CAPSTONE PROJECT REPORT

On

“Smart Pet Feeder: A Technological Solution for Modern Pet Cares”

Constrains:

(**Project Term:** January- May 2024)

CAP 769

Project Group Code: CARGC0130

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In partial fulfilment of the requirements of the award of degree of

Master of Computer Applications

LOVELY PROFESSIONAL UNIVERSITY

2024

DECLARATION

To whom so ever it may concern

We, Abhishek Dhaka: 12208085, P Pawan Kumar: 12208315, Suman Minz: 12204730, hereby declare that the work done by us on **"Smart Pet Feeder: A Technological Solution for Modern Pet Cares"** from January 2024 to May 2024 under **CAP769: CAPSTONE PROJECT WORK** at Lovely Professional University, Phagwara, Punjab. Is a record of original work for the partial fulfilment of the requirement for the award of the degree, **Masters of Computer Application**. The result embodied in this report have not been submitted to any subject or university.

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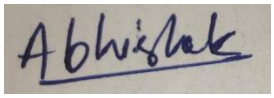

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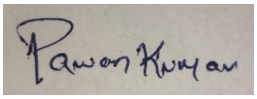

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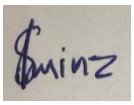

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For all the efforts behind the paper work & project, I first & for most would like to express my sincere appreciation to **Dr. Mukesh Kumar (UID:27406)**, School of Computer Application, Lovely Professional University. For their extended help & suggestions at every stage of this project work. It is with a great sense of gratitude that I acknowledge the support, time to time suggestions and highly indebted to guide us. Finally, I pay sincere thanks to all those who indirectly and directly helped us towards the successful completion of the project **"Smart Pet Feeder: A Technological Solution for Modern Pet Cares"**.

With due regards:

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CERTIFICATE

This is to certify that the project report titled **"Smart Pet Feeder: A Technological Solution for Modern Pet Cares"** is being submitted by the Group bearing number **CARGC0130**, in **MCA 4th Semester** is a record bonafide work carried out by them. The results embodied in this report have not been submitted to any other University for the award of any degree.

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Paper Presented & Submitted at:

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Paper ID: 2852

Paper Title: Design and Development of a Smart Pet Feeder: Enhancing Pet Care Through Automation

Abstract:
In Today's busy lifestyle, pet owners face many problems in ensuring regular and balanced feeding for their beloved pets ensuring pets receive the right amount of food at the right time. This Smart pet feeder addresses this issue by employing a based device to offer a fully automated smart feeder. The convenience of the owner and the well-being of the pets are both enhanced by this innovative system incorporates various technologies and devices. When feeding time arrives, a speaker with pre-recorded voice messages gently calls the pet to the food area, ensuring they are aware it's time to eat, in case the pet does not eat food immediately or pet leaves after eating a small portion of food then the system will call pet with a periodic reminder, encouraging them to eat food at their own pace. The device closes the pet's food bowl automatically after the pet leaves the pet feeder to guard against contamination and food spoiling and maintain the quality of the food. It includes real-time food level monitoring, and calling the pet at a scheduled time. It ensures that pets receive timely and sufficient meals, reduces food waste, and safeguards food quality.

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Thanks,
CMT team.

PATENT REGISTRATION

Request ID: 14305

Request Id - 14305 Requested By 27406

Request Id :	14305
EntryBy :	27406:Dr. Mukesh Kumar
Idea For :	Patent
Title :	FULLY AUTOMATED SMART PET FEEDER
Description :	This proposed system can help the pet owners. That is, by fully automating the pet's feeding system

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TOPIC APPROVAL PERFORMA

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Program : P164-NN1::MCA

COURSE CODE : CAP769 **REGULAR/BACKLOG :** Regular **GROUP NUMBER :** CARGC0130

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PROPOSED TOPIC : Smart Pet Feeder: A Technological Solution for Modern Pet Cares

Qualitative Assessment of Proposed Topic by PAC		
Sr.No.	**Parameter**	**Rating (out of 10)**
1	Project Novelty: Potential of the project to create new knowledge	8.35
2	Project Feasibility: Project can be timely carried out in-house with low-cost and available resources in the University by the students.	8.80
3	Project Academic Inputs: Project topic is relevant and makes extensive use of academic inputs in UG program and serves as a culminating effort for core study area of the degree program.	7.90
4	Project Supervision: Project supervisor's is technically competent to guide students, resolve any issues, and impart necessary skills.	8.35
5	Social Applicability: Project work intends to solve a practical problem.	7.90
6	Future Scope: Project has potential to become basis of future research work, publication or patent.	8.80

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Final Topic Approved by PAC: **Smart Pet Feeder: A Technological Solution for Modern Pet Cares**

Overall Remarks: Approved

PAC CHAIRPERSON Name: 27549::Dr. Ashok Kumar **Approval Date:** 17 Apr 2024

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03-05-24	Confirmation of Final Report	Suman Minz P Pawan Kumar	Validating the final report

Document Approval

The following software Requirements Specification has been accepted and approved by the following:

Signature	Approval Authority Name	Title	Date	Comments
	Dr. Mukesh Kumar (Supervisor)	Assistant Prof.	3-May-2024	Plag. check approval

ABSTRACT

In this era of having a busy lifestyle, many of the pet owners are struggle to ensure and provide consistent, balanced and optimal nutrition's for their beloved pets. The stress level in daily life makes it difficult to ensure that your pet gets the right amount of food at the right time. However, the emergence of intelligent animals has solved these problems. These special products use modern technology to provide special features that are important for the owner's comfort and the dog's health.

At the heart of this smart pet feeder is an ingenious base unit that easily integrates its many functions. During lunch, the device uses a built-in speaker that plays a pre-recorded sound to gently lure the animals into the feeding area. This effective defence ensures that the animal is immediately aware of the arrival of food, gradually creating a sense of habit and expectation. One more thing is the food that the dogs will not finish to keep them healthy so that they can get enough food for the dogs.

One of the most important features that a smart pet feeder must have is that it should preserve the quality, freshness and protect the food from the effect of environment. The device automatically closes the food bowl to prevent contamination and spoilage after the animal leaves the feeding area. This not only maintains the quality of the food but also reduces waste by providing quality food. The system also includes real-time food tracking, allowing pet owners to understand their pet's eating patterns and ensure timely replacement of food.

In addition, smart food products provide regular feeding convenience, allowing pet owners to adjust their feeding plans according to their pet's nutritional needs and live activities. This change improves the overall health of dogs and their owners by streamlining the feeding process and solving pet care problems. Combining technology with user-friendly design, smart pet feeders mark a significant advancement in pet care, offering pet owners a reliable option for the health and happiness of their furry friends every day.

1. INTRODUCTION

1.1. Purpose

This creative offer's main goal is to meet the demands of both pet owners and others who choose not to acquire pets because of their busy schedules. A prevalent obstacle encountered by several individuals is the incapacity to provide their pets with regular care and attention due to hectic schedules, sometimes culminating in disappointed yearnings for company. Identifying this gap, the suggested solution introduces an all-inclusive animal feeding machine in an attempt to reduce the stress related to routine pet feeding.

This cutting-edge system offers unique features, such as an integrated speaker that plays recorded noises to interact with dogs. Through the implementation of predictable, secure, and joyful feeding routines, the speaker cultivates a feeling of familiarity and comfort for pets—even when their owners are not around. Additionally, the method promotes self-sufficiency via moderation and compassion, addressing worries about dogs' feeding habits. Encouraging pets to eat on their own means that their health and well-being are preserved regardless of the owner's presence.

Essentially, by providing a comprehensive answer to the problems encountered by busy pet owners, this suggested method seeks to transform the pet care industry. It not only makes pet feeding easier, but it also creates a loving atmosphere that supports pets' mental and physical wellbeing by utilizing cutting-edge technology and creative design. By means of its easy-to-use interface and naturally occurring functions, it aims to enable pet owners to provide their cherished animals the best care and company possible, therefore bridging the gap between hectic lives and satisfying pet ownership.

1.2. Objective

This Proposed system is to help the people who have pets and people who are afraid to buy pets due to their busy lives they cannot take care of them every day. We all know that people are too busy in day-to-day life with office work and other stuff, many people out there want to buy companions but cannot feed them because they are busy. So proposed a system that is fully automated to feed pets in the absence of an owner [2]. A built-in speaker plays a pre-recorded voice gently calling out to the pet, this unique interaction not only captures the pet's attention but also establishes a routine that fosters a sense of security and excitement, the pet was waiting eagerly for feeding. Some pets can be picky eaters at times, so this smart pet feeder takes proactive measures to ensure their well-being. If the pet does not eat food immediately or pet leaves after eating a small portion of food, then the system will gently call the pet to encourage the pet to return to the food and consume their meal at their own pace. The integration of body sensor device technology in smart pet feeder system. when pet approaches near the pet feeder, the sensor detects pets' presence which sent signal to open the bowl. This idea helps a lot to save food from spoilage dust particles and react with oxygen. This smart pet feeder takes care of a crucial issue that goes beyond feeding by maintaining food quality. We keep dust and other impurities from contaminating the food leftover by pet by automating the feeding bowl's closing mechanism when the pet has done eating. By doing this, owner can reduce waste while maintaining the food nutritious value.

1.3. Definitions, Acronyms, Abbreviations

ESP-32: The main microcontroller is the ESP32, or Espressif System's Programmable System-on-Chip, version 32.
IOT: The idea of linking gadgets and sensors to the internet to share data is known as the Internet of Things, or IoT.
I2C: I2C (Inter-Integrated Circuit) is used with Liquid Crystal Display (LCD) to simplifies the hardware design, reduces pin count.

HX711: HX711 is a circuit board which is used as a precision 24-bit analog- to-digital converter (ADC) designed for weigh.

2. SYSTEM ANALYSIS

2.1. Introduction

Smart Pet feeders represent a revolutionary change in pet management, offering pet owners a solution to feeding time, food tracking and convenience. This article explains the complexities of designing and manufacturing such devices, highlighting their functions, benefits, and potential impacts on animal health. From keeping the pet safe and managing feeding to allowing time for adaptation, smart pets are designed and built with many considerations in mind.

One of the main features of feeding animals is that they can call the animals while eating and keep the food fresh by opening and closing the food bowl. The device uses technology to synchronize feeding with the animal's presence to not only reduce food waste but also ensure the animal receives the right food at the right time. Additionally, the automation of refilling the bowl provides convenience, with the remaining time remaining at the discretion of the owner.

Hardware, software development and user interface design are crucial to creating a reliable and efficient animal feeding system. This comprehensive guide facilitates the interaction between the equipment and its users, making it easier to operate and maintain the device. Additionally, these systems help improve pet care standards by providing pet owners with real-time information about their pets' diets and nutritional intake.

In summary, this article attempts to provide a better understanding of the creation and evolution of smart pet care. By exploring the potential, benefits, challenges and future prospects of smart food animals, it aims to contribute to ongoing discussions on improving the health of our animal friends. By installing this new solution, we want to create a culture of continuous improvement in animal care.

2.2. Existing Systems

The advancement of smart pet feeders has been a subject of significant interest in recent years, with researchers exploring various aspects of their design, functionality, and applications. Suffian et al. (2021) contributed to this field by presenting a detailed study on

a reliable smart pet feeding machine developed using an Arduino Uno starter kit [1]. The study likely delves into the hardware components, such as the feeding mechanism and sensors, as well as the programming and functionality of the feeder. It may discuss the considerations for ensuring reliability and safety in the design, providing valuable insights into the implementation of microcontroller-based systems for smart pet feeding. Marlina (2023) focused on the design of a smart pet feeder using Passive Infrared (PIR) sensors [2]. This approach is particularly interesting as it explores how sensors can detect pet presence and trigger feeding accordingly. The paper may discuss the integration of PIR sensors into the feeder, the detection algorithms used, and the overall energy efficiency of the system. By leveraging sensor technology, Marlina's work likely provides insights into creating pet-friendly and responsive feeding solutions that adapt to the pets' needs and behaviours. Jukan et al. (2017) provided a systematic review on smart computing and sensing technologies for animal welfare, which includes a discussion on smart pet feeders [3]. It is expected that this study will address different sensor technology, data processing methods, and how to use them to monitor and enhance animal welfare. It could highlight how important it is to include state-of-the-art sensor technology in pet feeders in order to detect eating patterns and health markers in real time.

Boateng and Akparibo (2022) introduced a multifunctional automatic dog-feeder with Bluetooth and Wi-Fi connectivity, emphasizing the importance of connectivity features in enhancing user interaction and remote monitoring [4]. Their work may discuss the implementation of these features, the user interface design, and the implications for pet owners in terms of convenience and peace of mind. Additionally, the paper may touch upon the challenges and considerations in ensuring reliable connectivity and data security in smart pet feeders. Bembde et al. (2023) explored the concept of robotic day-care for pets using sensors and Raspberry Pi [5]. Although not specifically focused on pet feeding, their study likely provides insights into the use of sensors and automation in pet care. It may discuss how sensor data is processed and used to provide interactive experiences and care for pets in the absence of their owners, potentially inspiring future developments in smart pet feeding technology.

2.3. Research Gap

In the collaboration of the authors, the speaker was included in the system to solve the loneliness of one of his animals. However, popular apps are different from traditional apps. The speaker is not used to give direct commands during feeding, but is used as an auxiliary device. If the animal does not finish its meal within the feeding time, the speaker will intervene after the set time and announce instructions to encourage the animal to eat. Despite this new approach, the project still has one big difference: the lack of an interactive model that allows direct interaction between owners and animals. This conflict can cause the animal to refuse to eat, especially if the owner cannot monitor the feeding process.

To solve this important problem, our team used a system designed to facilitate interaction between owners and pets. Recognizing the important role of speech in behavior, we created a solution that allows commands to be written skillfully. These commands are suggested by

the system at meal times, making the communication between the owner and the pet more effective. By infusing the system with the owner's personal voice commands, we aim to create a sense of awareness and security in the animals, ultimately promoting consistent feeding and adaptation.

Through our new approach, we sought to solve the limitations inherent in the original project design, particularly the lack of direct contact between owners and animals during feeding. We aim to create a more interactive and efficient way for pets by integrating the owner's voice commands into the system, thus creating a better relationship between the owner and their partner. Our solutions not only solve the pressing problem of supplementing pet food, but also provide the foundation for a deeper, better relationship between owners and their beloved pets.

2.4. Proposed System

The Smart Pet Feeder – a device designed to automate feeding schedules, monitor pets' eating habits, and provide convenience to pet owners. This paper delves into the design and development of such a device, exploring its functionalities, benefits, and potential impact on pet care practices. The design and development of a Smart Pet Feeder encompass a range of considerations, from ensuring pet safety and portion control to providing flexibility in feeding schedules. This paper examines the hardware components, software development, and user interface design required to create a reliable and effective solution. The smart pet feeder system is to the well-being of pets. Through an idea of calling pet at its mealtime and opening the bowl when pets arrive to smart pet feeder system and closing it when pets left the food bowl to preserve the food from spoilage. Our smart pet feeder's main purpose is to relieve pet owners of their stress while they remain busy with work. For pet feeding, it is an improved system to save food from spoiling by dust and ensure pets receive the right amount of food at the right time, minimize food waste, and protect food quality. Refiling of the bowl is scheduled by the owner, and it is fully automated, but refiling of food storage is done by the owner before it gets empty. In summary, this paper aims to provide a comprehensive understanding of the design and development of the Smart Pet Feeder, exploring its functionalities, benefits, challenges, and future directions. By shedding light on this innovative pet care solution, we hope to contribute to the ongoing conversation about improving the well-being of our beloved animal companions.

2.5. Advantages of Proposed System

1. Numerous Smart Pet Feeder concepts have been developed by researchers and hobbyists alike, each promising to improve how we care for our furry pets. But a striking oversight appears in many of these initiatives: there are no steps taken to stop food waste. Imagine this scenario: a pet neglects its meal, leaving the food exposed in an open bowl. Over time, factors including dust and exposure can contribute to deterioration, leaving the food unsafe for ingestion. This not only wastes resources but also puts our cherished pets' health at danger. In order to guarantee the efficiency and long-term viability of Smart Pet Feeder systems, this problem must be resolved.

2. Within the realm of these innovative projects, one notable inclusion stands out—a speaker designed to alleviate the loneliness of pets left home alone. However, a crucial feature is still not fully utilized in spite of this considerate addition. Many initiatives take a passive approach, failing to utilize the speaker's capacity to interact with the pet during feeding times. Instead, then persuading the pet to eat when it's mealtime, the speaker is just utilized as a call to action after a specified period, basically urging the pet to eat on its own. These programs lose out on an opportunity to improve pet-owner relationship and guarantee the health of the pet by failing to actively direct and promote feeding practices.

3. Another issue overlooked in most of these efforts is the lack of mechanisms to facilitate interaction between animals and their owners. Imagine a situation where the owner is away and the animal can fend for itself without worrying about food. The lack of interactive interaction exacerbates the problem, leaving animals to fend for themselves without the guidance or encouragement they need. Aware of this difference, our project has implemented a system designed to close the communication gap between owners and animals. Our system records and plays back the owner's voice commands, ensuring the animal receives clear instructions and support during feeding, even when the owner is not present. This good way not only creates a deep bond between animal and owner, but also contributes to the health of our furry friends.

2.6. Design & Implementation Constrain Methodology

The proposed smart pet feeder system's architecture combines state-of-the-art technology with careful design principles to provide a comprehensive approach to contemporary pet care. Through automation, monitoring, and control features, this network of linked components-based system seeks to transform the feeding experience for dogs and their owners.

The strong and adaptable ESP32 microcontroller, which acts as the brains coordinating the actions of all other components, is at the centre of this novel system. The ESP32's strong processing capabilities enable it to effectively oversee the processes of data collecting, analysis, and decision-making, facilitating smooth coordination and communication between the many components of the system.

The load sensor, which is one of the main hardware elements of the smart pet feeder, has been painstakingly calibrated to work in concert with the HX711 amplifier to deliver accurate weight measurements for the food dish. This makes it possible to precisely measure food intake, giving pet owners the ability to keep tabs on their animal companion's nutritional intake and make necessary modifications.

To further improve the system's responsiveness, an ultrasonic sensor is included, which detects the pet's presence and opens the food dish automatically when it gets close. This simple engagement mechanism encourages the pet's natural eating habits and sense of autonomy in addition to making it feel more convenient.

A vital component of the feeder's construction, the servo motor regulates the bowl cap's opening and shutting to maintain the pet food's ideal freshness and hygienic conditions. The servo motor helps prevent overeating and food spoiling by carefully controlling access to the food supply, improving the health and wellbeing of the pet.

Additionally, the addition of an LCD display gives pet owners instant feedback and insightful information about their pet's eating patterns and general behaviour. With the help of this interactive feature, pet owners may actively participate in their pet's care regimen, which strengthens their bond and knowledge of one another.

An additional special and cutting-edge feature of the smart pet feeder system is a pre-recorded audio message that calls the pet to the feeding area when it's mealtime. The relationship between the pet and owner is strengthened by this unique touch, which gives the feeding ritual a sense of coziness and familiarity.

The smart pet feeder system is supported by a dedication to sustainability and good pet care practices, in addition to its practical qualities. The method improves long-term pet health and well-being in addition to encouraging environmental stewardship by utilizing food preservation techniques and reducing food waste.

This innovative technology, which has undergone extensive testing and improvement, represents precision, dependability, and pet owners' peace of mind, signaling the beginning of a new phase of technological innovation in pet care. The fully automated smart pet feeder is an innovative step towards a future where caring for pets is enjoyable and simple by embracing technology and creativity.

3. Working of Proposed Modules

3.1. Flow Chart of the Proposed System

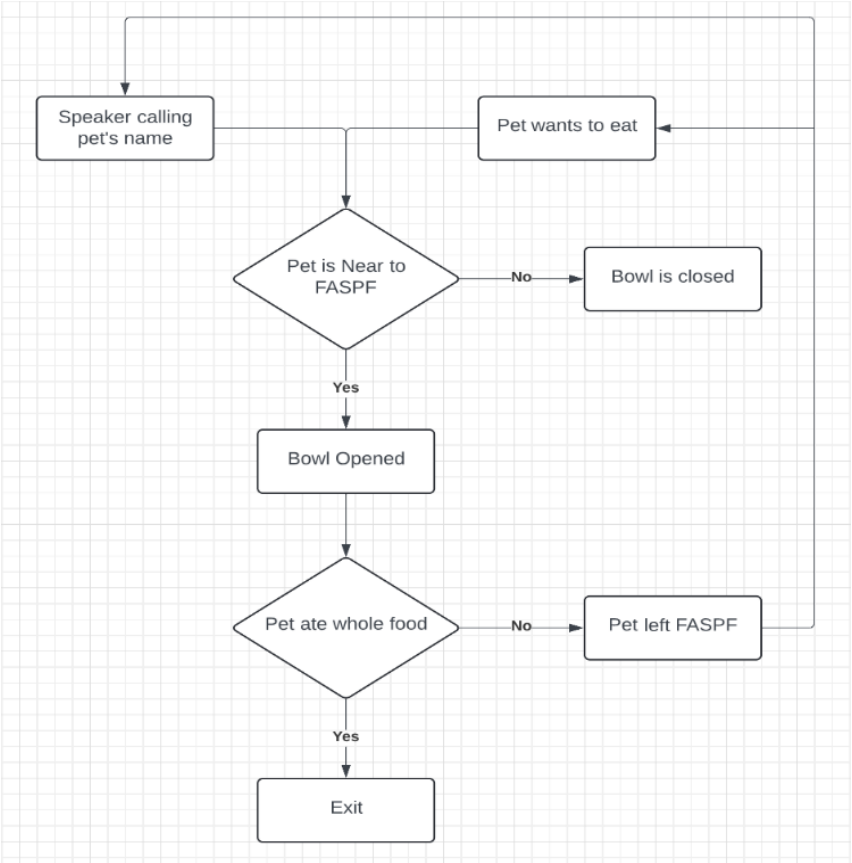

Fig 1. Flowchart explaining the working of the proposed model.

The suggested system in the research paper's working sequence is depicted in the flow chart shown in Figure 1. When the pet indicates that it is time for a meal or when the meal time is about to start, the speaker will summon the pet by calling it's name to begin the procedure. After this start-up, an important situation occurs: when the animal gets near the pet feeder, the system opens the bowl; if not, it stays closed.

However, a dangerous situation occurs when the pet eats the whole serving or decides to leave the feeding location before completing the meal. When this happens, the system goes into a crucial loop and initiates a sequence of events that are meant to motivate the pet to finish eating. Iteratively calling to the pet again, using incentives to motivate eating the leftover food, and continuing until the meal is finished or the pet leaves are all part of this procedure.

This loop of repetition is a dynamic component of the system that guarantees dogs eat enough food and reduces food waste. The system exhibits a responsive and user-centric approach to pet feeding by integrating this adaptable function, which accommodates the unique requirements and habits of every pet. The proposed research seeks to improve pet feeding systems' efficacy and efficiency by ongoing process optimization and refinement, which will eventually benefit pets' health and provide pet owners with more ease.

3.2. DFD of the Proposed System

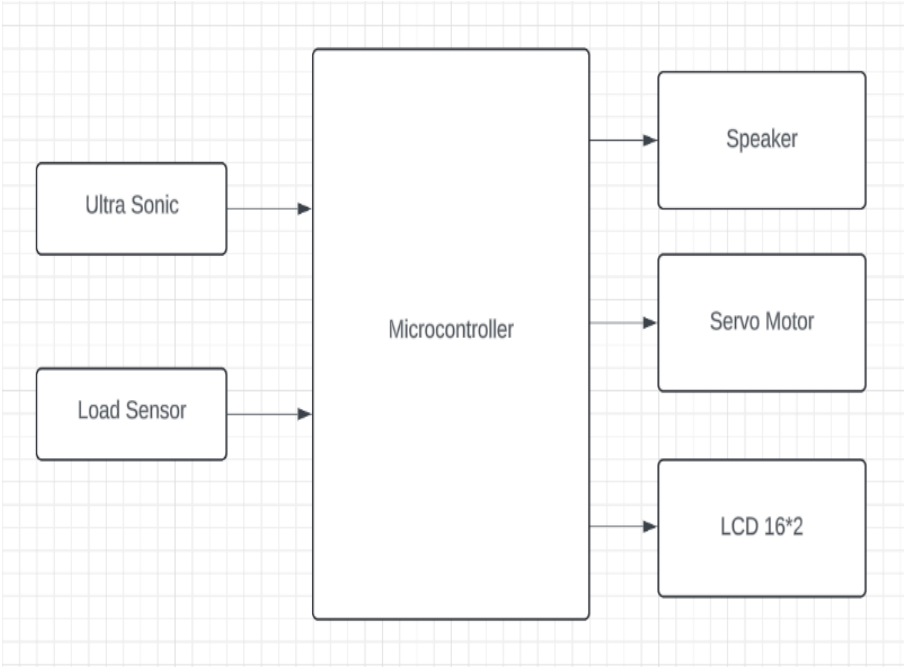

Fig 2. Data Flow Diagram of the input and the output sensors of the proposed model.

The Block Diagram for the suggested system in the research report is shown in Figure 2. The Ultra Sonic sensor and the Load sensor are the two main input sensors that the system depends on. These sensors are essential for obtaining information that is needed for the system to function. The microcontroller receives real-time output from the Ultra Sonic sensor, which gauges the distance between the pet and the pet feeder. In order to provide precise and quick information on the state of the food supply, the Load Sensor simultaneously weighs the food in the bowl.

Three key parts are used by the system on the output side: an LCD 162 display, a servo motor, and a speaker. These elements are essential for encouraging engagement and communication with the pet. When needed, the Speaker serves as a way to interact with the pet and notify them of mealtimes or other significant occasions. The bowl lid may be easily opened to reveal the food within thanks to the Servo Motor's control over its movement. Last but not least, the LCD 162 display functions as an easy-to-use interface, giving precise information on the pet's distance from the feeder as well as the weight of the food in the bowl at any given time.

The system guarantees effective and efficient administration of the pet's feeding procedure by means of the coordinated functioning of these input and output sensors. Through the use of cutting-edge technology and sophisticated sensors, it provides a simplified solution that improves the pet owner's capacity to precisely and conveniently attend to their pet's nutritional demands.

4. System Specification

4.1. Component Used

The suggested smart pet feeder consist of hardware component overview is provided in this section. To provide the user with insights, the ESP-32 Microcontroller is connected with speaker, Load sensor and HX711, LCD and I2C, Bread board, Bowl, Motion senser which is Ultra Sonic having main functionality in system, and both are controlled by microcontroller.

ESP-32: The ESP32 is a powerful microcontroller developed by Espressif Systems. It has gained popularity for its versatility, low cost, and extensive connectivity options, making it suitable for a wide range of IoT (Internet of Things) applications, including smart pet feeders. One of the key features of the ESP32 is its dual-core processor, which allows for multitasking and efficient handling of various tasks simultaneously. This makes it well-suited for applications where real-time processing and responsiveness are required, such as monitoring sensors and controlling actuators in a smart pet feeder. Additionally, the ESP32 offers built-in Wi-Fi and Bluetooth connectivity, allowing devices to communicate with each other and with the internet. This enables remote monitoring and control of the pet feeder, as well as integration with other smart home devices and services. The ESP32 also supports a wide range of peripheral interfaces, including GPIO pins, SPI, I2C, UART, and ADC, which can be used to interface with sensors, displays, motors, and other components commonly found in smart pet feeders. This flexibility allows developers to easily customize and expand the functionality of their pet feeder according to specific requirements. Furthermore, the ESP32 is supported by a rich ecosystem of development tools and libraries, making it accessible to both hobbyists and professional developers. Arduino IDE, PlatformIO, and Espressif's own ESP-IDF are among the popular development environments for programming the ESP32. In the context of smart pet feeders, the ESP32 can be used to create a robust and feature-rich solution that offers automated feeding schedules, remote monitoring, and control, as well as integration with other smart home devices. Its low cost, versatility, and ease of use make it an attractive choice for developers looking to create innovative pet care solutions.

Fig. 3.1. ESP32

Load Sensor: The Load Sensor in smart pet feeder is a 1 kg load sensor and will take weight of bowl as input and send output to microcontroller unit and microcontroller check whether the food in bowl is completely eaten or not, after receiving the input ESP32 will conclude the further process. HX711 is used a part of load sensor it will amplify these small signals up to 128 times and it incorporates a high-resolution 24-bit ADC that can convert the analog signal into a digital representation with high precision. Load sensors work on the principle of strain gauge technology, where a strain gauge is bonded to a flexible material (usually metal) that deforms under load. As the material deforms, the strain gauge undergoes a change in resistance, which is directly proportional to the applied force. This change in resistance is then converted into an electrical signal that can be measured and interpreted by a microcontroller or other electronic devices. In the context of a smart pet feeder, load sensors are typically used to measure the weight of the pet food remaining in the feeder's container. By continuously monitoring the weight, the feeder can determine when to dispense more food and when to alert the owner that the container needs refilling. The load sensor is typically placed underneath the food container or integrated into the feeder's dispensing mechanism. When food is added or removed from the container, the change in weight is detected by the load sensor. This information is then used to update the feeder's internal state and trigger actions such as dispensing food or sending notifications to the owner. Load sensors come in various shapes, sizes, and weight capacities to suit different applications. They can measure weights ranging from a few grams to several tons, making them suitable for a wide range of pet feeder sizes and types. In summary, load sensors play a crucial role in smart pet feeders by accurately measuring the amount of food remaining in the feeder's container. This allows for precise feeding schedules, prevents overfeeding or underfeeding, and provides owners with real-time information about their pet's feeding habits.

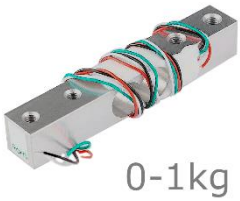

Fig. 3.2. 1kg Load Sensor

Ultra Sonic Sensor: An ultrasonic sensor operates on the principle of emitting high-frequency sound waves and measuring the time it takes for the waves to bounce back. This allows the sensor to calculate the distance between bowl and pet in its path. It takes distance between the bowl and pet as input and send it to the micro controller, which is ESP32, and it calculate weather to open the bowl or not. An ultrasonic sensor is a device that measures the distance to an object by emitting ultrasonic sound waves and then detecting the time it takes for the waves to bounce back. These sensors are commonly used in various applications, including robotics, industrial automation, and, relevantly, in smart pet feeders. The operation of an ultrasonic sensor is based on the principle of echolocation, like how bats and dolphins navigate. The sensor emits a burst of ultrasonic sound waves, which travel

through the air until they encounter an object. When the waves hit the object, they are reflected to the sensor. By measuring the time it takes for the waves to travel to the object and back, the sensor can calculate the distance to the object. In the context of a smart pet feeder, an ultrasonic sensor can be used to detect the presence of the pet near the feeder or to prevent the feeder from dispensing food if the pet is too close. This helps prevent accidents and ensures the safety of the pet. The ultrasonic sensor is typically mounted on the exterior of the pet feeder, facing outward. When the sensor detects an object within its range, it sends a signal to the feeder's control system, which can then take appropriate action, such as pausing the feeding process or emitting a warning signal. One advantage of ultrasonic sensors is their ability to work in various environmental conditions, including darkness and dust, unlike optical sensors which may be affected by ambient light. Additionally, ultrasonic sensors have a longer range compared to infrared sensors, making them suitable for detecting larger objects or pets from a distance. However, ultrasonic sensors may have limitations in highly reflective or acoustically noisy environments, which could affect their accuracy. Additionally, they may not be suitable for detecting certain types of objects, such as soft or absorbent materials, which may absorb the sound waves rather than reflecting them back to the sensor. In summary, ultrasonic sensors offer a reliable and versatile solution for detecting objects and ensuring the safety and functionality of smart pet feeders. By accurately measuring distances and detecting the presence of pets, they contribute to a more efficient and user-friendly feeding experience for both pets and their owners.

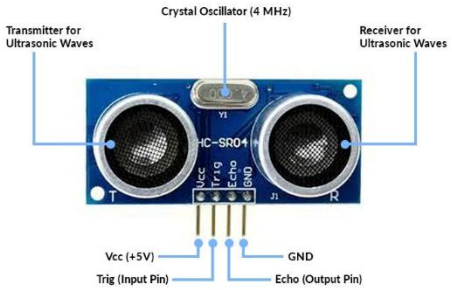

Fig. 3.3. Ultra Sonic Sensor

Servo Motor: Our Smart Pet Feeder System's servo motor integration transforms feeding by giving you exact control over the feeding bowl's cap's opening and closing. The servo motor provides the necessary force and precision to smoothly rotate the cap of the feeding bowl. Servo motor is different other motor since we have control over it, we can move cap of the bowl at any angle. A servo motor is a rotary actuator that allows for precise control of angular position. It consists of a motor coupled with a sensor for position feedback, typically a potentiometer or an encoder. Servo motors are widely used in various applications, including robotics, automation, and, relevantly, in smart pet feeders. In a smart pet feeder, a servo motor is often used to control the mechanism that dispenses food into the pet's bowl. The servo motor can precisely rotate to a specific angle, allowing for accurate control over

the amount of food dispensed. This enables the feeder to deliver precise portion sizes according to the pet's feeding schedule. Servo motors operate based on a closed-loop control system, where the position feedback from the sensor is compared to the desired position set by the user. The motor adjusts its rotation until the actual position matches the desired position, ensuring accurate and reliable operation. One of the key advantages of servo motors is their ability to provide precise control over position, speed, and torque. This makes them ideal for applications where accuracy and repeatability are critical, such as in smart pet feeders where consistent portion sizes are essential for the pet's health. Another advantage of servo motors is their compact size and high torque-to-weight ratio, allowing for efficient use of space in small devices like pet feeders. Additionally, servo motors are available in various sizes and torque ratings, making it easy to select the right motor for the specific requirements of the feeder.

Fig. 3.4. Servo Motor

Liquid Crystal Display (LCD): The integration of LCD makes a crucial feature of system, which very help full for interaction between the pet's owner and system. The LCD display provides a visual representation of the pet's distance from the feeder, making it possible to monitor this crucial interaction. The LCD display provides this crucial information by displaying the weight of the food within the feeder in real time. Using I2C with LCD modules simplifies the hardware design, reduces pin count, and offers flexibility and ease of use. The LCD serves as a crucial component in the user interface of the proposed smart pet feeder system. It provides real-time visual feedback to the user, displaying important information such as feeding schedules, remaining food levels, system status, and alerts or notifications. Integrated with the microcontroller, typically an ESP32, the LCD communicates with the firmware to dynamically update its content according to user interactions and system events. This interaction layer allows pet owners to easily monitor and manage their pet's feeding regimen, ensuring timely and accurate dispensing of food. By presenting information in a clear and intuitive manner, the LCD enhances the user experience, providing convenience and peace of mind to pet owners even when they are not physically present.

Fig. 3.5.

Speaker: The Buzzer in smart pet feeder will communicate with the pet, it is for owner to call pet for feeding. The speaker in our Smart Pet Feeder is more than a device, it is a conduit for connection and communication with the pet, ensuring they receive the nourishment they need in a manner that resonates with their natural instincts.

Fig. 3.6. Speaker

Inter-Integrated Circuit (I2C): The Inter-Integrated Circuit (I2C) protocol plays a crucial role in the communication infrastructure of the proposed smart pet feeder system. By facilitating communication between the microcontroller, sensors, and actuators, I2C enables seamless data exchange within the system. The microcontroller acts as the master device, orchestrating the communication process and controlling various peripherals such as sensors for monitoring food levels and environmental conditions, as well as actuators for dispensing food or indicating system status. Through the use of only two wires, I2C streamlines the connection of multiple devices, allowing for efficient and reliable communication in a compact space, such as inside the pet feeder. This simplicity and versatility make I2C an ideal choice for integrating diverse components within the smart pet feeder system, ensuring its functionality and responsiveness to user needs.

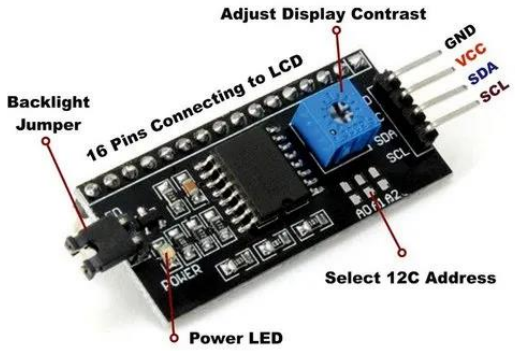

Fig. 3.7. I2C Circuit Board

HX711: HX711 is a special-purpose integrated circuit widely used in heavy-duty electronics and mobile applications. This precision amplifier and 24-bit analog-to-digital converter (ADC) provide high sensitivity and resolution to measure even small changes in load or weight. It is specifically designed to interface with load cells, gauges and other sensors to accurately convert analog signals into digital data. The HX711 has features such as adjustable gain and noise reduction tools to suit a variety of cell configurations to ensure stable and reliable measurements. Its connectivity (usually via SPI or I2C protocol) makes it compatible with many microcontrollers and embedded systems. Overall, the HX711 plays an important role in ensuring accurate and reliable weight measurement in industries such as industrial automation, consumer electronics and refining.

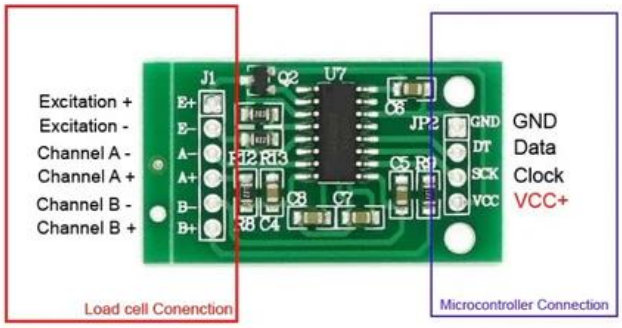

Fig. 3.8. HX711 Circuit Board

5. Working Prototype Design & Formulation

5.1. Introduction to Prototype Designing

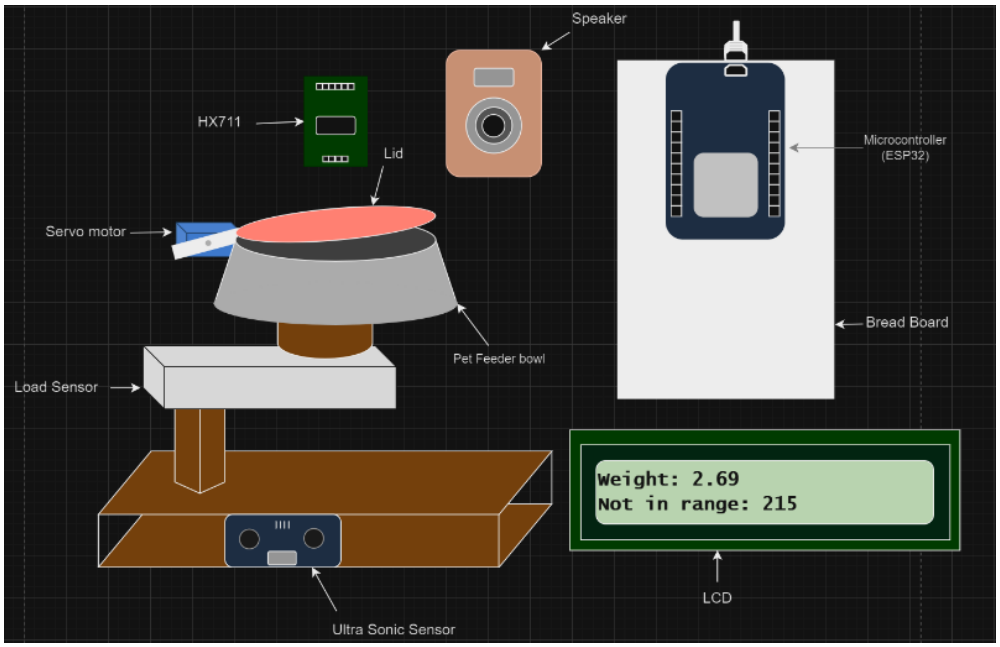

Fig. 4 Blueprint or prototype of the proposed model

The model prototype shown in Figure 3 provides an overview of the complex set of sensors and components important to the research paper. At the heart of the chamber is a load sensor located under the tray and securely fixed to the wooden block. This configuration makes it easy to measure the weight of the tray, allowing for accurate tracking of food. Servo motors are located next to the tray and are designed to operate the lid smoothly, allowing control of the delivery process. Additionally, integrated ultrasonic sensors are placed next to the wooden block to carefully detect and capture your pet's movements. The ability to follow the current not only improves the body's performance, but also helps adapt the diet to the animal's behaviour.

Furthermore, by placing an LCD 16*2 display unit in line of sight with the microcontroller, it improves user experience by providing feedback that is crucial. Here, important details like the weight of the bowl and the distance the ultrasonic sensor measured are displayed in an appealing way to enable easy interaction and monitoring. Moreover, a speaker that is subtly tucked under the bowl adds a touch of interaction by mimicking the sound of the pet feeder calling for food. This sound signal improves the dogs' eating experience by reinforcing the feeding schedule and giving them a sense of familiarity and comfort. With its unique appearance and functionality, this carefully crafted group of sensors and parts makes up a strong and adaptable pet feeding system that has the potential to completely change the pet care industry.

5.2. Existing Data Reports

Recent years have witnessed a surge in interest surrounding the advancement of smart pet feeders, with researchers delving into diverse aspects of their design, functionality, and applications. Contributing to this burgeoning field, Suffian et al. (2021) conducted a

meticulous study on a dependable smart pet feeding machine engineered using an Arduino Uno starter kit [1]. Their work likely delves into the intricacies of hardware components like the feeding mechanism and sensors, alongside the programming and operational aspects of the feeder. By addressing considerations for reliability and safety, their study offers valuable insights into the integration of microcontroller-based systems for smart pet feeding.

Marlina (2023) directed her focus towards crafting a smart pet feeder leveraging Passive Infrared (PIR) sensors [2]. This approach intriguingly explores the realm of sensor technology in detecting pet presence and subsequently triggering feeding actions. Expectedly, her paper discusses the seamless integration of PIR sensors into the feeder, the intricacies of detection algorithms employed, and the overarching energy efficiency of the system. Through the lens of sensor technology, Marlina's research sheds light on the development of pet-friendly and responsive feeding solutions attuned to the unique behaviors and needs of pets.

In a broader context, Jukan et al. (2017) undertook a systematic review encompassing smart computing and sensing technologies for animal welfare, including an examination of smart pet feeders [3]. This comprehensive study is anticipated to explore diverse sensor technologies, data processing methodologies, and their collective utilization in monitoring and augmenting animal welfare. It likely emphasizes the integration of state-of-the-art sensor technology into pet feeders, facilitating real-time detection of eating patterns and health indicators, thereby accentuating the imperative of technological advancements in fostering animal well-being.

Furthermore, Boateng and Akparibo (2022) introduced a multifunctional automatic dog-feeder endowed with Bluetooth and Wi-Fi connectivity, underscoring the pivotal role of connectivity features in enriching user engagement and enabling remote monitoring [4]. Their research may delve into the technical implementation of these features, the design considerations for user interfaces, and the implications for pet owners in terms of convenience and peace of mind. Moreover, it is plausible that their work addresses the challenges inherent in ensuring robust connectivity and data security in the realm of smart pet feeders.

5.3. Result & Outcomes

The field of smart pet feeders has attracted a lot of attention for research purposes, mainly because it has the ability to improve pet health and provide pet owners with ease. Smart pet feeders integrate automation and remote monitoring to simplify feeding schedules and offer information about food preferences and health state of pets. Through the investigation of crucial elements including hardware architecture, sensor technologies, networking functionalities, and user interface, scientists are establishing the foundation for increasingly perceptive and adaptive pet care solutions. These developments enhance pet welfare generally in addition to meeting the changing demands of both pets and their owners.

But even with all of the advancements in the creation of intelligent pet feeders, one important feature that is sometimes forgotten is the avoidance of food waste. There aren't many smart pet feeder ideas out there that take precautions against food waste and spoiling when pets don't eat or drink. The fact that uneaten food left out in uncovered bowls might become contaminated by dust and other environmental elements makes this error quite concerning. Since it directly affects pet health and resource usage, resolving this issue is crucial to the efficacy and sustainability of smart pet feeder systems.

Implementing strategies to stop food from spoiling and wasting should be the top priority in efforts to improve smart pet feeding systems. To guarantee that uneaten food is appropriately managed, this may entail adding features like portion control mechanisms, food freshness indicators, or automatic disposal systems. Researchers may further enhance smart pet feeder technology by addressing this issue, which will make the system more dependable, efficient, and supportive of responsible pet ownership as well as the welfare of pets.

6. Conclusion & Future Enhancement

In conclusion to the introduction of the Fully Automated Smart Pet Feeder system marks a major global leap in the administration of pet care. This creative approach promises to simplify feeding schedules while preserving the best nutrition for pets, as pet owners worldwide struggle to ensure the health and well-being of their cherished animals. Through the integration of an internal intelligent system that functions without reliance on cloud computing or internet access, the system reduces expenses by employing a microcontroller that lacks Wi-Fi capabilities. By ensuring accessibility to a larger segment of pet owners, this economical strategy addresses a prevalent issue in the industry.

Furthermore, the design of this clever pet feeder includes several components meant to enhance the feeding experience for both pets and their owners. The pet food container is simple to open and keeps its freshness and cleanliness thanks to a servo motor-driven lid mechanism. Additionally, a speaker system is built in to provide dogs with auditory signals that encourage prompt and efficient meal ingestion. In addition, a sensor-based system verifies the correct amount of food given to pets and provides alerts to motivate them to complete their meals. Together, these features increase the system's ability to motivate pets to eat healthily, which eventually enhances their overall welfare.

Pet owners may put their minds at ease regarding their pets' feeding routines, even when they are not around, by installing the Fully Automated Smart Pet Feeder system. Without the need for human interaction, the system's autonomous functioning guarantees that dogs receive timely and sufficient nutrition. Additionally, it is more affordable than other smart pet feeder solutions, which appeals to pet owners on a tight budget. The system has the potential to completely transform pet feeding methods globally, providing more ease and peace of mind for pet owners everywhere. This democratization of smart pet care technology is highlighted by this.

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