VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"Jnana Sangama", Belagavi-590018, Karnataka

Internship Report (18CSI85)

on

"VOICE CLASSIFICATION USING MACHINE LEARNING"

Submitted in partial fulfilment for the Award of the Degree of

Bachelor of Engineering

in

INFORMATION SCIENCE AND ENGINEERING

Submitted by

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1BI19IS020

Internship carried out

at

Compsoft Technologies

Rajajinagar-560010

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2022-2023

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CERTIFICATE

This is to certify that the internship carried out by **Ms. Hima Nidhi P** bearing USN **1BI19IS020** a bonafide student of VIII Semester BE, **Bangalore Institute of Technology** in partial fulfillment of Bachelor of Engineering in **INFORMATION SCIENCE AND ENGINEERING** of **Visvesvaraya Technological University**, Belagavi during the year 2022-2023. It is certified that all corrections /suggestions indicated for internal Assessment have been incorporated in the report. The internship report has been approved as it satisfies the academic requirements in respect of internship work prescribed for the said Degree.

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1)

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DECLARATION

I, **Ms. Hima Nidhi P** bearing USN **1BI19IS020** student of VIII semester, Bachelor of Engineering in **INFORMATION SCIENCE AND ENGINEERING** at **BANGALORE INSTITUTE OF TECHNOLOGY, Bangalore** hereby declare that the internship has been carried out at **COMPSOFT TECHNOLOGIES, Rajajinagar, Bangalore**. I further declare that the matter embodied in this report has not been submitted previously to any institution or University for the award of any other Degree/Diploma Certificate.

Name: Hima Nidhi P

USN: 1BI19IS020

Place: Bangalore

ACKNOWLEDGEMENT

I express my heartiest gratitude with great pleasure to **Bangalore Institute of Technology**, Bangalore that providing me with an opportunity to fulfill my cherished desire to attain my goal.

I immensely thank **Mr. Nithin K S**, Project Manager, Compsoft Technologies, for giving me an opportunity to work at Compsoft Technologies.

I immensely thank **Mrs. Vedasree T K**, Assistant Professor, Dept. of ISE, in supporting and guiding me in carrying out my preparations for the internship.

I would like to thank **Dr. Asha T**, Professor and HOD, Dept. of ISE, who continually helped me with her suggestions and ideas.

I extend my thanks to our Principal **Dr. Aswath M U,** for encouraging me in all aspects to complete the internship.

Finally, I thank one and all who have helped me directly or indirectly in the completion of the internship.

- HIMA NIDHI P

(1BI19IS020)

EXECUTIVE SUMMARY

The Report presents the work that has been carried out during the internship at "Compsoft Technologies", Bangalore. During my internship period, I learnt about Machine Learning (ML) using python and classification using ML. The Report contains different chapters which includes the information like company details, departments and projects carried out during the internship. The Project on which I worked during my internship period is voice classification using ML/Speech Emotion Recognition (SER).

As human beings speech is amongst the most natural way to express ourselves. Humans depend so much on it that they recognize its importance when resorting to other communication forms like emails and text messages where they often use emoji's to express the emotions associated with the messages. As emotions play a vital role in communication, the detection and analysis of the same is of vital importance in today's digital world of remote communication. Emotion detection is a challenging task, because emotions are subjective.

The Speech Emotion Recognition (SER) system is defined as a collection of methodologies that process and classify speech signals to detect emotions embedded in them. Such a system can find use in a wide variety of application areas like interactive voice based-assistant or caller-agent conversation analysis. This study detects underlying emotions in recorded speech by analysing the acoustic features of the audio data of recordings.

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CHAPTER 1

ABOUT THE ORGANISATION

Compsoft Technologies is a Technology Organization providing solutions for all web design and development, MYSQL, PYTHON Programming, HTML, CSS, ASP.NET and LINQ. Meeting the ever-increasing automation requirements, Compsoft Technologies specialize in ERP, Connectivity, SEO Services, Conference Management, effective web promotion and tailor-made software products, designing best solutions according to client's requirements. Compsoft Technologies, strive to be the front runner in creativity and innovation in software development through their well-researched expertise and establish it as an out of the box software development company in Bangalore, India. As a software development company, they translate this software development expertise into value for their customers through their professional solutions. They understand that the best desired output can be achieved only by understanding the clients demand better. Compsoft Technologies work with their clients and help them to define their exact solution requirement. They believe that Technology when used properly can help any business to scale and achieve new heights of success. It helps improve its efficiency, profitability, reliability; to put it in one sentence "Technology helps you to Delight your customers" and that is what they want to achieve.

1.1 VISION AND MISSION OF THE COMPANY

VISION

Compsoft Technologies are committed to going the extra mile to bring success to the clients consistently. They are dedicated to delivering the right people, solutions, and services to the clients that they require to meet their technology challenges and business goals.

MISSION

Optimizing client satisfaction with quality services. Delivering the most efficient and the best solution to clients to every client leveraging leading technologies & industry best practices.

1.2 OBJECTIVES OF COMPANY

- Increase the technical knowledge and real time industrial exposure of the students during the commencement of Industrial Training
- Maximize student's employability and increase the rate of placement.
- Branding of College & wider recognition by Industry and Corporate

- Higher Ranking for the College in Surveys
- Possibility of establishing the Centre of Excellence by the Industry

  To work with the clients and help them to define their exact solution requirement.
- To develop responsive, functional and super-fast websites which should be accessible even on a small view-port and slow internet connection

1.3 ORGANIZATIONAL STRUCTURE

An organization structure shown in Figure 1.1 is used by the organization to provide an overall hierarchy and reporting structure for each job within the organization, and defines how an organization will operate to meet its goals. For small businesses, one of several basic types of organizational structure can provide a platform to allow for future growth without making extensive changes to job responsibilities, the management structure or financial budgets for each area. Bureaucratic structures have many levels of management ranging from senior executives to regional managers, all the way to department store managers. Since there are many levels, decision-making authority has to pass through more layers than flatter organizations. A bureaucratic organization has rigid and tight procedures, policies and constraints.

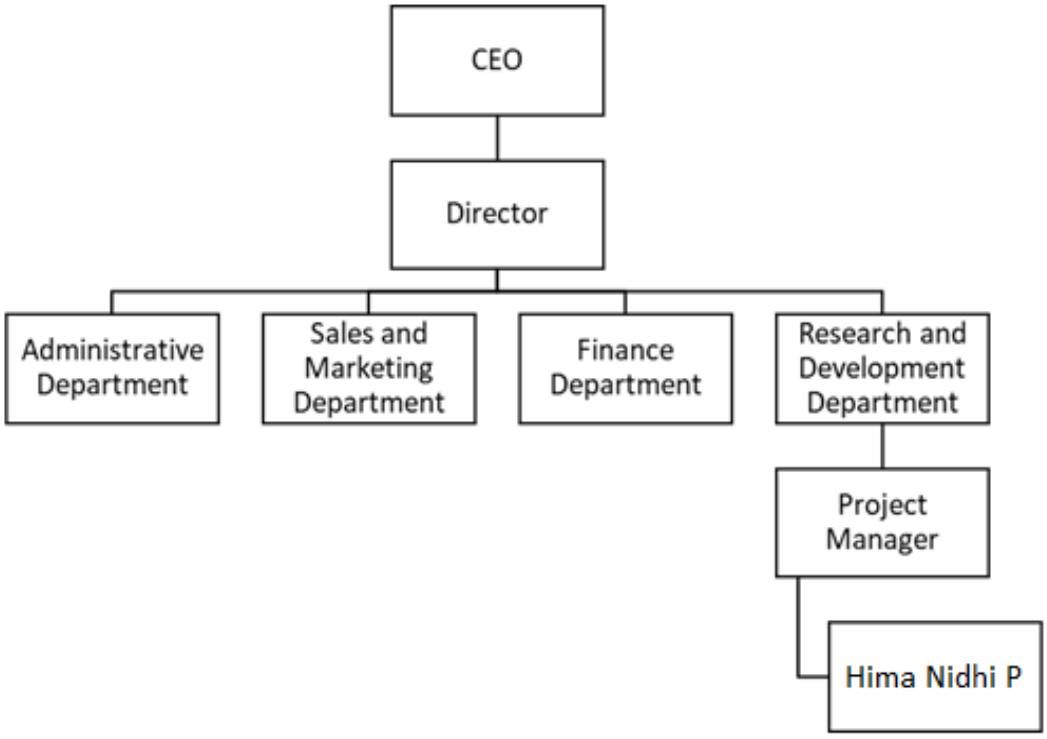

Figure 1.1: Organizational Structure

1.4 DEPARTMENTS

- **Administrative Department:** Administration department is backbone of an organization. An effective administrator is an asset to an organization. It is the link between an organization's various departments and ensures the smooth flow of information from one part to the other. Thus without an effective administration, an organization would not run professionally and smoothly. Administrator Department has the ability:

  • To understand general concepts of Administration
  • To enhance the office staff's ability to manage and organize office effectively and professionally
  • File in the proper way and filing standard
  • Develop an appropriate office management strategy
  • Develop an appropriate assets management strategy
  • Able to develop administrative procedures.
  • Able to plan and control administrative budget
  • To manage Infrastructure design.
  • To handle the Human resources in an effective manner.
  • To regularly check the Technical issues.
  • To endure the Office of Ethics in the organization.

- **Research and Development Department:** A research and development (R&D) department performs a number of highly important roles within an organization. They are responsible for research, planning, and implementing new programs and protocols into their organization and overseeing the development of new products. The industry in which a research and development department works will likely have an impact on their specific duties, as these professionals often find employment in fields like healthcare, technology, business, and pharmaceuticals. Research and Development Department has the ability to:

  • Develop concepts, products, and solutions by coordinating with business units.
  • Understand customer expectations on to-be manufactured product.
  • Determine and execute improved technologies used by suppliers, competitors, and customers.
  • Support Director to hire and develop R&D personnel.
  • Establish project goals and priorities by collaborating with Marketing and Operations.
  • Transfer new technologies, products, and manufacturing process into and out of the company.
  • Research, design and evaluate materials, assemblies, processes and equipment.
  • Monitor team metrics and objectives ensuring meeting of goals.
  • Document all phases of research and development.

- **Sales and Marketing Department:** The Sales and Marketing Department plays a vital role in promoting the business and mission of an organization. It serves as the face of company, coordinating and producing all materials representing the business. It is the Department's job to reach out to prospects, customers, investors and/or the community, while creating an overarching image that represents your company in a positive light. Sales and Marketing Department has the ability to:

    • Defining and managing the brand.
    • Producing marketing and promotional materials.
    • Monitoring and managing social media.
    • Producing internal communications.
    • Conducting customer and market research.
    • Overseeing outside vendors and agencies.

- **Finance Department:** Finance Department is the part of an organization that is responsible for acquiring funds for the firm, managing funds within the organization and planning for the expenditure of funds on various assets. It is the part of an organization that ensures efficient financial management and financial control necessary to support all business activities. The contributions of finance department to any company and how these contributions positively affect organizational performance will greatly depend on factors such as the extent to which the owner/ manager is involved in his company. Finance Department has the ability to:

    • Bookkeeping
    • Management of company’s cash flow
    • Budgets and forecasting
    • Advising and sourcing longer-term financing
    • Management of Taxes
    • Management of Company’s Investment

1.5 SERVICES OF THE COMPANY

They have a great team of skilled mentors who are always ready to direct their trainees in the best possible way they can and to ensure the skills of mentors they hold many skill development programs as well so that each and every mentor can develop their own skills with the demands of the companies

- **Development**

  They develop responsive, functional and super-fast websites. The company keeps User Experience in mind while creating websites. A website should load quickly and should be accessible even on a small view-port and slow internet connection.

- **Branding and Design**

  They offer professional Graphic design, Brochure design & Logo design. They are experts in crafting visual content to convey the right message to the customers. They also design custom wraps for your products (also known as package designing)

- **Search Engine Optimisation**

  They help you gain market share by leveraging our expertise. Their holistic approach to identify anything that may be hurting your traffic or rankings and show you just how to outrank the competition.

- **Embedded Systems and IoT**

  CST works with Consumer Electronics, Lighting, Home Automation, Metering, Sensor-Technology, Home Appliance and Medical Device companies to help them create smart and connected products.

CHAPTER 2

ABOUT THE DEPARTMENT

There are departments on various internships domains like the following.

- EMBEDDED SYSTEMS
- ARTIFICIAL INTELLIGENCE
- MACHINE LEARNING
- INTERNET OF THINGS

I had worked in the machine learning domain.

2.1 ABOUT THE WORKING DEPARTMENT

Today's highly increasing competitiveness over the industry demands high quality and most consistent products with a competitive price. To address this challenge number of industries considering various new product designs and integrated manufacturing techniques in parallel with the use of automated devices. Automation takes a step further mechanization that uses a particular machinery mechanism aided human operators for performing a task. Mechanization is the manual operation of a task using powered machinery that depends on human decision making. One of the remarkable and influential moves for getting the solutions of above-mentioned challenge is the industrial automation. Industrial Automation facilitates to increase the product quality, reliability and production rate while reducing production and design cost by adopting new, innovative and integrated technologies and services. Figure 2.1 depicts the domains under the Research and Development department.

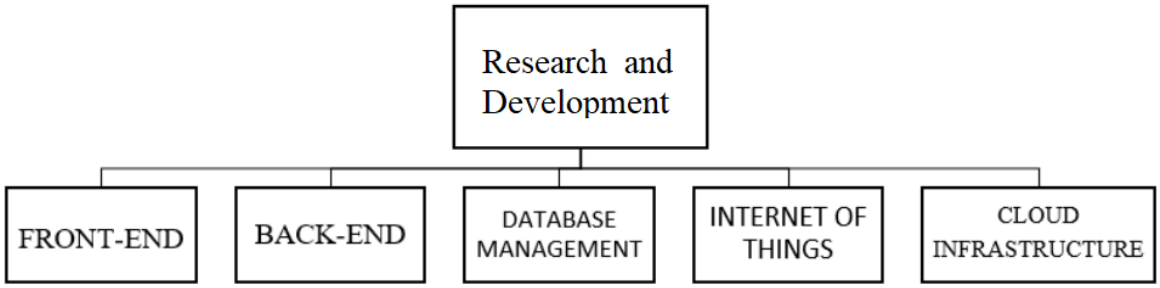

Figure 2.1: Research and development department

The Research and Development Department comprises of sub-departments and those are:

- **Front-end department** – The department includes front-end engineer who create, design, and implement a website or web-based application's user interface (UI). A front-end engineer's primary duty is to create a visual and easy-to-use experience for end users using data provided by the back-end engineers. Engineers of this department involve working on technologies like HTML5, CSS3, JavaScript, jQuery, AngularJS, ReactJS.

- **Back-end department** – The department includes back-end developers who experts build and maintain the mechanisms that process data and perform actions on websites. Unlike front-end developers, who control everything you can see on a website, back-end developers are involved in data storage, security, and other server-side functions that you cannot see. Engineers of this department involve working on technologies like Java, Python.

- **Cloud infrastructure** – The department includes engineers who provide services, specially opted for companies where they can simplify applications, store, share and protect content of their data while having access to the same from private networks across different platforms. They design the potential of cloud services that results in acceleration of business process and generate huge growth with greater flexibility. Engineers of this department involve working on technologies that include Azure, AWS, Azure apps, Docker, Elastic Beanstalk

- **IOT**- This department helps customers to understand and unlock the value of IoT and interact with IoT devices using apps built for web and mobile.

- **Database Management** - A data management team's main goal is to make sure enterprise data assets meet business requirements and the information needs of users. To achieve that, the team works to make data available and accessible for the planned uses and ensure that it's accurate, reliable and properly organized. This department involves working on technologies like Microsoft SQL Server, MySQL, Mongo dB, PostgreSQL.

2.2 OBJECTIVES OF DEPARTMENT

- Providing complete knowledge of AI & ML.
- Able to Program, Test & Debug of Software.
- Real-time Projects Execution.

2.3 ORGANIZATIONAL PROCEDURE

1. Analysis

- Pre-Project Analysis – Techno-Logics will perform a complete analysis of your requirements to ensure ease of integration and “Best in Class” solutions.

2. Proposal

- Accurate quotes that include detailed preliminary schedules
- Comprehensive risk analysis

3. Design

- Designing a complete network structure, schematics
- Prepare detailed sequence of operation.
- Detail a complete panel layout, wiring diagram, loop diagrams etc.
- Select all required controllers, field devices, components, peripherals and software.

4. Planning

- Detailed “Plan of Action” using Microsoft Project
- Communicate expectations to the clients/customer

5. Execution

- Detailed Scope of Work / Description of Operation
- Action item list
- Project risk management
- Customer approval milestones and project deliverable management.

6. Controlling/Monitoring

- Timely project status updates
- Networked tools for accurate project reporting

7. Summary/Closing

- Lessons learned

CHAPTER 3

TASKS ASSIGNED AND PERFORMED

During my internship on developing a project named “Voice classification using ML” I was assigned set of tasks which are described below in detail.

3.1 TECHNICAL ACTIVITIES PERFORMED IN COMPANY

As an Intern, I was assigned to work in the Engineering and Development department. My team had to work on developing AI/ML-based project named “Voice classification using ML” which includes the deep learning techniques which is based on simple algorithm for feature extraction and model creation which recognizes the emotion behind a speech. As an intern I was trained on selected libraries in jupyter notebook.

3.2 REQUIREMENT SPECIFICATION

System Requirements specifies the hardware and software requirements that are necessary to begin with performing the given tasks accurately.

3.2.1 HARWARE REQUIREMENTS

Table 3.1 Hardware Requirements

Processor	Intel Core i5 processor
RAM	8 GB or above
Hard Disk	40 GB or above
Memory	15.6 GB

3.2.2 SOFTWARE REQUIREMENTS

Table 3.2 Software Requirements

OS	Windows 8 or later
Programming Language	Python
IDE	Visual Studio Code
Dataset	Open source dataset

3.3 TASKS ASSIGNED AND PERFORMED

Table 3.3 Internship Timeline

SL. NO.	WEEK	TASKS ASSIGNED	TASKS PERFORMED
1	Week 1 (25th Aug 2022- 1st Sept 2022)	• Know about the company and interact with team. • Learn Basics of python modules and their implementation	• Knowing about company • Training on python modules.
2	Week 2 (2nd Sept - 8th Sep 2022)	• Selection of team leader • Formation of team • Learnt about AI/ML and the usage of it in real world to solve various problems.	• Domain Training • Team Leader Selection • Team Formation • Project Analysis & Design
3	Week 3 (9th Sep 2022-15th Sep 2022)	• Start to work on SER • Read about datasets and various factors that contribute to it.	• Collected datasets and started pre-processing it.
4	Week 4 (16th Sep 2022 – 22nd Sep 2022)	• Apply various algorithm on SER • Compare the results.	• Algorithms were applied on SER and results were compared to know which has best accuracy.

3.4 BASIC TRAINING

During the first 10 days of the internship, the interns were given basic training on topics involved in the project and basic concepts of machine learning. The following section summarises the basic training needed that the interns were given for working on projects.

3.4.1 MACHINE LEARNING

Artificial Intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think and act like humans. It involves the development of algorithms and computer programs that can perform tasks that typically require human intelligence such as visual perception, speech recognition, decision-making, and language translation. Machine learning is a type of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed.

Machine learning focuses on the development of Computer Programs that can change when exposed to new data. Machine Learning is making the computer learn from studying data and statistics. It is a step into the direction of artificial intelligence (AI). It is a program that analyses data and learns to predict the outcome. Lately, organizations are investing heavily in newer technologies like Artificial Intelligence, Machine Learning and Deep Learning to get the key information from data to perform several real-world tasks and solve problems. It can be called as data-driven decisions taken by machines, particularly to automate the process. These data-driven decisions can be used, instead of using programming logic, in the problems that cannot be programmed inherently. The fact is that it can’t be done without human intelligence, but other aspect is that it needs to solve real-world problems with efficiency at a huge scale. That is why the need for machine learning arises.

3.4.2 MACHINE LEARNING ALGORITHMS

i. Logistic Regression (Scikit-learn)

Logistic regression, despite its name, is a classification algorithm rather than regression algorithm. Based on a given set of independent variables, it is used to estimate discrete value (0 or 1, yes/no, true/false). It is also called logit or MaxEnt Classifier. Basically, it measures the relationship between the categorical dependent variable and one or more independent variables by estimating the probability of occurrence of an event using its logistics function. sklearn.linear_model . Logistic Regression is the module used to implement logistic regression.

ii. Naive Bayes (Scikit-learn)

Naive Bayes methods are a set of supervised learning algorithms based on applying Bayes' theorem with a strong assumption that all the predictors are independent to each other i.e. the presence of a feature in a class is independent to the presence of any other feature in the same class. This is naïve assumption that is why these methods are called Naïve Bayes methods.
Bayes theorem states the following relationship in order to find the posterior probability of class i.e. the probability of a label and some observed features, P(Y | features).

P(Y | features)=(P⁡(Y)P(features | Y)P(features))P(Y|features)=(P⁡(Y)P(features|Y)P(features))

Here, P(Y | features)P(Y | features) is the posterior probability of class.

P(Y)P(Y) is the prior probability of class.

P(features | Y) P(features | Y) is the likelihood which is the probability of predictor given class.

P(features)P(features) is the prior probability of predictor.

The Scikit-learn provides different naïve Bayes classifiers models namely Gaussian, Multinomial, Complement and Bernoulli. All of them differ mainly by the assumption they make regarding the distribution of ***P*** (features | Y)P(features | Y) i.e. the probability of predictor given class.

iii. Support Vector Machine (Linear) (Scikit-learn)

Support Vector Machines (SVMs) are powerful yet flexible supervised machine learning methods used for classification, regression, and, outliers' detection. SVMs are very efficient in high dimensional spaces and generally are used in classification problems. SVMs are popular and memory efficient because they use a subset of training points in the decision function. The main goal of SVMs is to divide the datasets into number of classes in order to find a Maximum Marginal Hyperplane (MMH) which can be done in the following two steps-

i. Support Vector Machines will first generate hyperplanes iteratively that separates the classes in the best way.
ii. After that it will choose the hyperplane that segregate the classes correctly.

iv. K-Nearest Neighbours (Scikit-learn)

Neigbor based learning method have 2 type namely supervised and unsupervised. Supervised neighbors-based learning can be used for both classification as well as regression predictive problems

but, it is mainly used for classification predictive problems in industry. Neighbours based learning methods do not have a specialised training phase and uses all the data for training while classification. It also does not assume anything about the underlying data. That's the reason they are lazy and non-parametric in nature. The main principle behind nearest neighbour methods is −

- To find a predefined number of training samples closet in distance to the new data point
- Predict the label from these number of training samples.

v. Decision Tree (Scikit-learn)

Decision tree is the most powerful and popular tool for classification and prediction. A decision tree is a flowchart-like tree structure, where each internal node denotes a test on an attribute, each branch represents an outcome of the test, and each leaf node (terminal node) holds a class label.

The strengths of decision tree methods are:

- Decision trees are able to generate understandable rules.
- Decision trees perform classification without requiring much computation.
- Decision trees are able to handle both continuous and categorical variables.
- Decision trees provide a clear indication of which fields are most important for prediction or classification.

The weaknesses of decision tree methods:

- Decision trees are less appropriate for estimation tasks where the goal is to predict the value of a continuous attribute.
- Decision trees are prone to errors in classification problems with many class and relatively small number of training examples.

3.4.3 PYTHON

Python is a high-level, interpreted, general-purpose programming language. Its design philosophy emphasizes code readability with the use of significant indentation. Python is dynamically-typed and garbage-collected. It supports multiple programming paradigms, including structured (particularly procedural), object-oriented and functional programming. It is often described as a "batteries included" language due to its comprehensive standard library.

3.4.4 ADVANTAGES OF PYTHON

i. Easy to Read, Learn and Write

Python is a high-level programming language that has English-like syntax. This makes it easier to read and understand the code. Python is really easy to pick up and learn, that is why a lot of people recommend Python to beginners. Less lines of code can perform the same task as compared to other major languages like C/C++ and Java.

ii. Improved Productivity

Python is a very productive language. Due to the simplicity of Python, developers can focus on solving the problem. They don't need to spend too much time in understanding the syntax or behaviour of the programming language.

iii. Interpreted Language

Python is an interpreted language which means that Python directly executes the code line by line. In case of any error, it stops further execution and reports back the error which has occurred. Python shows only one error even if the program has multiple errors. This makes debugging easier.

iv. Dynamically Typed

Python doesn't know the type of variable until the code is run. It automatically assigns the data type during execution. The programmer doesn't need to worry about declaring variables and their data types.

v. Free and Open-Source

Python comes under the OSI approved open-source license. This makes it free to use and distribute. User can download the source code, modify it and even distribute their version of Python. This is useful for organizations that want to modify some specific behaviour and use their version for development.

vi. Vast Libraries Support

The standard library of Python is huge, user can find almost all the functions needed for their task. So, they don't have to depend on external libraries. But even if they do, a Python package manager (pip) makes things easier to import other great packages from the Python package index (PyPi). It consists of over 200,000 packages.

vii. Portability

In many languages like C/C++, there is a need to change code to run the program on different platforms. Python follows write the code once and run it anywhere.

3.4.5 DIALOGFLOW

Dialogflow is a Google-owned framework that enables users to develop human-computer interaction technologies that can support Natural Language Processing (NLP). Basically, it lets them to make Digital Programs that interact with end users through natural languages.

3.4.6 JUPYTER NOTEBOOK INTERFACE

Jupyter notebooks allow users to combine executable code and rich text in a single document, along with images, HTML, LaTeX and more. When user creates their own Jupyter notebooks, they are stored in their Local Computer. Users can easily share their Jupyter notebooks with co- workers or friends, allowing them to comment on their notebooks or even edit them. To learn more, see Overview of Jupyter. To create a new Jupyter notebook user can use the File menu above, or use the following link create a new Jupyter notebook. Jupyter notebooks that are hosted by Anaconda Navigator to learn more about the Jupyter project, see jupyter.org

3.4.7 MODULES IN PYTHON

The various modules that was learnt during the training are: -

• NumPy

NumPy is a very popular python library for large multi-dimensional array and matrix processing, with the help of a large collection of high-level mathematical functions. It is very useful for fundamental scientific computations in Machine Learning. NumPy supports a wide range of hardware and computing platforms, and plays well with distributed, GPU, and sparse array libraries.

• SciPy

SciPy is a very popular library among Machine Learning enthusiasts as it contains different modules for optimization, linear algebra, integration and statistics. There is a difference between the SciPy library and the SciPy stack.

• Scikit-learn

Scikit-learn is one of the most popular ML libraries for classical ML algorithms. It is built on top of two basic Python libraries, viz., NumPy and SciPy. Scikit-learn supports most of the supervised and unsupervised learning algorithms. Scikit-learn can also be used for data-mining and data-analysis, which makes it a great tool who is starting out with ML.

• Pandas

Pandas is a popular Python library for data analysis. It is not directly related to Machine Learning. The dataset must be prepared before training. In this case, Pandas comes handy as it was developed specifically for data extraction and preparation. It provides high-level data structures and wide variety tools for data analysis. It provides many inbuilt methods for groping, combining and filtering data.

• Matplotlib

Matplotlib is a very popular Python library for data visualization. Like Pandas, it is not directly related to Machine Learning. It particularly comes in handy when a programmer wants to visualize the patterns in the data. It is a 2D plotting library used for creating 2D graphs and plots.

3.5 IMPLEMENTATION DETAILS

Speech Emotion Recognition (SER), is the act of attempting to recognize human emotion and affective states from speech. This is capitalizing on the fact that voice often reflects underlying emotion through tone and pitch. This is also the phenomenon that animals like dogs and horses employ to be able to understand human emotion. SER is tough because emotions are subjective and annotating audio is challenging.

If ever noticed, call centres employees never talk in the same manner, their way of pitching/talking to the customer's changes with customers. Now, this does happen with common people too, but how is this relevant to call centres? Here is the answer, the employees recognize customers' emotions from speech, so they can improve their service and convert more people. In this way, they are using speech emotion recognition. The primary objective of SER is to improve man-machine interface. It can also be used to monitor the psycho physiological state of a person in lie detectors. In recent time, speech emotion recognition also finds its applications in medicine and forensics.

3.5.1 EXISTING SYSTEM

An emotion recognition system based on digitized speech is comprised of three fundamental components signal pre-processing feature extraction and classification. Acoustic pre-processing such as denoising as well as segmentation is carried out to determine meaningful units of this signal. Feature extraction is utilized to identify the rare event feature available in the signal. Lastly, the mapping of extracted feature vectors to relevant emotion is carried out by classifiers.

In this section, a detailed discussion of speech signal processing, feature extraction, and classification is

provided also the differences between spontaneous and acted speech are discussed due to their relevance to the topic. Figure 3.1 depicts a simplified system utilized for speech-based emotion recognition. In the first stage of speech based signal processing, speech enhancement is carried out where the noisy components are removed. The second stage involves two parts, feature extraction and feature selection. The required features are extracted from the pre-processed speech signal and the selection is made from the extracted features. Such feature extraction and selection are usually based on the analysis of speech signals in the time and frequency domains. During the third stage, various classifiers such as GMM and HMM, etc. are utilized for the classification of these features. Lastly, based on feature classification different emotions are recognized.

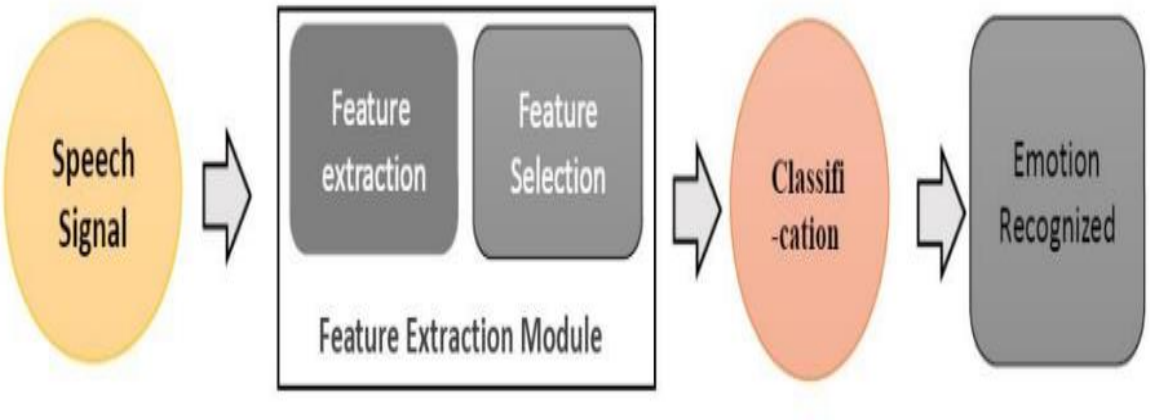

Figure 3.1: Traditional speech recognition system

3.5.2 PROPOSED SYSTEM

The system can recognize emotions from speech. It uses an MLP Classifier for this and sound file library to read the sound file, and the librosa library to extract features from it. The model delivered an accuracy of 72.4%. That's good enough yet.

Objectives of the system:

- Its application work in different areas
- Its implementation as a desktop Application
- This application as software that can be used for Speech Recognition
- Developing software for speech recognition
- Speech recognition is a technology that able a computer to capture the words spoken by a human with a help of microphone

- To build a model to recognize emotion from speech using the librosa and sklearn libraries and the RAVDESS dataset.

3.5.3 DESIGN ANALYSIS

The representation of emotions can be done in two ways:

- **Discrete Classification**: Classifying emotions in discrete labels like anger, happiness, boredom, etc.
- **Dimensional Representation**: Representing emotions with dimensions such as Valence (on a negative to positive scale), Activation or Energy (on a low to high scale) and Dominance (on an active to passive scale)

The dimensional approach is more elaborate and gives more context to prediction but it is harder to implement and there is a lack of annotated audio data in a dimensional format. The discrete classification is more straightforward and easier to implement but it lacks the context of the prediction that dimensional representation provides. The project uses discrete classification approach in the current study for lack of dimensionally annotated data in the public domain.

Data sources used for this project is RAVDESS it contains 2452 audio files, with 12 male speakers and 12 Female speakers, the lexical features (vocabulary) of the utterances are kept constant by speaking only 2 statements of equal lengths in 8 different emotions by all speakers.

Features used in this project are:

- **MFCC (Mel Frequency Cepstral Coefficients)**: In the conventional analysis of time signals, any periodic component (for example, echoes) shows up as sharp peaks in the corresponding frequency spectrum (i.e. Fourier spectrum. This is obtained by applying a Fourier transform on the time signal). Any cepstrum feature is obtained by applying Fourier Transform on a spectrogram. The special characteristic of MFCC is that it is taken on a Mel scale which is a scale that relates the perceived frequency of a tone to the actual measured frequency. It scales the frequency in order to match more closely what the human ear can hear. The envelope of the temporal power spectrum of the speech signal is representative of the vocal tract and MFCC accurately represents this envelope.

- **Mel Spectrogram**: A Fast Fourier Transform is computed on overlapping windowed segments of the signal, and we get what is called the spectrogram. This is just a spectrogram that depicts amplitude which is mapped on a Mel scale.

- **Chroma:** A Chroma vector is typically a 12-element feature vector indicating how much energy of each pitch class is present in the signal in a standard chromatic scale.

3.5.4 IMPLEMENTATION

Implementation is the stage where the theoretical design is turned into a working system. The most crucial stage in achieving a new successful system and in giving confidence on the new system for the users that it will work efficiently and effectively. The system can be implemented only after thorough testing is done and if it is found to work according to the specification. It involves careful planning, investigation of the current system and it constraints on implementation, design of methods to achieve the change over and an evaluation of change over methods a part from planning.

Two major tasks of preparing the implementation are education and training of the users and testing of the system. The more complex the system being implemented, the more involved will be the system analysis and design effort required just for implementation. The implementation phase comprises of several activities. The required hardware and software acquisition is carried out. The system may require some software to be developed. For this, programs are written and tested. The user then changes over to his new fully tested system and the old system is discontinued.

The first step in implementing the Speech Emotion Recognition system is to collect audio samples under different emotional categories which can be used to train the model. The audio samples are usually wave or mp3 files and publically available for download. Visualizing the data gives more understanding of the problem and the type of solution to be built. The distribution of classes, the number of instances under each category, the spread of the data, the correlation between the features and clustering are a few methods to visualize the data. Python provides statistical functions for data visualization.

3.6 RESULT

Using the matplotlib library the accuracy of the model is visualized as shown in Figure 3.2

```
epochs = list(range(50))
acc = history.history['accuracy']
val_acc = history.history['val_accuracy']

plt.plot(epochs, acc, label='train accuracy')
plt.plot(epochs, val_acc, label='val accuracy')
plt.xlabel('epochs')
plt.ylabel('accuracy')
plt.legend()
plt.show()
```

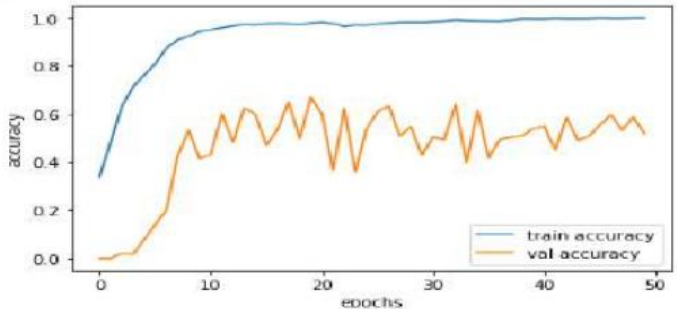

Figure 3.2: Accuracy of the model

Using the matplotlib library the loss of the model is visualized as shown in Figure 3.3

```
loss = history.history['loss']
val_loss = history.history['val_loss']

plt.plot(epochs, loss, label='train loss')
plt.plot(epochs, val_loss, label='val loss')
plt.xlabel('epochs')
plt.ylabel('loss')
plt.legend()
plt.show()
```

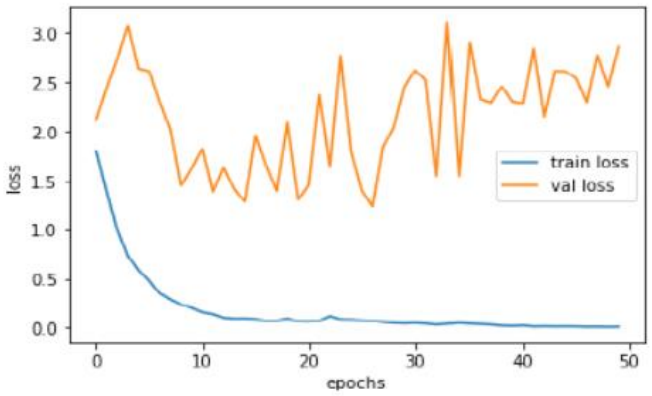

Figure 3.3: Loss of the model

The system achieved an accuracy of 72.4% and snapshot of the output is shown in Figure 3.4

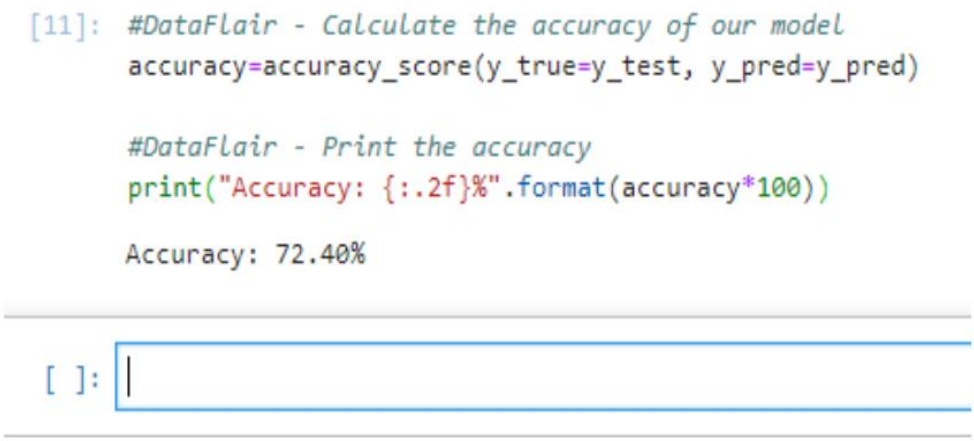

Figure 3.4: Output of Accuracy obtained in the system

Model was tried running by giving different data and the result obtained is as follows in Table 3.4

Table 3.4: Test cases for accuracy and loss

TEST CASE	VAL ACCURACY (%)	VAL LOSS (%)
1	73	27
2	70	30
3	68	32
4	70	30
5	75	25
6	70	30
MEAN	71 %	29%

CHAPTER 4

REFLECTION OUTCOMES

My technical capabilities as well as soft skills such as interpersonal communication, written skills, and presenting skills improved as a result of the internship. Internships enabled me to have a better awareness of industry norms and practices. It aided in the application of various technological abilities learned in the classroom to a real-world assignment. It also helped me to improve my technical knowledge.

An internship is a type of experiential learning that combines classroom knowledge and theory with hands-on experience and skill development in professional settings. Internships provide us with the opportunity to get practical experience. They are a great opportunity to obtain valuable work experience and expand your professional network. An internship can help you advance your career by giving you hands-on experience.

I was exposed to a variety of on-going technology, and there is always room for fresh ideas. It is far more crucial to be able to maintain and accomplish activities under pressure. Team meetings and sessions are beneficial in obtaining clarifications or answers to specific difficulties. Internship experience was beneficial since it strengthened both my technical and non-technical skills while also allowing me to gain practical experience in the business while working with seasoned experts who led me through the entire process.

After all, it allows us to demonstrate our talents, build work experience, and to understand institutional organization. Internships also provide an opportunity for us to get to grips with working – meeting deadlines and working in a team. Internships give us and the employer a chance to ‘try before you buy’ and clarify whether this type of work is really for us. It’s easy to characterize an internship as a “learning experience” or the opposite, but it takes a little more work to figure out what are the positive and negative elements of the experience. The internship's scope includes the need that students translate their practical experiences into a critical study of the internship. An assessment of the educational benefits they gained, an assessment of the activity in which they were involved, and a thoughtful judgement of the overall value that internship added to their education.

4.1 TECHNICAL OUTCOMES

- During internship, with the help of my mentors I was able to gain knowledge in addressing Engineering problems, Engineering Design practice, Risk assessment and I feel I am better prepared to enter Industries with this experience.

- Skills acquired are:
  - Artificial Intelligence and its domains.
  - Machine Learning Concepts.
  - Machine Learning algorithms.
  - Python Programing Fundamentals.

4.2 NON-TECHNICAL OUTCOMES

This section summarizes the non-technical aspects of the internship. It includes communication skills, interaction and soft skills, problem solving skills, adaptability skills and time management skills.

4.2.1 COMMUNICATION SKILLS

Communication is an integral part of any written and verbal communication for getting better results. The internship program has given me an opportunity to mobilize the information from various industry sources including company brochures, websites, journals, industry magazines and consolidate the required information according to the theme of the internship project undertaken.

4.2.2 INTERACTION AND SOFT SKILLS

The internship program has provided extensive interaction with industry professionals and academicians. The internship has groomed soft skills and builds multifaceted persona in me to create competencies and nurture personalities in students to serve the nation and world at large as engineering luminaries, technocrats, scientist and statesmen.

4.2.3 PROBLEM SOLVING SKILLS

In Compsoft Technologies corporate, problems of all kinds are sure to arise. It's inevitable. though you can't predict the nature of the problems you'll encounter in the future, you can prepare by hiring employees who are comfortable solving problems. An employee who can't solve problems on their own will require you to essentially do it for them which will be a burden on your time, your resources, and your patience. During this internship I learnt that the best opportunities and discoveries often arise from problems and someone's ability to creatively solve them. So, when issue came up, I did deep dive to look into root cause and come up with multiple approaches and provide good results to the project.

4.2.4 ADAPTABILTY SKILLS

Not everyone is adaptable from the beginning. Being adaptive to the company's surroundings easily is one of the most useful soft skills not only desirable to employers but also important to interns self-growth. This internship helped me improve my adaptability skills.

4.2.5 TIME MANAGEMENT SKILLS

Time management was one of the non-technical skills I had to master and manage during my internship course, according to my availability. Time management is a valuable skill that everyone should learn. It refers to not just how one uses time to achieve a specific activity, but also how one manages time and works efficiently. When a task is assigned, the first step is to prioritize it. The urgent tasks should be completed first than the important work. Taking breaks in between work is not at all a waste of time. I also believe that taking regular breaks between works helps to keep mind refreshed and improves the thinking capacity. At the end of the day, one has to complete the given the task within the given deadline. Time management may be aided by a range of skills, tools, and techniques used to manage time when accomplishing specific tasks, projects, and goals complying with a due date. Initially, time management referred to just business or work activities, but eventually, the term broadened to include personal activities as well.

REFERENCES

[1] Machinelearningmastery-https://machinelearningmastery.com/

[2] Kaggle- https://www.kaggle.com/

[3] Github- https://github.com/

[4] GoogleAI- https://ai.google/

[5] Speech Emotion Recognition(SER)- https://www.SpeechEmotionRecognition.com/

[6] Compsoft Technologies- https://www.compstechnologies.com/s