Panda TMax: Smart Panda Tracking Car

Year 2 Short Semester 2018

Group: 56

Group members:

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Category

1 Introduction

Our company's business philosophy is to provide users with the best experience of robot products. The implied meaning of Scorpio is to explore the nature and desire of things, which is consistent with the idea of our company. At the same time, the rocket's picture symbolizes our company's ability to stand out among many competitors. Our tracking products can also be like Scorpio, they can precisely position and track their targets.

Panda TMax is one of new products of our company, which is designed for zoo industry to attract more visitors. With environmentally conscious design and natural exterior, our product is characteristic of high response speed, high stability and low cost. The product is based on Bluetooth Application with additional IR remote control .etc, such as auto-tracking mode, obstacle-avoidance mode, IR control mode, track-following mode and so on. According to market research, there are few products in this zoo industry, which makes our product highly competitive.

Figure1： Panda TMax

2 Product Design

2.1 Main Function Introduction

Panda TMax includes five modes based on Bluetooth control with additional multimedia functions based on wireless WIFI HD camera.

2.1.1 Auto-tracing Mode

Panda TMax can be set to auto-track any tracked object within the safety distance of default value--50cm. And we design a special reaction mechanism: when target escapes detection space, the car goes into automatic rotation state until it finds the target again and continues to track. The rotation way of the car is counterclockwise by default, and for better user experience, the direction is designed by the turning state of the previous moment. For example, if the car turns right in the last second, the car will move clockwise at the next moment. The LCD screen will display necessary information about current mode and reminders for correct use to prevent invalid input. Time and distance also can be displayed in real time.

2.1.2 Tracking Mode

Panda TMax can be set to move along any designed black track.

2.1.3 Bluetooth Remote Control Mode

Panda TMax can be controlled remotely by the mobile phone through Bluetooth communication. Controlled states are: forward, backward, left, right, clockwise, counterclockwise.

2.1.4 Remote Control Mode

Panda TMax can be controlled by infrared remote controller. Controlled states are: forward, backward, left, right, clockwise, counterclockwise.

2.1.5 Obstacle Avoidance Patrol Mode

Under this mode, Panda TMax goes straight by default. When the obstacle is detected 50cm away, the car turns clockwise or counterclockwise until it finds safe to move again.

2.1.6 Additional Functions

- **Play music:**

Our car can play any songs, and here we designed the codes for “Song of joy”.

- **Environmental temperature and humidity monitoring:**

The real-time monitoring of environmental temperature and humidity can be carried out on mobile phones.

- **Rear light:**

The light of our product can be turned on when using at dark environment.

2.1.7 Multimedia Function

Mobile phone, computer and tablet all can monitor the car in real time. Our product can be used for photographing, video recording with replay choice. Objects at high moving speed also can be captured for photo. Multiple pixel viewing modes are available on the phone APP.

2.2 Software Design

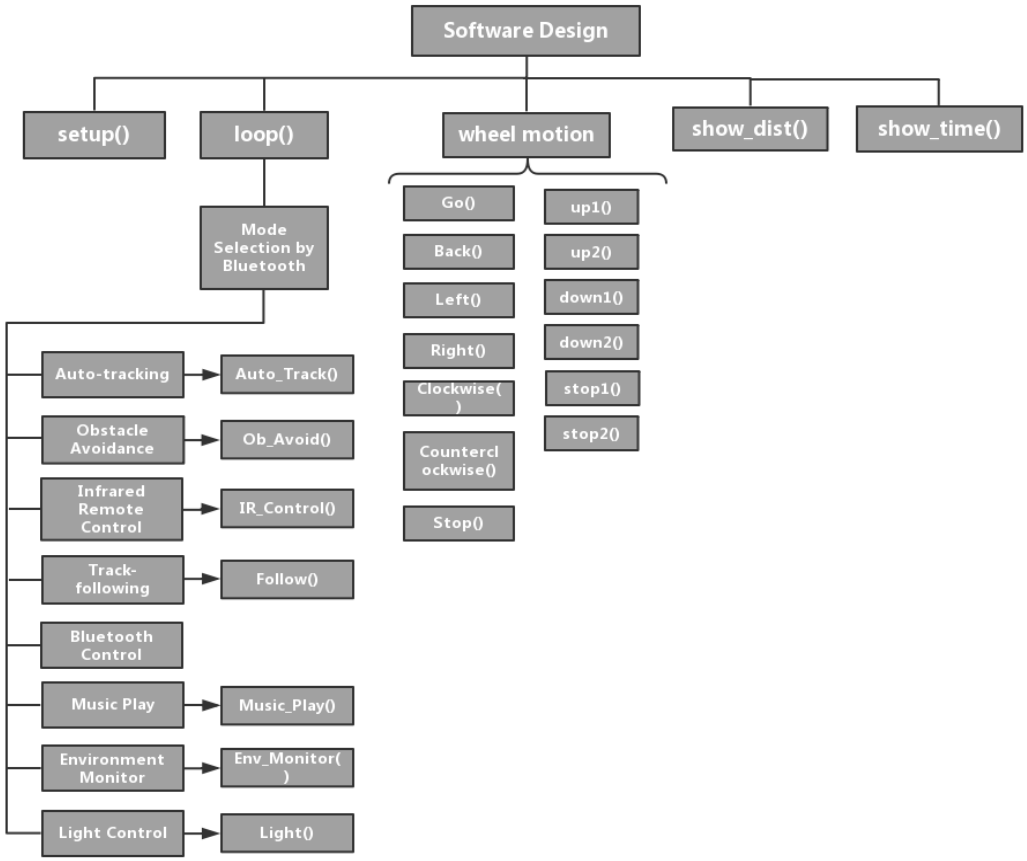


Figure 2: The function of software design

To make the code easier, we use several libraries:

```
//libraries
#include <LiquidCrystal.h>     //for LCD display
#include <SoftwareSerial.h>   //for Blutooth connection
#include <IRremote.h>          //for infrared remote control
#include <dht.h>               //for DHT detection
```

Figure 3: Libraries

2.2.1 setup()

The setup() function is called to initialize variables, pin modes, start using libraries, etc. The setup() function will only run once, after each power-up or reset of the Arduino board.

2.2.2 loop()

The loop() function is used to actively control the Arduino board.

- Mode Selection by Bluetooth:

In order to make our product easy to use, we integrate all functions with Bluetooth module. The mode of smart car can be switched arbitrarily through the mobile phone terminal.

```
void loop() {
    while(Serial.available())
  {
   comm=Serial.read();
   }
   switch(comm){
     case '1':{Auto_Track();break;}
     case '2':{Ob_Avoid();break;}
     case '3':{IR_Control();break;}
     case '4':{Follow();break;}
     case '5':{lcd.clear();lcd.setCursor(0, 0);lcd.print("Go");up1();up2();break;}
     case '6':{lcd.clear();lcd.setCursor(0, 0);lcd.print("Back");down1();down2();break;}
     case '7':{lcd.clear();lcd.setCursor(0, 0);lcd.print("Turn Left");up1();stop2();break;}
     case '8':{lcd.clear();lcd.setCursor(0, 0);lcd.print("Turn Right");up2();stop1();break;}
     case '9':{lcd.clear();lcd.setCursor(0, 0);lcd.print("Stop");Stop();break;}
     case 'a':{lcd.clear();lcd.setCursor(0, 0);lcd.print("Clockwise");down1();up2();break;}
     case 'b':{lcd.clear();lcd.setCursor(0, 0);lcd.print("Counterclockwise");down1();up2();break;}
     case 'c':{lcd.clear();lcd.setCursor(0, 0);lcd.print("Playing music");Music_Play();break;}
     case 'd':{lcd.clear();lcd.setCursor(0, 0);lcd.print("Monitoring Environment");Env_Monitor();break;}
     case 'e':{lcd.clear();lcd.setCursor(0, 0);lcd.print("Control Light");Light();break;}
     default:{{lcd.clear();lcd.setCursor(0, 0);lcd.print("Invalid Input");break;}
   }
}
```

Figure 4: Code for loop()

- Auto_Track()：

In the case of object moving too fast and causing long search time, we set up a flag in the code to predict the movement of the car. The LCD displays the running time of the car, the distance from the object, and the state of the car (stop / miss / find).

```
void Auto_Track(){
  show_dist();//show distance in real time
  show_time();//show time in real time

  value_1 = digitalRead(ray_sensor_1);
  value_2 = digitalRead(ray_sensor_2);

  if (dist<30) {direc='7';lcd.setCursor(8, 1) ; lcd.print(" stop");}
  else if (dist<50&&value_1 == LOW && value_2 == LOW) {direc='1';lcd.setCursor(8, 1) ; lcd.print(" find");}
  else if (value_1 == HIGH && value_2 == LOW) {direc='4'; flag=1;lcd.setCursor(8, 1) ; lcd.print(" find");}
  else if (value_1 == LOW && value_2 == HIGH) {direc='3'; flag=0;lcd.setCursor(8, 1) ; lcd.print(" find");}
  else if (flag==0){direc='3';lcd.setCursor(8, 1) ; lcd.print(" miss");}
  else if (flag==1){direc='4';lcd.setCursor(8, 1) ; lcd.print(" miss");}

  switch(direc){
    case '1':{ Go(); break;}
    case '2':{ Back(); break;}
    case '3':{ Counterclockwise(); break;}
    case '4':{ Clockwise(); break;}
    case '5':{ Right(); break;}
    case '6':{ Left(); break;}
    case '7':{ Stop(); break;}
  }
}
```

Figure 5: Code for Auto_Track()

- Ob_Avoid()：

Same principle as Auto_Track().

```
void Ob_Avoid(){
  show_dist();
  show_time();

  value_1 = digitalRead(ray_sensor_1);
  value_2 = digitalRead(ray_sensor_2);

  if (dist<30) {direc='2';lcd.setCursor(8, 1) ; lcd.print(" warn");}
  else if (dist>50 && value_1 == HIGH && value_2 == HIGH) {direc='1';lcd.setCursor(8, 1) ; lcd.print(" safe");}
  else if (value_1 == HIGH && value_2 == HIGH) {direc='1';lcd.setCursor(8, 1) ; lcd.print(" adjust");}
  else if (value_1 == HIGH && value_2 == LOW) {direc='3'; flag=1;lcd.setCursor(8, 1) ; lcd.print(" adjust");}
  else if (value_1 == LOW && value_2 == HIGH) {direc='4'; flag=0;lcd.setCursor(8, 1) ; lcd.print(" adjust");}
  else if (flag==1){direc='3';lcd.setCursor(8, 1) ; lcd.print(" adjust");}
  else if (flag==0){direc='4';lcd.setCursor(8, 1) ; lcd.print(" adjust");}

  switch(direc){
    case '1':{ Go(); break;}
    case '2':{ Back(); break;}
    case '6':{ Left(); break;}
    case '5':{ Right(); break;}
    case '4':{ Clockwise(); break;}
    case '3':{ Counterwise(); break;}
    case '7':{ Stop(); break;}
  }
}
```

Figure 6: Code for Ob_Avoid()

- IR_Control():

We use if-else to choose the response to the received command.

```
if(irrecv.decode(&results)){
  dump(&results);
if(results.value == run_car){direction = 1;}
else if(results.value == back_car){direction = 2;}
else if(results.value == right_turn){direction = 3;}
else if(results.value == left_turn){direction = 4;}
else if(results.value == left_car){direction = 5;}
else if(results.value == right_car){direction = 6;}
else if(results.value == stop_car){direction =7 ;}
irrecv.resume();// Receive the next value
}
```

Figure 7: Code for IR_Control()

- Follow():

We summarize all eight conditions of three infrared obstacle avoidance sensors and with if statement decide the motion of wheels.

```
if(data[1]){c=1;}
if(data[0]){c=2;}
if(data[2]){c=3;}
if(!data[0]&&!data[1]&&!data[2]){c=4;}
```

Figure 8: Code for Follow()

2.2.3 Motor

This part is common because the movement of wheels is the foundation of all modes. The stepper motor will adjust angle of the rotation of the trolley every time method called. We write the code for each wheel to better control the direction of the car. Here is an example of the forward motion of left-wheel:

```
void up1()
  {
    switch(_step1){
    case 0:
      digitalWrite(wheel1_pin1, LOW);
      digitalWrite(wheel1_pin2, LOW);
      digitalWrite(wheel1_pin3, LOW);
      digitalWrite(wheel1_pin4, HIGH);
    break;
    case 1:
      digitalWrite(wheel1_pin1, LOW);
      digitalWrite(wheel1_pin2, HIGH);
      digitalWrite(wheel1_pin3, LOW);
      digitalWrite(wheel1_pin4, HIGH);
    break;
    case 2:
      digitalWrite(wheel1_pin1, LOW);
      digitalWrite(wheel1_pin2, HIGH);
      digitalWrite(wheel1_pin3, LOW);
      digitalWrite(wheel1_pin4, LOW);
    break;

    case 7:
      digitalWrite(wheel1_pin1, HIGH);
      digitalWrite(wheel1_pin2, LOW);
      digitalWrite(wheel1_pin3, LOW);
      digitalWrite(wheel1_pin4, HIGH);
    break;
    default:
      digitalWrite(wheel1_pin1, LOW);
      digitalWrite(wheel1_pin2, LOW);
      digitalWrite(wheel1_pin3, LOW);
      digitalWrite(wheel1_pin4, LOW);
    break;
  }
   _step1++;

  if(_step1>7){    _step1=0;  }

  delay(stepperSpeed1);
}
```

Figure 9: Code for Left-wheel Forward Motion

For the smoothness of the car and the precise of the code, we integrate the code for wheel motion. Here we set 50/360 degree every time the method called:

```
void Go(){ //go straight
   for(int i=0;i<50;i++){
    up1();up2();
   }
}
```

Figure 10: Code for Forward Motion of The Car

2.2.4 show_dist() / show_time()

By mathematical operations, we get the distance. In addition, millis() method is used to return the milliseconds when the Arduino board starts running the current program. We convert it into 60 binary timing mode by mathematical methods.

```
void show_time(){
  unsigned long seconds;
  int s = 0, m = 0, h = 0, d = 0, mon = 0, y = 0;                    //time carry
  int second = 0, minute = 0, hour = 0, day = 0, month = 0, year = 0;   //current time
  int SECOND = 0, MINUTE = 0, HOUR = 0, DAY = 0, MONTH = 0, YEAR = 0;   //initial time

  seconds = millis()/1000;
  second = (SECOND + seconds) % 60;                                  //calculate second
  m = (SECOND + seconds) / 60;                                       //carry of minute
  minute = (MINUTE + m) % 60;                                        //calculate minute
  h = (MINUTE + m) / 60;                                             //carry of hour
  hour = (HOUR + h) % 24;                                            //calculate hour

  lcd.setCursor(0, 1) ;
  lcd.print(hour);
  lcd.print(":");
  lcd.print(minute);
  lcd.print(":");
  lcd.print(second);
}
```

Figure 11: Code for Displaying Real time

2.2.5 Env_Monitor()

We send data to the cellphone per 2000ms through Bluetooth. To tackle the error more easily, we also return the error reminder to users for better dealing.

```
void Env_Monitor(){
  Serial.write("DHT11, \t");
  int chk = DHT.read11(DHT11_PIN);
  switch (chk){
    case DHTLIB_OK: { Serial.write("OK,\t"); break;}
    case DHTLIB_ERROR_CHECKSUM: { Serial.write("Checksum error,\t"); break;}
    case DHTLIB_ERROR_TIMEOUT: { Serial.write("Time out error,\t"); break; }
    case DHTLIB_ERROR_CONNECT: {Serial.write("Connect error,\t"); break;}
    case DHTLIB_ERROR_ACK_L: { Serial.write("Ack Low error,\t"); break;}
    case DHTLIB_ERROR_ACK_H: { Serial.write("Ack High error,\t"); break;}
    default: { Serial.write("Unknown error,\t"); break;}
  Serial.write(DHT.humidity, 1);
  Serial.write("\t");
  Serial.write(DHT.temperature, 1);
  delay(2000);
}
```

Figure 12: Code for Env_Monitor()

2.2.6 Light() and Music_Play()

The switching status of the lights is controlled by the high or low level of the pin using digitalWrite() method .And for playing music, we define the frequency and tone to design the music realization. Here is an example for music “joy”:

```
//list all rhythm
int tunejoy[]=
{
  NTD3, NTD3, NTD4, NTD5,
  NTD5, NTD4, NTD3, NTD2,
  NTD1, NTD1, NTD2, NTD3,
  NTD3, NTD2, NTD2,
  NTD3, NTD3, NTD4, NTD5,
  NTD5, NTD4, NTD3, NTD2,
  NTD1, NTD1, NTD2, NTD3,
  NTD2, NTD1, NTD1,
  NTD2, NTD2, NTD3, NTD1,
  NTD2, NTD3, NTD4, NTD3, NTD1,
  NTD2, NTD3, NTD4, NTD3, NTD2,
  NTD1, NTD2, NTDL5, NTD0,
  NTD3, NTD3, NTD4, NTD5,
  NTD5, NTD4, NTD3, NTD4, NTD2,
  NTD1, NTD1, NTD2, NTD3,
  NTD2, NTD1, NTD1
};

  //list all melody
  float durtjoy[]=
  {
    1, 1, 1, 1,
    1, 1, 1, 1,
    1, 1, 1, 1,
    1+0.5, 0.5, 1+1,
    1, 1, 1, 1,
    1, 1, 1, 1,
    1, 1, 1, 1,
    1+0.5, 0.5, 1+1,
    1, 1, 1, 1,
    1, 0.5, 0.5, 1, 1,
    1, 0.5, 0.5, 1, 1,
    1, 1, 1, 1,
    1, 1, 1, 1,
    1, 1, 1, 0.5, 0.5,
    1, 1, 1, 1,
    1+0.5, 0.5, 1+1,
  };
```

Figure 13: Music Code

2.3 Hardware design

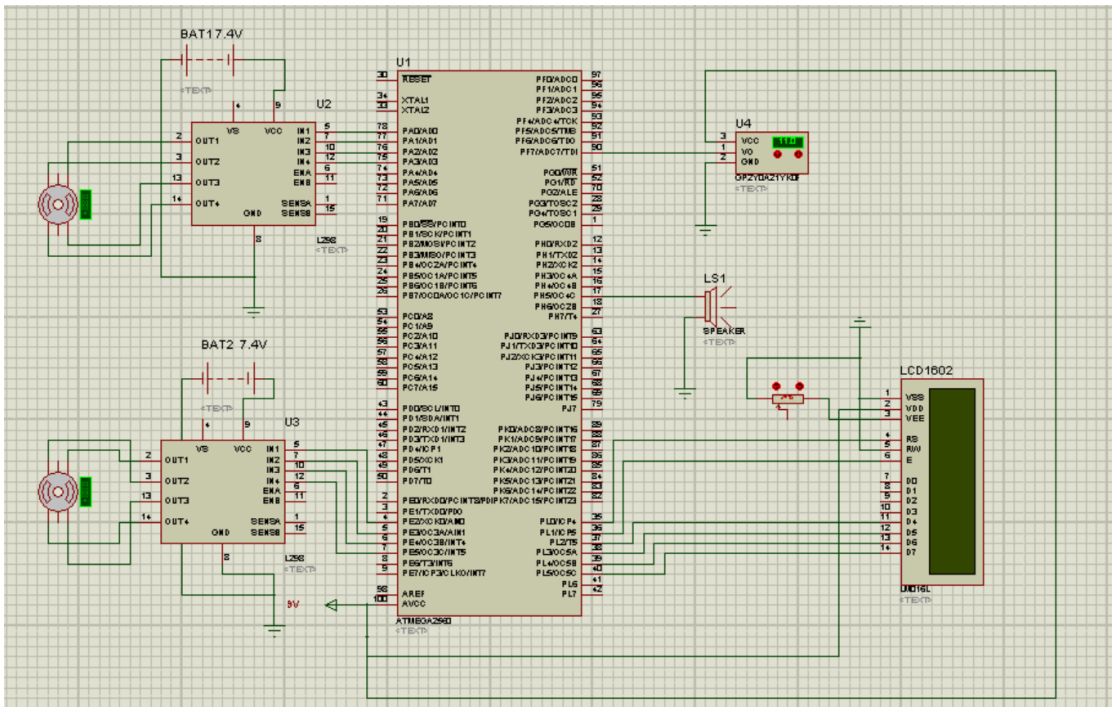


Figure 14: Circuit Diagram of Hardware

Figure 13 is the main circuit of our product. For the simple layout which indicates the disassembly convenience and better maintenance of product, we finally chose the plan as the picture above shows (the picture is only a part of the entire circuit).

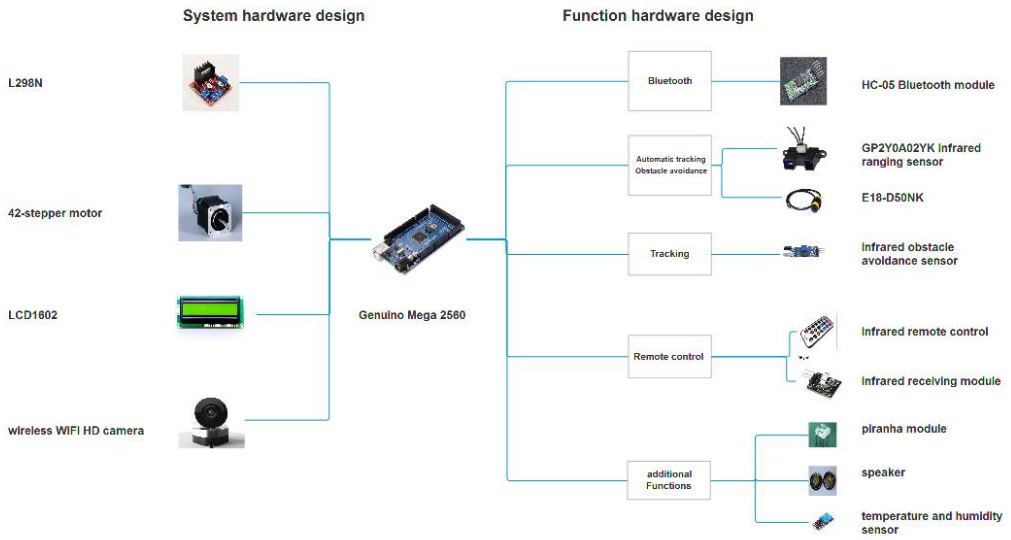


Figure15: Diagram of System and Function Component

2.3.1 Genuino Mega 2560

The Genuino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins, 16 analog inputs, 4 UARTs, a 16MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button. For the merits of its comprising multiple pins, we finally chose Mega 2560 as the core microcontroller of our robot, which is sufficient to realize our product design.

2.3.2 System Hardware Design

- **Stepper Motor**

The 42-stepper motor divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps. Here we set a fix number of steps for accurate positioning. The speed of wheels can also be set by controlling the pulse frequency so as to achieve the goal of speed regulation. Each stepper motor is driven separately by an L298N motor drive module.

- **Liquid Crystal Display Screen**

LCD1602 module is small in size and light in weight, with high display quality and low power consumption. In the circuit design, we use 8 wire connection method to achieve high rate transmission of data.

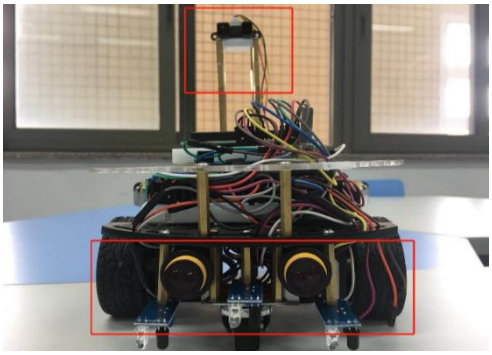
- **Wireless WIFI HD Camera**

This additional accessory is easy to install for users who need invoke the video function. The 1080P HD camera can be monitored in wireless WIFI network. The Huawei Heath chip inside the camera also make wide angle field of vision up to 160-degree.

2.3.3 Function Hardware Design

- **Automatic tracking and Obstacle avoidance function design**

We use an infrared ranging sensor and two infrared obstacle avoidance sensors for automatic tracking and Obstacle avoidance functions.



GP2Y0A02YK infrared ranging sensor
GP2Y0A02YK has better performance in accurate distance measurement and anti-interference. Its measuring range is 20-150cm. Considering the length of the car is 20 cm, we installed it on the rear of the car.

E18-D50NK infrared obstacle avoidance sensor:
Measuring range is 20-150 cm.

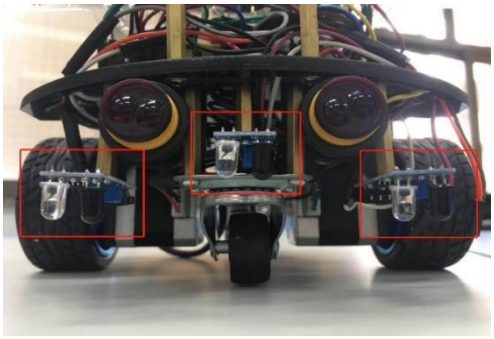


Figure 16,17: Sensors

● Tracking Function Design

We use three infrared obstacle avoidance sensors. The equidistant linear installation of modules outperforms.
Infrared obstacle avoidance sensor:

Measuring range is 3-50 cm.

● Additional Function Design

The car has a speaker that can play music through Bluetooth. The temperature and humidity sensor can monitor environmental temperature and humidity in real time. Two piranha modules are installed below the car as the headlights, which can be controlled via Bluetooth.

● The way of Data Transmission

1. Bluetooth Transmission
The integrated Bluetooth module of HC-05 host and slave is used to realize the communication between microcontroller and mobile phone.

2. WIFI Transmission
The video data of the camera is transmitted to mobile phone or PC by means of WIFI transmission.

2.4 Appearance Design

2.4.1 Design Concept

Panda, Chinese national treasure, is deeply loved by people all over the world for its lovely appearance, which also make the movie Kung Fu Panda a big success. Since our theme is to develop a new type of robot that can automatically filming pandas in real time in the zoo, we elaborate the appearance into a panda which is quite different from humanoid robots on the market. It is designed a more attractive appearance product that is close to nature and human life. With the main shape as a panda, our product also remains part of the general model of a smart car in a streamlined body design.

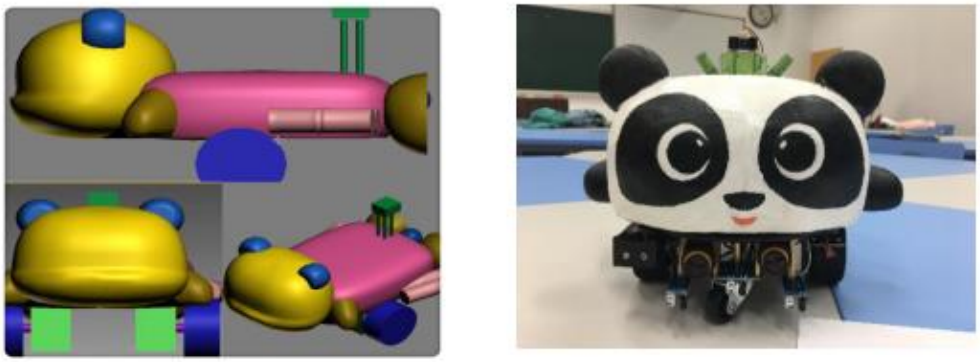


Figure18: Product Model

2.4.2 Color and Pattern Design

Based on regular color – black and white-- of panda, our product keeps the normal body structure with limbs, which makes the product more approachable. We also added the bamboo element design on the back side to make the it closer to the nature. To satisfy additional functions like carriage, we make the slot at the rear of the car and paint our company logo on it, so that the car can carry things such as business card and leaflet when it moving, making the car function closer to human life.

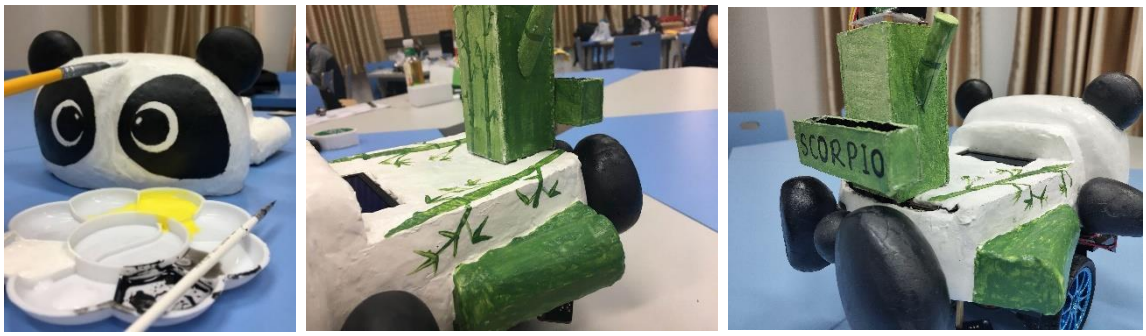


Figure19: Color and Pattern

2.4.3 Material Selection

In order to improve the details and design a simulated panda car product, we abandon the way of paper making and 3D printing, and adopt the method of hand-clay molding for smooth surface without edges, and gaps.

We have done a lot of thinking and research on material selection before decided. Considering material properties, appearance maintenance and market demand, and from an environmental point of view, we finally use PVA/PE (polyvinyl alcohol plastic) lightweight clay. The clay seamlessly mesh with the hardware body also can reduce the risk of users' getting injured.

Other reason we chose it is as follows:

- Color fastness and resists fading, which ensure the time duration of the product.
- Excellent strength, high elasticity and high plasticity, which ensure the quality of the product.
- Low cost, light weight, which expands the competitive advantage of the product market.

2.4.4 Additional Product Design

Panda TMax has some additional products. For example, we designed several obits to realize the trac-following function of the car. We use light wood to make the track. The background color of the track is green, which show the appeal for environmental protection concept. We also put some lovely panda patterns on the track panel to simulate scenes.


Figure 20, 21, 22: Additional product

2.5 Maintainability and Duration

MAINTAINABILITY	DURATION
The external appearance of the car is a whole which is light and installed tightly so that it’s easy to disassemble for internal inspection	Bluetooth pairing need user enter the matching password for safe control. The product can only work with specific input which avoid work with other accidental input character.
The circuit is clear and concentrated so that the car is easy to check.	The camera is protected by the password of WIFI hotspot for information safety reason.
After the outer covering disassembled, the battery can be exposed for convenient disassembly and replacement without affecting the internal circuit structure	Dupont Line have great durability.
	3.7V Rechargeable Battery last a long time

Table 1 : Maintainability and Duration

2.6 Cost Estimation

No.	Specification	Amount	Unit Price	Sum
1	Genuino Mega 2560	1	80	80
2	Vehicle Chassis（with wheels）	1	30	30
4	HC-05 Bluetooth module	1	15	15
5	Stepper Motor	2	10	20
6	LCD1602	1	20	20
7	WIFI HD camera	1	150	150
8	E18-D50NK infrared obstacle avoidance sensor	2	15	30
9	infrared obstacle avoidance sensor	3	10	30
10	GP2Y0A02YK infrared ranging sensor	1	45	45
11	speaker	1	3	3
12	IR Remote Control	1	5	5
13	Piranha module lamp	2	5	10
14	3.7V Rechargeable Battery	4	20	80

15	9V Battery	1	6	6
16	Dupont Line (needle-needle)	1	4	4
17	Dupont Line (no needle-no needle)	1	4	4
18	Dupont Line (needle-no needle)	1	4	4
19	Copper Pillar	10	1	10
20	Nuts and Bolts（diameter 4mm）	20	0.1	2
21	Paperboard	1	0.5	0.5
22	electrical tape	2	3	6
24	Light clay	2	10	20
25	pigment	1	15	15
Sum Price		589.5		

Table 2 : Cost Estimation

3 Website Design

Scorpio's website's appearance and function design is aim to give users a clear and impressive corporate image and product image and expand their influence. For this reason, we have designed a sales platform that enables users to browse company and product information conveniently and quickly and purchase products, as well as a feedback platform that allows company managers to communicate with users in a timely manner.

3.1 Appearance Design

We believe that a good web design is not only eye appealing, it’s usable, intuitive, simple in hierarchy yet complex enough to keep the user interested. Therefore, Scorpio's marketing department decided to add technical elements that fit our robot company's image and robot product theme on the basis of keeping the page simple and elegant. The appearance of our web page is all dominated by the blue and white collocation, which makes the page information prominent and clear. In addition, our carefully selected background images make the web page simple but not very rigid for users.

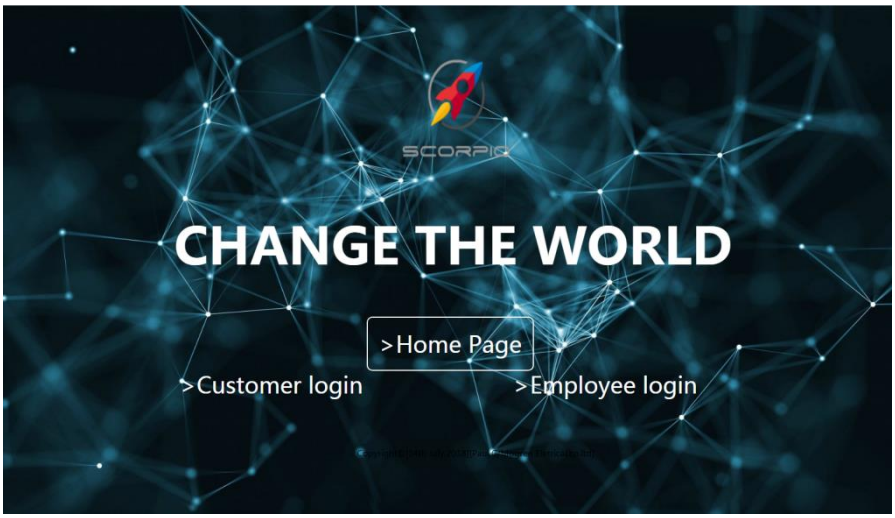


Figure 23: First Page

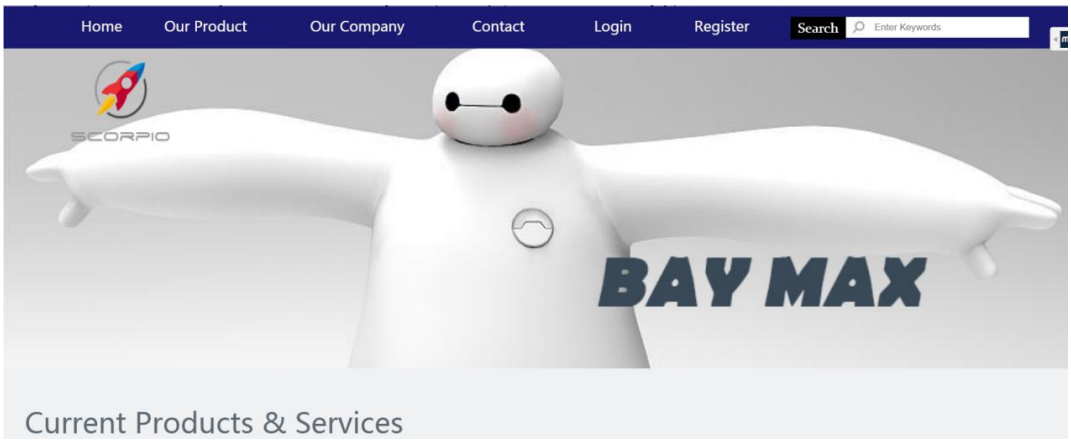


Figure 24: Home Page

3.2 Web Pages Structure Design

Scorpio classifies web page viewers into three categories:

Visitor users : They can browse all information normally but can't make purchases. They can register and leave messages.

Logged-in customers : Addition to the basic information browsing function, they can add items to their shopping carts to purchase and view purchased items.

Logged-in Managers : Managers can browse all information as well as view all the messages left by users.

Because the index bars for different web visitors have different links, we have to created three sets of pages for three categories of viewers. The page structure is as follows:

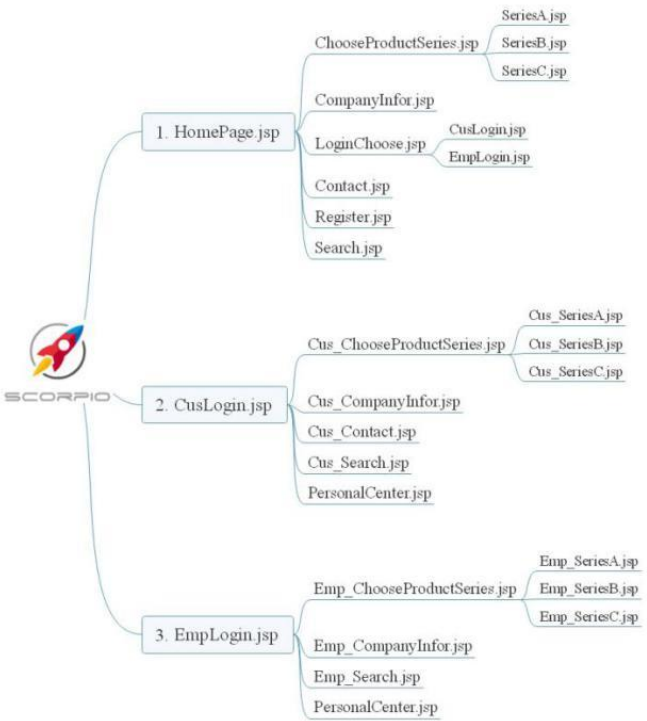


Figure 25: Pages Structure

3.3 Function Design

In terms of the functions of the website, Scorpio attaches great importance to the practicability and intuition of the website and hopes to provide all the functions and services that users may need, while minimizing users' work to use it. First of all, we have made the most basic functions such as registering, browsing goods and company information, purchasing goods, checking orders and leaving messages. In addition, in order for the user to quickly find the commodity information they need, we have created a search function that can directly jump to the corresponding commodity page through the search results. At the same time, in order to get feedback from users in a timely manner, we have created an administrator thread.

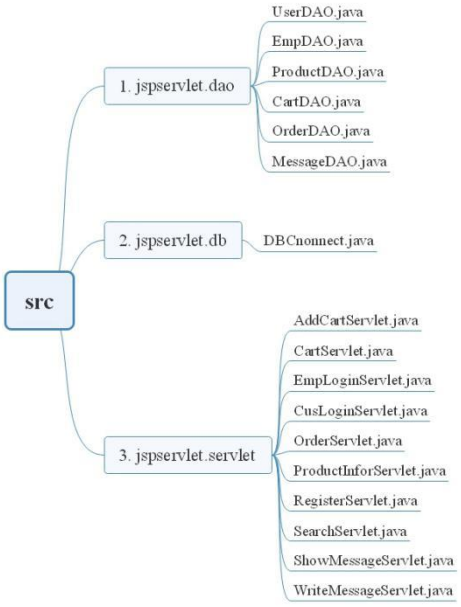


Figure 26: Server Logic

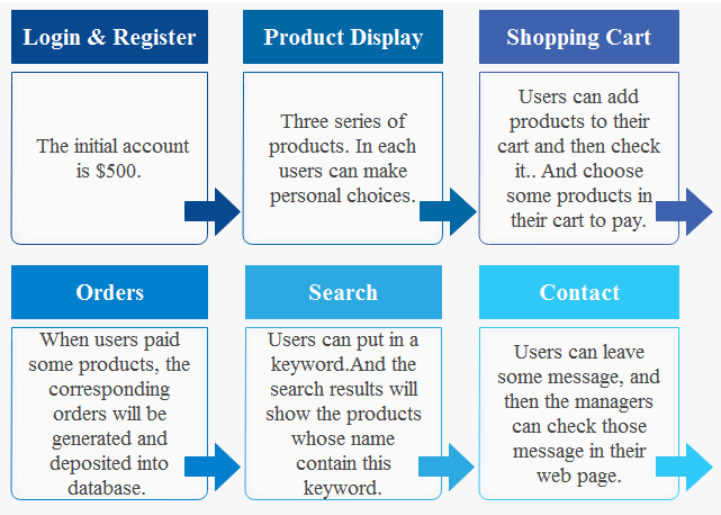


Figure 27: Functions of Our Website

3.3.1 Login & Register

The registration page requires the user to enter basic information, and the appearance of the login interface and the registration interface are basically the same. The user's registered information is stored in the database instantly.

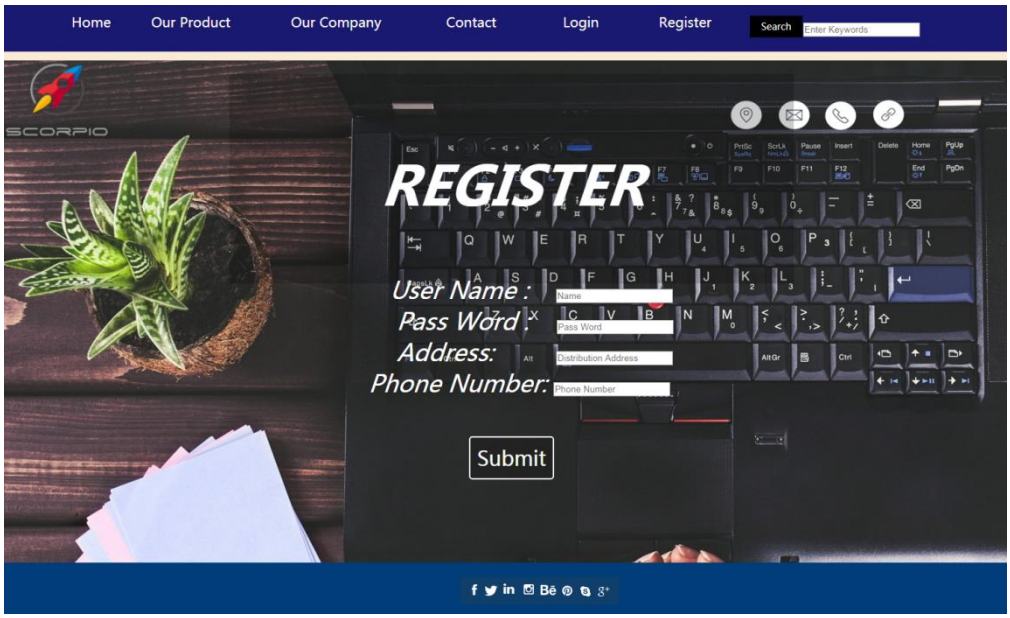


Figure 28: Register Page

3.3.2 Product Display

Scorpio's products are divided into three series: entertainment robots, nurse robots and tracking robots. Our main product, Panda Car, is a tracking and camera robot that belongs to the tracking robot series. And it is mainly for animal researchers or public animal protection areas.

Users can directly jump to the commodity pages by click the links in the navigation bar to browse different series of commodity information. They can then select a certain item and the required color and size, and add it to the shopping cart to prepare for payment. For users who are not logged in, they need to log in or register to complete this operation.

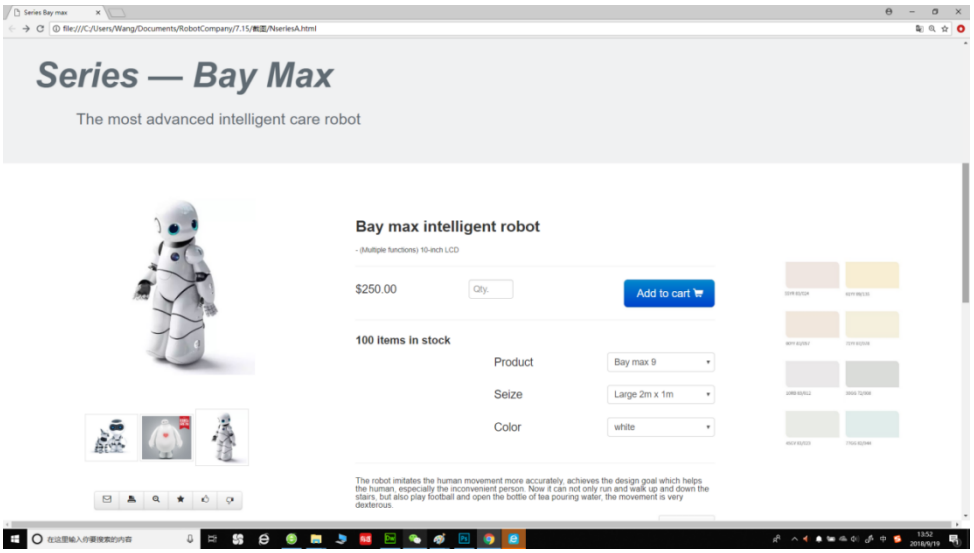


Figure 29: Product Page (Nursing Series)

3.3.3 Personal Information & Shopping Cart

The personal center has three parts: personal information, shopping cart information and orders generated after purchase. Users can view personal distribution information and balance, and the information of added items in the shopping cart, then check items to pay for them.

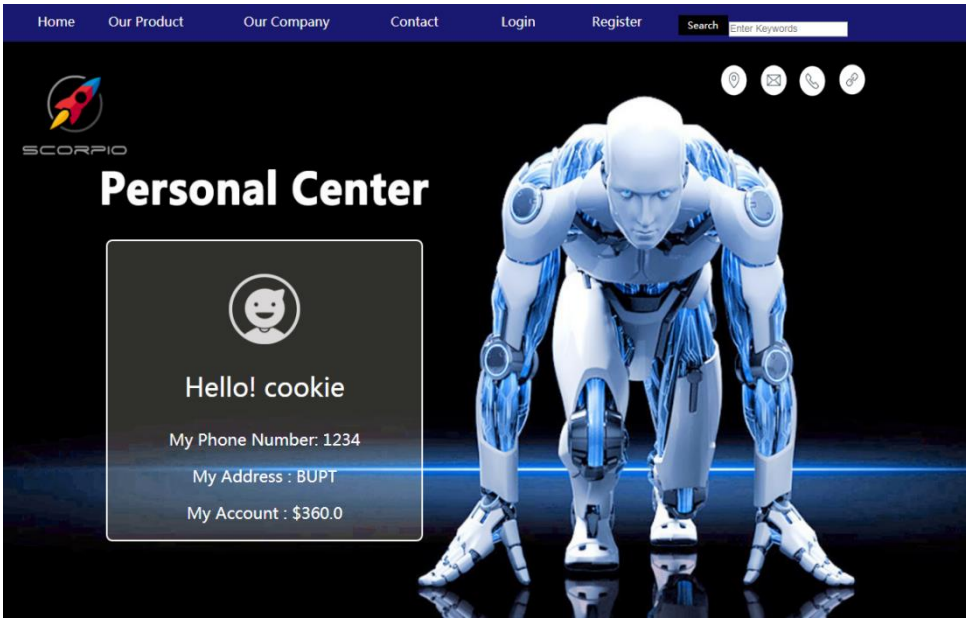


Figure 30: Personal Page - Personal Information

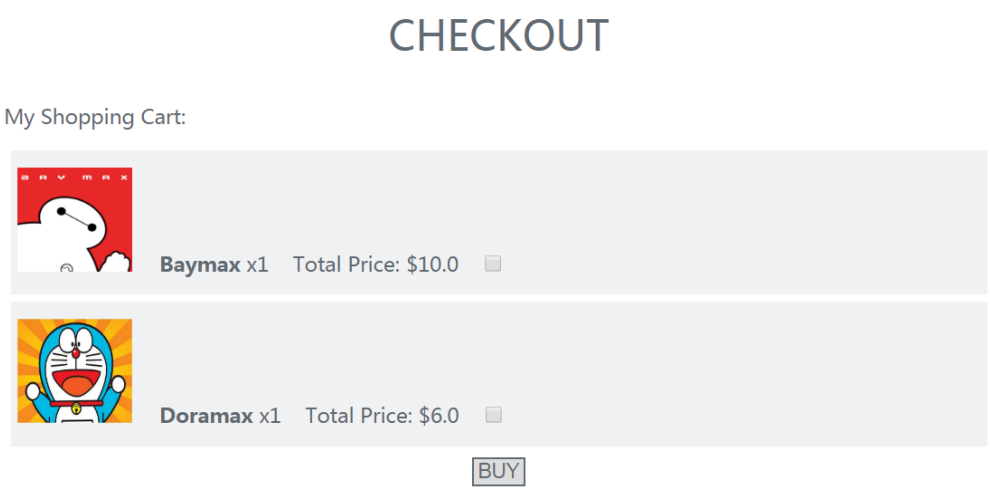


Figure 31: Personal Page - Shopping Cart

3.3.4 Orders

Once some items in shopping cart are paid, the corresponding orders will be generated and displayed in the order section below the personal center. This part displays the goods purchased, the quantity, the total cost and the time of purchasing.

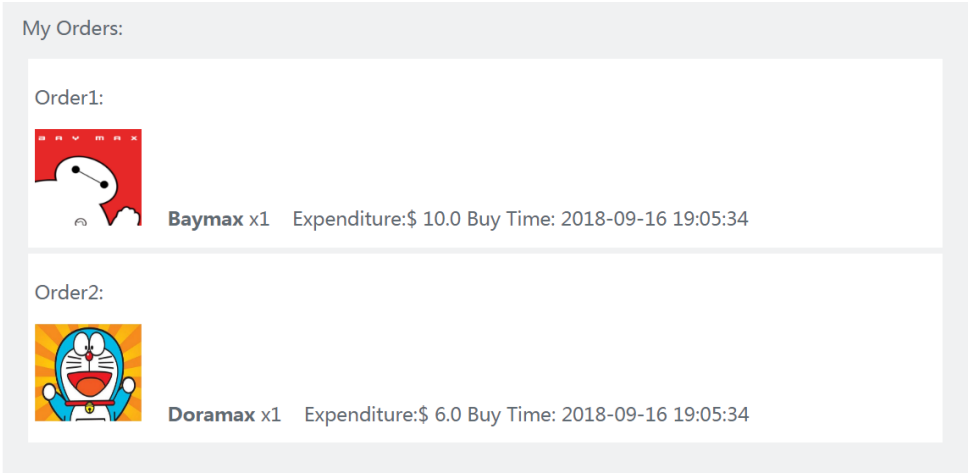


Figure 32: Personal Page - Orders

3.3.5 Search

The search box in the upper right corner of the navigation bar in every page allows users to search for items that need to be quickly found. The search results show the picture, price and introduction of the corresponding goods. Click on the search results to jump to the corresponding product page.

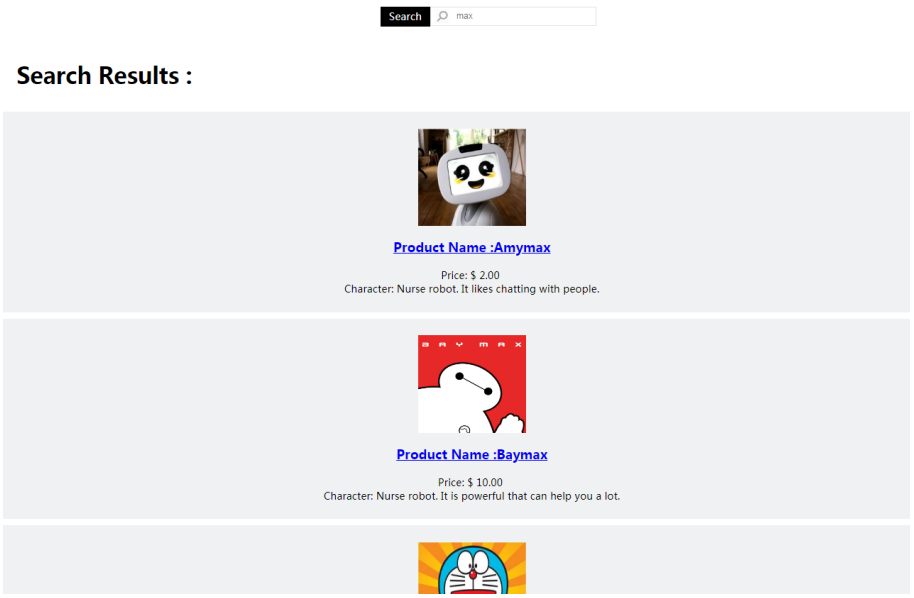


Figure 33: Search Results

3.3.6 Contact

When users encounters a problem that cannot be solved by themselves, they can leave a message quickly and conveniently by clicking the " Contact" button on the navigation bar. Users who are not logged in need to enter a name and phone number when leaving a message so that managers can easily contact them. The user's message will be stored in the database along with the user's personal information and message time.

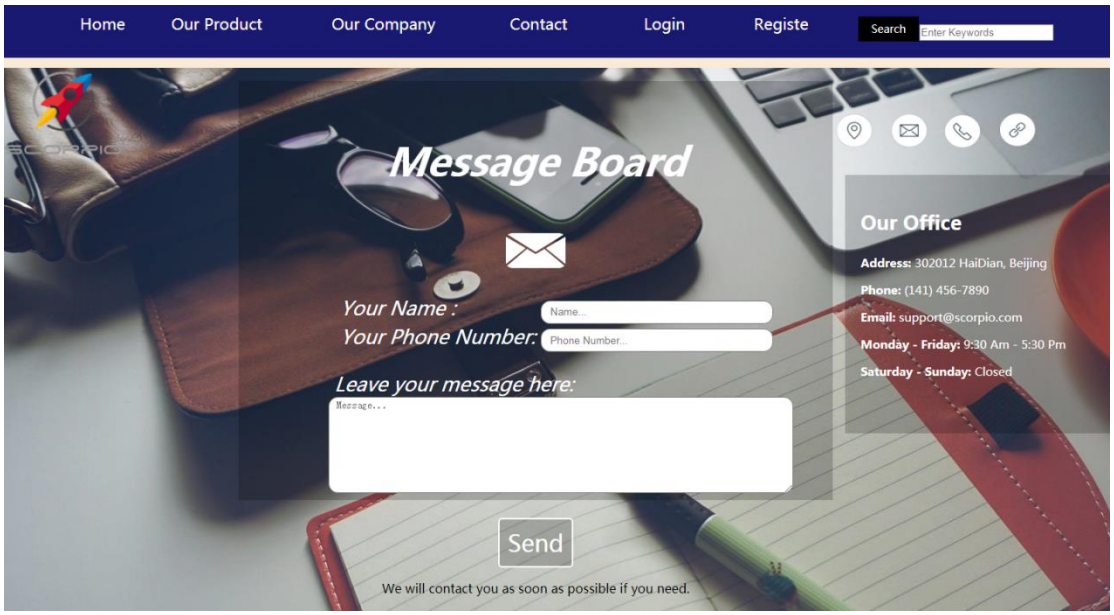


Figure 34: Search Results

3.3.7 Manager Check Feedback

It is very important for the development of the company to be able to process the feedback information of users quickly. After logged in, the administrator can view their personal information and position in the personal center, as well as the messages left by users. In order to maintain the competitiveness of the company, good managers need to respond to users' feedback information in time and take measures after listening to users' suggestions.

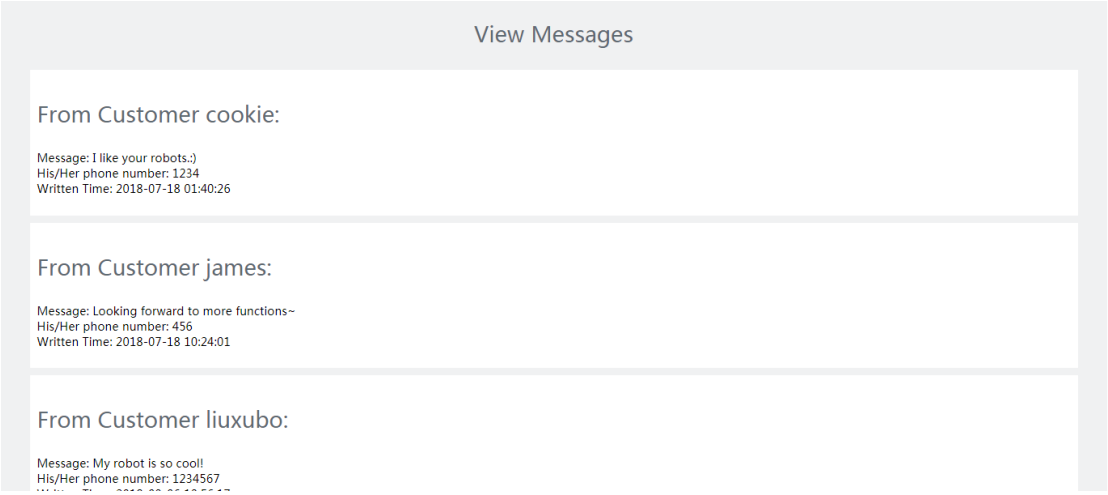


Figure 35: View Messages

4 Database

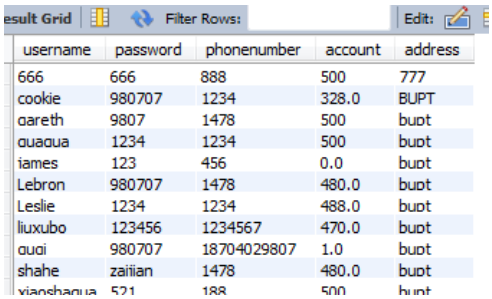
Scorpio's marketing department decided to set 6 tables in our back-end database to support the functional comprehensiveness and high-efficiency of the web pages. The pages can retrieve data or store data to the database in a fast speed.

userinfo	(username, password, phonenumber, account, address)
empinfo	(empname, password, position, phonebumber)
proinfo	(proname, character, ener_efficiency, price, series, photo)
cart	(proname, username, amount, total_price, photo)
ordertable	(proname, username, amount, total_price, buytime, photo, color, size)
messageboard	(mes, username, phonenumber, writetime)

Figure 36: Database Table

4.1 Userinfo Table & Empinfo Table

The register page stores the personal information input by the users to the userinfo table. And personal information includes basic distribution information and account, which is initialized as $500. Employees' information includes their positions besides some other attributes that are the same as customers'. All the web viewers can check their personal information in the personal center.

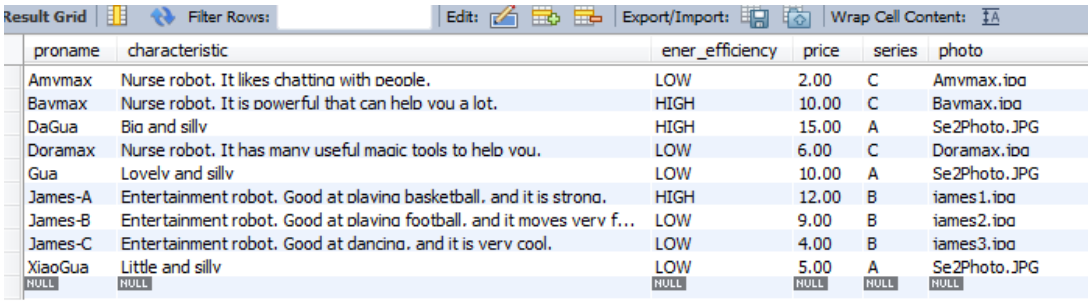

esult Grid | Filter Rows: | Edit:

username	password	phonenumber	account	address
666	666	888	500	777
cookie	980707	1234	328.0	BUPT
gareth	9807	1478	500	bupt
guagua	1234	1234	500	bupt
iames	123	456	0.0	bupt
Lebron	980707	1478	480.0	bupt
Leslie	1234	1234	488.0	bupt
liuxubo	123456	1234567	470.0	bupt
ouoi	980707	18704029807	1.0	bupt
shahe	zaiiian	1478	480.0	bupt
xiaoshaqua	521	188	500	bupt

Figure 37: Userinfo Table

4.2 Proinfo Table

Proinfo table stored the products' names, character, energy efficiency, price, series which them belong to and the links of their photos. This table supports the function of the product display pages and search results page.

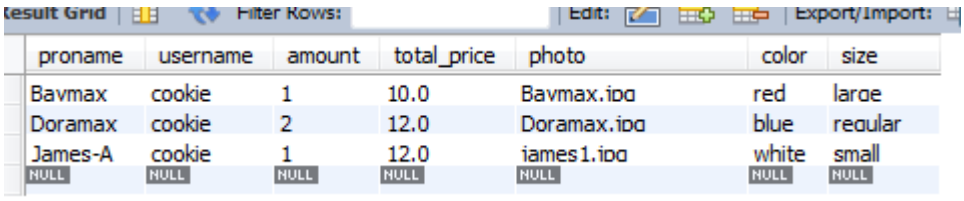


proname	characteristic	ener_efficiency	price	series	photo
Amvmax	Nurse robot. It likes chatting with people.	LOW	2.00	C	Amvmax.jpg
Bavmax	Nurse robot. It is powerful that can help you a lot.	HIGH	10.00	C	Bavmax.jpg
DaGua	Big and silly	HIGH	15.00	A	Se2Photo.JPG
Doramax	Nurse robot. It has many useful magic tools to help you.	LOW	6.00	C	Doramax.jpg
Gua	Lovely and silly	LOW	10.00	A	Se2Photo.JPG
James-A	Entertainment robot. Good at playing basketball, and it is strong.	HIGH	12.00	B	james1.jpg
James-B	Entertainment robot. Good at playing football, and it moves very f...	LOW	9.00	B	james2.jpg
James-C	Entertainment robot. Good at dancing, and it is very cool.	LOW	4.00	B	james3.jpg
XiaoGua	Little and silly	LOW	5.00	A	Se2Photo.JPG
NULL	NULL	NULL	NULL	NULL	NULL

Figure 38: Proinfo Table

4.3 Cart Table

This table will be altered when a user put some products into his/her cart or purchase some products in his/her cart. It will also conclude what color and size the user chose.

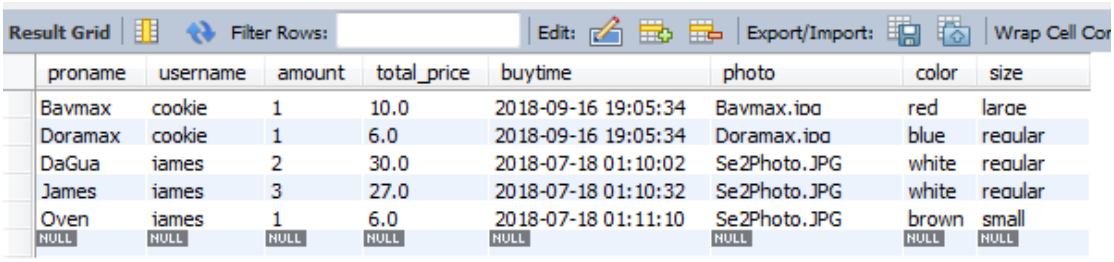


proname	username	amount	total_price	photo	color	size
Bavmax	cookie	1	10.0	Bavmax.jpg	red	large
Doramax	cookie	2	12.0	Doramax.jpg	blue	regular
James-A	cookie	1	12.0	james1.jpg	white	small
NULL	NULL	NULL	NULL	NULL	NULL	NULL

Figure 39: Cart Table

4.4 Order Table

When some products in carts are paid, the orders will be generated immediately. This also includes ‘buytime’ as part of the primary key. A user’s orders can be viewed in his/her personal page.

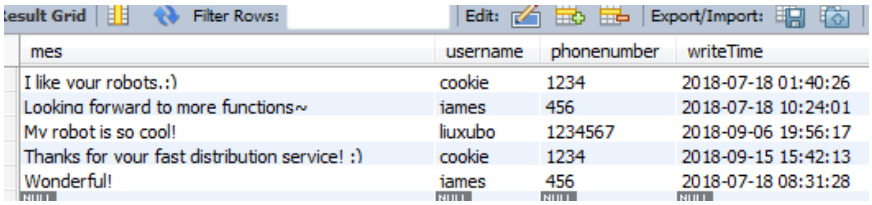


proname	username	amount	total_price	buytime	photo	color	size
Bavmax	cookie	1	10.0	2018-09-16 19:05:34	Bavmax.jpg	red	large
Doramax	cookie	1	6.0	2018-09-16 19:05:34	Doramax.jpg	blue	regular
DaGua	james	2	30.0	2018-07-18 01:10:02	Se2Photo.JPG	white	regular
James	james	3	27.0	2018-07-18 01:10:32	Se2Photo.JPG	white	regular
Oven	james	1	6.0	2018-07-18 01:11:10	Se2Photo.JPG	brown	small
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Figure 40: Order Table

4.5 Message Board Table

This table stored the messages left by the users, as well as the users' information and the time they wrote the messages. In the employees' personal pages, data in this table are called out.


esult Grid | Filter Rows: | Edit: | Export/Import:

mes	username	phonenumber	writeTime
I like your robots.:)	cookie	1234	2018-07-18 01:40:26
Looking forward to more functions~	james	456	2018-07-18 10:24:01
My robot is so cool!	liuxubo	1234567	2018-09-06 19:56:17
Thanks for your fast distribution service! :)	cookie	1234	2018-09-15 15:42:13
Wonderful!	james	456	2018-07-18 08:31:28
NULL	NULL	NULL	NULL

Figure 41: Order Table

5 Propaganda Design

5.1 Video design

In order to combine product application scenarios and show the functions of the product efficiently and intuitively, our video design starting from the actual scene of the zoo, using the innovative application model and product perfect functions to attract the attention of the customer. The script is mainly divided into two parts.

The first scenario:

A group of tourists in the zoo want to see pandas more clearly, and they don’ t need to worry about this. A lovely panda robot appeared in the cage. The robot follows the animals in tracking mode, and the images can be uploaded to the visitors' mobile phones in real time, so that visitors can clearly watch the animals. Workers can also use the control mode to control the robot's position and perspective, allowing visitors to view animals from multiple angles.

The second scenario:

The robot is patrolling the zoo in a tracking mode, with some bottles of water and leaflets placed on it’ s back. Visitors can randomly collect water and leaflets on their own. The weather was very hot and the visitors who got the water were very satisfied. The visitors who got the leaflet were also glad to learn more about the small animals. The video shows the appearance, design and function of the product.
Our product can bring a lot of useful help and many happy experiences to tourists.

5.2 Poster design

We design different style posters to advertise product well. For example:

Figure42: Poster

6 Management and Team Work

6.1 Minutes of Team Meetings

In order to ensure the progress of product development and website development, our group organized regular group meetings. Since the three majors have different work, we can timely exchange our information and adjust our plan through these regular meetings, which can also improve our team cohesion.

We attach great importance to the efficiency of each meeting, so we would plan the discussion topic and discussion process before each meeting. And after each meeting, we would decide the time of next meeting and make a list of the work we should done before next meeting.

6.1.1 Minutes of The Meeting Arrangement

Date/Time: July 9, 2018, 1:30 p.m.
Location: The Teaching Building S-107, Shahe campus of BUPT
Present: All of the members of group 56.
Leader: Xubo Liu
Proceeding:
1. Self-introductions of every one.
2. Make a list of the things we should do and deadline.
3. Members of three majors respectively introduced what they have learned and what responsibilities they should take to achieve our collective goals.
4. Decided what kind of robot company we should have, the name, logo, and departments.
5. Discussed what kind of product our tracking robot can be.
6. The responsible persons of three majors decided to report their work progress every three days.
7. Determined the time of next meeting.

Date/Time: September 8, 2018, 3:30 p.m.
Location: The Third Teaching Building 425, main campus of BUPT
Present: All of the members of group 56. (Two members absented)
Leader: Xubo Liu
Proceeding:
1. Responsible persons of three majors reported what they have done and the remaining work.
2. Decided the application scenarios and other details of our tracking robot such as supplemental functions and appearance.
3. All the members gave some suggestions about the revision of the website.

4. Discussed how to make the video advertising.
5. Assigned the task of writing different parts of the user manual and report.

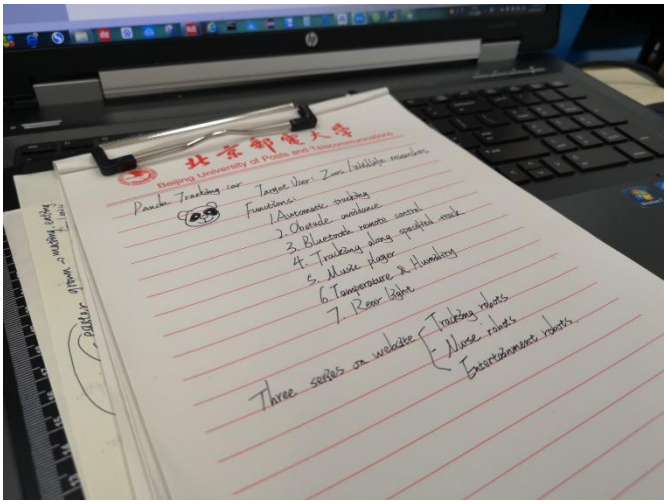


Figure 43: Notes of A Meeting

6.2 Work Flow

Design Management of Three Majors

Our group has a clear division of labor, and each member has his/her own task arrangement.

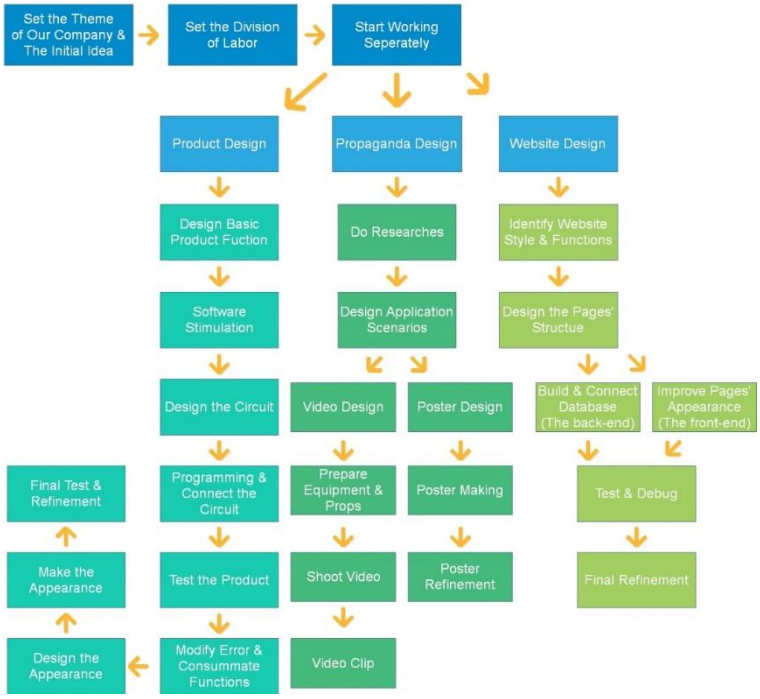


Figure 44: Flow Chart of Our Work

Gantt Charts

ID	Task Name	Start	Finish	Duration
1	Learning Background knowledge	2018-07-09	2018-07-12	4.0 days
2	Company Design	2018-07-11	2018-07-11	0.5 day
3	Function Design	2018-07-11	2018-07-11	0.5 day
4	Circuit Design	2018-07-12	2018-07-13	2.0 days
5	Programming	2018-07-13	2018-07-14	1.5 days
7	Software Simulation	2018-07-13	2018-07-13	1.0 day
8	Connect the Circuit	2018-07-14	2018-07-15	2.0 days
9	Prototype Test & Debug	2018-07-16	2018-07-19	4.0 days
9	Website Design	2018-07-11	2018-07-11	1.0 day
10	Dtabase Development	2018-07-12	2018-07-16	4.5 days
11	Front-end Web Development	2018-07-12	2018-07-16	5.0 days
12	Website Test & Debug	2018-07-17	2018-07-19	3.0 days
13	Appearance Design	2018-07-18	2018-07-19	2.0 days

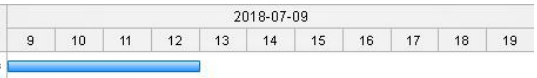


Figure 45: Gantt Chart - Before the Summer Vacation

ID	Task Name	Start	Finish	Duration
1	Function Supplement & Refinement	2018-09-08	2018-09-10	2.5 days
2	Appearance Making	2018-09-10	2018-09-12	3.0 days
3	Final Product Testing	2018-09-13	2018-09-13	1.0 day
4	User Manual Making	2018-09-12	2018-09-15	4.0 days
5	Website Refinement	2018-09-14	2018-09-16	2.5 days
6	Final Website Test	2018-09-16	2018-09-17	1.0 day
7	Report Making & Refinement	2018-09-16	2018-09-19	3.5 days
8	Video Shooting	2018-09-16	2018-09-19	3.5 days

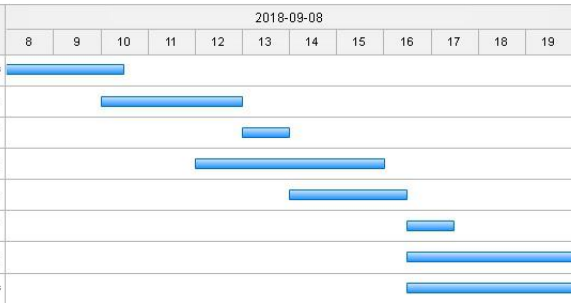


Figure 46: Gantt Chart - After the Summer Vacation

Our Division of Main Tasks

By reasoning division of main tasks, we can work more efficient.

Product design	Xubo Liu	product function design and hardware design
	Jingyi Wan	software design and test
	Qi Zhang	Appearance design and making
	Zhaoyuan Yin	Project report and user manual making
Web design	Chang Wang	Front-end page design
	Wanting Li	Background function design
	Tianqi Qu	Background function making
Database and Propaganda design	Shengjie Ji	Data base design
	Shengyi Gao	Video design and shooting
	Jiang He	Video editing and poster making

Table 3 : Main Task

Figure 47: Meetings

7 Conclusion

In this summer short semester, every member in our group has a great harvest. What we have learned is not only a wealth of software and hardware knowledge, but also how to work as a team, time arranging skills as well as how to make plans and summaries. We come from three different majors and have different aspects of knowledge, so we learned how to divide tasks and cooperate effectively based on each other's strengths during our team work.

When we were facing difficulties, we can get the best solution through group discussion. This not only enhanced our ability to solve problems and ability to communicate, but also cultivated our sense of responsibility as a member in a team.

In general, we all have learned a lot in this short semester’ s experience. And at the same time, we enjoy the joy of the process of completing the work.