

Monitoring Scheduling and Feeding of Dogs Based on IoT (Internet of Things)

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Abstract— The main problem with dogs is their diet. This is because many people are busy but still want a dog because they are a low maintenance animal. However, the reality is not so simple. In fact, many dog owners are too busy outdoors to feed their dogs when they're hungry. This research suggests the development of automated dog feeding technology to address this issue. In this study, dog feeders were controlled remotely via a website. This paper develops an automated dog feeding tool and website to facilitate dog feeding during peak hours. The microcontroller used is based on the ESP-8266 and is linked to the website. Both services allow dog owners to remotely adjust meal schedules, history, streaming, food portions and food offerings. Based on the findings and analysis of this study, it can be concluded that the developed application and IoT will provide information on pet feeding schedule and pet weight control. The amount of food coming out and information on the remaining food supply. In the QoS test conducted according to the ITU-T G.1010 standard, the minimum average delay occurs at night, which is 70.13 seconds, and the maximum delay occurs in the morning, which is 98.55 seconds. .1010, the results achieved were classified as good. The throughput test results show that the average throughput in the morning is the smallest, at 2467bps, and the average throughput in the evening is the largest, at 2733.4bps. Based on the results obtained according to the ITU-T G.1010 standard, the total data transfer volume per unit time from the device to the database was rated as very good with an index of 4. The packet loss results of the first night test and the first night test were 0.24% and 0.25% respectively.

Keywords — feeding, scheduling, arduino, website, develop, iot

I. INTRODUCTION

Dogs can serve as human companions. For those looking for friends or entertainment, this could be a unique solution. However, these dogs need to be cared for, have their basic needs met, and be given a proper home. The dogs in their care are usually loyal, beautiful and entertaining. This is also regulated by Act No. 18 of 2009, which states that, pursuant to Article 66 on Animal Husbandry and Animal Health, the keeping, safety, care and protection of animals shall be as good as possible so that they are kept healthy, free. Hunger and thirst, disease and abuse, anxiety and depression [1].

Feeding a dog is the most basic fulfillment of dog rights. This is often taken for granted and not given much thought. However, feeding a dog can often be a problem, especially when going out for business or running a business. Owners often forget to feed their dogs, as is the case with dogs. Because dogs are considered to be easy dogs to keep and care for. In fact, care must be taken when feeding dogs and dogs, because these animals are classified as ordinary animals.

Dogs and dogs are usually fed two to three times a day in amounts appropriate for their age, weight and activity level. According to the New York Veterinary Medical Center, adult dogs expend approximately 2 percent of their body weight[2]. Adult dogs now eat about 10 percent of their body weight, according to Dr. Elvina Ruth. For example, overfeeding or overfeeding can lead to obesity. Overweight dogs are more likely than normal weight dogs to develop osteoarthritis and diabetes [3]. This has the potential to worsen the dog's condition.

Hand feeding is often manpower-intensive, and pet owners must manually feed the right amount and keep an eye on their food reserves when hungry. Hand feeding is inefficient because it can lead to overfeeding or underfeeding, both of which are harmful to the dog. Most dog owners also ignore or ignore the amount of food in the food storage bins, causing many dogs to starve when food supplies are low.

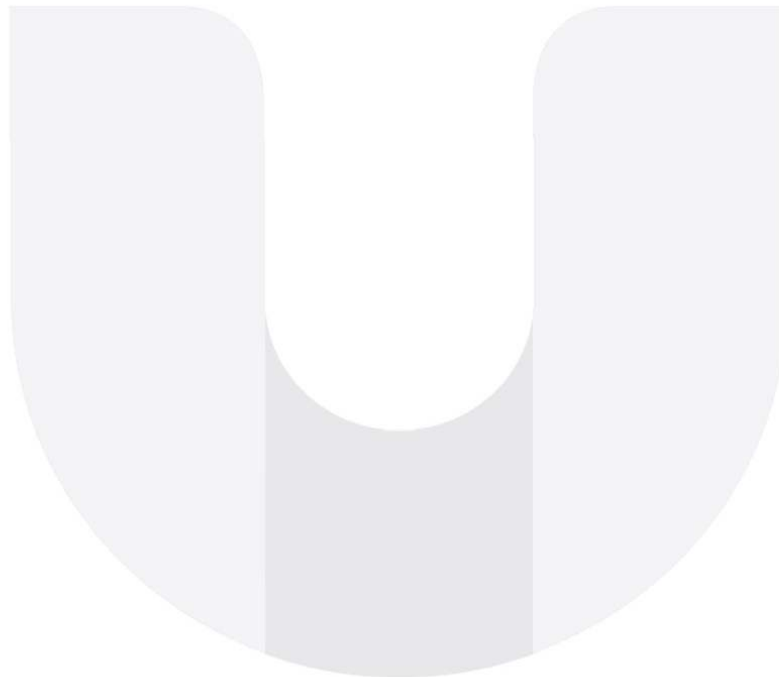
A dog feeder is a pet feeding device that automatically creates a feeding schedule and regulates pet feeding without human intervention. Additionally, the instrument can track food supplies. The purpose of this tool is to free dog owners from worrying about the mechanics of their dog's diet while they are on the go. There are many dog feeders available for various pet feeding devices.

Therefore, as part of this research, dog feeding tools and websites were developed to overcome these problems. The technology should enable dog owners to adjust the amount of food based on the animal's weight and monitor the current food supply. Dog owners can control the dog's feeding on the website, and can configure the feeding time function according to the required time. Therefore, this tool can make feeding dogs easier, and owners don't have to worry about their dogs starving even when they are away from home for a long time.

II. BASIC CONCEPT

A. Internet of Things

Digital innovation expert Kevin Ashton coined the term "Internet of Things" in 1999 as the title of a corporate presentation he gave at his employer, Proctor & Gamble [4]. Kevin Ashton proposed the idea of building a radio frequency identification (RFID) sensor network to address these new challenges [4]. The Internet of Things (IoT) is a current communication paradigm envisioning a near future in which everyday objects will be equipped with microcontrollers, transceivers for digital communication [5]. IoT can also be



explained as connecting everyday things to the internet. With IoT, objects can be controlled using mobile computer platforms.

B. Arduino IDE

The Arduino Integrated Development Software (IDE) is a piece of software that allows you to create sketches for microcontroller devices. The Arduino IDE is classified as an integrated program development software because it provides a menu-based interface for various displays. Arduino demonstrates the mistake and accuracy of directly writing computer code [8].

C. Website

Website has two properties there is a dynamic and static website. Static websites are usually used in hospitals, hotels, and other company profiles where only the website owner can update the website. This website requires a code reset to update the page. Meanwhile, a dynamic website has the means to add, edit and delete displayed media. This website does not require a code reset to change the page. Search engines, networking, and social media, e-commerce usually use dynamic websites because it needs to update flexibly.

D. Hypertext Preprocessor

Hypertext Preprocessor (PHP) is a popular general purpose programming language that is well suited to web development and can be integrated in HTML[10]. On June 8, 1995, programmer Rasmus Lerdorf released "Personal Home Page Tools (PHP Tools) version 1.0" as a suite of scripts for maintaining his website[10]. These were expanded in version 2 in 1997, and in version 3 the following year, the name was altered to a recursive acronym "PHP: Hypertext Preprocessor"[10].

E. MySQL

My Structured Query Language (MySQL) is the most widely used database program in the planet. It is known as DataBase Management Software (DBMS) or Relational DataBase Management Software and is used to manage stored data (RDBMS). Michael Wildenius and David Axmark co-founded MySQL in 1995. The MySQL Community Server version is freely accessible software that is utilized on some of the most popular websites[10].

F. Laravel Framework

Laravel is a free, open-source PHP web framework, created by Taylor Otwell and intended for the development of web applications following the model view controller (MVC) architectural pattern. Some of the features of Laravel are a modular packaging system with a dedicated dependency manager. The laravel framework is easy to understand and powerful, the framework itself provides authentication, routing, session manager, caching, IoC container and tons of most commonly used component, also amazing database migration tools and integrated unit testing support, all these tools give developers the ability to build complex applications[11].

G. Hypertext Markup Language

The language used to produce web page documents is called HyperText Markup Language (HTML). HTML is a markup language, which means it is a method for identifying and defining the various components of a document, such as headers, paragraphs, and lists. It is not a programming

language. The markup identifies the underlying structure of the document[12].

H. Dog Feeder

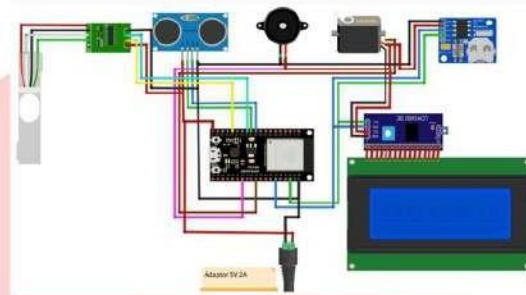


Figure 1 Dog Feeder

Dog feeders are dog cutlery that shaped a bowl. The development of dog feeders is getting sophisticated. Based on the type of dog feeder divided by two, manual dog feeder and automatic dog feeder. Manual dog feeder means using human resources directly. Some manual dog feeders use a button for the feed from food storage by press the button, and some poured from origin place such us plastic or jars use measuring spoon. In comparison, an automatic dog feeder is dog cutlery that does not use human resources directly. Besides feeding the food automatically, an automatic dog feeder can set the time, and food portions also control remaining food supplies in storage.



Figure 2 ESP8266

ESP8266 is used to communicate data from an Arduino to an IoT platform, where the user may access it. Wi-Fi module with TCP/IP protocol integration and self-contained SOC. Because it has its own program code, ESP8266 can easily supply wifi when connected to an Arduino board. It acts as a link between a wi-fi network and an existing microcontroller[16].



Figure 3 Loadcell

A load cell is a transducer that senses force and produces an electrical signal as a result. It has strain gauges in a Wheatstone bridge design to detect resistance values[18].



Figure 4 HX711 Module

The HX711 module, usually called the Load Cell module, operates as a weight detector on the weight sensor (Load Cell) in terms of weight measurement. The HX711 component of the Load Cell Module type functions as an output signal amplifier from the Load Cell and HX711 Module, which converts analog data into digital data or more commonly known as analogue-digital Converter (ADC) connecting the Load Cell Pin module to the Arduino MEGA 2560, which functions as a microprocessor[18]. In theory, the load cell sensor senses the mass load and then converts the analog voltage from the load cell sensor into digital data via the HX711 Module. The HX711 module is shown in Figure 4.



Figure 5 Ultrasonic Sensor

An ultrasonic sensor is a device used to determine the distance between two objects. The distance measured is about 2-450 cm. This gadget communicates the read distance via two digital pins. This ultrasonic sensor operates by transmitting reflected sound waves which can be used to determine the presence or distance of an item with a certain frequency and to calculate the time in microseconds taken. It is called an ultrasonic sensor because it detects the distance of an object using ultrasonic waves (ultrasonic sound)[19].



Figure 6 Realtime Clock

The Real Time Clock sensor is a device that provides real-time information and is used to keep track of the current time. The RTC device displays the date, time, and year, as well as the month, which is automatically adjusted[20].



Figure 7 Liquid Crystal Display

A Liquid Crystal Display (LCD) is an electrical type display board that displays characters, writing, letters, and numbers. LCD function on the idea of capturing and reflecting light from the front-lit or transmitting light from the backlit[21].



Figure 8 Servo Motor

A servo motor is one that is controlled and regulated by pulses. There are three positions on the servo motor 0 degrees, 90 degrees, and 180 degrees. The servo motor shaft must be connected to a mechanism so that its movement can be adjusted[21].



Figure 9 ESP-32CAM

The ESP 32 low-noise receiver, filter, and power management module is built and developed by Espressif Systems. The ESP32-CAM microcontroller equipped with camera OV2640 is used to retrieve data from the sensor, take pictures as visual documentation of human presence after the PIR sensor captures human movement, and sends data using the MQTT protocol that is connected to the internet. The ESP32-CAM is connected with Wi-Fi for internet Connection[23].



Figure 10 Buzzer

Buzzer is an electrical component. It converts electrical waves into vocal vibrations. Buzzer are made up of coils connected to a diaphragm that are then fed electricity to turn them into electromagnets. Each movement of the coil causes the diaphragm to move back and forth, causing the air to vibrate and produce sound[19].

III. SYSTEM DESIGN

A. General Description of the System

Dog feeders are expected to make it easier for animal owners to feed animals and can reduce mortality caused by obesity or lack of food. This dog feeder is designed to be controlled remotely using a website platform. The website is used to control feeding on the dog feeder but you must log in first, after logging in you will be directed to the menu available on the dog feeder which presents three features that can monitor.

B. Work Flow of the System



Figure 11 Work Flow of the System

In this study, ESP-8266 sends and receives data to the website. Send and receive data to website (laravel) using api (with token) and website (laravel) send and receive data into mysql database.

C. Data Structure and Website Database System

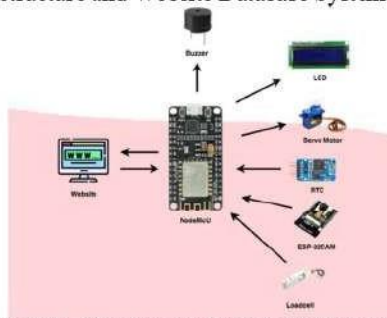


Figure 12 Data Structure on the website Database System

It can be explained that the buzzer receives data from ESP8266 (in the form of sound), while the LCD sensor receives data from ESP8266 and displays the data in written form. The servo motor receives data from the ESP8266 and displays the data in the form of rotation. The RTC sensor sends time data to the ESP8266. The loadcell sends feed weight data to the ESP8266. ESP32-CAM sends data in video form. ESP-01 sends and receives data to ESP8266 for inclusion in the website.

D. Website Flowchart

In Figure 13 what is needed in using the website is browsing. The website will instantly expose the user to a menu of features available on the dog feeder.

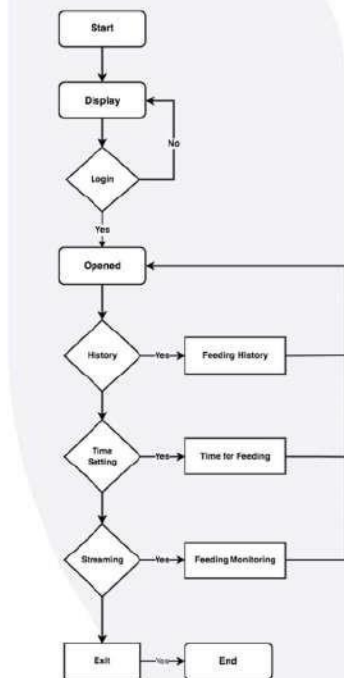


Figure 13 Flowchart Website

First pressing history, the display shows the history of feeding the dog over time. Second pressing the time setting, the display will display the meal time setting, which can be set through the website. The last menu you press stream, the display visually shows the condition of the dog feeder when feeding the dogs. The website can only be used on a laptop. The website exactly shows what the dog feeder menu looks like. After completing all data collection, the website will store the prepared data. Then the application can be closed.

E. ESP8266 Flowchart

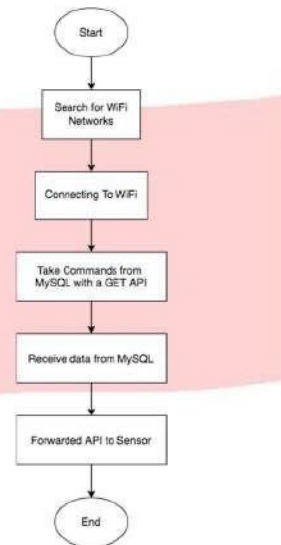


Figure 14 ESP8266 Flowchart

In Figure 14, it can be explained that ESP8266 looks for wifi connectivity to connect, after ESP8266 is connected to the wifi network then ESP8266 sends data from the sensor to mysql using the API, then the website takes fire from mysql.

F. Functionality Testing

This section will explain functionality testing, where this test is carried out to test every feature on the system, namely login, register, history page, time setting page, and streaming page, running well with the IoT tool system that has been designed.

G. Hardware Testing

In this section, hardware testing will be described, hardware testing is carried out to determine whether the function of the device that has been designed is functioning properly.

H. Quality of Service

Quality of Service (QoS) is a measure of how good a network is, it attempts to identify the characteristics and types of services, and it attempts to define the characteristics of services. QoS is used to measure a specific set of performance attributes associated with a service. In Internet Protocol (IP), IP QoS refers to the performance of IP packets on one or more networks. QoS is designed to help end users increase productivity by ensuring they get reliable performance from network-based applications [25].

I. Throughput

This measure counts the number of successful information transfers from the ESP8266 to the MySQL database in the desired processing time. The analysis will be performed using Wireshark. Throughput is visualized with a line graph, where the input data will be stored in Microsoft Excel. The measurement scenario is divided into nine sessions, where one session equals one hour of observation time.

J. Packet Loss

In this section, packet loss is packet loss in a network. This packet loss test is performed when transferring data from

the Website to the ESP8266 and from the ESP8266 to the Website.

K. Delay





As with throughput, this performance parameter is analyzed using Wireshark. The measurement also uses the same scheme, where the calculation is divided into nine sessions. Calculation of this parameter aims to get the time needed for the system to cover the distance between the ESP8266 and the MySQL database via a localhost connection.

IV. RESULT AND ANALYSIS

A. Implementation Website Interface

The interface is a view that has been applied from the design that has been made. The results of the implementation of the website interface that have been created are described in table 1 below:

Table 1 Implementation Website Interface

No	Figure	Features	Description
1.		Login Website	Login function to enter the website using email and password
2.		History Page	Dog feeder history page to see how much feed is spent each day.
3.		Time Setting Page	Time setting page to set the meal schedule in the application
4.		Streaming Page	Owner's streaming page to monitor feed and to monitor the dog when it eats.

B. Testing Hardware

Tests are carried out to determine the function of the devices used are working properly, such as ESP-8266, LiquidCrystal_I2C Sensor, RTC_DS1307, ESP-32CAM and Servo Motor.



Figure 15 Hardware Design

Furthermore, hardware testing is carried out whether it is successful or not. The following is table 3 of the hardware test results:

Table 2 Testing Hardware

Hardware	Indicator	Scenario	Status
ESP8266	The light on the indicator lights up and can connect to the internet network via wifi	Connect the sensor pin with esp8266 and connect the sensor to the internet network via wifi	Success
Sensor LiquidCrystal_I2C	Lcd can be lit and display writing	Connecting the lcd sensor pins to the Arduino atmega and configuring the posts to be displayed on the lcd	Success
RTC_DS1307	The light on the sensor indicator lights up and can detect the pre-configured clock	Connect real time clock sensor pins to Arduino atmega and configure date and time	Success
ESP-32CAM	The ESP-32 CAM records	The ESP-32 CAM records what will be streamed on the website	Success
Motor Servo	Servo to open a food place	Servo motor rotates to an angle of	Success

		50° and Back to 0°	
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C. The Quality of Service Test

This test is carried out to determine the quality of the network when sending and receiving data into a system. The parameters tested are Throughput and Delay.



Figure 16 ESP8266 and website application throughput test graphs

Figure 4.2 above is the result of the throughput test that has been carried out, for the smallest average throughput in the morning of 2467 bps while the largest in the afternoon is 2733.4 bps. In accordance with the ITU-T G.1010 standard with the results obtained, that the throughput averaged 20 kilobits per second during the test period.



Figure 17 ESP8266 and website application delay test graphs.

Figure 4.3 above is the result of testing the delay from the device to the database, the smallest average delay that occurs at night is 70.13 s, while the largest delay occurs in the morning, which is 98.55 s. Based on the ITU-T G.1010 standard, the average one-way delay on this network is 81 ms.

Table 3 Packet Loss

Time	Packet Loss (%)
Morning 1	0
Morning 2	0
Morning 3	0
Morning 4	0
Morning 5	0
Evening 1	0.24
Evening 2	0
Evening 3	0
Evening 4	0
Evening 5	0
Night 1	0.25
Night 2	0
Night 3	0
Night 4	0
Night 5	0

In this section, in this section shows the results of packet loss. This test was carried out 3 times with 5 trials for each test, and the testing times were in the morning, evening, and night. There are two times that packet loss causes the quality

of the internet. To view packet loss by typing tcp. analysis. Ack lost segment, apply a display filter and the code to show packet loss that did not arrive.

V. CONCLUSION AND SUGGESTION

Based on the results and analysis that have been carried out in this study, it can be concluded that the application and IoT that have been designed will provide information about pet feeding schedules and weight control in pets, which will be classified as pets. The amount of food that will come out and information on the rest of the food storage. In QoS testing according to the ITU-T G.1010 standard, the average for the smallest delay that occurs in the evening is 70.13 s, while the largest delay occurs in the morning, which is 98.55 s. Based on the standardization of ITU-T G.1010, the results obtained are classified as good. the result of the throughput test that has been carried out, for the smallest average throughput in the morning of 2467 bps while the largest in the evening of 2733.4 bps. In accordance with the ITU-T G.1010 standard with the results obtained, the total data transfer per unit time from the device to the database is classified as very good category with an index of 4. The packet loss result is in the first evening test and first night test, and the result is 0.24% and 0.25%.

The drawback of the system in this study that can be used as research material in the future is monitoring and controlling pet feed supplies only using the website platform and pet feeders still using local hosts and websites.

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