

Project Report

Group 5



Date of Report: September 19th , 2018

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Content

1. Hardware's Product Design Process.....	4
1.1 Concept Development	4
1.1.1 Target Specification	4
1.1.2 Function Design.....	5
1.1.3 Concept Generation	5
1.1.4 Concept Selection	6
1.2 System-Level Design.....	13
1.3 Detail Design	14
1.3.1 Circuit Design and Simulation	14
1.3.2 Code Design.....	15
1.3.3 Appearance Design	16
1.3.4 User Interaction Design	18
1.4 Design for Environment	21
1.4.1 DFE Goal	21
1.4.2 Apply DFE Goal to Product Design	21
1.5 Production Ramp-Up	22
2. Website Design	24
2.1 Identify Needs.....	24
2.2 Determine Website Functions.....	24
2.2.1 Home Page.....	24
2.2.2 Registering.....	24

2.2.3	Logging in and Logging Out	25
2.2.4	Product	25
2.2.5	Cart.....	25
2.2.6	Order	25
2.2.7	Merchandise Query.....	26
2.3	Database Design	26
2.3.1	Design Purpose	26
2.4	Detail Design	26
2.4.1	Cart Table.....	26
2.4.2	Cart Include Product Table	27
2.4.3	Order Include Product Table.....	27
2.4.4	Product Table	27
2.4.5	The Order Table	28
2.4.6	The User Table.....	28
3.	Planning and Management.....	29
3.1	The Planning and Production of The Video	29
3.2	Budget.....	30
3.3	Division of Labor.....	31
3.4	Team Structure.....	32
3.5	Meeting minutes	33
4.	Time Line.....	37
4.1	Gantt Chart.....	37

1. Hardware's Product Design Process

In our product design process, we followed the product development flowchart as follows.



Fig. 1 Product development process

1.1 Concept Development

1.1.1 Target Specification

According to SBCR's record (State Bureau of Cultural Relics), the number of visitors of Chinese museums has increased year by year from 2006 to 2017. In 2017, there were 971.72 million tourists visiting Chinese museums, which showed a huge market potential.

Tour guides are already an integral part of the museum, which are divided into two types: the human guide and the voice guide. However, the pain points of human guides include: 1) shortage of museum tour guides; 2) high cost of training; 3) poor accent and quality.

voice guide can perfectly solve these problems, which greatly facilitates the development of museums. However, the voice guides in the market nowadays are cumbersome, inconvenient to carry. Moreover, the appearance is too monotonous to bring more comprehensive user interaction and emotional appeal.

Therefore, our company designed a innovative AI voice guide to tackle the problems above.

1.1.2 Function Design

The function design part is the foundation of the entire design process. Our product positioning is an AI voice guide of museum. The core function of our product is to automatically follow a specific user and avoid obstacles. Based on this, the voice guide will tell the stories of each exhibit according to user's location. What's more, a vivid cartoon character is designed to enhance users' emotional experience.

1.1.3 Concept Generation

At first, we divided our product into 6 modules and tried all the possible solutions as follows.

Supply Power	Display	Appearance	Track	Avoid obstacles	Narrator Module
Stepper Motor	Single-color LED panel	Car shape	Ultrasonic Sensor	Ultrasonic Sensor	Buzzer
	All-color LED panel	Ship shape	Infrared sensor	Infrared sensor	Transistor+ SD card+ Loudspeaker
		Animal shape	Bluetooth+ color recognition		
			Human-Pyroelectric sensor		
			Flame sensor		

Fig. 2 Concept combination table

1.1.4 Concept Selection

1.1.4.1 Power Module

First of all, we assembled the car, and made the car move with the help of stepper motor.

1.1.4.2 Tracking Module

Tracking module is our primary module. We first proposed 5 different methods. The sensor can recognize objects around them and keep a certain distance between the object and the sensor. But the problem is, when another object stands in the way, the sensor has no idea about which to follow and which to avoid. Detailed features and problems of these methods is shown in Fig. 3.

Name	Ultrasonic Sensor	Infrared Sensor	Human-Pyroelectric	Flame Sensor	Bluetooth
Feature	Sensitive	No interference with each other	Only follow person	Track the flame and extinguish it.	Can specify which object to follow
					stable
Problem	Interference with each other	Not sensitive	Not sensitive	Quite dangerous	User have to set the phone's bluetooth

Fig. 3 Feature and problem of tracking module's methods

Bluetooth with color recognition can perfectly changes this dilemma.

As shown in Fig. 4, first, we attached a fluorescent bandage on user's right foot. At the same time, we attached a cell phone to the car and used

the camera to capture the fluorescent bandage.

Second, we called the Open CV library (an open source computer vision and machine learning software library) to recognize the certain color. Then, we got the color's coordinates based on the screen plane.

Third, we finished the bluetooth connection between the phone and the Arduino board so that the coordinates data can flow between these two.

Fourth, our codes would tell the car how to move according to the bandage's coordinates. For example, the bandage is the top right corner, then our code will ask the motor to turn right firstly so that the x-coordinate is just in the middle. Later, our code will ask the motor to go straight so that the y-coordinate is just in the middle. In this way, we can always keep the bandage in the middle of the screen. What's more, if the bandage is out of sight, the car will keep turning right until the bandage is in the scope.

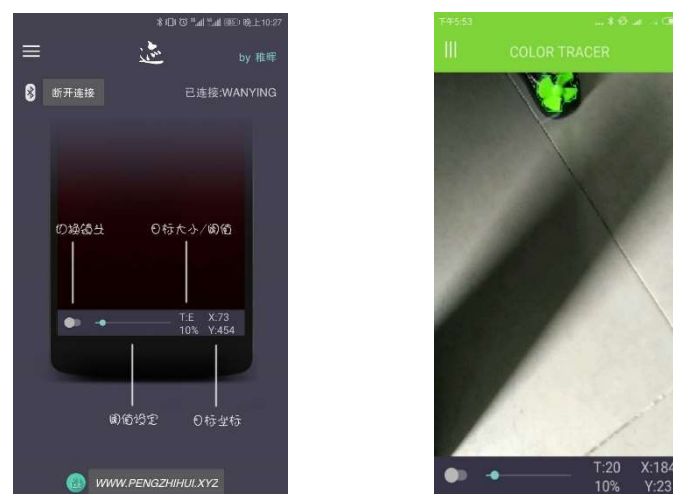


Fig. 4 The coordinates of the bandage and the bluetooth connection

1.1.4.3 Avoiding Obstacles Module

Avoiding obstacles is another important function. Considering the infrared sensor and ultrasonic sensor have complementary features, we decided to use the both to realize the functions. The avoiding module operates when the distance is less than 20 centimeters, while the tracking module follows the user's foot in a distance of 50~100 centimeters.

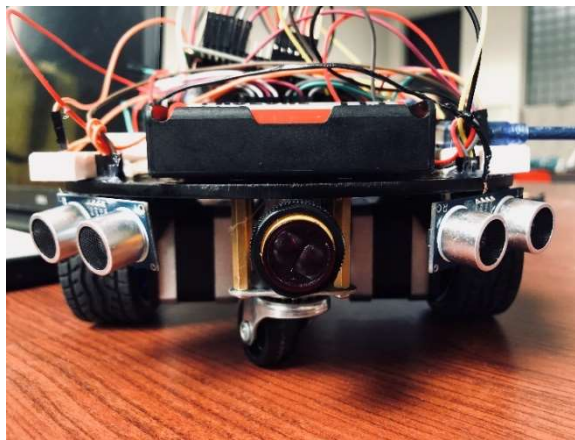


Fig. 5. The avoiding module

1.1.4.4 Narrator Module

At first we tried to use buzzer, but obviously it couldn't play a recorded sound. Through our investigation and research, we adopted the second method: we stored the recorded sound in the SD card, and used transistor to process and loudspeaker to amplify.

Then, in order to automatically play specific commentary in front of different exhibits respectively, we explored the IR remote controller. A number should be showed beside the exhibit. The tourist can press the number on the remote controller accordingly and listened to the story.

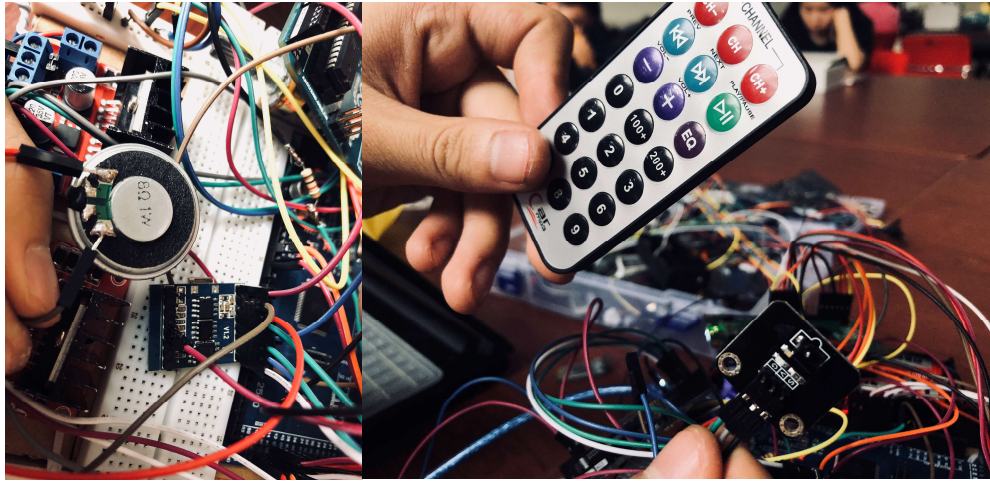
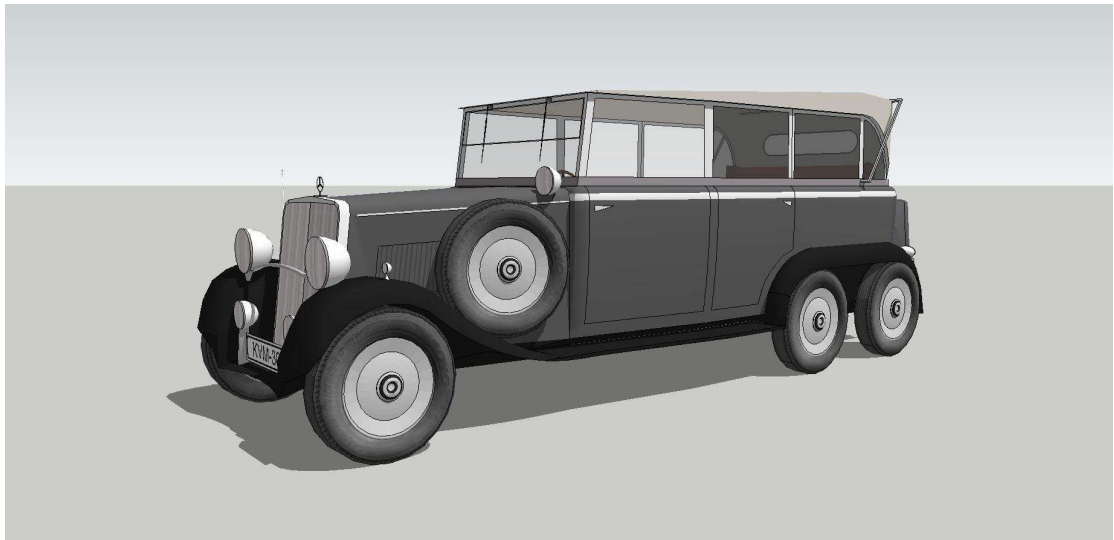


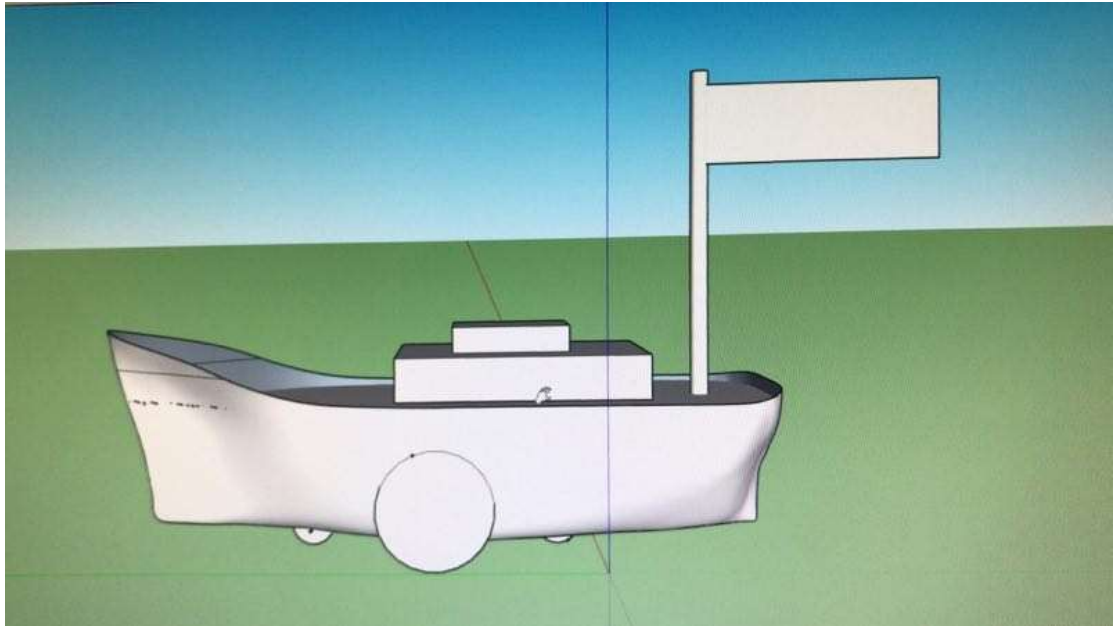
Fig. 6 Narrator module and IR remote controller

1.1.4.5 Appearance Module

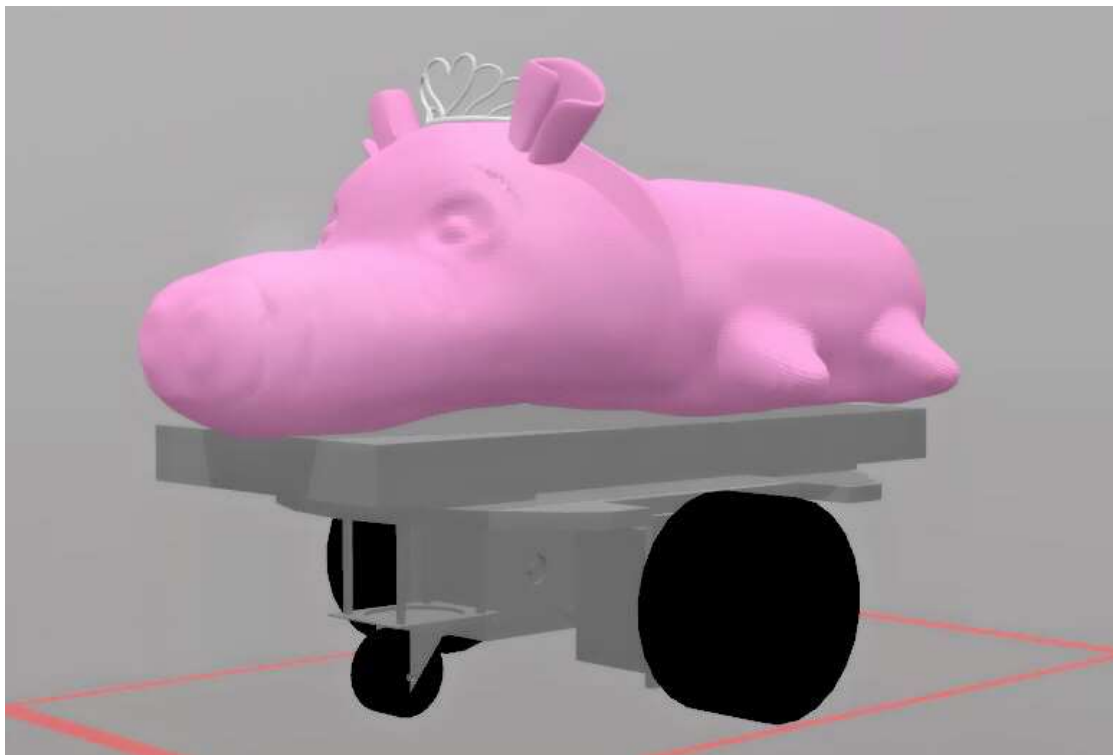
At first, we proposed 3 types of appearance and drew the prototypes as follows.



A. Car shape



B. Ship shape



C. Animal shape

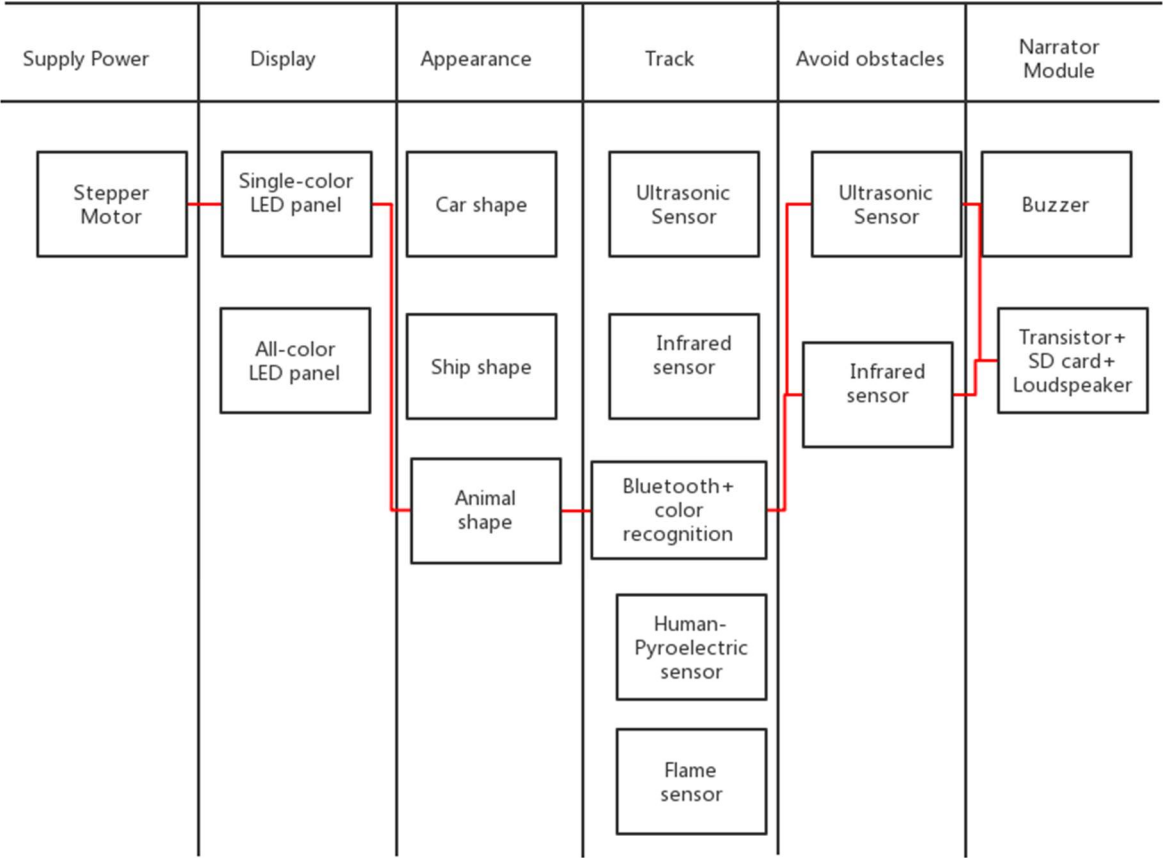
We finally chose the animal shape, since the car shape and ship shape is not innovative and attractive enough. Besides, this cartoon character made users feel warm and cordial despite the cold hardware

inside. And this vivid animal character can provide user with more natural user interaction. For example, it can wave its hands to the users when it recognizes him/ her. Besides, the user may feel that it is not a cold hardware talking to them, but a cute piglet telling them funny stories.

Furthermore, we planned to use the cotton and cloth to make the piglet, which highly conformed to our DFE goal: Zero hazardous waste generation. By contrast, making ship shape and car shape needs chemical paints and plastic, which may lead to air pollution.

What's more, the manufacturing process of animal shape is easier, and no extra assembly labor cost, compared to car shape and ship shape. The manufacturing and material cost of animal shape is also cheaper

Finally, we proposed our preliminary concept as follows.



1.2 System-Level Design

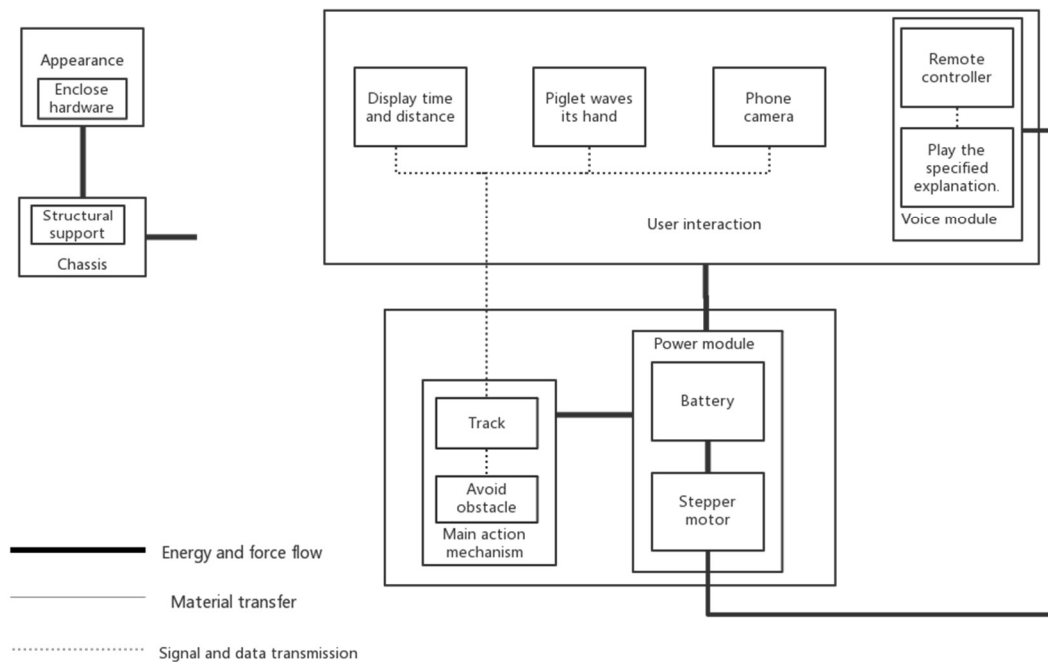


Fig.7 Product architecture

We further developed our modules, and figured out the interaction between these modules. Since the avoiding module and the tracking module shared relative function, we clustered these two into a chunk. Furthermore, because the tracking module, avoiding module and power module are similar in design and technology, so we clustered these 3 into a chunk and physical location.

In addition, our user interaction includes: Displaying time and distance, Piglet's action, Phone camera and Voice module, which are what we should improve in the user interaction design process.

Next, every team member was mainly responsible for a specific chunk.

1.3 Detail Design

1.3.1 Circuit Design and Simulation

To realize the functions, a circuit is designed to contain components that provide expected functions. Specifically, the circuit should include an Arduino board, two steppers with two drivers, a LCD screen, a Bluetooth receiver, and all the sensors. We used Proteus to draw a circuit diagram, and simulated the circuit with the help of Proteus., as shown in Fig. 8.

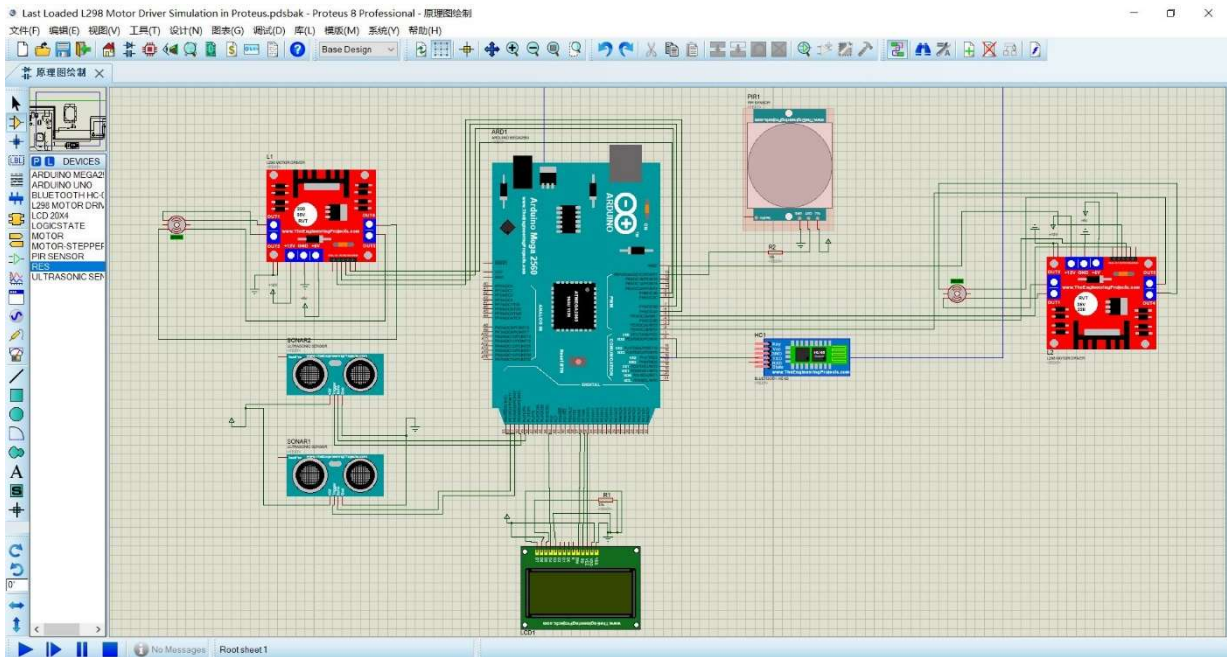


Fig. 8 Circuit design

1.3.2 Code Design

we designed a flow chart to specify the coding process.

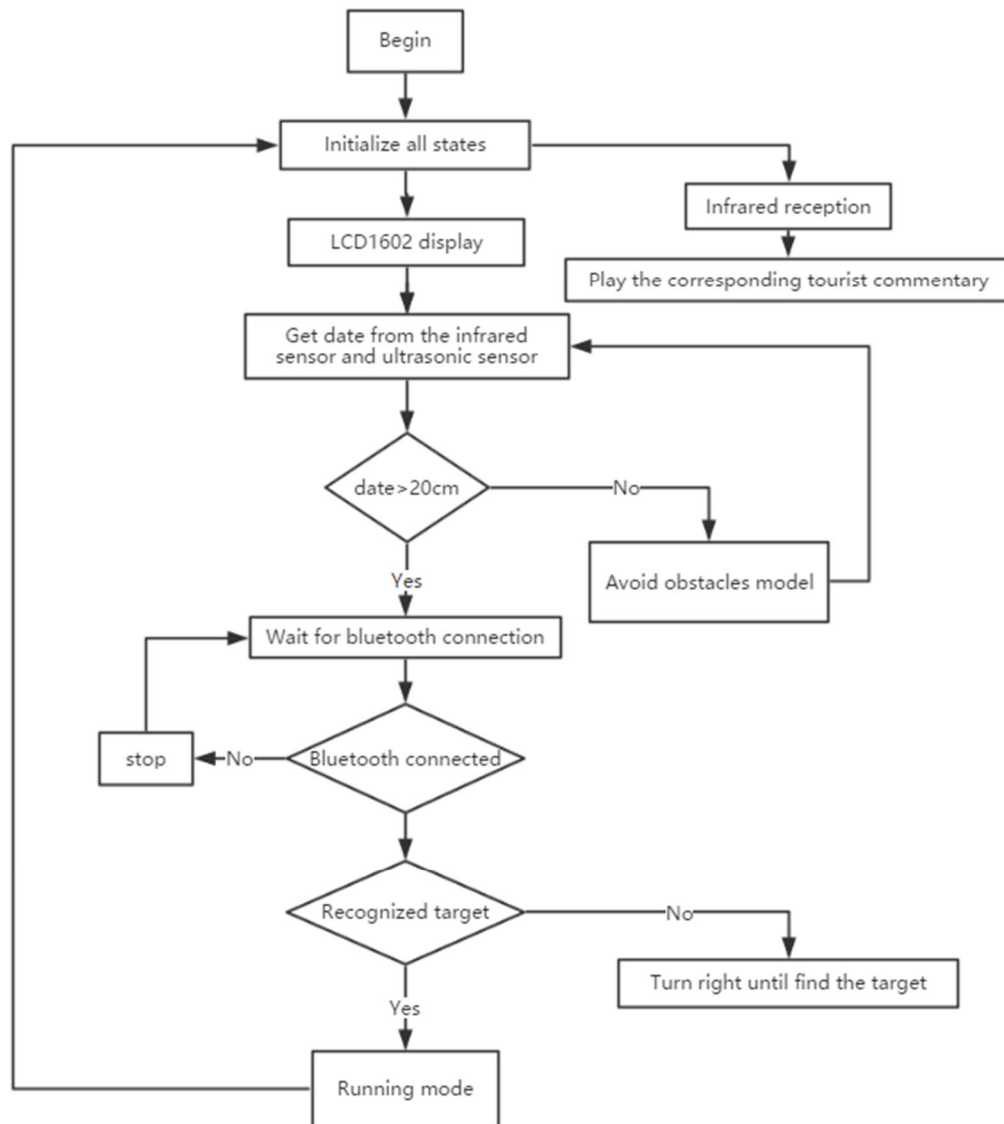


Fig.9 Code design

1.3.3 Appearance Design

First, we used software Sketch Up to draw the analytical prototype, in order to communicate the concept and make the decision, as shown in Fig. 10.

Second, we made a comprehensive physical prototype within given budget, in order to communicate with potential investors and customers, integrate different modules, test and refine.

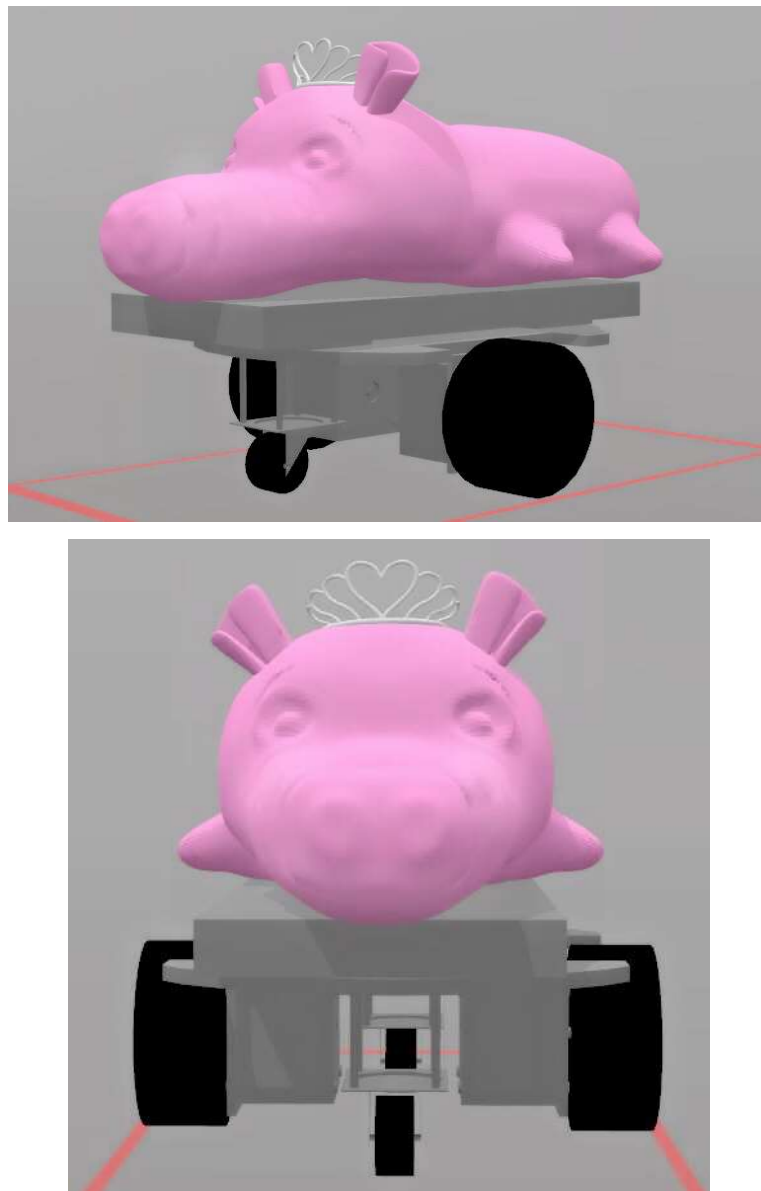


Fig. 10 Analytical prototype

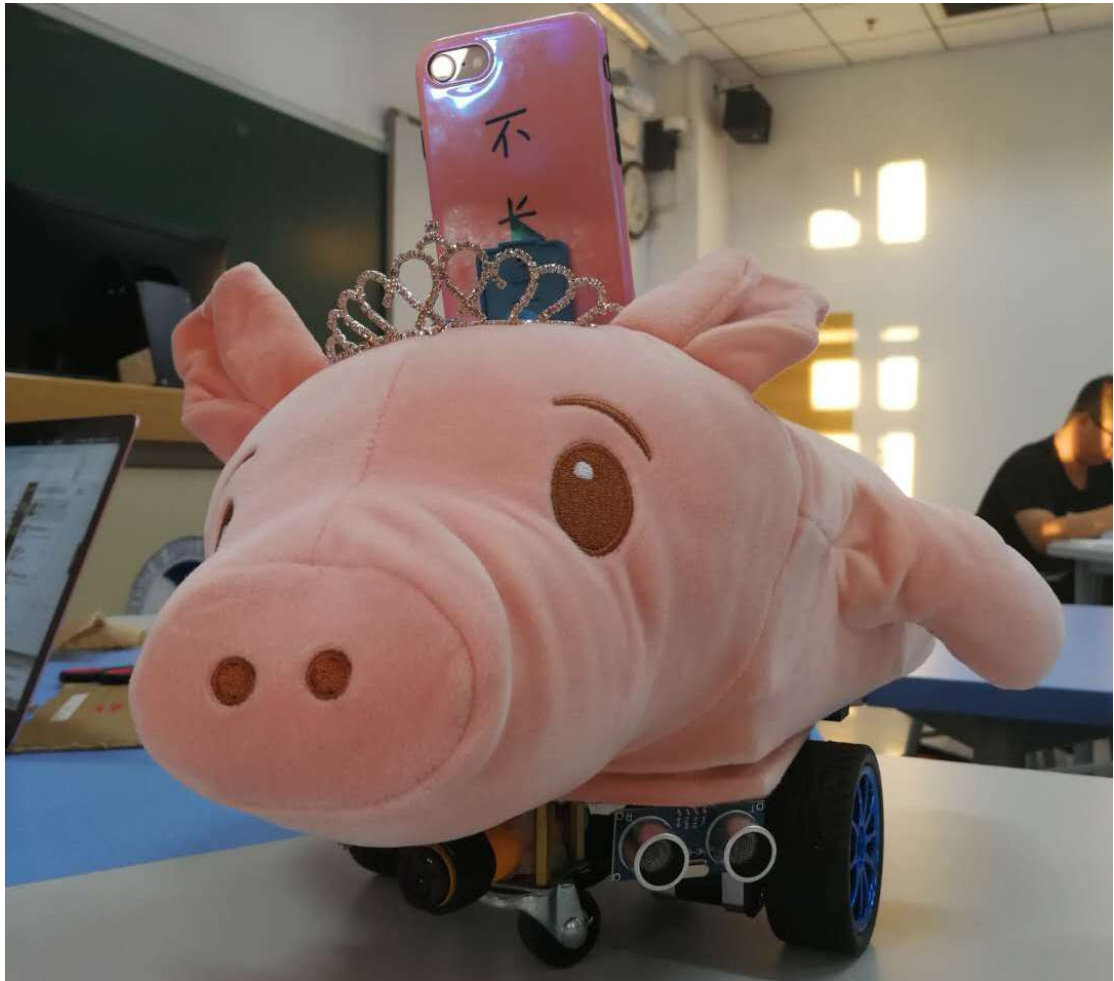


Fig. 11 Comprehensive physical prototype

1.3.4 User Interaction Design

To improve the experiences of user, we consider the ID process from the following aspects.

- A. Emotional appeal
- B. User's ability to maintain and repair
- C. Easy to use
- D. Novelty
- E. safe

1.3.4.1 User interaction Process

A. User places their cell phone on the hardware.

In order to enhance the user's emotional appeal, we designed a crown stent to bolster the cell-phone. We hoped to make this simple action become the intimate start of interaction, and eliminate user's concerns.

Besides, since the cell-phones may have different models and sizes, we have revised our codes to adapt to different models and sizes. So far, we have tested iPhone 5/6/7/8/X, Honor 10/9i, Huawei NOVA/ MATE 10/P10, Sumsung Galaxy S/S8/S9.

B. User powers on the hardware.

At the first stage, we used the battery to power on the motor, and the mobile power bank to power on the arduino board, which is not easy to use for the users. Besides, the user has to pull in and out the battery to turn on the motor, which is absolutely unsafe.

To solve the problem, we combined these two power systems into one, and make a switch button for it. In this way, the interaction process would be easy and secure.

C. User opens the app and connects the bluetooth.

We provide a QR Code in our user manual, so the museum's staff can put it up in the museums, and the user can scan it to download the app more easily.

Besides, Connecting the bluetooth maybe troublesome for the elders. So we enhanced our app guidance function, hoping to make it easier to finish the phone setting.

D. The piglet recognizes the user and wave's its hand

One of our innovative points is that, we design a vivid piglet to provide user with more intimate user interaction. For example, it can wave its hands to the user when it recognizes him/her. In this way, we hoped to make our hardware closer to user's heart, and eliminate user's concerns.

E. The piglet follows the user and tells the stories of the exhibits

The narrator module contributes to our product differentiation. It makes us stands out among other competitive products. A number should be showed beside the exhibit. Then the tourist can press the number on the remote controller accordingly and listened to the story.

We provides Chinese and English commetary in our demo. Museums

can records their own commetary and store in the SD card, which is quite convenient to manipulate.

G. User maintains and repairs the product.

A fully charged battery provides the power for 24 hours' use. We also provide a charger for the butterfly. If the piglet runs out of power, the museum's staff can easily find the battery case at the bottom of the hardware and charge it, or change another butterfly.

If the piglet becomes dirty, the museum's staff can also remove the piglet shell easily and wash it with water.

1.4 Design for Environment

1.4.1 DFE Goal

- Zero hazardous waste generation.
- Zero harmful air emissions.
- Zero landfill.

1.4.2 Apply DFE Goal to Product Design

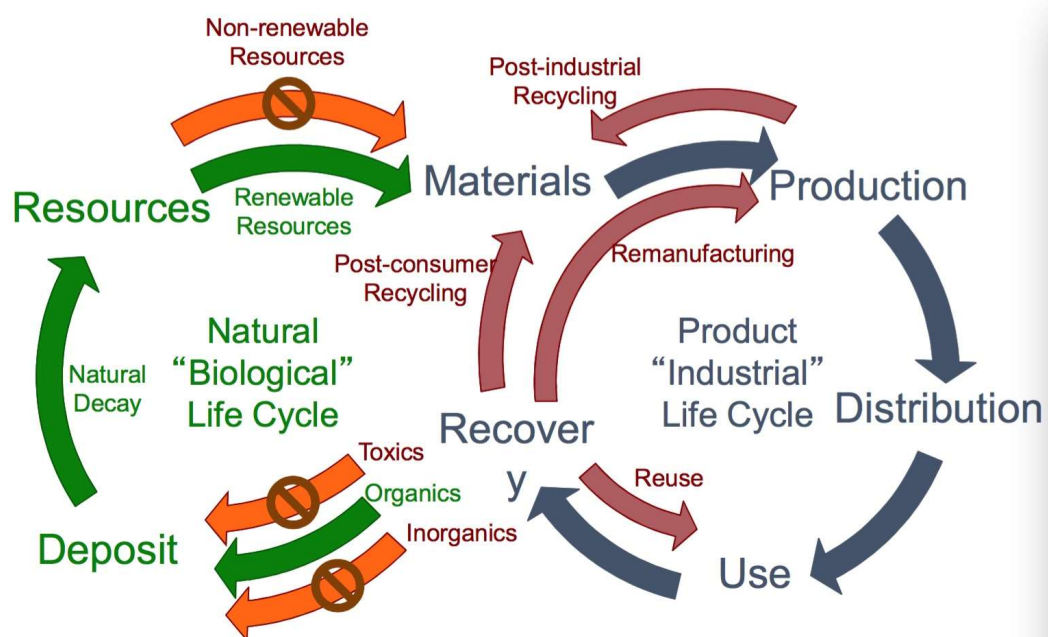


Fig.12 Environment cycles

Materials	Use the cotton and cloth to make the piglet, which adds no burden on the environment
Production	Use the standard electronic components from suppliers, so the manufacturing process is easy,
	Our appearance production only involves spinning and weaving, which is zero pollution to the air.
Use	Extend the life span of the hardware
Recovery	The cloth, cotton and batteries are easy to be collected and recycled.
	Use tie and screw to assemble the hardware, which is easy to disassemble during recycling

1.5 Production Ramp-Up

Since it is the preliminary prototype of our product, there are still many drawbacks in our model. If given enough time, money and technology support, we will do a lot more to improve our work.

- We plan to use GPS to get the user's detailed location, and automatically play the corresponding recordings. We also plan to broadcast the museum's notices to the users.
- We plan to provide the user with a pair of wireless earphones, so that the user won't be disturbed by other user's piglet.
- We plan to replace the single-color LCD panel by the large-screen all-color LCD panel, so that we can display map, video and subtitle.

- We plan to further revise our code to adapt to more cell phone models.
- We plan to further develop our app, so that it can push some exhibits' information. We hope to establish a museum's information platform, which can generate extra income and bring more potential customers.

2. Website Design

2.1 Identify Needs

Our company's website is designed for displaying and selling our products, so we have identified the customer's needs in order to determine the function of our website.

2.2 Determine Website Functions

2.2.1 Home Page

There is a navigation bar on the top of the home page, through the navigation bar users can not only register or login their account but also search the products and view their shopping cart. Below the navigation bar is the picture and the information of our products.

2.2.2 Registering

There is a "user login" button on the navigation bar. And a login window will be popped up when user moves the cursor to that button. On the bottom of the window there is a "sign up" button, and when user click this button the page will jump to registration page. User need to fill in their real name, password, id, E-mail, phone number, address and account balance as required. After fill all blanks, user can click "submit" button and finish registering, and user's information will be stored in the database. If there are some mistakes in registration information, please registration again.

2.2.3 Logging in and Logging Out

When user login, user can do most of things on our website, such as adding products to their cart, generating orders, and so on. While, user can logout by clicking the logout button, after that, users can't use most of function.

2.2.4 Product

On the shopping page. Users can find all information about our robots, include picture, id, price, size, weight, describe. And when users click on the picture, it will turn to the detail page. Detail pages can show users more detail information about the products which are delivered from the database.

2.2.5 Cart

Users can add products to their cart by clicking the “add” button on each product detail page. There is also a cart button on the navigation bar, when user clicks the button the page will jump to the detail page of the user's cart items, and user can delete their cart items on this page.

2.2.6 Order

On the cart items page, user can click a button to generate order, the order contains order id, user id, creation time and total price. Also, users can know their historical orders by clicking a button. The orders are all

recorded in the database, when the computer catch the signal that you want to check your historical orders, we will get them from the database.

2.2.7 Merchandise Query

On the navigation bar, there is a search box, users can find the product by inputting the product id or keywords on the search box.

2.3 Database Design

2.3.1 Design Purpose

Database is the foundation for building a website. The database is built in the form of tables, and all of columns of tables can't be NULL. Personal information and the behavior of browsing and buying goods will be recorded in the database. However, only administrators have rights to insert, delete and change the database, which can protect the rights of the users who use our website.

2.4 Detail Design

2.4.1 Cart Table

Cart id (VARCHAR(30)) - This is the primary key. It represents different carts.

User id (VARCHAR(30)) - This column shows the user id.

Creation time (VARCHAR(30)) - This column shows the time when the

cart is built.

2.4.2 Cart Include Product Table

Cart id (VARCHAR(30)) - This is the primary key. It represents different carts.

Product id (VARCHAR(30)) - This column shows the product id.

Quantity (INT(5)) - This column shows the quantity of the user's cart items.

2.4.3 Order Include Product Table

Order id (VARCHAR(30)) - This is the primary key. It represents different orders.

Product id (VARCHAR(30)) - This column shows the product id.

Quantity (INT(11)) - This column shows the quantity of the products.

2.4.4 Product Table

Product id (VARCHAR(30)) - This is the primary key. It represents different products.

Product name (VARCHAR(100)) - This column shows the product name.

Price (DECIMAL(10,2)) - This column shows the price of the corresponding product.

Category (VARCHAR(100)) - This column shows the category of the product.

Size (VARCHAR(100)) - This column shows the product size.

Storage (INT(11)) - This column shows the inventory of products.

Description (VARCHAR(1000)) - This column describes the products detail.

2.4.5 The Order Table

Order id (VARCHAR(50)) - This is the primary key. It represents different orders.

User id (VARCHAR(30)) - This column shows the user id.

Creation time (DATETIME) - This column shows the time when the order is built.

Total price (DECIMAL(20,2)) - This column shows the total price of the products which user wants to buy.

2.4.6 The User Table

User id (VARCHAR(30)) - This is the primary key, the id can identify different users. It can not be NULL or more than 30 characters .

User password (VARCHAR(45)) - It is designed to identify user identities.

Real name (VARCHAR(45)) - This column shows the users real name.

Phone number (VARCHAR(12)) - It shows the customer's phone number.

Email (VARCHAR(45)) - It shows the customer's email address

Shipping address (VARCHAR(45)) - It shows the customer's address.

Account balance (DECIMAL(20,2)) - It shows customer's account balance.

3. Planning and Management

3.1 The Planning and Production of The Video

- Scene 1

The subtitle: Traditional tour guide? Too expensive! Too many people! And! The pretty guide works so hard!

(imitate the apple's promotion video)

- Scene 2.

A girl comes in. The piglet says hello and waves its hands to the girl.

The girl say: "Can you help me? I want to know something about the museums."

Then the piglet follows the girl.

- Scene 3.

The girl stops in front of an exhibit, saying: "What's this?"

The piglet starts to tell the stories of the exhibit.

- Scene 4.

The girl went down and gently touch the piglet's head, saying : " Thank you."

3.2 Budget

At the planning stage, we set a budget for our group: 500 yuan.

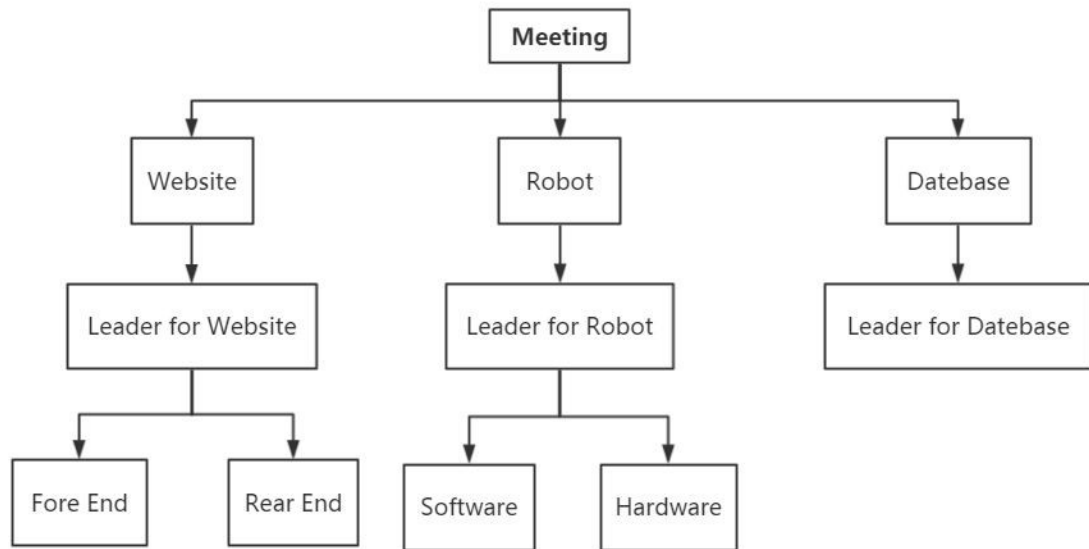
In the product development process, we make it simple to manufacture and efficient in use of materials. At last, we only spent 209 yuan in total.

Name	Number	Total price/ yuan
Dupont Line	120	24
Arduino uno board	1	37
Mega board	1	77
Transistor	5	2
Loudspeaker	1	2
Piglet toy	1	10
Switch button	1	3
Card Board	5	1
SD card	1	10
Ties and screws	30	3
Total		209

3.3 Division of Labor

Name	ID	Major	Work
Yang Du	2016213151	Telecommunications Engineering with Management	Manage the group. Build the Tracking and avoiding module. Code and test.
Wanying Xi	2016213202	Telecommunications Engineering with Management	Build the narrator module, LCD display screen.
Linger Shen	2016213272	Telecommunications Engineering with Management	Proteus Simulation. Build the Tracking and avoiding module. Video production.
Haoyuan Guan	2016213996	Telecommunications Engineering with Management	Finish the appearance module
Zhen Tian	2016213051	Telecommunications Engineering with Management	Write the Project report, plan and PPT.
Mudi Liu	2016213308	E-Commerce and Law	Write the function of users login and registration, the products display , part of cart, part of items query and the project report.
ZhangXin	2016213333	E-Commerce and Law	Writing the whole front web page and helping the connecting part.
Zijun Wang	2016213276	E-Commerce and Law	Construct database, write the back end of the website, implement the following functions: add the goods to the shopping cart, generate the order, display the shopping cart goods, display all the goods, find the goods by keyword, and complete the Java statement in the JSP files.

3.4 Team Structure



3.5 Meeting minutes

Group meeting for overall design

Jul
10,2018
Classroom340

MINUTES

A. Preliminary items

Present:

Title	Name
Mr.	Yang Du (Chair)
Ms.	Wanying Xi (Secretary)
Ms.	Linger Shen
Mr.	Haoyuan Guan
Ms.	Zhen Tian
Ms.	Xin Zhang
Mr.	Mudi Liu
Mr.	Jianyu Gao
Mr.	Zijun Wang
Mr.	Hengpei Zhao
Mrs.	Xinyi Zhao

B. Topics for discussion

- Create a schedule for the whole process
- Learn the knowledge of making the car
- Brain-storm for the concept.
- Distributing the each module to different group.

C. Other matters

- Self-introduction
- Date of the next meeting:2018/7/13

Group meeting for tracking and avoiding module

Jul
13,2018
Classroom301

MINUTES

A. Preliminary items

Present:

Title	name
Mr.	Yang Du (Chair)
Ms.	Wanying Xi
Ms.	Linger Shen (Secretary)
Mr.	Haoyuan Guan
Ms.	Zhen Tian

B. Topics for discussion

- Check the completion of each person's task
- Select the concept for tracking and avoiding module
- Improve the function and appearance of the car
- Adjust the schedule according to the situation

C. Other matters

- DDL for the tracking module:2018/7/15
- Date of the next meeting:2018/9/12

Group meeting for further website design

Jul
12,2018
Classroom201

MINUTES

D. Preliminary items

Present:

Title	name
Mr.	Zijun Wang (Back-end development)
Mr.	Mudi Liu (Back-end development)
Ms.	Xin zhang (Front-end development)

E. Topics for discussion

- Determine the database structure.
- Determine the website function.
- Unified the program variable.
- Determine which methods we will use.

F. Other matters

- Date of the next meeting:2018/9/12

Group meeting for further design

Sep
12,2018
Classroom103

MINUTES

A. Preliminary items

Present:

Title	name
Mr.	Yang Du (Chair)
Ms.	Wanying Xi
Ms.	Linger Shen
Mr.	Haoyuan Guan
Ms.	Zhen Tian
Ms.	Xin Zhang
Mr.	Mudi Liu (Secretary)
Mr.	Jianyu Gao
Mr.	Zijun Wang
Mr.	Hengpei Zhao
Mrs.	Xinyi Zhao

B. Topics for discussion

- Discuss the disadvantages of our preliminary products
- Evaluate each group's work and provide suggestions to improve
- Make the new time schedule
- Discuss the report's structure
- Brain-storm for the promotion video

C. Other matters

- Share the experiences of team management
- Share the most meaningful moments
- Date of the next meeting:2018/9/23

4. Time Line

4.1 Gantt Chart

We drew the Gantt chart as follows. The red line is what we plan to do, and the green line is what we actually complete.

As the Gantt chart shown, we followed the time schedule and completed the tasks on time, except for some specific situation. For example, the materials were on the way so we delayed the work of voice module.

What's more, we adjusted the Gantt Chart according to our progress status.

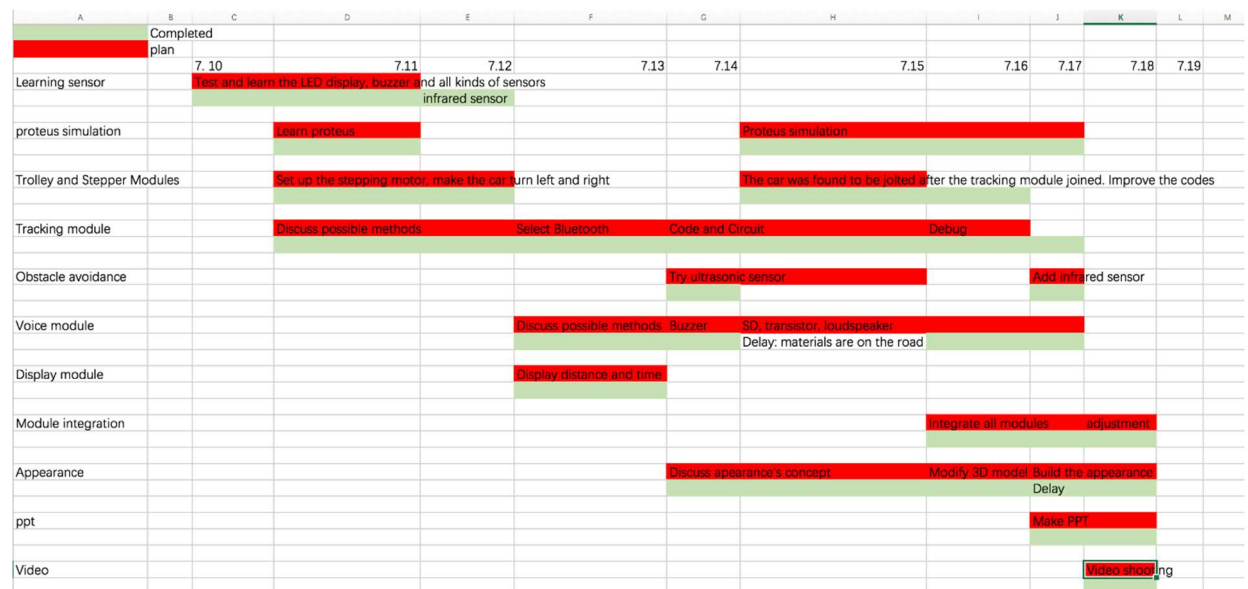


Fig.13 Gantt Chart