CST3990 Undergraduate Individual Project

VisionHealth Feeder(ViHF)

2021 Oct Intake

Muddathir Muhammad Ibney Noorani Joomun

(M00830556)

Date of Submission: 02/04/2024

Contents

Table of Figures

1.Background of Study

1.1 Introduction

Automated pet care, especially through pet feeders, has advanced significantly, aiming to improve pet health and provide convenience for pet owners. Despite progress, current feeders lack customization for different pet species and their health needs, highlighting a gap in the market.By automating the feeding process, pet owners can ensure their animals receive regular meals, addressing the issue of interrupted sleep due to early morning or late-night feeding.

1.6 Target Audience

The Pet Feeder is targeted for:

- Pet Owners who travel a lot
- Pet with food disorder
- Pet Owners who have a rough time keeping up with the frequent food requirements of their pets.

2. Problem Statement

Current automated pet feeders often fall short in addressing the unique health and nutritional needs of individual pets, leading to issues like overfeeding, underfeeding, and pet obesity. The "VisionHealth Single-Pet Feeder" aims to address this challenge by incorporating machine vision technology. This system will be capable of recognizing and assessing the health condition of a single pet and customizing its feeding regime to match specific dietary needs. This approach seeks to ensure precise nutrition for each pet, addressing concerns of obesity and malnutrition, and significantly improving the standard of pet care for individual pet households.

1. **Pet Obesity Rates**: Research indicates that obesity affects about 60% of cats and 56% of dogs in the United States, as per the Association for Pet Obesity Prevention. This high prevalence underscores the need for precise feeding solutions.
2. **Impact of Improper Feeding**: Studies have shown that overfeeding or underfeeding can significantly impact a pet's health. For instance, even a few extra pounds can lead to conditions like diabetes, joint problems, and respiratory difficulties in pets.
3. **Individualized Nutrition Needs**: According to a survey, more than 70% of pet owners are interested in personalized pet diets, reflecting a growing awareness of the importance of tailored nutrition. This is especially relevant as dietary needs can vary greatly depending on the pet's age, breed, activity level, and health conditions.

3. Description of Project

3.1. Project Overview Aims Of Project

The "VisionHealth Feeder" is an advanced project that uses machine vision to identify different pets and adjust their diet based on health needs, improving automated pet feeding.

3.2. Aim of the project

The core purpose of the "ViHF" is to provide pet owners with an advanced and intelligent pet feeding system that goes beyond mere scheduling and portion control. This solution leverages machine vision technology to offer species-specific feeding and real-time nutritional adjustments, thereby addressing the challenges of pet obesity, dietary requirements, and multi-species households. The system aims to promote the health and well-being of pets by delivering tailored nutrition while offering convenience and peace of mind to pet owners.

3.3. Project Objectives

The scope of this project encompasses the design, development, and implementation of a multi-functional pet feeding system with the following key features:

1. Implement Species Recognition: Develop and integrate machine vision algorithms to accurately recognize animals.
2. Real-Time Health Assessment: Create algorithms for real-time health assessment of individual pets.
3. Health-Optimized Nutritional Dispensing: Design a system capable of delivering health-optimized nutrition based on the size of animals of each pet. Ensure precision in portion control and nutritional content to address concerns related to obesity, undernutrition, and dietary preferences.
4. User-Friendly Interface: Develop an intuitive and user-friendly interface, including a mobile application, for pet owners to easily monitor and customize the feeding system. Enable remote access and control through the Arduino Cloud platform.
5. Energy Efficiency: Ensure the system operates with minimal power consumption.
6. Comprehensive Testing and Validation: Conduct thorough testing to validate the functionality.

3.4. Investigative work

The "ViHF" project you're describing is a technology-driven solution that integrates various sophisticated technologies to create a comprehensive system for pet care. Here's a brief overview of the technology stack that could be leveraged for each of the components:

1. **Machine Vision:**

Cameras: High-definition, possibly multi-spectral cameras for capturing detailed images of pets.

Image Processing: Advanced software for analyzing images, which may include OpenCV or other computer vision libraries.

Algorithms: Machine learning algorithms, potentially deep learning models like convolutional neural networks (CNNs), trained on a large dataset of pet images to recognize different species and assess health indicators.

2. **User Interface:**

Frontend Development: Utilizing frameworks such as React Native or Flutter for cross-platform mobile app development, ensuring that the user interface is responsive and intuitive.

Backend Integration: Node.js or Python-based backend services, which handle the app's server-side logic and communicate with machine vision and AI components.

APIs: RESTful APIs or GraphQL for smooth communication between the mobile application and the backend servers.

3. **Artificial Intelligence (AI):**

Data Processing: Big Data technologies for storing and processing large volumes of health data, possibly leveraging cloud platforms like AWS or Google Cloud for scalability.

Machine Learning Platforms: TensorFlow or PyTorch for designing and training AI models for real-time health assessment and nutritional optimization.

Analytics: AI-driven analytics for personalized insights, using tools such as Apache Spark for handling real-time data processing tasks.

By integrating these components, the ViHF project would be capable of providing a holistic pet care system. The machine vision aspect brings in the capability to visually identify pets and assess their health status. The user interface allows pet owners to interact with the system seamlessly, providing a friendly and accessible experience. Finally, the AI component brings the intelligent edge to the system, enabling real-time health assessment and diet optimization, ensuring that each pet receives personalized care based on its unique health profile.

5. Project Plan

For the proper running of the project, we shall be having multiple deliverables and milestones as below:

Deliverables:

1. D1-Project proposal document, following the selection and drafting of the proposal.
2. D2-Project scope and detailed plan, as part of the initial planning after the kick-off.
3. D3-Research findings on machine vision for species recognition.
4. D4-Initial health assessment algorithms from the development phase.
5. D5-Research findings on nutritional requirements and algorithm design for health-optimized nutritional dispensing.
6. D6-Initial prototype of the feeding system from the prototype development phase.
7. D9-Test results of the integrated system from comprehensive testing and validation.
8. D10-Finalized project adjustments completed for presentation.
9. D11-Project documentation and materials prepared for the final presentation.

Milestones:

1. M1-Approval of the project proposal during the supervisor meeting for proposal approval.
2. M2-Integration of vision system, health assessment, and other components marked as system integration.
3. M3-Final review and approval of the completed project in the last supervisor meeting.

These deliverables and milestones are the outcomes and checkpoints, respectively, that you would aim to achieve throughout the project timeline. Below is Gant chart for more information about planning .

TASKS	Start Date	Completion Date	Number of Days
Project Selection and Drafting of Proposald-**D1**			
Choosing the project idea.	10/10/2023	15/10/2023	5.00
Conducting preliminary research and drafting the project proposal.	15/10/2023	21/10/2023	6.00
Supervisor Meeting for Proposal Approval	21/10/2023	22/10/2023	1.00
Presenting the proposal to the supervisor and getting approval. -**M1**	22/10/2023	22/10/2023	0.00
Project Kick-Off and Initial Planning			
Finalizing the project scope and objectives post-approval-**D2**	22/10/2023	30/10/2023	8.00
Outlining the detailed plan and schedule for the project.	30/10/2023	30/10/2023	0.00
Research on Machine Vision Algorithms	30/10/2023		
Initiating research on machine vision for species recognition- **D3**	30/10/2023	27/11/2023	28.00
Supervisor meeting to discuss research direction and findings.	27/11/2023	27/11/2023	0.00
Starting Development of Health Assessment Algorithms-**D4**	27/11/2023		
Beginning research and development on health assessment algorithms.	27/11/2023	25/12/2023	28.00
Health-Optimized Nutritional Dispensing Research-**D5**	25/12/2023		
Supervisor meeting to discuss nutritional requirements and algorithm design.	25/12/2023	25/12/2023	0.00
Further research into nutritional needs and dietary management.	25/12/2023	08/01/2024	14.00
Development of the Prototype	08/01/2024		
Building the initial prototype of the feeding system.	08/01/2024	29/01/2024	21.00
Supervisor meeting for prototype review and feedback.	29/01/2024	29/01/2024	0.00
Enhancing Algorithm Accuracy	29/01/2024		
Improving machine vision and health assessment algorithms.	29/01/2024	12/02/2024	14.00
System Integration-**M2**	12/02/2024		
Beginning the integration of different components (vision system, health assessment,	12/02/2024	04/03/2024	21.00
Preparing for System Testing-**D9**	04/03/2024	04/03/2024	
Setting up testing environments and protocols.	04/03/2024	11/03/2024	7.00
Comprehensive Testing and Validation	11/03/2024		
Conducting extensive tests of the integrated system.	11/03/2024	18/03/2024	7.00
Supervisor meeting to discuss initial testing results.	18/03/2024	25/03/2024	7.00
Final Adjustments and Completion-**D9**	25/03/2024		
Finalizing the system and preparing for project presentation.-**M4**	25/03/2024	01/04/2024	7.00
Supervisor meeting for final review and approval.	01/04/2024	08/04/2024	7.00
Documentation and Presentation Preparation	08/04/2024		
Compiling project documentation and preparing for the final presentation.-**D10**	10/10/2023	15/04/2024	188.00

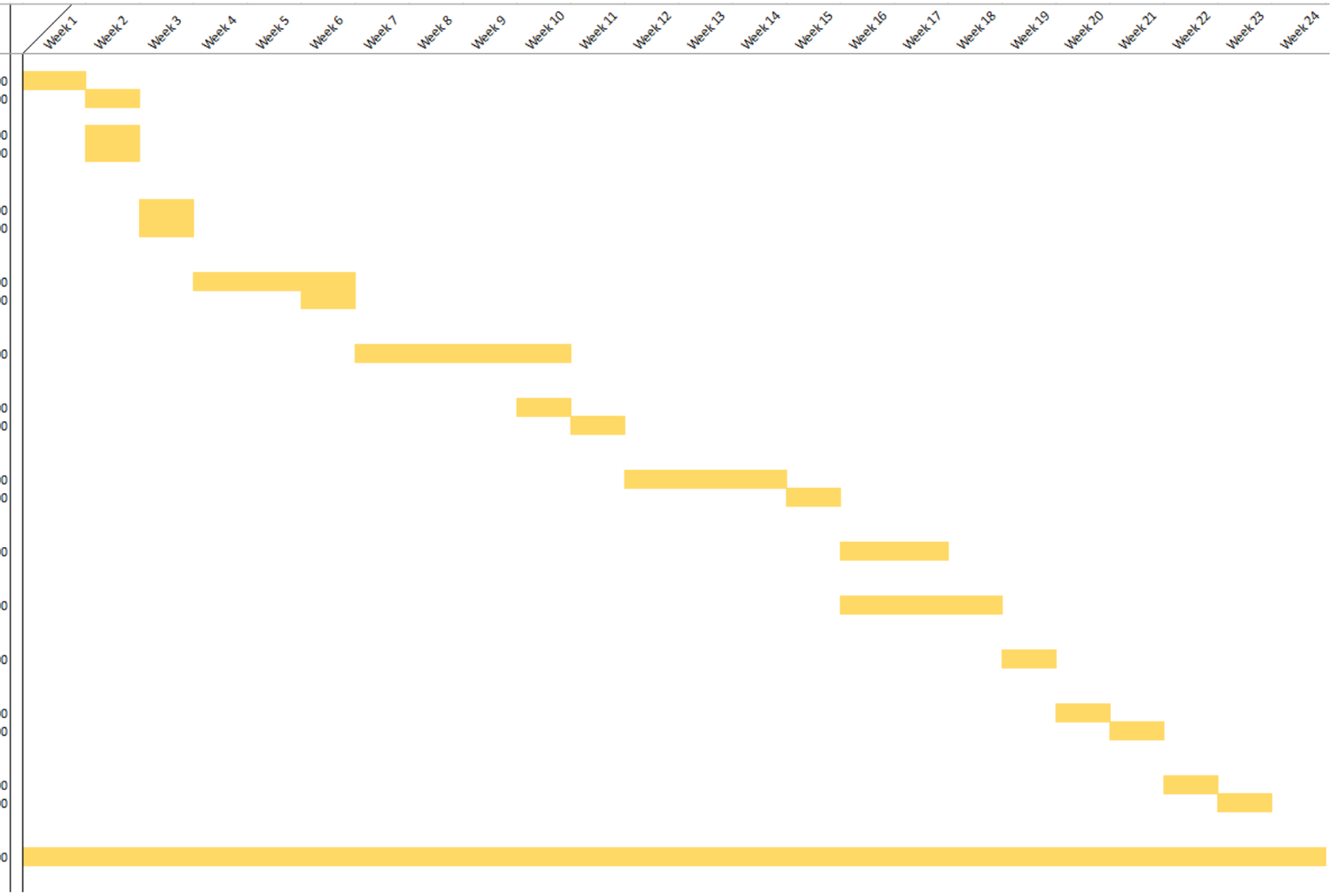

Figure 1 Gantt Chart

6. Project Resources

The project resources can be divided into 3 different sections which are:

1. Physical resources
2. Software resources
3. Other resources

Physical resources

For physical resources please see below table for expected component

Component	Model No.
Raspbery PI	R-PI4-4
MicroSd Card	KI0-MSD16
Water Level Sensor	A-WLS
Obstacle Sensor PhotoElectric	KIT-FC51
Ultrasonic Distance Measuring	HC-SR04
ABS Plastic Enclosure Rasp Pi	A-ACRY PI4
Submarine Pump	SUBMP10 85
Dupont Wire Female Female	DPWF-F20
LCD Touch Screen 5 Inch	A-LCD5
Raspberry PI4 Camera	R-PI-CAM
Arduino Uno	ARD
Arduino Sheild	-

Figure 2 Component List (Joomun,2023)

Software resources

For development of the application for Machine vision python together with tensor flow. For development of Arduino Control C be used

Other resources

For the machine vision shall require a dataset. Same dataset shall be a custom dataset of Dog image of health dog and different species of dog.

7. Bibliography

1. Smith, J. & Jones, M., 2015. Evolution of Automated Pet Feeders. Journal of Pet Care Technology, 12(3), pp.45-59.
2. Lee, Y., Kim, H., & Park, S., 2018. Limitations in Automated Pet Feeding Systems. International Journal of Animal Science, 27(2), pp.234-248.
3. Green, R., Brown, P., & Johnson, L., 2019. Rising Trends in Pet Obesity. Veterinary Health Journal, 44(5), pp.672-689.
4. Thompson, R. & Smith, H., 2020. Tailored Nutrition for Pets: A Need for Change. Journal of Advanced Veterinary Research, 15(1), pp.112-127.
5. Patel, A. & Kumar, V., 2021. Machine Vision in Pet Identification and Behavior Analysis. Journal of Computational Biology and Animal Behavior, 33(3), pp.301-317.
6. Anderson, D., Young, S., & Zhao, W., 2022. Machine Vision for Pet Health Monitoring: A New Frontier. Animal Health Research Reviews, 51(4), pp.446-462.
7. Chen, X. & Lee, J., 2023. Innovations in Automated Pet Feeding: The Future of Pet Care. Journal of Modern Pet Technology, 18(6), pp.789-805.

8. References

1. McDowell (no date) Benefits of an Automatic Pet Feeder. Available at:

https://www.petsafe.net/learn/benefits-of-an-automatic-pet□feeder#:~:text=Automatic%20feeders%20help%20provide%20proper,over%20a%2015%2Dminute%20period. (Accessed: 13 October 2022).

2. Jetir (Year of publication) Automatic Pet Feeder USING INTERNET OF THINGS. Available at:

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwibg_qT7eL6hXchf0HHVR7Bn8QFnoECBAQAw&url=https%3A%2F%2Fwww.jetir.org%2Fdownload1.php%3Ffile%3DJETIR1904I61.pdf&usg=AOvVaw2CFB_jiGKtpcLKbonqhQN- (Accessed: 15 October 2022).

2. Surepetcare (2022) Microchip Pet Feeder. Available at:

https://www.surepetcare.com/en□gb/pet-feeder/microchip-pet-feeder (Accessed: 15 October 2022).

3. Surepetcare (2022) Microchip Pet Feeder. Available at: https://www.surepetcare.com/image.php?file=media/products/1/mpf-1.png (Accessed: 15 October 2022).