

**JOMO KENYATTA UNIVERSITY OF AGRICULTURE**

**AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING**

**BSc Electrical and Electronic Engineering**

**PROJECT REPORT**

**PROJECT TITLE:**

**AUTOMATED FOOD DISPENSER FOR PETS**

**Submitted by:**

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*A Final Year Project Proposal submitted to the Department of Electrical and*

*Electronic Engineering in partial fulfillment of the requirements for the award of a*

*Bachelor of Science Degree in Electronics and computer Engineering.*

**NOVEMBER 2021**

**DECLARATION**

This project report is my original work, except where due acknowledgement is made in the text, and to the best of my knowledge has not been previously submitted to Jomo Kenyatta University of Agriculture and Technology or any other institution for the Award of a degree or diploma.

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**TITLE OF PROJECT: AUTOMATED FOOD DISPENSER FOR PETS**

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**ABSTRACT**

Electronics revolutionize the world and simplify life. However, existing pet food dispensers

provide minimal adaptability or user personalization. Despite their popularity, they lack

functionality and have critical design flaws. Some continuously provide food by utilizing

gravity which results in overfeeding and, consequently, premature food depletion. Others

prevent overfeeding by restricting the quantity dispensed with respect to time, but they lack any

animal feedback. This risks waste and lacks adaptability.

The Automated Food Dispenser (AFD) for pets reforms the pet industry and provides

unprecedented food capacity and delivery capability, giving pet owners worry-free

vacationing. Sensors and timers optimize functionality and reduce waste while improving

reliability and usability. User-defined settings and customization gives the device

adaptability to meet every customer’s needs. Furthermore, a database is made whereby the

device will send information pertaining the pet’s food consumption after every month thereby

allowing the user to effectively plan for future needs.

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**LIST OF ACRONYMS AND ABBREVIATIONS**

1. AFD – Automated Food Dispenser
2. APPA - American Pet Products Association
3. AIDC – Automatic Identification and Data Capture
4. CNN – Convolution Neural Network
5. EEPROM – Electrically Erasable Programmable Read Only Memory
6. HTML – Hyper Text Markup Language
7. IoT – Internet of Things
8. KB - Kilobytes
9. LCD – Liquid Crystal Display
10. LED – Light Emitting Diode
11. MHz – Megahertz
12. MCU – Microcontroller Unit
13. RAM – Random Access Memory
14. RFID – Radio Frequency Identification
15. SMS – Short Messaging Service
16. TCP/IP - Transmission Control Protocol/Internet Protocol
17. USART – Universal Synchronous Asynchronous Serial Receiver and Transmitter

**CHAPTER ONE**

1. **INTRODUCTION** 
   1. **Background Information**

“If you want a friend in Washington, get a dog,” advised the former U.S President Harry S. Truman. Pets have been human friends for the longest time possible since ancient times. A pet is an animal that is kept for one’s entertainment or company, and has no functional purpose [1]. From early suggestions in Archeology, humans began rearing dogs as pets around 12,000 years ago. The love for these animals would be seen by the ancient Romans and Greeks who could engrave the animals on tombstones to show that they were grieving their loss. In the British empire, people around the seventeenth to eighteenth century viewed pet keeping as a “rich-man’s” way of life. However, through the years, the keeping of pets has been embraced by everyone. A study by APPA National Pet Owners Survey, 2020-2021, revealed that more than 60% of the households in most developed countries have a pet, which leads to a pet population of more than 140million. It is evidently clear that pets have a huge significance in most families, with some families treating pets as part of the family [2].

The evolution of pets can be grouped into different categories [3], with the initial hypotheses stating that the keeping of pets is an activity that enhances some qualities like health and social well-being of the owner. In this study people who owned pets and had heart attack issues were noted to have a one-year chance of survival. Further, the hypothesis reveals that stress levels were minimal among pet owners and that these people had a higher life span [4]. The second theory defined that caring for pets gave one the ability to have parental skills. According to the study women are attracted to men with pets as proven by Guegen and Ciccotti (2008) who carried out the experiment [5]. The third hypothesis was also much like the second and suggested that people who cared for pets had empathy and parental skills which would make them better care for human infants. Keeping pets is a nurturant behavior that has evolved to cultivate sustained care of human infants [6]. When humans were made lonely they were inclined to think about their pets anthropomorphically [7].

The pet industry has been and is still one of the most essential industries in the market. Pets are kept for various reasons including entertainment, their appearance, intelligence and others due to their personalities. In a pet survey carried out in Ontario, 1994, most people owned pets for the sole purpose of “companionship” then followed by “love and affection” and those families that did not own pets, did so due to “lack of time to effectively care” for the pets. The relationship between humans and pets has increased over the years [8]. Other advantages attached to owning pets include reducing the events that lead to stress and sicknesses related to anxiety, leading to recovery from certain illnesses like stroke and cancer and overall keeping the owners entertained [9]. In addition, pets like dogs provide security hence enhancing safety.

The feeding program is especially a crucial factor in the life of pets as different pets have different feeding programs. In a present study, 79% of dogs and 90% of cats fed on conventional food. Sixty four percent dogs and 46% cats were offered homemade foods which included raw food [10]. Unconventional feeding practices led to nutrient deficiency and associated conditions. This led to the evolution of pet feeders.

**Table 1.1** Daily amounts of food for pets (Dogs and Cats)



Despite the need to ensure a healthy feeding program for pets, most pet owners are quite busy therefore posing a serious problem on how the pet is reared, and becomes a challenge when the owner is a very busy person or needs to take a vacation. The AFD for pets seeks to solve this problem by giving the owner the ability to provide sustainable and efficient way of feeding his/her pet while being able to carry out other important duties and enjoy vacations void of any anxieties.

* 1. **Problem Statement**

Humans have grown fond of pets over the recent years and this has led to an increase in population of pet owners. Pets serve the purpose of entertainment to most people and therefore as a pet owner, one has to efficiently take care of them. However, most of the people lack the proper knowledge on how to keep the pet healthy and especially when it comes to the food given to the respective pets. For instance, giving raw foods to dogs and cats will eventually have detrimental effects on the pet. In addition, most pet owners still do not know how much a pet should feed thereby end up underfeeding or overfeeding the pet, which may lead to death of the animal.

For some owners, time spent feeding the pet becomes an issue as they are very busy. Some of them forget to feed their pets due to the huge loads of work. Sometimes one will need to take vacation and as a result leave the pet unattended to. These hurdles will lead to an irregular feeding pattern to the pet and overall effect to its health. The feeding patterns of an animal could be used to monitor its health thus knowing this information proves vital to the owner.

* 1. **Project Justification**

The AFD for pets is a solution designed to give the owners time to have their vacations and carry out their daily activities without any perturbing concerns. The device will be customizable to allow the user to select the amount of food being delivered to the pet. Additionally, he/she will select the time intervals between the feeding times. Moreover, given that each pet has a different feeding pattern and/or the pets are expected to be growing hence change in the feeding pattern, he/she is capable of monitoring this growth or change and adjust accordingly. In addition to this the device provides animal feedback thereby minimizing wastage of food.

At the end of each month, data containing the feeding program of the pet is sent to a database which will also be stored for future reference. This will allow the owner to plan efficiently for the coming months and analyze the pet’s health through its feeding.

* 1. **OBJECTIVES** 
     1. **MAIN OBJECTIVE**

1. To design a product that automatically releases food to pets based on user settings and sends the corresponding data to a database.
   * 1. **SPECIFIC OBJECTIVES**

1. To design a proximity sensor circuit that detects distance of the pet from the device.
2. To design an automation system for opening and closing of a feeder door.
3. To design a display circuit to allow the user to customize options and view the changes made. The display should have the ability to give the following information:

* Amount of food remaining in the device and
* Time till the next feed

1. To design a feedback circuit that enables the device to hold or release food by detecting presence of food on the feeder plate.
2. To design a database system to store information pertaining the feeding.

**CHAPTER TWO**

1. **LITERATURE REVIEW**

INTRODUCTION

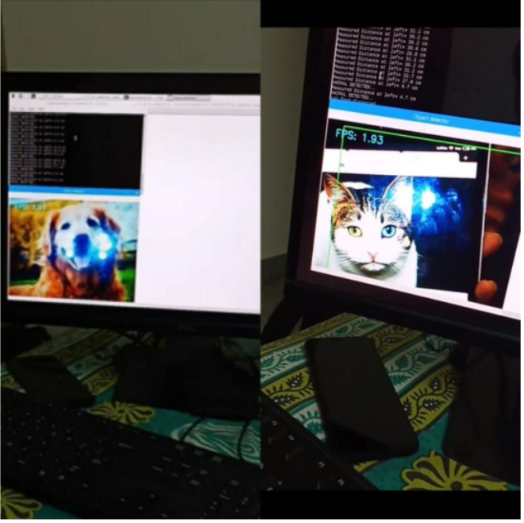
This section provides the literature review of the working principles of the food dispenser for pets and how the different Engineering principles have been incorporated into the designs. There have been quite a number of different aspects and methods used in the development of the Automatic food dispenser with majority of them focusing on dogs and cats, being the majority of pets owned. The various themes have been outlined below:

* 1. **DETECTION**

The method used to detect presence of an animal is a key property of the food dispenser. Different devices use the various methods to detect the presence of the pet and this determines the efficiency of the said device. The different methods have been highlighted:

[11] proposed a design on May 2016, that uses RFID as a means to detect presence of the pet and deliver the food. An RFID is a technology whereby digital data that is encoded in RFID tags is captured by a reader via radio waves. It belongs to a technology called AIDC which automatically identify objects, collect the relevant data about them and save the information directly into a database without the need of human intervention. There are many types of RFID but they are mainly divided into 2 categories: Active or passive [12]. An active tag needs a source of power in order to work while a passive tag requires no power source and needs minimal maintenance. Passive tags only become active only on exposure of some external energy. It is made of three main parts: an Antenna, a semiconductor chip attached to the antenna and a body to protect the whole device. The antenna captures the energy from the reader and communicates data between the reader and the tag. The advantage of an RFID is that it can work even when the object is not in the line of sight, but is in the noticeable range of the module. In this design the author suggests a module that will be used to distinguish between different pets before dispensing the food. Each animal is given a tag. The RFID module here reads at 125KHz frequency having a range of 15cm. The module reads the tag number of the first animal entering the reading range. As long as this animal is in the detectable range the module will not detect any other tag.

*Advantages / Disadvantages* - The advantage of this method is that more than one pet can be fed by the dispenser since each pet has its own tag. It also serves as good method to feed an animal as long as it is hungry since the pet will move towards the device when in need of food. However, the device poses a big limitation of food wastage. If the animal is in range after very small intervals, then there will be release of food after very short intervals, which may lead to wastage of the feed and hence wastage of finances for the pet owner. Another problem is that an animal might finish the meal but still be lying around the detectable area and this would be read as a false alarm hence releasing food when not needed. A proposed solution to this model would be to include a proximity sensor or a digital image processing device which would only dispense the food if the animal is in front of the device.

According to a recent design, [13], the authors suggest a method where the dispenser uses digital image processing to dispense food. Image processing is a method that is commonly used to improve the quality of a raw image. An image is taken as an input and an output provided in the form of an image with extra features. Various algorithms are used to perform the processing on an image. We have 2 types of image processing: Analog and digital [14]. The major processes involved in digital image processing are image processing, image segmentation and feature extraction. In image processing the processor converts the signals from digital to analog or vice versa. In segmentation, the image is isolated into pixels with the goal to achieve precision.

*Fig 2.1 Example of a digital Image Processing. Recognition of pets*

The article uses this concept to detect the presence of the pet before dispensing food. In the project, a pet call that indicates feed time is provided where it uses a recorded voice through a speaker. The device then uses the Ultrasonic sensor to determine if the animal is in front of the system. Once this is confirmed the camera is switched on and it takes the image of the pet. The image is taken so as to confirm that the pet is the required one and that it is the species to be fed. The device can feed 2 different pets therefore has two DC motors that rotate depending on the signal sent from the camera. This also means there will be two food containers and two food bowls. The rotation of the motors is controlled in order to give a specified amount of food. The detection of the pets is done using Convolution Neural Network technique. CNN is a deep learning algorithm that are commonly used in image processing and are fast [15]. In the technique, the network is trained in two stages, a forward and a backward stage. The forward stage mainly represents the input image and its parameters in multiple layers. The first layers find corners, edges and lines while the other layers find objects and shapes. The backward stage will then calculate the gradient of each of the parameters. After repeated iterations of the forward and the backward stages then the learning can be stopped.

As proposed in the design, the authors scrapped 200 images of dogs and cats from Google Images and Pixabay. They then manually labelled the images using a software and used a pre trained model checkpoint before being exported as a single file to be used for reference. The video stream is initialized and the camera is given time to warm up and then the frames per second counter is started. The frame is read form the stream and is resized in terms of width and height. A CNN module then converts the frame to a blob. The blob acts as the input to the neural network which is then complete and the confidence is checked and decided if it is to be drawn.

*Advantages / Disadvantages* - This approach has an advantage that it feeds more than one pet due to the fact that the camera can distinguish between the different pets. Another bonus is that the device will only dispense after noticing the pet to be fed hence will not give food to the wrong one. However, this design faces a problem of complexity. It will take time for the device to learn the pets and even so, it may not fully recognize the pet as is the problem with digital processing. Any symbol that may have a resemblance close to that of the pet may be mistaken to be the pet and hence food will be dispensed illegally. The device does not also provide feedback from the animal after feeding hence may lead to wastage of food. With the fact that it feeds two pets shows that the device is bulky and hence is not as portable.

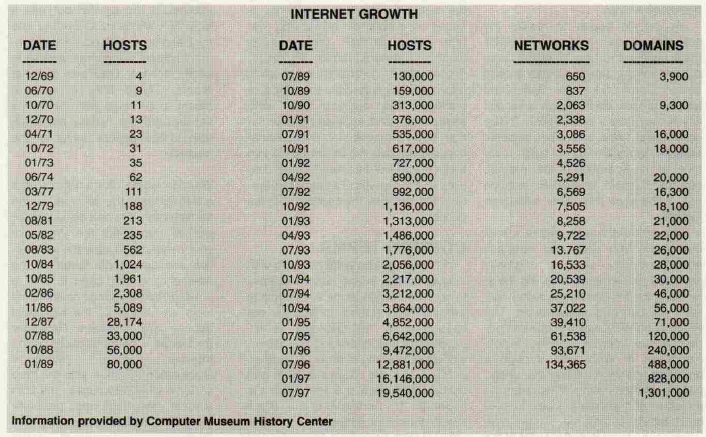
* 1. **WIRELESS COMMUNICATION**

Communication between the user and the device is one of the ways that introduced efficiency. Given the fact that most of the pet owners are busy people, having a means to communicate with the device creates a more reliable system. The AFD may be incorporated to communicate with the pet owner via various means. Below are some of the means highlighted:

[16] focuses on a design that uses GSM module to communicate with the pet owner. GSM is a globally accepted standard that is used for digital cellular communication whereby it provides standards that define the functions and the interface requirements in detail but they do not address the hardware [17]. A GSM module is a customized hardware that is designed for wireless radiation monitoring through SMS. The module receives data serially from radiation monitoring devices and sends this information as text SMS to the host server. The microcontroller processes all incoming SMS, extract and also store configuration from the host server and finally transmits SMS data at every fixed interval according to the configuration set by the host [18].

In this design, the pet owners can feed their pets by just sending a text message, even without their presence near the device. When power is supplied to the system, a message is sent to the owner to signal working of the device. The owner will then send a text message which will trigger the servo motor to open and dispense the food. For water, the device also contains a solenoid valve which is also triggered by an SMS from the owner, which opens to let out water. At the end of food dispensing the machine will then send a text message signaling end of the process. The GSM shield used here enables the device to perform as a basic phone where it will send and receive a message from other phone users.

*Advantages / Disadvantages* – One outstanding quality of this design is that it can serve both food and water to the pet. Working by sending a message also means that the user can control the device even from a distant away hence can be used by users who have quite a busy schedule. The downside with the system is that the user needs to control the device despite the fact that it uses the GSM, i.e., it only works on receiving a text. The system also has no means to take the animal feedback hence can lead to food wastages.

[19] IoT can be defined as a large number of data points brough into a cloud environment in which analysis can be done to influence the outcomes. It uses any physical entity such as sensors and actuators, that are capable of connectivity and directly link to the physical world. It is a technology that enables one to control and monitor devices that are connected to the internet. IoT acts as means of wireless communication between devices, where the related devices may exchange information. The growth of the internet since 1989 to 1997 could be summarized as below:

*Fig 2.2 Internet growth (1989 – 1997)*

[20] A general-purpose web server contains an operating system, a fast processor, some memory and special purpose hardware, running applications and a few web pages. A client may access the server through a LAN router and the Internet, by sending a request which is processed by the router to connect to the internet. The web handles the request and connects to the desired web server from where the required data is sent to the client. When working with digital equipment, analog inputs from a sensor are converted into digital outputs by a controller and stored in memory. These values are stored are then compared with standard values and decisions are made by the circuit hence automation. For controlling the web browser, the user needs access to the web page. The microcontroller will be continuously sending data to the website. Code for the webpage is written in HTML and uploaded via an ethernet module and TCP/IP address.

[21] In this design the author uses the device by controlling it via a web server. An LCD display shows the feeder’s web display which contains the information about the servo position, distance between the food container and the sensor and a link to feed the animals. When the link is clicked, the servo motor opens the food valve when the distance between the food container and the sensor is more than 0.05m. the Ultrasonic sensor measures the food in the container and if it less than 0.05m the servo closes the food valve. If there is no food in the container a buzzer will ring.

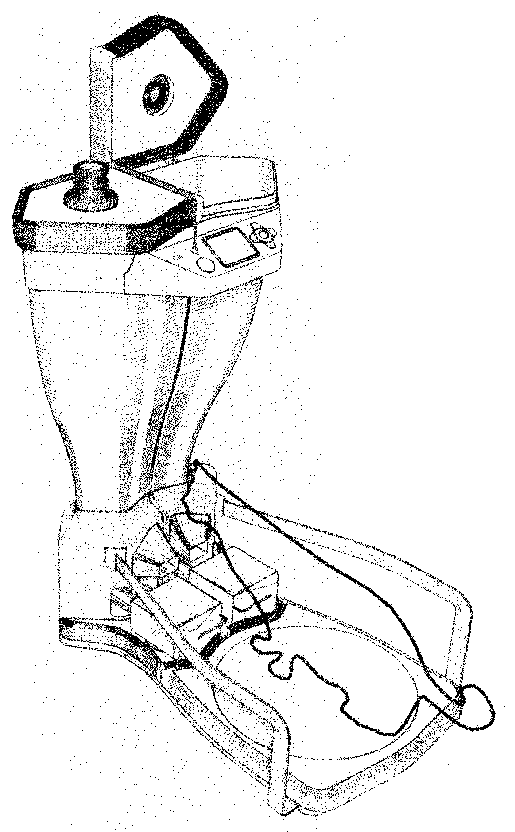
*Advantages / Disadvantages* – The device can be controlled remotely hence removing the need for human interaction. However, the user needs to be connected to the internet in order to control the device.

[22] suggests a method where mobile application is used to control the device. The device uses IoT and an app called Happy Bites whereby the owner sets the time he/she wants the device to dispense food. According to the author, mobile applications are more versatile and flexible for data transfer as compared to web applications. Using mobile apps would be hypothetically managed and this would create a greater opportunity for the mobile app developers to create new applications. In this design, the app will be developed by Android studio software and the database will be handled by Firebase platform, which will store data concerning the admin, the pet owner, feeding schedule and the microcontroller. The device contains an RTC module and Ultrasonic sensor that are connected to a microcontroller that links them to the mobile application-Happy Bites. The user registers and logs in into the app before setting the schedule time for the device. The feeding schedule is stored in Firebase and when the scheduled time reaches, the dispenser is triggered to release food into the food plate. When the food level decreases in the food container a notification is sent to the user via the microcontroller.

*Advantages / Disadvantages* – Due to the fact that mobile phone usage has been increasing over the years, this design serves to meet most of the modern applications. The user can schedule the time from anywhere as long as he/she has the app. It is also easier working with a mobile application as opposed to working with a webpage. However, this device provides no animal feedback and therefore may release food even when the pet is not around. This may lead to wastage.

* 1. **FOOD DISPENSING**

This section highlights various methods by which different food dispensers will deliver the food and how differently the concept of food delivery has been incorporated in each of them.

[23] suggests a device that delivers food using the concept of weight.

*Fig 2.3 Weight controlled pet feeding system*

The device includes an automatic computerized weight and food release mechanism. Information about a specific pet is entered to the device via a pin pad. This includes the pet’s current weight, the desired weight and the general pet information. The feeder then calculates the exact amount of food to be given to the pet. When feeding, the pet will have to step on the weight scale, where its current weight will be updated and the appropriate amount of food will be released. The device is also capable of storing the pet’s data and weight loss/gain progress.

*Advantages / Disadvantages* – The pet’s information especially the weight is constantly measured, hence the health can be monitored. The downside is that a pet is only fed on stepping on the weigh scale.

[24] proposes a device that not only dispenses food but also controls water delivered to the animal. The owner timing and the amount of food to be released. By using a float sensor, the water level in the container can also be monitored and refilled. When the specified time reaches, the servo motor rotates to open the valve that releases food and the pipe to release water. The advantage is that this design performs a complete feeding for each time it feeds the pet. However, it may also lead to water wastage if not properly controlled.

[13] is a design that can feed two different types of pets depending on the digital signal generated. A pet call is made to indicate feed time. When the pet reaches as sensed by the ultrasonic sensor, the camera is switched on and scans the pet to determine what type it is. The design therefore has two DC motors and two food containers which will contain the food for the specific pets. There will also be two food bowls to which the detected pet will feed before the device sends a completion message to the owner of what pet has been fed. The advantage with this design is the ability to cater for the needs of the people with more than one type of pet, as it eliminates the chance of getting two different feeders. However, the design has to be made large as compared to other designs due to the concept of two food containers.

* 1. **SPECIAL DESIGNS**

Majority of pets owned by people include dogs and cats. However, there is a group of people who have other pets which include fish, rabbits, eels or hamsters. Mentioned below is an example that seeks to be a solution to people who own fish as pets, or rear fish in the small scale level like their houses or their rooms.

[25] Argues that feeding management of a device has a possibility of producing a limited feeding and this results to carps that do not reach maximum growth. The author therefore designs a feeder that provides predetermined amounts of food to four fish tanks. Three tanks worked as rearing tanks and the fourth one is a nursing tank. Three points of the nursing tank were selected as feeding spots. Each point is wirelessly controlled an provides the necessary food therefore giving the fish chance to obtain their provisions without competition. A microcontroller controlled the exact feed dosing based on the requirements of the tank dependent on the carp cycle. The parameters monitored include temperature, fish age, body weight and the amount of oxygen consumed.

*Advantages / Disadvantages* – The fish feeder system can be monitored online hence the owner only needs to have a smartphone. However, this design can only work in a small-scale scenario. If a pond is to be used then the user cannot check the environment under the water.

CONCLUSION

From the above given designs, it is noted that some of the pet feeders have critical design flaws and more so do not provide feedback from the feeding pattern of the animal.

**CHAPTER THREE**

1. **METHODOLOGY**

This section provides a brief explanation of the components, methods and the approach that was used in the successful design of the Automatic Food Dispenser.

* 1. **Components and their specifications**

|  |  |  |
| --- | --- | --- |
| **HARDWARE** | **QUANTITY** | **DESCRIPTION** |
| Laptop | - | To be used to view data from the database |
| ESP 8266-01 | 1 | To send data to the database |
| LCD/I2C module | 1 | Display pertinent information |
| Servo motor SG90 | 1 | Open/close the feeder door |
| ATMega328P | 1 | Main microcontroller |
| Load Cell / HX711 | 2 | Sense the weight of food on feeder plate |
| RTC DS3231 | 1 | Act as the system clock |
| MB102 Power Supply | 1 | Module to provide power to the circuit |
| Push Buttons | 3 | To be used to select option on the LCD |
| **SOFTWARE** |  | **DESCRIPTION** |
| Arduino IDE | - | Environment to code the ATMega328P instructions |
| Notepad++ | - | Platform to code the database |
| XAMPP | - | Platform to act as the web server |

**Table 3.1** Components

Hardware modules

1. **ATMega328P**

This project uses the Arduino UNO micro controller which has the following features and specifications:

* 28 pins
* 8-bit microcontroller
* Operating voltage – 1.8 to 5.5V
* Operating current – 1.5mA (active mode), 1µA (power-down)
* Operating temperature - -40 to 85°C
* Operating frequency – 16MHz
* 32KB flash program memory
* static RAM - 2KB
* EEPROM - 1KB
* 1 I2C module
* 1 USART

The ATMega328P was used since it has the desired number of pins and is relatively cheaper as compared to the Raspberry Pi microcontroller.

1. **RTC DS3231**

The Real Time clock is a low cost and very accurate I2C module that has an integrated temperature compensated crystal oscillator. The RTC maintains hours, minutes, seconds, date, day, month, and year information. Among the features of this module are:

* Operating voltage - 5V
* Operating current - 300µA (active mode), 170µA (stand-by)
* Operating temperature – -40 to +85°C
* 12hr/24hr mode clock operation
* 32KHz crystal for time keeping
* Battery backup
* I2C EEPROM with address - 0x68

This module since it maintains accurate time keeping even when the main power supply is interrupted

1. **ESP 8266-01**

The ESP 8266-01 is a Wi-Fi module integrates low power 32-bit MCU micro that supports complete TCP/IP protocol stack. Some of its features include:

* Wi-Fi 2.4 GHz, support WPA/WPA2
* Integrated TCP/IP protocol stack
* Integrated 10-bit ADC
* Wi-Fi 2.4 GHz, support WPA/WPA2
* Operating voltage – 3.3 to 3.6V
* Operating current – 80mA
* Operating temperature range -40C ~ 125C
* Wi-Fi mode – station/ Access Point / station + Access Point

1. **LCD/I2C module**

The 16x2 LCD is a display unit that uses liquid crystals to produce a desired visual image. On the other hand, the I2C interface for the LCD is a high-quality module with contrast adjustment, backlight and I2C communication interface that enables reduction of I/O pins used on the Arduino. The following are the features:

* Operating voltage – 5V
* Operating current – 1.1mA
* I2C default address - (0x27)
* Display format - 16 by 2
* Operating temperature – 30 to +60°C

1. **HX711**

This is a 24-bit Analog-to-digital converter that is specifically made for weighing scales. It boasts the following features:

* Operating voltage – 5V
* Operating current - 1.5mA (active mode), 1µA (power down)
* On-chip power supply/regulator for the load cell
* Operating temperature - 40 to +85°C

1. **SG90 9g Servo Motor**

This is the device that is used to control the feeder door. The following are its working specifications:

* 180° rotation
* Operating voltage – 5V
* Operating current - 250mA (movement), 10mA (idle)
* Torque – 1.8Kg-cm
* Speed – 0.1sec/60°

1. **MB102 Power Supply**

The MB102 is a power supply module that supplies voltage and current to the circuit. Its specifications are as follows:

* Output voltage - 3.3V min and 5V max
* Input voltage – 6.5-12V
* Max output current – 700mA
  1. **Input and output devices**

The pet owner will be able to see the following inputs and outputs on the device.

**Inputs:**

* 3 push buttons

1. Left button used to display feeding time 1 when clicked and used to set the respective feeding time when long pressed. It also acts as a decrement button when setting time, date or amount of food to be fed
2. Right button used to display feeding time 2 when clicked and used to set the respective feeding time when long pressed. It also acts as an increment button when setting time, date or amount of food to be fed
3. Control button used to display amount of food remaining when clicked and used to set the time and maximum amount of food when long

* 2 weight sensors

1. Pet sensor is used to measure the weight of the pet to enable the device release the respective amount of food based on its weight
2. Feeder plate sensor used to measure the amount of food in the plate. Also used as feedback: The device will only release food if the feeder plate is empty

**Outputs:**

* LCD to display options for user to select and pertinent information. The information to be displayed by the LCD includes:

1. Current time, day, date and year
2. Time to the next feed
3. Enabled/disabled feed time indicator
4. Current temperature
5. Feeding times
6. Amount of food remaining in the device container

* LED to signal working of the device.

1. Green LED to signal normal operation/ power ON of the device
2. Red LED flashes to indicate feeding time

* Buzzer to give audible indication of the feeding time
  1. **Flowchart**

LCD flowchart

The LCD is the primary display of the device as it enables the pet owner interact with the device. This is a flowchart to demonstrate the LCD display during operation of the device

Start

Initialize LCD- Welcome screen

delay

Display current time and Time to next feed

Key Press

Key Hold

Ctrl Key

Rt Key

Lt Key

delay

Ctrl Key

Rt Key

Lt Key

Show date and feed amount

Show feed time1

Show feed time2

Set clock

Set feed time2

Set feed time1

delay

delay

*LCD flowchart*

Set max feed amount

Device flowchart

Start

Initialize LCD and calibrate weight sensors

Display current time and Time to next feed

No

Is feeding time?

Yes

Buzzer; flash LED

No

Is pet detected?

Yes

No buzzer; LED flash off

delay

Is feed plate empty?

No

Yes

Pet weight measured

Open feeder door

No

Is feed weight=X?

*Food dispensing flowchart*

Close feeder door

Yes

* 1. **Block diagram**

**Inputs Outputs Server Controller**

Database

Web server

User Phone/Laptop

User Input

Buttons

WIFI module

ESP 8266

Microcontroller

ATMega328P

Ultrasonic Sensor

HC-SR04

LCD

Strain Gauge

Servo Motor

SG90

Load Cell Amplifier

HX711

*Fig 3.2 Block diagram of entire system*

**CHAPTER FOUR**

1. **RESULTS**

At the end of the design process the device is expected to:

1. Detect the presence of the pet by sensing its proximity
2. Automatically open/close a feeder door based on the input from the proximity sensor
3. Display the user settings and the device information such as time to the next feed and amount food remaining in the food container on an LCD screen
4. Measure the weight of food on the feeder plate and decide whether or not to deliver the next feed
5. Send information concerning the feeding plan to a database to be accessed by the pet owner.

**CHAPTER FIVE**

**BUDGET**

**Table 5.1** Budget plan

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | Description | Quantity | Rate | Amount |
| 1 | Wi-Fi Module ESP8266-01 | 1 | 2000 | 2000 |
| 2 | LCD screen | 1 | 1000 | 1000 |
| 3 | Servo Motor SG90 | 1 | 1100 | 1100 |
| 4 | Ultrasonic Sensor HC-SR04 | 1 | 1200 | 1200 |
| 5 | Load Cell/Load Cell Amplifier HX711 | 1 | 900 | 900 |
| 6 | Arduino UNO | 1 | 4500 | 4500 |
| 7 | RTC DS3231 | 1 | 1500 | 1500 |
| 8 | Push Button | 4 | 100 | 400 |
| 9 | LED | 2 | 50 | 100 |
| TOTAL | | | | **12700** |

**CHAPTER SIX**

**TIME-PLAN**

**Table 5.2** Time plan

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **ACTIVITIES** | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| **Documentation** |  |  |  |  |  |  |  |
| **Proposal Writing** |  |  |  |  |  |  |  |
| **Literature Review** |  |  |  |  |  |  |  |
| **Proposal Presentation** |  |  |  |  |  |  |  |
| **Design and Coding** |  |  |  |  |  |  |  |
| **Hardware configuration, testing and adjustment** |  |  |  |  |  |  |  |
| **Final report writing** |  |  |  |  |  |  |  |
| **Final presentation** |  |  |  |  |  |  |  |

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