Experiment 4: Garbage Classification

一、Scene Description

With the increasing production of garbage and the gradual deterioration of environmental conditions, how to classify and manage garbage, maximize the effective use of resources, and improve the ecological environment has become one of our common concerns. This experiment simulates the process of automatically sorting garbage, so as to reduce the cost of manual sorting, increase the resource recovery rate, and contribute to improving the ecological environment.

二、Experiment Principle

In this experiment, an automatic garbage sorting system was built, using voice recognition technology and image recognition technology to realize automatic sorting of garbage by the robot. First, we need to build a data set; then collect images of various types of garbage through the system's camera and save various types of garbage image information in the data set; then use the data set to train this intelligent garbage classification system and let the intelligent garbage classification system recognize the image after learning each image information; finally let Magician Lite perform the garbage sorting work.

三、Experiment Equipment

Equipment Image	Name	Number
	Dobot Magician Lite	1
	Suction cup	1
	Camera	1
	Power adapter	1
	Tape-C cable	1
	Garbage models	Several

	Map	1
	Garbage bins	4

四、Experiment Steps

1. Scene Create

（1） Flow diagram of the placement of robot, garbage bins, and garbage models is shown in Figure 4.1.

Figure 4.1 The map of garbage classification system

（2）Prepare the experimental equipment and place the equipment, the physical picture is shown in Figure 4.2.

Figure 4.2 The physical map of garbage classification

2. Program Design

Step 1: Read the flow diagram of goods warehouse, as shown in Figure 4.3

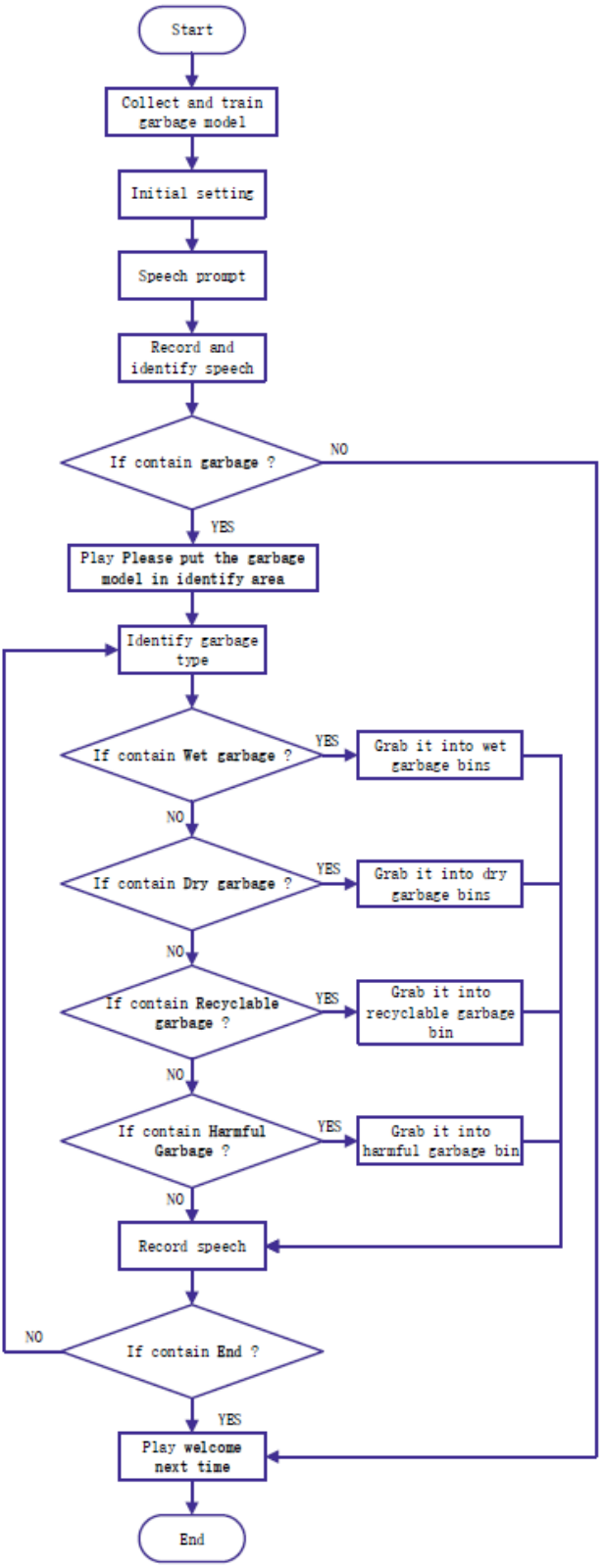


Figure 4.3 The flow diagram of garbage classification

Step 2: Garbage image collection and training.

1）Connect Magician Lite, add AI extension module, select **AI**, and click "New classification date", as shown in figure 4.4.

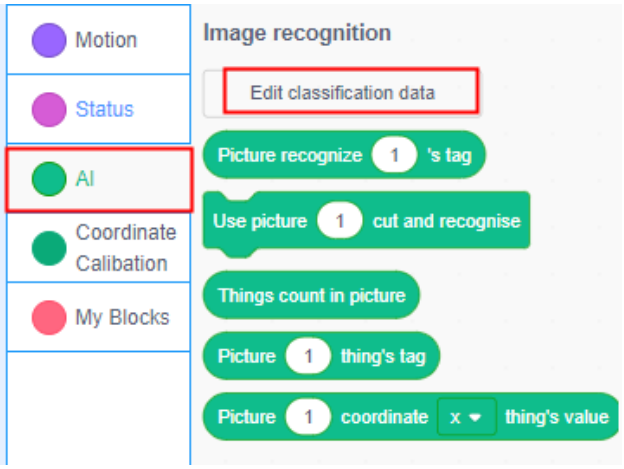


Figure 4.4 New classification data

2）Add features and data. When collecting garbage image data, it is necessary to collect image data at different angles and in different directions. Take and store the garbage images that need to be recognized, as shown in Figure 4.5

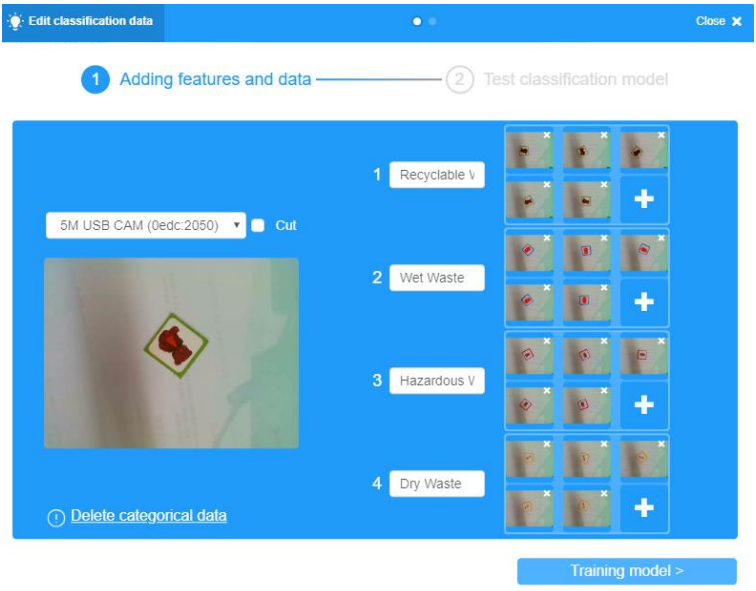


Figure 4.5 Collect garbage image

3）Train model. The process of garbage image preprocessing and feature extraction is the process of computer learning, as shown in Figure 4.6.

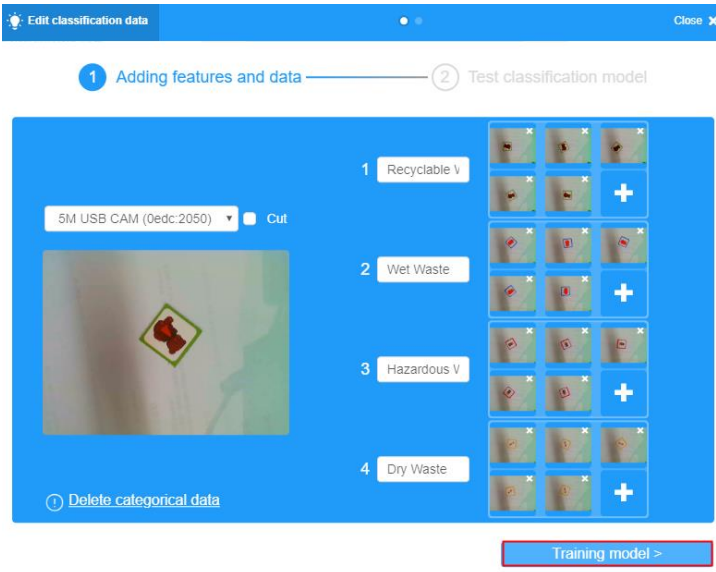


Figure 4.6 Train model

4）Test and save the model. Put all kinds of garbage under the camera to test the accuracy of recognition; click Finish to save the file. As shown in Figure 4.7.

Figure 4.7 Test and save model

Step 3： Initial setting. Set the end tool of

the robot to the suction cup and set the initial position of the robot, as shown in Figure 4.8.

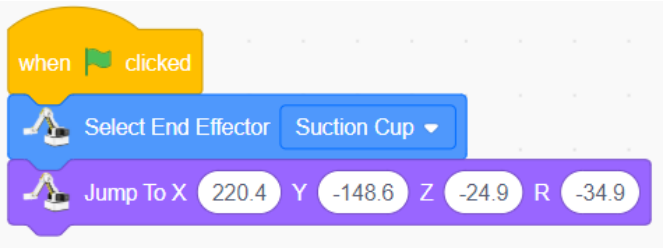


Figure 4.8 Initial setting

Step 4: Voice prompts. The robot introduces itself first, then asks, as shown in Figure 4.9.

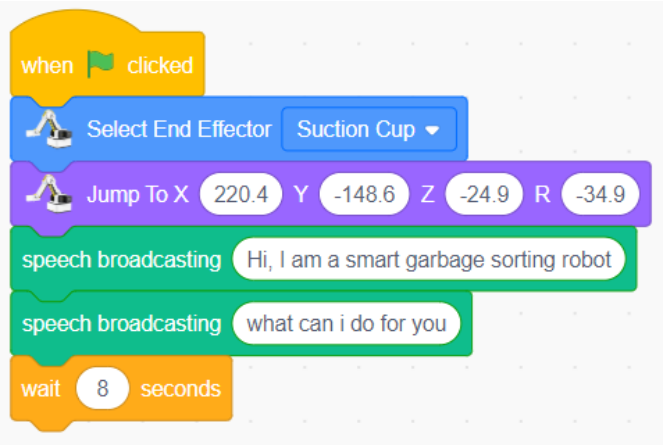


Figure 4.9 Speech prompt

Step 5:Record voice data and recognize voice, change the duration to 3 seconds, as shown in Figure 4.10.

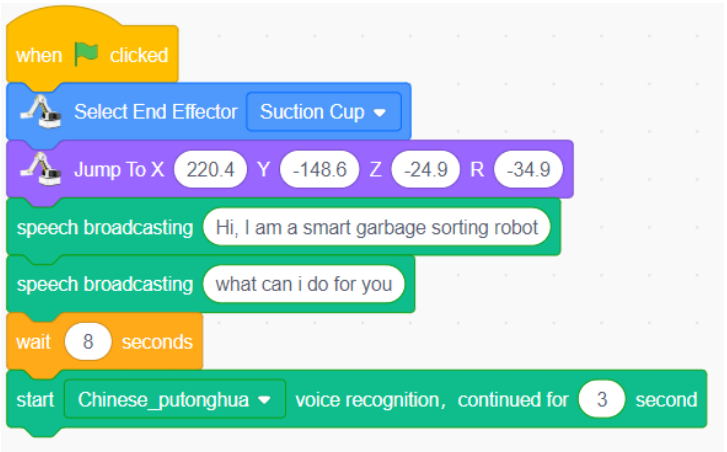


Figure 4.10 Record and recognize speech

Step 6： Determine whether the voice recognition result contains the keyword "garbage". If it contains, perform garbage classification-related operations; otherwise, the voice playback "Welcome next time", as shown in Figure 4.11.

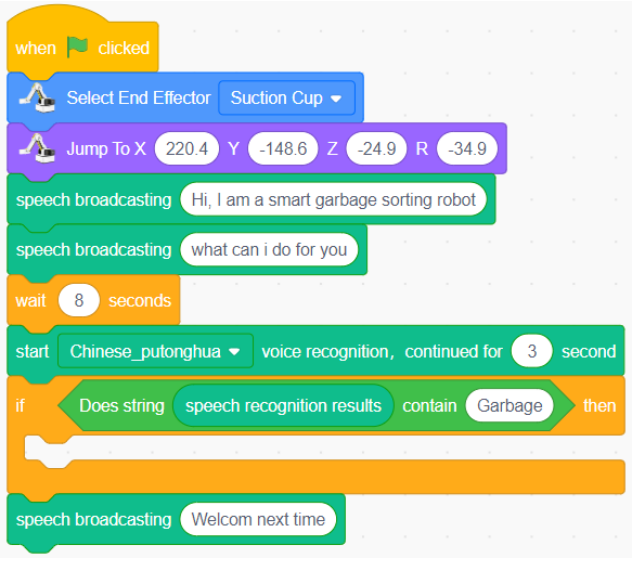


Figure 4.11 Determine speech result

Step 7： If the voice recognition result contains the keyword "garbage", voice play "please place the garbage model in the identify area" first, automatically take pictures to obtain the garbage model and identify type, and then grab the garbage model, as shown in Figure 4.12.

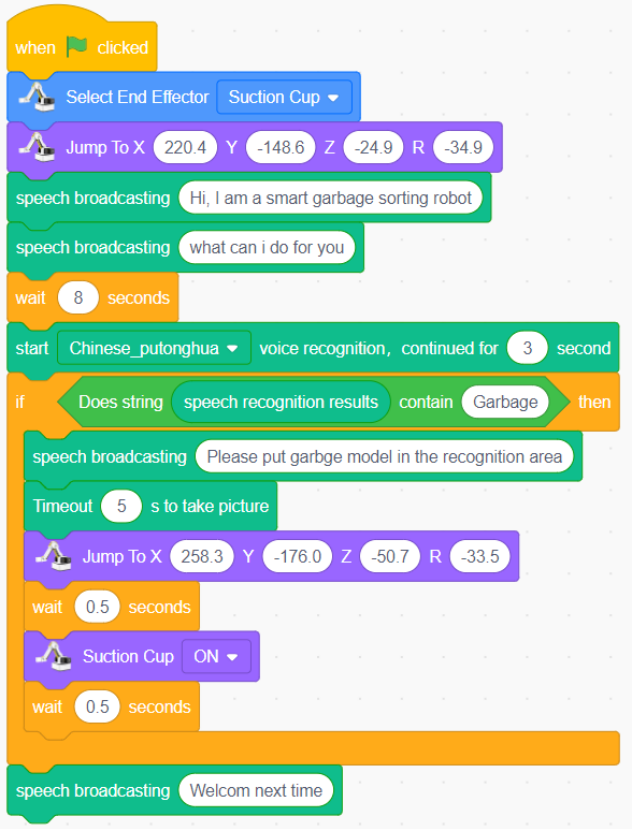


Figure 4.12 Recognize and grab garbage model

Step 8: Determine whether the image recognition label contains "wet garbage". If it does, the robot puts the captured garbage image card into the wet garbage bin, and then the voice prompt "please continue to put garbage", record the voice again; otherwise it will judge whether it is other types of garbage, as shown in Figure 4.13.

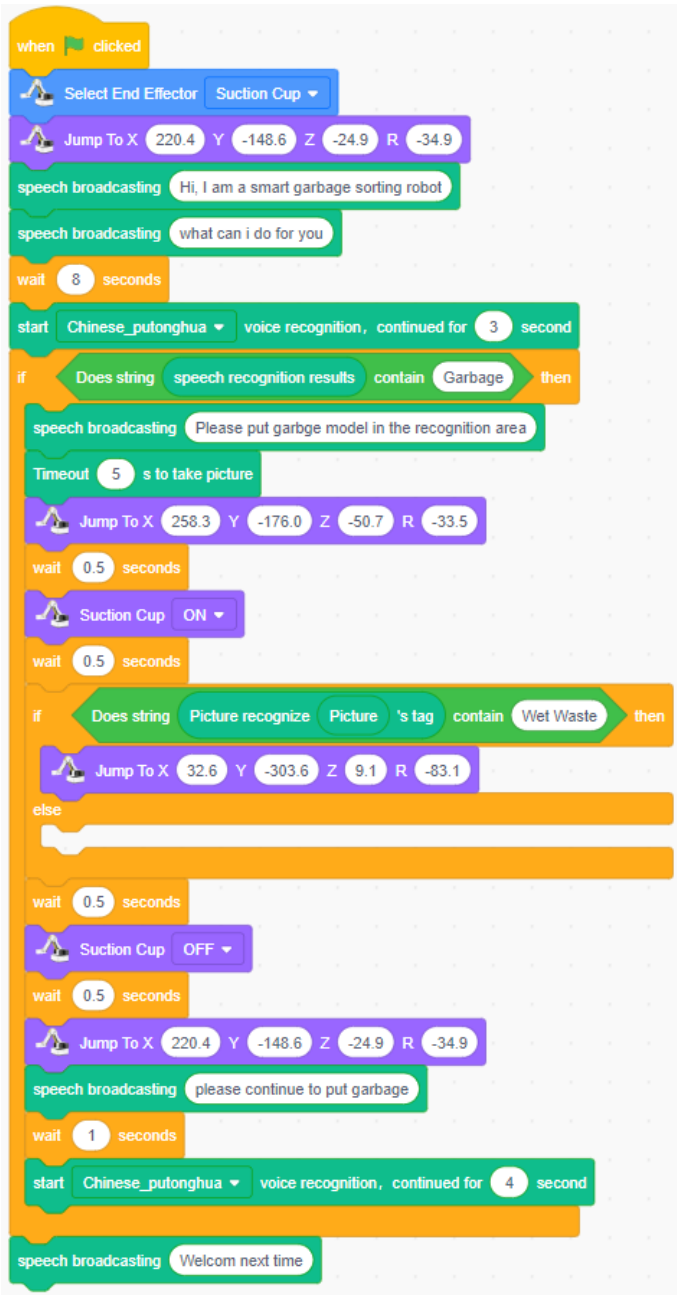


Figure 4.13 Recognize wet garbage

Step 9: If the image recognition label does not contain "wet garbage", it is judged whether other garbage is recognized, and the captured garbage image card is put into the corresponding garbage bin, as shown in Figure 4.14

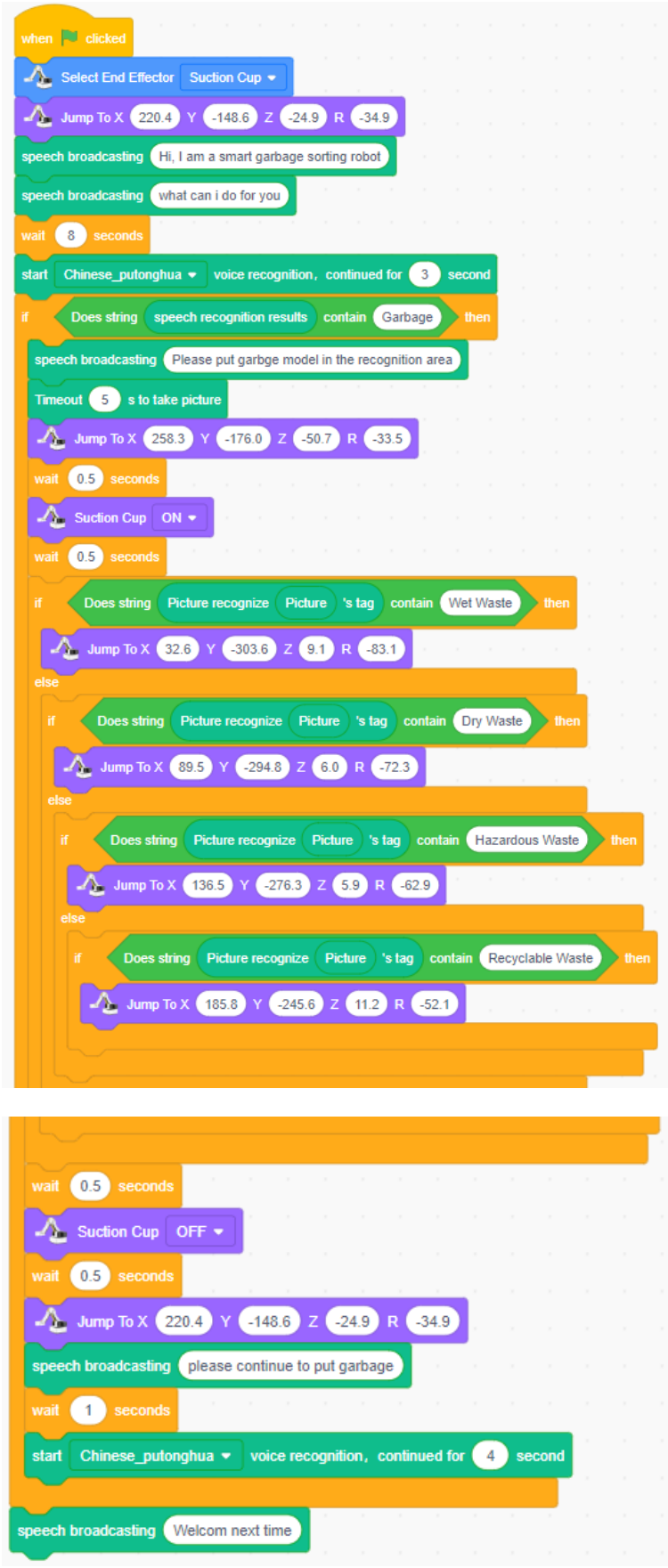
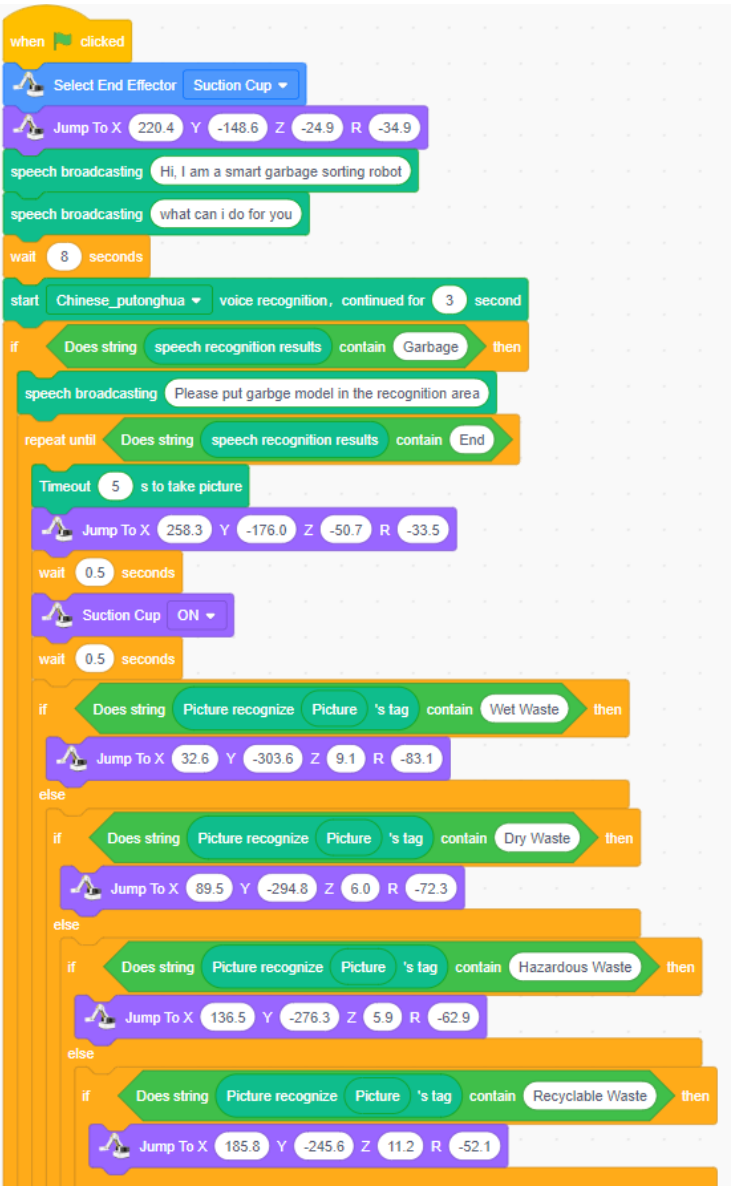


Figure 4.14 Recognize other garbage

Step 10： There is usually more than one garbage that needs to be sorted, and it is necessary to repeatedly identify and classify different kinds of garbage; until the speech recognition reaches the keyword "finish", the garbage classification is stopped, as shown in Figure 4.15.



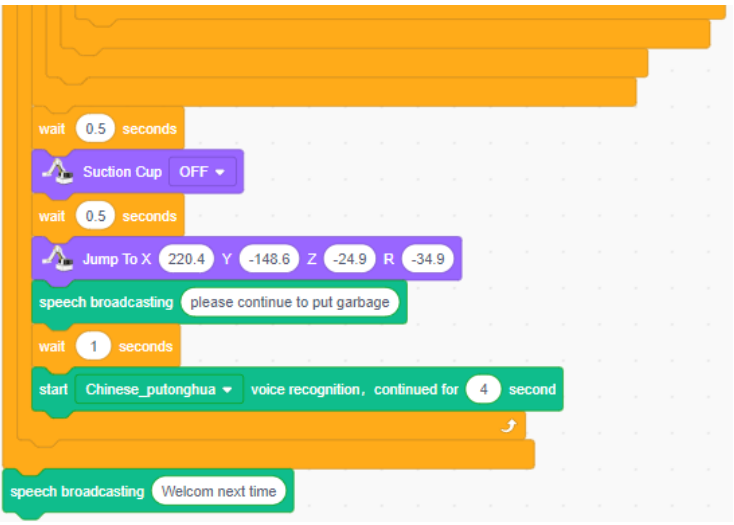


Figure 4.15 The completed program of garbage classification