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Cat Feeding Using Microcontroller Arduino Uno TCS3200 Sensor and Internet of Things

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ABSTRACT

Petting animals is one way for humans to reduce stress levels and entertain themselves. When coming home from work, a person needs entertainment at home, namely by keeping cute animals; one of the attractive and widely kept pets is a cat. The presence of cats in the house can help restore mood or feelings, and animals that like to be invited to play. For that, the owner must love his own pet without reducing affection for his pet; a cat's diet must be maintained even though the owner is busy working, especially outside the city, because cats need a good diet. Therefore, the purpose of doing this research is to facilitate cat owners in feeding while doing other activities outside the home. In addition, previous research still cannot feed the cat automatically but can monitor the state of cat activity. This tool uses several sensors, namely the RTCDS3231 sensor, TCS3200, Load Cell, HX711, ESP32CAM. The results obtained are Cat Feeding Using Arduino Uno Microcontroller TCS3200 Sensor, and Internet of Things is a tool system that can notify that the feed has run out, can feed the cat automatically, and can find out the activity of the cat by using the sensor. Several pet shop parties strongly agree that this tool is very helpful, namely to reduce the worry of the owner in feeding the cat.

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1. INTRODUCTION

Petting animals is one way for people to reduce their stress levels and keep themselves entertained. Having a pet brings positive benefits to the mental body. Many workers who live alone choose to keep pets, where the stress level of workers continues to increase along with the work in the company where they work. When coming home from work, a person needs entertainment at home, namely by keeping cute animals [1]. One of the cute and widely kept pets is a cat. Some people keep animals for emotional support, The presence of cats at home can help restore mood or feelings, and the hobby of keeping animals keeping a cat can entertain and reduce the owner's sadness if the cat owner is sad because the cat's adorable behavior can make the owner become entertained [2].

Cats can be animal friends for both parents and children. When the owner is at home but again alone, the cat can be a playmate when alone for. That the owner must love his own pet without reducing the affection for his pet, especially the cat's diet, which must be maintained even though the owner is busy working let alone out of town for several days is maintained even though the owner is busy working let alone out of town for several days [3]. Cats need a good diet; feeding cats that are not efficient and effective because irregular diets can cause irregular digestion in feline animals. along with the progress of increasingly modern times, namely 5.0 with technology that is very advanced and sophisticated [4]-[5].

The development of technology runs very fast and affects the manufacture of sophisticated tools, therefore increasing progress in the world of technology. As for previous research that discusses similar tools, D. Bailey *et al.* [6] examined behavior monitoring in cats. The results showed that this study had weight monitoring in cats. in previous studies had a weakness, namely not being able to feed cats automatically. Therefore, the author thinks to have an idea, namely building a cat feeder with an Arduino Uno microcontroller and TCS3200 sensor and the Internet of Things so that managers are no longer worried that this tool can feed cats remotely and is supported by the Internet of Things. To develop a cat feeding device using Arduino Uno microcontroller TCS3200 sensor and Internet of Things technology in order to perform remote feeding and reduce the worry faced by cat owners in feeding due to busy activities outside the home. The Internet of Things allows us to control various devices, thus changing the way we communicate with machines [7]-[8]. It also saves time and money as you can receive and transmit data remotely. The Internet of Things is a technology that allows everything to be connected; with the Internet of Things, all work becomes practical and easier [9]. This device will use the telegram application that uses the internet network, and telegram is an application that supports the Internet of Things. The main challenge in IoT is bridging the gap between the physical world and the information world [10].

It is expected that billions of physical things or objects will be equipped with various types of sensors connected to the internet through networks as well as technology support such as embedded sensors and actualization, radio frequency radio identification (RFID), wireless sensor networks, real-time and web services, IoT is actually a cyber-physical system or network of networks [11]-[16]. Telegram service is an application that can send messages that are used as a medium of communication; Telegram has storage, so it will be very easy to send messages to each other because telegrams have storage space [17]. Telegram is easy to get on all smartphones and can be obtained by downloading the application feature on smartphones. Telegram launched a bot which can be operated by the program [18]. The volume of cat food will be detected using a load cell sensor, and hx711 by utilizing the weight of cat food will be detected using the weight of cat food and connected to a telegram so that it can send a notification that the cat food has run out [19].

Arduino is an open-source single-board microcontroller designed to make electronics easier to use in various fields [20]. The hardware is powered by an Atmel AVR processor, and the software has its own programming language. Arduino is open source aimed at anyone who wants to prototype interactive electronic equipment based on hardware and software that is flexible and easy to use [21]-[24]. Arduino Uno is a microcontroller that can be programmed using the Arduino ide programming language, which has syntax similarities with the C programming language [25]. The TCS3200 Color Sensor is a programmable sensor consisting of 64 photodiodes as object color detectors and frequency filters based on wavelength. This sensor reflects and absorbs different wavelengths of light in the RGB range [26], so if the sensor absorbs the color value of the object, it automatically adjusts what commands are detected from the sensor. In addition, this sensor has a focus lens that is useful for sharpening the photodiode's detection of light intensity with a reading distance of 2 mm from the IC lens [27]-[30]. The servo motor is a motor with a close feedback system where the motor position will be informed back to the control circuit inside the servo motor [31]-[34], [35]-[43], [44]-[46]. This research still contributes to monitoring and feeding, which makes it easier for cat owners to take immediate action when something goes wrong in a residential area. not to worry about feeding when they are busy at work.

2. METHODS

In this study, to assist in the maintenance of feed in cats and who use Arduino technology and the Internet of Things. The system created integrates color recognition and identification of feed that will run out through telegram notifications that must be sent to the administrator using the internet network and this research with observation methods, software design, hardware manufacturing, and direct data collection. Research methods shown in Fig. 1.

Fig. 1. Research methods

In this section, we conducted a review of previous studies to obtain comparisons, and contributions from these studies. The results we get are a supporting theory to implement this research and several previous studies. Where in general research Previous research, controlled cat feed must have an internet connection, and others still use ultrasonic sensors which result in feed going out continuously when the cat approaches the sensor.

2.1. Design

In this section, it is necessary to carry out the software and hardware design process. In the hardware section, the circuit design and block diagram are made in this system, the hardware design is made using the fritzing software application.

Based on Fig. 2 describes the initial steps in making a hardware circuit for the physical embodiment of a cat feeder using an Arduino Uno microcontroller and TCS3200 sensor by adjusting the desired components and sensors, then adjusting the pins on the microcontroller port on the Arduino Uno and the sensors used. Based on Fig. 3 is a flow chart; the Real Time Clock Sensor is used to detect the time as instructed, which is arranged in a plastic black box. TCS3200 sensor is used to detect the color of an object; besides that, it is used to detect the color of a cat. Load Cell Sensor, HX711, is used to detect the mass of an object. In addition, it is used to detect cat feed, whether it is still a lot or wants to thin out. ESP32CAM has two benefits in this study. Namely, to connect to a smartphone and can photograph an image of the state of cat activity.

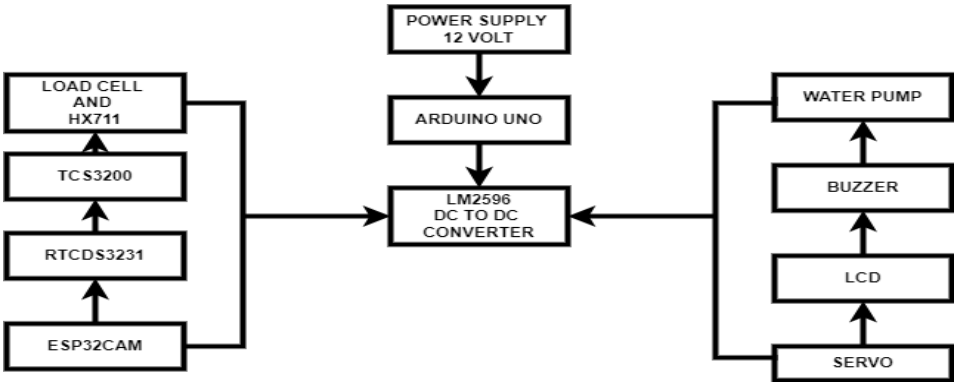

Fig. 2. Block diagram of the circuit

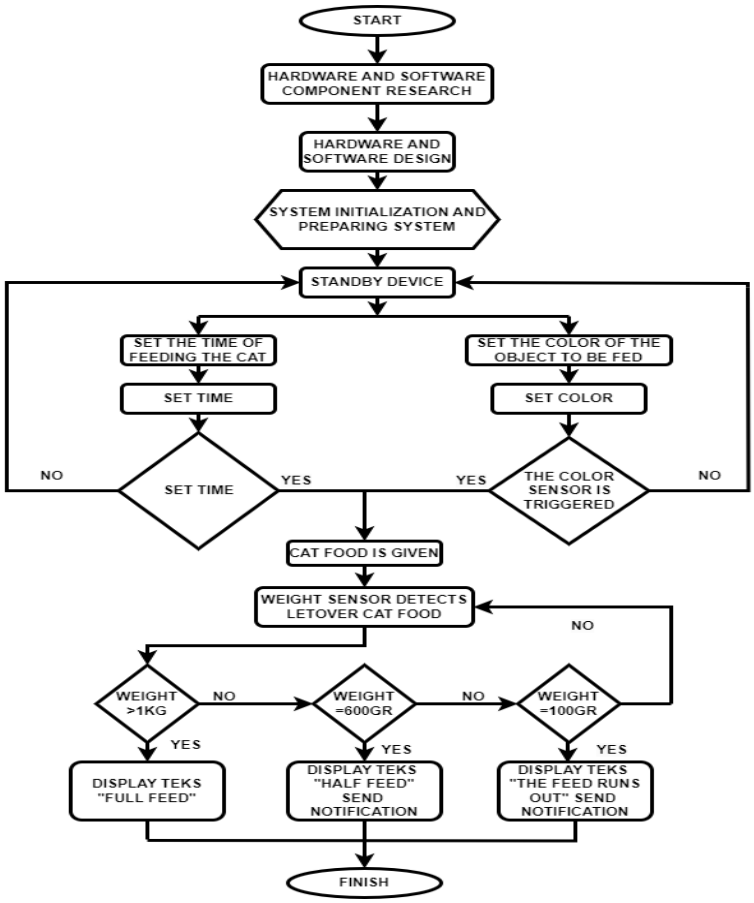

Fig. 3. Sensor reading flowchart

In Fig. 4 there are several modules, namely Load Cell and HX711 sensors as load detectors, TCS3200 sensors detect color, Real Time Clock sensors as Real Time, ESP32CAM sensors as cameras and as for connecting this system to smartphones, Arduino Uno as a Microcontroller, LM2596 as stabilizes the voltage from 12 volts to 5 volts, buzzer as an alarm or notification via sound, Liquid Crystal Display as a data viewer on the device, servo that functions to control movement, and water pump as a water pump.

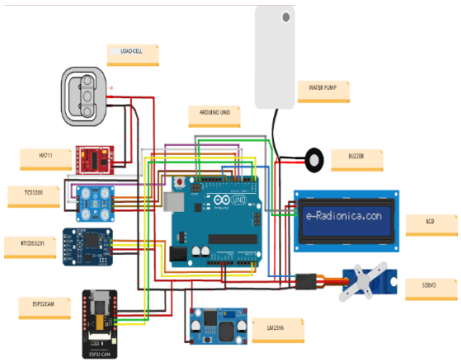

Fig. 4. Hardware layout design

2.2. Testing and Data Collection

Prepare a power outlet and plug it into the mains. Connect the device with the Android application, i.e., telegram. After connecting with the application on Android, the cat feeder is ready. This tool is equipped with several sensors; for example, the ESP32CAM sensor is used for connection between the tool and the smartphone; if it is connected, it can photograph the state of cat activity if the command displays photo data on the smartphone. Load Cell, which is used to detect that the feed is running low or runs out. In addition, the Load Cell sensor will notify the LCD; the buzzer will make a sound and send a notification to the smartphone. TCS3200 sensor is used to detect the color of the cat; if the cat approaches the TCS3200 sensor and detects the color of the cat according to the command or according to the color of the cat owned, then the feed will come out automatically using a servo. The Real Time Clock sensor is used to detect the time to feed the cat according to a predetermined time; if at the time of the clock matches the command, then the feed will come out automatically using a servo.

In this study, various experiments were carried out by simulating the program that had been made; the simulation process for hardware was carried out by using the Arduino IDE software and then opening the serial monitor. In addition, the application simulation process was also carried out on a smartphone regarding the notifications on the Telegram application.

3. RESULTS AND DISCUSSION

The tool produced from this research is an Internet of Things-based cat feeding device and software on a smartphone, namely a telegram application that function as a remote or as a notification when the feed is running low or runs out.

3.1. Hardware Circuit Result

Fig. 4 is the result of a circuit that is arranged or connected between components and sensors using cables to connect to each other and put in a neat black plastic container. Hardware tool set results shown in Fig. 5.

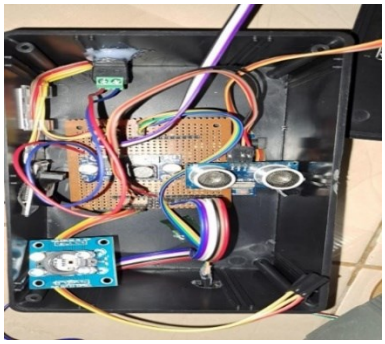

Fig. 5. Hardware tool set results

This hardware design has several sensors and has a task according to the commands made in the program, and this device uses a plastic box. This device is arranged in a plastic box and a pipe in which it functions to put and remove cat food. The final hardware design is described in Fig 6.

Fig. 6. Design results of the cat feed

3.2. RTCDS3231 Sensor Testing Results

For example, the test results on cat feeding experiments using the RTCDS3231 sensor can provide feed in real time and can be seen in Table 1.

Table 1. Testing the feed giver using real time sensor

Test Run	Time Set RTCDS3231	Time Match	Description
1	07.05.00	07.05.15	servo turning
…	…	…	…
2	12.00	12.01.00	servo turning
…	…	…	…
3	17.00	17.01.45	servo turning

Table 1 is the result of testing the Real Time Clock or RTCDS3231 sensor, which is used as a cat feeder timer which is done three times in 1 day and can feed the cat according to the hour that has been set or adjusted. This RTCDS3231 sensor is a timer on this research tool. If the owner forgets to give food to the cat because of the rush and the food is still in the tool, then at a predetermined hour, the feed comes out automatically if the RTCDS3231 sensor detects the set hour.

3.3. Load Cell Sensor Testing Results

Furthermore, the test results on the Load Cell sensor and the HX711 Module are to detect cat feed runs out; if when the feed runs out, and the sensor detects it, it will send a notification to the smartphone. The test results on the cat feed notification experiment run out using the Load Cell sensor, and the HX711 Module can be seen sending notifications as in Table 2 and Fig 7.

Table 2. Testing feed out notification using load cell sensor and HX711 module

Test To	Feed Weight	Description
1	1 Kg	Full
2	600 Kg	Half full
3	400 Kg	Thins and Sends Notifications
4	250 Kg	Refill
5	100 Kg	Runs Out and Sends Notifications and Buzzer Sounds

Fig. 7 is the result of the load sensor and hx711 module detecting that the cat's feed has run out and sending a notification to a smartphone connected to the telegram application. Where if the feed runs out and the sensor detects that the feed has run out, the sensor will send a notification. The purpose of the load cell sensor and hx711 is to notify the cat owner to refill the feed on the cat after knowing that the cat's feed has run out or can notify the owner to buy more cat feed if the stock at home has run out.

3.4. TCS3200 Sensor Testing Results

Before testing the sensor, do a test by taking the color value of the cat to get the appropriate color, namely by bringing the cat close to the TCS3200 sensor and then opening the serial in the Arduino ide application; it will get the RGB value as Table 3 and Table 4 show that the results of taking the color value on the TCS3200

sensor and after getting the value when taking the value then entering the value in the program. The following is the result of testing the TCS3200 sensor, namely how the results of cat food will come out automatically according to the color of the cat that has been set or determined in the program that can be obtained from taking color values; in this study, there are two color objects in cats, namely white and orange. If the TCS3200 sensor detects the appropriate color from the value obtained, the servo will rotate automatically, and the food will come out, and the results in Fig. 8 shows that the TCS3200 Sensor detects the color of the white cat according to the color value code reading read on the cat which previously obtained the color value at the time of data collection and has been entered in the program. TCS3200 sensor reading detecting white color shown in Table 3.

Fig. 7. Load cell sensor and HX711 module detect feed out and send notification (pengaturan notifikasi = notification setting, hapus = delete, makanan akan habis = food will run out)

Table 3. TCS3200 sensor reading detecting white color

No	R	G	B
1	25	20	24
2	23	25	23
3	23	25	24
4	24	25	24
5	23	25	24
6	23	25	24
7	23	25	23
8	23	25	23
9	24	26	24
10	26	26	24
Total	237	247	237
Average	23.7	24.7	23.7
Maximum	26	26	24
Minimum	23	20	23

Fig. 8. White color reading result

Furthermore, before experimenting on the second cat color is like the way in Table 3, namely by looking for the value of cat color data by looking for the value of Red, Green, Blue and if it is obtained then enter the value in the program.

Then in Fig. 9 shows the results of the TCS3200 sensor experiment which detects the orange color of the cat and feeds the cat with a color theme that matches the value in the table and if the value is appropriate, the TCS3200 sensor will detect the color of the cat and the servo rotates.

Table 4. TCS3200 sensor reading detecting orange colour

No	R	G	B
1	118	195	222
2	127	198	225
3	128	205	233
4	118	183	203
5	116	184	202
6	112	175	195
7	116	183	200
8	117	186	205
9	118	185	204
10	117	188	209
Total	1.187	1.882	2.098
Average	118.7	188.2	209.8
Maximum	128	205	225
Minimum	112	175	195

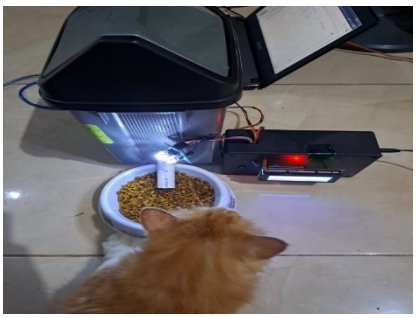

Fig. 9. White color reading result

The TCS3200 sensor works very well which feeds the cat automatically because the cat eats erratically, for example, in the next 10 minutes the cat wants to eat again with the TCS3200 sensor if the cat approaches the feed device and the sensor detects the feed will automatically come out the feed.

3.5. ESP32CAM Sensor Testing Results

Furthermore, the results of the ESP32CAM sensor are used as a camera to determine the presence of cats and cat activities connected to the telegram application on a smartphone by photographing an image. ESP32CAM sensor sending image results on telegram shown in Fig. 10.

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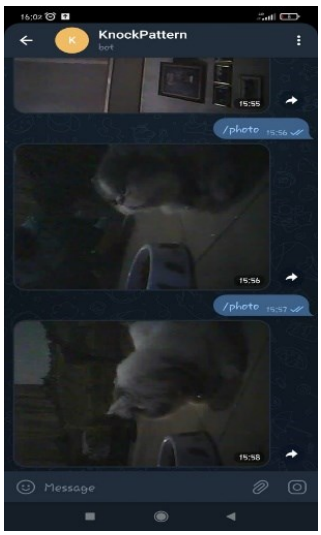

Fig. 10. ESP32CAM sensor sending image results on telegram

As Fig. 8 is the result of how to use it, namely by typing "/photo," then ESP32CAM will send an image to the telegram application with a delay of 0.1 seconds if the network conditions are smooth and if the

network is less stable than ESP32CAM will send an image to the telegram application no later than approximately 1 minute. With this ESP32CAM sensor, the owner can find out what cat activities are done on the cat.

4. CONCLUSION

Internet of Things for monitoring and notification that the feed has run out using ESP32CAM has been running well according to the percentage of success of 100% where the system can send images of cat conditions. The notification delivery time to the user is 1 to 4 seconds because there is a time lag if the internet network is smooth, and if the network is disrupted for delivery, it allows up to 60 seconds or 1 minute.

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