DESIGN AND IMPLEMENT OF IOT-BASED PET FOOD FEEDER ROBOT

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Abstract— **Today automation technology is a trend that is easy to access, user friendly and easy to observe. Having pets can be a joy in our lives. Feeding pets is a major task and the purpose of this article is to automatically feed the pet when the owner is away from home. Over the past few years, many researchers have developed an automatic feeding machine, but their functionality is limited to the home. This advanced machine can provide real time food to the animal and monitor the animal's behavior. The IoT Based Automatic pet food feeder uses ESP-32 CAM camara module, Ultrasonic sensor, Motor control module, and consists of an interface with DC servo motor, and other hardware equipment. A software code is dumped into the micro controller to perform operations of ultrasonic sensor, rotating motors. The web base application developed by the PHP and HTML programming language and the real time data link with firebase database. The whole feeder system is controlled using a mobile phone. The user sends signals to the micro controller using mobile application through cloud. When the DC servo motor runs, the motor rotates the propeller which is in the feeding device. Using of ultrasonic sensor to get pet foods scale on real time. ESP32- cam to get video input to web application and could watch the behavior of the pet.**

Keywords- Internet of Things; Pet Food Feeder; Real time monitoring

I. INTRODUCTION

In the area of wireless telecommunications, a new technology known as the Internet of Things (IoT) has received a huge interest in academia and industry over the last decades. These technologies have started to transform our lives in every way. The invention of the smartphone wasthe catalyst for the most significant transformation. Since then, we may have seen an increase in smart devices such asapps, games and tools with various functions. Those are acting by communicating with smartphones, which are carried by the majority of individuals nowadays [1]. As a result, we might refer to IoT as a new Internet concept in the twenty-first century [2]. New services that can be easily implemented around our real life can use the above concepts and technologies.

In the modern generation, almost everybody wants a pet because they believe that having a pet in the house reduces daily stress, boredom, and loneliness. However, in a developing country, citizen activity is at an all-time high, reducing the ability to provide necessary food and water for pets regularly. They are busy with various activities and have little time to keep an eye on their pets at home. In the current scenario, it is critical to provide food to pets in a variable quantity at a designated time. The pet food feeders' market is also related to intelligent technologies with the Internet of Things (IoT) and smartphones, which can provide convenient services with various aspects for pet owners.However, the current pet food feeders are restricted to simplefunctioning products such as the automatic feeder with timer and monitoring camera. [1] [3]

In this research work, we have proposed a new pet food feeder system with Real-time features that can feed the pets while the owners are absent from their homes, monitor their movement and status, and control move the robot through the owner's smart phones. And also, the system has a mobile feature that can follow the pet. The camera here can observe his activities. The proposed system is distinctive from others in terms that the proposed system is based on IoT technologies, which use many sensors and wireless communications.

II. PROBLEM STATEMENT

It is common to know that pet care burdens the pet owner. Any pet needs to be taken care of, and the owner needs to be there to take care of them. Some pet cannot control their diet and will eat as long as there's food for them. Other pets will eat a particular type of food. In other words, the owner cannot leave the pet alone. The problem occurs when the owner has to leave their pet for a particular time, and there's no one there to watch them. Therefore, to solve the problem, a system that can automatically feed the pet without the owner is needed to ensure that the pet stays healthy.

III. LITERATURE REVIEW

There are many various types of pet food feeders on the market nowadays attempting to solve the problem of making sure that each animal has access to a healthy scaleof food throughout the day, regardless of the owner's schedule.

Soumallya Koley in "Smart Pet Feeder" [3] has shown a prototype is offered to address the issue of supplying food and water for all types of pets when the owner is away from home, such as during a lockdown situation. The owner can provide food and water to their pet on their schedule by using this prototype. An ATMEGA32 microcontroller is used to control the proposed system. A servomotor has been added to the bowl to control the discharge of food through a PVC conduit. In the system the owner can assign the timing and quantity of food through a keyboard to supply food depending on the instantaneous weight of the food in the bowl.

According to Automatic pet feeder [4] is a device that feeds food at predetermined intervals; all timings are preprogrammed in the microcontroller's program. There are two knobs and one dc motor on it. The first knob controls the feeding intervals, while the second knob controls the timing of the food outlet's opening and closing. The food outlet is opened and closed by a dc motor. A buzzer indicates the presence of food. There's a possibility that foodwill become stuck along the way because of the use of a vibrating dc motor.

New patent invention of Automatic Pet feeder [5] is the device of the present invention relates to an automatic pet feeder, which has an integrated timer control module and pie-shaped bowl for feeding pets at preset programmed times. The device consists of a minimal number of parts. The consumer can easily replace the parts in a matter of minutes in the event of a failure. The electronics device is housed in a single module which can be upgraded and customized to the requirements and needs of the consumeras time passes. Ease of cleaning, maintenance and replacement is facilitated, as the components are all made inplastic. The device operates with 3 AA batteries. The timer module can communicate with external devices so that a computer, gates, doors can control it, sensors such as infrared, proximity, motion etc. and other devices, such as a handheld remote.

"Smart Pet Monitoring and Feeding Based on Feedback Control System" [6] was designed to produce the impact of continuous work in automation. It is an operating system approach controlled by the microcontroller system and based on the driver design and control principal technology. Its operation ensures that the food is released at precisely the right time, according to the schedule. The IoT can also be used to record and monitor the system. The machine's basis of operation is that the food is stored in a silo with a screw conveyor inside that feeds the dog food. The use of an ultrasonic sensor, the camera to detect the dog's movement, and a loadcell for feedback control make up the machine. Every meal is weighted and scheduled for each mash and ensures that the dog gets the proper food at each meal. Second, the action is controlled by an IoT system operated by a mobile phone, and the system can be monitored at any time.

IV. METHODOLOGY

The first step of methodology, design the system architecture for the system. As pre the previous related works we design project works automatically and uses the devices mentioned in this chapter below. The operation of this project is shows in the Fig. 1. We used the ultrasonic sensor to get the pet foods scale, servo motor to open and close the value, L289N motor shield to control wheels and ESP32 CAM to get video input. Collect all the data using this ESP32 microcontroller. Then send this data to the cloudserver. On another side, the client can control this device using a mobile phone or laptop like any internet-accessible device. The IoT architecture clearly show at Fig. 2.

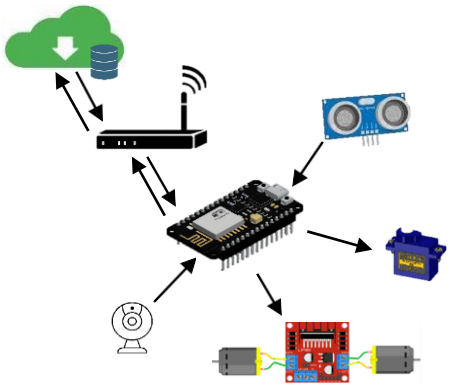

Fig. 1. Hardware system architecture

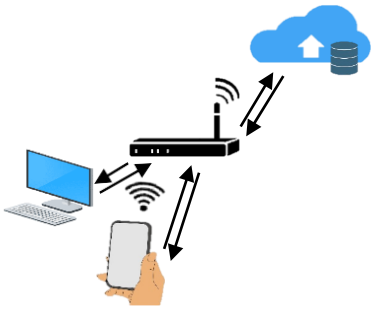

Fig. 2. IoT architecture

The following components use for the hardware development.

A. *ESP32 CAM*

The ESP32-CAM is a small size module based on the ESP32 microcontroller. Its low-power camera module and deep sleep current are as low as 6mA. It comes with an OV2640 camera and provides an onboard TF card slot. The ESP32-CAM can be widely used in intelligent IoT applications such as wireless video monitoring, WIFI image upload, and QR identifications. The module can supportWIFI video monitoring and WIFI image upload. The onboard ESP32-S module supports WIFI and Bluetooth. The WIFI protocol is IEEE 802.11. there have several Peripheral interfaces. Such as UART, SPI, I2C and PWM. Figure 3. Shows the ESP32 CAM module.

B. *Motor drive module*

The motor drivers use for an interface between the control circuits and the motors. The controller circuit operates on low current signals, whereas the motor requiresa high amount of current. Motor drivers' purpose is to convert low-current control signals into higher-current signals that can drive a motor. The motor drive module usedfor the L298N Motor Driver Module is a high-power motor driver module for driving Stepper and DC Motors. Thismodule consists of a 78M05 5V regulator and L298 motor driver IC. L298N Module can control up to 4 DC motors or 2 DC motors with speed and directional control. The L298Ndrive can up the 46V motor supply voltage and 2A maximum motor supply current. Their drive voltage and drive current respect 5-35V and 2A. The PCB has a heatsinkfor better performance.

C. *Servo motor*

According to cost analysis, we use the MG995 metal gear servo motor. MG995 Metal Gear Servo Motor is a standard high-speed servo that can rotate approximately 180 degrees (60 in each direction). Also, it provides 10kg/cm at 4.8V and 12kgcm at a voltage of 6V. The motor is a digital servo motor which receives and processes PWM signals better andfaster. Its highly developed internal circuitry offers higher torque, holding power, and faster updates in response to outside forces. They are well sealed in a solid plastic container, making them water and dust-resistant, a quality that is highly beneficial for pet food feeder machines. The motor Operating Speed at no load (4.8V) is 20sec/ 60 deg. Operation Voltage is 4.8 to 7.2V. All gears are metal, which helps excellent holding power and accurate positioning.

D. *Metel Gear motor*

Small brushed DC gear motors can deliver much power for their size. As per the literature review, we selected the brushed gear motor. The selected gear motor is a 12V brushed DC motor with long-life carbon brushes combined with a 32:1 metal spur gearbox. The D shaped output shaft is 4 mm in diameter and extends 18 mm from the face plate of the gearbox on the gearmotor, which has a cylindrical shape and a 20 mm diameter. It's no lord condition the speed is 450 RPM.

E. *Ultrasonic Sensor*

The ultrasonic sensor uses ultrasonic sound waves to detect the distance to a target object and converts the reflected noise into an electrical signal. The Transmitter which is generates sound using piezoelectric crystals. The Receiver encounters the sound after it has travelled to and from the target. The sensor measures the time between the Transmitter's sound emission and contact with the Receiver to calculate the distance between the sensor and the target [7].

F. *Li-Po Battery Pack*

This pet feeder robot uses the Protek R/C Li-Poly 2300mAh receiver battery pack with ultra-thick 20awg silicone wire [8]. This ultra-light Li-Poly battery is made to power the electronics of 1/10th and 1/8th scale nitro race cars. The primary advantage of using a Li-Poly receiver battery is that the battery voltage to your receiver and servoswill remain constant during the race with the use of a voltage regulator.

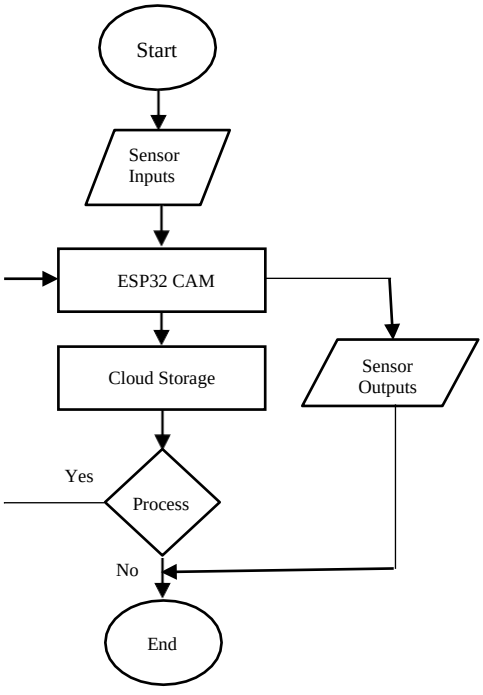

Fig. 3. System flow chart

The process of pet food feeder and there will be procedures and check the machine operator with a working plan as a flow chart in the Fig. 3.

V. IMPLIMENTATION

A. *Hardware Development*

The whole operation collects data through the sensors and actuators. Which gathers all information regarding pets with the sensor implemented in the Smart Pet food feeder System. As shown in figure 8, the automatic feeder was implemented with a 3-D printer. Firstly, we implemented thefood container and dispending using the 3D printer. The selected 3D printer material is High-density polyethene (HDPE). HDPE is a thermoplastic polymer produced from the monomer ethylene. Thermoplastic is a polymer that becomes plastic and flexible upon heating and hardens uponcooling. HDPE is made up of a string of ethylene molecules,which gives it the 'poly' in polyethene. It is well-known and liked for being strong, lightweight and easy to shape. The servo motor, ESP32-CAM and ultrasonic sensor are mountedinside the food container and dispensed.

According to Fig. 4., the food container and dispending unit is used to contain the food and hold the control equipment for the food dispensing unit and has spaces for the ESP32-CAM unit, servo motor and wires. Red color dashed lines show the ESP32-CAM unit partition and the wire path. Magenta color dashed lines show the servo motor partition and its wire path.

Another 3D print part is the food container top cover. This part to the client can open the animal feed machine. It'sthe food container lid. The amount of food in the container can be measured using the ultrasonic sensor. And it can be remotely detected.

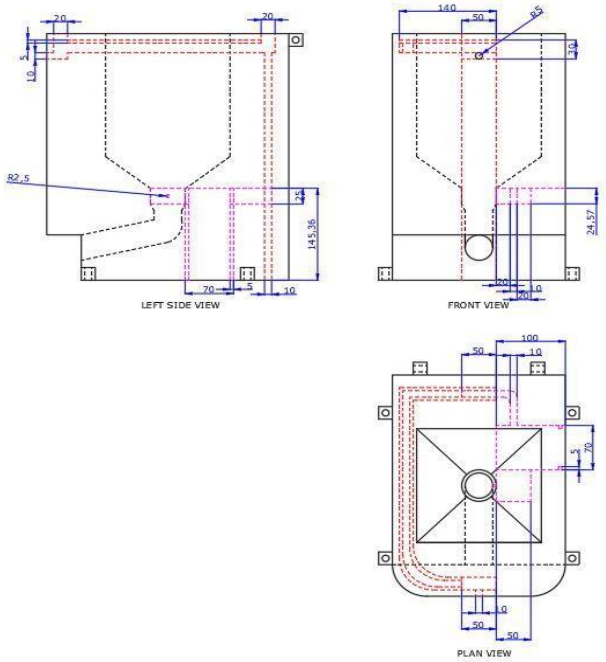

Fig. 4. Food container and dispending unit

B. *Software Development*

The Firebase is a real-time database that enables secure direct client-side code access, allowing developers to create complex, collaborative apps. Data is locally stored, and real-time events continue to happen even when the user is offline, providing a responsive experience. Fire base is different from conventional app development, which often entails creating both frontend and backend software. The client does the task in Firebase products since the traditionalbackend is bypassed. The Firebase console offers access as an administrator to each of these products.

Fig. 5. Firebase architecture

Programming on an Arduino board can be made more accessible with the help of the Arduino IDE, an open-source environment. The Arduino IDE is highly user-friendly, and this is likely one of the key reasons why the Arduino platform has become so popular in the first place. The interoperability of a new microcontroller board with theArduino software development environment is one of the most critical requirements (IDE). The Arduino IDE now allows you to handle third-party boards and libraries while still maintaining the ease of programming the board itself. The Arduino IDE software package includes an IDE and core libraries [9]. The IDE is built in a Java programming environment. C and C++ are the languages of choice for the library core. Field sensor data may be inaccurate or corrupted due to random system failures. Efforts should be made to correct these misinterpretations. During each cycle of ambient data transmission, data packets are generated andprocessed.

VI. TESTING AND RESULTS

Field testing of the finished product was a success, and we got the learning opportunity. The final design of the pet food feeder is shown in Fig. 6. The mechanism used in the pet feeder is rotational to linear motion. The wheels and gear motor assembly are installed between the component's base part. The robot pet food feeder works efficiently and fulfils the objective of feeding pets without its master. The servomotor rotates the propeller, and food gets delivered to the plate according to master mobile control. The whole system is connected to the mobile phone via the internet. The entire real-time data is transmitted to data base and mobile web application.

Fig. 6. Final design of pet food feeder

Also, we develop the client-side web base application for controlling the robot. We used HTML and CSS to create front end of web application. The camara video and robot control keys on the front of web application.Below is Fig. 7. of this demo application.

Fig. 7. Demo application

Below Fig. 8. Shown the Firebase console of data base development.

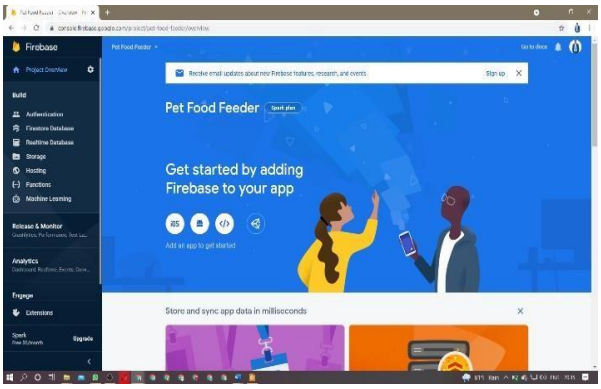

Fig. 8. Firebase console

VII. CONCLUSION

This paper introduces the design and implementation of pet food feeder robot based on IoT technology. Modern world people have their busy life, and they enjoy with pets. Nowadays, we can see many new devices invented with the aid of IoT. We believe IoT can also change the pattern of the existing structure of pet food feeder robots. In this paper, we describe and implement a new pet food feeder robot that can feed the pets while the owners are absent from their homes and monitor their movement and provide their foods through the owner's smartphones or devices. The implemented system is distinctive from others in that the proposed method is based on IoT, which uses many sensors and wireless communications.

The IoT-based pet food feeder is a helping hand as it works efficiently in the absence of its own. It helps to develop creativity in crating projects and modify existing projects to be more energy efficient with new fabrication methods through this system. This pet food feeder innovation makes it easy for consumers to feed their pets and will not leave their pets hungry again. This automatic pet feeder we developed helps give pets smaller, more frequent meals, which is helpful for weight loss and managing medical disorders such as diabetes. Adequate food intake benefits weight loss and drives medical conditions such as diabetes. When exposed to outside animals, animals or pests cannot damage the remaining food. The future can develop a mobile app for monitoring data and controlling the robot. Another significant development includes the AI-based food care system, which can analyze the behavior of the pet care system for future forecasting.

ACKNOWLEDGMENT

The authors wish to express their gratitude to all academic staff members of the Department of Mechanical & Manufacturing Technology, Faculty of Engineering Technology, University of Vocational Technology for their support. Sincere thanks should go to all supporting peoples in this study.

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