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Monitoring and Feeding System for Pets

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Abstract: ***Over the years, more and more households are beginning to have pets. So, the most important issue recently was how to raise pets in an easy way. In today's world, there is a growing focus on the regular interactions between human and physical devices. This paper introduces a smart pet monitoring and feeding system that is working in an environment of Internet of Things (IoT). Pet feeders came into existence as pet owners found it difficult to cater time to feed their pets. This system allows the owner to schedule and manage feeding times, portion sizes, and food supply for pets. They are controllable on smartphones using blynk and computers in order to feed them even when owners are away. The food dispensing mechanism is performed by the servomotor. It allows the user to monitor the pets using IP camera. A voice recording module is interfaced to the Arduino Uno with the owner's voice recording for calling the pets at the meal time. Automatic water refilling has been designed and implemented along with the food dispenser.It offers new and developed way of feeding pets without the need of human intervention with refill alert and feeding alert. . Using smart pet feeder in houses will assure pet owners and increase comfort and peace of mind. Especially when we are unavailable for them.***

Keywords: Internet of Things (IoT), blynk, servomotor, voice recording module, Arduino Uno, refill alert

I. INTRODUCTION

Smart home devices and gadgets are becoming more popular with consumers who enjoy having all their devices interconnected to serve the purpose of increased comfort, energy efficiency and most importantly personalization which is one of the focus points on this project, with the help of automation of electronics and IoT the experience becomes much more personalized for the user. The goal of this project is to introduce, design and implement a monitoring and feeding system for pets. The emphasis on choosing this as title is because, it gives a solution to a problem faced by many of us. Human interference on the part of taking care of pet when they are busy is difficult. And hence our system will be efficient enough to overcome the hurdles faced by human in taking care of pets.

The interaction between human and physical devices and devices in the real world is gaining more attention, and requires a natural and intuitive methodology to employ. According to this idea and living well, life has been a growing demand. Thus, how to raise pets in an easy way has been the main issue recently. This project examines the ability of computation, communication, and control technologies to improve human interaction with pets by the technology of the Internet of Things. This work addresses the improvement through the pet application to help pet owners raise their pet based on the activity and eating control easily.

Pet feeding can be difficult in this busy age but the perfect Pet feeder delivers a worry free solution to modern, caring pet-parents while away. There are many various types of automated pet feeding devices in the market now. Generally most pet feeders are commonly for cats and dogs but for a few special cases, some pet feeders for instances, like the fish pet-feeder or the hamster pet feeder are specifically designed to suit only for that particular type of pet due to their size and environmental living conditions. In this design user can adjust the feed time, time gap between consecutive feeds and the quantity of feed served. This design also contains the call for pet at feed time, refill alert, dual power supply with battery charger, notification alert system for the owner in case if pet doesn't get its feed, sensor based system to serve previously served feed in case of left feed and the priority feeder with dual option of dispensing either in manual mode or automatic mode. This system allows us to monitor our pets using camera and voice recorders which will make the pets feel safe. A speaker is interfaced to the Arduino with the owner's voice recording for calling the pets at the meal time. In the software, Blynk mobile app is used to trigger a measure of dry food and adjust the updating time for food dispensing. Usage of electronic components is kept minimal and cost efficient. Any type of wiring will be hidden to ensure the safety of the pets. Also the safety of the model is important, keeping that in mind the model will be made opaque and wall mounted so that the pets don't play around it. After every successful food dispensing, the owner is sent a notification of the same. Both automatic and manual mode for dispensing food is used. A load cell is placed beneath the food bowl which gives accurate readings. An ultrasonic sensor is used to detect the level of the water which will prevent it from over spilling. Water refilling is facilitated by the pump for refilling on timely basis and ensures proper hydration of the pet.

II. LITERATURE SURVEY

A. Programming using a Microcontroller

In this paper, the author Tessema.G.B et al [1] proposes a method in which a Microcontroller (18F Series) was used. A turn-table which was a container divided into 4 sections to select the type of food to be dispensed was designed. The stepper motor was placed at the bottom to hold and control the positioning. The Programming of the system was made using a MPLAB IDE which is mainly used to program the timer for setting delays in dispensing the food and for the buzzer to alert the pets as soon as the food was dispensed. Both the buzzer and dc motor were always in the waiting mode and were activated once the turn-table was in position. Both the buzzer and the dc motor were then turned on for 5 seconds before it turnrd off and back to the waiting mode.

B. Implementation of a Dispenser along with a pooping pad for pet care using IOT Method

In this paper, the author Seungcheon.K et al [2] proposed a pet care system that can feed the pets and monitor their movement and status and also control its defecation pad through owner's smart phones, The system used IoT technologies, the system used five main components i.e Raspberry Pi camera, dispenser (arduino), defecation(arduino),wifi router and apps for smartphone. In addition, users could set the amount of food based on the weight of the pet. Every control for setting could be done through user's smart phones. The proposed automatic pooping pad can detect pet's defecation with a help of sensors. The history of feeding or replacement of pooping pad is recorded in the home server and can be displayed through mobile web and APP for smart phone

C. A Pet Feeder System using Servo Motor and Arduino Uno

In this paper, the author Mainak.B et al [3] proposed a system whose work was about feeding the pet automatically for a daily minimum period of time of eight hours. The food for pet was kept inside a box while leaving the home. The food would be served to the pets automatically up to a certain quantity only when the pet came near to the box when they felt hungry. The automatic pet feeder was powered by arduino, using an auger, and programmable with two feeding times with user set quantity of food, with a battery backed up internal clock. Real Time Clock (RTC) was connected to arduino. The time was set by using KY-040 rotary decoder encoder. When real time matched with the RTC, it gave the signal to motor and motor started rotating. Further, motor gave the motion to the auger which transfered the food to the dish.

D. Design of an automatic pet feeder using Raspberry pi module

In this paper, the author Priya.M et al [4] proposed a device helpful for feeding the pet automatically and also to maintain pet's diet. After logging in, the user will click on feed button where food will be thrown through the servo motor. Before the pet feeder is started, an image is captured and stored in cloud and then it is taken from cloud. The whole system was divided into the four modules, Raspberry Pi Module was a single computer board with credit card size, was used for many tasks that the device does. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Expressive Systems, and hardware which was based on the ESP-12 module. The firmware used the Lua scripting language. It consists of a suitable motor coupled to a sensor for position feedback.

E. Design of Automatic pet feeder using digital image processing

In this paper, the author Vineeth.S et al [5] explains the identification of the pet using image processing method. In this project a pet call was provided using a recorded voice through a speaker to indicate feed time of the pet is initiated. The Ultrasonic sensor was placed in order to detect the pet in front of the system. Once the pet detection was done using an ultrasonic sensor, the camera was switched on and camera captured image of the pet and processes. If the pet was recognized, a dc motor was activated to dispense food. The dc motor was rotated to serve food and the rotation was controlled by H-Bridge. This System was implemented to feed one pet or more than one pet of either same species or different species using Image processing. Once the required pet was fed successfully, the message was sent to the owner's mobile number using a Twilio API. Pets Detection and recognition was done using Convolution Neural Network technique.

F. Using RFID and Bluetooth module

In this paper, the author Henry.D et al [6] proposed a method in which the RFID was embedded into pets' tags to differentiate types of pets for different food needs. The main purpose of the control module was to receive input signals from sensors and RFID and send instructions to motor and transfer data with Bluetooth module. The PCB processed the inputs and sent different instruction to other module in different situations. First, RFID detected the tag at the set feeding time. Second, when the weight module measured insufficient amount of food at feeding time.

Third, when there was no sufficient food left in the container. In addition, the microcontroller stored pet's food consumption data and sent it to the software upon Bluetooth request. It consists of two separate parts: ID12LA RFID Reader and the passive RFID tags, which were attached to the pet's bracelets. ID12LA is a high frequency RFID reader, it provides around 30 cm range for detection after antenna.

III.PROPOSED SYSTEM METHODOLOGY

Feeding system for pets is the process of dispensing food on time in the absence of the pet parent and also refill the water in the water bowl on a timely basis. Considering the various scenarios and hurdles related to hospitality of pets, it is very much necessary to address this issue. The Project is focused on management of domestic pets. Given the big demand there is a huge scope of innovation both in terms of improving the hardware and software aspects, we have implemented the same using the Arduino Uno board, ESP332 module and Blynk application which is a cloud-based system that is a software as a service (SaaS) which is free to use to design, debug and compile. The Wi-fi module being implemented here is the ESP32 which is used by the Arduino Uno board to communicate to the user via a secure wireless connection via standard IEEE networking protocols.

The Below diagram illustrates the proposed block diagram we are implementing in the project. The Arduino Uno is the microcontroller we are employing in the system. We have used the Arduino Uno as it is an an open-source microcontroller board based on the Microchip ATmega328P microcontroller system and being a low-cost single board computer used to reduce the complexity of systems in real time applications.

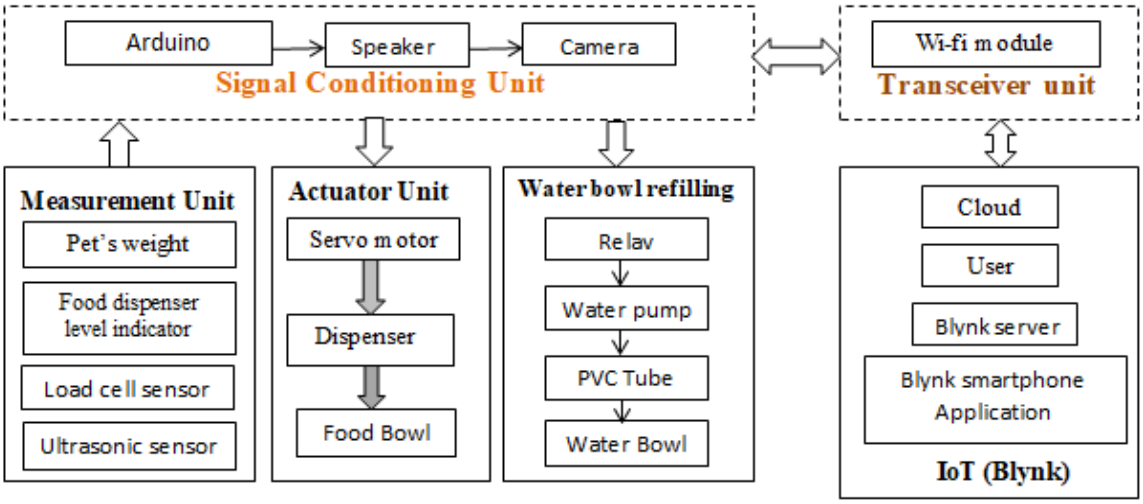

Fig. 1 Block Diagram of monitoring and feeding system for pets

A. Food Dispenser

The proposed system runs based on periodic measurements of the pet's weight and food level inside the tank. The system can be set to control mode which allows user to dispense food with two different methods. The control mode can be run as:

1) *Automatic*: Under the automatic control mode, the system can be scheduled for certain time to dispense the food with adjustable dispensing time.
2) *Manual:* Under manual control mode, user can dispense food at any time for certain duration defined as adjustable dispensing time using the Blynk application.

The actuator unit of the system consists of SG90 servo motor which is attached with a lid at the bottom of the container for easy dispensing action. The servo motor dispenses the food based on the modes defined by user. The whole system is powered up by an external 12v DC power supply.

B. Load Cell

The load cell is mounted beneath the food bowl using a z-plate configuration and a level indicator is achieved by placing an ultrasonic sensor on top of the dispenser.The measurements are taken from load cell and ultrasonic sensor in a period manner. The duration can be set by user. For example, taking measurements at each 10 seconds. The measurements are effective in the process of system. The measurement of:

1) *Load cell:* The weight sensor is one of the crucial elements to define the right amount of food to be dispensed based on the predefined value and notifies the user when the food has been consumed by the pet as a result of zero reading of the load cell.
2) *Food level meter*: The ultrasonic sensor can prevent the dispensing process and notify user about emptiness status of food container when the value goes below the threshold.

The 2kg load cell along with HX711 amplifier is mounted on acrylic sheets to obtain the z plate configuration and the food bowl is placed over this setup. The load cell is controlled using blynk via ESP32 wifi module.

The flow of software operation using blynk for automating the dispensing is as shown in the flowchart and the process completes its cycles of operation according to the operating modes and time set by the user. The rotation of servo is based on the quantity selected.

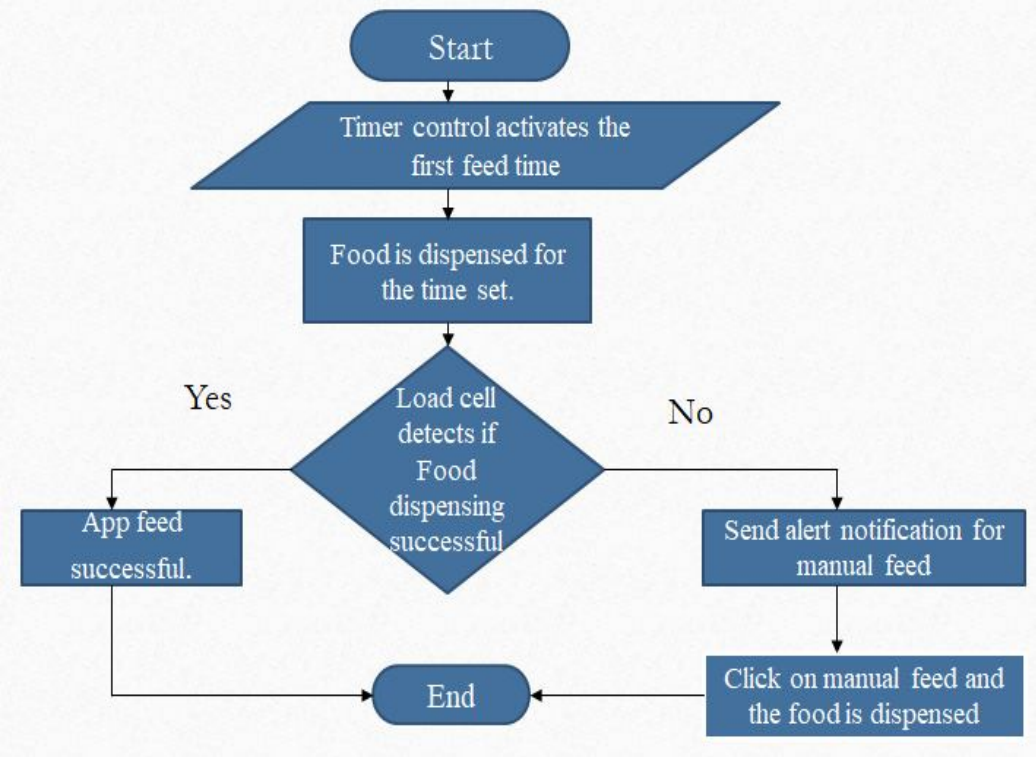

Fig. 2 Flowchart of food dispensing using Blynk

C. Water Refilling System

Another important part of the actuator unit is the water refilling system. It consists of an ultrasonic sensor which detects the level of water based on the received sound signals. The ultrasonic sensor is interfaced with the ESP32 module for automatic refilling when the detected level goes less than the set value. A 12V mini water pump is used to pump water from the water can into the water bowl. The below block diagram illustrates the working of the system.

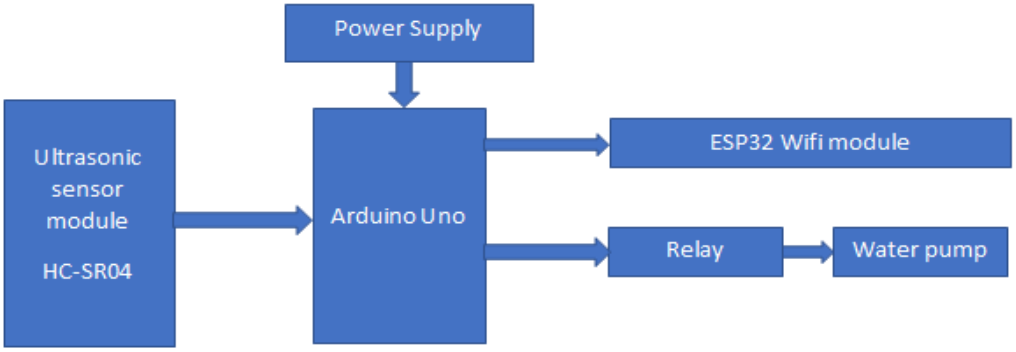

Fig. 3 Block diagram of water refilling system

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A single channel relay is used along with the water pump to perform refilling of water to the bowl. Based on the ultrasonic sensor reading the 12V DC pump turns on and refills the bowl up to a particular level. The 12V adapter is used to power the relay and is interfaced with the ESP32 module. PVC pipe is attached to the water pump and is fixed just above the water bowl.
The software flowchart is shown in the below diagram.

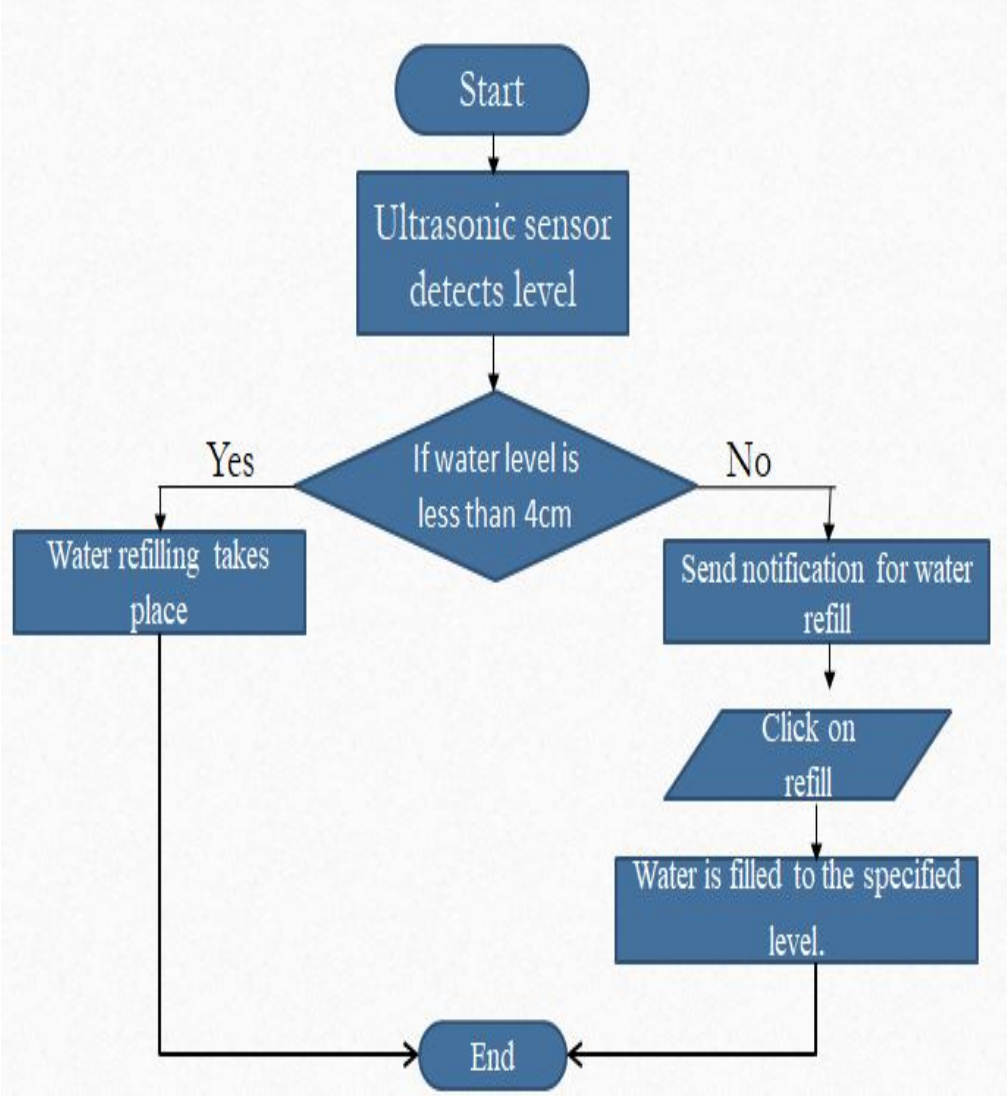

Fig. 4 Flowchart of water refilling using Blynk

The entire system is then mounted on a wooden box and is made opaque to ensure it is not prone to damage. It is fabricated using plywood. It can also be wall mounted and all the components are fixed in such a way that they are not visible to the pets and is made safe. Tupperware box is used as a dispenser in this project for ensuring good food quality and the pipe attached below it helps for the direct flow of food into the food bowl as a result of gravity.
The output of each of the components is read by the arduino and is stored in the Blynk cloud. Successful communication is established between the blynk server and blynk app by entering the authentication token provided eclusively for each user and system. Using the various widgets provided by the application, the food level indicator is used to show the content in the dispenser. Alert widgets are used to send notifications and start time and feed time timer widgets are customized and are made available to the user with which they can change and update the feed times.
IP camera is mounted over the wooden setup which can move 360 degrees and the live streaming can be viewed on the V380 application. Using blynk we can interface the streaming along with other widegets, thereby viewing everything in one tab which improves efficiency and reduces time consumption that would be spent on switching the applications.

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IV. HARDWARE AND SOFTWARE REQUIREMENTS

A. *Hardware Components*

1) *Arduino Uno*: Arduino Uno is a microcontroller board developed by Arduino.cc which is an open-source electronics platform mainly based on AVR microcontroller Atmega328. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery.

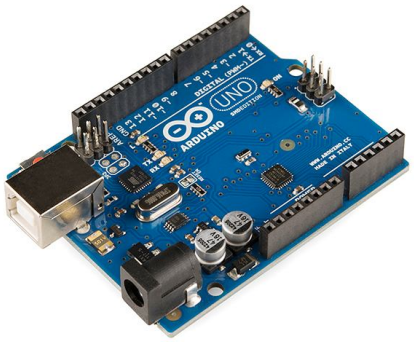

Fig. 5 Arduino Uno

2) *Servo Motor*: A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. Servomotor SG90 is a tiny and lightweight server motor with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller.

Fig. 6 Servo motor SG90

3) *Load Cell*: A load cell is a force transducer. It converts a force such as tension, compression, pressure, or torque into an electrical signal that can be measured and standardized. As the force applied to the load cell increases, the electrical signal changes proportionally. The most common types of load cell used are strain gauges, pneumatic, and hydraulic.

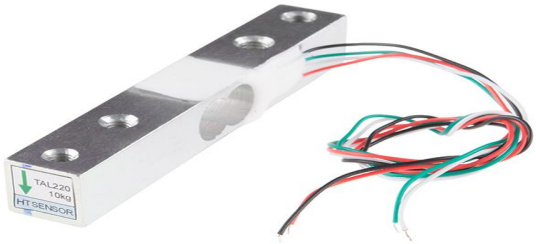

Fig. 7 Load cell

4) *HX711 Load cell Amplifier*: HX711 module is a Load Cell Amplifier breakout board for the HX711 IC that allows you to easily read load cells to measure weight. This module uses 24 high precision A/D converter chip HX711. It is a specially designed for the high precision electronic scale design, with two analog input channel. The input circuit can be configured to provide a bridge type pressure bridge (such as pressure, weighing sensor mode), is of high precision, low cost is an ideal sampling front-end module.

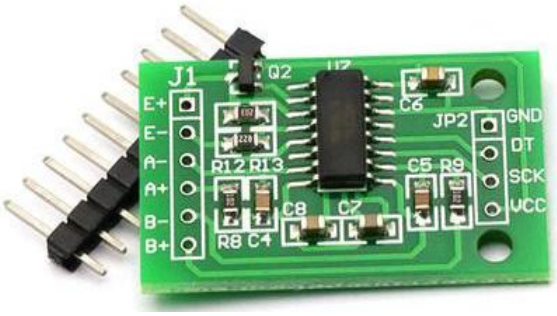

Fig. 8 HX711 Amplifier

5) *Ultrasonic sensor HC-SR04:* The HC-SR04 uses non-contact ultrasound sonar to measure the distance to an object, and consists of two ultrasonic transmitters (basically speakers), a receiver, and a control circuit. The transmitters emit a high frequency ultrasonic sound, which bounce off any nearby solid objects, and the receiver listens for any return echo. That echo is then processed by the control circuit to calculate the time difference between the signal being transmitted and received.

Fig. 9 Ultrasonic sensor HC-SR04

6) *12V DC mini water pump:* A mini 12V DC water pump is a centrifugal water pump, which means that it uses a motor to power an impeller that is designed to rotate and push water outwards. The motor is located in a waterproof seal and closely connected to the body of the water pump which it powers. The DC motor is contained in a sealed case attached to the impeller and powers it through a simple gear drive. When the motor turns on, electricity runs through the coils, producing a magnetic field that repels the magnets around the rotor, causing the rotor to spin around 180 degrees.

Fig. 10 DC mini water pump

7) *ISD1820 Voice Recording module*: Voice Record Module is based on ISD1820, which a multiple-message record or a playback device. It offers true single-chip voice recording, no-volatile storage, and playback capability around 10 seconds. This module is easy to use which you could direct control by push button on board or by Microcontroller such as Arduino, STM32, ChipKit etc. From these, it is easy to control record , playback and repeat and so on.

Fig. 11 ISD 1820 Voice recording module

8) *ESP32 Wifi Module*: ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. ESP32 can perform as a complete standalone system or as a slave device to a host MCU, reducing communication stack overhead on the main application processor. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality through its SPI / SDIO or I2C / UART interfaces.

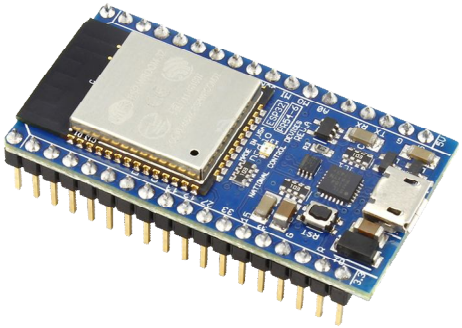

Fig. 12 ESP32 Wifi module

9) *IP Camera*: An Internet Protocol camera, or IP camera, is a type of digital video camera that receives control data and sends image data via an IP network. They are commonly used for surveillance but unlike analog closed-circuit television (CCTV) cameras, they require no local recording device, only a local area network. V380 Camera also produced both
Wired Camera and Wireless IP Camera, which satisfies all different kinds of needs.

Fig. 13 V380 IP Camera

B. Software Description

1) *Arduino IDE:* Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module. It is an official Arduino software, making code compilation too easy. The Arduino IDE is incredibly minimalistic, yet it provides a near-complete environment for most Arduino-based projects. The middle section of the IDE is a simple text editor that where we can enter the program code. The bottom section of the IDE is dedicated to an output window that is used to see the status of the compilation, how much memory has been used, any errors that were found in the program, and various other useful messages. Projects made using the Arduino are called sketches, and such sketches are usually written in a cut-down version of C++ (a number of C++ features are not included). There are a number of device specific libraries (e.g., changing pin modes, output data on pins, reading analog values, and timers).

Fig. 14 Arduino IDE

2) *Blynk Application:* Blynk is a hardware-agnostic IoT platform with white-label mobile apps, private clouds, device management, data analytics, and machine learning. It has features like similar API UI for all supported hardware & devices , set of easy-to-use widgets. , direct pin manipulation with no code writing, easy to integrate and add new functionality using virtual pins, history data monitoring via SuperChart widget, Device-to-Device communication using Bridge widget, sending emails, tweets, push notifications, etc. It can control hardware remotely, it can display sensor data, it can store data, vizualize it and do many other things. Blynk App allows you to create amazing interfaces for the projects using various widgets. Blynk Server is responsible for all the communications between the smartphone and hardware. Blynk libraries for all the popular hardware platforms enable communication with the server and process all the incoming and outcoming commands.

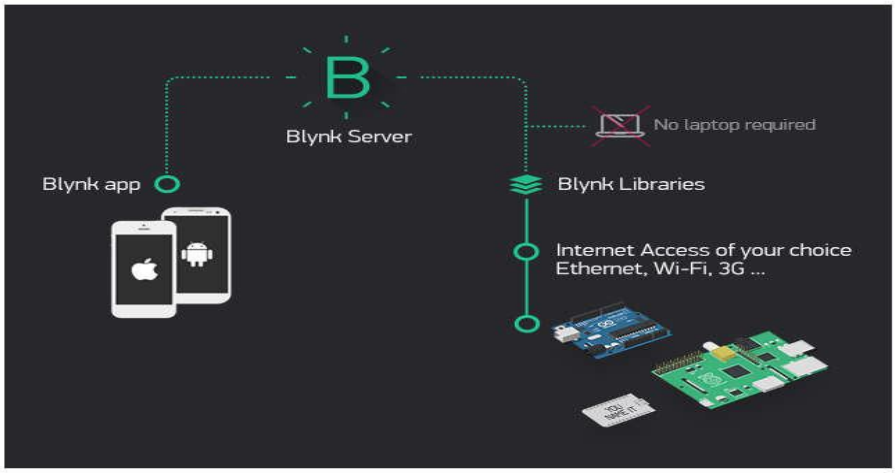

Fig. 15 Blynk application

V. RESULTS

The Arduino Uno is programmed in a way that it sets the servo motor working.The pet call is given at each feed time with the help of ISD 1820 recording module and speaker mounted near the container. The amount of food dispensed is based on the rotation of servo motor and measured using a load cell which is designed in the form of a z-plate configuration as shown in the figure. After the food is dispensed, the motor is programmed to rotate thus closing the lid.

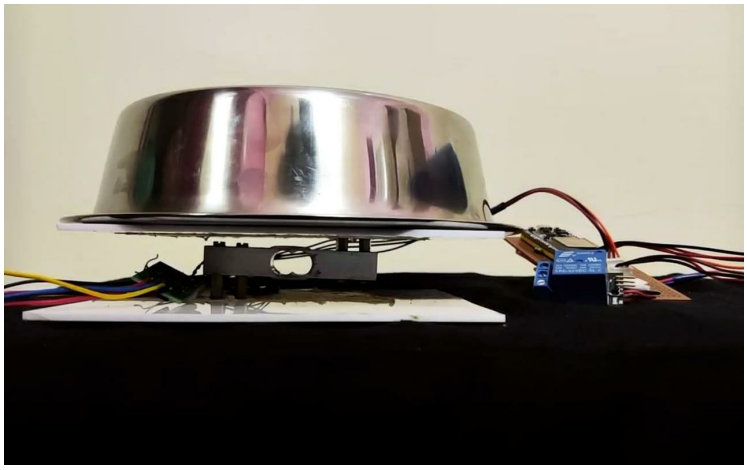

Fig. 16 Z-Plate configuration of load cell

The food dispenser is controlled using an android application which gives the control to the device through a Wi-Fi module (ESP32) for dispensing the food. The Blynk application proves helpful in this case as it can control the time for how long the motor stays in the opening position. The user can control the dispensing either manually or automatically by pressing the widget on the blynk application as shown in the figure. The time for feed can be set in prior by updating the required feed times on the app. Blynk application also shows the amount of food in the container. Refill alert is added to give an alert for the owner in case if the container of feed is going to be empty.

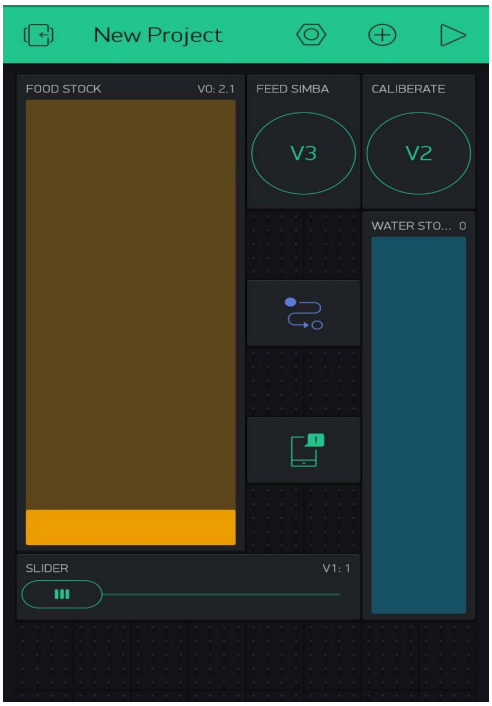

Fig. 17 Feeding system user view in blynk app

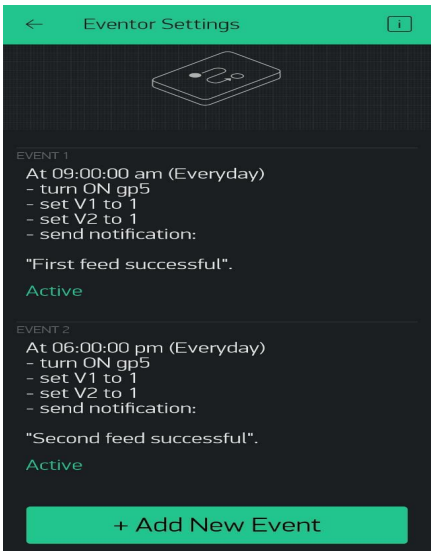

Fig. 18 Timer events for dispensing using blynk

The water refilling system has an ultrasonic sensor mounted above it for level detection. The water pump is interfaced with the ESP32 Wi-fi module along with a single channel relay for automating the process. The water refilling is facilitated by the PVC pipe attached to the mini water pump placed inside a water can. The Monitoring and feeding system for pets as an entire single entity is as shown in the figure below. An IP camera is placed over the system for monitoring the activities of pet in real time. Live activities of the pet can be recorded and viewed on the mobile along with Blynk app using the V380 Pro application.

Fig. 19 Final Product

VI. FUTURE SCOPE

Further innovations would comprise of a product in which all the features are included in a modernized machine with low maintenance. Cleaning mechanism of the bowls can be implemented by using brush for maintain hygiene. The water bowl often stays on the floor filled with stagnant water and thus collects dirt and grime that the pets may drink. Thus, an automated pet fountains can be installed thus not allowing the water to be stagnant and preventing contamination. More upgrades can be made to the model by improving sanity levels due to constant food storage, the food may get spoiled, so sensors can be added to alert the owner about change of food also the material of the dispenser can be chosen accordingly.Given the big demand there is a huge scope of implementing such a system for feeding the thousands of strays. With a bigger capacity, it can also be used in the zoo and animal parks for feeding the wild.

VII. CONCLUSION

The proposed system introduces the novel smart monitoring and feeding system based on IoT technology. As the number of single house hold is increasing, we can expect that the number of pet owners will increase. Nowadays we can see lots of new devices invented with the aid of IoT. We believed that IoT also can change the pattern of the existing structure of pet care system. In this paper, we have proposed a pet care system that can feed the pets while the owners are absent at their homes and can monitor their movement and status through smart phones. The proposed system is distinctive from others as it is based on IoT technologies, which uses lots of sensor and wireless communications. Therefore, the proposed system is not restricted in the space and time only if the wireless communications are provided. Up to now, only food and water feeding system has been devised. However, we think that we can expand the usage of the smart pet care system along with the demand of the pet owners. We believe that we can create whatever the pet owners want. The Feeding System was planned to ensure the time to time feeding of pet in absence of its master so that master can do his other tasks without worrying about feeding. Automatic Pet Feeding System has attractive design and aesthetic model.

VIII. ACKNOWLEDGMENT

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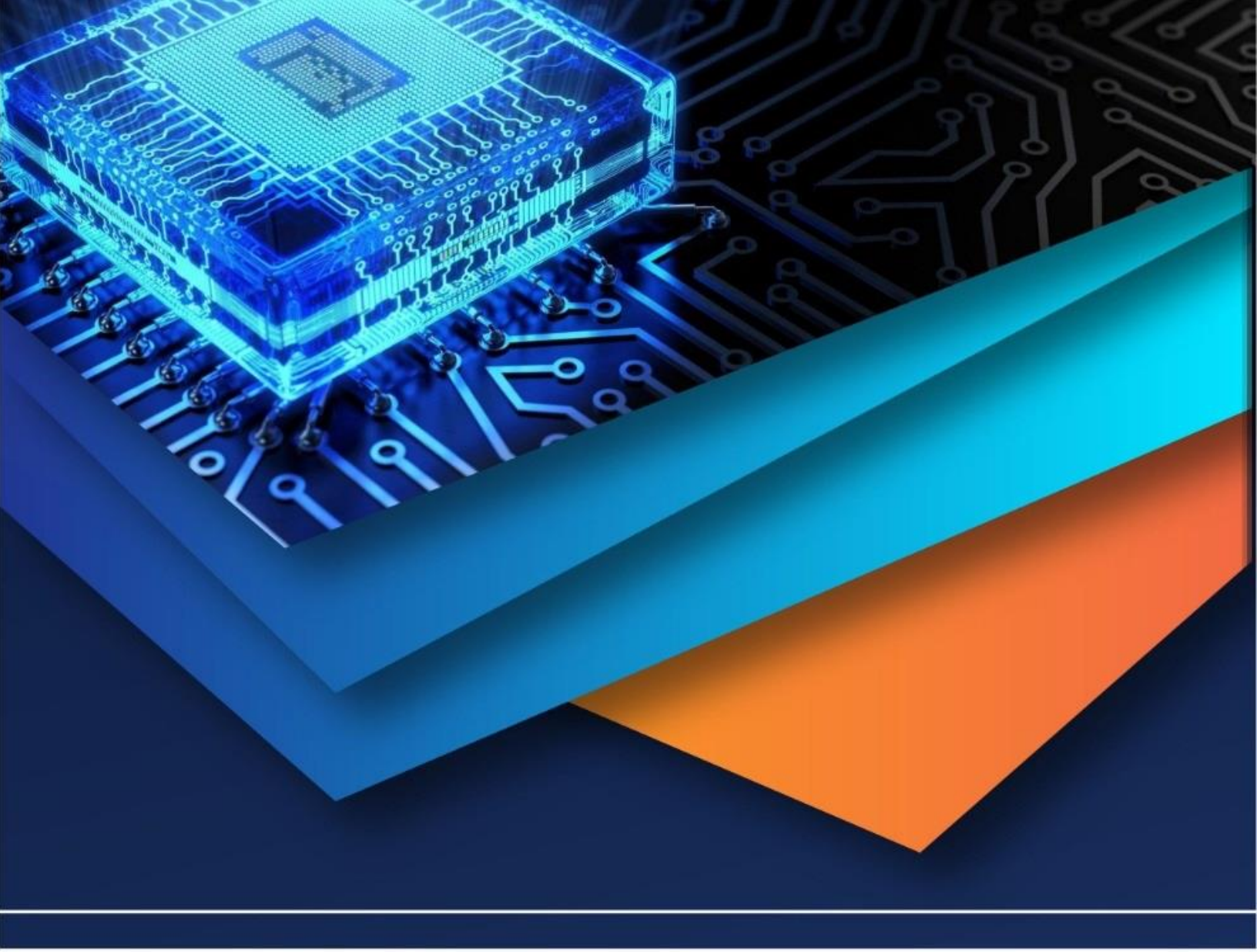

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