

Human-computer interaction report

Part A: Requirements Analysis

People

- 1.叶怡轩 3170101790 18888920350 3170101790@zju.edu.cn(Leader)
- 2.郑昌熙 3170101796 17342016630 3170101796@zju.edu.cn
- 3.楼晨阳 3170101798 17342020906 3170101798@zju.edu.cn

General characteristics of the system's users

Those convenience store operators are our system's users. Our system can provide personalized and customized sound to meet unique demands. Take a simple example, the doorbell will say "Hello, welcome!" when someone is entering the convenience store, while the doorbell will say "Bye! Hope to see you again!" when someone is leaving the convenience store. In this way, the convenience store can attract all kinds of people: layers, drivers, doctors and so on. If the convenience store is near a gym, you can record an advertised ringtone to sell salad like "Welcome, today's salad are fresh and yummy!"

Potential Users Analysis

To do this thing, we try to ask many different potential users for advices and questions. In the next part, we will show problems in five different ways by showing unique five typical people.

The 1st Person

The first one is a male collage student ,to be exactly, he is our classmate. As a student, he often goes to school stores to buy some food and daily necessities.

His Questionnaire

1. 请问您的年龄大致是? *

<18岁
 18-25岁
 25-37岁
 >37岁

2. 请问您的职业是? *

学生
 服务业
 自由职业
 其他

3. 请问您一周中去便利店的次数大概是? *

基本不去
 1-2次
 3-6次
 >6次

4. 请问您去便利店的时间段一般来说是? *

0:00-6:00
 6:00-12:00
 12:00-18:00
 18:00-24:00

5. 请问您去的便利店有没有智能门铃的设计呢? *

有
 无

6. 对于您而言, 理想中的智能门铃应该要做到怎么样呢? *

应该能够做到根据用户的不同来决定不同的问候

In our school, almost every stores have no smart bell, at last, we asked him what a smart bell should be able to do. And he thinks smart doorbell should be able to decide different greetings according to different users.

We think it's a good idea, but it maybe something difficult. It needs CNN to recognize people and tagged them correctly and in a short time. Accuracy is the most problem, we have to take it into our consideration and try more.

The 2nd Person

The second one is a store manager in a small town. As a manager, he has to organize some events to attract consumers. As there is no smart doorbell in his store, he think it is necessary for him.

His Questionnaire

1. 请问您的年龄大致是? *

- <18岁
- 18-25岁
- 25-37岁
- >37岁

2. 请问您的职业是? *

- 学生
- 零售业
- 自由职业
- 其他

9. 请问您工作的时间大致在? *

- 0:00-8:00
- 8:00-18:00
- 18:00-24:00

10. 请问您的店中有没有智能门铃呢? *

- 有
- 无

13. 您希望您的店中有一个智能门铃吗? *

- 是
- 否

14. 能简单说下您自己对于智能门铃的看法吗? *

He thinks it's very important for a small store. It's a good way to attract customers and improve their impression. In addition, he thinks if it can customize some voice in and out to adapt to different people would be better.

We reckon what he said is correct. It can really change consumers' mind, and if we support user to define own music, it can attract different people in different time. It can be useful to store managers.

The 3rd Person

The third one is a white-collar worker, to be exactly, he works in IT's area. He often goes to stores near his company and the store has a smart doorbell, but he is not satisfied with it.

His Questionnaire

- 零售业
- 自由职业
- 其他

3.请问您一周中去便利店的次数大概是? *

- 基本不去
- 1-2次
- 3-5次
- >5次

4.请问您去便利店的时间段一般来说是? *

- 0:00-8:00
- 8:00-12:00
- 12:00-18:00
- 18:00-24:00

5.请问您去的便利店有没有智能门铃的设计呢? *

- 有
- 无

6.请问您觉得现在的便利店的门铃的设计是否会对您有所困扰呢? *

- 无
- 有一些，但不是非常严重
- 我觉得它有些干扰到了我的心情
- 我觉得这是一个很糟糕的设计

He thinks it should be improved. When entering and leaving, it always says welcome to him. It makes him feel like he want to enter the store again. It should be handled separately.

We think doorbell surely need to treat consumers in different ways depend on what they tend to do, such as entering and leaving. It can improve consumers' satisfaction.

The 4th Person

The fourth one is a salesman in a store in a big city, where has a smart doorbell in use. He needs to entertain many consumers in a day.

His Questionnaire

1.请问您的年龄大致是? *

- <18岁
- 18-25岁
- 25-37岁
- >37岁

2.请问您的职业是? *

- 学生
- 零售业
- 自由职业
- 其他

9.请问您工作的时间大致在? *

- 0:00-8:00
- 8:00-18:00
- 18:00-24:00

10.请问您的店中有没有智能门铃呢? *

- 有
- 无

11.请问您认为智能门铃对于您的业绩有没有影响呢? *

- 有
- 无

12.能简单说下您对于这个的评价和改进建议吗? *

He deems the use of smart doorbell has a considerable impact on the mood of customers, especially after comparing it with his previous shop without smart doorbell. But there are still many problems. First of all, the intelligent doorbell need to improve the sensitivity of recognition. It is often recognized in advance. It will be very embarrassing. In addition, I think the incoming and outgoing voice should be corresponding separately, otherwise it will make consumers feel embarrassed.

It can be difficult to improve sensitivity and accuracy of recognition based on current technique. We think it may rely on CNN development, as we said before, it can be hard. And separate incoming and outgoing voice, as the third one, we should support users to upload customized music for this one in order to attract people of different ages.

The 5th Person

The fifth one is an old woman, living in a big city. She often goes to the store near her house, which has a smart doorbell. She reckons it is a great invention. She says she always feels warm when hearing the greeting, even it comes from a machine.

Her Questionnaire

2. 请问您的职业是? *

- 学生
- 零售业
- 自由职业
- 其他

3. 请问您一周中去便利店的次数大概是? *

- 基本不去
- 1-2次
- 3-5次
- >5次

4. 请问您去便利店的时间段一般来说是? *

- 0:00-8:00
- 8:00-12:00
- 12:00-18:00
- 18:00-24:00

5. 请问您去的便利店有没有智能门铃的设计呢? *

- 有
- 无

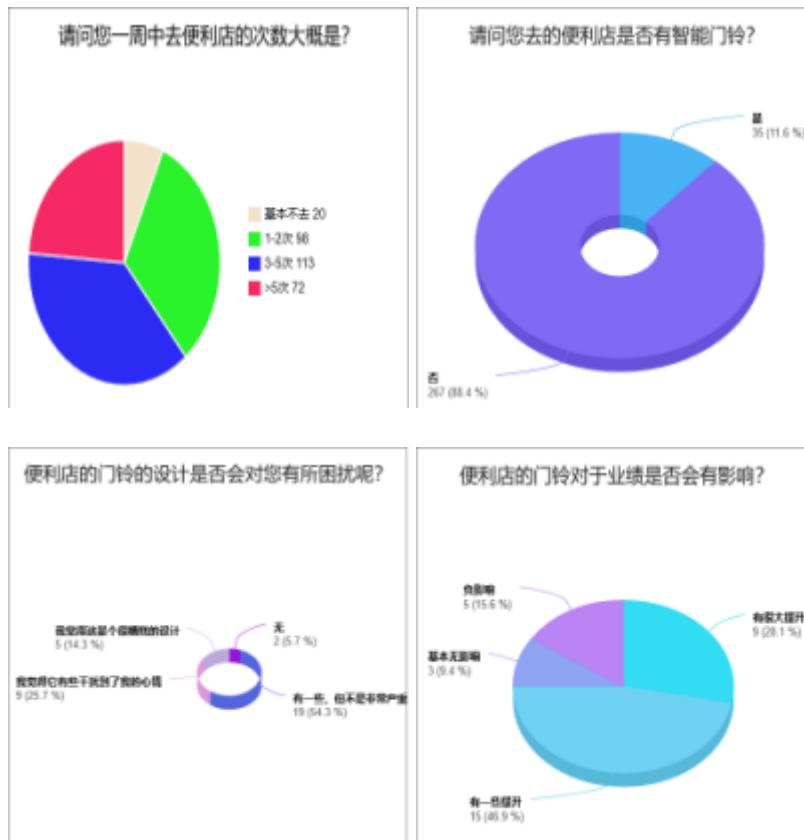
6. 请问您觉得现在的便利店的门铃的设计是否会对您有所困扰呢? *

- 无
- 有一些, 但不是非常严重
- 我觉得它有些干扰到了我的心情
- 我觉得这是个很糟糕的设计

She hopes to hear more vivid and energetic greetings. When she go out, it will say thank you for your patronage and have a nice day.

From her, we can see it's meaningful. It provides people a feeling of being taken care of. And as she said, we could do more and make it better, such as providing customized voice to take care of the olds.

Total Analysis



Smart doorbell is not so popular now, it mostly used in big cities. So most consumers may even don't know what it is.

At present, most convenience stores are not equipped with smart doorbells, so most of the people we investigated have not been exposed to this thing. In the actual contact with it, we found that most of the people are very innovative and can improve their mood to a certain extent, but there are still some problems, such as the same voice in and out.

Among the convenience store employees, especially those with smart doorbells, we also conducted a series of surveys. Most of them think that the doorbell can affect their performance to a certain extent. Giving customers a good impression and a good mood is very important, and make them more confident to entertain customers. As what we researched before, we can also find some problems. Most of which are about monotonous greetings, that can be innovative, and choose different voice to attract people of different ages.

Thus, we hope to achieve as many functions as we can, such as user-defined voice upload. We hope to easily interact with users through a web page. On the top, we can also have some extended functions, such as the distribution of customers in convenience stores over time, for the reference of shopkeepers. We also hope to improve the way of detection means to realize the distinction of in and out voice and reduce the discomfort of users.

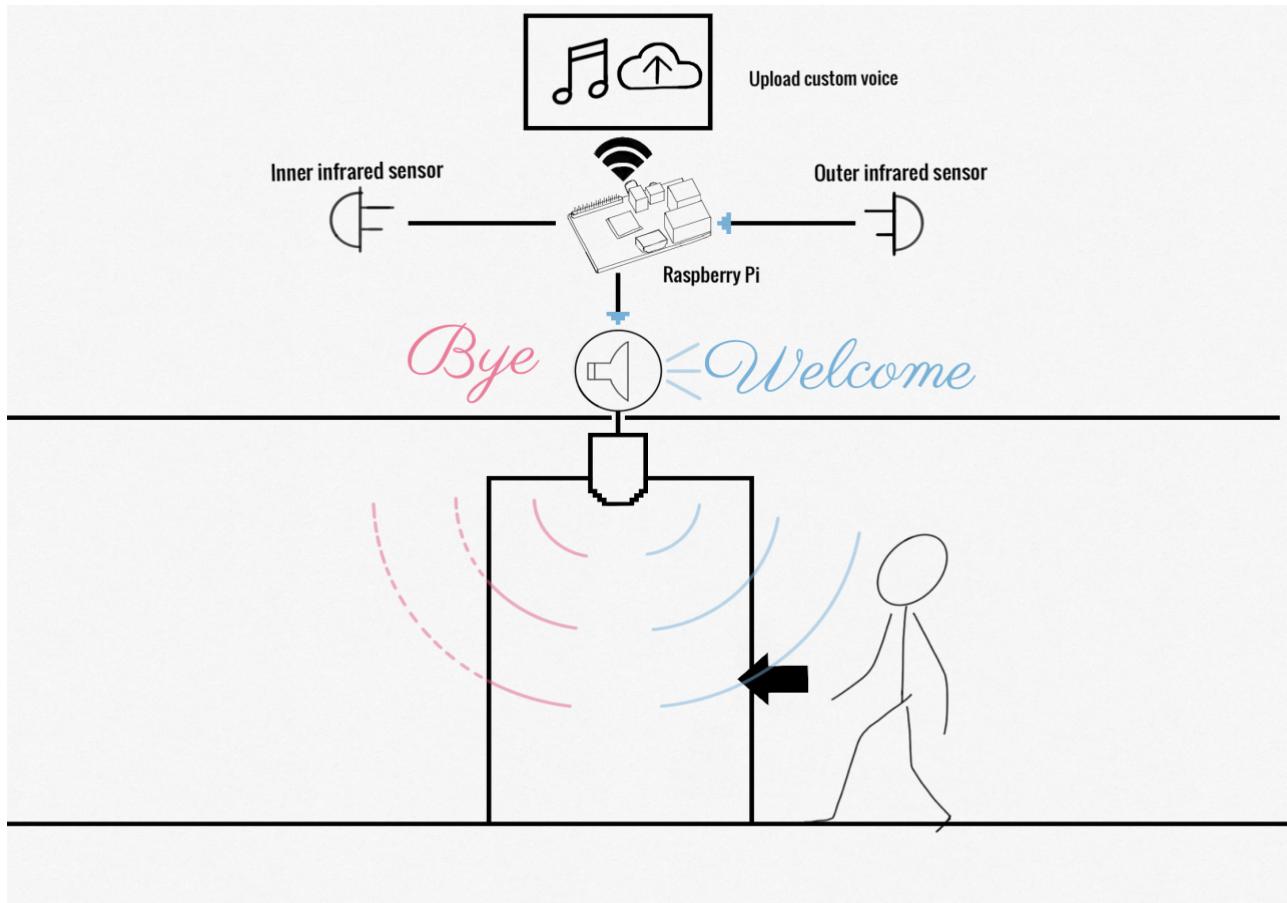
Part B: Building a Prototype

Part 1. Scenarios and Paper-based Mock-up

When you walk into a convenience store, the doorbell will say "Hello, welcome!" to you. Such a simple greeting can bring good mood to the consumer. Nonetheless, when you walk out of a convenience store, the doorbell will still say "Hello, welcome!" to you. You may feel a little embarrassing and ignored. Because, you just receive common greeting all the time, no matter your are about to enter the convenience store or get out

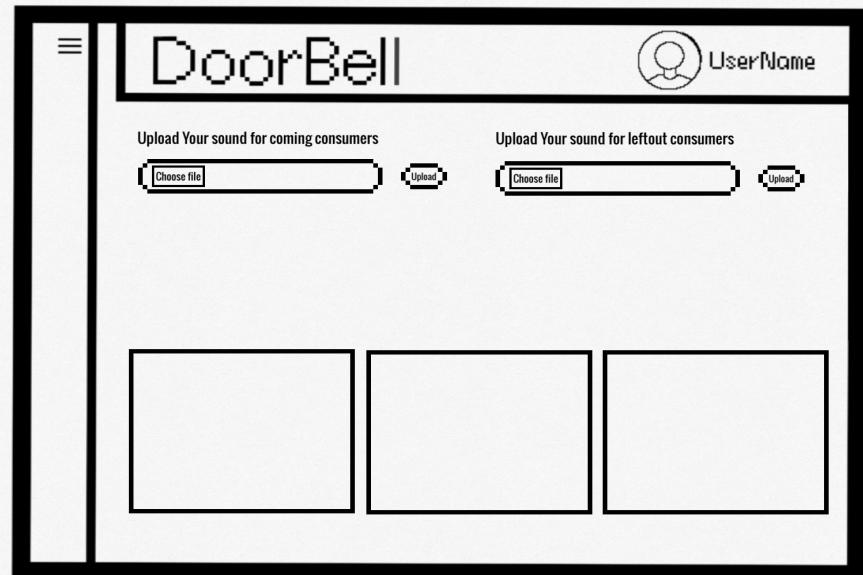
of the convenience store. At this moment, you suddenly realize that what welcome you is not a real person, but a machine. To solve this problem, we put forward two different scenarios.

1. Two-way doorbell based on infrared detector

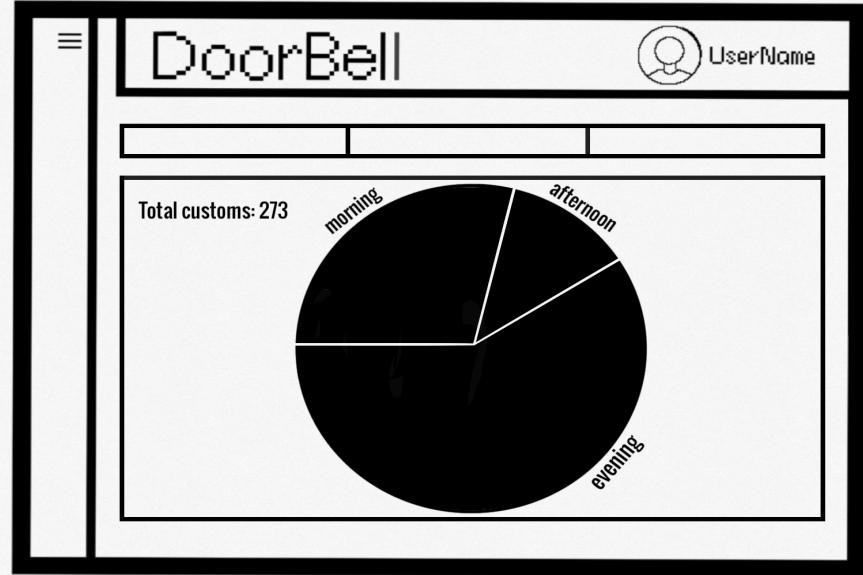


Our idea is to use two infrared detectors to detect customers approaching the door from different directions. When customers approach, they send signals to raspberry pi. Raspberry pi determines the customers' access by judging the order of infrared signals on both sides, so as to play the corresponding voice. Moreover, users can upload customized voice on the web page, and make free changes according to the actual use situation and user needs. In addition, the two-way doorbell can record the information of customers' access and upload it to the web page for visual presentation in the form of charts to help the shopkeeper.

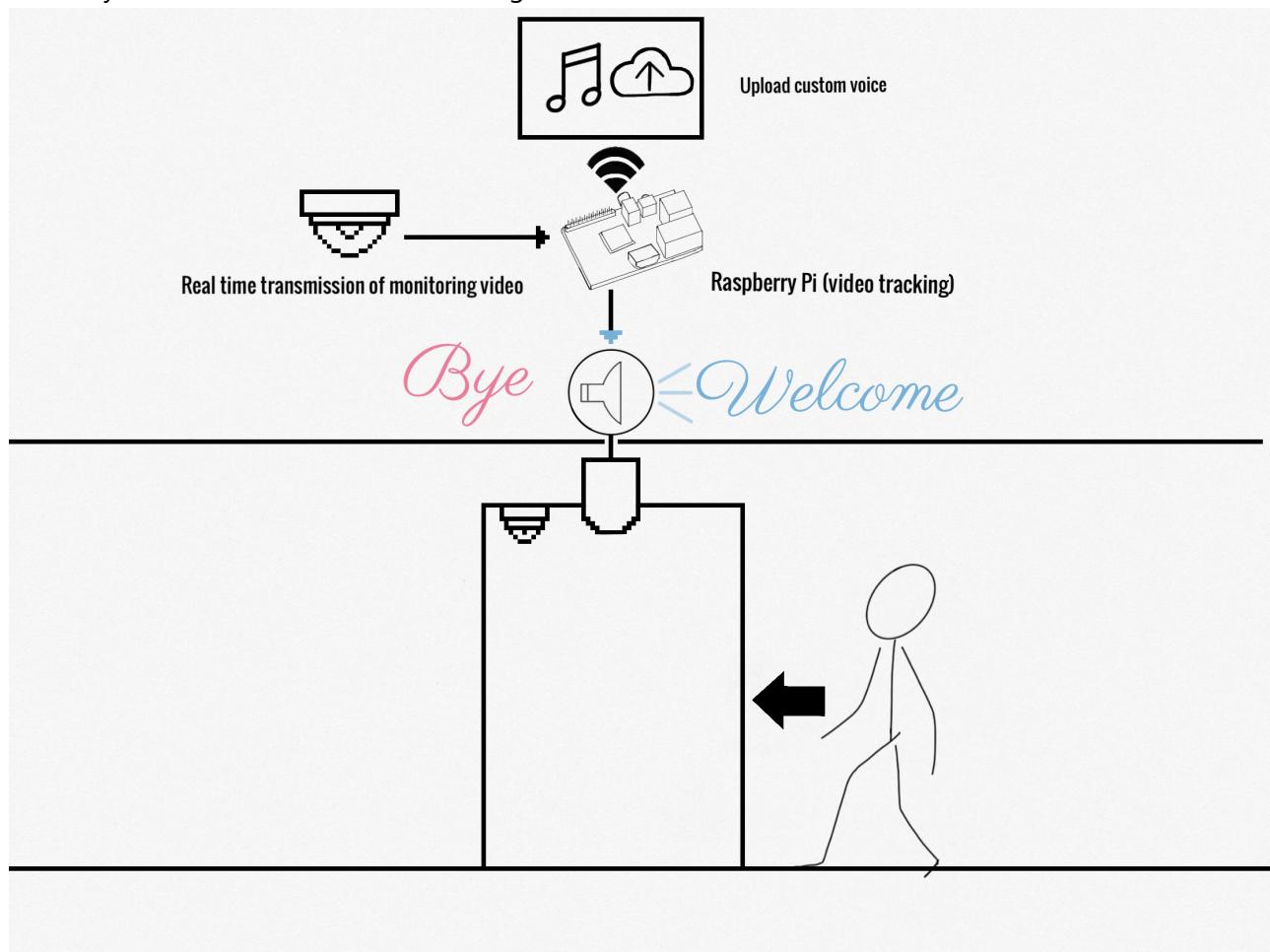
Upload custom voice



Visual information presentation



2. Two-way doorbell based on video tracking



Our idea is to connect the two-way doorbell with the monitoring camera, and the monitoring video at the door is transmitted from the monitoring camera to raspberry pi in real time. Raspberry pi determines the customers' access directions by tracking the characters in the video, so as to play the corresponding voice. Moreover, users can upload customized voice on the web page, and make free changes according to the actual use situation and user needs. In addition, the two-way doorbell can record the information of customers' access and upload it to the web page for visual presentation in the form of charts to help the shopkeeper.

Part 2. Cognitive Walkthrough

We further explored the two ideas and found some problems.

For the two-way doorbell based on the infrared sensor, the accuracy of the infrared sensor is very important, the sensing range and delay of the infrared sensor need to be very fine adjustment and testing to achieve satisfactory results, but the infrared sensor can only output whether the signal is detected or not, and can not provide more specific information, which is very inconvenient for debugging. And because the infrared sensor can't detect the number of signal sources, so in the face of many people frequent in and out of the situation, this assumption is not good, voice playback will become too frequent and very confusing.

For these problems, we think we can use infrared camera instead of infrared sensor. The infrared camera can present the captured infrared image on the screen in real time, which not only can see the signal output in real time during debugging, but also can better cope with the complex changes of people flow.

For the two-way doorbell based on video tracking, the first step is to identify the customer from the video, and then use video tracking technology to determine the direction of the customer's movement. The amount of computation is relatively large, which has high requirements for the hardware conditions and code optimization level of raspberry pie. The memory of raspberry pie is only 256MB, which is difficult to meet the computing requirements of this idea, and it is difficult to process real-time video data in a timely manner. To solve this problem, first of all, we need to compress the video file to a certain extent to reduce the amount of data. Then we use backtracking pruning algorithm to optimize the code as a whole, reduce the operation time, and reduce the delay of doorbell to an acceptable level.

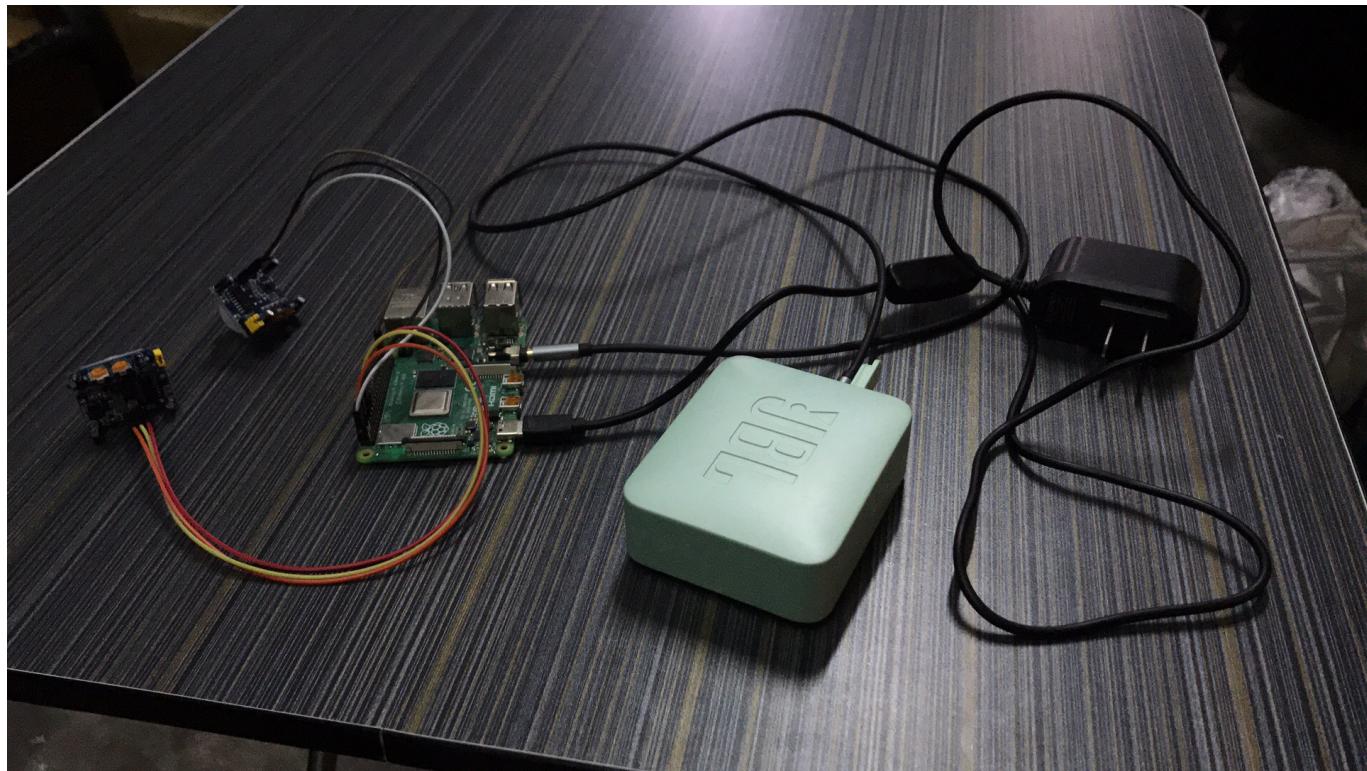
For the two-way doorbell based on video tracking, the first step is to identify the customer from the video, and then use video tracking technology to determine the direction of the customer's movement. To analyze and calculate the video data frame by frame, the amount of calculation is relatively large, which has high requirements for the hardware conditions of raspberry pie, and requires a high level of code optimization. The memory of raspberry pie is only 256MB, which is far less than the memory of ordinary computers. It is difficult to meet the computing requirements of this idea, and it is difficult to process real-time video data in time, which leads to unbearable delay.

For this problem, because all we need to do is to distinguish the direction of motion, so there is no high demand for the resolution of video. We can compress the video file to a certain extent and reduce the amount of data appropriately. Then we use the backtracking pruning algorithm to optimize the code as a whole, especially in the case of tracking multiple targets, so as to reduce the operation time and the delay of doorbell to an acceptable level.

Part C: Requirements Analysis

Required materials :

raspberry pi 4, HC-SR501 Infrared body sensor module, loudspeaker box



Steps

1. Install raspberry pie system and related drivers
2. Download flask package and build basic web page
3. Decorate the web page with CSS and JS and add upload button

4. Obtain the audio file uploaded on the web page through Python script and save it locally

```

<form method="post" action="http://172.20.10.3:5000/upload"
enctype="multipart/form-data">
    <h4 style="position:relative;bottom:40px;left:50px;font-family : 宋体,sans-serif;font-size : 15pt;font-style:italic;font-variant:small-caps;letter-spacing : 1pt;line-height : 200%;font-weight:bold;">Upload Your sound for coming consumers</h4>

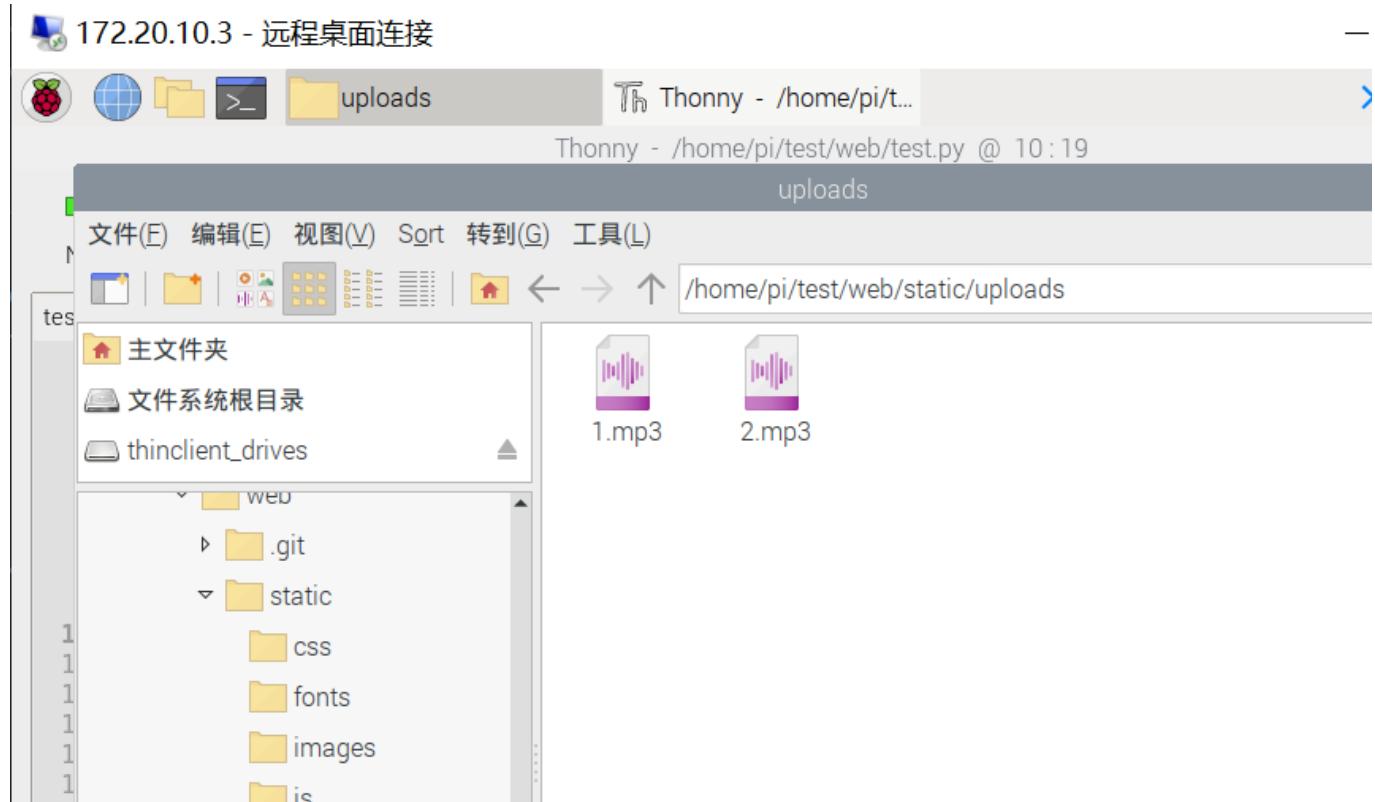
```

```

<input type="file" name="file" class="file" style="border-radius: 15px; position: relative; bottom: 30px; left: 30px;" />
<input type="submit" class="file" style="border-radius: 15px; position: relative; left: 420px; bottom: 65px" value="上传" >
</form>
<form method="post" action="http://172.20.10.3:5000/upload1" enctype="multipart/form-data">
<h4 style="position: relative; bottom: 147px; left: 670px; font-family: 宋体, sans-serif; font-size: 15pt; font-style: italic; font-variant: small-caps; letter-spacing: 1pt; line-height: 200%; font-weight: bold;">Upload Your sound for leftout consumers</h4>
<input type="file" name="file1" class="file" style="border-radius: 15px; position: relative; bottom: 137px; left: 650px;" />
<input type="submit" class="file" style="border-radius: 15px; position: relative; left: 1040px; bottom: 172px" value="上传" >
</form>

```

Local pictures are stored in the following path



5. Get the signals of two infrared sensors of human body through Python script, and play different audio according to different signals

```

#!/usr/bin/python
#encoding:utf-8
import RPi.GPIO as GPIO
import time
import pygame
...
def info(bool status1,bool status2,bool former1,bool former2):
    print("s1{} s2{} f1{} f2{}".format(status1,status2,former1,former2))

```

```
...
time_out=1
Infrared=38

#GPIO.setwarnings(False)
GPIO.setmode(GPIO.BOARD)
GPIO.setup(Infrared,GPIO.IN)
GPIO.setup(12,GPIO.IN)
GPIO.setup(11,GPIO.OUT)
status1 = False
status2 = False

former1 = False
former2 = False

pygame.mixer.init()

while(1):
    if GPIO.input(12) == True and status2 == False and former1 == False:
        #print(time.strftime('%Y-%m-%d %H:%M:%S',time.localtime(time.time()))+"1Someone is closing!")
        #beep()
        status1 = True
        former1 = True
        continue
    elif GPIO.input(12) == True and status2 == True and former1 == False:
        status2 = False
        status1 = False
        former1 = True
        former2 = True
        #beep()
        pygame.mixer.music.load('/home/pi/test/web/static/uploads/1.mp3')
        print("jinmen")
        print("s1{},s2{},f1{},f2{}".format(status1,status2,former1,former2))
        info(status1,status2,former1,former2)
        pygame.mixer.music.play()
        continue
    elif GPIO.input(38) == True and status1 == False and former2 == False:
        #print(time.strftime('%Y-%m-%d %H:%M:%S',time.localtime(time.time()))+"2Someone is closing!")
        #beep()
        status2 = True
        former2 = True
        continue
    elif GPIO.input(38) == True and status1 == True and former2 == False:
        status1 = False
        status2 = False
        former1 = True
        former2 = True
        #beep()
        print("chumen")
        print("s1{},s2{},f1{},f2{}".format(status1,status2,former1,former2))
        pygame.mixer.music.load('/home/pi/test/web/static/uploads/2.mp3')
```

```
pygame.mixer.music.play()
continue
elif GPIO.input(38) == False and GPIO.input(12) == False:
    status1 = False
    status2 = False
    former1 = False
    former2 = False
else:
    #GPIO.output(11, GPIO.HIGH)
    #print(time.strftime('%Y-%m-%d %H:%M:%S',time.localtime(time.time()))+"Noanybody!")
    #time.sleep(4) #每6秒检查一次

GPIO.cleanup()
```

In addition, we have prepared 2 videos to show how our system works.