



**Final Documentation
For
Final Year Project
Bachelor of Science in Information Technology**

DrukeBird

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CERTIFICATE

This is to certify that the BSc.IT project report titled “DrukeBird”, which is being submitted by Cheki Lhamo(12190043), Dema Lhamo (12190047), Karma Choda (12190055), Nar Bdr Kharka(12190065) and Tshering Wangchuk(12190099) the students of Bachelor of Science in Information Technology, prepared during the academic year 2023. This is comprehensive documentation of bird information and record-keeping systems for birders, researchers and monitoring birds habitats.

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(Project Guide)

Lecturer

BSc.IT

Gyalpozhing College of Information Technology

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We would also like to express heartfelt thanks to our college management for providing us with the opportunity to work on such a fascinating project titled “DrukeBird”. This project not only allowed us to conduct extensive research but also enriched our knowledge by interacting with us numerous new concepts. Not to forget the RSPN team for providing the information and data they have provided about the Birds in and around Bhutan.

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Lastly, we are always grateful to our friends and parents for their unwavering support, tremendous assistance, and encouragement, especially during difficult times, without which the entire endeavor would have failed.

ABSTRACT

The aim of DrukeBird is to develop an application to create an organized and centralized platform for gathering and sharing information about bird observations across the country. DrukeBird is a comprehensive and collaborative effort to gather and share data on bird observation in and around Bhutan. It is a React App that allows birdwatchers, researchers and other people who are interested in learning about the birds to record and store the birds' sightings, contributing to a vast database of the birds' information. This abstract provides an overview of DrukeBird, its purpose, features, and significance in the field of ornithology.

DrukeBird serves as a database center for the birds sighting in and around Bhutan, enabling birdwatchers of all levels of expertise to submit their observations and contribute to a growing knowledge of birds. This application helps to collect important information such as species identifications, locations, date, time, allowing for the analysis of the patterns and trends of birds.

One of the Biggest aspects of DrukeBird is for data collection on the birds, which includes all individuals in giving the information about birds. The information gathered through DrukeBird has far-reaching implications for bird conservation and management. Researchers and conservationists rely on the data to assess bird populations, identify priority areas for conservation efforts, and monitor the impacts of environmental changes and habitat loss. Additionally, DrukeBird data are used in scientific studies, ecological research, and the development of conservation strategies.

Overall, DrukeBird represents a significant advancement in the field of ornithology, enabling the collective power of birdwatchers and scientists to contribute to a comprehensive and dynamic dataset. By engaging the national community in the collection and sharing of bird observations, DrukeBird has revolutionized the way we understand and conserve the species, making it an indispensable tool for birdwatchers, researchers, and conservationists worldwide besides bhutan.

TERMINOLOGY

Terms	Definitions
DrukeBird	DrukeBird is a Mobile application that enables users to collect information about birds and add data to the bird database.
React-Native	Open source JavaScript framework for mobile application development.
Mongodb	Open source NoSQL database management programs.
RSPN	Royal Society for Protection of Nature
Birding	Birding refers to the activity of observing and identifying birds in their natural habitats.
Checklist	In birding, birders keep track of the different bird species they have observed or identified during their outings or over a specific period of time.

LIST OF ABBREVIATIONS

Birds, Researchers, RSPN (Royal Society For Protection of Nature), Checklist, Birding, DrukeBird.

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CHAPTER 1 INTRODUCTION

1.1 PROJECT BACKGROUND

The rapid advancements in technology have brought about significant knowledge-oriented innovations in various fields. However, in many bird habitation centers in Bhutan, the data collected remains decentralized and disorganized, despite the world shifting towards the era of technology and automation. Preserving and tracking bird species are crucial aspects of birding, which has now become an important factor for both researchers and birdwatchers in wildlife conservation. The existing practice of recording bird sightings in personal notebooks by birdwatchers poses challenges in accessing and analyzing this valuable data.

In Bhutan, as one of the least developed countries, there is a need for a platform that provides researchers with accurate information on bird observations. This is where DrukeBird steps in, offering birdwatchers a reliable platform to track their bird sightings and share them with other users. Users can create checklists of the species they have encountered, including details such as name, time, date, location, and species. These checklists can be shared within the DrukeBird community, enabling the tracking of changes in bird habitation and population over time.

Moreover, DrukeBird goes beyond being a space for birdwatchers to share observations; it also serves as a valuable tool for researchers to study bird population, distribution, and migration patterns. Overall, DrukeBird emerges as a powerful application catering to the needs of researchers and bird watchers alike, providing a collaborative platform that contributes to our understanding of birds and their conservation efforts.

1.2 NEEDS STATEMENT

Bhutan, with its rich biodiversity, is home to numerous plant and animal species, including a remarkable diversity of birds, with approximately 774 bird species. Thanks to Bhutan's strict conservation policies and protected areas, the bird population in the country is thriving, attracting birders and researchers from around the world. However, despite this wealth of bird diversity, there is a lack of a proper platform to store, share, and access accurate and up-to-date information on bird populations and distributions.

Currently, birdwatchers in Bhutan record their sightings in personal notebooks, making it challenging for researchers to collect and analyze this valuable data. This creates a significant barrier to understanding the population, abundance, location, and distribution of bird species. There is a pressing need for a centralized platform that can address these challenges and provide comprehensive, standardized data on bird sightings and observations.

DrukeBird aims to bridge this gap by offering a centralized platform for collecting and sharing bird observation data in a standardized format. By providing a user-friendly interface, it enables birdwatchers and researchers to contribute their observations, facilitating the collection of accurate and up-to-date information on bird species, their abundance, and distribution. This platform will serve as a valuable resource, allowing researchers to compare and analyze data from various sources, fostering a deeper understanding of Bhutan's bird populations and supporting conservation efforts.

1.3 AIMS

The aims of DrukeBird Project are:

- Develop a centralized platform called DrukeBird to store and share accurate and up-to-date information on bird populations, distributions, and observations in Bhutan.
- Facilitate the collection, organization, and accessibility of comprehensive bird observation data for researchers, birdwatchers, and conservationists.
- Contribute to the understanding of bird diversity, abundance, and distribution patterns in Bhutan to support wildlife conservation efforts.

1.4 GOALS

The goals of DrukeBird Project are:

- Create a user-friendly mobile platform, DrukeBird, that allows birdwatchers to record and share their bird sightings in a standardized format.
- Establish a centralized database for bird observation data that can be easily accessed and analyzed by researchers and other stakeholders.
- Encourage active participation from birdwatchers and researchers to contribute their observations, creating a collaborative and comprehensive data repository.
- Provide tools and features within DrukeBird for researchers to study bird populations and monitor changes in bird habitat.

1.5 OBJECTIVES

DrukeBird project will focus on the following objectives:

- Develop the DrukeBird platform with intuitive user interfaces, allowing birdwatchers to easily enter and share bird sighting data.
- Implement a robust and scalable database system to store and manage bird observation data collected through DrukeBird.
- Enable researchers to access and analyze the collected data for studying bird populations, identifying trends, and making informed conservation decisions.
- Continuously enhance the functionality of DrukeBird based on user feedback and evolving research needs.

1.6 CONSTRAINTS/FEASIBILITY

The feasibility study assesses the viability and practicality of the DrukeBird project. It evaluates various aspects to determine whether the project is technically, economically, and operationally feasible. The following considerations have been examined as part of the feasibility study:

- **Data Reliability:** Ensuring the reliability and accuracy of user-reported data poses a significant constraint for DrukeBird. Misidentification or false reporting of bird sightings, particularly for unknown species, is a potential challenge. To address this, DrukeBird incorporates a system of data verification through regional experts and reviewers who validate the reported sightings.
- **User Participation:** The success of DrukeBird relies on active user participation. However, a constraint may arise if there is a limited number of birdwatchers in certain

regions, resulting in sparse data coverage. Feasibility is influenced by the engagement and motivation of birdwatchers to contribute their observations regularly.

- **Geographic Coverage:** DrukeBird aims to be a global citizen science project. However, constraints may arise in terms of geographic coverage. Remote or underdeveloped areas with limited internet connectivity or low smartphone penetration may pose challenges for active user participation. Expanding the reach and accessibility of DrukeBird in such regions is a feasibility consideration.
- **Privacy and Data Protection:** DrukeBird collects and stores data about bird sightings, counts, and types, which may include personal information of users. Ensuring the privacy and security of user data is a critical constraint and feasibility concern. DrukeBird needs to comply with relevant data protection regulations and implement robust security measures to safeguard user information.
- **Integration with External Systems:** DrukeBird's feasibility can be influenced by its ability to integrate with other environmental and conservation systems. Technical barriers or resistance from external stakeholders to collaborate and share data may pose constraints to achieving seamless integration.

Addressing these constraints and ensuring their feasibility is an ongoing process for the DrukeBird team. By continually improving data verification mechanisms, expanding user engagement initiatives, maintaining a strong technical infrastructure, and fostering collaborations, DrukeBird can overcome many of these challenges and enhance the application's effectiveness as a global citizen science platform for birdwatching.

1.7 SCOPE

1.7.1 SYSTEM SCOPE

The DrukeBird app is targeted to all the enthusiastic birders and researchers in and around Bhutan. The system scope extend and boundaries of DrukeBird application, including it's features, functionalities, and the overall purposes of the application it serves.

The scope of the DrukeBird project includes the following key components:

- **Data Collection:** DrukeBird allows birdwatchers to record their sightings and observations, including species, location, date, and time. The platform provides a standardized format for capturing and documenting this data, ensuring consistency and accuracy.
- **Data Verification:** To ensure the reliability of the reported data, DrukeBird incorporates a system of data verification through regional experts and reviewers. These experts validate the reported bird sightings, adding credibility and accuracy to the collected data.
- **Data Sharing:** DrukeBird provides a platform for birdwatchers to share their observations and checklists with the DrukeBird community. This encourages knowledge sharing among birdwatching enthusiasts and researchers.
- **Data Analysis:** The platform enables researchers to access the collected data for analysis and study of bird populations, distribution patterns. By aggregating and organizing the data, DrukeBird aims to contribute to scientific research and conservation efforts.
- **Platform Scalability:** The scope of the project includes designing a scalable platform that can accommodate a growing user base and increasing data volume.

1.7.2 USER SCOPE

1. **Registration:** Registration in the DrukeBird app refers to the process of creating an account with the app in order to access its features and functionalities. To register, users are required to provide their name, email address, Date of Birth, Country, profession and a password. Registration helps to authenticate the identity of the user, ensuring that only authorized users can access the features and functionalities of the app. It also helps to ensure the security of user data and protect against unauthorized access or use of the app.
2. **Login:** Once the user is registered, they must log in using email address and password to access the application fully. Login helps to ensure the accuracy, integrity, and privacy of the data being submitted to DrukeBird, while also encouraging collaboration and community among birders and researchers.
3. **Birding:** Start Birding feature allows the users to quickly and easily create a checklist of birds that they have observed at a particular location at a particular time.
4. **Checklists:** Users can create and submit their bird species checklists, recording sightings with details like date, time, location, and number of individuals observed. The checklist can either be saved in draft or submit it directly.
5. **UnknownBird Submission:** If users are not able to identify or recognize the bird, they can submit an UnknownBird along with it's picture, counts, date, time and location which will be verified by the admin.
6. **Unknown Verification:** If the UnknownBird has been verified by the admin, the users will be able to see the name of the bird along with it's picture submitted during the UnknownBird submission.
7. **Explore:** The Explore section of DrukeBird provides more information about observed bird species and birding sites. Users can search for specific bird species and view detailed graphs and data related to their observations. This feature enhances the user's birdwatching experience by visual representations of bird species data.
8. **Search:** The search feature has been implemented to search the bird species and birding sites by the users.
9. **Delete:** The draft checklist and unknown verification can be deleted if the users don't want it to appear in their dashboard.
10. **Profile:** In the Profile section of DrukeBird, users can view and update their personal information. This includes their name, birding date, profession, and the option to upload a profile picture. Additionally, users have the ability to update their password for enhanced account security. The Profile section provides a convenient and user-friendly interface for managing and customizing user information.

- 11. About:** The About section of DrukeBird provides a concise overview of the platform's purpose. It highlights the motivation behind DrukeBird, which is to promote wildlife conservation and enhance our understanding of birds and their habitats.
- 12. Help:** The Help section of DrukeBird serves as a comprehensive guide for beginner users, providing detailed information about the platform's important features.
- 13. Contact Us:** The Contact Us section of DrukeBird provides a convenient form for users to send their feedback, queries, or any other inquiries to the administrators. This form serves as a direct communication channel between users and the DrukeBird team, enabling users to easily reach out for assistance or share their thoughts.
- 14. Logout:** DrukeBird grants users the privilege to securely log out from the application. By selecting the Logout option, users can safely end their session and protect their account from unauthorized access.

Non-Functional Requirements

Some non-functional requirements of DrukeBird app are as follows:

- 1. Performance:** The DrukeBird app is fast and responsive, even when there are large amounts of data to load or process. This ensures that users can quickly and easily record sightings without experiencing delays or crashes.
- 2. Reliability:** The DrukeBird app is reliable, with minimal downtime or errors. Users rely on the app to store and manage their birding data, so any loss of data or system failures could be detrimental.
- 3. Usability:** The DrukeBird app is user-friendly and easy to navigate. It has a clear and intuitive interface that makes it easy for users to record and view their bird sightings.
- 4. Security:** The DrukeBird app is secure, with robust data encryption and protection mechanisms. This ensures that users' birding data is kept safe and private.
- 5. Compatibility:** The DrukeBird app should be compatible with a wide range of devices and operating systems. This ensures that users can access the app from their preferred devices and platforms.

1.8 LITERATURE/TECHNICAL SURVEY

1. ebird mobile application.

eBird is a global online checklist programme launched in the USA in 2002 by the Cornell Lab of Ornithology and the National Audubon Society, and worldwide in 2012, that gathers information on bird distribution and abundance. The demand for better information on bird populations and distribution has inspired the creation of the eBird project.

The eBird project comprises both web application and mobile application making it easier for the users to use. Application is for users and web for the dashboard for admin. It contains features such as start checklist, my checklist, search, explore and add information on the unknown birds and adding the information on the bird species.

Sullivan et al. (2009) present an overview of the eBird project, outlining its inception, data collection system, and its applications in research and conservation. The paper highlights the complexities of developing a citizen science platform capable of handling extensive data from diverse users. The authors delve into the challenges faced during the project's construction and detail the approaches employed to overcome these obstacles.

2. White-bellied heron conservation. Royal Society For Protection of Nature.

The Royal Society of Protection of Nature (RSPN) has actively participated in the conservation project for the White-bellied Heron (WBH) and Black-necked Cranes (BNC) in Bhutan. Through their efforts, valuable insights have been gained regarding their conservation status, potential threats, and conservation measures. Given the critical endangerment of the WBH, Bhutan has taken a pioneering role in its protection. However, the rapid pace of development necessitates immediate interventions for the bird's survival. Recognizing this, the RSPN has initiated conservation initiatives, and mobile apps like DrukeBird Bhutan app can play a vital role in assessing species status and implementing appropriate actions.

3. Analytical guidelines to increase the value of community science data: An example using eBird data to estimate species distributions.

Community science or citizen science (CS) data is playing an increasingly important role in ecological research and conservation planning. CS projects involve members of the public recording species observations, covering a wide range of taxa. The number of CS projects is growing rapidly, but they differ in terms of complexity, data collection methods, and participation. This document highlights the rising popularity of CS projects as a practical and effective approach to species conservation. Consequently, it is feasible to develop a similar project in our country.

4. A citizen-based bird observation network in the biological sciences.

In 2009, Sullivan described eBird as a platform that enables birdwatchers to collect and share valuable data for scientific and birding communities. The data collected helps in understanding species occurrence, migration patterns, and abundance on different scales. Through eBird, users also enhance their scientific skills by learning standardized data-gathering techniques and interacting with experts. This concept inspires the idea of developing a similar platform for our country, providing birdwatchers and conservationists with a centralized database to record their observations and track their personal bird sightings and lists.

5. Deploying React Native with Node.js and MongoDB by Prashant Surya.

The deployment of React Native mobile applications using Node.js and MongoDB requires careful consideration of the backend infrastructure. Prashant Surya's article titled "Deploying React Native with Node.js and MongoDB" provides valuable insights into the best practices and steps involved in this process. This literature review explores the key findings and recommendations presented in the article, along with additional research that supports and expands upon these concepts.

Surya emphasizes the simplicity of integrating Node.js with React Native for backend development. He suggests using Express.js, a minimalistic web application framework, to handle

the API endpoints. According to Surya, Express.js provides a robust foundation for routing and middleware implementation, allowing for efficient request handling in the Node.js backend.

In terms of data storage, Surya recommends MongoDB, a NoSQL database, for its flexibility and scalability. MongoDB's compatibility with React Native and its ability to handle unstructured data efficiently are highlighted as key advantages. The document-based storage approach and dynamic schemas offered by MongoDB align well with the development patterns of React Native applications.

In addition to Surya's recommendations, other research supports the benefits of utilizing CI/CD (Continuous Integration/Continuous Deployment) pipelines for efficient deployment. Jenkins, GitLab CI, and CircleCI are popular tools that automate the build, testing, and deployment processes, resulting in a streamlined workflow.

In conclusion, Prashant Surya's article provides valuable insights into deploying React Native mobile apps with Node.js and MongoDB. The integration of Node.js with React Native, utilization of MongoDB for data storage, cloud hosting for scalability, and implementation of CI/CD pipelines and monitoring tools are key components of a successful deployment process. By following these recommendations, developers can achieve a reliable and scalable backend infrastructure for their React Native applications.

CHAPTER 2 METHODOLOGY

2.1 METHODOLOGY OF THE STUDY

For the development of the 'DrukeBird', the Agile methodology was used. The stages of the Agile methodology typically followed are project initiation, requirements gathering and analysis, design and development, testing and quality assurance, and continuous iteration and improvement. The following are the main stages of the Agile Methodology:

1. Project Initiation

During this phase, the Scrum team was assembled, comprising the Product Owner (RSPN team), Scrum Master, and Development team. Extensive discussions were conducted to determine the project's needs and gained a comprehensive understanding of its scope and objectives. The team actively collaborated with key stakeholders, including project guide and the enthusiastic team, to gather all the requirements. This involved conducting several meetings and engaging in ongoing communication with the client. Once the requirements were identified, they were documented as User stories. These User stories served as the foundation for creating product backlog items (PBIs), a prioritized list of tasks that incorporated client feedback and considerations.

2. Design

In the DrukeBird application, for the collected requirements, the design phase of the project was initiated, encompassing multiple aspects. This phase encompassed the creation of a prototype, formulation of the system architecture, design of the user interface, and establishment of the database structure. A High Fidelity prototype was developed and based on this one other phases were carried out.

3. Planning

In the planning stage, the team carefully selected a specific set of user stories from the product backlog items (PBI) to prioritize for the upcoming sprint. Furthermore, the team established a well-defined sprint goal and identified the requisite tasks to successfully complete the chosen backlog items for the DrukeBird. Additionally, the team diligently estimated the level of effort required for each task.

4. Implementation

In the implementation phase for the DrukeBird, subsequent to the completion of sprint planning, the team began executing the tasks enlisted in the sprint backlog. Moreover, the team conducted testing on the accomplished tasks with manual testing as well as unit testing with the jest(a testing method for react native project). Throughout the sprint duration, the team carried out meetings to see the progress and the completed work and tasks that are not completed. These concise gatherings served the purpose of synchronizing the team's efforts, reviewing progress, and addressing any encountered obstacles. During these meetings, team members provided concise updates on their progress and engaged in discussions pertaining to any challenges faced.

5. Review and Retrospective

In the review and retrospective phase, a sprint review meeting was conducted at the end of each week within the group. When there is confusion in the meetings, we conduct the meeting with the project guide and client. The client provided feedback, suggested changes, or proposed additions to the project. This iterative feedback process allowed for early adjustments in the development process, ensuring that the final product aligned with the client's expectations.

Following the sprint review, a sprint retrospective meeting was held at the beginning of each week to reflect on the team's performance and identify areas for improvement. This retrospective session facilitated introspection and provided an opportunity to assess the team's effectiveness, identify successful practices, and determine areas where enhancements could be made.

For this specific project, the development process was divided into three sprints, with each sprint spanning a duration of three weeks. Upon the completion and evaluation of each sprint, the process cycles back to the planning and estimation phase. This signifies that once a sprint concludes, a new sprint planning phase commences, thereby perpetuating the iterative cycle. The inherent iterative nature of the Scrum methodology enables regular feedback, adaptability, and continuous improvement throughout the project lifecycle.

Followings are the technology used for the development of DrukeBird application:

Front-End Technology

React Native - React Native is a popular open-source framework for building mobile applications using JavaScript and React. It is a popular choice for building mobile applications due to its cross-platform capabilities, high-performance, and ease of use for developers.

Back-End Technology

Node js - Node.js is an open-source, cross-platform, server-side JavaScript runtime environment that runs on the JavaScript Engine, and executes JavaScript code outside a web browser.

Express.js - is a widely-used framework in app development for creating the backend server and APIs that drive mobile applications. It offers a powerful set of tools for managing HTTP requests, routing, middleware, and data interactions. With its capabilities, Express.js is highly suitable for building the server-side components of an app, enabling efficient handling of requests, managing routes, implementing middleware, and facilitating data communication.

MongoDB - is a robust and extensively utilized document-oriented database management system that offers a dependable, scalable, and user-friendly solution for handling and manipulating data in various applications. It is well-suited for React Native due to its compatibility with JSON-like data and its scalability. Its flexible schema-less design and real-time data sync capabilities make it a popular choice for efficient data management in React Native applications.

Version Control

GitLab - GitLab is a comprehensive platform that enables teams to manage their software development process from start to finish, with features like version control, continuous integration and deployment, issue tracking, and more.

Design

Figma (Prototype) - Figma is a powerful tool that enables designers to collaborate, iterate, and create high-quality designs in a seamless and efficient manner.

2.2 FINAL DESIGN

1. Splash Screen

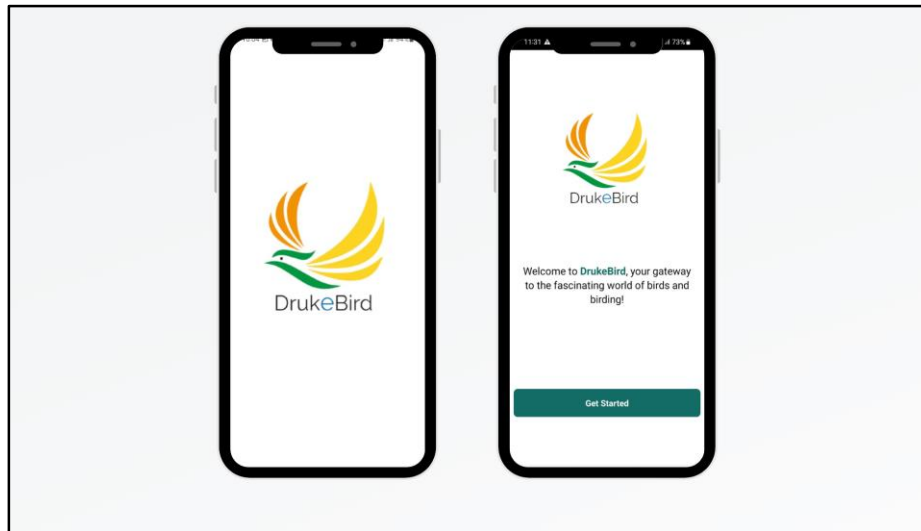


Figure 1: Splash Screen

The DrukeBird app presents a splash screen that serves as the initial interface upon opening. To access the app's features, users simply need to click on the prominently displayed 'Get started' button. This action enables users to begin utilizing the various functionalities offered by the DrukeBird app.

2. Registration

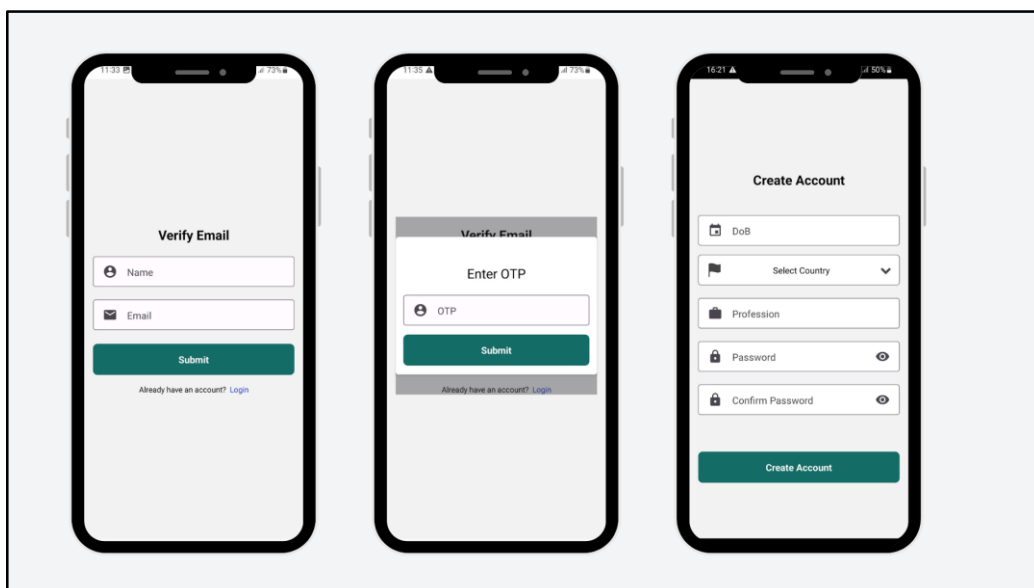


Figure 2: Registration Form

Registration in the DrukeBird app refers to the process of creating an account with the app in order to access its features and functionalities. During registration, users are required to provide essential information such as their name and email address. To verify the user's email, an OTP (One-Time Password) is sent for confirmation. Once the email is successfully verified, users are then asked to provide additional details like their date of birth, country, profession, as well as set a password and confirm it.

3. Login

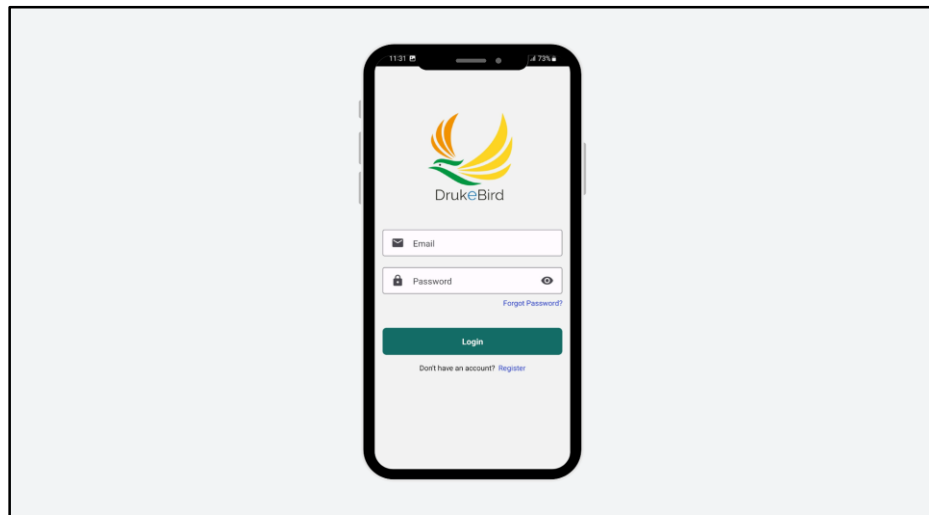


Figure 3: Login

The login page requires users to enter their email and password. If they forget their password, they can reset it by clicking the "Forgot Password" option.

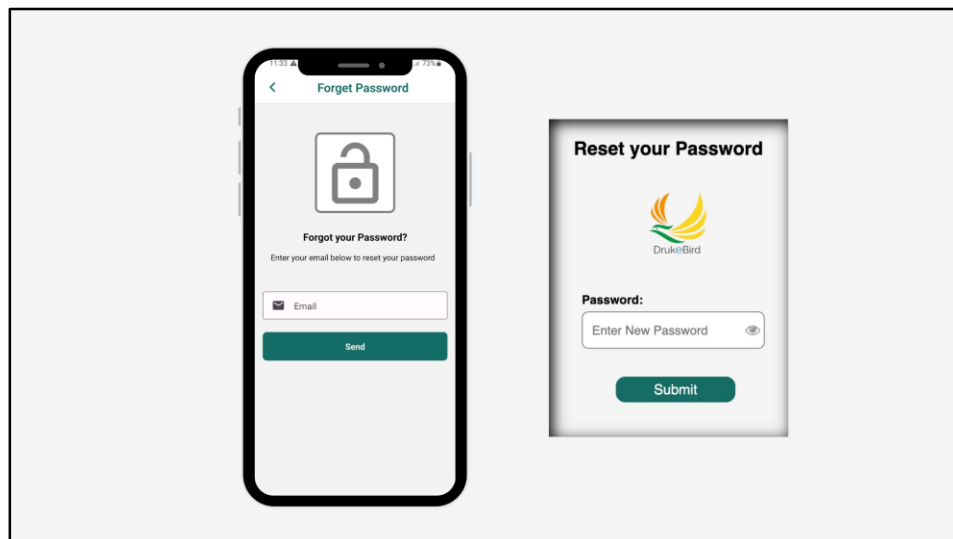


Figure 4: Forgot Password

Clicking on the "Forgot Password" option, the user will be redirected to a page shown above in figure where they need to provide their email address. Subsequently, a password reset link will be sent to the user's email, allowing them to reset their password.

4. Home Page

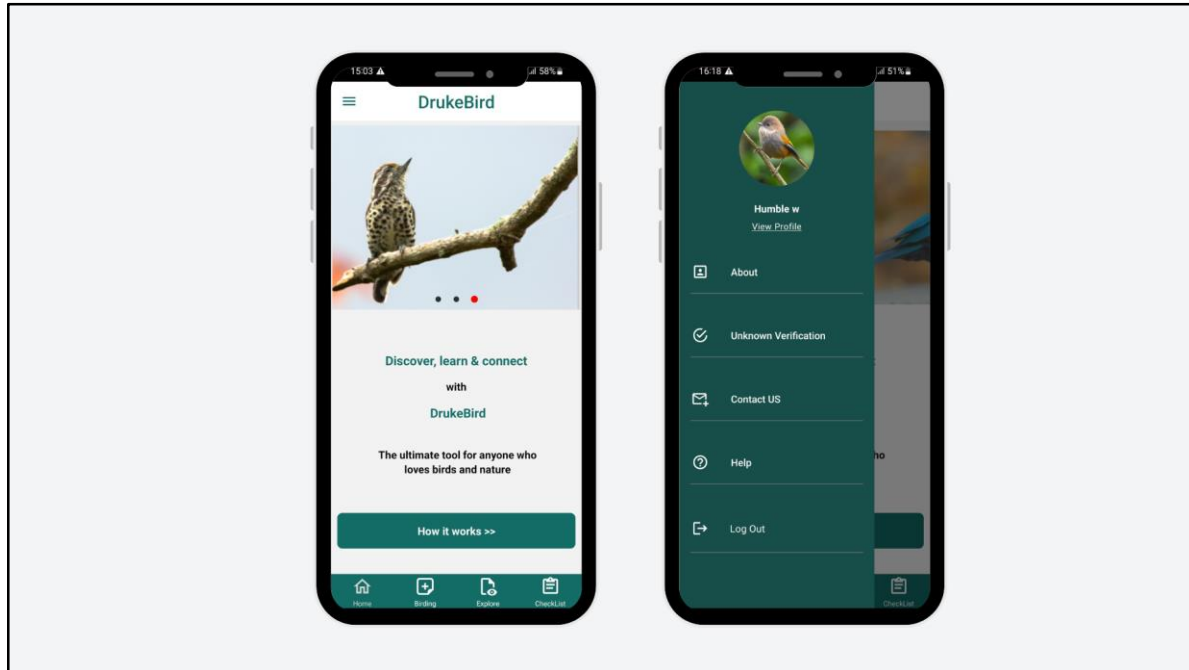


Figure 5: Home Page

Once users successfully log into the system, they will be redirected to the home page of the DrukeBird app, as depicted in the image above. This page serves as the main hub where users can access various features and functionalities. It also contains a 'How it works' button. By clicking on this button, users can easily access a tutorial that provides guidance on how to effectively utilize the DrukeBird app. This tutorial aims to enhance the user experience by offering step-by-step instructions and explanations of the app's functionality. The DrukeBird app's side navigation, positioned on the left side, presents a range of features for easy access. These include About, UnknownVerification, Contact Us, Help, and Logout.

5. About/Contact Us/Help Page

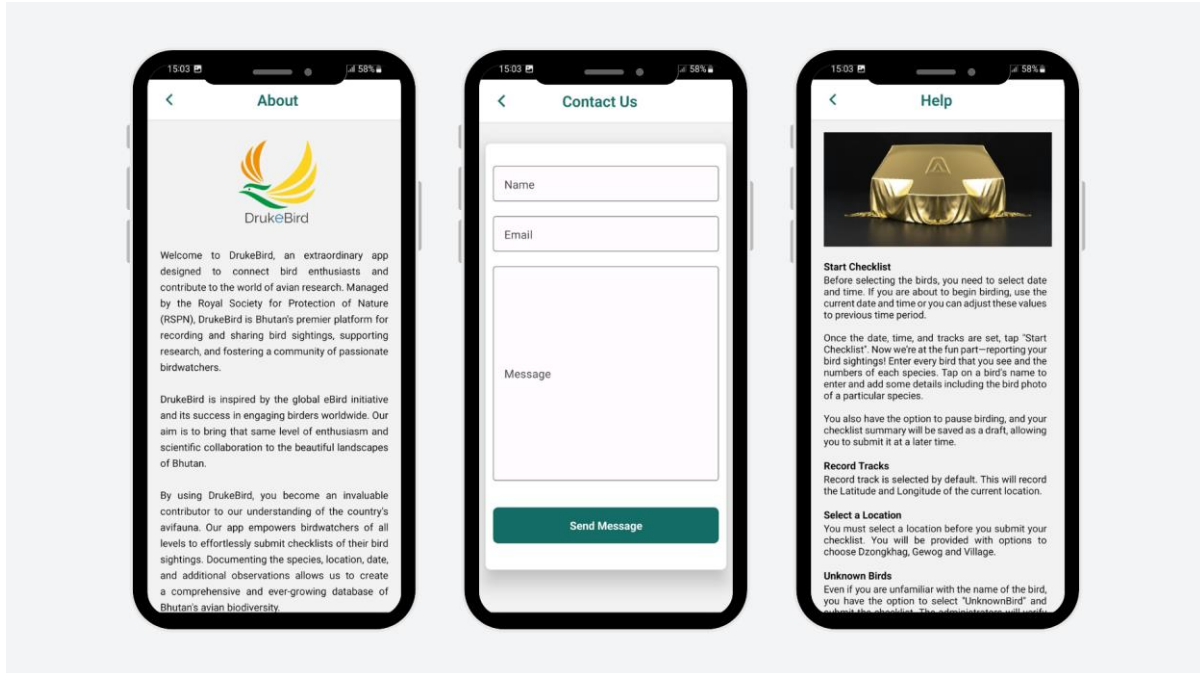


Figure 6: About/Contact Us/ Help Page

About: The About section of DrukeBird provides a concise overview of the platform's purpose. It highlights the motivation behind DrukeBird, which is to promote wildlife conservation and enhance our understanding of birds and their habitats.

Help: The Help section of DrukeBird serves as a comprehensive guide for beginner users, providing detailed information about the platform's important features.

Contact Us: The Contact Us section of DrukeBird provides a convenient form for users to send their feedback, queries, or any other inquiries to the administrators. This form serves as a direct communication channel between users and the DrukeBird team, enabling users to easily reach out for assistance or share their thoughts.

6. Profile Page

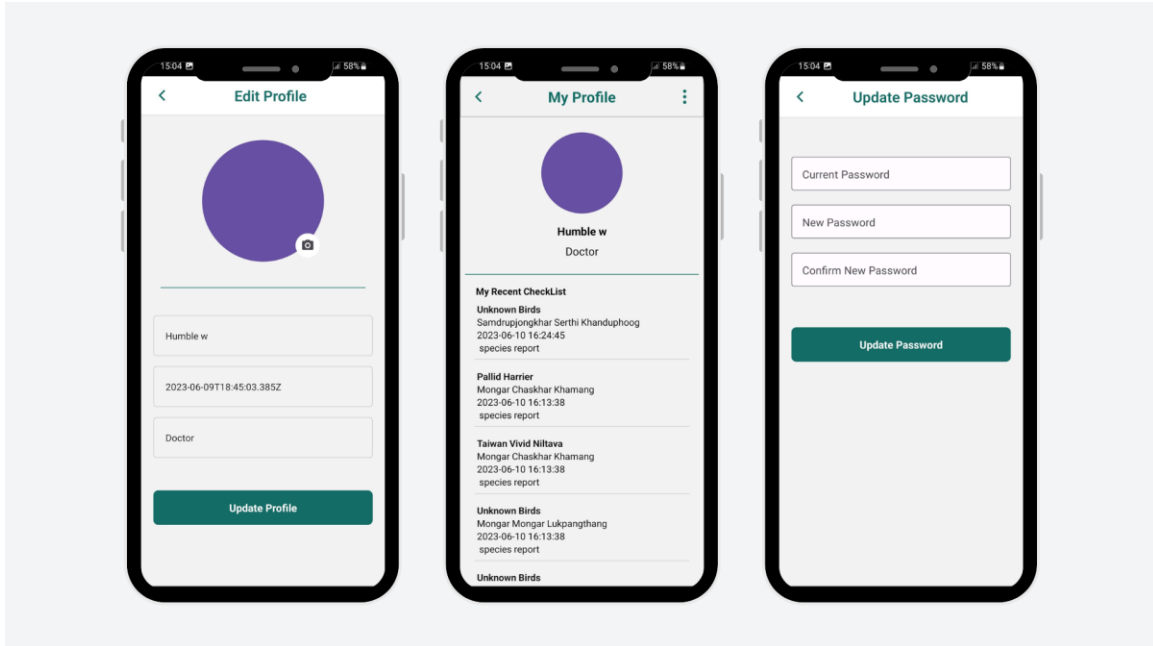


Figure 7: Profile

In the Profile section of DrukeBird, users can view and update their personal information. This includes their name, birding date, profession, and the option to upload a profile picture. Additionally, users have the ability to update their password for enhanced account security. The Profile section provides a convenient and user-friendly interface for managing and customizing user information.

7. Start Birding

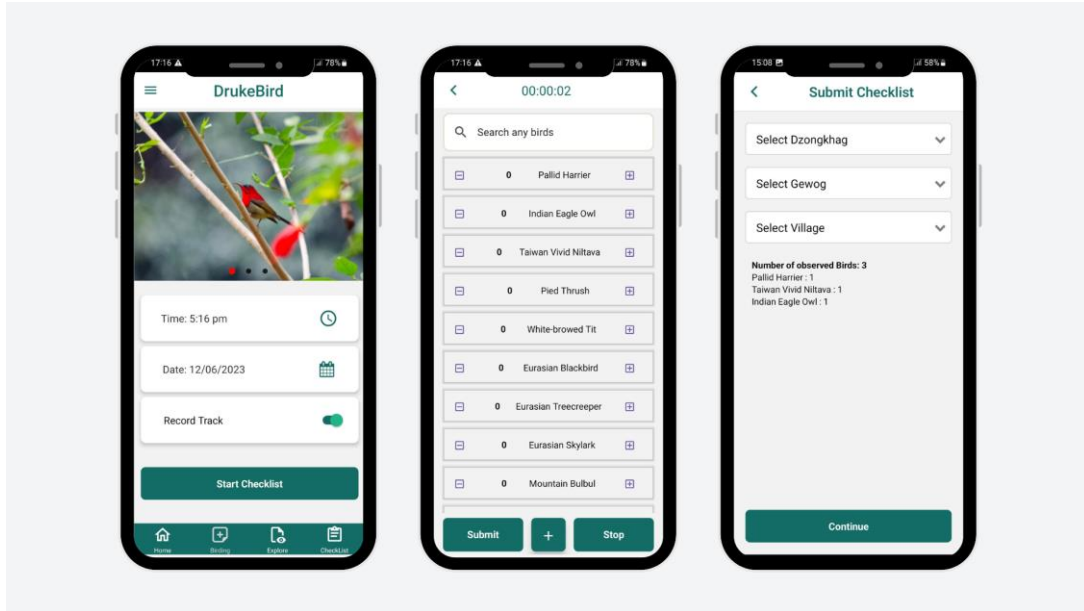


Figure 8: Start Birding

Start Birding feature allows the users to quickly and easily create a checklist of birds that they have observed at a particular location at a particular time. If users know the bird's name, they can click on the '+' sign to add it to their list or the '-' sign to subtract the number of observed birds. After that, they can click on the 'Submit' button. Following that, users need to provide the location where they spotted the bird.

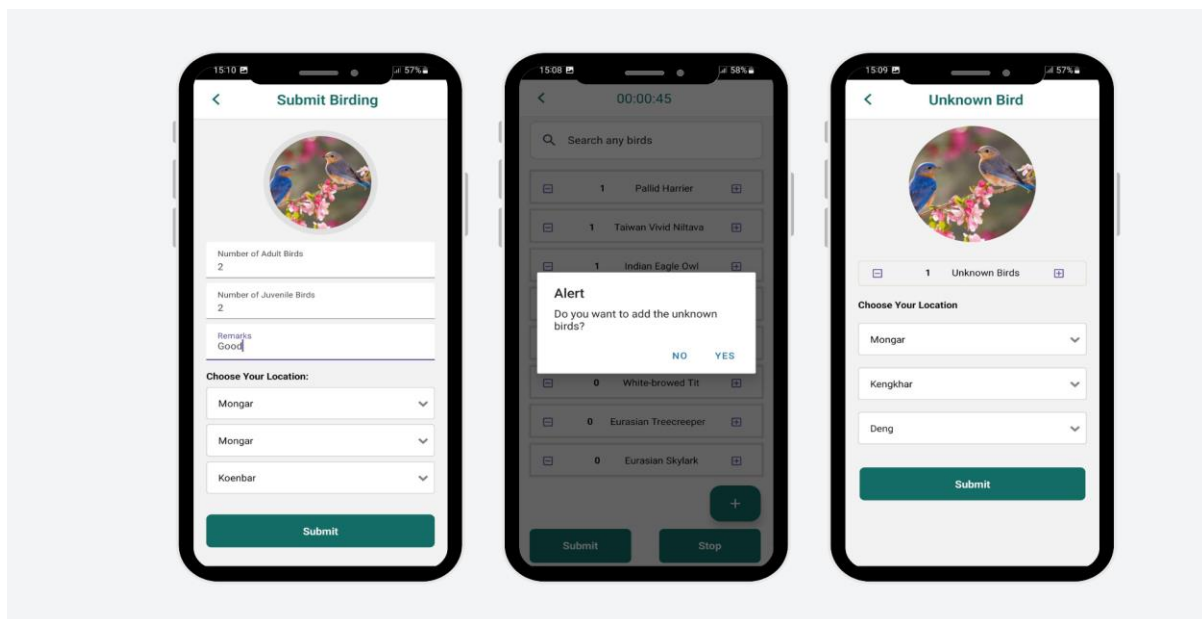


Figure 9: Start Birding

For expert users, the app provides an option to click on the bird's name in the displayed list. This enables them to enter additional details such as a photo of the bird, its type (juvenile or adult), add a review, and specify the bird's location. After entering the necessary information, they can click the 'Submit' button to submit their observation.

If users are new to birding, they can click on the '+' button to add the bird they observed. This action will take them to a page where they can upload a picture of the bird from their phone gallery or capture one using the camera. They can also specify the number of bird counts they observed and provide the location where the bird was sighted.

8. Explore

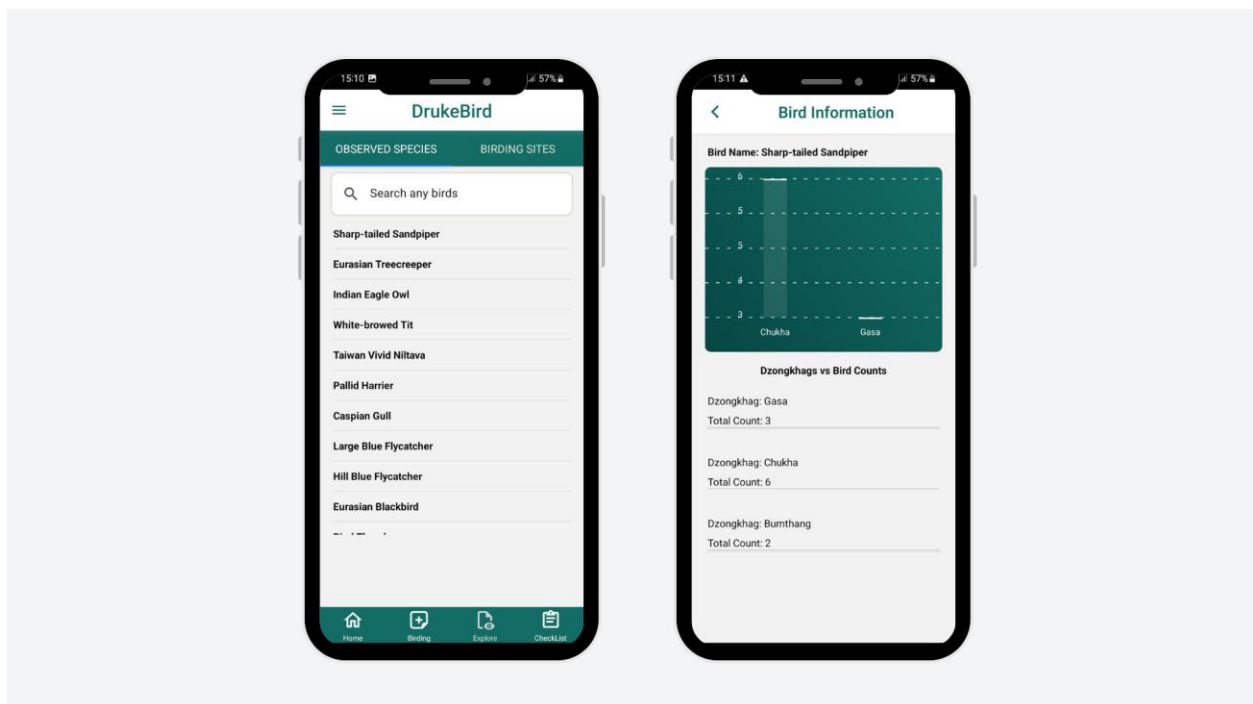


Figure 10: Explore

The Explore section of DrukeBird provides more information about observed bird species and birding sites. Users can search for a specific bird and see where they are commonly found, along with the count of sightings and a graph showing the top 2 places based on the checklist submitted by the other user.

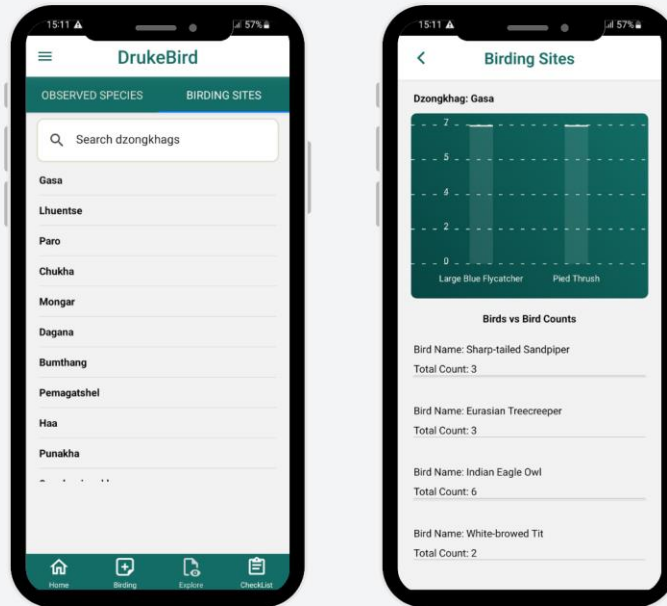


Figure 11: Explore

Additionally, users can search for birding sites by place name and view the species found there, along with their respective counts. They can also see the top 2 species at that location based on the number of species reported by other users.

9. Checklist

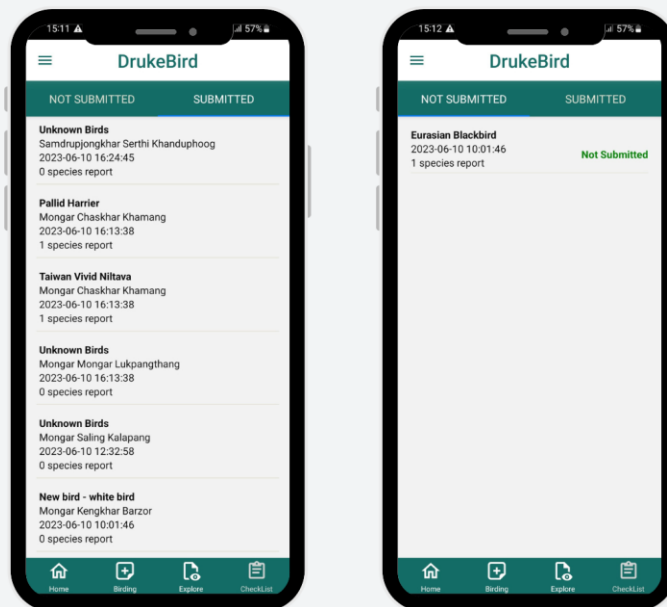


Figure 11: Checklist

The bird information submitted by the user through the Start Birding feature will be securely stored in the checklist for future reference. If the user confirms the submission during the birding session, it will be saved in the submitted checklist. However, if the user clicks on the 'stop' button during the birding session, the draft will be stored in the not submitted checklist. In the not submitted checklist, users have the option to upload the draft by providing the bird's location, or they can delete the bird information from the not submitted checklist.

10. Unknown Verification

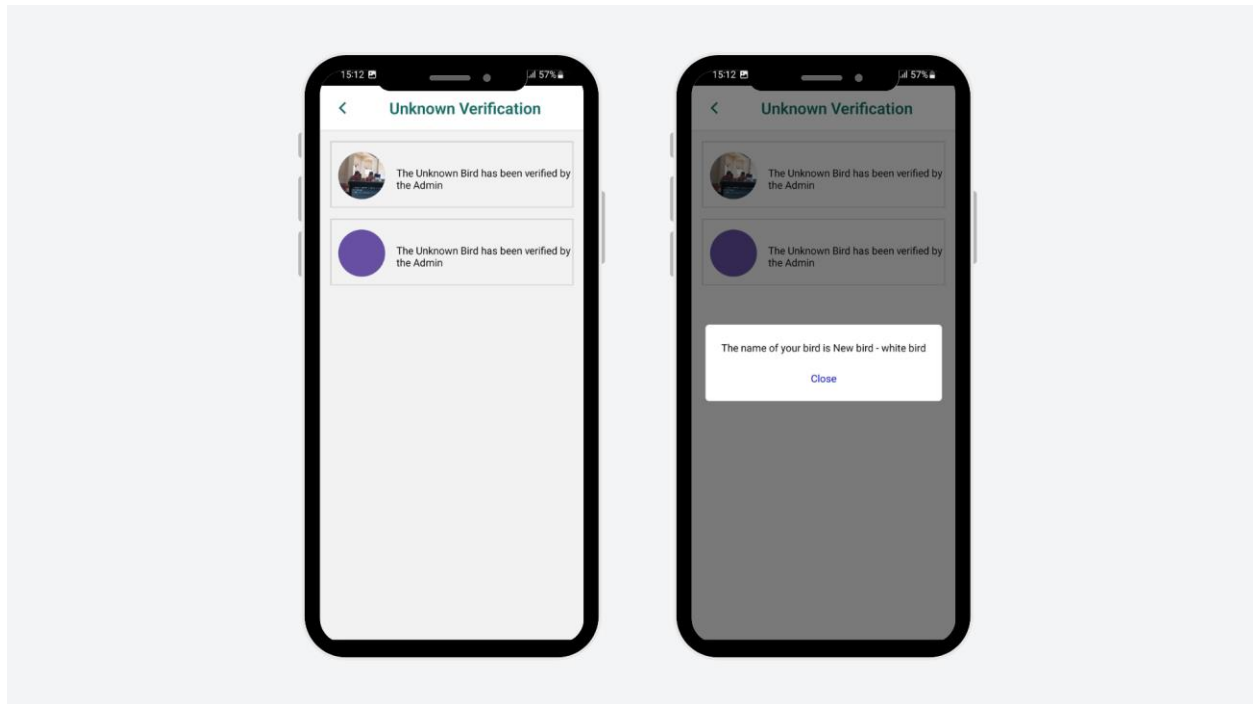


Figure 12: Unknown Verification

The bird image submitted by users during their bird watching activities. Upon submission, the images are automatically forwarded to the administrator for verification. The administrator meticulously examines each image to confirm the presence of a bird. If the administrator successfully identifies the species of the bird in the image, they send the information back to the user. Additionally, the verified information is stored in the "Unknown Verification" section of the application. To access this section, users can simply click on the designated tab, which redirects them to a dedicated page displaying the verified images of unidentified birds. On this page, each image is accompanied by a message informing the user that their unknown bird has been verified by the administrator. Moreover, when users click on an image, a pop-up message appears, revealing the specific name of the bird species. This feature enables users to easily obtain the identified species information for their bird sightings.

11. Logout

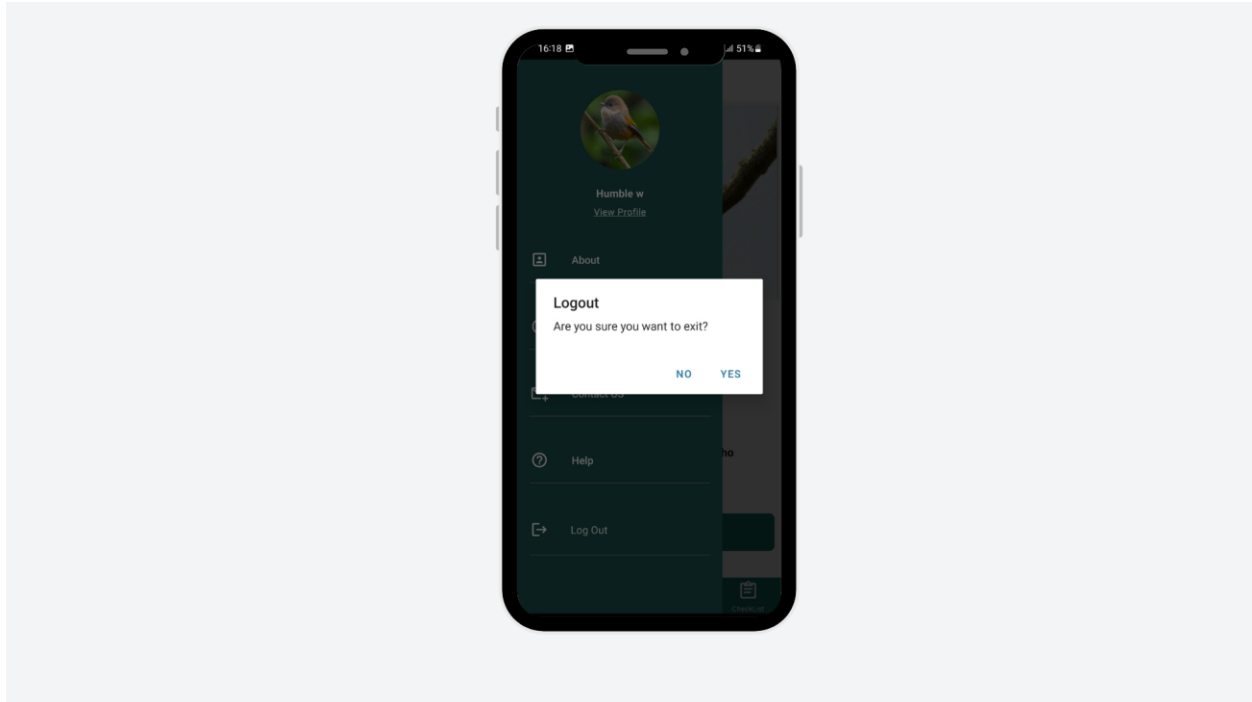


Figure 13: Logout

To end the session with the application, users can simply click on the "logout" tab. This action ensures that their access is terminated and maintains the security of their account.

2.3 SYSTEM DESCRIPTION

2.3.1 System Design

In this project, the team chose to utilize the Model-View-Controller (MVC) architecture, a widely accepted design pattern that is commonly used to organize and structure software applications. This architectural approach entails dividing the application into three interconnected layers: the model, the view, and the controller.

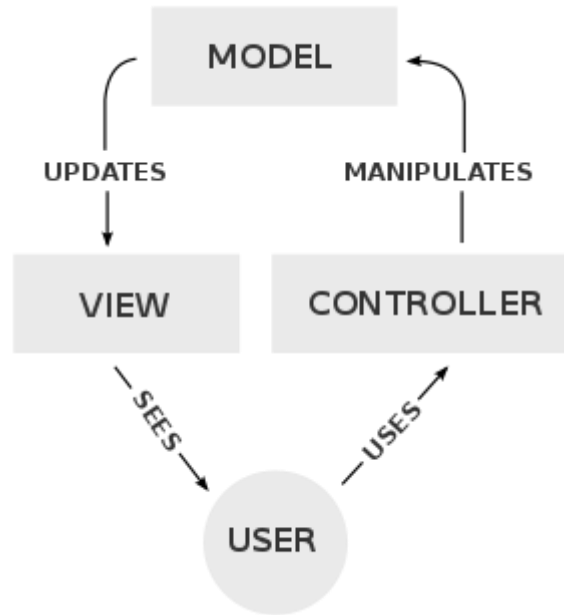


Figure 14: MVC architecture

1. Model

The model layer assumes responsibility for managing the application's data and implementing the business logic. Within this project, it encompasses various tasks, including interactions with the database and data validation. The model layer comprises classes and components that define the structure and functionality of entities, such as users, checklists and notifications. It offers a set of methods that facilitate the manipulation and retrieval of data, ensuring data integrity and consistency within the application.

2. View

The view layer serves as the interface through which users interact with the application's graphical user interface (UI). Within this project, it encompasses various elements such as screens, forms, and interactions that facilitate interactions between the birders, researchers and the system. The primary objective of the view layer is to enhance usability and provide an optimal user experience.

3. Controller

The controller layer serves as a mediator between the model and view layers within the application's architecture. It assumes the responsibility of receiving user input from the view layer, interacting with the model layer to access and retrieve relevant data, and subsequently updating the view layer to reflect the changes. In the context of this project, the controller layer is specifically tasked with managing various functionalities, such as checklists submission, profile updates, delete checklist and user registration, among others. It accomplishes this by invoking the suitable methods within the model layer that correspond to the user actions, ensuring the appropriate processing and manipulation of data, and subsequently updating the view layer to provide the user with the latest visual representation of the system's state.

2.3.2 Usecase

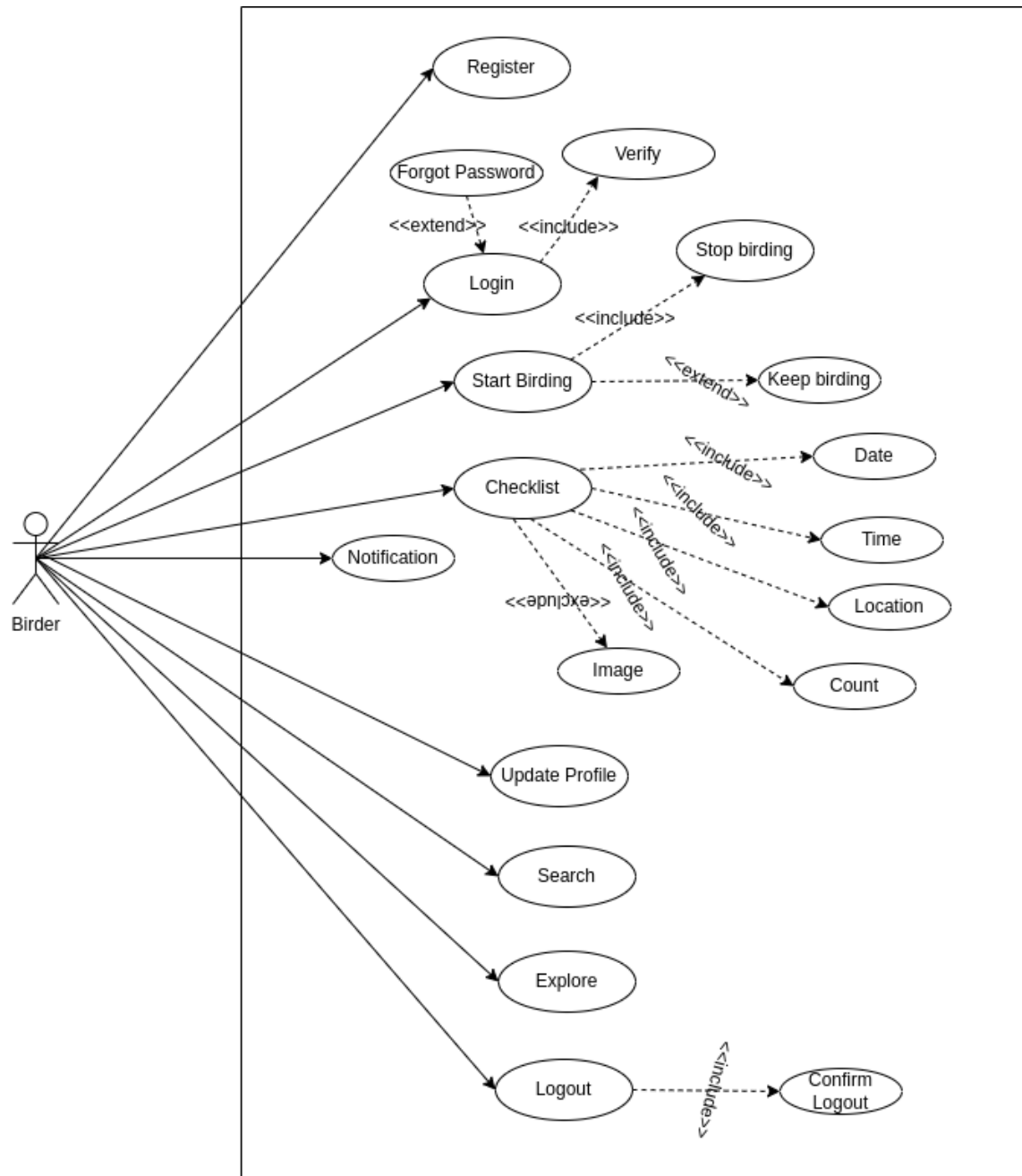


Figure 15: User usecase

Enthusiast Birder/Researchers: A user passionate about birdwatching who uses the mobile app to record and share bird sightings. Users who analyze recorded bird sightings to gain insights into bird populations.

Login: Enthusiast birders and researchers can log in to the mobile app after completing the registration process. This grants them access to the app's features.

Update Profile: Users can update their profile including profile picture, name, date of birth and profession.

Record and Submit Sightings: After logging in, users can click on the "Start Birding" button to record and share their bird sightings. This contributes to the app's database and helps researchers understand bird populations.

Checklist Submission: Users can choose to submit their checklists, which are then verified by the admin. This ensures the accuracy and reliability of the recorded data.

Search for Nearby Birds: Users can search for nearby bird species using the app's search functionality. This helps users identify bird species in their vicinity.

Search for Birding Sites: Users can search for birding sites within the app, providing information about locations known for birdwatching. This assists users in discovering suitable birdwatching spots.

Unknown Bird Verification: When users submit sightings of unknown birds, the admin verifies the submissions to identify the species. This ensures accurate data collection and identification of bird species.

Logout: Users can log out of the app when they have completed their activities.

2.3.3 Entity Relationship Diagram

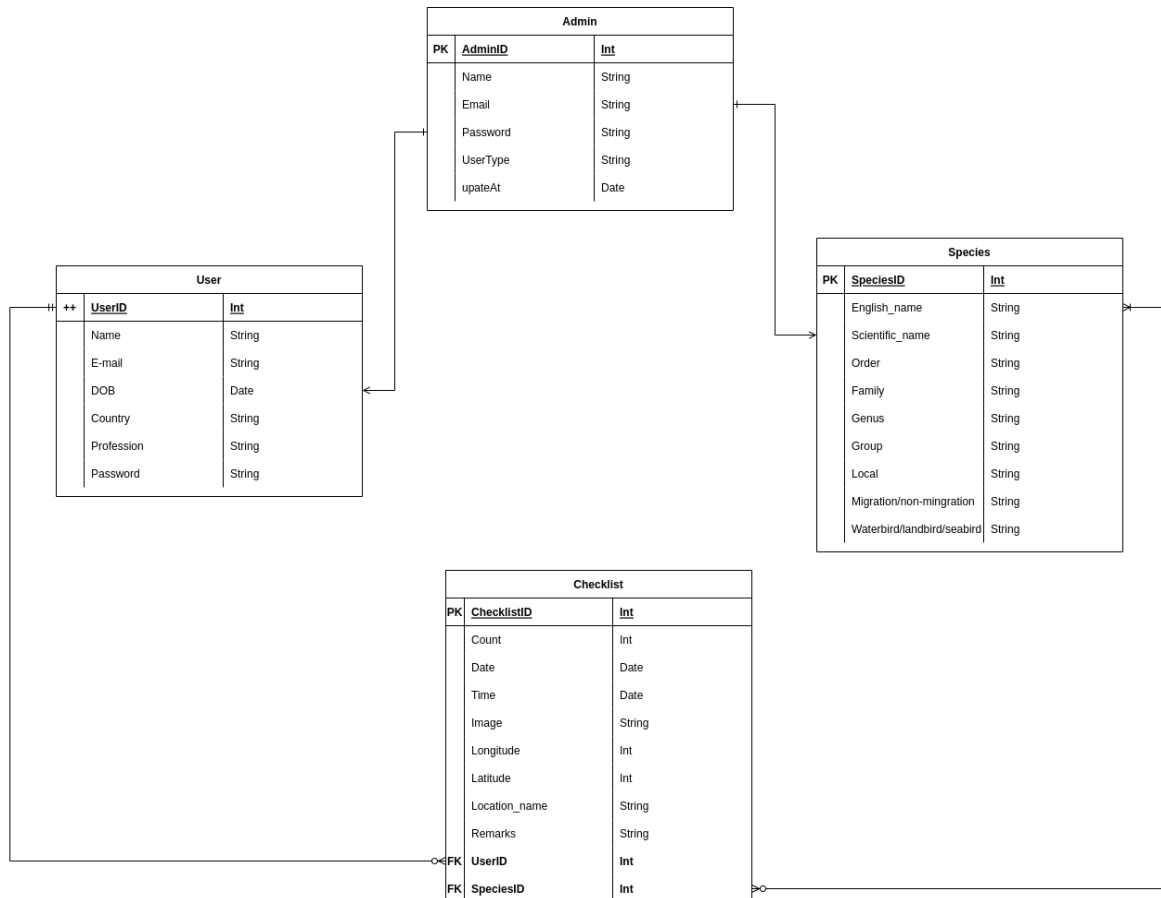


Figure 16 :Entity Relationship Diagram

An Entity-Relationship Diagram (ERD) is a visual representation that depicts the entities (objects), attributes (properties), and relationships between entities in a database system.

Entities:

1. User:

Attributes: UserID, Username, Email, Password, Profession, Date of birth and Country.

2. Admin:

Attributes: AdminID, Username, Email and Password.

3. Species:

Attributes: SpeciesID, EnglishName, ScientificName, Order, Family, etc.

4. Checklist:

Attributes: ChecklistID, UserID, SpeciesID, Location, Date, Time, Photo, Remarks etc.

Relationships:**1. User-Admin (One-to-Many):**

The relationship between the User and Admin entities represents the fact that one admin can manage multiple users.

2. Admin-Species (One-to-Many):

The relationship between the Admin and Species entities indicates that the admin can add multiple species to the system.

3. User-Checklist (One-to-Many):

The relationship between the User and Checklist entities represents the fact that a user can submit multiple checklists.

4. Admin-Checklist (One-to-Many):

The relationship between the Admin and Checklist entities indicates that the admin can update, verify, and delete multiple checklists.

2.3.4 Workflow

The following diagrams shows the workflow of DrukeBird:

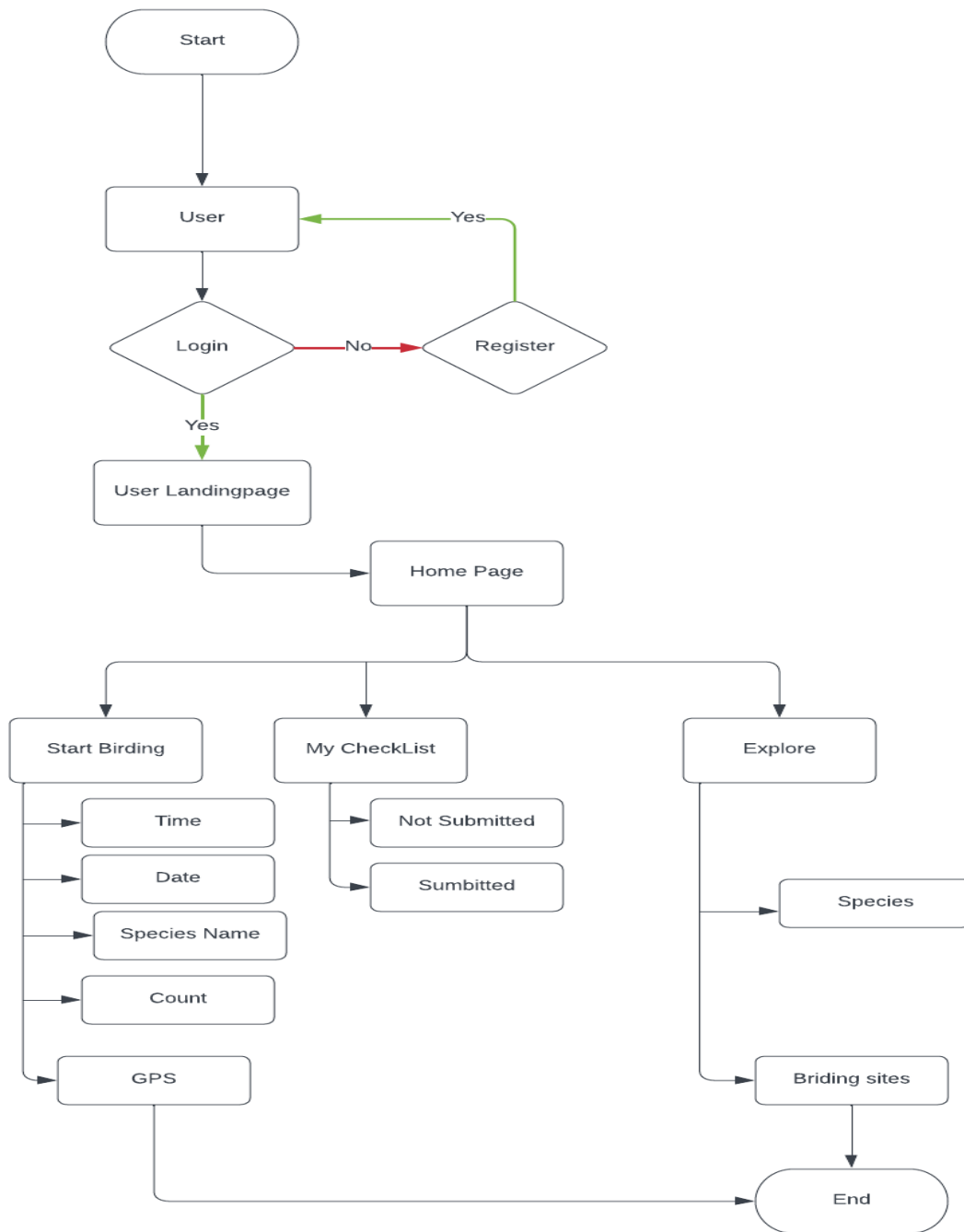


Figure 17: User Workflow

Login:

Users can log in to the system using their registered credentials, email and password.

Start Birding:

After logging in, users can initiate the birding activity, where they can record and submit their bird sightings. This activity allows users to document information about the observed bird species, location, date, time, and count of birds.

My Checklist:

Users can access their personal checklist, which displays the bird sightings they have recorded. The users can also view their draft checklist which they can submit or delete later.

Search:

Users can utilize the search functionality to find specific bird species or explore birding sites. This feature helps users discover the nearby bird species and birding sites.

Delete:

Users can delete their own checklists if they no longer wish to keep them in the system. This action removes the selected checklist from their personal records.

Logout:

Users can log out of the system, terminating their current session and ensuring the security of their account.

2.4 MODULE WISE SPECIFICATIONS

2.4.1 User Management Module

The user management module includes creating a user account, login and profile management within the DrukeBird app.

The features of included in User management modules are:

1. **Registration:** Users have the option to create an account on the DrukeBird app by providing various details, including their name, email address, date of birth, profession, country, and password. These pieces of information are required during the registration process to establish a personalized account for the user.
2. **Authentication:** To ensure secure access to the user's account, email verification is required during registration. This involves validating the user's email address by confirming the One-Time Password (OTP) sent to their email. Additionally, the account password must meet certain criteria, including at least one uppercase letter, one lowercase letter, and one digit. These measures are implemented to safeguard the account from unauthorized access.
3. **Login:** Once the account creation process is successfully completed, users are required to log in to gain access to the full range of features offered by the DrukeBird app. Logging

in is necessary to authenticate the user's identity and provide a secure entry into the app. Once logged in, users can explore and utilize all the available features and functionalities.

4. **Profile Management:** Upon logging into the DrukeBird app, users are granted the privilege to manage their profile. This includes the ability to make changes to their name, date of birth, and profession. Furthermore, users have the option to update their profile picture and password as well. These features empower users to maintain an up-to-date and personalized profile that reflects their current information and preferences.
5. **Password Reset:** In the event that users forget their account password, the DrukeBird app provides a convenient "Forgot Password" option. This feature allows users to initiate the password reset process. By following the instructions provided, users can verify their identity through email. Once the user's identity is confirmed, they can proceed to reset their password and regain access to their account. This ensures that users can regain control of their accounts even if they forget their original password.
6. **Logout:** Users have the ability to log out from their DrukeBird account whenever they wish. By selecting the "Logout" option, users can securely terminate their session and disconnect from the app. This action ensures that their account remains protected and inaccessible to unauthorized users.\

2.4.2 Search Module

The DrukeBird app includes a comprehensive search module designed to enhance the user experience when looking for specific bird species and birding sites. The search module is integrated with the following features:

1. **Searching for specific bird species:** Users can easily search for a particular bird species within the app. This feature is useful when users come across an unfamiliar bird and wish to submit a checklist for that species. Additionally, users can search for bird species to access information regarding their abundance and population count in various regions of Bhutan.
2. **Searching for birding sites:** The search module also allows users to search for specific birding sites. When users input a particular birding site, they receive a list of bird species that can be found in that specific location. This feature helps users identify birding hotspots and plan their birding activities accordingly.

2.4.3 Delete Module

The DrukeBird app incorporates a delete module, which allows users to remove draft submissions and notifications according to their preferences. The delete module includes the following features:

1. **Draft Checklist Deletion:** Users have the option to create checklists in draft mode, which can be submitted at a later time. If users decide not to proceed with the submission, they can delete the draft checklist to remove it from their records.

2. **Notification Deletion:** Users receive notifications, particularly for unknown verified sightings, from the app's administrator. After reviewing the notification, users can choose to delete it from their notification list.

2.4.4 Post/Submit Module

The post module in the DrukeBird app enables users to submit checklists of birds they have encountered. This module is integrated with the following features:

1. **Known Bird Checklist Submission:** Users can create a checklist by directly entering the name of the bird species they have observed, along with the count of each species.
2. **Unknown Bird Checklist Submission:** In cases where users are unable to identify a bird species, they can submit the bird as unknown. The app's administrator will verify the sighting and send a notification to the user regarding the verification status. Users are required to capture a photo of the unknown bird for submission.
3. **Expert Bird Checklist Submission:** Expert birders have the option to provide additional details about the birds they observe. This includes specifying the bird's identification (juvenile or adult), adding remarks or comments, entering the bird count, and uploading a photo for reference.

2.5 DESIGN VALIDATION

Test Scenario ID	User Requirement	Test Scenario Description	Validation Test
TS_001	Login	Validate the responsiveness of the Login page. Validate the functionality of the Form Validations	Test if the login page is responsive in all the screen sizes. Verify that the login process is successful when using the correct username and password. Validate by clicking sign in without entering any values in username and email and check the error message. Verify valid username and invalid password and check how the error message displayed. Verify invalid username and valid password and check how the message displays. Verify login with invalid username and invalid password and check the error message display.

			Click on the password reset link provided in the email and ensure that it redirects to the password reset page and display a success message.
TS_002	Forgot Password	Validate the functionality of Forgot Password	<p>Test with invalid email on reset password form and check if it displays an error message.</p> <p>Verify by entering valid email with a registered account and verify that the system accepts the email. Check how the reset link has been sent.</p> <p>Verify by entering invalid email with a registered account and verify that the system accepts the email. Check the error message display.</p> <p>Test whether the recent password is able to log into the page.</p> <p>Check on the password reset link provided in the email after a few hours and check the error message displayed.</p>
TS_003	Dashboard	Validate the responsiveness of the page	<p>Verify responsiveness of the page in different screen sizes.</p> <p>Test all the functional buttons are well aligned in different sizes.</p> <p>Check if it redirects to the checklist once I select any single bird species and click on submit.</p> <p>Check whether it redirects to the checklist once you select many bird species at a time and click on submit.</p> <p>Validate whether it redirects to the not submit list once I click on the stop button after I select any single bird species.</p>

			<p>Validate whether it redirects to the not submitted list once I click on the stop button after I select many bird species.</p> <p>Validate whether it redirects to the not submit list once I click on the stop button after without selecting any single bird species and check the alert messages displayed.</p>
TS_04	Data, Time Record Track	<p>Validate the functionality of date and time.</p> <p>Validate the functionality of record track.</p>	<p>Verify by selecting the present date and time to start birding.</p> <p>Verify by selecting previous date and time to start birding.</p> <p>Verify by selecting the future date and time to start birding.</p> <p>Check the default recording of the track is on.</p> <p>Test whether the warning message is displaying or not when we click on turn off.</p>
TS_005	Graph	Validate the functionality of Graph	<p>Test the presence of appropriate labels and legends.</p> <p>Validate the accuracy of the data presented in the graph.</p> <p>Check how graphs change with the change of values.</p>
TS_006	Logout	Validate the functionality of Logout button	Validate the functionality of Logout button
TS_007	Notification	Validate the functionality of notification	<p>To ensure proper functionality, verify the notification page when there are no notifications. Confirm that it displays relevant and informative messages. This ensures users are appropriately informed when there are no pending or unread notifications.</p> <p>To confirm the notification system's effectiveness, test whether notifications are</p>

			<p>received when there are updates in the database. Make sure there is an active connection to the database, and upon any new update, such as bird verifications, check if the app generates notifications.</p> <p>To assess the functionality of managing notifications, test whether users can delete notifications after viewing them. After accessing and reviewing a notification, ensure there is an option or mechanism to delete it.</p>
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CHAPTER 3 IMPLEMENTATION

3.1 DEPLOYMENT

The project is accessible to users through a mobile application deployed on the Play Store. The backend of the project is deployed on the DigitalOcean platform. DigitalOcean is a cloud computing platform that provides developers with a simple and efficient way to deploy, manage and scale applications in the cloud. It supports the backend infrastructure such as API servers, databases and other backend services. With robust networking infrastructure and data centers located globally. DigitalOcean ensures low latency and high availability for the deployed application. It offers various features like automatic backup, monitoring and scaling options to optimize the application's performance and security.

3.2 IMPLEMENTATION NOTE OF ALL MODULES

Module 1: User Registration

Implemented a user registration form that collects essential user details such as name, email, password, date of birth, country, and profession. Validated the form data to ensure accurate and complete information. Stored the registration details securely in the database, assigning each user a unique identification (ID) for future reference.

Module 2: User Authentication

Developed a login form to capture user credentials (email and password). Validated the entered credentials by comparing them with the stored user data in the database. Implemented secure authentication protocols to ensure the privacy and integrity of user accounts.

Module 3: Checklist Submission

Created a form to capture bird observation details, including species, location coordinates (latitude and longitude), date, time, etc. Implemented data validation to ensure the completeness and accuracy of the submitted information. Linked the observation data to the corresponding user by using session tokens or user IDs. Stored the observations securely in the database for analysis and retrieval.

Module 4: Checklist Data Retrieval

Implemented a search functionality that allows users to query bird observation data based on specific criteria such as species or birding sites. Processed the search queries and retrieved relevant observation data from the database. Presented the retrieved data to the users in a user-friendly format in a list.

Module 5: Bird Species Information

Established a database table to store comprehensive information about various bird species. Developed functionality to fetch species information based on user queries or selected species. Displayed relevant details, including birding sites and species counts, using bar graphs.

Module 6: Data Visualization

Retrieved bird information along with their respective counts and implemented visualizations to present the data in an easily interpretable format. Utilized graphs to display bird species abundance and distribution patterns, enhancing the user's understanding of the data.

Module 7: User Settings and Preferences

Enabled users to manage their account settings and preferences. Implemented functionality to update user details such as name, password, and profile picture. Stored the modified settings and preferences securely in the database for future reference and personalization.

Module 8: Notifications

Implemented a notification system to inform users about the verification status of their submitted checklists with unknown bird species. Once the admin verifies the checklist, a notification is sent to the user to provide updates or necessary actions.

Module 9: Mobile Application Integration

Developed a mobile application interface to enhance user accessibility and provide a native mobile experience. Integrated application programming interfaces (APIs) to establish a connection between the mobile app and the backend modules. The integration enables seamless data exchange and functionality between the mobile app and the DrukeBird system.

3.3 TEST RESULT

Test Scenario ID	Test Scenario Description	Test Case ID	Steps	Test Data	Expected Result	Actual Result	Status(Pass/Fail)
TS_001	Verify the email authentication for registration	TC_register_001	1.Open DrukeBird app. 2. Click on the register button. 3.Enter email and Name. 4. Click on the submit	Name: Karma Choda karmachoda11@gmail.com	Redirect to form detail	successful redirect form.	Pass
TS_002	Verify the registration functionality	TC_register_001	4.Enter DOB 5.Select Country 6.Enter professions 7.Enter Password	DOB:11/02/200 Country: Bhutan Profession:Student	Successful registration	Successful registration.	Pass

			8.Enter confirm password	Passwor d:Karma choda12			
TS_00 3	Verify the login functionality	TC_1 ogin_002	1. Input the registered credentials. 2. Click on login button	Email: karmachoda11@gmail.com Password: Karmachoda11	Login should be successful	Login Successful. Successfully redirected to Homepage.	Pass
TS_00 4	Check with valid email and invalid password	TC_1 ogin_002	1. Enter valid email 2. Enter invalid password 3. Click on submit buttons	Email: karmachoda@gmail.com Password: kc123	Error message should be displayed.	“Invalid email or password”	Pass
TS_00 4	Check invalid email and invalid password	TC_1 ogin_002	1. Enter invalid email 2. Enter invalid password 3. Click on the submit buttons	Email: cchokey@gmail.com Password:Karma123	Error message should be displayed.	Invalid email or password	Pass
TS_00 5	Verify forgot password	TC_f ogot pass word_003	1.Enter email address 2.Click on reset password	Email: Email: karmachoda11@gmail.com	Should display successful message with reset password link in the email	Displays successful message and receives reset password link.	Pass
TS_00 6	Check forgot password	TC_f ogot pass	1. Go to email 2. Click on the	Email: karmachoda11@gmail.com	Should reset password	Password has been reset successfully.	pass

	with valid email	word _003	Reset password Link 3. Enter the new password 4. Click on the reset button	ail.com	successful		
TS_007	Check forgot password with invalid email	TC_forgot password _003	1. Enter email address 2. Click on reset password	Email: kc@gmail.com	Should be display invalid email	Your email is not registered	Pass
TS_008	Check start birding functionalities	TC_startBirding _004	1. Click on the StartBirding tap. 2. Submit Known Birds. 3. Submit Unknown Birds. 4. Submit more details of the birds by expert birders.	Provided all the necessary details.	All the functionalities should work without any errors and display necessary messages.	Successful submission of all checklists	Pass
TS_009	Check start birding functionalities	TC_startBirding _004	1. Click on the StartBirding tap. 2. Submit Known Birds. 3. Submit Unknown Birds 4. Submit more details of the birds by expert birders.	Provided all the necessary details.	All the functionalities should work without any errors and display necessary messages and it should redirect to NotSubmitted	Saved in Not Submitted checklist	Pass

					Checklist, when users click on Stop button.		
TS_0010	Check the explore feature functionalities	TC_explore_005	<p>1. Click on the explore tap.</p> <p>2. Search for bird species and birding sites.</p> <p>3. Check whether the graph changes in real time with data provided by the users.</p>	<p>Search: Mongar</p> <p>Search: Indian Owl</p>	<p>The graph should be displayed for both bird species and birding sites.</p> <p>The search functionalities should work as expected.</p>	<p>The graphs are displayed successfully and change in real time with change in data.</p> <p>The search function is working as well.</p>	Pass
TS_011	Check Checklist feature functionalities	TC_checklist006	<p>1. Click on the checklist tap.</p> <p>2. Check the draft checklist and submitted checklist.</p> <p>3. Submit a draft checklist.</p> <p>4. Delete the draft checklist</p>	<p>Select Dzongkhag: Mongar</p> <p>Select Gewog: Mongar</p> <p>Select Village: Drepong</p>	<p>The draft submission should be successful.</p> <p>The delete function should delete the draft checklist.</p>	<p>Draft checklist successfully submitted</p> <p>Draft checklist successfully deleted</p>	Pass
TS_012	Check Unknown Verification feature	TC_unknownVerification_007	<p>1. Click on Unknown verification menu</p> <p>2. Check for notification</p> <p>3. Tap on the</p>	-	<p>The Unknown verified message should be displayed.</p> <p>The bird name</p>	<p>Unknown verification messages displayed.</p> <p>The name of the bird is also displayed.</p>	Pass

			notification 4. Delete notification		should be displayed after Clicking on the notification. The notification should be deleted successfully.	The notification is successfully deleted.	
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3.4 CONCLUSION

In conclusion, the development of the DrukeBird application has been successful in creating a centralized platform for gathering and sharing information about bird observations in Bhutan. DrukeBird allows birdwatchers, researchers, and anyone interested in birds to record and store sightings, contributing to a valuable database of bird information.

By collecting details like bird species, locations, and timestamps, DrukeBird helps analyze patterns and trends in bird sightings. This data is essential for understanding bird populations, identifying conservation areas, and monitoring the impacts of environmental changes and habitat loss.

The collaborative nature of DrukeBird encourages participation from people of all backgrounds, ensuring a comprehensive collection of bird data. This information has far-reaching implications for bird conservation and management. It supports scientific studies, ecological research, and the development of effective conservation strategies.

Overall, DrukeBird represents a significant advancement in our understanding and conservation of birds in Bhutan. Its user-friendly interface and collaborative features make it a valuable tool for bird enthusiasts, researchers, and conservationists locally and globally.

3.5 FUTURE PLANS

Integration with AI: In the future, DrukeBird aims to incorporate artificial intelligence (AI) technologies to enhance its functionalities. By leveraging AI, the application can provide advanced features such as automated bird species recognition and identification. Users will be able to capture bird images within the app, and AI algorithms will analyze the images to identify the species. This integration will significantly streamline the data collection process and improve the accuracy of bird identification.

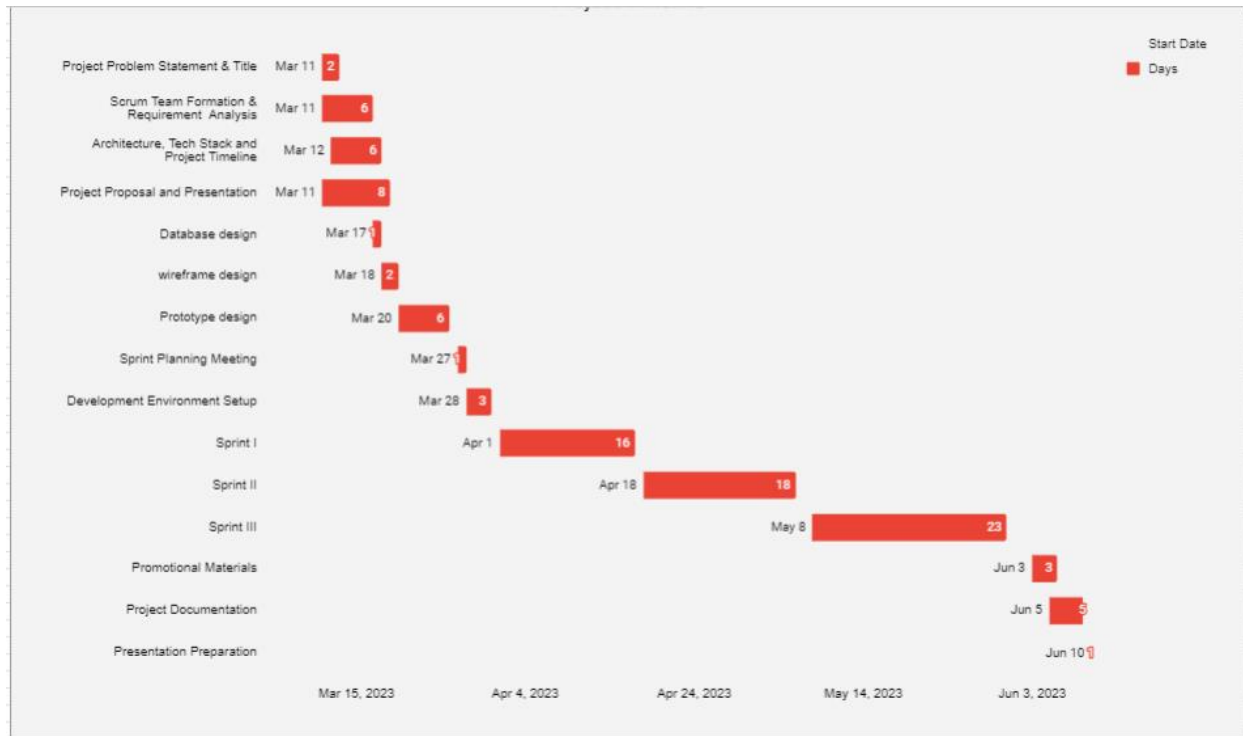
Real-time Chat System: To further enhance user interaction and engagement, DrukeBird plans to implement a real-time chat system. This feature will allow birders, researchers, and enthusiasts to communicate and collaborate within the app. Users will be able to exchange information, share insights, and seek assistance from fellow users in real-time. This chat system will foster a sense of community and provide a platform for knowledge sharing and collaborative birding efforts.

By integrating AI and introducing a real-time chat system, DrukeBird envisions providing users with advanced tools and a more immersive experience. These future developments will elevate the application's capabilities, making it an even more powerful resource for bird enthusiasts, researchers, and conservationists in Bhutan and be

CHAPTER 4: REFERENCE

PROJECT SCHEDULE / MILESTONE CHART / WORK PLAN

Task	Start Date	End Date	Duration
Project Conception and Initiation			
Project Problem Statement & Title	3/11/2023	3/13/2023	2
Scrum Team Formation & Requirement Analysis	3/11/2023	3/17/2023	6
Architecture, Tech Stack and Project Timeline	3/12/2023	3/18/2023	6
Project Proposal and Presentation	3/11/2023	3/19/2023	8
Project Design and Planning			
Database design	3/17/2023	3/18/2023	1
wireframe design	3/18/2023	3/20/2023	2
Prototype design	3/20/2023	3/26/2023	6
Sprint Planning Meeting	3/27/2023	3/28/2023	1
Development Environment Setup	3/28/2023	3/31/2023	3
Project Development			
Sprint I	4/1/2023	4/17/2023	16
Sprint I Review Meeting			
Sprint I Retrospective Meeting			
Sprint II	4/18/2023	5/6/2023	18
Sprint II Review Meeting			
Sprint II Retrospective Meeting			
Sprint III	5/8/2023	5/31/2023	23
Sprint III Review Meeting			
Sprint III Retrospective Meeting			
Deliverance and Presentation			
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Project Showcase			



GITLAB LINK

https://gitlab.com/Humblewangss777/druk_e-bird/-/tree/main

PROMOTIONAL VIDEO LINK

<https://www.youtube.com/watch?v=WruSCN-oUuk>

POSTER LINK

https://gitlab.com/Humblewangss777/druk_e-bird/-/blob/main/Images/Final_Poster.jpeg

USER'S MANUALS

Welcome to the user manual for “DrukeBird”. This manual provides step-by step instructions to help you navigate and utilize the application efficiently. The application is developed for creating a centralized database for the birds around Bhutan.

1. System Overview

The DrukeBird app is a comprehensive and collaborative platform designed to gather and share bird observation data in and around Bhutan. It serves as a centralized hub for birders, researchers, and other enthusiasts to record and store sightings, contributing to a

vast database of bird information. The app is built using the React Native framework, providing a user-friendly interface and native mobile experience.

The app offers a range of modules to support various functionalities. Users can register and login to the app using their credentials, enabling them to access its features. Upon login, users can engage in bird watching activities by clicking on the "Start Birding" button. This functionality allows them to record and share their bird sightings, contributing to a better understanding of bird populations and trends across the country.

The "My Checklist" module allows users to manage and view their submitted checklists. They can track their observations, including details such as species, location coordinates, date, and time. The app also facilitates data retrieval through a search functionality, allowing users to query specific bird species or birding sites. This feature provides valuable insights into the distribution and abundance of birds, aiding researchers and conservationists in their work.

The app incorporates user settings and preferences, allowing individuals to personalize their profiles and manage account details. Users can update their information, such as name, password, and profile picture, ensuring a customized experience within the app.

To facilitate communication and notifications, the app includes a notification module. Users receive notifications regarding the verification status of their checklists, particularly those containing unknown bird species. Admin verification ensures the accuracy and reliability of the submitted data.

In addition to its mobile application, DrukeBird offers integration with AI and real chat systems as future plans. This integration would enhance the app's capabilities by leveraging artificial intelligence and enabling real-time interaction for users.

Overall, the DrukeBird app revolutionizes the field of bird observation and conservation by providing a centralized platform for data collection, analysis, and sharing. It empowers users to contribute to a comprehensive bird database, aiding researchers, conservationists, and birdwatching enthusiasts in their efforts to protect and understand the bird species of Bhutan.

2. Getting Started

Start Checklist

Before selecting the birds, you need to select date and time. If you are about to begin birding, use the current date and time or you can adjust these values to the previous time period.

Once the date, time, and tracks are set, tap "Start Checklist". Now we're at the fun part-reporting your bird sightings! Enter every bird that you see and the numbers of each species. Tap on a bird's name to enter and add some details including the bird photo of a particular species. You also have the option to pause birding, and your checklist summary will be saved as a draft, allowing you to submit it at a later time.

Record Track

Record track is selected by default. This will record the Latitude and Longitude of the current location.

Select a Location

You must select a location before you submit your checklist. You will be provided with options to choose Dzongkhag, Gewog and Village.

Unknown Birds

Even if you are unfamiliar with the name of the bird, you have the option to select "UnknownBird" and submit the checklist. The administrators will verify the unidentified bird, and you will be able to view its name from the "Unknown Verification" section.

Explore

The Explore feature allows you to search for specific birds or birding sites based on the checklists submitted by all users. Additionally, it provides a graph displaying the top three bird species and birding sites, as determined by the checklists submitted.

Checklist

Once you have submitted a checklist, you will be able to access and view all the checklists you have submitted in the "Checklist" section. This section will also include any draft checklists that you can choose to submit at a later time.

7. Bibliography

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