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Streamlining Pet Food Distribution: A Review of the FeederFusion Matrix

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Abstract : *FeederFusion: The PetFeast Matrix is an innovative automated pet feeding system designed to offer precise and controlled feeding experiences for pets. It integrates key components such as food containers, a bowl, a waste collector, and a stand bar to function seamlessly. Controlled via a smartphone app, the system enables pet owners to manage feeding routines remotely with ease. Leveraging mobile connectivity, FeederFusion allows real-time control, enabling users to dispense food, adjust portion sizes, and monitor feeding activity anytime, anywhere. This dynamic approach ensures pets are fed on demand rather than adhering to rigid schedules. Instead of sensors, the system utilizes a camera to monitor food levels in the bowl, providing a live feed through the app for visual confirmation. Users can release more food as needed, ensuring adequate feeding. The waste collector minimizes mess by capturing excess food and is easy to detach and clean, maintaining hygiene with minimal effort. The sturdy stand bar ensures structural stability, preventing tipping even with larger pets. FeederFusion combines innovation, convenience, and practicality, providing a smart solution for modern pet care.*

Keywords - *Automated feeding, Camera monitoring, Hygiene, Pet care, Smartphone control*

1. INTRODUCTION

The evolution of automated pet feeding systems originates from the need to provide improved care for pets while overcoming the constraints of manual feeding routines. Traditionally, feeding pets required strict adherence to fixed schedules and significant human involvement. The introduction of mechanical feeders marked the first shift towards automation, with gravity-based systems providing continuous food supply. However, these early solutions lacked precision and failed to accommodate pets with specific dietary needs. Technological advancements paved the way for more sophisticated automated feeding systems. Early electronic models incorporated timers and motors, enabling pet owners to schedule feeding times and regulate portion sizes. These systems were an improvement over basic feeders but still had notable limitations. Gravity-based feeders were affordable and low maintenance but could not provide the precision required for pets with specific dietary needs. Advanced feeders with timers and portion control offered greater flexibility but were often expensive and lacked intuitive interfaces, making them challenging for non-technical users.

Recent developments in smart technology have introduced IoT-enabled feeders that connect to home Wi-Fi networks, allowing remote control through mobile apps. These systems offer real-time monitoring, customizable schedules, and dietary insights. Some advanced feeders even incorporate AI and machine learning to analyze feeding patterns and optimize meal schedules. Despite these innovations, many feeders still face significant challenges, such as ensuring hygiene, maintaining food safety, and accommodating the unique needs of diverse pets. Additionally, the complexity and high costs of these systems can deter widespread adoption. This paper aims to address the persistent challenges in automated pet feeding systems by presenting *FeederFusion*, a state-of-the-art solution that combines advanced technology with user-centric design. The study seeks to develop a system that offers precise portion control, real-time monitoring, and prioritizes hygiene, ease of use, and

adaptability to diverse pet needs.Many existing feeders fail to accommodate varying dietary requirements or feeding habits, often offering rigid solutions. Additionally, while IoT and AI-enabled feeders have introduced significant advancements, they frequently lack accessibility due to complex interfaces or high costs. *FeederFusion* bridges this gap by integrating advanced functionality with simplicity and affordability.

2. LITERATURE REVIEW

A survey was done on the existing literature and products to find out their shortcomings and research gaps in their systems. This survey consisted of more than 15 literature papers wherein the most relevant ones are listed below.

Gus Erniatia, etc [1], "Design and Build of a Blynk-Based Automatic Cat Food and Drinking Water Dispenser." The paper presents the development of an IoT-based automatic cat food and drinking water dispenser that leverages the NodeMCU8266 module and Blynk software to remotely control the feeding and watering process via a smartphone. The system uses two ultrasonic sensors, HX711 load cell, and servo motors to monitor food and water levels and dispense them as needed. The Blynk app sends real-time notifications to the owner's smartphone if the food or water falls below a certain level, allowing owners to activate the dispenser remotely. The load cell measures the remaining food, and ultrasonic sensors detect both water levels and the cat's proximity to the dispenser. The system addresses the challenges faced by cat owners who may not be at home to feed their pets, ensuring that food and water are available as per the cat's needs. The project demonstrates how IoT technology can improve pet care by automating feeding tasks and providing real-time monitoring.

Kajal Shrivas etc [2], The paper "Internet of Things (IoT) Based Smart Pet Feeder" This paper discusses the development of an IoT-based smart pet feeder designed to automate pet feeding while allowing remote monitoring and control through a mobile app. The system aims to ensure that pets are fed on time even when their owners are busy or away. It utilizes components such as the NodeMCU ESP8266 microcontroller, servo motors, and sensors to dispense food automatically at pre-scheduled times. Features include voice recording for pet familiarity, food level alerts, and portion control to maintain the pet's health. The system offers peace of mind to pet owners by integrating IoT technology, enabling remote feeding and monitoring via smartphones, and potentially reducing stress related to pet care.

Nofri Wandi etc [3], "Design of an Internet of Things-Based Automatic Cat Feeding Control Device (IoT)"This paper presents the design of an IoT-based automatic cat feeding system utilizing the NodeMCU ESP8266 microcontroller with a built-in WiFi module. The system integrates the HCR04 ultrasonic sensor to monitor the food level and sends notifications to the MQTT application when the feed is low. The Blynk application is used for remote control, allowing users to manage feeding times, monitor food consumption, and receive notifications. The design aims to automate feeding schedules for busy cat owners, ensuring regular feeding even when away from home. The tool was tested using the black box method to ensure functionality, providing remote monitoring and scheduled feeding through a smartphone interface. The research addresses the problem of inconsistent feeding, reducing the risk of health issues in cats due to missed meals, and offers convenience through the automation of feeding and real-time updates on feed levels.

Handava Wardana etc [4], The paper titled "Cat Feeding Using Microcontroller Arduino Uno TCS3200 Sensor and Internet of Things" discusses the development of a smart cat feeding system that uses an Arduino Uno microcontroller, TCS3200 color sensor, RTCDS3231 real-time clock, ESP32CAM, Load Cell, and HX711 module to automate cat feeding and monitoring. The system is designed to help cat owners feed their pets remotely and automatically, particularly when they are busy or away from home. The feeder includes several features: it dispenses food based on preset schedules using the real-time clock, detects food quantity with the Load Cell and HX711 module to send notifications via the Telegram app when food is running low or finished, and uses the TCS3200 sensor to identify the presence of the cat by detecting its color. The ESP32CAM allows real-time monitoring by sending images of the cat's activities to the owner's smartphone. The system was tested to ensure that it could notify the user when food was low, feed the cat automatically, and monitor the cat's behavior. Results showed the system successfully reduced owner concerns about feeding schedules and allowed efficient remote management of the pet's diet. The use of IoT technology, including the integration of Telegram for notifications and remote control, enhances convenience and reliability for busy pet owners.

Prima Imanuela Putri, etc [5], "Application of Design Thinking Method to the Innovation Business Design Process of Automatic Aquatic Pet Feeder with IoT." The paper explores the use of the design thinking method to create an innovative business model for an Automatic Aquatic Pet Feeder with IoT. The authors emphasize four stages of design thinking—empathize, define, ideate, and prototype—focusing on fish keepers' needs. Using Business Model Canvas (BMC), the study maps customer segments, value propositions, channels, and other business elements to create a simplified model. The feeder is designed to allow remote feeding and monitoring of fish, using IoT technology to automate the process and notify users. Through surveys and interviews with 97 fish keepers, the research finds that fish owners are highly interested in this product, as it alleviates worries about feeding schedules, particularly when they are away. The application of design thinking allows for the development of a practical solution, addressing customer pain points such as missed feeding times and difficulties in aquarium maintenance, offering peace of mind to fish owners.

Brianbojoyou J, etc [6], "Automated Pet Feeder with RFID Technology Using Design Thinking Approach" This paper presents the design and development of an automated pet feeder system using RFID technology, integrating Arduino as the microcontroller. Developed by Brianbojoyou J, Ashivin A, Abilash V, and Dr. V. Murali Bhaskaran, the system aims to improve pet feeding routines by identifying pets via RFID-tagged collars and dispensing the correct food portions at scheduled times. A servo motor controls food dispensing, triggered only when the RFID tag corresponding to a particular pet is detected, ensuring tailored portion control. The real-time clock (RTC) is used to maintain precise feeding schedules, and the system allows customization through a user-friendly interface. The design thinking methodology was used throughout the development process, beginning with understanding the needs of pet owners, defining the key problems, ideating solutions, prototyping, and conducting tests. This approach ensures the system meets user requirements, such as addressing portion control, managing multi-pet households, and offering convenience for busy pet owners. Future improvements could include machine learning for analyzing pet feeding behaviors, environmental sensors for monitoring food storage conditions, and voice recognition for interactive feeding. The system was successfully tested, showing its potential to maintain a consistent feeding schedule while promoting pet health.

Wong Sie Woo, etc [7] authored the paper titled "Automatic Solar-Based Pet Food Dispenser System". This project aims to design a solar-powered automatic pet feeder controlled by Arduino, incorporating a DS3231 Real Time Clock (RTC) for scheduled feedings. The system dispenses specific portions of food (up to 20 grams per meal) using a servo motor, ensuring pets are fed even in the owner's absence. Solar energy powers the feeder, promoting sustainability. The pet feeder allows the user to set the feeding time and portion size using a 4x4 keypad and displays the information on an LCD. The food is released through a motorized valve, ensuring precise portions. The prototype was tested with various shapes and sizes of cat food, and the results showed that the system can dispense food efficiently based on the schedule. The project highlights the potential of integrating solar energy and automation in pet care, with future recommendations to incorporate IoT for remote monitoring and control.

The paper titled ″Pet Feeder using IoT″ is authored by Adnan Shah, Syed Tajuddin, Irfan Hamid Darzi, etc [8], from the Department of Electronics and Communication Engineering at AMC Engineering College, Bangalore. This paper presents a solution to improve automated pet feeding systems using IoT technology. It outlines the design and implementation of a smart pet feeder controlled via a mobile application. The system uses an Arduino UNO, a BOLT Wi-Fi module, and servo motors to automate the feeding process. The feeder operates with a simple mobile command, dispensing food into a bowl when the user clicks a button in the app. This IoT-based solution is intended to help pet owners feed their pets conveniently when they are away from home, providing ease and reliability. The paper concludes that the IoT pet feeder is effective and has potential for future enhancements, such as adding a camera or sensors for improved pet monitoring.

Thineswari A/P Pulainthran etc [9] authored the paper titled IoT Based Smart Pet Cage, which focuses on developing a smart pet cage that leverages IoT to automate various aspects of pet care. The cage features sensors for temperature, weight, and water level, allowing it to dispense food and water automatically and open the cage gate when temperatures exceed safe levels. The system is controlled via the Blynk mobile app, enabling real-time monitoring of the pet's environment and feeding status. The paper discusses the integration of hardware such as

the ESP32 microcontroller, servo motors, and water pumps, alongside software that allows for remote management. Tests show the system can accurately dispense food, refill water, and ensure pet safety by reacting to environmental changes. This IoT solution offers a convenient way for pet owners to manage their pets' needs, especially when they are away.

Erni Marlina etc [10] authored the paper titled The Design of Smart Prototype Pet Feeder Using Passive InfraRed (PIR) Sensors. This research presents the design of an automatic pet feeder prototype, particularly for cats, utilizing a PIR sensor to detect movement around the feeding bowl. The system, developed using the ATMega8535 microcontroller and programmed in C language, opens the food valve through a DC motor when a pet is detected. The PIR sensor is capable of detecting objects up to 6 meters away, and the food valve closes once the desired amount of food has been dispensed, monitored by a photodiode. The hardware and software were tested thoroughly, and the system responded effectively within the detection range. However, the system also detects humans or other living beings that emit heat, which can unintentionally trigger the food dispensing mechanism. The study concludes with recommendations for improving object-specific detection to enhance the system's functionality.

Muzakki Mubarok Simamora etc [11]. authored the paper titled Designing a Cat Feeding Automation System Using Microcontroller Application-Based Scheduling. This project focuses on developing an IoT-based automatic cat feeding system controlled via Telegram, enabling users to feed cats remotely using a smartphone, tablet, or PC. The system uses ESP32 microcontrollers to manage operations, including detecting a cat's presence with ultrasonic sensors and dispensing food through servo motors. A load cell sensor ensures the food is dispensed in the correct portion (1-2 grams) and prevents overfeeding. The system operates both online and offline and includes features like a camera to monitor feeding, humidity and temperature sensors, and a load cell to track the food's weight. Telegram bots provide user notifications and control. Despite some latency issues related to Wi-Fi signals and sensor response times, the system successfully automates cat feeding, contributing to better care for pets even in the owner's absence.

The paper titled ″Pet Feeder using IoT″ is authored by Adnan Shah, Syed Tajuddin, Irfan Hamid Darzi, etc [12], from the Department of Electronics and Communication Engineering at AMC Engineering College, Bangalore. This paper presents a solution to improve automated pet feeding systems using IoT technology. It outlines the design and implementation of a smart pet feeder controlled via a mobile application. The system uses an Arduino UNO, a BOLT Wi-Fi module, and servo motors to automate the feeding process. The feeder operates with a simple mobile command, dispensing food into a bowl when the user clicks a button in the app. This IoT-based solution is intended to help pet owners feed their pets conveniently when they are away from home, providing ease and reliability. The paper concludes that the IoT pet feeder is effective and has potential for future enhancements, such as adding a camera or sensors for improved pet monitoring.

Harshini Manimaran, etc [13] authored the paper titled "Automatic Pet Feeder" This paper presents the design and implementation of an IoT-based automatic pet feeder using Raspberry Pi 3B+ to help working pet owners feed their pets on time. The feeder dispenses food and water automatically at set intervals, maintaining hygiene and ensuring the pet's diet is managed. The system addresses issues like overfeeding, indigestion, and pet anxiety by providing proper meal timing. The feeder includes features like cleaning the food bowl before feeding and monitoring through a camera. The project aims to improve the lives of both pets and their owners and suggests future enhancements like adding a camera and speaker for remote interaction.

The paper titled "IoT and Its Benefit in Feeding Domestic Pets" is authored by Vefa Kirbac etc [14] from the Electrical and Electronics Engineering Department at Dogus University, Istanbul. The study explores the use of IoT technology to address the challenges of feeding domestic pets when owners are away. The IoT-based pet feeder system automates feeding by dispensing a predetermined amount of food at set intervals, controlled through a mobile app. The system includes features like monitoring the pet's eating habits using weight sensors, alerting the user if the pet has not eaten, and checking the food level in the storage tank using ultrasonic sensors. Additionally, a camera provides real-time visuals of the pet's environment, enhancing security and monitoring. This system provides practical solutions for busy pet owners and includes a user-friendly interface designed via the Blynk platform. The paper concludes that IoT solutions offer significant advantages for pet care, and the

integration of additional features like cameras and sensors ensures the health and well-being of pets while simplifying the feeding process.

4. CONCLUSION

FeederFusion: The PetFeast Matrix offers an innovative solution for modern pet feeding by combining convenience, flexibility, and hygiene. Its remote smartphone control allows pet owners to manage feeding schedules, adjust portion sizes, and monitor food levels in real-time from anywhere, eliminating the need for preset feeding times. The integrated waste collector minimizes mess and promotes cleanliness, while detachable components ensure easy maintenance. The sturdy stand bar prevents tipping, even with larger pets, ensuring the system is reliable and durable for households of all sizes.

Despite its advantages, FeederFusion has some limitations. Its reliance on Wi-Fi connectivity may cause issues in areas with unstable internet, potentially affecting remote control and monitoring. Additionally, the quality of the camera feed depends on connection strength, which may limit its effectiveness in certain conditions. FeederFusion is ideal for busy pet owners or those with varying schedules, providing on-demand feeding and real-time monitoring. Future enhancements, such as AI-driven feeding schedules or integration with smart home devices, could further expand its capabilities, making it an even more intelligent solution for the future of pet care.

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