Automatic Animal Feeding Place Based on Microcontroller System with Sound Sensor and Weight Sensor

Iman Fahruzi
Departement of Electrical Engineering
Batam State Polytechnic
Batam, Indonesia
imanfahruzi@gmail.com

Athaya Rizqa Amanda
Departement of Eelectrical Engineering
Batam State Polytechnic
Batam, Indonesia
athaya.rizqaa@gmail.com

Animal care requires a lot of time and effort in maintaining and caring for them, especially in feeding. In the era of technology 4.0, humans need technology that can make it easier, one of which is in feeding animals automatically. The purpose of this research is to be able to detect the rattling sound used by animals, detect the weight of the feed in the control reservoir for the Microcontroller-Based Automatic Animal Feeding Place. To support this research, the author takes several examples of research that has been carried out related to the title "Automatic Animal Feeding Places Based on Microcontroller Systems using Sound Sensors and Weight Sensors". As a reference, the authors take examples of research from the past 3 years as an improvement for this research based on the shortcomings and weaknesses of previous studies, the authors have innovations to solve problems that occur with the presence of a sound sensor using the Easy VR module, a weight sensor using a load cell scale, and servo motor to control the valve opening and closing. so that the pet's food and drink needs will always be available when the animal needs it without direct human control first and without periodic feeding.

Keywords—Feed, Microcontroller, Easy VR, Load Cell, Servo Motor.

I. INTRODUCTION

Eating and drinking is one of the body's most important needs, which is a need for living things to increase energy, one of which is pets. In pets, the need for animal feed becomes very important so that food and drink are not scattered. Animal maintenance requires a lot of time and energy in maintaining and caring for and caring for them, especially in feeding and drinking. However, many of owners are negligent in caring for pets because they are busy. So sometimes they forget to feed and water their animals. In the era of technology 4.0 humans need technology that can make things easier, one of them is in feeding and drinking pets automatically.

Many new innovations to make a tool for Animal Feed Place Automatic Microcontroller Based. Previous research that has been done regarding Arduino-based automatic animal feeders that use RTC has a weakness because feeding and drinking are regulated periodically so that food and drink are not available when the animal is in need periodically so that food and drink are not available when pets need [1].

Based on these problems, a design system is proposed. "Automatic Animal Feed Place Based on Microcontroller System Using Sound and Weight Sensor" so that the needs of eating and drinking pets will always be available when the animal needs it. will always be available when the animal needs it, because this system is equipped with Easy VR sound sensor as a rattling sound sensor to order the issuance of food, Load cell scales as a weight sensor to find out if the animal feed container is empty or full, and a Servo Motor that will open the animal feed container valve automatically. [2][3][4].

II. RELATED WORKS

To support this research the author took several examples research that has been carried out is related to the title "Animal Feeding Places Microcontroller Based Automatic using Sound and Weight Sensors" in the form of the following design and analysis. As a reference for the author taking the past 3 years as improvement for this research. It is as follows :

A. Based on research conducted by Cristin Yesica Aritonang (2019) "Design of Pet Feeding Equipment Arduino based" [5].

Based on testing and analysis of feeding equipment on pet where it uses arduino and reading RTC setting which will give a signal to the servo motor according to the time which has been set by the owner on Android, and the servo motor will open for a few seconds to release the food on pet feed until the LCD displays food available, It can be concluded that this tool will automatically issue food according to the time set at the beginning. But lacking from designing pet feeding equipment, namely no there is knowledge of when food containers are empty and when they are not it's time to put out the food but the cat already feels hungry [5].

B. Based on Research conducted by

Based on testing and analysis, the research designed an automatic pet feeding device via the web using the SDLC or System Development Live system method Cycle that can be operated using a cellphone and also using Arduino Uno as a microcontroller, it can be drawn The conclusion is that this tool can dispense food automatically IOT-based or must be controlled first via the web using a cellphone. But on the other hand, from an automatic-based perspective IoT, this still has weaknesses that must be controlled first by the owner when he is away from the animal pets, whose owners themselves do not know when they are animals whether the pet is hungry or no [6].

C. Based on research conducted by Habillah Abbas, Kusnadi Kusnadi, Wanda Ilham, and Suhadi Parman (2021) "Equipment Control System Automatic Cat Feeder Using NodeMCU Module" [7].

Based on several tests and analysis, the research authors observed that they designed an automatic animal feeding control system using the nodeMCU module to make things easier for owners animals who find it difficult to feed themselves animal [11]. This tool can work automatically using real modules time clock (RTC) for setting the feed delivery time controlled by the nodeMCU module as a microcontroller and can also controlled directly via the user's smartphone when desired add to the feed [12]. It can be concluded that this tool can dispense feed automatically with time settings which is controlled by the nodeMCU module as a microcontroller and can controlled by the pet owner via a connected smartphone. But a side Otherwise, this tool still has weaknesses where it cannot be used detects if the animal feels hungry or not, because it doesn't close It is possible that the animal owner was negligent or forgot to control the feed using his cellphone which is connected to the feed device the animal and also the RTC module which regulates the time of feed release, will make the animal wait for food to come out according to the RTC settings.

Based on the shortcomings and weaknesses in previous research, then The author has an innovation to solve the problems that occurred above by adding a sound sensor using the Easy VR module and sensor weight using a load cell scale. Voice Recognition technology identifies the speaker by extractin and analyzing the features that relate to these individual phsyical and behavioral characteristics [13]. Where with the Sound Sensor that will responds to rattling sounds and a weight sensor that will detect empty or When the reservoir is full, food will automatically be released when the tank is full hear the rattling sound of animals approaching the food and if If the reservoir is still less than the weight that has been set, in this research, an arduino microcontroller is used as a data processor and second sensor what is used is a load cell which is positioned to detect the weight produced. Then the weight data is processed into the amplifier to read the value so that the value can be read by microcontroller [14]. The servo motor will gets a signal that will open the valve automatically to release food and when the reservoir is full, the feed valve will automatically close open even though it responds to the rattle of an approaching animal. Servo motors are elements/components that convert energy from direct current electric current, into mechanical energy in the form of rotational movement. Servo motors as a source of driving power, controlling the rotation of the motor shaft is done by controlling the current or voltage in the anchor coil [15]. That matter to make it easier for the owner because there is no control from pet owners directly.

III. PURPOSED SYSTEM

A. Modeling and function of the proposed system

able.

The main purpose of making this tool is to facilitate the feeding of pets. The hardware and software requirements for the proposed system are shown in TABLE I.

TABLE I. HARDWARE AND SOFTWARE REQUIREMENTS

Category	Component	Function
Hardware	Arduino UNO	As a microcontroller
	Easy Voice Recognition 3.0	As a sound sensor
	Load Cell HX-711	As a weight sensor
	Motor Servo	As a open and close feed reservoir
	LED	As an indicator lamp of a tool
	Adaptor Power Supply	As a provider of electrical power needed to operate electronic devices such as Arduino
Software	Arduino IDE	To write and send programs to hardware

B. Implementation of the proposed system

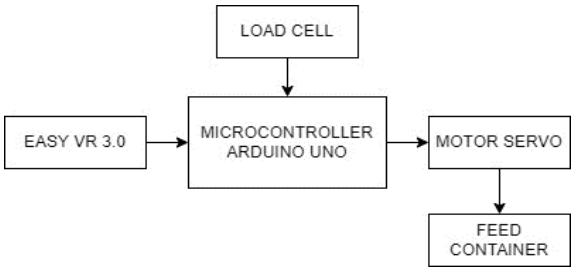

Fig. 1. Blok diagram of the proposed system.

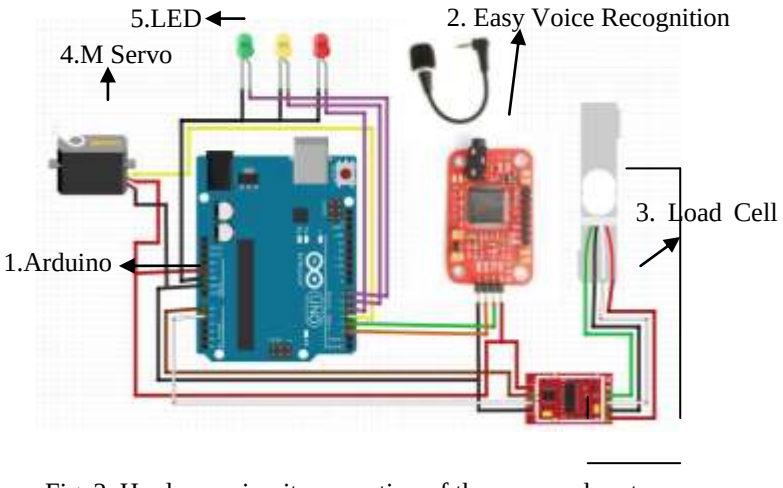

Fig. 2. Hardware circuit connection of the proposed system.

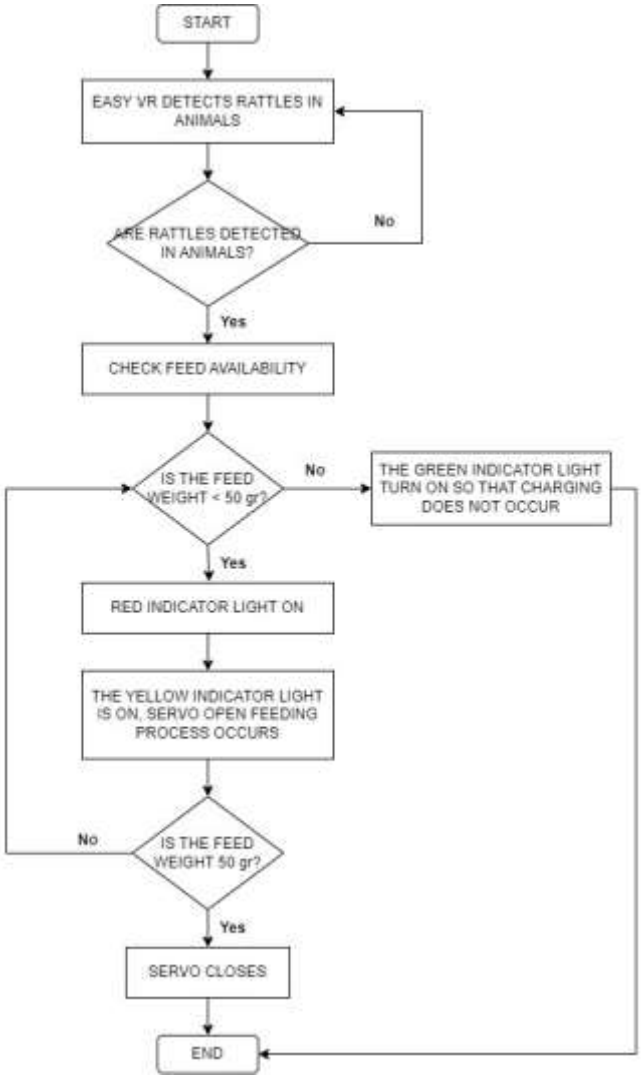

Fig. 3. FlowChart of the proposed system.

Fig. 1 Shows the block diagram of the Microcontroller-based Automatic Animal Feeding Station Using Sound Sensor and Weight Sensor. There is the Arduino UNO as the microcontroller, then the Easy Voice Recognition 3.0 sensor as the sound sensor. There is an Arduino UNO as a microcontroller, then the Easy Voice Recognition 3.0 sensor as a sound sensor that detects the sound of rattles on animals, Load Cell HX-711 Sensor as a weight sensor on the scale under the feed container. Servo motor as a driving force to open and close the animal feed container if it gets a response from Easy VR 3.0 and Load Cell HX-711 according to the program command.

Fig. 2 shows the hardware circuit of this research. A wiring diagram is a schematic drawing that explains the connections between one component and another component in detail in a chain wiring [9].

Based on the Hardware circuit connection, it can be elaborated that:

1. Arduino UNO
2. Easy Voice Recognition 3.0
3. Load Cell HX-711
4. Motor Servo
5. LED

Where Arduino Uno as a Microcontroller system of the automatic animal feeding device, In making the processing system tool using Arduino Uno. The Arduino Uno specifications have 14 digital I/O pins which can be used as input or output (there are 6 pins which can be used for PWM). Arduino Uno also has 6 analog inputs. Arduino generally works at 5 volts [16]. Easy Voice Recognition 3.0 sensor as an input that works to detect the sound of the rattles used in animals, then sends a signal to the Load Cell module hx-711 weight sensor as a feed scale in the container, then the output is the feed released by the feed reservoir valve which is opened by the servo motor according to the applicable command.

Where Easy VR 3.0 has 4 pins that will be connected to the Arduino UNO (GND from Easy VR 3.0 connects to GND Arduino UNO, Serial communication protocol Receive Data (RXD) connects to pin 2 Digital Arduino UNO, Transmit Data (TXD) connected to pin 3 Digital PWM Arduino UNO, and VCC is connected to pin 3 Digital PWM Arduino UNO, and VCC to the 5V Arduino UNO pin). Load Cell sensor with the HX-711 module as its weight sensor, where the HX-711 Load Cell has 4 pins that will be connected to the Arduino UNO (The GND of the Load Cell HX-711 is connected to the GND of the Arduino UNO, the DT and SCK pins of the Load Cell HX-711 are respectively connected to the Analog pins A0 and A1 of the Arduino Uno, last the VCC pin is connected to the 5V pin of the Arduino UNO. The Servo Motor as a feed tandon unscrew drive has 3 pins connected to Arduino UNO (GND Servo Motor connected to GND Arduino UNO pin, Servo Motor VCC pin connected to Arduino UNO 5V pin, Servo Motor PWM pin connected to pin 4 Digital Arduino UNO), last 3 red yellow green LEDs as indicator lights of running tool according to purpose (pin + to GND Arduino UNO, and pin - red LED to pin no 5, pin - yellow LED to pin no 6, and finally pin - green LED to pin no 7 Digital Arduino UNO.

Fig. 3 shows the flow chart, which is the step-by-step approach followed in writing the automatic feed bin program, which allows the execution of the commands desired by the author.

Broadly speaking, the program design consists of four design stages, namely flowchart design, use of Arduino IDE software, and design of tools and materials used in the circuit. Each step in system design requires foresight, accuracy and accuracy because the initial design will determine the end of a design in the process of making tools. If we do the design stage well and meet the specified standards, then the designed tool will operate as expected.

IV. RESULT

In this section contains the results of the tool with an automatic animal feed system based on a microcontroller system using sound sensors and weight sensors, testing is done by testing the sound system of rattles on animals and the weight system of feed filled by food. the things that will

be tested are the accuracy of the sound of animal rattles and the accuracy of the weight of the feed filled.

A. Tool design results

The design of the tool consists of several components assembled on one hollow PCB board, this tool uses 1 microcontroller, namely Arduino Uno. the voltage source needed in this tool is 5 volts for the Arduino Uno microcontroller, 4.8 volts to 5 volts for the Easy Voice Recognition 3.0 sensor component, load cell module hx-711 sensor, servo motor, and 3.5 volts for the LED indicator light component. the following is an image of the finished tool.

Fig. 4. Tool Results.

In Figure 4 we can see a tool consisting of several components that have been integrated. This automatic animal feed system will work if 1 sensor has been verified, namely the easy voice recognition 3.0 sensor which sounds the sound of the rattles on the animals that have been recorded (train) before. if the sound of the verified rattles is detected, the hx-711 load cell will respond to the servo motor, whether the servo motor will open or remain closed according to the previous design.

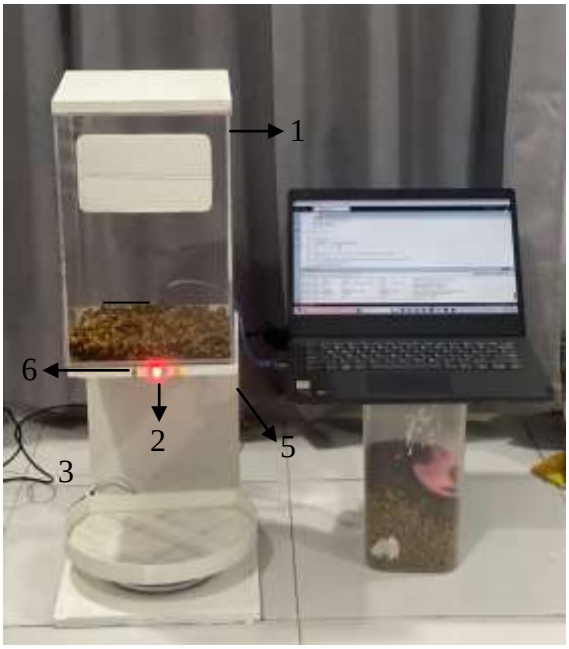

Fig. 5. Mechanical Design Results

Based on the mechanical results of the finished tool design, it can be elaborated that:

1. The image designated on arrow no. 1 is an animal feed tandon containing feed,
2. The image designated arrow no 2 is Servo motor as a drive to open the lid of the feed hopper to dispense feed,
3. The image designated arrow no 3 is a feed container, in order to accommodate the ejected feed,
4. The image designated on arrow no 4 is a load scale cell as a feed weight gauge that is in the feed container,
5. Arrow no. 5 is on its back where the place its electrical circuit,
6. Arrow no 6 is an LED light as an indicator light of the running of the tool according to the purpose.

B. Motor Servo Testing

To test this servo motor, it is done by charging it program it first to the microcontroller. The program is a program to activate the servo motor. As is known that the servo motor is activated by providing a PWM (Pulse Width Modulation) signal with a pulse width certain. This signal will tell the servo motor to rotate CW (Clock Wise = clockwise) or CCW (Counter Clock Wise = counterclockwise) [10].

The servo motor rotation has 2 directions, namely clockwise and clockwise counterclockwise. The direction of rotation of the servo motor is determined [10], by trial and error of several pulse output values with using a program that is already running.

C. Sound Sensor and Weight Sensor Testing

The testing process is that the first is testing the rattling sound sensor system by Easy Voice Recognition 3.0., the second is the weight sensor by the HX-711 load cell. whether it can run well or not. Testing This is done by connecting the tool to a laptop or computer. You can upload programs to Arduino as a microcontroller. Before starting tool testing, a train is carried out voice as voice recognition which will be saved in the Arduino Uno database by the load command on the GUI display.

Following are the steps to open the detection display of the rattling sound sensor and weight sensor :

1. Open the Arduino IDE Application.
2. Connect the electrical circuit that has been assembled to the laptop/PC.
3. Make sure the program has been created successfully uploaded to Arduino Uno and confirm connection to the Program and connect using a PC/Laptop

Fig. 6. Running Test Display

D. Sound Detection Accuracy Testing

Easy Voice Recognition 3.0 is a compact and easy-control speaking recognition board. This product is a speaker-dependent voice recognition module. It supports up to 80 voice commands in all. Max 7 voice commands could work at the same time. Any sound could be trained as command. Users need to train the module first, before let it recognizing any voice command. This board has 2 controlling ways: Serial Port (full function), General Input Pins (part of function). General Output Pins on the board could generate several kinds of waves while corresponding voice command is being recognized. This module is arduino compatible [8].

Speaker independent systems are also available, they are costly. Thus, the voice recognition module VR 3, which is speaker dependent, is best suited, for use in projects of making automated systems [8]. Here the researchers saved/trained 25 rattling sounds, but only 7 sounds could be detected that were loaded.

TABLE I. RATTLES DETECTION TESTING

No	Rattles Model	Sound Intensity (dB)	Number of rattles sound commands	Number of succesful rattles	Percentage of success (%)	Description
1	light blue 1	50	20	20	100	Detected
2	gold 2	61	20	20	100	Detected
3	dark blue 3	52	20	20	100	Detected
4	pink 4	55	20	20	100	Detected
5	red 5	54	20	20	100	Detected
6	mixthree 6	65	20	20	100	Detected
7	mix1-6 7	74	20	20	100	Detected
8	grey 8	57	20	0	0	Undetectable
9	yellow 9	59	20	0	0	Undetectable
10	green 10	58	20	0	0	Undetectable
11	orange 11	60	20	0	0	Undetectable
12	nude 12	51	20	0	0	Undetectable
13	black(1) 13	62	20	0	0	Undetectable
14	black(2) 14	67	20	0	0	Undetectable
15	black(3) 15	64	20	0	0	Undetectable
16	brown(4) 16	53	20	0	0	Undetectable
17	gr+yl 17	66	20	0	0	Undetectable
18	gr+grn 18	63	20	0	0	Undetectable
19	yl+grn 19	68	20	0	0	Undetectable
20	bl(1)+bl(2) 20	69	20	0	0	Undetectable
21	red+bl(1) 21	70	20	0	0	Undetectable
22	red+bl(2) 22	72	20	0	0	Undetectable
23	nude+gr 23	71	20	0	0	Undetectable
24	nude+gr+grn 24	73	20	0	0	Undetectable
25	all 25	80	20	0	0	Undetectable

Based on the test table that can be seen, there are 25 types of models or rattle sounds with different levels of interference intensity (dB) that have been trained, but only 7 types of models or rattle sounds can be loaded. Because

Maximum 7 voice commands can work simultaneously. Any sound can be trained as a command. Users need to train the module first, before letting it recognize any voice commands.

TABLE III. RATTLE TEST BY DISTANCE IN SILENT ROOM

No	Distance	Number of rattles given in SILENT ROOM	Number of successes in each rattles model							Percentage of success (%)
			light blue 1	gold 2	dark blue 3	pink 4	red 5	mixthree 6	mixall 7	
1	10	20	20	20	20	20	20	20	20	100
2	30	20	20	20	20	20	20	20	20	100
3	60	20	20	20	20	20	20	20	20	100
4	100	20	20	20	20	20	20	20	20	100
5	150	20	20	20	20	20	20	20	20	100
6	200	20	20	20	20	20	20	20	20	100
7	300	20	20	19	19	20	20	20	20	98,6
8	350	20	20	20	19	19	19	20	20	97,9
9	400	20	20	19	20	20	20	20	20	99,3
10	500	20	20	20	20	20	20	20	20	100
11	700	20	20	18	19	20	20	20	20	97,9
Average Success										99,4

Based on table III, it can be seen that the sound sensor test on animal rattles in a silent room, the percentage of success reached 99,4%. Where in a silent room the maximum distance is detected a rattling sound is at a distance of 700 cm, and if it is more than 700 cm the rattling sound is not detected by Easy Voice Recognition 3.0.

No	Distance (cm)	Number of rattles given in NOISY ROOM	Number of successes in each rattles model							Percentage of success (%)
			light blue 1	gold 2	dark blue 3	pink 4	red 5	mixthree 6	mixall 7	
1	10	20	20	20	20	20	20	20	20	100
2	30	20	20	20	20	20	20	20	20	100
3	60	20	20	17	20	20	20	20	20	97,9
4	100	20	18	19	19	15	18	20	15	88,6
5	150	20	16	16	17	16	17	15	18	82,1
6	200	20	19	20	17	18	15	17	20	90
7	300	20	20	18	18	14	15	20	20	89,3
8	350	20	15	15	15	15	17	20	19	82,9
9	400	20	16	19	17	16	18	19	18	87,9
10	500	20	14	18	19	16	17	16	19	85
11	700	20	13	18	17	17	15	18	17	82,1
Average Success										89,6

TABLE IV. RATTLE TEST BY DISTANCE IN NOISY ROOM

Based on table IV, it can be seen tha the sound sensor test on animal rattles in a noisy room, the percentage of success reached 89,6%. Where in a noisy room the maximum distance is detected a rattling sound is at a distance of 700 cm, and if it is more than 700 cm the rattling sound is not detected by Easy Voice Recognition 3.0.

TABLE V. WEIGHT SENSOR

No	Weight Sensor (gr)	Responses
1	0	feeding container open
2	50	feeding container close
3	48	feeding container open
4	50	feeding container close
5	49	feeding container open
6	50	feeding container close
7	40	feeding container open
8	50	feeding container close
9	50	feeding container close
10	20	feeding container open
11	50	feeding container close

Based on table V, we can see that for the weight of the feed in the feed container <50 grams, the feed tank will open if the rattling sound is detected in the animal, but if the weight of the feed in the feed container is >=50 grams, the feed tank will remain closed even if the rattling sound in the animal is detected.

V. CONCLUSION

Based on the manufacture and testing of tools carried out by the author, it can be concluded that the automatic animal feed container based on a microcontroller system using the Easy Voice Recognition 3.0 sound sensor and the Load Cell HX-711 weight sensor has worked well in accordance with the wishes and objectives of the author. Where the Easy VR 3.0 sensor can detect the sound of rattles on animals almost perfectly up to a distance of 700 cm, and if it is more than 700 cm the rattling sound is not detected by Easy Voice Recognition 3.0. The Load Cell HX-711 sensor as a weight sensor for scales on the feed container runs well where when the feed filled in the feed container <50 gr and detected the sound of rattles on the animal by Easy VR 3.0 then the servo moves to open the feed container to remove the feed in the available container, whereas if the feed >= 50 gr then what happens the servo does not move meaning that the feed container remains closed even though Easy VR detects the sound of rattles used in animals. This animal feed shelter system will open when both systems, namely the Easy Voice Recognition 3.0 sensor and the HX-711 Load Cell sensor, meet or are detected. If there is only one of them, then the servo motor under the automatic feed reservoir will not open and will not run.

REFERENCES

[1] Ummul Khair dan Tiara Sabrina, "Alat Pemberi Makan Kucing Otomatis Berbasis Arduino Uno pada Pet Shop", *Sebatik*, vol.23, no.1, pp.10-13, Jun. 2019.

[2] Suhendra Cahyadi. "BAB III Perancangan Alat dan Program." Internet: https://adoc.pub/bab-iii-perancangan-alat-dan-program-untuk merealisasikan-me.html, Des. 06, 2015 [Mar. 02, 2022].

[3] Samrasyid. "Pengertian Sensor Beban Load Cell." Internet: https://www.samrasyid.com/2020/12/pengertian-sensor-beban load-cell.html, Des. 10, 2020 [Feb. 27, 2022].

[4] Fitriani Purba. "Pemanfaatan Motor Servo untuk Pembuka dan Penutup Jendela Otomatis Berbasis Atmega 8." Tugas Akhir, Universitas Sumatera Utara, Medan, 2018.

[5] Cristin Yesica Aritonang. "Rancang Bangun Alat Pemberi Makan Hewan Peliharaan Berbasis Arduino." Projek Akhir 2, Universitas Sumatera Utara, Medan , 2019.

[6] Saputro, "Alat Pemberi Makan Hewan Peliharaan Otomatis Berbasis Teknologi Internet of Things (IoT)", *Jurnal Teknologi Informatika dan Komputer MH Thamrin*, Vol. 6, No. 1, Mar. 2020.

[7] Abbas, "Sistem Kendali Alat Pemberi Pakan Kucing Otomatis Menggunakan Modul nodeMCU", *Jurnal Ilmiah Digital of Information Technology*, Vol. 11, No.2, pp.166-177, 2021.

[8] S. Joshi Aarti Kumari, P. Pai Saiesh Sangaonkar, and S. Assistant Proffesor, "Voice Recognition System," *Journal for Research* , vol. 03, 2017, [Online]. Available: www.journal4research.org

[9] A. Rufa *et al.*, "PROTOTYPE ALAT PEMBERIAN PAKAN AYAM OTOMATIS MENGGUNAKAN ARDUINO DAN INTERNET OF THINGS UNTUK NOTIFIKASI KETERSEDIAAN PAKAN," 2022.

[10] S. Fakultas Matematika dan Ilmu Pengetahuan Alam, "PENGENDALI MOTOR SERVO BERBASIS MIKROKONTROLER BASIC STAMP 2SX UNTUK MENGEMBANGKAN SISTEM ROBOTIKA."

[11] S. Kendali Alat Pemberi Pakan Kucing Otomatis Menggunakan Modul Nodemcu -Habillah Abbas and W. Ilham, "SISTEM KENDALI ALAT PEMBERI PAKAN KUCING OTOMATIS MENGGUNAKAN MODUL NODEMCU ABSTRAK," 2021.

[12] R. Ndalusandi, "OKTAL : Jurnal Ilmu Komputer dan Science ALAT PAKAN KUCING OTOMATIS BERBASIS INTERNET OF THINGS (IOT) MENGGUNAKAN TELEGRAM DAN MIKROKONTROLLER WEMOS D1 R1", [Online]. Available: https://www.arduino.cc/en/software

[13] K. Takafumi and L. Kong Aik, "Special Issue on Social Value Creation Using Biometrics Safety, Security, and Convenience: The Benefits of Voice Recognition Technology."

[14] Y. Mukhammad, A. Santika, S. Haryuni, and A. W. Artikel, "Analisis Akurasi Modul Amplifier HX711 untuk Timbangan Bayi INFO ARTIKEL ABSTRAK", doi: 10.18196/mt.v4i.

[15] I. Sahat, P. Siahaan, M. T. Simanjuntak, and D. Lumbantoruan, "Studi Analisis Dan Rekayasa Pengendalian Motor Servo DC Di Laboratorium Dasar Sistem Kendali Dengan Metoda Pole Placement," 2021.

[16] R. Muttaqin1 and D. B. Santoso2, "Prototype Pagar Otomatis Berbasis Arduino Uno Dengan Sensor Ultrasonic Hc-SR04." [Online]. Available: www.jurnalteknik.unisla.ac.id/index.php/