

# IoT - Based Cat Feeding and Cage Door Control

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**Abstract.** A much-loved pet is a cat because of its cute and adorable behavior, in keeping animals sometimes many owners have busy outside the home, so that the basic needs of cats such as cage conditions, feed, and activities outside the cage to play are less controlled. In this increasingly sophisticated era, there are many technologies that can be utilized, especially the utilization of the Internet of Things. Therefore a tool is needed that can control the cat's cage door and feed when the owner is busy, this tool uses ESP32 as a microcontroller and telegram application as a remote control. Where this tool uses the HCSR04 Ultrasonic Sensor as a distance detector for cats outside the cage which is limited to 100 cm from the sensor and the HCSR501 PIR Sensor as a detection of cat movement in the cage. When the distance of the cat is less than 20 cm from the ultrasonic sensor then the door will open and the PIR sensor will detect the cat, if the cat is detected then the door will close, from the test results using ultrasonic sensors and rulers it is found that measurements at a distance of less than 50 cm have a smaller difference than the distance of more than 50 cm.

**Keywords:** Internet of Things, Telegram, Cat, ESP32, Technology

## 1 Introduction

Internet of Things (IoT) is familiar to some people, but there are still many who do not know about it. Basically, IoT can be concluded where objects or objects around us can communicate with each other through the internet network[1]. IoT can also be used to control lights[2], health monitoring systems[3][4], water quality monitoring systems[5], intelligent irrigation systems[6], intelligent agricultural monitoring systems[7], automatic door locks[8] and others. With the development of technology, there are many benefits that are felt, one of which is making it easier to keep favorite animals.

Having a pet means that you must be ready to care for, maintain, and pay attention so that your pet's health and growth can be maintained properly. Pets can also provide benefits to their owners both in terms of mental, and physical health. One of the most popular pets is cats because of their cute and adorable behavior.

Cats are animals that easily blend in with humans so that they can accompany their owners' daily lives. The most important thing in keeping a cat is regular feeding and keeping it from getting stressed. It will be different if the cat owner has a busy activity

outside the home, the cat's basic needs such as cage conditions, feed, and activities when the cat wants to leave the cage to play less controlled [9]. Of course it is highly avoided because it can cause cats to get sick, malnourished, stressed and even lead to death.

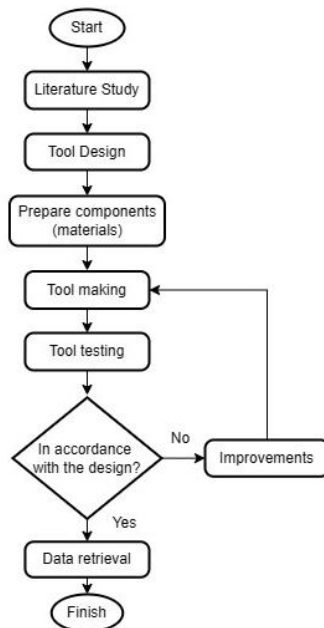
In this increasingly sophisticated era, there are many technologies that can be used to facilitate all human needs in caring for pets. One of them is an automatic cat feeder [10]. In previous research, cat cage design tools using IoT and Telegram have been implemented well [11], but the research has not paid attention to aspects of the feed needs of pets. But in addition to the use of IoT and telegram for pet control, there are various uses that can be utilized, one of which is as a tool that can monitor the state of the house [12][13], automatic trash can monitoring [14], and package receiving devices [15].

Based on these problems, this research was conducted to facilitate the owner in controlling the cage as well as feeding the cat remotely using the telegram application. It is hoped that by making this tool the cat's needs can be met properly when left by the owner.

## 2 Methods

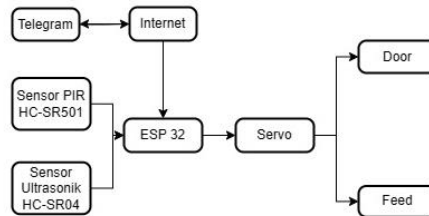
### 2.1 System Design

In this research, the most important stage to do first is planning on the tools to be made. Stages can be seen in Figure 1.



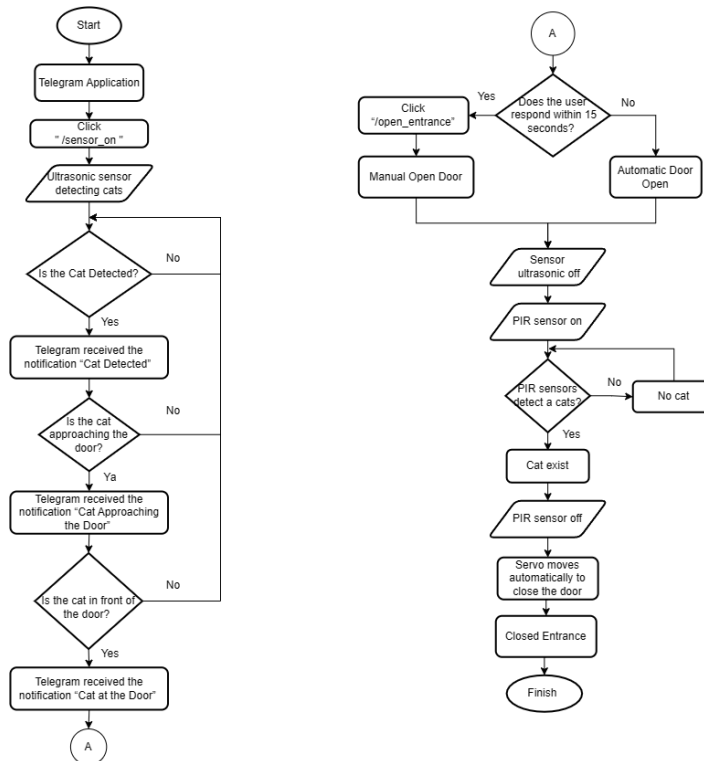
**Figure 1.** Planning Diagram

In Figure 1, this IoT-Based Cat Feeding and Cage Door Control consists of several stages, namely design starting from literature study, electrical and mechanical design process, collection of components and materials needed, then making the tool. After the tool is successfully done, tool testing can be done to see if the tool can function properly so that data collection can be done.



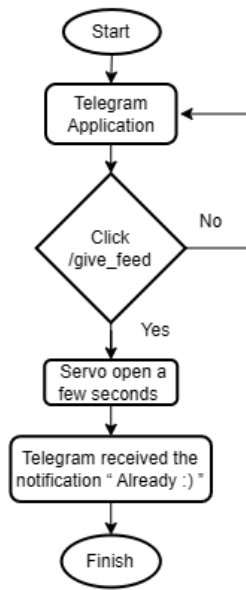
**Figure 2.** Block Diagram

In Figure 2 the HC-SR04 ultrasonic sensor detects the cat, if detected the servo will open the cage door. Then when the HC-SR501 PIR Sensor detects a cat, the ESP32 will send a message to the telegram that the cat is in the cage or not. Users can also send messages to open and close the door by sending commands via telegram. To feed the cat the user can send a message via telegram so that the servo opens to release cat food.



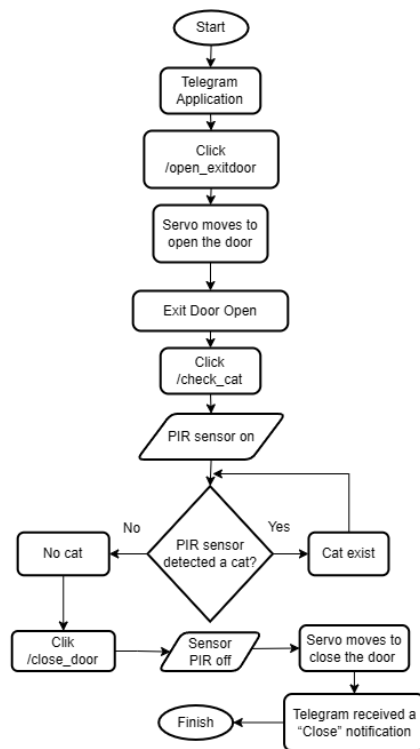
**Figure 3.** Cat System Design When Entering The Cage

In Figure 3 is the flow in the system when the cat wants to enter the cage. This system will work if the user gives the command “/sensor\_on”, so that the ultrasonic sensor can detect cats with a distance of less than 100 cm. When the cat is detected and the message “The cat is in front of the door!!!” then the door can be opened via user command or automatically. Then when the door is open the PIR sensor will be active to detect whether the cat is in the cage or not, if detected in the cage then the door will be closed automatically.



**Figure 4.** Feeding System Design

In Figure 4 is a system design or flow in feeding cats. When the user gives the command to “/give\_feed” then the cat food will come out.



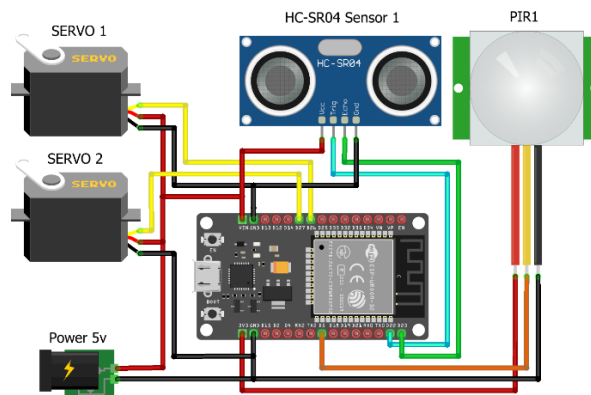
**Figure 5.** Cat System Design Exit Cage

In Figure 5 is the flow in the cat out of the cage system. When the user gives the command “/open\_exitdoor” then the door will open, then the user can give the command “/check\_cat” to detect the presence of a cat whether the cat has left the cage or not. If the cat is not detected in the cage then the user can command “/close\_door” so that the door can be closed immediately.

## 2.2 Electrical Design

This design consists of a series of components that will be used, namely:

1. ESP32
2. HC-SR04 Ultrasonic Sensor
3. PIR Sensor HC-SR501
4. Servo SG90
5. 5 volt adapter
6. USB host Shield



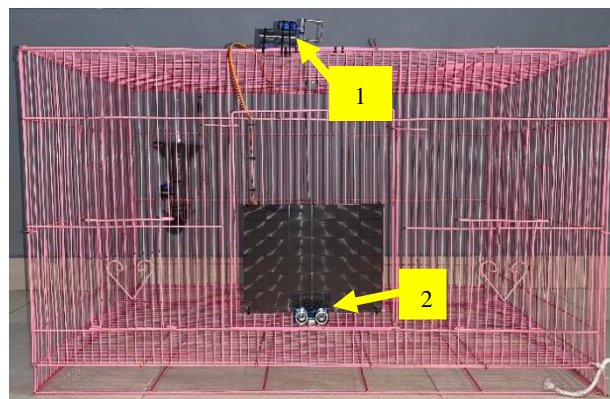
**Figure 6.** Electrical Design

In the electrical design there is an ESP32 which is used as a microcontroller and will be connected to a telegram, where the telegram functions as a remote control. Ultrasonic sensors are used to detect the presence of cats when they are outside the cage. The PIR sensor is used to detect the movement of the cat, whether it is in the cage or not. Using 2 servo motors, 1 servo is used to open or close the cat cage door, while the other servo is used to open the cat feeder.

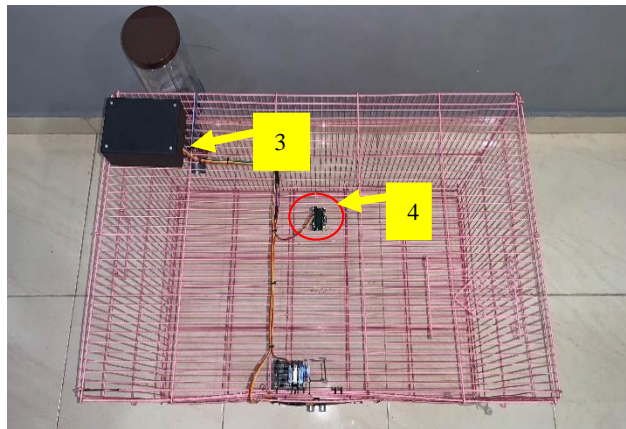
### 3 RESULTS AND DISCUSSION

#### 3.1 Tool Design Results

At this stage is the result of the design that has been designed. Where there is a cat cage with a size of 75 cm long, 45 cm wide and 45 cm high which is designed to be open or closed and there is a cat feeder designed to be able to dispense cat food using a smartphone via a telegram application.



**Figure 7.** Front View of the Tool



**Figure 8.** Top View of Tool



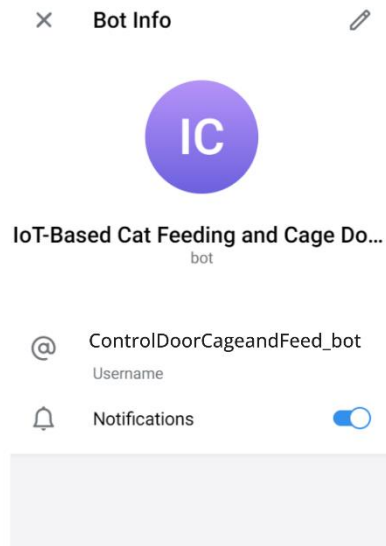
**Figure 9.** Feed Bin

The explanation of the location of each component:

1. Servo which is useful for making the door open and close.
2. Ultrasonic sensors are useful for detecting if the cat is within a range of <100 cm from the cage.
3. A box to store the microcontroller and connect with the components used.
4. PIR sensor that serves to detect the movement of cats in the cage.
5. Servo which is used to open the cat's feeder so that food can come out.

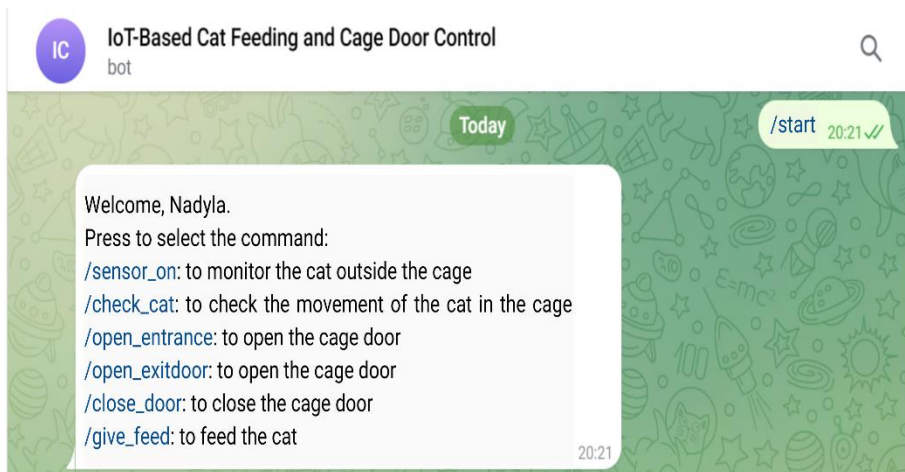
### 3.2 Telegram App Testing

At this stage, it starts by creating a telegram bot first to get TOKEN\_BOT and CHAT\_ID, which will connect telegram with IoT so that it can exchange messages.



**Figure 10.** Telegram Bot Profile

In Figure 7 is a profile of the telegram bot that has been created which functions as a remote control and is named IoT- Based Cat Feeding and Cage Door Control.

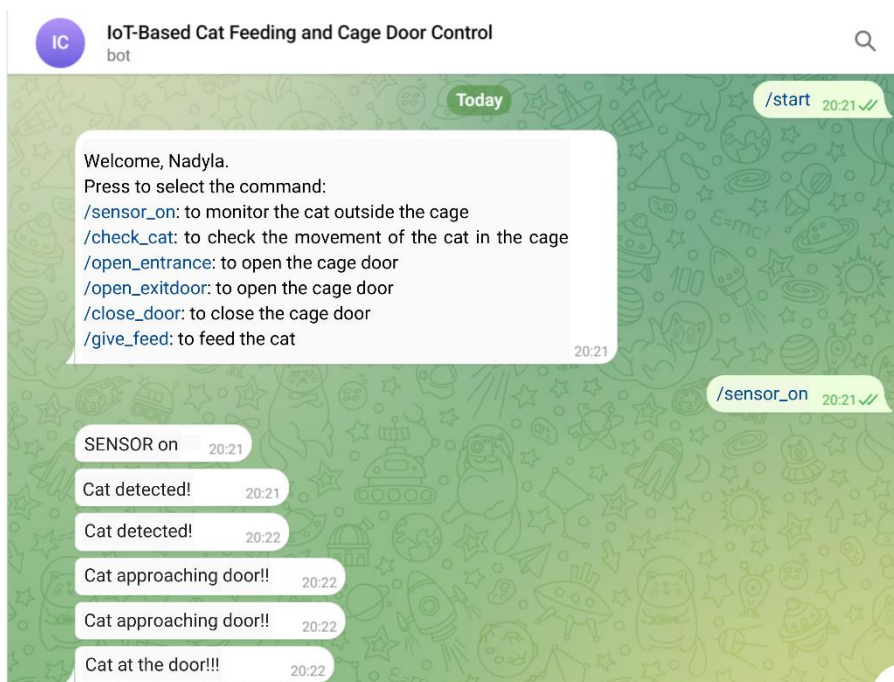


**Figure 11.** Telegram Bot view

Testing the telegram application is done in order to find out whether the application can run as expected. The “/start” command on the display is used to start the process on the tool, if there is a Welcome reply it means that the connection is connected and the tool is ready to use.

The more detailed explanation of the commands above is as follows:

1. /sensor\_on: serves to turn on the ultrasonic sensor so that it can detect cats when outside the cage.
2. /check\_cat : serves to find out the movement of cats whether they are in the cage or not.
3. /open\_entrance : serves to rotate the servo to open the door when the cat wants to enter.
4. /open\_exitdoor: serves to rotate the servo to open the door when the cat wants to get out.
5. /close\_door : serves to rotate the servo to close the cage door.
6. /give\_feed : serves to rotate the servo so that food from the cat's feeder can come out.



**Figure 12.** Telegram Bot View When Censorship is On

Based on Figure 12 when the user sends the command “/sensor\_on”, the telegram bot will send an active sensor message which will then detect the presence of the cat and the results will be sent to the telegram.

### 3.3 HC-SR04 Ultrasonic Sensor Testing

**Table 1.** Ultrasonic Sensor Testing Against Distance

Actual Distance (cm)	Trial 1	Trial 2	Trial 3	Average	Difference	Error%
10	10	9,91	9,93	9,95	0,05	0,50%
20	20,04	20,04	20,04	20,04	0,04	0,20%
30	30,12	30,12	30,11	30,12	0,12	0,40%
40	41,6	39,44	39,44	40,16	0,16	0,40%
50	49,66	49,04	49,33	49,34	0,66	1,30%
60	58,97	58,97	58,84	58,93	1,07	1,80%
70	68,61	68,53	68,6	68,58	1,42	2,00%
80	77,79	77,89	77,35	77,68	2,32	2,9%
90	88,32	87,26	87,43	87,67	2,33	2,60%
100	96,25	97,94	98,74	97,64	2,36	2,40%
<b>Average</b>					1,05	1,30%

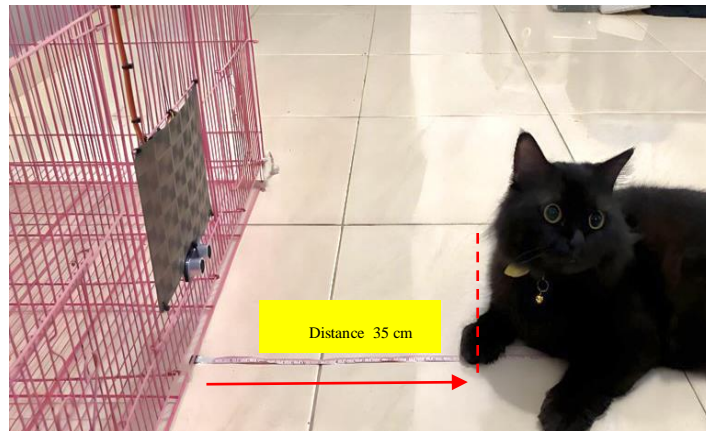
Table 1 is the result of testing the ultrasonic sensor. There are 3 trials at each measured distance, the measurements taken with a ruler or meter are slightly different from the value measured by the ultrasonic sensor. Based on the measurement results with the sensor and the measurement results with a ruler, the average value of the measurement difference is 1.05 cm and the average error value is 1.3%.

**Table 2.** Ultrasonic Sensor Testing of Objects

No	Distance ( cm )	Description
1	14,98	Cat at the door
2	20,04	Cat approaching the door
3	35,56	Cat approaching the door
4	50,05	Cat detected
5	96,24	Cat detected

Table 2 is the result of testing the object.

- If the sensor detects an object < 20 then the result is a statement “Cat at the door”.
- If the sensor detects an object > 20 & & < 50 then the result is “Cat approaching the door”.
- If the sensor detects an object > 50 & & < 100 then the result is “cat detected”.



**Figure 13.** Testing with objects

When the sensor is activated and the cat is within range of the sensor, a message will appear in the telegram. Based on Figure 10 the object is at a distance of 35 cm from the sensor which means “The cat is approaching the door”. If the information “cat in front of the door”, then the user will send the command /open\_entrance. However, if the user is busy and cannot respond for 15 seconds, the cage door will open automatically. The sensor detection distance of the object is limited to a measurement of 100 cm, if more than 100 cm then the sensor will not detect the object.

**Table 3.** Delay ( Ultrasonic )

No	Object Description	Serial Monitor	Telegram	Delay ( sec )
1	Cat detected	11.27.34	11.27.34	0
2	Cat detected	11.27.41	11.27.41	0
3	Cat detected	11.27.48	11.27.48	0
4	Cat detected	11.27.52	11.27.51	1
5	Cat approaching the door	11.27.59	11.27.59	0
6	Cat approaching the door	11.27.59	11.28.03	0
7	Cat approaching the door	11.28.10	11.28.09	1
8	Cat approaching the door	11.28.13	11.28.13	0
9	Cat at the door	11.28.17	11.28.17	0
<b>Average</b>				0,2

Table 3 is the result of delay testing done at one time or when the ultrasonic sensor is activated. This calculation is done to determine the time it takes for the ultrasonic sensor to detect an object that will be displayed on the serial monitor and telegram in Real Time. However, there is a slight difference in the second time in the serial monitor and telegram when the ultrasonic sensor detects the object, where the serial monitor reads 1 second slower than the telegram with an average delay of 0.2 seconds.

### 3.4 HC-SR501 PIR Sensor Testing

**Table 4.** Testing the PIR Sensor Against Objects

<b>Cat Condition Entry</b>	<b>Description ( On Entry )</b>	<b>Cat Out Condition</b>	<b>Description ( On Exit )</b>
None	Not yet entered	None	Not out yet
None	Not yet entered	Exist	Not out yet
None	Not yet entered	None	Already out
None	Not yet entered	None	Already out
Exist	Already entered	None	Already out

Based on the results in Table 4 is done in each detection or when the PIR sensor detects an object. When the cat will enter the cage, the PIR sensor will detect the presence of the cat whether the cat has entered the cage or not. If the cat is detected “ Exist” then the door will be closed automatically.

In the condition that the cat will leave the cage, the sensor does not detect the presence of a cat even though the next condition is that the cat is detected. This can happen because the object is stationary, so the sensor cannot detect movement. This happens because the object does not emit passive infrared light waves between 8 to 14 micrometers. The emission of infrared rays causes the sensor to detect objects. Because if it is in a stationary condition the wavelength produced is almost the same as the conditions in the surrounding environment. However, when the cat is detected “Non” repeatedly, the user can send a command for the door to be closed immediately.

**Table 5.** Delay ( PIR )

No	Object Description	Serial Monitor	Telegram	Delay ( sec )
1	No cat	20.55.34	20.55.38	4
2	No cat	20.55.38	20.55.41	3
3	No cat	20.55.41	20.55.45	4
4	No cat	20.55.44	20.55.48	4
5	Cats exist	20.55.48	20.55.51	3
<b>Average</b>				3,6

Table 5 is the result of delay testing carried out at one time or when the PIR sensor starts detecting objects. This calculation is done to determine the time it takes for the PIR sensor to detect an object that will be displayed on the serial monitor and telegram in Real Time. However, there is a slight difference in the second time in the serial monitor and telegram when the PIR sensor detects the object, where in the telegram there is a delay of 3-4 seconds slower than the serial monitor with an average delay of 3.6 seconds.

#### **4 Conclusion**

Based on the design and testing, it is concluded that the control of cage doors and cat feeders that can be controlled remotely using a smartphone with the telegram application has been successfully carried out. The time required for telegrams to send data and receive notifications works very fast with an average delay between serial monitors and telegrams that is less than 4 seconds, the results obtained also depend on the internet network used. In testing ultrasonic sensors with distance, the difference value obtained at a distance below 50 cm is smaller than the distance above 50 cm, the average difference value is 1.05 cm and the average error value is 1.3%.

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