

# School of Computing and Engineering

## Project Proposal Report

# Personalised Canine Nutrition and Diet Management

A Mobile App Using AI for Custom Dog Diet Plans



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## Table of Abbreviations

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1. **AI** - Artificial Intelligence
2. **ML** - Machine Learning
3. **CNN** - Convolutional Neural Network
4. **GANs** - Generative Adversarial Networks
5. **UI** - User Interface
6. **UX** - User Experience
7. **ML** - Machine Learning
8. **MQL** – MongoDB Query Language

# Introduction

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## The challenge

Dogs are not just pets; they are beloved members of many families and require more than just affection. Ensuring their well-being transcends beyond the routine play and affection: it delves into the realm of proper nutrition, a critical aspect often overshadowed by the complexities it entails.

The challenge lies in the vast diversity of dietary needs, intricately varied across dog breeds, and further influenced by their age, health, and lifestyle. Each dog requires a unique nutritional approach, making it an overwhelming task for pet owners who desire the best for their furry companions.

## Motivation

This project was born from a personal journey into the world of canine care, initiated by the adoption of a puppy. This first-hand experience revealed the complexities and uncertainties commonly faced by pet owners, similarly to the findings of J. Wainwright's 2022 study (J. Wainwright et al., 2022). It highlighted the widespread need for accurate and accessible guidance in canine nutrition, a challenge especially daunting for those new to pet ownership.

Coupled with this is my passion for technology and its potential to positively impact lives. This research is driven by a dual motivation: a commitment to enhance animal well-being and a desire to harness the power of AI for societal good. By leveraging AI as a tool for empowerment, this project aspires to provide pet owners with reliable, scientifically-backed dietary recommendations for their dogs.

## The Role of AI in Canine Dietary Management

In response to this challenge, the field of Artificial Intelligence emerges as a modern hope. AI's potential in revolutionizing canine dietary management is vast and untapped. With its advanced capabilities in data processing, pattern recognition, and predictive analytics, AI can tailor nutrition plans specific to each dog's needs. This project is set to leverage these capabilities, aiming to bridge the gap between complex nutritional requirements and accessible, personalized solutions for pet owners. As highlighted in "Artificial Intelligence and Sustainable Development" (Margaret A. Goralski, Tay Keong Tan, 2020), AI's transformative impact across various sectors demonstrates its potential to significantly enhance pet care.

## Proposed Solution

The proposed solution is the development of an AI-driven mobile application, crafted to address the unique dietary needs of dogs. This application stands as the cornerstone of this project, embodying a harmonious blend of technological innovation and practical pet care.

Utilizing AI algorithms, the app will analyse data specific to each dog, including breed, age, and lifestyle, to generate customized nutrition plans. This ensures that every dog receives a diet tailored to its individual requirements. Moreover, the app will offer a user-friendly platform that simplifies the complexities of canine nutrition. It will guide pet owners through a seamless journey of understanding and managing their dogs' dietary needs. Importantly, the app's features and functionality will be informed by insights gathered from surveys conducted with both dog owners and veterinarians. This integration of real-world feedback and professional expertise will ensure the app not only aligns with user expectations but also upholds scientific credibility.

The envisioned application aims to transform the way pet owners approach canine nutrition. It will serve as a reliable, easy-to-use tool that demystifies dietary management, thereby enhancing the overall health and well-being of dogs.

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## Project Scope

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### Aims

To develop a user-centric AI-driven mobile application for canine diet and nutritional management that offers personalized dietary plans, tracks calorie intake, and provides nutritional advice specifically tailored to individual dog breeds and their unique activity level, with an emphasis on enhancing user engagement and satisfaction through an optimized interface design.

### Objectives

- To conduct a literature review that thoroughly examines current canine nutritional science, AI applications in pet care (or relative implementations), and the market landscape of existing diet management solutions.
- To analyse dog owners' needs, current pain points and expectations through surveys, ensuring the app's features are aligned with real-world requirements.
- To survey veterinarians to incorporate their recommendations on breed-specific dietary needs and create datasets accordingly.
- To design and develop a mobile application that offers a user-friendly interface for profile management, dietary tracking, and personalised advice.
- To integrate an AI mechanism tailored to understand and process specific data for individual dog breeds and unique dietary requirements.
- To implement features for manual dietary input and barcode scanning, providing users with multiple ways to track and manage their dog's nutrition.
- To carry out usability testing with dog owners, using their feedback for future app improvements.

### Research Questions

1. How does AI-generated dietary advice for dogs compare to traditional methods in terms of accuracy and breed-specific customization?
2. What are the challenges and solutions in integrating AI with user input for precise canine diet tracking?
3. Can pet owners trust AI to manage their dogs' diets, and what measures ensure the reliability of its recommendations?
4. What design principles should guide the user interface of an AI-driven dog diet app to ensure it is intuitive and engaging for pet owners?

The image below illustrates the correlation between the objectives and research questions, highlighting the connections and alignment within the project scope.

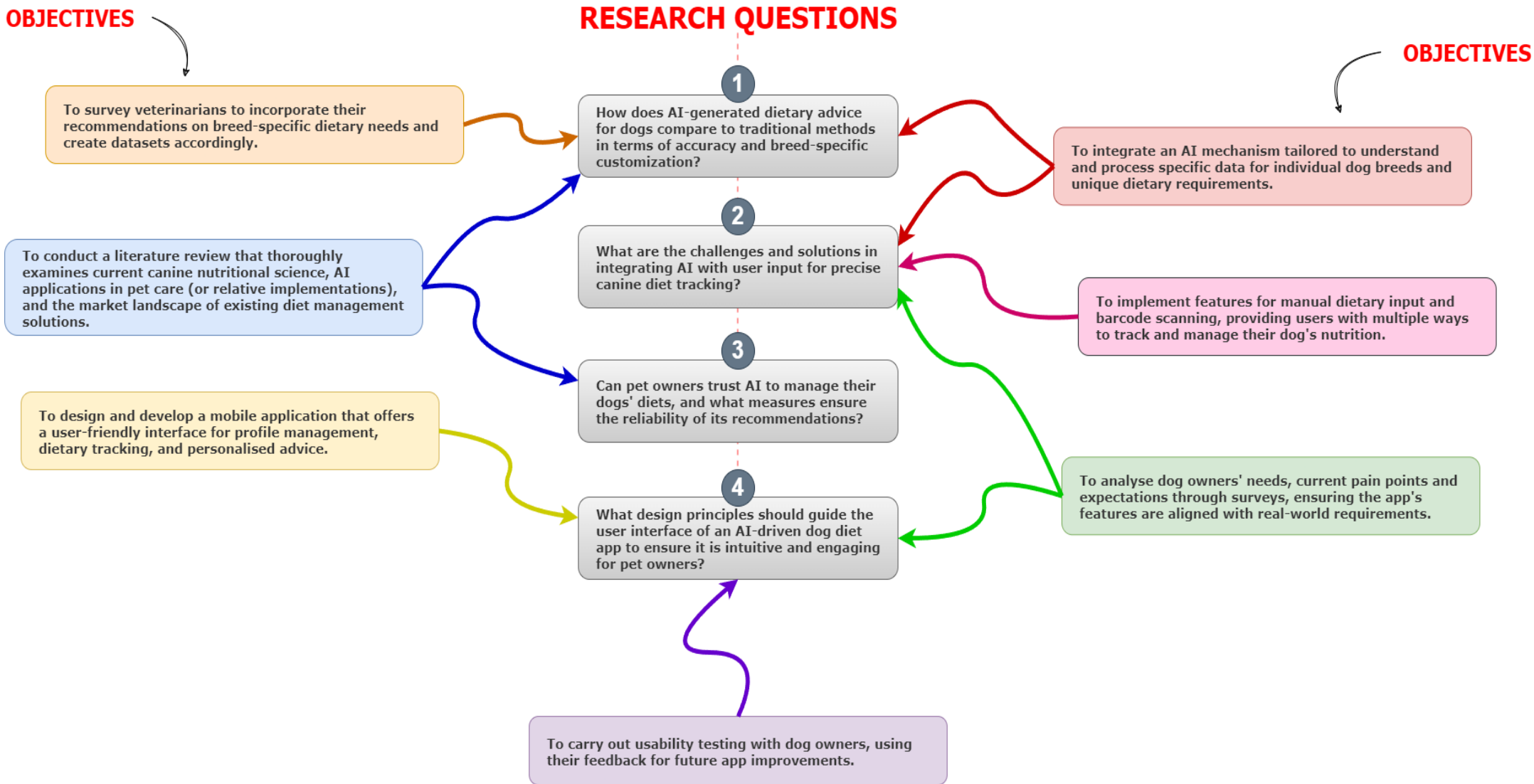


Figure 1 - Mapping Objectives to Research Questions

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## Literature Review

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This literature review examines key studies that contribute to the development of a mobile application capable of generating and managing personalized canine diet plans.

In 2022, J. Wainwright's study on dog nutrition found that only 9% of owners followed vet advice, with most using past experience for feeding (J. Wainwright et al., 2022). Surprisingly, 54 out of 147 dogs were overweight, and many underweight, showing a gap between owners' intentions and their dogs' actual dietary needs. This indicates a knowledge deficit, not a lack of care, highlighting the potential value of an AI application in providing accurate canine dietary recommendations.

Dr. Anjali Gautam's 2018 research contributes significantly to our understanding of breed-specific nutritional needs (A. Gautam et al., 2018). Her study emphasizes the varying requirements based on factors like breed size, age, and lifestyle, offering crucial insights for the app's algorithm to deliver personalized nutritional plans.

Building on this, Katarzyna Kazimierska and Wioletta Biel's study from the University of Technology in Szczecin, Poland, delves deeper into the distinct nutritional needs of sporting versus non-sporting breeds (Katarzyna Kazimierska and Wioletta Biel, 2020). Similarly, Zoran's study contributes a crucial element by focusing on the specific needs of working dogs (Zoran, 2021). These researches ensure that the app's dietary plans are appropriately calibrated for dogs with higher activity levels and nutritional demands, tailoring advice to their specific lifestyle.

Further species-specific insights are provided by a study published in "Indian Farmer", emphasizing the distinct nutritional requirements between dogs and cats (S. U. Farooq et al., 2023). This research reinforces the app's need for dog-centric dietary recommendations, avoiding the pitfalls of generalized pet nutrition solutions.

In the field of Artificial Intelligence, research has made significant strides that can be leveraged for canine dietary management. E. S. Madhan's work showcases AI's potential in accurately identifying dog breeds through efficient Convolutional Neural Network (CNN) models (E. S. Madhan et al., 2022). This ability is key to the app's functionality, enabling it to provide breed-specific dietary advice, which is fundamental to its personalized approach. Moreover, Appleby and Basran's discussion on AI in veterinary practices offers a broader context for the application of technology in animal healthcare (Appleby, Basran, 2022).

Edward Y. Chang highlighted the importance of a data-centric approach in healthcare AI, discussing techniques like data augmentation, transfer learning, federated learning, and generative adversarial networks (GANs) (Chang, 2022). While Chang's focus was on healthcare, the methodologies discussed are equally applicable in canine nutrition, emphasizing the need for robust and diverse datasets to train AI models effectively.

Crucially, a paper published in the Journal of Small Animal Practices, raise awareness of the risks of nutritional deficiencies in diet plans (L. Gaylord et al., 2018). This research serves as a cautionary tale for the app's development, stressing the importance of creating comprehensive and balanced diets to avoid health complications in dogs.

In summary, the research shows that dog nutrition is complicated, and AI can help solve these issues. The planned app will offer tailored diets for different dog breeds and ages, and considering their lifestyle, helping owners understand better and improving dog health.

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## Analysis of Existing Solutions

This section evaluates existing mobile digital solutions that align fully or in part with the project scope and literature review:

1. **PAWSM:** Offers veterinarian-backed nutrition calculations but lacks AI-driven personalization. User feedback points to a need for more breed-specific features (PAWSM, n.d.).
2. **Daisy:** Provides AI-powered dog care but falls short in dietary personalization. With under 1,000 downloads and limited UK availability, it indicates early development stages (Daisy, n.d.).
3. **The Fat Dog Diet:** An iPhone app by Dr. Patty Khuly for weight loss, without modern technological integration. It primarily offers general healthy eating and exercise guidance (Khuly, n.d.).
4. **DogCat Pet Health Care Tracker:** Features health tracking and reminders but does not incorporate AI in diet management. Its general approach to pet health lacks the project's desired breed-specific dietary advice (DogCat, n.d.).

Other apps like “Dog Buddy Free”, “ASPCA”, and “Pet Master Pro” were reviewed. They focus on health and medical tracking but do not address canine diet management or use AI/ML technology.

In summary, existing apps generally lack breed-specific customization and interactive, AI-driven experiences, highlighting the need for an application that provides a more tailored approach to canine nutrition.

## Literature Gap

This project's literature review and analysis of existing applications reveal several gaps in the current landscape of canine dietary management:

- **Advanced AI Integration for Personalized, Breed-Specific Design:** Current applications show a clear need for effective AI use in bridging the knowledge gap in canine nutrition, particularly for breed-specific requirements. This project will develop a user-centric, AI-driven solution that provides personalized dietary advice, focusing on individual breed needs and enhancing the user experience.
- **Practical AI Application for Canine Diet Management:** There is a deficiency in practical, real-world AI applications in canine diet management. This project intends to leverage AI for practical, personalized diet plans, addressing this gap.
- **Trust and Reliability in AI Recommendations:** Limited research on pet owners' trust in AI for pet health underlines the need for reliable AI dietary recommendations. This project will focus on building trust in AI through credible and scientifically-backed advice.

By addressing these gaps, the project aims to contribute significantly to canine nutrition, combining AI technology with a practical approach for dog owners.

# Methodology

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## Research Methodology

This project employs a qualitative research methodology focused on understanding canine diet and nutritional management. The approach includes:

- **Surveys:** Conducting surveys with dog owners and veterinarians to gather insights on canine nutrition preferences and expectations for an AI-driven dietary management system. The surveys, attached in the Appendix, aim to collect descriptive data on current practices and challenges in canine nutrition.
- **Data Analysis:** Analysing the qualitative data from these surveys to extract key information. This analysis will inform the development of the mobile application, ensuring it aligns with real-world needs and preferences of dog owners and veterinary professionals.

## Software Development Methodology

The software development for this project will utilize the Kanban methodology. Kanban, known for its flexibility and visual task management, is ideal for solo projects due to its emphasis on continuous delivery without overburdening the developer (Atlassian, 2023). The key features of this methodology in the project include:

- **Visual Task Management:** Using a Kanban board to manage and visualize all tasks related to the development of the mobile application.
- **Continuous Delivery:** Implementing a workflow that allows for regular updates and improvements to the application, ensuring a responsive development process.
- **Limiting Work in Progress:** Focusing on a manageable number of tasks at any given time to maintain high-quality development standards.

## Project Management Methodology

The project management approach is a customized blend of traditional and agile methodologies, tailored for the solo development environment. This approach includes:

- **Goal Setting and Scope Management:** Establishing clear, achievable goals and employing strategies to manage the project scope effectively.
- **Time Management:** Utilizing tools such as Gantt charts to schedule and monitor the project timelines, ensuring adherence to deadlines.
- **Task Prioritization and Flexibility:** Prioritizing tasks based on their importance and urgency, while remaining flexible to changes and new developments in the project.
- **Quality Assurance:** Regular testing and validation steps are integrated into the project plan to ensure high standards are maintained throughout the development process.
- **Resource Allocation:** Efficient management of resources, including software tools and research materials, to maximize productivity.
- **Documentation and Reporting:** Maintaining comprehensive documentation of the project's progress and adhering to any reporting requirements set forth by supervisors or academic guidelines.

# Project Plan

## Work Breakdown

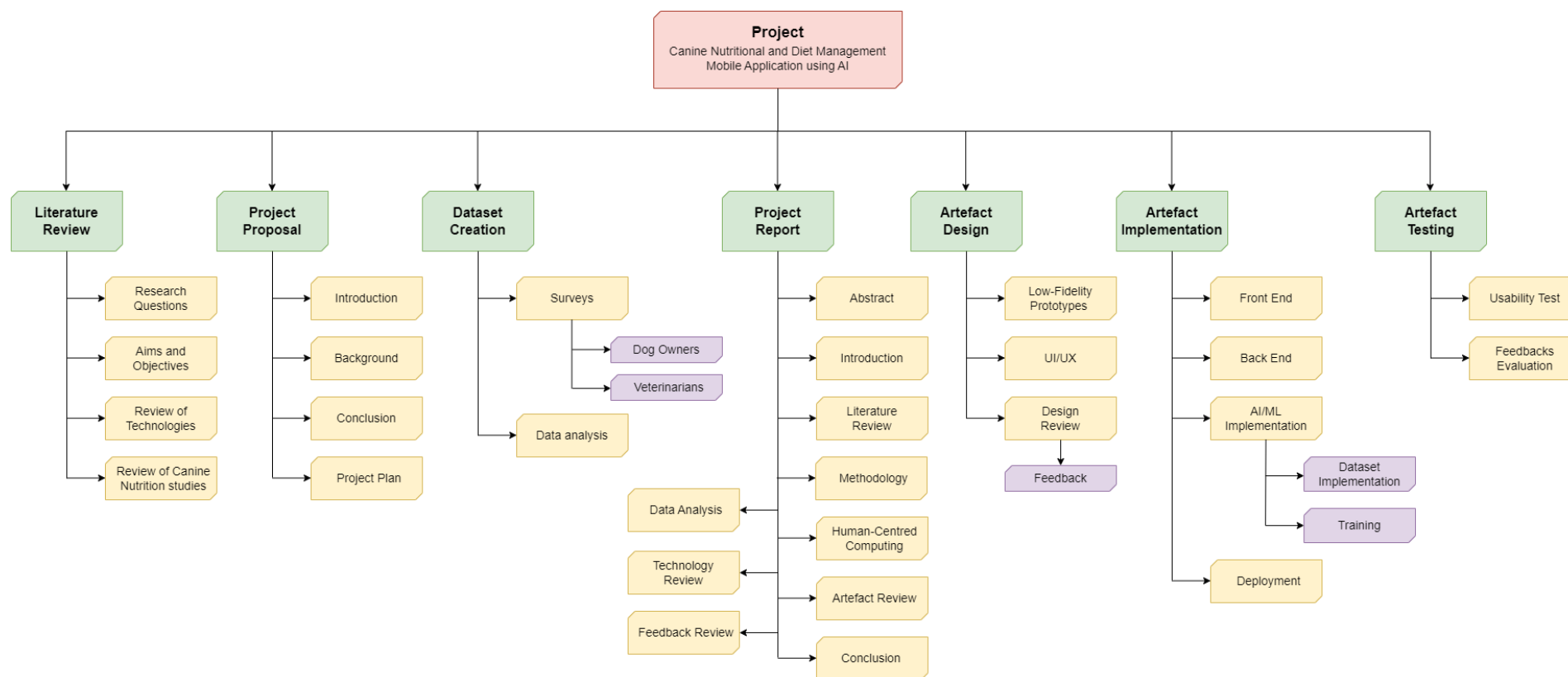


Figure 2 - Work Breakdown

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## Deliverables

The project includes several deliverables, contributing to the AI-driven mobile app's development for canine dietary and nutritional management:

1. **Surveys and Data Analysis:** Gathering data through surveys with dog owners and veterinarians to gain insights into canine nutrition and dietary needs. This data will inform the app's development.
2. **Literature Review:** Undertaking a comprehensive review of research in canine nutrition and AI applications in pet care to identify market gaps and establish a theoretical foundation for the app.
3. **Study of Human-Centred Computing Principles:** Examining principles of human-centred computing to ensure the app is user-friendly and meets audience requirements.
4. **Development of the Application Prototype (Artefact):** Creating an AI-powered mobile application, leveraging insights from surveys, literature review, and human-centred computing studies.
5. **Usability Testing:** Testing the prototype to assess the app's functionality, interface, and user experience. Feedback from this testing will be used to guide future enhancements.

## Tools and Skills

Tools	Skills	Description
React Native	JavaScript	For cross-platform mobile app development
Visual Studio Code	-	Code editor for app and AI development
MongoDB	MQL, Data Analysis	Database management system
Figma	Design	Interface design tool
GitHub	Git	Version control platform
Jupyter Notebook	Python, Data Analysis	For AI model experimentation and testing
TensorFlow or PyTorch	Python, Machine Learning	Libraries for machine learning and neural network development

Figure 3 - Tools and Skills

## Risks

Risks	Description	Mitigation Measures	Likelihood	Impact
Time management	While pursuing the final year of Computer Science, I also need to work to pay for my expenses and I regularly apply for jobs related to this industry	Plan academical work ahead, avoid distractions	Low	High
Lack of knowledge	Despite the fact that I always been involved with tasks related to coding, this projects promises to use AI technologies which I am new about.	Research about technologies before starting the project, follow tutorials, use spare time to do small practices, read documentations	Medium	High
AI inaccuracy	The AI might produce inaccurate data during development process	Test the AI repetitively, double check dataset accuracy for AI training	Medium	Medium
Application bugs	I will definitely encounter bags during the development process, and this might slow down my work	Use apposite debugging tools, check packages updates, test App repetitively, manage process with GIT controls	High	High

Figure 4 - Risks Assessment



## Conclusion

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This project represents a fusion of canine nutrition and artificial intelligence, aiming to revolutionize canine dietary management with an innovative mobile application. Drawing on key findings from the literature, such as Wainwright's study on dog owners' reliance on anecdotal experiences and Gautam's insights into breed-specific nutritional needs, the project seeks to bridge the existing knowledge gap in canine dietary care. It leverages AI to create personalized nutrition plans for each dog, addressing the complexities identified in the literature review. The app's design combines scientific accuracy with a user-centred approach, making it intuitive and engaging for pet owners. Anticipated challenges include ensuring accurate data collection for AI training and building user trust in AI recommendations. Nonetheless, the project is poised to provide a practical, advanced solution beyond traditional pet care methods. In conclusion, driven by personal motivation and extensive research, this venture is set to make significant contributions to the fields of canine nutrition and pet care technology, enhancing the well-being of dogs and empowering owners with reliable, personalized dietary guidance.

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