Cattle Aid- Application of Ontology – Based veterinary information extraction for cattle skin disease diagnosis.

TMP-2023-24-001

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Introduction to the overall project

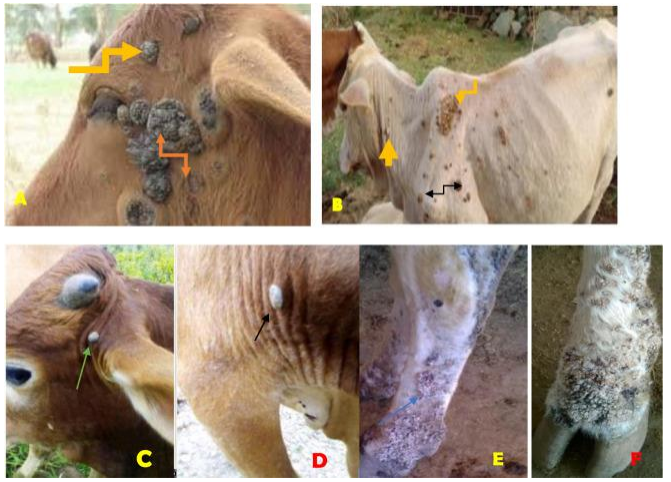
In the dynamic landscape of veterinary medicine, technological innovations have emerged as crucial tools for addressing the challenges faced by livestock industries. In this context, our research endeavours to revolutionize the diagnosis and management of cattle skin diseases through the integration of advanced technologies and domain-specific knowledge. Our research topic, "Application of Ontology-Based Veterinary Information Extraction for Cattle Skin Disease Diagnosis," encapsulates a multidimensional approach that harnesses the power of artificial intelligence (AI) and ontology-based information extraction to enhance the understanding and handling of cattle skin diseases.

Common Cattle Skin Diseases

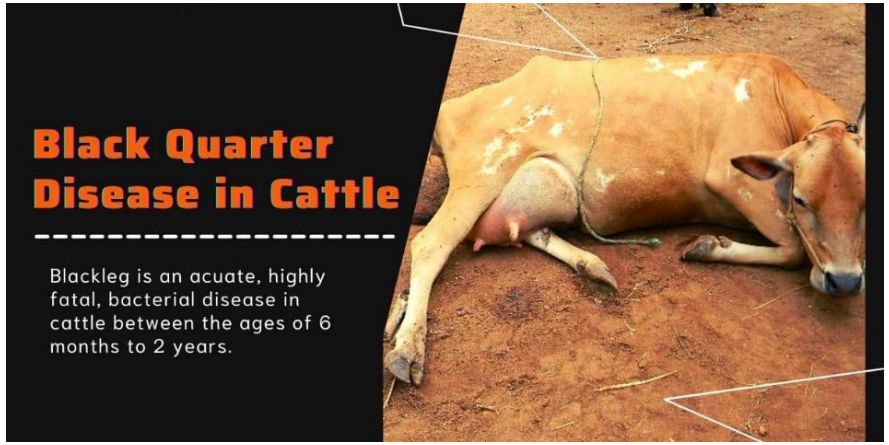
How many cows are there in Sri Lanka?

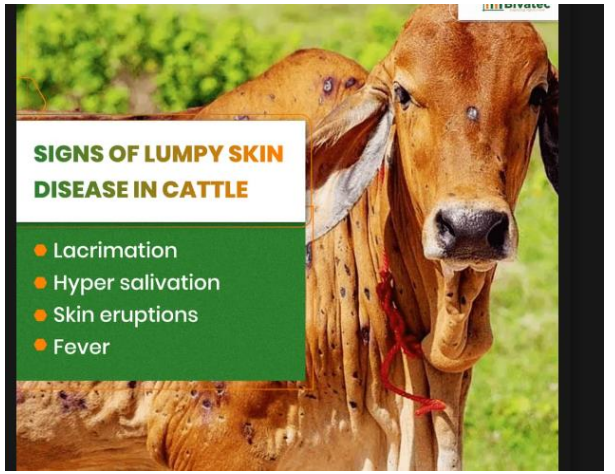
Department of Census and Statistics

Cattle		Year
		2020
Milk Cows	Milking at Present	237,240
	Milking not at Present	215,400
Other Cows		33,330



papillomatosis





Overall Project Description

Research Problem

The cattle industry in Sri Lanka, a vital component of the agricultural sector, is pivotal to the nation's economy. However, the occurrence of skin diseases among cattle remains a pressing concern, impacting animal welfare, productivity, and economic stability. The conventional methods of diagnosing these diseases often rely on subjective visual assessments, leading to inconsistencies and delays in treatment. Moreover, the accurate assessment of disease severity and the efficient extraction of relevant information from diverse data sources pose formidable challenges.

Overall Project Objectives

Our research focuses on tackling cattle skin diseases using four interconnected methods. We want to change how these diseases are diagnosed and managed.

we're working on a powerful system that uses modern image techniques and special computer models to spot and categorize different skin diseases in cattle pictures. This will help veterinarians diagnose quickly.
Then, we're creating smart algorithms that can measure how serious skin disease is. By looking at patterns in images, we can give better advice on how to treat the disease.

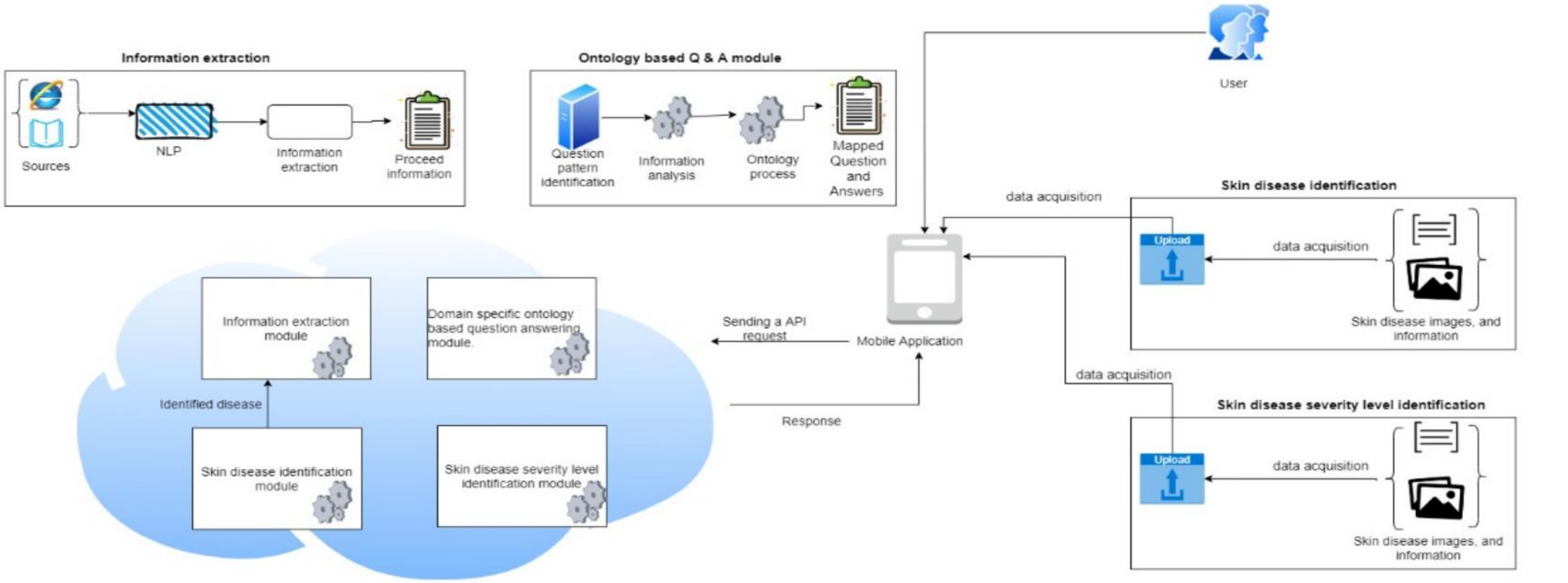
After that, we're making a big collection of information about these diseases. This will help us quickly get important details from different sources to get a full picture of each disease.

Lastly, we're building a smart computer assistant using all this knowledge. This helper will give real-time advice to vets and animal caretakers for accurate diagnosis, judging how bad a disease is, and suggesting the right treatments.

Overall Project Sub Objectives

- Cattle Skin Disease Detection Using Image Processing and CNN Models
- Severity Level Detection of Skin Disease.
- Ontology-Based Information Extraction from Data Resources
- AI-Driven Smart Assistant for Cattle Skin Diseases

Overall System Diagram



- The total cattle population has been recorded as 1,105,590 with the sum of local (828,120) and Improved (275,450) breeds of cattle in 2020.

- **total milk production of cattle was 471,592,800 and 396,198,000 liters in 2018 and 2017**, respectively. As the results, cattle milk production has been increased by 19.02% year on year, where domestic milk is sufficient with the achievement of 42% of the total demand at present. However, **the per capita availability of Milk has been recorded as 9.27 (Kg/Year), as being the percentage of Milking Cows has been reduced by 5.6% (284,400) in 2017**. Therefore, the availability of total milk within the country was increased by 1.6% (to 1,158 million liters) which led to the per capita availability to 52.81 liters in 2020 (52.26 liters – 2018). Although there was a decreasing trend in livestock population and technical aspects in 2020 to 2018, the number of livestock holders are increased with the year. As the result, fluctuation of production is common in the country (Department of Animal Production and Health, 2017).

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Introduction and Background

Cattle Skin Disease Detection Using Image Processing and CNN Models.

Cattle skin diseases impact livestock health, economics, and animal welfare. Detecting them accurately and promptly is vital. However, traditional methods struggle to blend veterinary knowledge with modern tech.

My solution is a unique approach that merges advanced image processing and deep learning. By enhancing images and using transfer learning, we're aiming to improve the precision, speed, and dependability of cattle skin disease detection.

Research Gap and Novelty

- Research Gap :-

  - **Integrating Veterinary and Image Expertise**: A gap exists in combining veterinary insights with image processing for accurate cattle skin disease detection. Current methods may not optimally use domain-specific knowledge.

  - **Innovative Image Enhancement:** The use of the Structural Similarity Index (SSIM) and Retinex algorithm for image enhancement in cattle skin disease detection is new. Traditional techniques may not suit veterinary images.

  - **Unique Transfer Learning Approach:** Applying four different CNN models with transfer learning for cattle skin disease classification is innovative in the veterinary context. This approach's benefits and performance differences remain unexplored.

Novelty :-

1) **Enhanced Image Quality:** Unique use of the Structural Similarity Index (SSIM) and Retinex algorithm boosts color, contrast, and texture aspects, elevating classification accuracy.

2) **Diverse CNN Models:** Novel application of various CNN models (Convolution pattern (sharpening, blurring, and embossing processes),, ResNet 50, ResNet152V2, Inception V3) via transfer learning reveals optimal fit for the veterinary domain.

3) **Domain Integration:** Innovatively merging veterinary expertise with image processing yields more precise classification and richer result interpretation.

Features	Research 1 [1]	Research 2[2]	Research 3 [3]	Research 4 [4]	Proposed Solution
Integration of image processing techniques with veterinary diagnostics	✗	✗	✓	✗	✓
Innovative Image Enhancement Techniques Hybrid approach: SSIM + Retinex	✗	✗	✗	✗	✓
Varied CNN model: Convolution, ResNet 50, ResNet152V2, Inception V3	✗	✓	✗	✗	✓
Extensive CNN transfer learning	✗	✗	✗	✗	✓

Research Problem

Issue: Current cattle skin disease detection lacks advanced image processing combined with veterinary insights.

Gap: Applying novel hybrid image enhancement (SSIM + Retinex) and multi-model transfer learning (Convolution, ResNet) remains unexplored for accurate classification.

Need: Develop an innovative approach that uses enhanced images and diverse CNN models to improve cattle skin disease detection accuracy.

Specific Objectives

1) **Integrate Methods:** Blend advanced image processing with veterinary diagnostics to improve cattle skin disease detection.

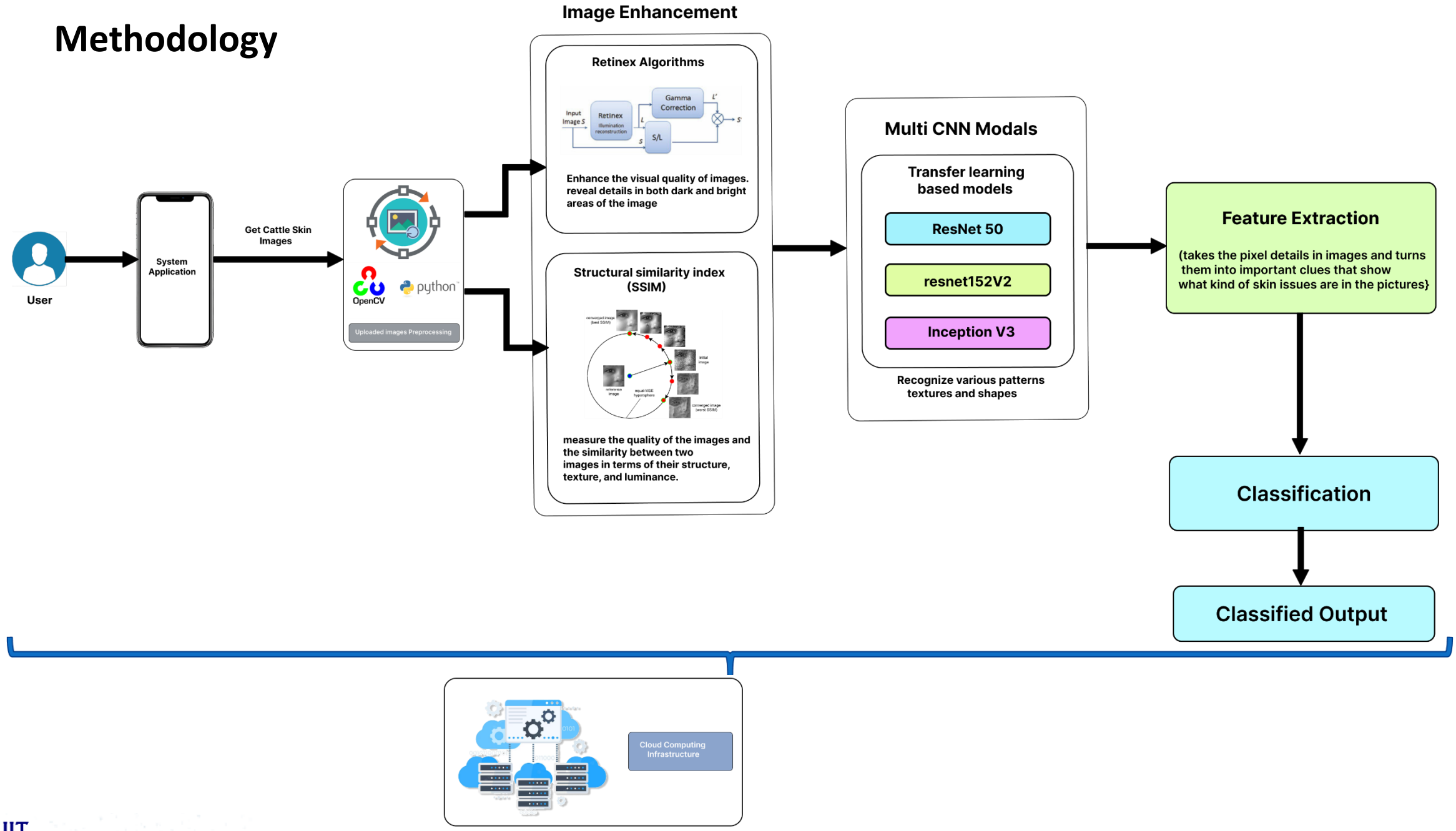
2) **Enhance Images:** Use innovative techniques like SSIM and Retinex to improve image quality for better diagnosis.

3) **Explore CNN Models:** Evaluate different CNN models (Convolution, ResNet 50, ResNet152V2, Inception V3) using transfer learning for precise classification.

4) **Boost Accuracy:** Improve detection accuracy by combining advanced image processing and deep learning.

5) **Practical Impact:** Assess how our approach can practically enhance livestock health management in veterinary practices.

Methodology

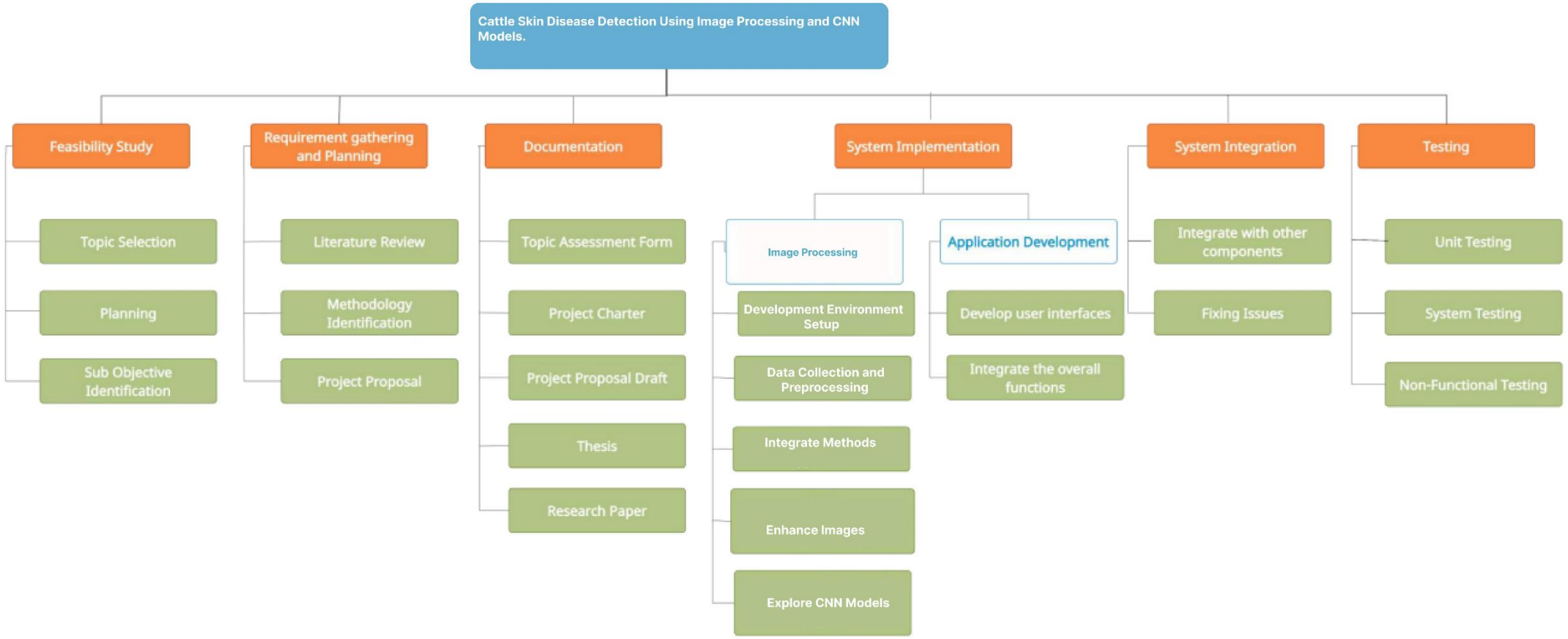


Tools and Technologies

Functional / Non-Functional Requirements

Functional Requirements	Non-Functional Requirements
1. Develop an image preprocessing module for data consistency.	Accuracy
2. Implement hybrid image enhancement using SSIM and Retinex algorithms.	Usability
3. Create a module for multi-model transfer learning with specified CNN models.	Performance
4. Design feature extraction component for CNN input.	Security
5. Develop a classification module using trained CNN models.	Scalability

Work Breakdown Structure



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Introduction

The severity of skin disease is crucial for appropriate treatment decisions. This component involves developing algorithms that can assess the severity of the detected skin diseases. The severity level detection could be based on factors like lesion size, color, distribution, and other visual characteristics.

Research GAP

Current research lacks comprehensive utilization of deep learning techniques for accurate severity level detection of cattle skin diseases. While deep learning has proven effective in medical imaging tasks, its potential in this domain remains largely unexplored. This study aims to bridge this gap by designing and evaluating tailored deep-learning models.

Novelty

The novelty in severity-level detection of skin diseases is the incorporation of advanced computer vision techniques with a focus on cattle. Existing methods often lack specificity for livestock. This study proposes a dedicated approach that tailors algorithms to account for diverse cattle skin disease presentations, enhancing accurate severity assessment and personalized treatment strategies.

Features	Research 1	Research 2	Research 3	Research 4	Research 4	Proposed solution
Feature Exploration and Selection	✓	✓	—	—	—	✓
Algorithm Development and Training	—	—	✓	—	—	✓
Performance Evaluation and Metric Selection	—	—	✓	✓	—	✓
Clinical Validation and User Feedback:	—	—	—	—	✓	✓

Research Problem

How can accurate and objective algorithms be developed for automated severity-level detection of various cattle skin diseases?

Specific objectives

Build an objective algorithm to automate severity level detection using various image features such as texture, color, shape, and spatial distribution to identify those that are most indicative of disease severity.

Research Problem

How can accurate and objective algorithms be developed for automated severity-level detection of various cattle skin diseases?

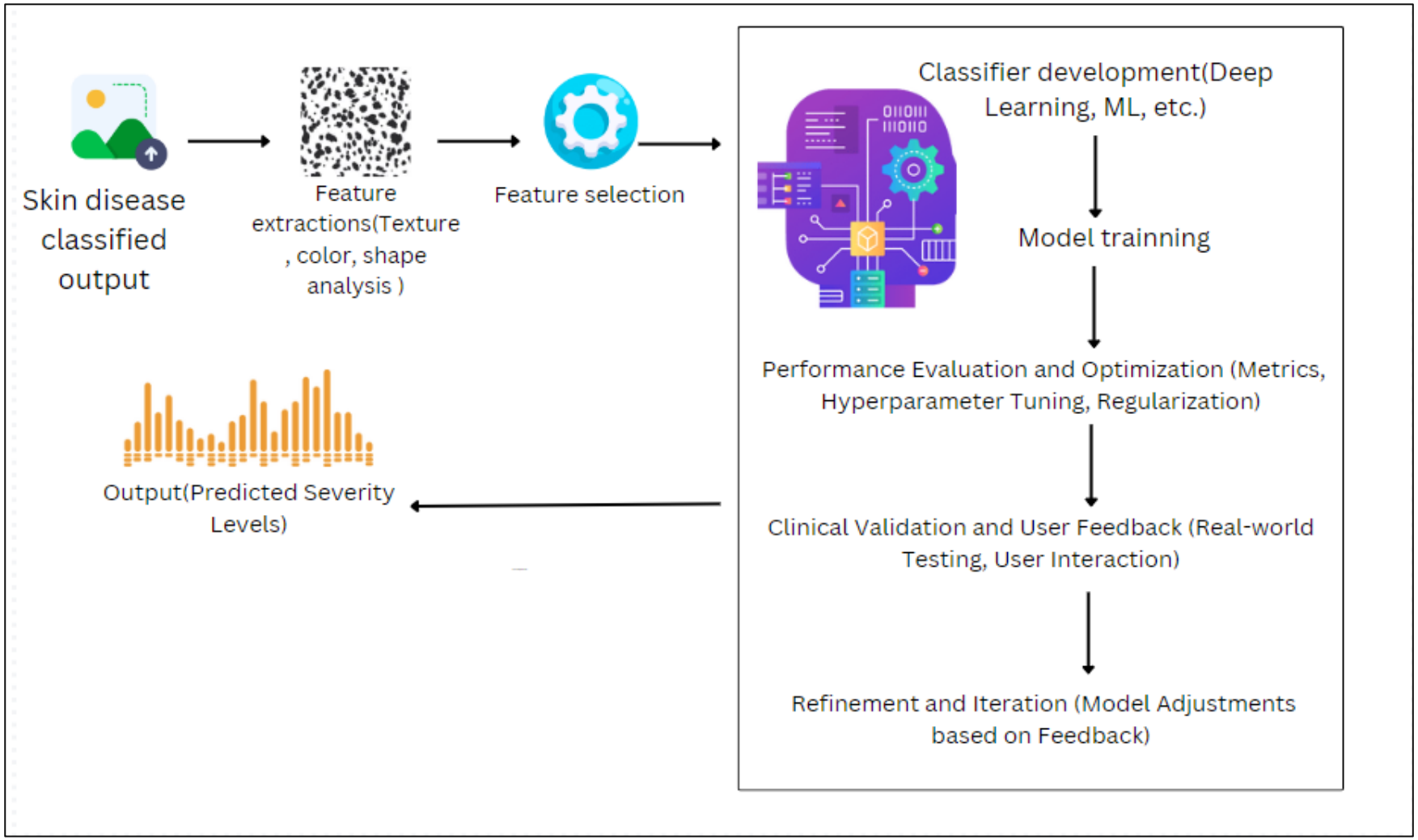
Specific objectives

Build an objective algorithm to automate severity level detection using various image features such as texture, color, shape, and spatial distribution to identify those that are most indicative of disease severity.

Sub Objectives

- **Feature Exploration and Selection:**
  - Identify a set of relevant image features (e.g., texture, color, shape) indicative of disease severity.
- **Algorithm Development and Training:**
  - Design and implement a machine learning or deep learning algorithm for severity level detection.
- **Performance Evaluation and Metric Selection:**
  - Define and select appropriate evaluation metrics (e.g., accuracy, precision, recall) to measure the algorithm's performance in severity-level prediction.
- **Clinical Validation and User Feedback:**
  - Collaborate with veterinary experts to validate the algorithm's performance in a clinical setting.

Methodology



Tools and Technologies

Tools and Technologies

- Visual Studio code
- google colab
- python
- GitHub

Libraries

•Natural Language Processing (NLP) Library- NLTK (Natural Language Toolkit), spaCy, Hugging Face Transformers

•Computer Vision Library- TensorFlow with Keras

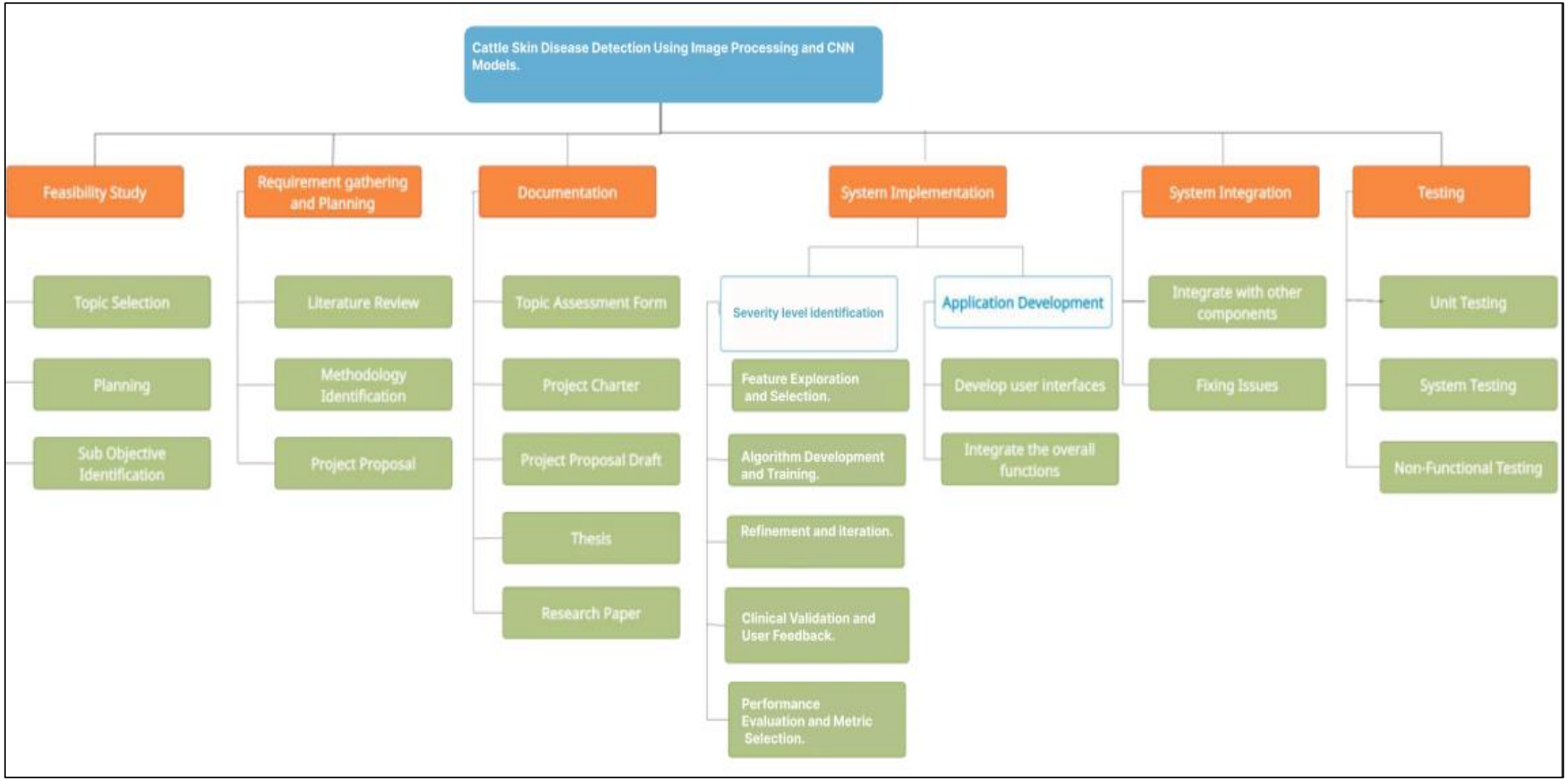
Algorithms

- Texture Analysis
- Color Analysis
- Shape Analysis

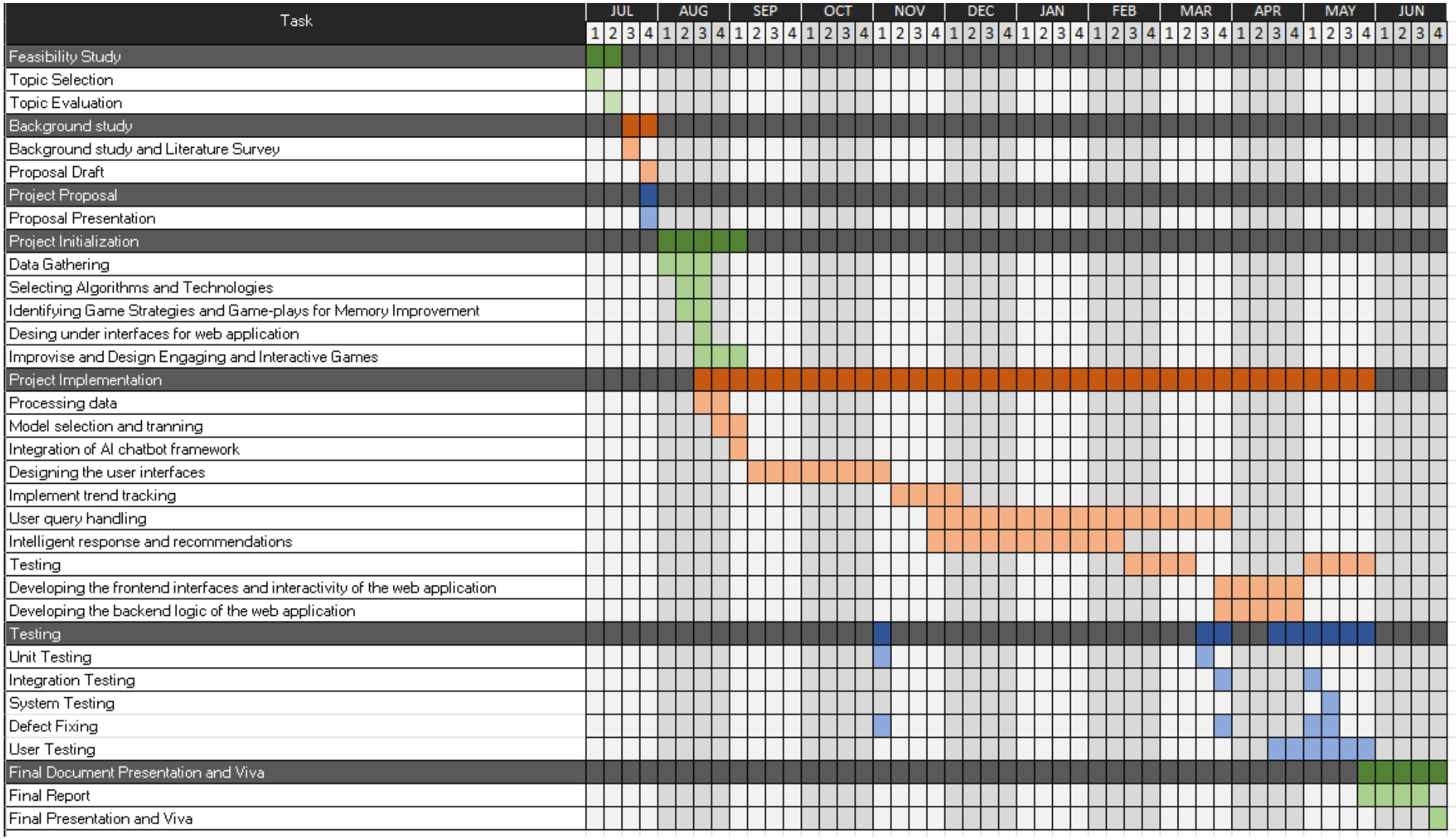
Functional and Non-Functional Requirements

Functional	Non-Functional
Development of an Annotated Dataset	Performance
Exploration of Relevant Features	Scalability
Algorithm Development and Training	Accuracy
Objective Metric Selection	Security

Work Breakdown Structure



Gantt Chart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Feasibility Study
Topic Selection
Topic Evaluation
Background study
Background study and Literature Survey
Proposal Draft
Project Proposal
Proposal Presentation
Project Initialization
Data Gathering
Selecting Algorithms and Technologies
Identifying Game Strategies and Game-plays for Memory Improvement
Desing under interfaces for web application
Improvise and Design Engaging and Interactive Games
Project Implementation
Processing data
Model selection and tranning
Integration of AI chatbot framework
Designing the user interfaces
Implement trend tracking
User query handling
Intelligent response and recommendations
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Developing the backend logic of the web application
Testing
Unit Testing
Integration Testing
System Testing
Defect Fixing
User Testing
Final Document Presentation and Viva
Final Report
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References

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INTRODUCTION AND BACKGROUND

Ontology-based information extraction from domain resources of cattle skin diseases.

- Generating relevant treatment and other information based on veterinary information and diagnostic information.
- What is Ontology-Based Information Extraction?
- What is the importance of using an Ontology-based approach for organizing veterinary information?

RESEARCH GAP AND NOVELTY

Research Gap :-

In Sri Lanka, a considerable amount of veterinary information concerning cattle skin diseases is documented across various departments, ministries, and institutes. However, a significant research gap exists in the utilization of this amassed data to generate valuable information such as predicting future disease outbreaks or enhancing treatment methods. Furthermore, there is a lack of sharing this accumulated knowledge with small-scale farmers, who could greatly benefit from practical insights for disease prevention and management.

Features	Research 1 [1]	Research 2 [2]	Research 3 [3]	Proposed Solution
Ontology-based information extraction from veterinary information of cattle skin diseases.	✗	✗	✗	✓
Use of semantic parsing to improve the accuracy of ontology-based information extraction.	✗	✓	✗	✓
Use of hybrid approaches to improve the accuracy and efficiency of ontology-based information extraction using machine learning with crowdsourcing.	✓	✗	✗	✓

Research Problem

- How to build an ontology-based information extraction approach that can utilize this veterinary data for improved treatments and also create methods to directly share this knowledge with small-scale farmers for disease prevention and management.

Specific Objectives

- Build an ontology-based information extraction approach to identify relationships and limitations within a cattle skin diseases domain to organize knowledge and provide information.

Sub Objectives

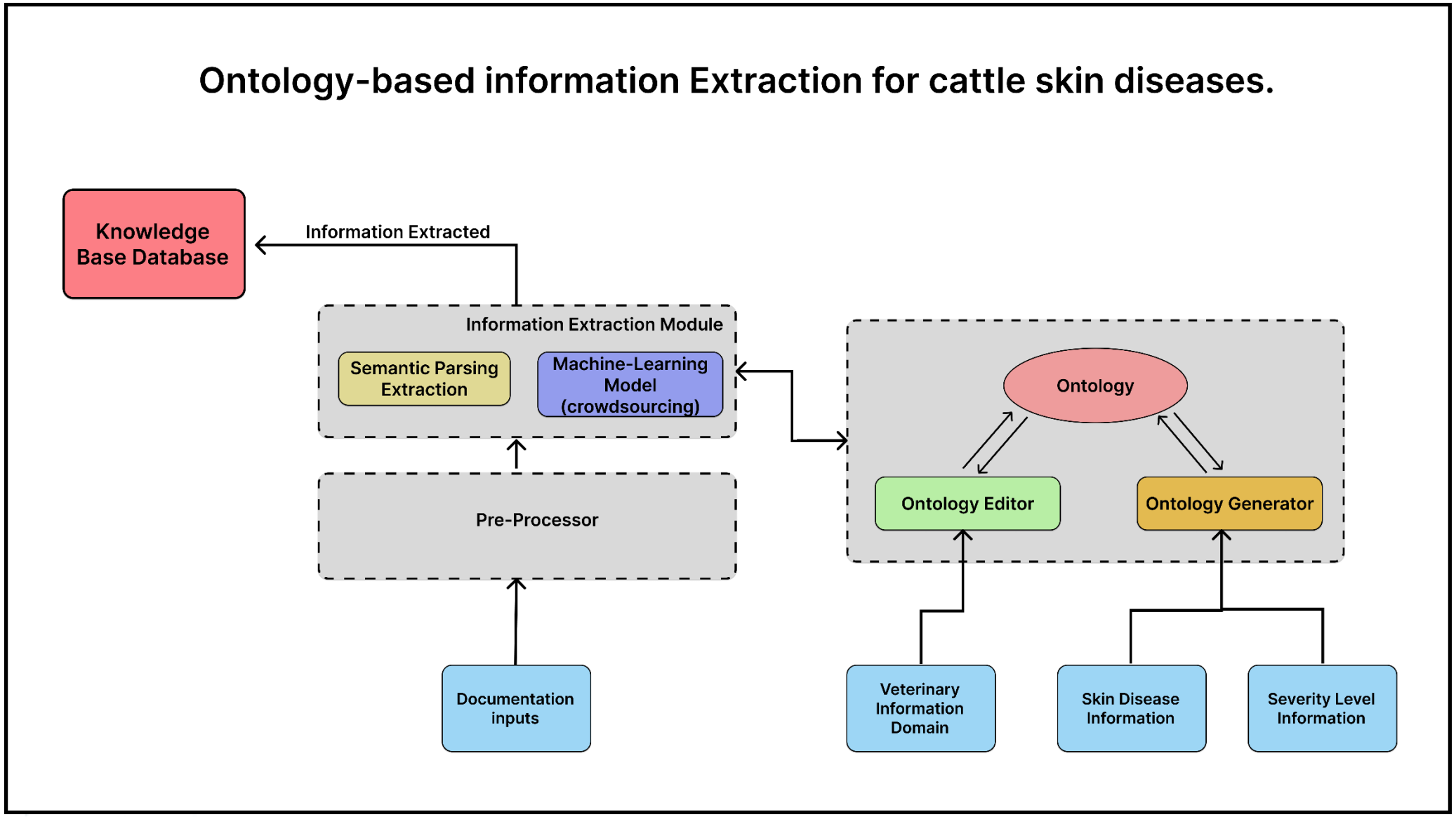
- **Ontology Development and Construction:** Develop a comprehensive ontology for the domain of cattle skin diseases. Identify and define key concepts, relationships, attributes, and hierarchies that accurately represent the domain's knowledge.

- **Information Extraction and Relationship Identification:** Implement techniques to extract information from various data sources related to cattle skin diseases. Use Natural Language Processing (NLP) methods to identify and capture meaningful relationships between concepts, symptoms, causes, treatments, and other relevant aspects.

- **Knowledge Organization and Dissemination:** Structure and organize the extracted information within the ontology. Develop mechanisms to ensure consistency, accuracy, and completeness of the ontology's content. Design interfaces or platforms for effective knowledge dissemination, catering to veterinarians, researchers, and small-scale farmers.

Methodology

System Architecture



Tools and Technologies

Tools and Technologies

- Visual Studio code
- google colab
- python
- GitHub

Information Extraction

- Natural Language Processing (NLP)
- Named Entity Recognition (NER) Models.

Ontology Development

- Web Ontology Language (OWL)
- Protégé

Functional Requirements

- Data Source Integration: The system should be able to efficiently integrate and access data from various departments, ministries, and institutes that document veterinary information on cattle skin diseases. It should support data retrieval from different formats and sources, ensuring a seamless flow of information for extraction.

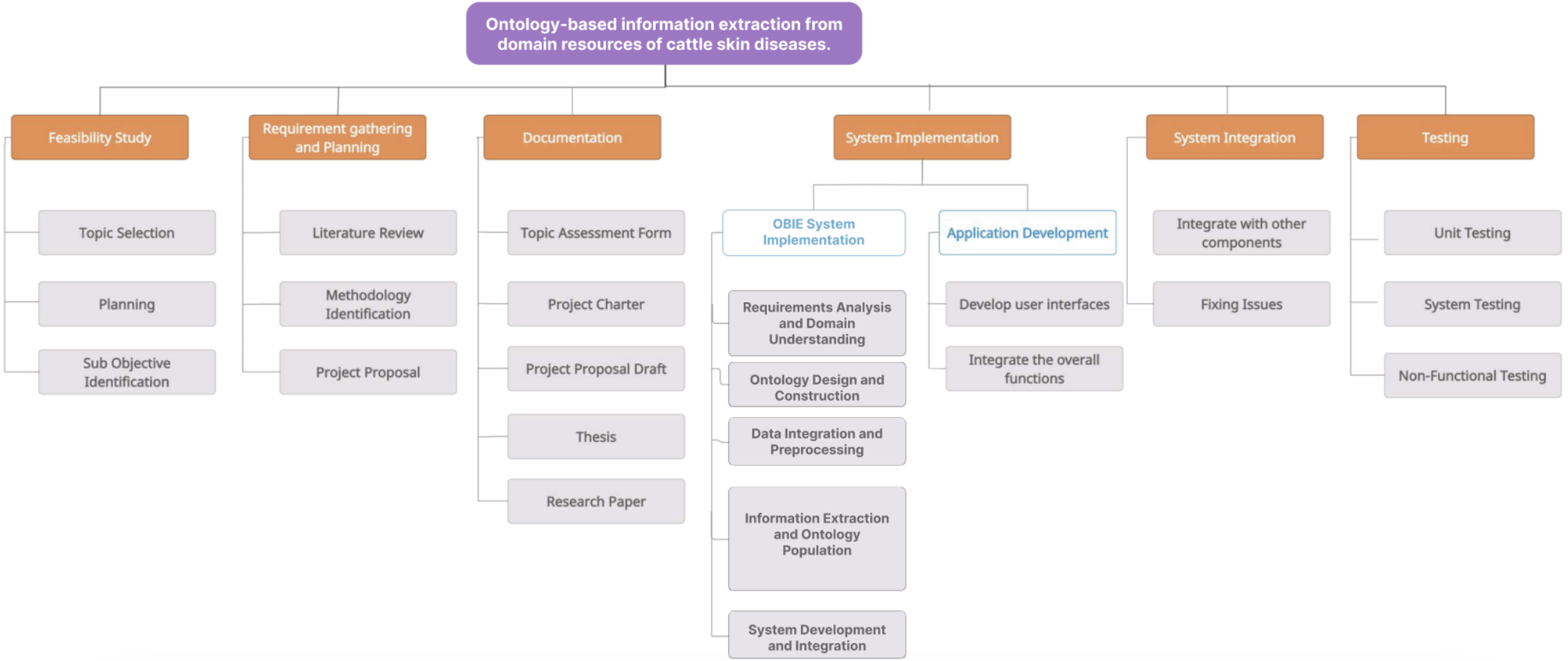
- Ontology Construction : The system should facilitate the construction of an ontology tailored to the domain of cattle skin diseases. It needs to provide tools for defining and structuring concepts, relationships, and attributes specific to the domain. Additionally, it should enable the population of the ontology with extracted information, ensuring accurate representation of knowledge.

- Information Extraction : The system should employ Natural Language Processing (NLP) techniques to perform information extraction tasks, including Named Entity Recognition (NER), relationship extraction, and attribute identification. It should enable the inference of new knowledge based on existing ontology content, providing valuable insights beyond explicit information.

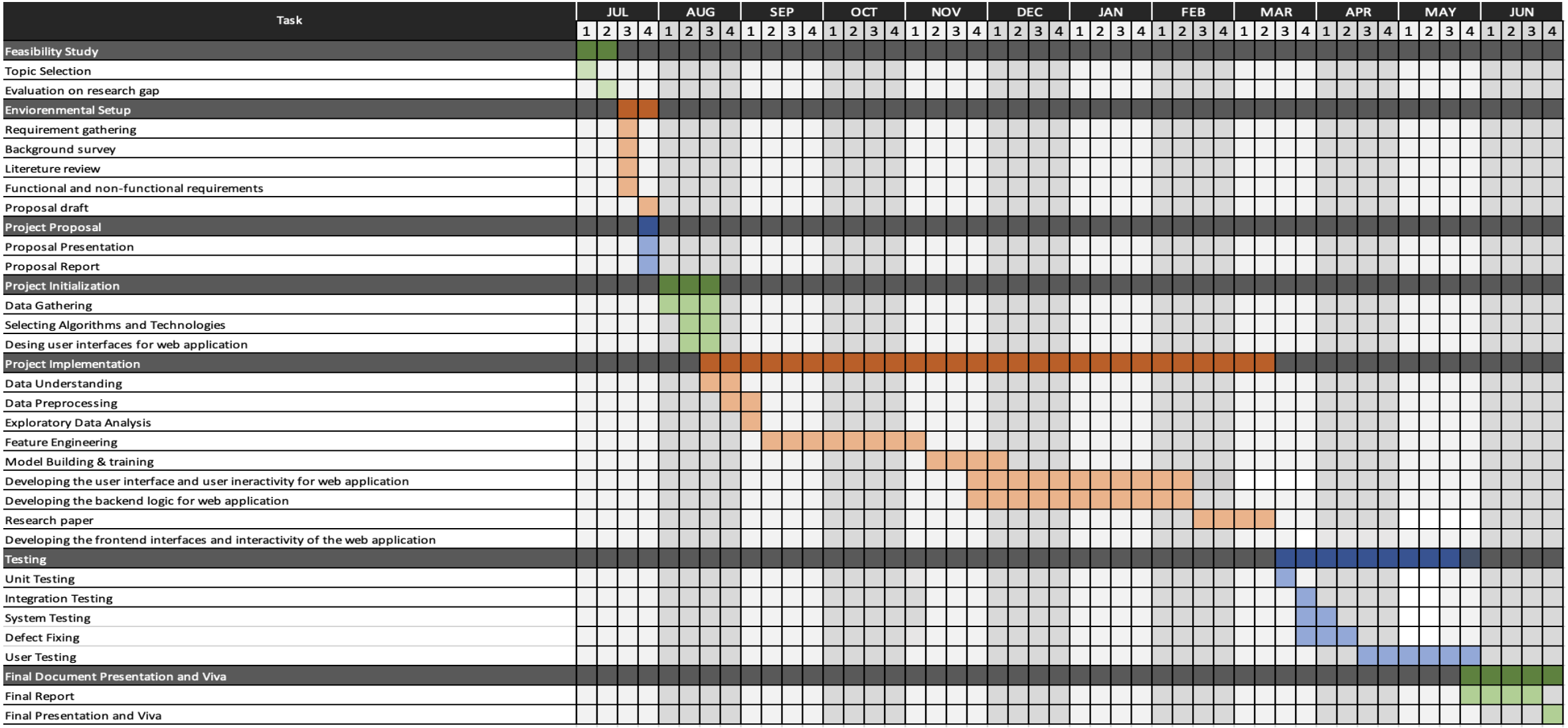
Non-Functional Requirements

- Accuracy
- Scalability
- Efficiency
- Usability and User Experience
- Availability

Work Breakdown Structure



Gantt Chart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Feasibility Study
Topic Selection
Evaluation on research gap
Enviorenmental Setup
Requirement gathering
Background survey
Litereture review
Functional and non-functional requirements
Proposal draft
Project Proposal
Proposal Presentation
Proposal Report
Project Initialization
Data Gathering
Selecting Algorithms and Technologies
Desing user interfaces for web application
Project Implementation
Data Understanding
Data Preprocessing
Exploratory Data Analysis
Feature Engineering
Model Building & training
Developing the user interface and user ineractivity for web application
Developing the backend logic for web application
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Introduction and Background

- Focus on building AI-driven smart assistant using sentiment analysis, tailored to the domain of cattle skin diseases.
- The smart assistant can interact with users (veterinarians, cattle farmers, etc.) to provide information about disease detection, severity assessment and potential treatments.
- Sentiment analysis can be integrated to understand user emotions and responses, enhancing the interaction experience.
- By processing textual and verbal interactions, the assistant offers personalized advice, treatment suggestions, and educational information, fostering better collaboration and informed decision-making.

Research Gaps & Novelty

- Utilize sentiment analysis algorithms to interpret the emotional tone of user queries. This could involve classifying user input as positive, negative, or neutral, allowing the assistant to tailor its responses accordingly.
- Implement a response generation system that takes into account the sentiment of user queries. the assistant could respond with empathy and reassurance while providing relevant information.
- Enhance user understanding by incorporating visual aids such as interactive images to supplement textual responses. This could be particularly useful for explaining disease progression or treatment options.
- Implement a dialogue management system that adapts its responses based on the user's emotional state and the context of the conversation. This could involve dynamically adjusting the assistant's tone, language, and level of detail.
- Generate personalized care plans for cattle based on the severity of the disease and user preferences. The assistant could provide step-by-step instructions for treatment and monitoring. This could be particularly useful for explaining disease progression or treatment options.

Features	Research 1 [1]	Research 2 [2]	Research 3 [3]	Research 4 [4]	Proposed Solution
Sentiment Analysis Integration	✗	✗	✓	✗	✓
Empathetic Responses	✗	✗	✗	✗	✓
Natural Language Generation for Care Plans	✓	✗	✓	✗	✓
Adaptive Dialogue Management	✗	✗	✓	✗	✓
Visual Emotion Recognition	✓	✗	✗	✗	✓

Research Problem

In the field of handling the health of cattle, an important gap exists in the capability of artificial intelligence (AI) to understand and react to the complicated emotional expressions of veterinarians and farmers. The difficulty is in creating an AI system that can dynamically change its responses depending on developing emotional context within domain-specific conversations on cattle skin diseases.

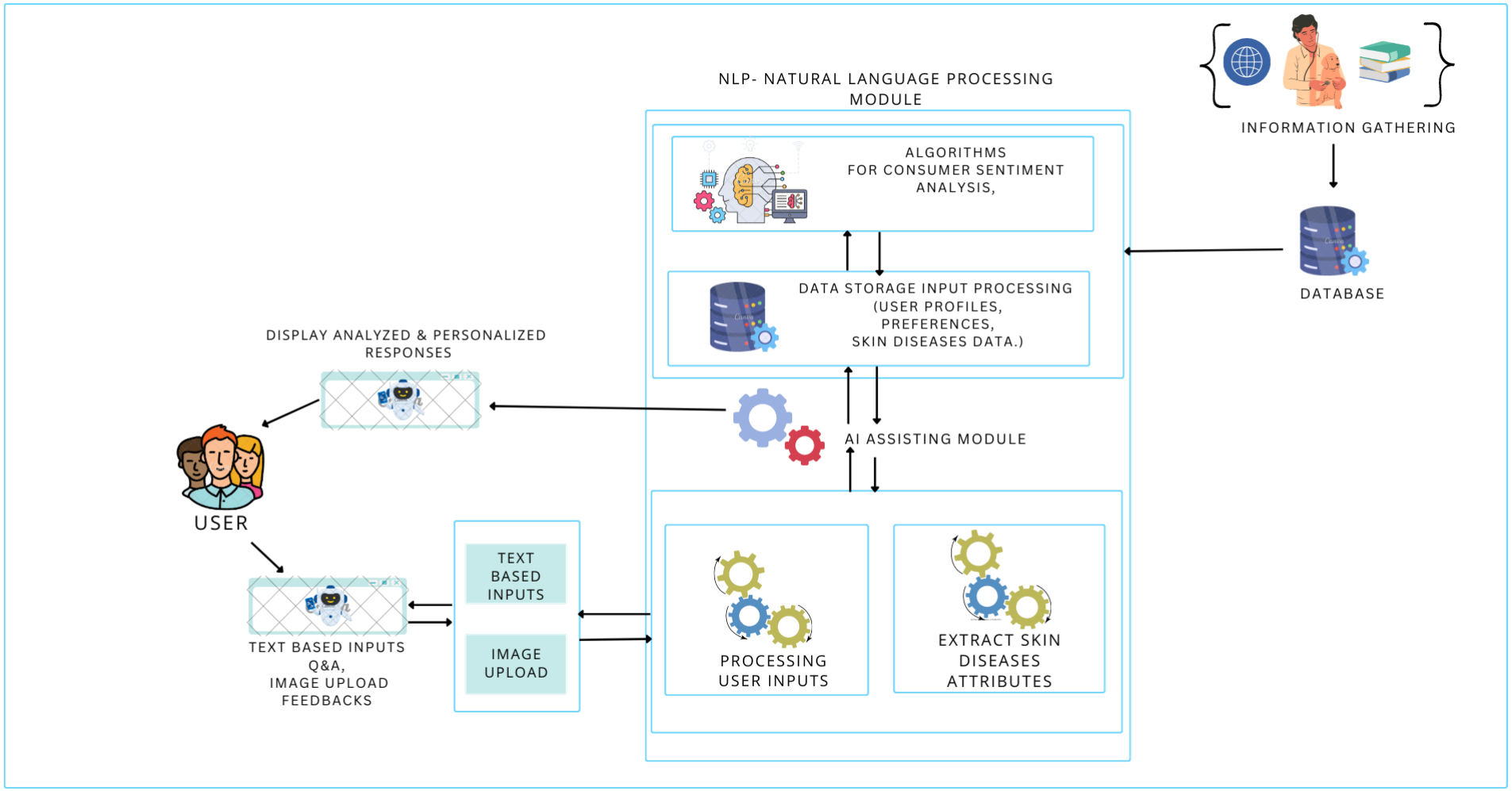
Specific Objectives

- Data Analyzing of cattle skin diseases
- Develop an Emotionally Intelligent AI Smart Assistant
- Implement an Advanced Dialog Management
- Generate personalized care plans
- Address Ethical Considerations and Data Privacy

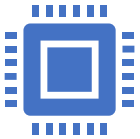
Sub Objectives

- Analyze Data
- Real-Time Updates
- Data Integration and Compatibility
- Anonymization and Data Security
- Dynamic response and adaption

System Architecture Diagram



Tools & Technologies



Tools & Libraries

Visual Code

Google Colab

Python Libraries for NLP

spaCy for text processing

Algorithms

Web Scrapping

Clustering Algroithms

BERT, VADER for sentiment analysis

TextBlob for processing textual data.

Technology Stacks

Rasa, DialogFlow for conversational experience

React/ ReactNative

Node.Js/ Java- Android

Technologies & Services

Git/ GitHub/ GitLab

Cloud Services

NoSQL Databases

TensorFlow

Functional Requirements

USER INPUTS ANALYSIS

REAL-TIME EMOTIONAL MONITORING

DYNAMIC RESPONSE ADAPTION

DIALOG MANAGEMENT

PRIVACY AND DATA PROTECTION

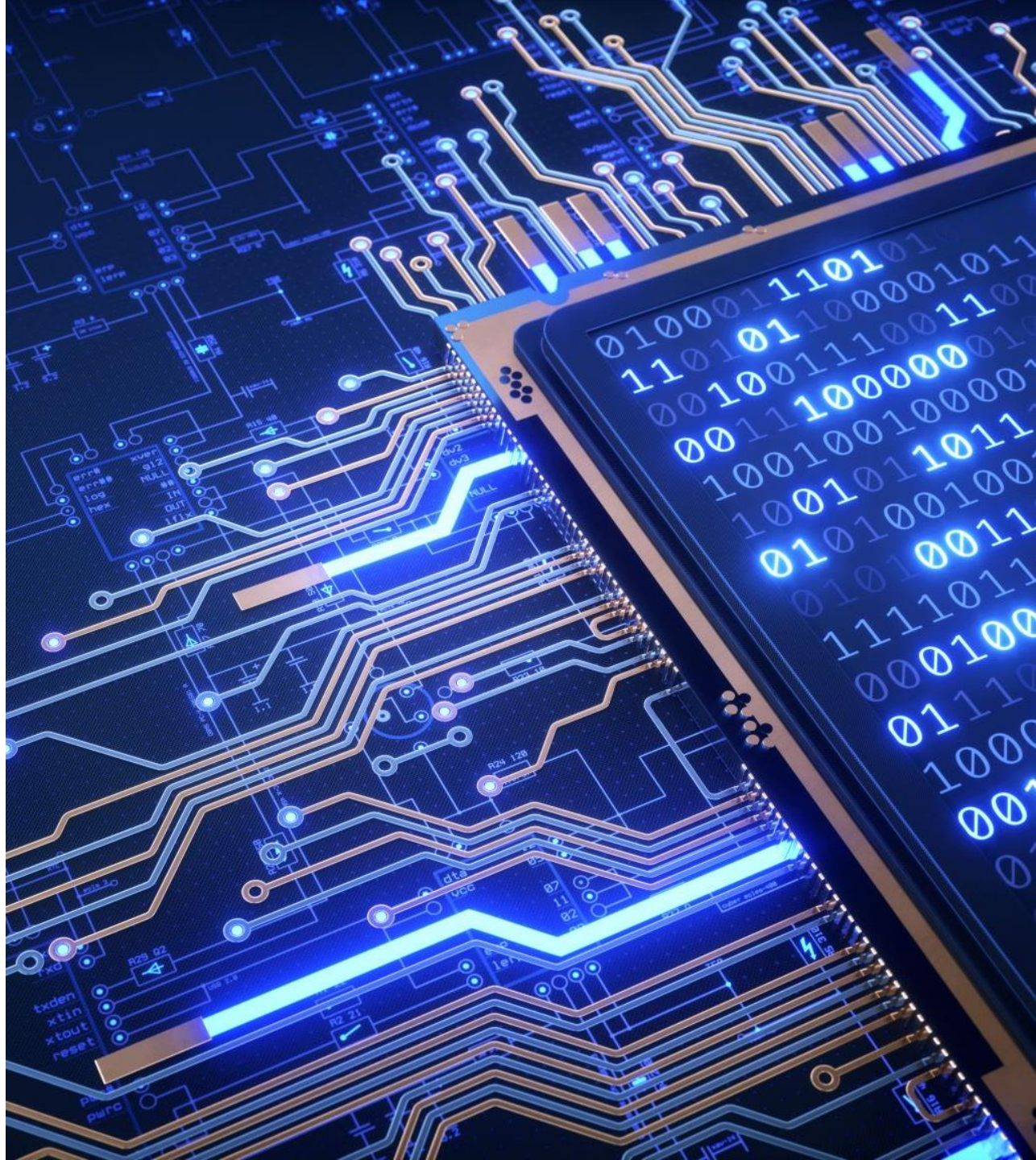
ENHANCE THE USER EXPERIENCE

USER FEEDBACK AND RATING SYSTEM

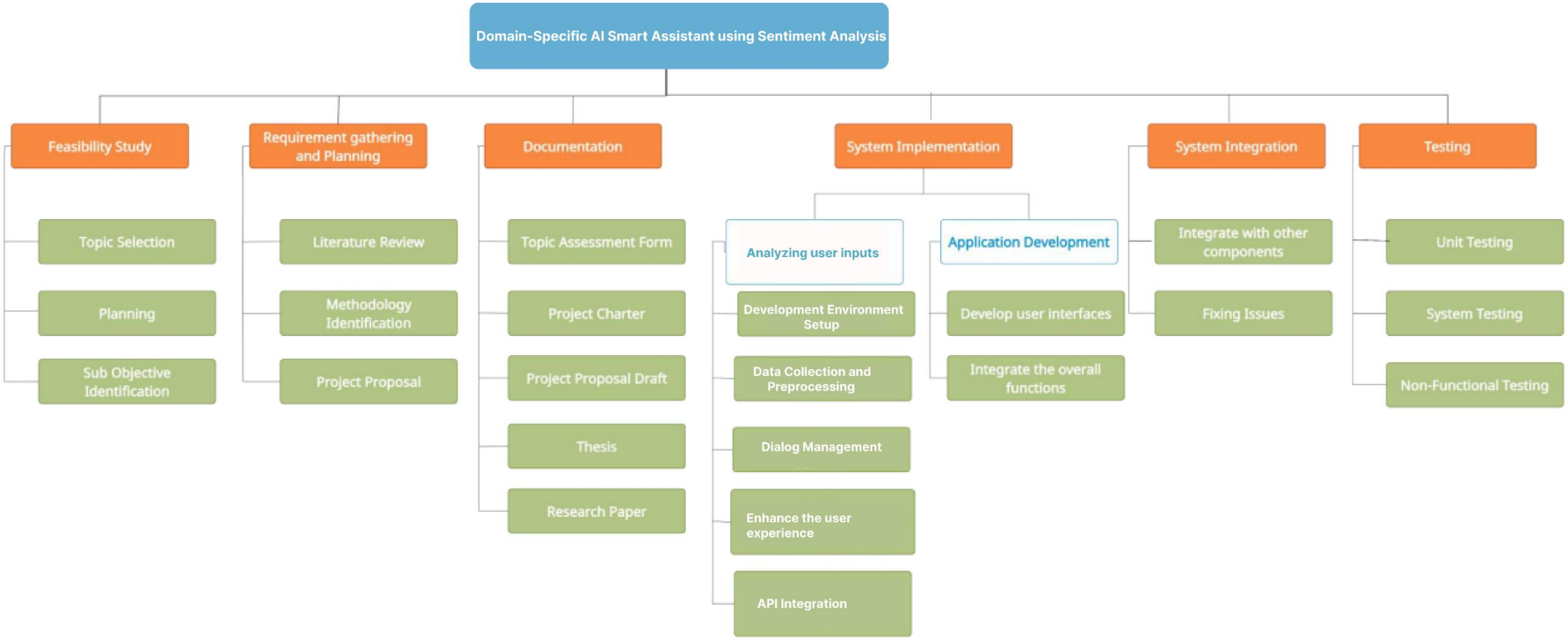
APIS AND INTEGRATIONS

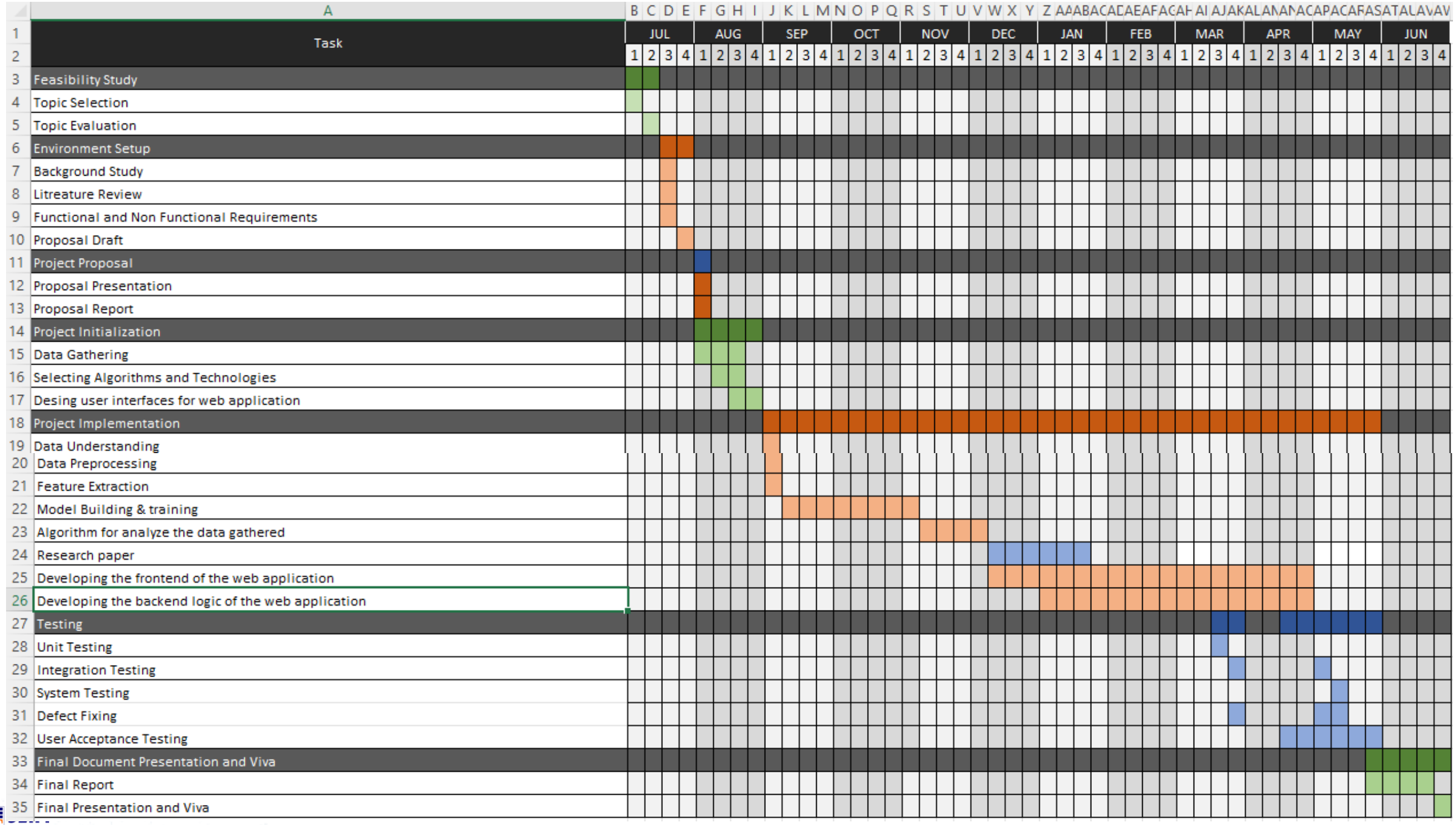
Non-Functional Requirements

- Performance
- Accuracy and Personalization
- Usability and User Experience
- Reliability and Availability
- Security
- Compatibility
- User Experience and Engagement



Work Break-Down Chart




Task
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
Feasibility Study
Topic Selection
Topic Evaluation
Environment Setup
Background Study
Litreature Review
Functional and Non Functional Requirements
Proposal Draft
Project Proposal
Proposal Presentation
Proposal Report
Project Initialization
Data Gathering
Selecting Algorithms and Technologies
Desing user interfaces for web application
Project Implementation
Data Understanding
Data Preprocessing
Feature Extraction
Model Building & training
Algorithm for analyze the data gathered
Research paper
Developing the frontend of the web application
Developing the backend logic of the web application
Testing
Unit Testing
Integration Testing
System Testing
Defect Fixing
User Acceptance Testing
Final Document Presentation and Viva
Final Report
Final Presentation and Viva

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