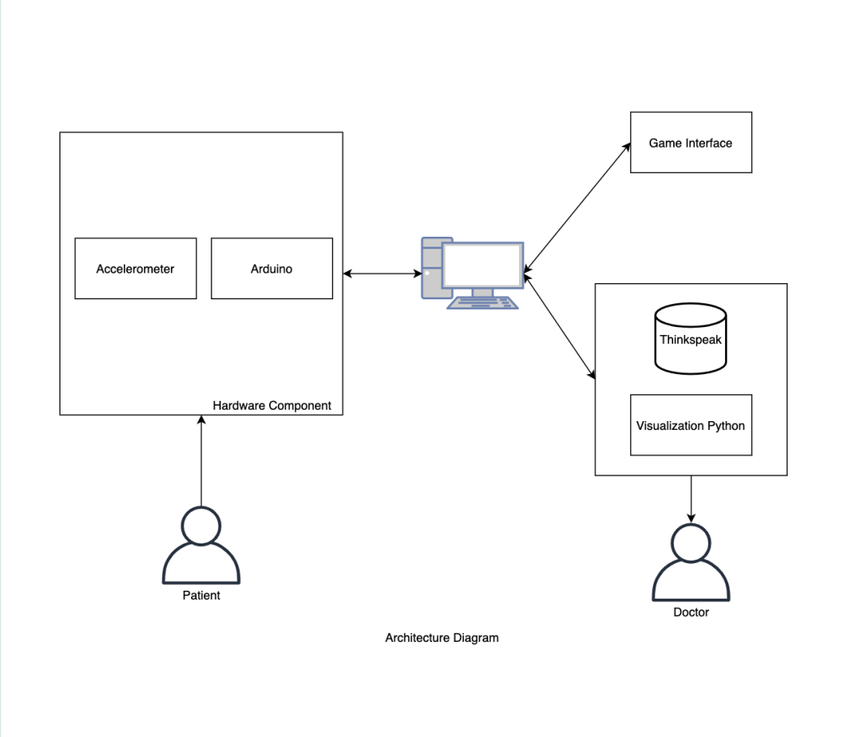
The patient will be provided with a hardware component which consists of Arduino Nano and Accelerometer soldered onto a PCB board and made into a small hand-held device or a wrist band. An accelerometer is connected to the Arduino Nano with female and male pins. The sensor captures the movement and converts the data into the X and Y-axis. The is being sent to the Arduino Nano which then passes the data to the local computer via the serial port. The data captured by the local computer is transmitted via HTTP POST Request to ThinkSpeak cloud to analyze and store data. At the same time, the data collected is being used for gamification. Doctors would be granted admin access to the cloud where they can see the graphs and also download the required data for their further examination.



Methodology

The hardware unit consists of a sensor (Accelerometer) that detects the movement of the limbs. This sensor is connected with the Arduino chip which helps in transmitting the data to the local PC using the serial port. The data generated from the sensor movement is in the form of the X and Y axis which in turn will be stored in the ThingSpeak cloud and also be visualized simultaneously through ThingSpeak API. The visualizations and graphs can be used by doctors to monitor the patients and check for improvements in the course of exercise.

Architecture



Result/Discussion

The gamification and visualization done for this project emphasize two axis X and Y respectively. This is also to be improvised to Z-axis for three-dimensional game development. Specific games for each limb or each type of exercise can be developed to make it more personalized for the patients and the doctors for better improvement.

References

- Daoud, M. I., Alhusseini, A., Ali, M. Z., & Alazrai1, R. (2020). A Game-Based Rehabilitation System for Upper-Limb Cerebral Palsy: A Feasibility Study. Basel: Sensors.
- Vugts, M., Zedlitz, A., Joosen, M., & Vrijhoef, H. (2020). Serious Gaming During Multidisciplinary Rehabilitation for Patients With Chronic Pain or Fatigue Symptoms: Mixed Methods Design of a Realist Process Evaluation. J Med Internet Res.
- Hung, Y.-X., Huang, P.-C., Chen, K.-T., & Chu, W.-C. (2016). What Do Stroke Patients Look for in Game-Based Rehabilitation. Medicine.

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Information Engineering and Computer Science, M. Sc.

HOCHSCHULE RHEIN-WAAL
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Fakultät
Kommunikation und Umwelt

Fake News Detection

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Problem Statement

One of the things that is having an impact on our day-to-day life is fake news. With the worldwide use of social media, online news resources, and a huge number of websites present, fake news is also being produced rapidly. Not only it gets produced but also gets popular among the people which has led people to believe the fake news without knowing if it is genuine or not. It has been seen people being negatively affected by such kinds of news, and it happens more in the political world.

Fake news has paved the way for deceiving people and has created a way for people to promote their ideologies and spreading the wrong information. Spreading this kind of fake information holds various intentions, in particular, to gain favor in political elections, products, and businesses. This has led to difficulties for humans to differentiate between real and fake news. That is why fake news detection is an emerging research area that is gaining interest.

Related Works

Fake news detection is a complex task, there are different forms of fake news, like product reviews, text-based fake news, image-based fake news, humor based fake news, and many more. One of the popular examples of fake news detection is the one used by Twitter, where all the tweets are collected and stored in a Twitter database. Later one if users want to know if it's a piece of genuine news or not, they can copy links to the fake news detection tool of Twitter (Dey, 2020). This application by Twitter uses Named Entity Recognition (NER) for fake news detection.

Solution/Experiment/Design

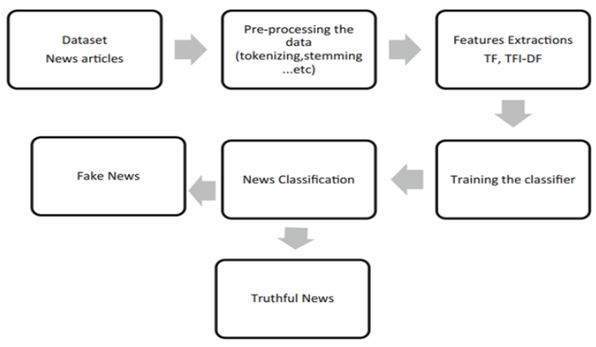

Fig 1: Fake News Detection Processes
(Kaur, Singh Boparai, & Singh, 2019)

This project uses the dataset from the google search results after the user has inserted the search keyword. The web pages' content is then preprocessed using various Natural Language Preprocessing techniques like tokenizing, stemming etc., then the useful features are extracted with TF-IDF algorithm which will later use by the classifier model to classify the news.

We are mainly using two algorithms for detecting fake news i.e., TFIDF (Term Frequency-Inverse Document Frequency-Inverse Document) and LDA (Latent Dirichlet Allocation) algorithms. Both of them uses the concept of word frequency in the document.

Term Frequency-Inverse Document Frequency (TFIDF) is a statistical tool to find the relevancy of a particular word in the documents. Python libraries like NumPy and pandas are used by this TFIDF algorithm to convert textual information into the Vector Space Model (VSM) so that it can be easily processed by the LDA fake news detection model.

After the TFIDF score is calculated, then it is fed into the LDA (Latent Dirichlet Allocation) model. This algorithm maps all the documents to the topics and finds the probability of selecting a particular part when sampling a particular topic and the probability of selecting a particular topic when sampling a particular document. After the probability is calculated if the probability is greater than 0.5 it is referred to as Genuine news, as it shows higher relevancy to the document of similar topics.

Implementation

Our Project ''Fake News Detection" was developed using the Following Tools and Technologies:

1. HTML/CSS/Bootstrap was used to set the overall web layout and design of the website.
2. We used Django framework to set the backend part of our project.
3. PostgreSQL was used for the database.

Result

We successfully run our system in the localhost with the following features:
1. User registration and Login
2. Take the keywords from the user
3. The search results provide the webpages from the google in response to the keywords inserted by the user by using the 'google' module in Python.
4. These results are then pre-processed to extract the features using NLP techniques like tokenizing and stemming.
5. The features extracted with the TF-IDF algorithm serves as the clean data for further classification of the news
6. Then, the genuineness of news is evaluated using LDA algorithm. This algorithm uses the approach of relevancy of topics in the document.
7. Display if the news if GENUINE or NOT
8. Logout from the system

Outlook

This system can be used in various organizations or for personal use to check whether the given news is Genuine or not.

References

Dey, S. (2020). Named Entity Recognitioner on Twitter. Retrieved 12 05, 2020, from towardsdatascience.com: https://towardsdatascience.com/named-entity-recognition-ner-on-twitter-using-bi-directional-lstm-with-tensorflow-in-python-8b85cccc649c

Kaur, P., Singh Boparai, R., & Singh, D. (2019). Hybrid Text Classification Method for Fake News. Retrieved 2020, from ijeat.org: https://www.ijeat.org/wp-content/uploads/papers/v8i5/E7622068519.pdf

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Malware Analysis
(Research & Implementation)

Winter 2020/21
SuperVisor
Prof. Timoh Kahl
Marwin Wiegard

Problem Statement

Malware attacks has been an ongoing process and there is no system in place which ensure complete safety or prevention. Sometime the damage are so huge that the organization run into reputational and financial damage. Data Science being todays leader and machine learning already playing huge rule in early detection of attacks but it reduces the computation so an enriched solution would help us to prevent such an attack.

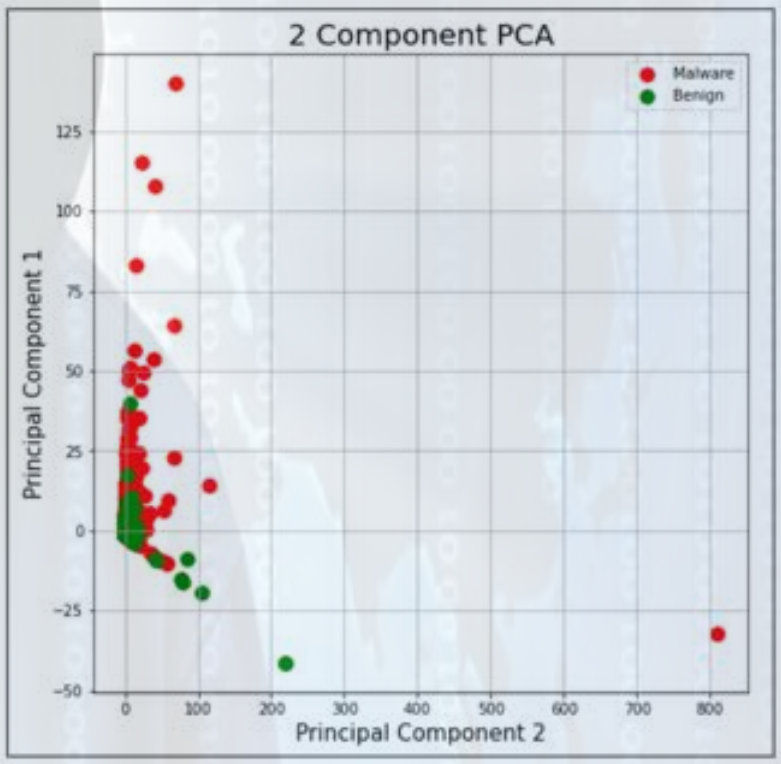
Our Solution

Despite so many attacks happening new solution has been proposed to prevent it

- Two datasets has been thoroughly challenged to see the level of accuracy and result in bring with different Machine Learning Algorithm.
- Various area of analysis has been researched and the gap analysis is performed to understand what could be done better.
- Ensembling allow us to extract the feature of a dataset and ensure high computation
- Behavioural analysis is performed and pattern is considered to understand the various type of attack

Current Results

Classification result shows how the data has been clustered together



Training and Test data has been implemented with machine learning algorithm model to derive the best accuracy in place

```
DecisionTree : 0.9691650853889943
RandomForest : 0.9829222011385199
Adaboost : 0.9715370018975332
GradientBoosting : 0.9772296015180265
GNB : 0.33633776091081596
LinearRegression : -240897784.99544618
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