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Smart Pet Monitoring and Feeder using IOT

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Abstract: *The Internet of Things (IOT) expands the network of objects that routinely exchange data as the world becomes more connected. IOT expands the capabilities of the internet to include everyday household items like light bulbs, locks, smart microwaves, and other technologies in addition to smart phones and computers. Consumers that appreciate having all of their electronics connected for the sake of greater convenience, comfort, energy efficiency, and most significantly, personalization , which is one of the project's focus areas, are growing more and more interested in smart home gadgets and devices. This helps in solving the starvation of small pets such as dogs and cats in absence of their owners. Through this proposed design, the user can adjust the feed time, the time between consecutive feeds, and the amount of feed served. The user can modify the feed time, the gap between successive feeds, and the quantity of feed served using this proposed design. This paper develops the automation of pet feeders using the Internet of Things (IOT). Over 55% of dogs and cats are overweight, which poses serious health risks like heart and lung issues, kidney illness, and diabetes. This problem will be resolved by the proposed device, which helps with weight management by giving pets the portioned meals they need. The project's main elements include an Arduino Uno for the smart automatic pet feeder, an RTC module for timing and managing feeding schedules, a distance sensor for checking food levels, and a servo motor SG90 with a wide-angle servo (0°-180°) for controlling the flow of the food dispersed.*

Keywords: IOT, Pet feeder, Data, Arduino Uno

I. INTRODUCTION

One of the best things is having a pet at home. But one ofthe biggest issues with maintaining a pet is consistent feeding. Each pet's diet and feeding habits need to be carefully examined in order to raise a healthy pet. Pets' health is directly impacted when food is not given to them on schedule. As a result, the proposed machine will provide a solution to the problems like malnutrition and obesity. The major benefit of this clever automatic pet feeder is the ease as you simply need to refill it every few days. This saves youtime and energy because they operate on timers that can dispense food to pets numerous times each day to meet their nutritional needs. As a result of electronic automation and IOT, the machine's IOT-based design allows for a much more individualized user experience. In order to decrease therisk of disease, it can be used to monitor the amount of food supplied to the pet at each meal. The ideal pet owner is one who is constantly on the road and has inconsistent schedules since an automatic pet feeder can feed the pet according to the personalized schedule and helps make it easier to keep a regular feeding plan. Parallelly, is also useful for elderly dog owners who have difficulty bending over to fill their pet's feeding bowls on a daily basis. These devices assist the dog in reducing the physical and emotional stress that traditional approaches may worsen. The proposed design is easy to clean and maintain compared to other machines withmore complex designs, where cleaning can be challenging and the unit may need to be disassembled to properly clean moving parts. The pet care market and industry are growing yearly,hence newtechnologicallybased solutions are required.

II. RELATED WORK

One of the main issues with IOT automated systems is the integration of heterogeneous data from various sensors and their ability to execute joint jobs. Interoperability appears to be the primary objective in these systems by providing [1] a common method of accessing and concealing the heterogeneity of various home devices. Every pet owner has a unique lifestyle; [12][2] using this machine will be different from the traditional method of owners feeding their dogs by hand since it will provide more accurate feeding at the times we specify, as well as the abilityto manage it from a distance,

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something the traditional method cannot provide. In [3] the smart pet door is made witha detecting tag on the collar that enables the pet owner to keepan eye on their pet's movements. To remotely operate the car, anautomated system is created employing an Internet protocol (IP)camera and a microcontroller. [15][8] A MQTT (MQ TelemetryTransport) server, the microcomputer receives MQTT messages from mobile devices. Through its specified pin layout, the microprocessor transmits the GPIO (General Purpose Input /Output) signals to the motor hardware. The microcomputer will simultaneously receive video streaming from the IP (Internet protocol) camera. The screen of the mobile phone can receive this streaming. This design makes use of a brand-new embedded development board and a brand-new Wi-Fi development board. The CC3200 uses the compilation function of the Yocto Project Linux kernel. [7], which can undertake routine and quantitative feedingroutines, as well as automate pet feeding and watering. The feeder has a more precise control over the food and water delivery thanks to Internet of Things (IoT) technology. Real-time monitoring of the pet's behaviour can be done with a remote camera, and the feeding situation can be observed with a phone[14]. This pet feeder design [10][13] has elements that make pet care more convenient for both the owner and the pet. In order to help solve the overfeeding issue, this system also provides information about the pet's feeding, including whether it is eating or not and how much is being consumed. This approach also aids in reducing feed waste because it supplies the leftover feed last. A interactive remote control is provided [9], this design also eliminates the traditional manual adjustment of pet feeders

Additionally, this design does away with the standard manual adjustment of pet feeders. The priority feeding of pets could be adjusted to use a camera rather than sensors as an example of an innovation. On demand, this device may also send a brief video clip [5] [6] of the pet eating to the owner via multimedia message. IoT can be used to diagnose health problems such as body feeding, remote monitoring, and temperature analyses [4]. used sensors built into Radio Frequency Identification (RFID) tags that can be tracked using GPS to address the issue of animal identification at great distances. a smartphone app, a Raspberry Pi camera, and an automatic [11] pooping pad.Three tiers of the automatic feeder receive equal distributions of food. The serving size is decided by a weight sensor, and Arduino controls the feeding mechanism. The Raspberry Pi webcam is used to keep an eye on both the automatic feeder and the poop pad. Both a client and a server are performed by the Raspberry Pi.

III. PROPOSED WORK

3.1 System Design

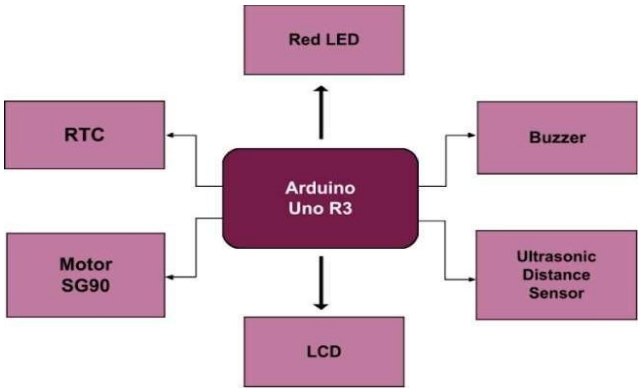

Fig. 1.Block Representation of IOT pet feeder.

Arduino Uno R3: It is employed to regulate the Pet Feeder's operations for a variety of purposes. The proposed IoT pet feeder's block diagram is shown in Figure 1. For starting user-friendly communications and producing single-board microcontrollers for controlling digital devices, Arduino's open-source hardware and software are employed. The most recent model of the Arduino Uno is the Uno R3. The reference versions of Arduino are the Arduino board and Integrated development environment (IDE) software, both of which are upgradable. The Uno-board, the first in a line of USB- Arduino boards, is the default design for the Arduino platform.

In the creation of Arduino boards, a variety of microprocessors and microcontrollers can be utilised. The boards with digital and analogue I/O pins that can be connected to breadboards or shields (for prototyping) and other circuits are taken into consideration. The boards can alsobe programmed using serial communications connections, including USB

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on some variants. The computer languages C and C++ as well as the common Application programming interface (API) known as "Arduino language" can be used to create programmes for microcontrollers. Along with conventional compiler tool chains, the Arduino project alsooffers an IDE and a command-line interface (Arduino-cli) built in Go.
Red LED: An average 5mm has a 2V forward voltagedrop and a forward current of 20mA. When a LED is connected to the Arduino, a current-limiting resistor must be used.
Piezo Buzzer: This device replaces the electromagnet found in most speakers. To produce sound waves, one uses the piezoelectric effect. Applying a square wave could be used to create sound at the desired frequency.
Real-Time Clock(RTC): An RTC is a time- measuring electrical device (often in the form of an integrated circuit). The Real Time Clock module's internal battery makes sure that even when the systemis turned off, the computer keeps the right date and time. Once this module is installed, use the Time Preferences or Set Clock command to enter the proper date into the computer and save it. The workbench clock will then always show the right time.
Servo Motor SG90: It is a servo motor with a low price and great output power.It can rotate upyo 180 degrees,with a maximum of 90 degrees ever step.To regulate its movement, it simply needs a single outputpulse signal.In contrast to a DC motor, a servo motor is employed for precise position control.The white/yellow wire is the control signal, the black/brown wire is ground, and the red.orange wire is 5V.But other colouring schemes exist. The 5V wire must be linked to a separately regulated 5V source rather than the Arduino's 5V supply due to the high power consumption of servos.
Ultrasonic Distance Sensor: Transducers and ultrasonic sensors are devices that produce or detect ultrasound radiation. These devices fall into one of three major categories: transmitters, receivers, or transceivers. While transmitters convert electrical impulses into ultrasound, transceivers may bothtransmit and receive ultrasound. Arduino Ultrasonic distance sensor is used to determine the distance of the object utilising Sound Navigation and Ranging (SONAR). 40KHz or 40000 Hz is the frequency at which ultrasound is produced.
LCD: Here, polarizers and liquid crystals with light- modulating properties are employed. Liquid crystals don't emit light directly; instead, they produce colour or monochromatic images using a backlight orreflector. A two-line display with 16 characters per line is represented by the number 162. On this LCD, each character is displayed in a 5x7 pixel matrix..

3.2 Software Design

1) Flow Chart: Figure 2 uses a flowchart to illustrate the algorithm's diagrammatic representation

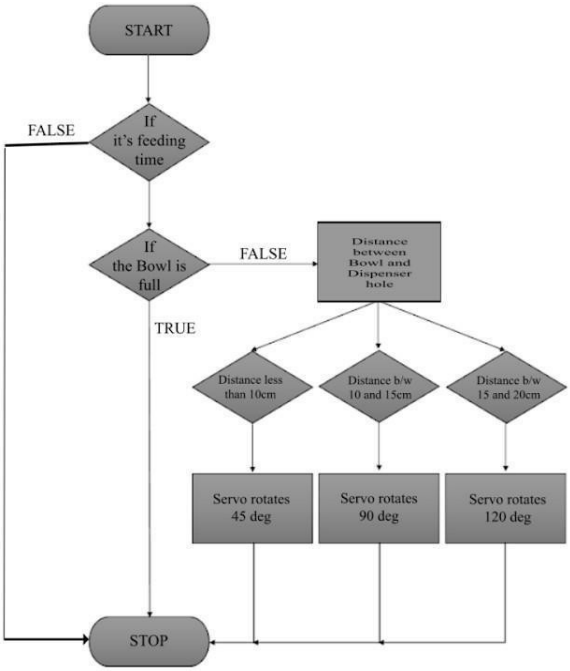

Fig 2. Pet feeder flow chart for simulation

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Simple hardware and software are used by the open-source electronics platform Arduino, which can be programmed and interfaced with. An LED can be turned on, a motor can be started, or anything may be published online by using Arduino boards to take inputs like light from a sensor, hitting a button, or a tweet and turn them into output. Code could be used to send commands to the board's microcontroller. This is done using the Arduino Software (IDE), which is based on Processing, and the Wiring-based Arduino programming language. Arduino is able to perceive its surroundings by taking information from add-on gadgets like sensors, and it can control its surroundings by modifying the brightness of lights, the speed of motors, and other actuators.

Wokwi Arduino Simulator: The www.wokwi.com website simulates the suggested design. The Wokwi Arduino Simulator, which runs on the AVR8js framework, was created to satisfy many additional unmet needs. A web- based Arduino Simulator is what it is. Web browsers are used by both mobile and desktop computers to operate the Wokwi Arduino Simulator. The user interface is straightforward and displays virtual components and the Arduino sketch side by side. It also supports code formattingand uploading to a real Arduino (in beta). Coding on the fly is feasible because to the website's mobile friendliness.

3.3 Methodologies

There are several uses for pet feeders. In this technique, the bowl will be filled at a certain time and refilled when it is empty.

Here, the program is set up so that the buzzer periodically buzzes to indicate how much pet food is still in the feeder. When the buzzer is activated, the food dispenser regulates how much food is dispensed based on how much feed the animal has consumed. The Arduino Uno R3, Ultrasonic distance sensor HC-SR, and Servo motor SG90 are the components used.

Steps in the algorithm:

Connector Pins:

The pins 7 and 6 for the ultrasonic distance sensor

The Pin 2 for servo

The Pin 3 for the buzzer

The Pin 8 for LED

The setup() function performs all componentinitialization.

Using an ultrasonic distance sensor, the functionloop() measures distance.

With the help of the function microseconds t to Centimetres ()and the formula cm=(duration*2)/29, the microseconds are converted into centimetres, where duration denotes the time it takes for the pulse to change from low to high.

The time and date are displayed on the 16x2 LCD screen in the following way: the first line is the time, in the time format of hh-mm-ss, and the second line is the day, followed by the date, in the format of dd-mm-yy. The servo motor then activates and rotates at predetermined intervals that the user sets under the following circumstances:

i) The LED and buzzer are simultaneously turned on to draw the attention of the pet for 5 seconds if the distance, measuredin cm, is 10. The servo rotates by 45° and returns to 0° after this time.

Ii)The LED and buzzer are turned on simultaneously to grab the pet's attention for 5 seconds if the distance measured is between 10 cm and 15 cm. The servo rotates by 90° and returns to 0° back after 10 seconds.

If the distance is between 10 cm and 15 cm, the LED and buzzer both turn on at once to get the animal's attention for 5 seconds. After 10 seconds, the servo rotates by 90° and then reverses direction.

The servo doesn't rotate at all and nothing happens if none of the conditions are met.

The real date and time can be set using SETDATATIME()

The Dec To BCD() function converts decimal to BCD using the following equation: ((value/10*16)+(value%10)).

The function BCD To Dec() converts BCD to decimal using the following formula: ((value/16*10)+(value%16)).

The two functions mentioned above are utilised to make the LCD show the date and time.

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IV. RESULTS AND DISCUSSION

There are no complicated steps in the procedure, making it simple to use. As it employs an onboard battery in the RTC, it is light and portable and may be powered by energy. As a result, this model aids in the elimination of the overweight and obesity issues that are prevalent in dogs and cats, which make up over 55% of the population and pose serious health risks like heart and lung issues, kidney illness, and diabetes.

Schematic illustration: (see image 3)

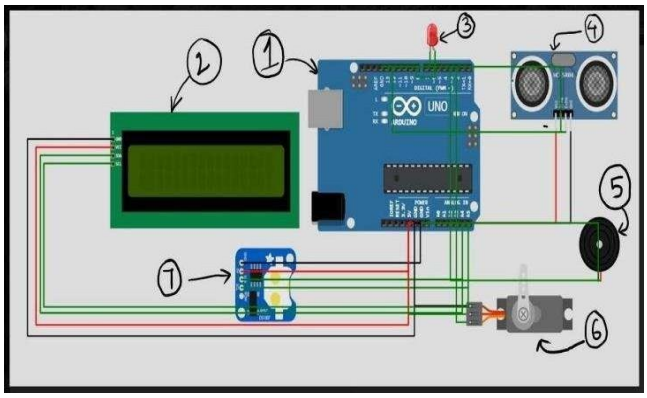

Fig 3. Pet feeders labeled simulated wire diagram

From the figure 3:
Arduino Uno R3
LCD
LED
Ultrasonic Distance Sensor
Piezo Buzzer
Servo Motor SG90
RTC

Observations

The following observations are based on simulated findings as shown in Table 1 and were made after simulating the hardware parameters using the soft tool and creating all possible scenarios of the feeder fullness.

TABLE I. DIFFERENT CONDITIONS FOR SERVO MOTOR ROTATIONS

Distance Measured by the distance sensor	**Condition**	**Rotation done by Servo**
Less than 10 cm	The animal has consumed very little food.	45o
Between 10 to 15 cm	The pet has consumed a modest amount of food.	90o
Between 15 to 20 cm	The pet is almost done with the provided food.	120o

Distance less than 10 cm: Less than 10 cm: Assume a space of 6 cm between the bowl and the dispenser hole when the distance is less than 10 cm. In order to open the dispenser hole for 10 seconds, the servo arm rotates at a 45° angle. Figure 4 illustrates this by showing the LED and Buzzer ON for 5 seconds.

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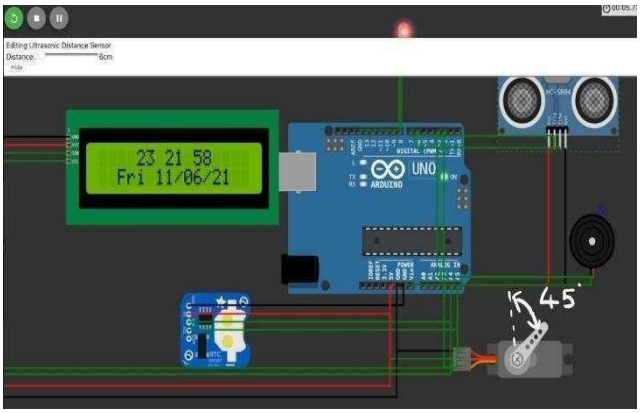

Fig 4. Simulated Output when distance is 6 cm from bottom or top

A distance of 10 to 15 cm: The simulated output at a 13 cm distance is depicted in figure 5. Consider the distance between the bowl and the dispenser hole to be 13 cm for the condition of the distance between 10 and 15 cm. In order to open the dispenser hole for 10 seconds, the servo arm rotates by 90 degrees. Even the LED and Buzzer are activated for 5 seconds during this

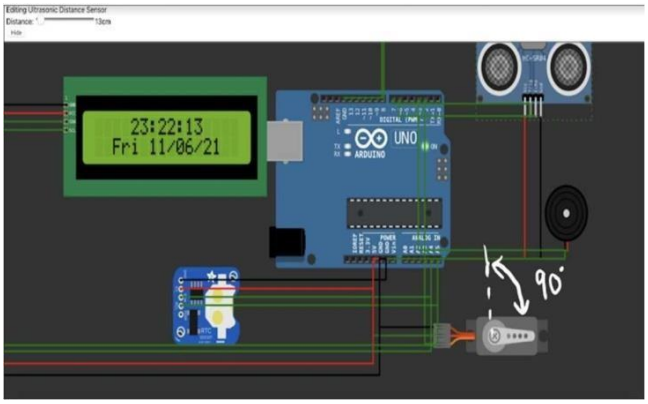

Fig5. Simulated Output when distance is 13 cm from bottom or top

A space of 15 to 20 cm : Consider the distance between thebowl and the dispenser hole to be 17 cm for the case where the gapis between 15 and 20 cm. In order to open the dispenser hole for 10seconds, the servo's arm rotates by 120 degrees. As depicted in Figure 6, even the LED and Buzzer turn on for 5 seconds during thistime.

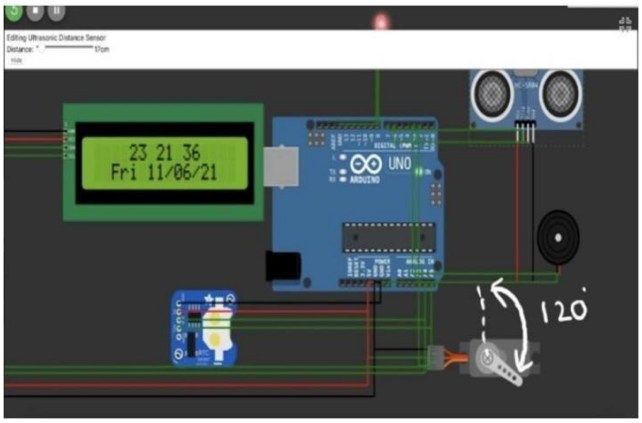

Fig6. Simulated Output when distance is 17 cm

V. CONCLUSION AND FUTURE SCOPE

The features in this prototype design will make it simpler for both the owner and the pet to take care of pets. The required components are the Arduino Uno R3, Ultrasonic distance sensor HC-SR, Servo motor SG90, RTC, Buzzer,

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and LED, as was previously indicated. The intake of pets can be observed using the simulated data from above. Additionally, different pet food requirements can be changed, including the frequency of feedings, the quantity of food dispersed, and the length of time the dispenser holeis left open.

This design offers numerous brand-new features when compared to earlier iterations. In this design, you can change the feed time, the gap between successive feeds, and the amount of feed that is delivered. This design also features a refill reminder and a call that the pet will hear when it's time to feed. Future innovations are expected to be exciting thanks to the current trend of fusing IoT technologywith pet management. Additional features, such as a second camera that enables the owner to check on whether their pet is eating, can be added to the Automated Pet Feeder in orderto conduct more extensive study. Additionally, pet collars with RFID tags can be utilised to identify the animal.

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