CST3990 Undergraduate Individual Project

VisionHealth Feeder(VHF)

2021 Oct Intake

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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.

1.8 Health-Optimized Nutritional Dispensing

Machine vision extends beyond species recognition. It enables the feeder to assess the condition and health of the pets. This real-time assessment is used to optimize the nutritional content of the dispensed food. For example, if a pet is overweight, the feeder can adjust the portion size accordingly to support weight management. This dynamic approach to pet feeding not only promotes overall health but also mitigates the risks associated with obesity and undernutrition.

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.

3. Description of Project

3.1. Project Overview

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. Purpose of the Solution

The core purpose of the "VHF" 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. Scope of the Project

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. Technology Stack

The "VHF" leverages a range of cutting-edge technologies, including but not limited to:

1. Machine Vision: Utilizing machine vision algorithms for species recognition and health assessment through cameras and image processing.
2. User Interface: Developing a user-friendly interface accessible through a mobile application for convenient system control and monitoring.
3. Artificial Intelligence (AI): Incorporating AI for real-time health assessment and nutritional optimization.

By integrating these technologies, the project aims to create a comprehensive and responsive system that caters to the unique needs of individual pets and transforms the way pet owners care for their animals.

4. Systems Analysis and Design

The VHF system architecture will consist of the following components:

1. Raspberry Pi with Camera: The Raspberry Pi with a camera will be used for pet detection and identification using computer vision technology.

2. Food Storage Container: The food storage container will store the food and dispense the appropriate amount based on the identification of each pet.

3. Water Dispenser: The water dispenser will be connected to a water source or container and will provide fresh water to pets as needed.

4. Interface: The interface will allow pet owners to interact with the system directly, monitor the feeding schedule, adjust the portion sizes, and receive notifications.

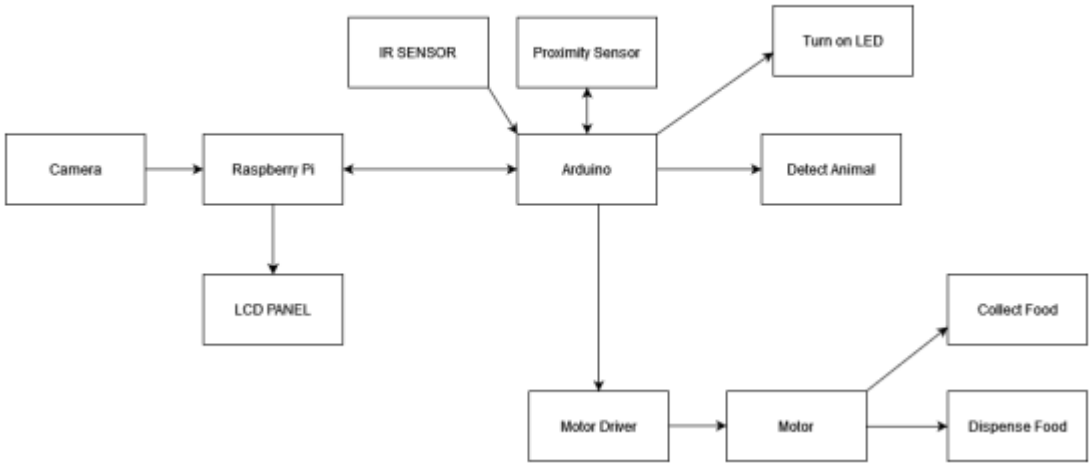

Figure 1 Block Diagram

4.1. Implementation and Testing

The system shall be powered by Ardunio & Raspberry pi to handle all the process below is an sample design of the robot and a series of test

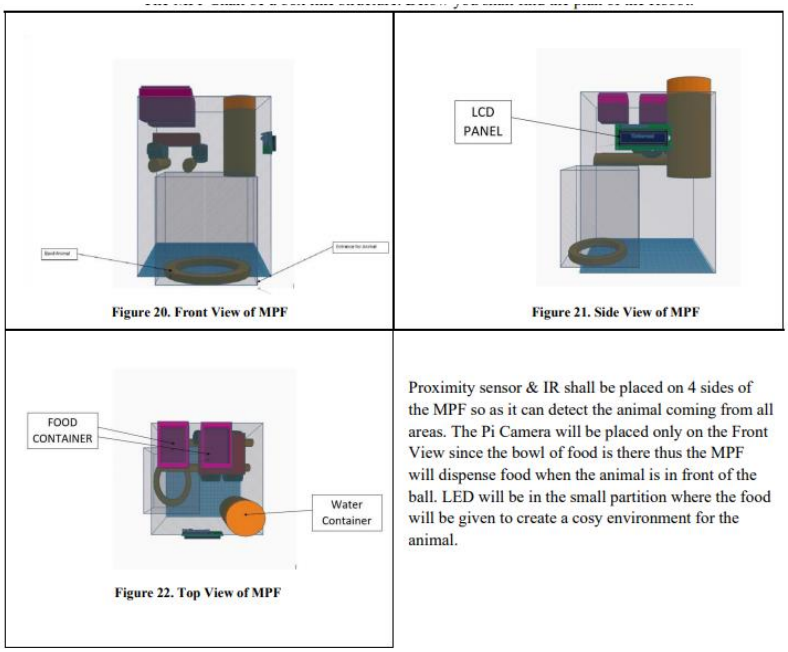

Figure 2 Proposed Diagram (Joomun,2023)

COMPONENT/ID	Test Requirements
Rasp01/A02	Input voltage should be properly checked for not to burn out the board
Rasp02/V01	Check & Test calibration of camera
Rasp03	Test if RaspPi Sending correct into to motors and check for power
A02	Test if all sensors are powered on
A03	Check if all connection is ok and run some dummy test
V04	Connect Monitor to Robot to visualise and check if accurate data is being collected
P01	Check if pulley well mounted to motors and if spinning correctly
P03	Check if pulley on kart is moving horizontally
S01	Test Ultrasonic sensors with different distances
S02	Test motors if moving in clockwise and anti clockwise direction
S03	Check if all codes are correct for robot to function efficiently
S04	Check if data is well received between the arduino and the raspberry pi and the sensors by running dummy test

Figure 3 Test Cases (Joomun,2023)

5. Project Plan

Project planning is a key aspect for the success of this project. Some Milestones are required as below. Below you shall find a Gantt Chart for the Project

- Proposal Approval
- Prototype Development
- System Integration
- Comprehensive System Testing
- Final Project Presentation and Submission

TASKS	Start Date	Completion Date	Number of Days
Project Selection and Drafting of Proposal			
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.	22/10/2023	22/10/2023	0.00
Project Kick-Off and Initial Planning			
Finalizing the project scope and objectives post-approval.	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.	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	27/11/2023		
Beginning research and development on health assessment algorithms.	27/11/2023	25/12/2023	28.00
Health-Optimized Nutritional Dispensing Research	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	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	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	25/03/2024		
Finalizing the system and preparing for project presentation.	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.	08/04/2024	15/04/2024	7.00

KEYS	
	Milestones

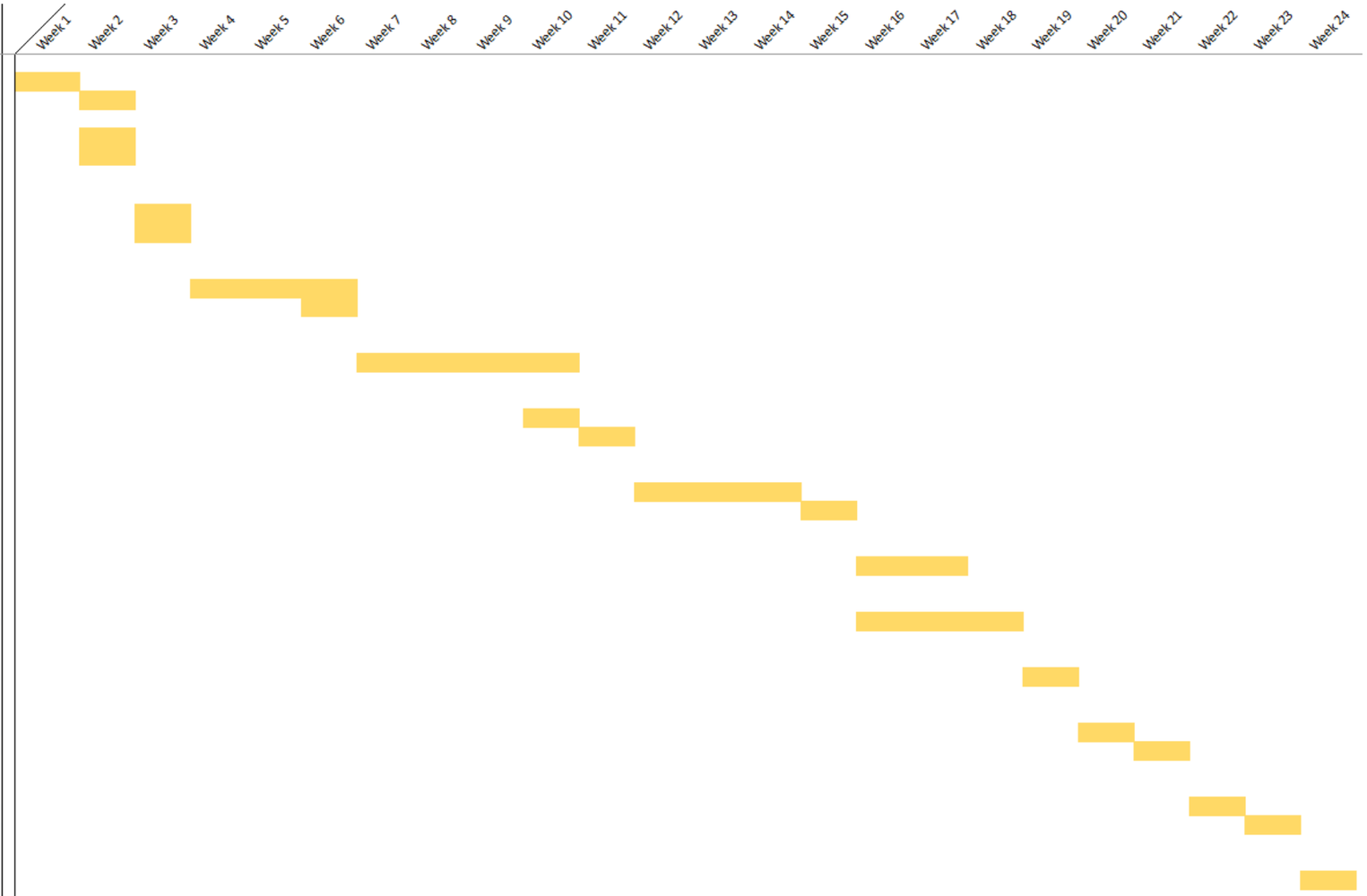

Figure 4 Gantt Chart

6. Project Resources –

The budgeted data is as below together with the materials required for the building of the robot.

Qty	Component	Model No.	Price(Rs) incl VAT
Already Bought			
1	Raspbery PI	R-PI4-4	9250
1	MicroSd Card	KI0-MSD16	240
1	Water Level Sensor	A-WLS	35
6	Obstacle Sensor PhotoElectric	KIT-FC51	45
4	Ultrasonic Distance Measuring	HC-SR04	60
1	ABS Plastic Enclosure Rasp Pi	A-ACRY PI4	150
1	Submarine Pump	SUBMP10 85	85
40	Dupont Wire Female Female	DPWF-F20	2
1	LCD Touch Screen 5 Inch	A-LCD5	1600
1	Raspberry PI4 Camera	R-PI-CAM	250
1	Arduino Uno	ARD	500
1	Arduino Sheild	-	450
		Supplied by Transcom Total	12667
Not Bought Yet			
8	Acrylic Pane	-	3200
4	Metallic Rode	-	400
		Supplied by General Store Total	3600
		Gross Total	16267

Figure 5 Budget (Joomun,2023)

7. References

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.