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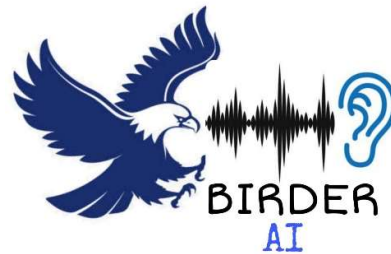
Department of Computer Science and Engineering

FINAL REPORT

for

BirderAI

Prepared by Team Falcon



PES organization

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25/11/2022



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SYNOPSIS FOR THE PROJECT

Proposed project description

The purpose of this project is to classify different types and species of the birds by capturing and analysing the voices made by them. Basically this product monitor the birds by their sound which is important for many environmental and scientific purposes, to estimate population trends and to identify the bird count in the specific area. This software is intended to define a development methodology for the user, beginning with the requirements phase and continuing through to the execution phase.

Features:

The system user is able to perform following points-

- Either he/she can log into the system software.
- After login redirects to upload page where he/she can upload the audio file.
- Finally, he/she able to get the particular bird name and its image as the output related to the uploaded file.

For our project we are using the scrum methodology



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SOFTWARE REQUIREMENT SPECIFICATION

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Introduction

Purpose

The purpose of this project is to classify different types and species of the birds by capturing and analysing the voices made by them. With the help of this project users are able to know the name of an unknown bird by recording the sounds produced by them. The primary goal of this document is to describe the technical and operation requirements that meet the needs of our project and in adequate details to provide the basis for the system design.

Intended Audience and Reading suggestions

The document is intended for requirements engineer, domain expert, developers, tester and project manager who would work on further development of the project. The clients review this SRS document to ensure the documentation completely and accurately describes the intended functionality.

This document need not be read sequentially, users are encouraged to jump to any section they find relevant. Below is a brief overview of each part of the document:

- 1)Introduction: This section offers a summary of the BirderAI project, including goals and objectives, project scope and general system details.
- 2)Overall Description: This section of the document describes the context and origin of the product being specified in this SRS and also provides an overview of the overall functionality of the product.
- 3)External interface requirements: This section of the document includes GUI standards of user interfaces, connections between this product and other software components, communication requirements.
- 4)Analysis models: In this section information, functions and the behaviour of the system is defined and these are translated into the architecture, interface and component level design in the 'design modelling'. It includes class diagrams, entity-relationship diagrams, or use-case diagrams.
- 5)System features: This section illustrates organizing the functional requirements for the product by system features, the major services provided by the product.
- 6)Other non-functional requirements: This section of the document specifies the quality attributes of a software system, such as responsiveness, usability, reliability and performance.



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7)Other requirements: This section includes requirements for the project which are not covered elsewhere in the SRS like database requirements.

8)Appendices: This section includes any additional information like abbreviations, definitions related to project which may be helpful to readers.

Product Scope

The software being developed is a simple application. The main purpose of this software is to identify the birds based on their voice. Classification of bird species by their sound signals could be a essential supplementary monitoring method compared with traditional tools such as the telescope, specifically, when a bad weather condition is taken into account. Monitoring birds by their sound is important for many environmental ad scientific purposes like:

- Reduce the need of volunteers in this kind of biological project
- Identify and count birds in a specific area
- To estimate long-term population trends.

Since this project will help us collect a large variety of data about different species of birds, it has great potential in providing assistance to numerous wildlife associations and bird sanctuaries. The project will help in providing optimum information about the characteristics and features about the species of birds and will also help them to find and protect some of the endangered species of birds which would prove to be quite beneficial for these organizations and wildlife sanctuaries.

References

- 1) <https://towardsdatascience.com/sound-based-bird-classification-965d0ecacb2b#:~:text=Birds%20have%20many%20types%20of,and%20longer%20than%20%E2%80%9Ccall%E2%80%9D>
- 2) <https://asmp-eurasipjournals.springeropen.com/articles/10.1186/s13636-018-0143-7>
- 3) https://www.researchgate.net/publication/251999286_Animal_voice_recognition_for_identification_ID_detection_system
- 4) <https://www.topcoder.com/thrive/articles/voice-data-classification-using-deep-learning>



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Overall Description

Product Perspective

This product is a new one and not a follow-on of other products. Automatically classifying bird species by their sound signals is of crucial relevance for the research of ornithologists and ecologists. This software extracts the acoustic features of bird sounds reflecting characteristics for the distinction of bird species. This software is intended to define a development methodology for the user, beginning with the requirements phase and continuing through to the execution phase. A simple UI will aid the user in easily focussing on the task at hand.

BirderAI does not require installation of any other program and does not modify the host system.

Product Functions

These are the major functionalities of the software BirderAI will achieve:

- Takes an audio file as an input.
- Analyses the sound.
- Recognises the bird.

User Classes and Characteristics

Users of the BirderAI include researchers, public users, and software developers.

Researchers : Who require birds data for research purposes.

Public users: One who uses this software for recognising a bird by their voice.

Software developers: Who need full access to code to develop the project.

However, users should have a good understanding of the tasks, activities, and artifacts of either process in which they may be interested.

Operating Environment

BirderAI will be designed to work on any version of Windows, Linux (kernel 2.7 and above) and Mac platform.

Design and Implementation Constraints

- Data used for the project can be modified by the developers if necessary.
- Recognition should be done in a less time (less than 2min).



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- The interface of resulting system will be easy to use and accessible without a time or location constraint.
- Software is not multilingual. User must know English.

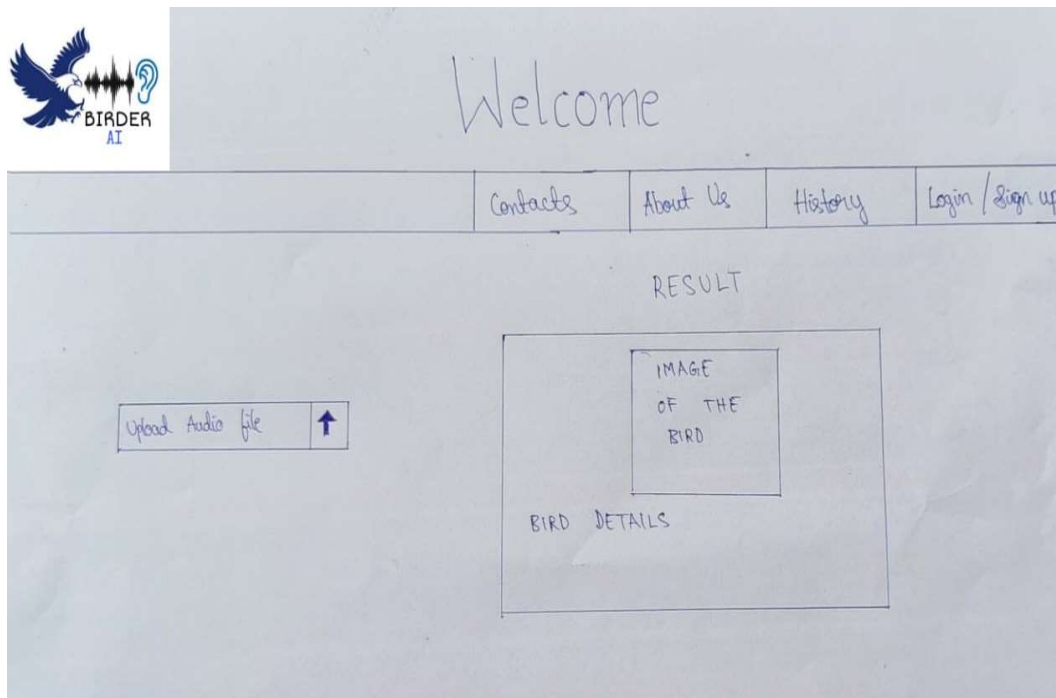
2.6 Assumptions and Dependencies

- The client machine must run Python applications.
- The project's success depends on the input data quality and processing to a great extent.
- While recording voice background noise should be less and only one species voice should be recorded at the same time.

External Interface Requirements

User Interfaces

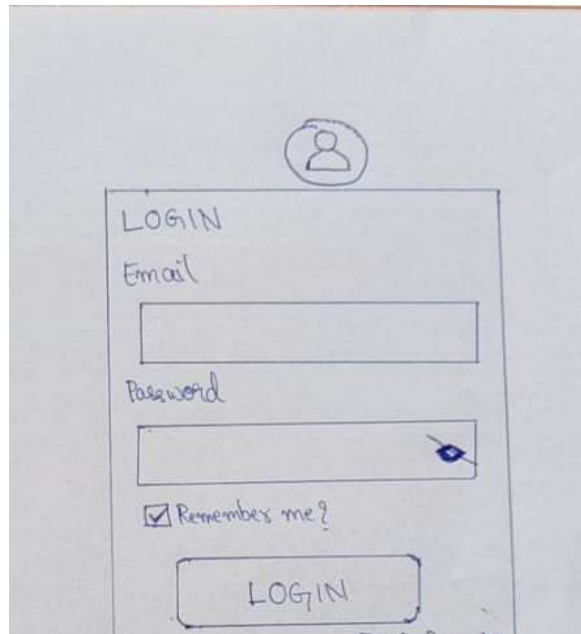
The user interface design is simple and easy to understand. User can add the audio file of bird's voice and easily get the result which he/she requires.





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Software Interfaces

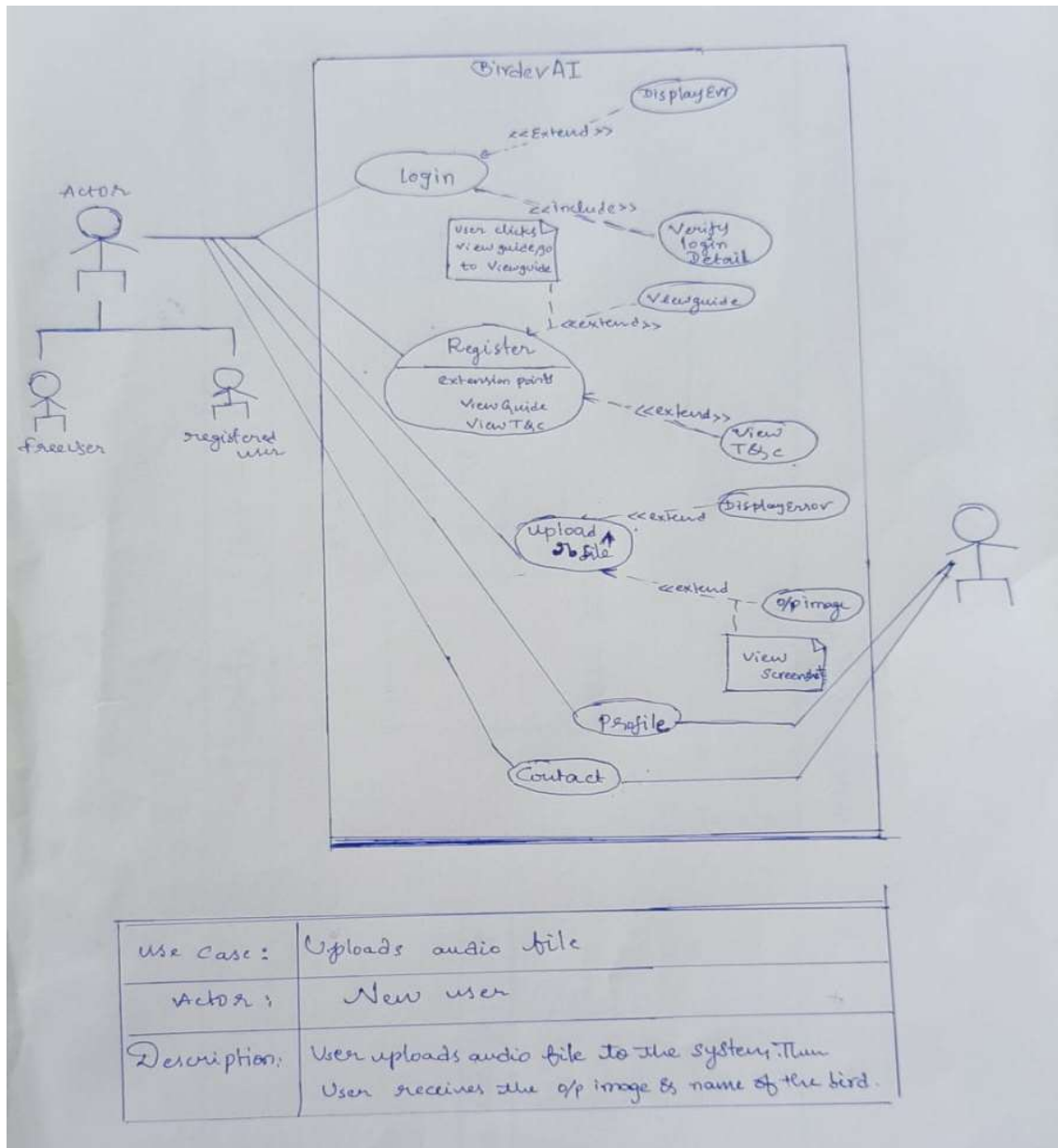
The software is operating system independent. It runs on Linux, Windows and Mac.

Communications Interfaces

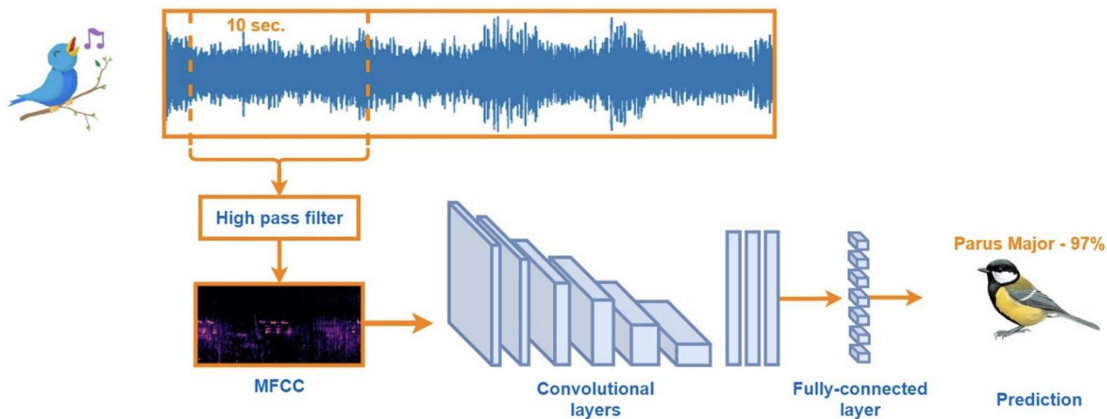
The communication architecture must follow the client-server model. The client-server communication must be stateless. A uniform interface must separate the client roles from the server roles. A web browser is a basic necessity for the software to be deployed. Authentication uses HTTPS for security.

Analysis Models

USE-CASE DIAGRAM:



ACTIVITY DIAGRAM:



A wave format recording enters this module; the recording is divided into individual 10-ms-long frames. A sequence of frames with bird vocalization forms code values of various lengths. The selected wavefront is sent into the high pass filter which reduces the noise. Almost all solutions to recognize voice uses Convolutional Neural Networks (CNNs) or Recurrent Convolutional Neural Network (RCNNs). The gap between CNN-based models and shallow, feature-based approaches remained considerably high. Even though many of the recordings were quite noisy the CNNs worked well without any additional noise removal and many teams claimed that noise reduction techniques did not help data augmentation techniques seemed to be widely used, especially the techniques used in audio processing such as time or frequency shift.



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System Features

System Feature 1: LOGIN

As we know that client privacy play a significant role in gaining the client trust, each customer will first have to login with their credentials to access the software facilities.

5.1.1 Description and Priority

USE CASE:	Helps users to login
ACTOR:	Existing user
DESCRIPTION:	User can login through the login page and further can access the software.

5.1.2 Stimulus/Response Sequences

For the login page, the stimulus sequence will be that the software will first demand the user to give its login credentials. If the login is successful, the software will respond by navigating the user to the next input page where he will be asked to input the audio file and as an output, he will be provided with the details of the bird. If the login is unsuccessful, the software will respond by displaying an error message.

5.1.3 Functional Requirements

The software has the necessary functional requirement which requires the user to put the correct credentials after which only the user will be able to pass to the next page. If the user enters the incorrect login credentials, then with the help of some functions, the software will display an error message.

System Feature 2 : Uploading Audio

5.2.1 Description and Priority

USE CASE:	Helps users to upload an audio file.
ACTOR:	Registered user
DESCRIPTION:	User can upload an audio file to recognise the bird species .

5.2.2 Stimulus/Response Sequences

As soon the user uploads an audio file of the bird voice our software starts extracting the features from that audio file and finally it displays the bird's name and its image as output.



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5.2.3 Functional Requirements

The project demands some necessary requirements with respect to the audio files. The software is only compatible with “.wav” file. Thus the user is required to input the audio file in that particular extension otherwise the software will not be able to perform the required set of tasks and ultimately will result in an error.

Other Non-functional Requirements

Performance Requirements

PR-1: RESPONSE TIME: The software system shall likely show no deterioration in accessing the required information about the bird whose audio recording was given as input to the software. Any major delay might be possible because of some incompatible properties of the audio file or the input or the duration or the resolution of the sound which might take the software longer than usual time to respond. The average time the software takes to load the result is from couple of seconds to some minutes.

PR-2: LOADING SPEED : The software has a fairly less probability of taking a unusually longer time to run . There might be some productivity tools or file issues or some problems related to the environment on which the system is running, which may lead to some lags and loading issues. So in cases where the client has to give a higher resolution input audio, they are advised to run the software on a comparatively higher performance system.

Safety Requirements

Data of the software is to be protected from power loss and crashing due to logging from excess queries. Also there might be chance that output generated will not have the optimum quantity of information due to loss of some info while transmitting it from server to the client machine. Thus a good internet connection and submitting queries in a structured manner will help protect the software data.

Security Requirements

The project will have four primary security requirements. They are authentication, confidentiality, data integrity, availability.

SCR-1: AUTHENTICATION:



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The software will follow good quality authentication practises. This will help the researchers to keep their search information confidential and will the clients will be able to use the system with full privacy.

SCR-2: CONFIDENTAILITY:

The software will provide optimum security facilities to the client so that the privacy of the user is not tampered with. The system will prevent any unauthorized access to the information of it's clients by keeping track of the suspicious activities taking place in the software.

SCR-3: DATA INTEGRITY:

Another important aspect of security that the project will be providing is the integrity of the user data provide to the client. The software must be protected from any illegal access requests which lead to any kind of corruption, tampering, overwriting, destruction or deletion of the data of not only the client but also the software models . As any type of such activities might prove to be fatal to the user as well as the developer, maintaining data integrity is one the most important tasks of the software.

SCR-4:AVAILABILITY:

The software will be providing optimum availability of the data to the authorized users. As this will be used by researchers and ornithologists the smooth availability of the data is one of the most significant aspects of the software. Thus the software will provide the necessary output to the users almost 24/7.

Software Quality Attributes

SQ-1: PORTABILITY:

The software will be built to support multiple environments and systems so that the client will have the freedom to perform their search function any time, any place. The portable ability of this software will help the client to quick results and on spot analysis of different species of birds and thus will help them to execute their research efficiently.

SQ-2: ADAPTABILITY:

The software will be on the basis on a flexible and logical which will help the users implement their inputs and get accurate results . The software will also provide a versatile environment which help users get information about their enquired audio recordings



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SQ-3: USABILITY:

The software will provide accurate and optimum information related to the asked birds and their species. This will help the users get a better understanding of the birds and will help them to perform their research in an effective and swift manner.

Business Rules

The software will provide a compact and necessary information about the birds which will be analysed by the machine intelligence model which help detect the bird and their species . The machine learning model will play a significant roles in giving the results for the voices of the birds.

Other Requirements

There are no additional requirements. All are specified in above sections.

For information regarding interface requirements, refer to section 3.

For information regarding functional requirements, refer to section 5. Each feature has its requirements listed alongside the feature information.

For information regarding non-functional requirements, refer to section 6.



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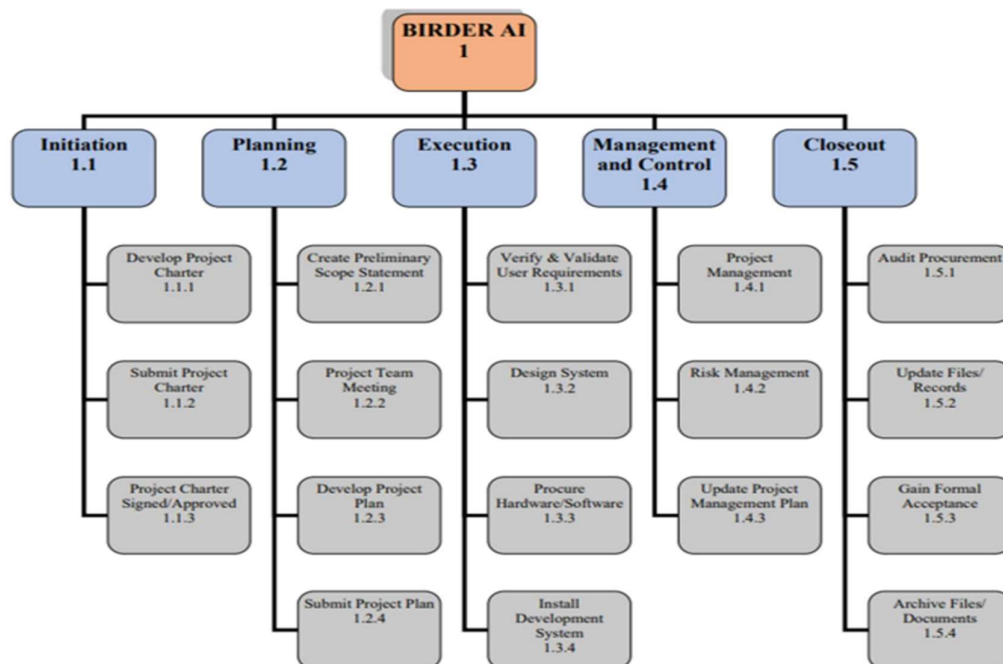
Appendix A: Glossary

SNo.	Abbreviation / Key word	Definition
1	SRS	SRS stands for Software Requirement Specification. It is a document that completely describes all of the functions of a proposed system and the constraints under which it must operate.
2	UI	UI stands for User Interface. It is defined as the space where interaction between humans and machines occurs.
3	HTTPS	HTTPS stands for Hypertext Transfer Protocol Secure. This protocol is a widely used communications protocol for secure communication over a computer network, with especially wide deployment on the Internet.
4	Ornithologist	A person who studies or is an expert on birds.
5	AI	AI stands for Artificial Intelligence. Artificial intelligence is the capability of a computer system to mimic human cognitive functions such as learning and problem-solving.

WORK BREAKDOWN STRUCTURE (WBS)

INTRODUCTION: The WBS is a view into the project which shows what work the project encompasses. It is a tool which helps to easily communicate the work and processes involved to execute the project. There are many ways you can present the WBS for your project; this template provides the tree based WBS.

TREE STRUCTURE VIEW OF WBS: The Tree Structure View is the most popular format for the WBS. It presents an easy to understand view into the WBS specifically designed for creating this organizational chart structure.



WBS DICTIONARY: The WBS Dictionary contains all the details of the WBS which are necessary to successfully complete the project. Most importantly it contains a definition of each Work Package which can be thought of as a mini scope statement.

Level	WBS Code	Element Name	Definition
1	1	BIRDER AI	All work to implement our project.
2	1.1	Initiation	The work to initiate the project.
3	1.1.1	Develop Project Charter	Develop the Project Charter.(consisting of objectives, detailed deliverables)
3	1.1.2	Submit Project Charter	Project Charter is delivered to the Project Sponsor.
3	1.1.3	Project Charter Signed/Approved	The Project Sponsor approves the Project Charter to move to the Planning Process.
2	1.2	Planning	The work for the planning process for the project.
3	1.2.1	Create Preliminary Scope Statement	Project Manager creates a Preliminary Scope Statement.
3	1.2.2	Project Team Meeting	The planning process is officially started with a project kickoff meeting .
3	1.2.3	Develop Project Plan	The Project team develops the project plan.
3	1.2.4	Submit Project Plan	Project team submits the project plan for approval.
2	1.3	Execution	Work involved to execute the project.
3	1.3.1	Verify & Validate User Requirements	The original user requirements is reviewed by the project manager and team, then validated with the users/stakeholders. This is where additional clarification may be needed.
3	1.3.2	Design System	The technical resources design the new widget management system.
3	1.3.3	Procure Hardware/Software	The procurement of all hardware, software and facility needs for the project.
3	1.3.4	Install Development System	Team installs a development system for testing and customizations of user interfaces.

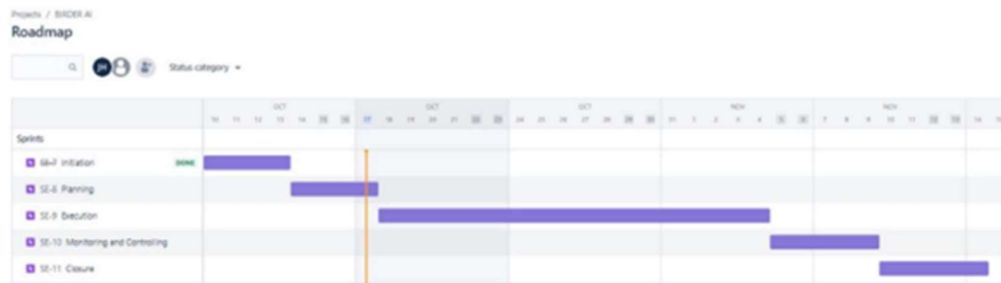


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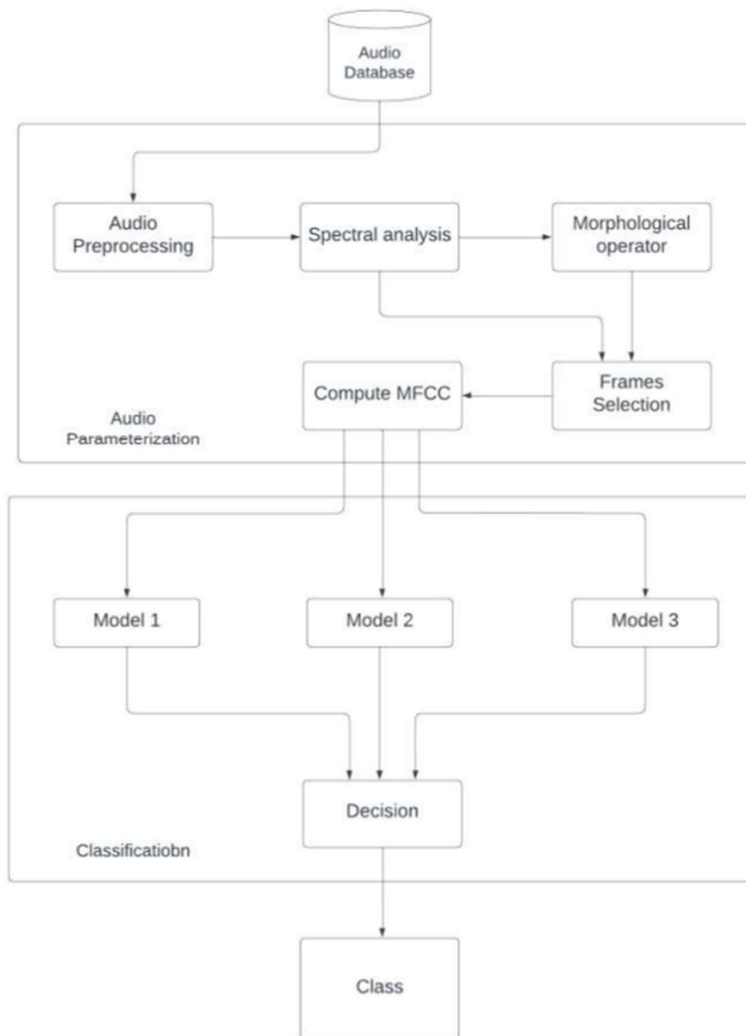
2	1.4	Control	The work involved for the control process of the project.
3	1.4.1	Project Management	Overall project management for the project.
3	1.4.2	Risk Management	Risk management efforts as defined in the Risk Management Plan.
3	1.4.3	Update Project Management Plan	Project Manager updates the Project Management Plan as the project progresses.
2	1.5	Closeout	The work to close-out the project.
3	1.5.1	Audit Procurement	An audit of all hardware and software procured for the project, ensures that all procured products are accounted for and in the asset management system. Documents the lessons learned for the project.
3	1.5.2	Update Files/Records	All files and records are updated to reflect the widget management system.
3	1.5.3	Gain Formal Acceptance	The Project Sponsor formally accepts the project by signing the acceptance document included in the project plan.
3	1.5.4	Archive Files/Documents	All project related files and documents are formally archived.

GANTT CHART:



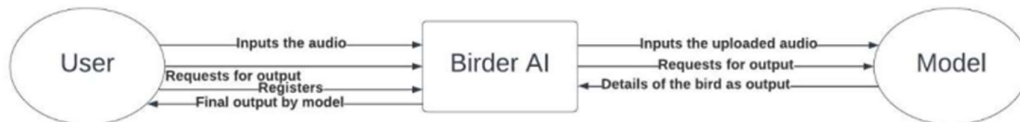
DESIGN DIAGRAMS

UML DIAGRAM:

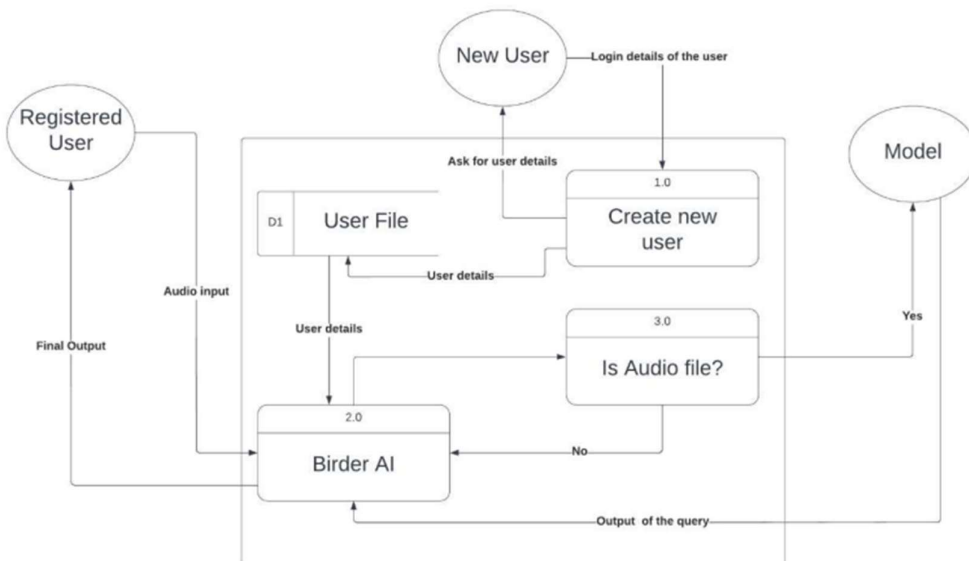


DATA FLOW DIAGRAMS:

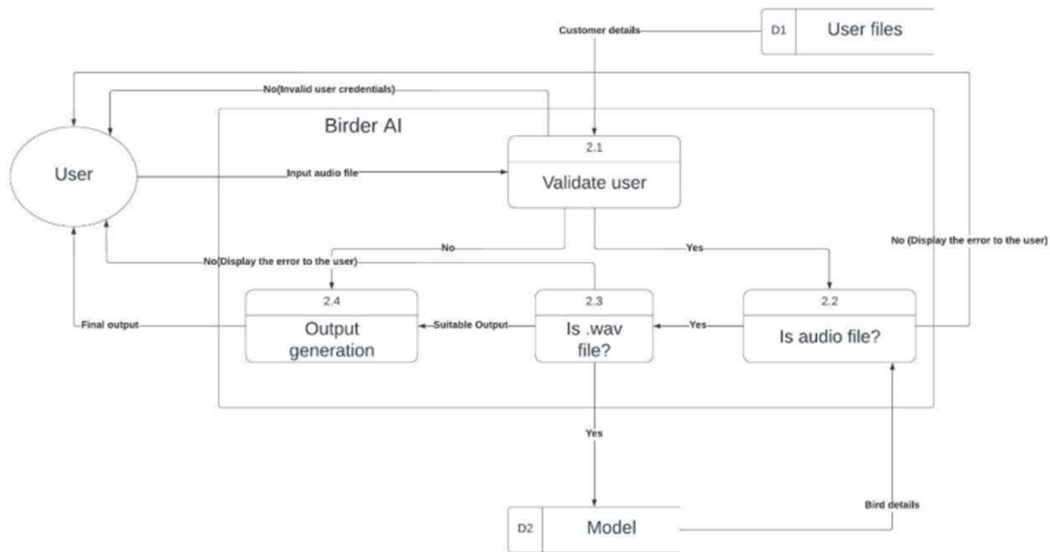
LEVEL 0:



LEVEL 1:



LEVEL 2:





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CODING PRACTISES

THESE ARE THE CODING PRACTISES THAT WE HAVE FOLLOWED IN OUR PROJECT IN ORDER TO MAKE IT EASY TO UNDERSTAND AND MAXIMIZE CODE PORTABILITY

- For loading extracted features we used .npy and for loading the metadata of the audio files we used csv data structure.
- For loading the module we used .h5 model and to deploy our model we used a flask application for our frontend operations.
- Followed rules for usage of global variables.
- Reusing code via modularity.
- We converted all the deeply nested networks into simple codes. Software program should be simple and clear.
- We have not used any "GOTO" statements.
- Code is written in such a way that it is easy for the testing team to test and debug the program.
- Followed naming conventions LIKE CAMEL CASE whenever necessary.
- Added comments for better reading and understanding.
- Logically grouped together codes related to a single function into files.
- Only authorized users(who have signed up) can access our software.



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SCM

In our project, we used branching and versioning SCM methods.

- After adding two to three features, the code was incrementally committed.
- Our project has three branches, with the main branch initially containing modules for feature extraction from the dataset.
- Following completion of each branch including the code for the CNN model, Flask app, and HTML templates, the branches were added one at a time and merged into the main branch by confirming the pull requests.
- Several commits were made within the main branch itself in order to increase model accuracy and various functionalities, such as improving the User Interface.

The screenshot shows a GitHub repository page for 'Himakar21 / Voice_Based_Classification-of-Birds'. The repository is public and has 3 branches and 0 tags. The main branch is selected. The file list shows the following files and their commit times:

File	Commit Time
public	40 minutes ago
static/css	40 minutes ago
templates	40 minutes ago
test	36 minutes ago
README.md	32 minutes ago
app.py	38 minutes ago
cnn_model.ipynb	1 hour ago
cnn_model1.hdf5	1 hour ago
feature_extraction_cnn.ipynb	1 hour ago
mfcc_feature_extraction_svm.ipynb	1 hour ago
svm_model.ipynb	1 hour ago

The README.md file content is as follows:

```
Dataset - Subset of Cornell Birds Call Identification Dataset  
Best model - CNN  
Used a python flask app for Model deployment
```

The right sidebar shows the repository's statistics: 0 stars, 0 watching, and 0 forks. It also includes sections for Releases, Packages, and Languages.



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Test Document

Test Case ID	Name of Module	Test case description	Pre-conditions	Test Steps	Test data	Expected Results	Actual Result	Test Result
UT-01	Login page module	To test and see if the user is able to login with the correct credentials.	Access to Chrome Browser	1: Navigate to login page 2: Enter Username and Password 3: Click Login	Username: Himakar Password: 1234567	Login should be successful with navigation to the 'Home page'.	Login successful And user gets navigated to the 'Home page'.	Pass
UT-02	Login page module	To test whether the user is able to enter the password in encrypted(dotted) format	Access to chrome browser	1.Navigate to the "login"page 2.Enter the username and password	User name: Himakar Password:1234567	The user will enter the password and the password will appear in encrypted format	The user is able to enter his password in encrypted format where the original characters are not visible	Pass
UT-03	Login page module	To test what will happen if we click submit without entering any values in form	Access to the browser	1.Navigate to the "login" page 2.Click the submit button in the login page without entering any values.	Click the "login" button	The result should give an error message of "Invalid user"	The login page reacts with an error message of "Invalid user"	Pass
UT-04	Prediction module	To check how will the home prediction page react if given an input audio file	Access the chrome browser	1.Navigate to the "predict" page 2.After filling the	An input audio file of the bird's voice the user wants to check for	The result should output the name of the predicted	The user gets the predicted name of the bird and	

				details in the form click the submit button 3.Enter the input audio file 4.Click the “Predict the bird” button		bird along with the image of that bird	predicted image of it.	
UT-05	Prediction module	To check whether the output photo of the bird is correct wrt the predicted bird	Access the chrome browser	1.Navigate to the “predict” page 2.After filling the details in the form click the submit button 3.Enter the input audio file 4.Click the “Predict the bird” button	An input audio file for the prediction model	When we give an input audio file then the model should predict and give the respective bird’s image along with it’s name	When we give the input audio file for prediction it will return the bird name along with it’s image.	Pass
UT-06	Prediction module	To check the successful integration of the components and pages of the project.	Access the chrome browser	1.Navigate to the page 2.After filling the details in the form click the submit button	The valid details of the user and upload an audio .	We should test the integration by checking if after a successful login , the user is able to navigate to the “Home page”	As the user enters the correct credential and tries to login info the login info is correct it is navigated to the home page	Pass
UT-07	Prediction model	To check whether the input audio file is of the specified extension or not	Access the chrome browser	1.Navigate to the “” page 2.After filling the details in the form click the submit button 3.Enter the input audio file	An input audio file of the bird’s voice	If the user input the audio file in the specified “WAV” format, then the file will go to the model for prediction	As the user enter the audio input file of the birds voice the audio file goes to the prediction model for it to	Pass



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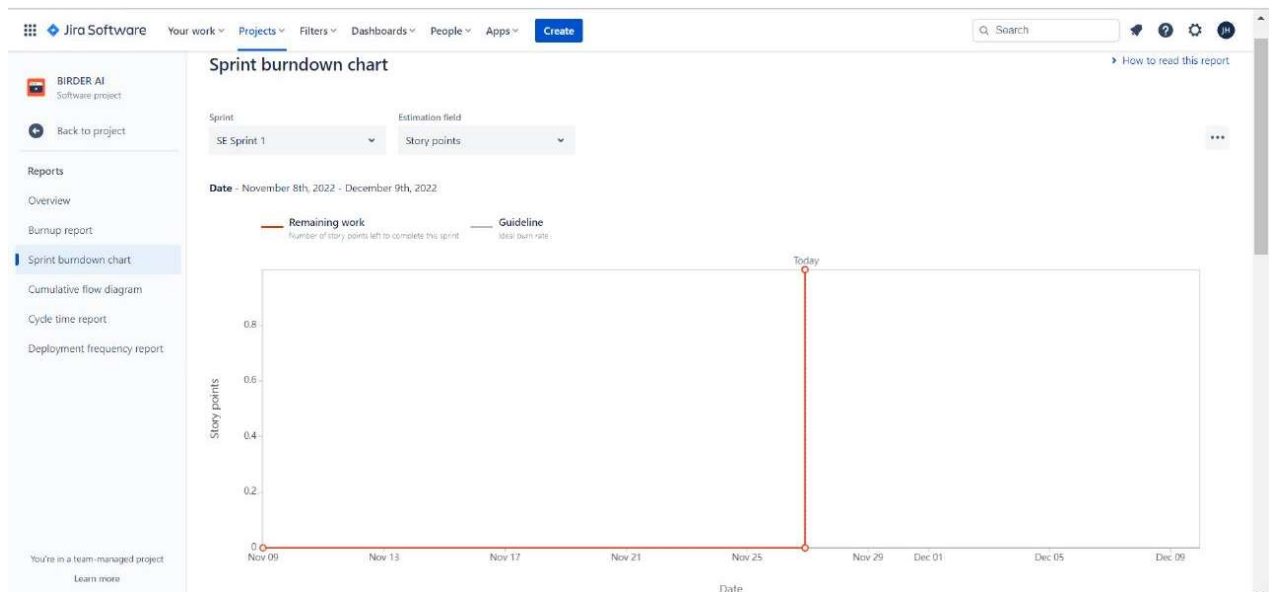
				4.Click the “Predict the bird” button			predict the bird’s name	
UT-08	Predictio n model	To check if the prediction model will return an error case in response to an incorrect/ random audio file	Access the Chrome browser	1.Navigate to the “predict” page 2.After filling the details in the form click the submit button 3.Enter the input audio file 4.Click the “Predict the bird” button	An unknown audio file	When the user enters the incorrect audio file, the model should respond with an error message	As we enter the incorrect audio file, the module responds with an error message showing “unknow n audio”	Pass



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BURNDOWN CHART





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JIRA/GANTTPRO REPORT

Bugs:



Bug report:

[SE-9] Monitoring and controlling Created: 17/Oct/22 Updated: 22/Nov/22 Due: 25/Nov/22 Resolved: 22/Nov/22	
Status:	Done
Project:	BIRDER AI
Components:	None
Affects versions:	None
Fix versions:	None

Type:	Epic	Priority:	Medium
Reporter:	J Himakar	Assignee:	Unassigned
Resolution:	Done	Votes:	0
Labels:	None		
Remaining Estimate:	Not Specified		
Time Spent:	Not Specified		
Original estimate:	Not Specified		



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Issue links:	Blocks
	is blocked by SE-12 The model is giving random prediction... Done
	is blocked by SE-13 Input format Done
Rank:	0 i0001b:
Start date:	20/Oct/22
Issue color:	purple

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Roadmap showing all completed tasks:

