UM – SJTU JOINT INSTITUTE

UNDERGRADUATE PROGAMME

VG 100 PROJECT No.2

Summer 2017

Glare-reduction device

Figure 1. Team LOGO

Team #8 Prototype

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1. Executive Summary

Our group noticed that cars' glare effect on drivers at night was an unavoidable thing and glare-reduction glasses were also not convenient to wear, especially for the drivers with short eyesight. Strong glare's effect on drivers is still a big problem in our daily life. An automatic glare-reduction device that can detect and shield the strong glare accurately and timely is urgently needed. That's the reason why we came up with our idea of designing a glare-reduction device for cars. Our device can improve the safety of drivers and pedestrians, decrease the number of traffic jams and reduce the trouble of police officers. Our device can solve the trouble caused by strong glares at night at night.

Our product is divided into two parts according to our design: the glare-detection part and the glare-reduction part. Arduino Mega plays the controlling role in both two parts. The glare-detection part is made up of a photosensitive sensor, a luminous intensity sensor and an open MV camera, aiming at detecting the location and the size of the strong glares if there is one or are several. The glare-reduction part consists of the glare-reduction film and its corresponding power supply, aiming at shielding the right areas on the windshield to decrease the strong glares' effect on drivers.

Our product solves the realistic problem by automatically detecting the existence, the position and the size of the strong glare and shielding it on the windshield, thus drivers won't be disturbed by strong glares at night and the pedestrians' safety will also be improved. The main audience that will take advantage of our product is drivers, pedestrians and police officers.

2. Introduction

Our team is named Prototype, and our team has 4 members: team leader Hu Zechen, team members Liu Ziwei, Liu Zhouge and Shen Yeqin. We choose Prototype as our team's name because it has a primary but promising meaning. We hope our team to have the similar implication. Although we have no experience and use the simplest tools and materials, we want to show our potential and try to be promising.

Figure 2. Team members

For our team logo, we use two primary color: bright red and black. These two primary color imply the primary tools we use and the primary concept of our team. For the figure holding the firing touch with naked body and mask, we intend to express a promising and unexpected figure of our team. The design of the logo of our team is to express a primary but promising concept.

Figure 3. Team logo

Each member in our organization has his or her strength: Hu Zechen is good at programing and coding, so he takes responsibility for major programing part. As the team leader, he is also skilled in organizing the whole team and distributing tasks to

every team member. Liu Zhouge is skilled in designing and building mechanical frames and constructions, so he takes responsibility for major mechanical structure building part. Liu Ziwei is good at communicating and changing the abstract ideas into detailed sentences and essays, so she takes responsibility for writing major technical communication parts of the poster and other paper works. Shen Yeqin has experience using Photoshop and pays a lot of attention to rigor of the paper works, so she is responsible for the some pictures in the paper works, error correction and collection part of major paper works.

Our group divides some tasks for group members to finish separately, but there are still some work we decide to do together. Because of that, we apply everyone's strength into the whole project and try our best to make our project the best. Besides, we totally trust our teammates and help each other when one needs help. The working atmosphere of our whole group is harmonic and warm. We try our best to finish our project and ensure its quality.

3. Problem

3.1 Statement of the problem

Many drivers have experienced this situation: when they are driving at night, the glares of other cars are so strong that they disturb the drivers from seeing the front road clearly. At night, especially when there are many cars, the impact of other cars' glares is so disturbing that it may cause some traffic accidents. Some drivers use one hand to shield the strong light and use another hand to operate the steering wheel. However, it is also dangerous for drivers to use one hand to drive.

To those drivers who are affected by the strong glares of other cars, those pedestrians who pass by the cars whose drivers are affected by the strong glares, their safety of lives is a huge problem.

According to a survey covering more than 100 people conducted by us, for the question.1 : Have you ever been disturbed by the strong glare at night, about 84% people who have driving experience say that they have been affected by the strong glare of other cars. Besides, when researching drivers' attitudes towards our project with the question.2: How do you think about our project, more than 90% drivers think they are excited about and looking forward to our final product.

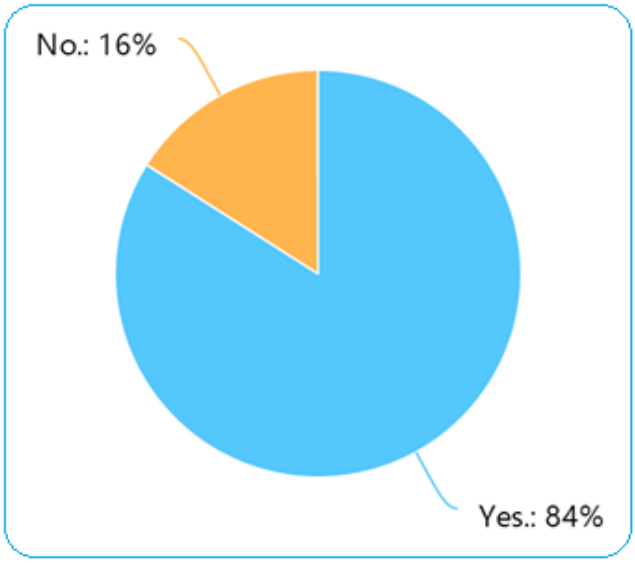

Chart 1. Survey response: Qusetion.1

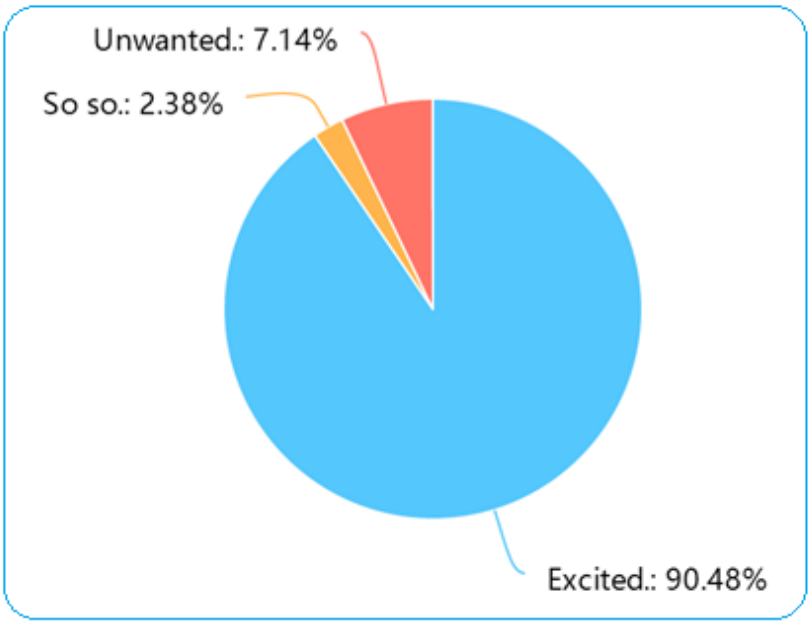

Chart 2. Survey response: Question 2

In order to shield the strong glare of other cars at night, there is a product which has been already launched onto the market called glare-reduction glasses, but few people have heard of this product. Besides, since glare-reduction glasses is a pair of glasses, it's impossible for people with short eyesight to wear two glasses at the same time while driving. Glare-reduction glasses has its shortage in usage.

All in all, the glare-reduction glasses on the market is far from the drivers' satisfactory. In order to improve the safety of the drivers and the pedestrians, in order

to reduce the trouble of the police officer, we design our project: glare-reduction devices.

3.2 Summary of the problem

In summary, shielding the strong glare of other cars has been a long-existed problem which people haven't figure out a best way to solve. Nowadays, the following problems still exist.

1). **The impact of strong glare of other cars may be dangerous for both drivers and pedestrian**
2). **Using hands to shield the strong glare is neither a safe nor a permanent way for drivers to shield the glare.**
3). **The low usage of glare-reduction glasses in the market makes it not convenient for drivers**

4. Needs

4.1 Criteria

To establish our goal of shielding the strong glare accurately and automatically, our glare-reduction device should:

1). **Automatic.**
Our device should detect the strong glare light automatically and shield the strong glare light sources automatically.
2). **Accurate.**
Our glare-reduction film should make the right place of the film vague to shield the strong light source accurately
3). **Affordable**
Our glare-reduction should be lower than 2500 yuan when we manufacture it in order to make the ordinary driver to accept.
4). **Convenient**
Our code should be input in advance so that drivers can wear nothing and enjoy the glare-shielding process directly
5). **Efficient**
The reaction time of our device should be less than 1 second to establish the efficient goal.
6). **Adjustable**
We should input different coding in order to fit for different driver with different sitting position so that our device has high adjustability.

4.2 Constraint

According to our device's characteristic, it has the following constraints:

1). **Constant power supply**
Our glare-reduction film, open MV, and Arduino Mega board all need constant power supply to keep them functioning. Arduino Mega needs 9 V constant power supply. The glare-reduction film needs 60V electric voltage to remain

completely clear when there are no strong lights.

2). **Potential risks**

Since our glare-reduction film is not water-proof, it may fall off from the front windshield of the car when it is a rainy day. There exists the potential risk on rainy days.

3). **Material restriction**

The material we use is an advanced composite material combining PDLC Film: dispersed liquid crystal polymer light film with Silica gel hardened layers. Since it is a fixed and precious material, there's a restriction in choosing the materials.

4.3 Validation

Since the power of basic car light is around 65w, we prepare a 65w-light to analog the real situation.

1). Reaction time:

We first test the reaction time of detecting process. It takes photosensitive sensor 0.23s to detect the strong light and transform it to Arduino. Then, we set that Arduino Mega has received the strong light information to test the reaction time of locating process. It takes open MV 0.46s to recognize the figure of the strong light. Last but not least, we input a certain figure of light source and test the reaction time of glare-reducing process. The corresponding piece of film takes 0.03s to become vague. The whole glare-detection and reduction process takes less than 1s to finish its tasks.

2). Light intensity:

Before we adding the film, the measured light intensity of the 65w light is 234LM. However, after the glare-reduction film becomes vague, the measured light intensity under same circumstance is 87LM, which decrease 63% of its original light intensity.

5. Objectives

5.1 Methods to address the needs

Objective1: Accurate strong glare recognition

In order to make our device accurately detect the strong glare, we use photosensitive sensors and luminous intensity sensor to ensure our device's accuracy. High accuracy ensures that almost all disturbing strong glares can be recognized and then be shielded to decrease the strong glare's uncomfortable effect on drivers.

Objective2: Automatic glare figure plotting

In order to gain the information of the size and the location of the strong glare automatically, we use openMV camera to plot the glare's figure accurately. Automatic plotting of the strong glare can ensure the shortness of response time of the device and eliminate the delay. Glare figure plotting can also provide the precise information in order to shield the right area on the windshield.

Objective3: Efficient and affordable glare shielding function

In order to make our device and efficient and affordable, we use glare-reduction film instead of mechanical arm to reduce the response time and the cost of our device. Efficient and affordable shielding part can not only decreases almost all disturbance of strong glare to drivers and help drivers' driving experience at night comfortable and safe but also saves users' money.

Objective4: Convenient and adjustable frame and coding design

In order to reduce people's trouble of wearing glasses and make our device adjustable for different people with different sitting position, we install our glare-reduction film directly on the windshield and input different kinds of coding in order to fit different people with various sitting position. Convenient and adjustable frame and coding design can provide users more freedom, comfort and convenience.

5.2 Design to solve the problem

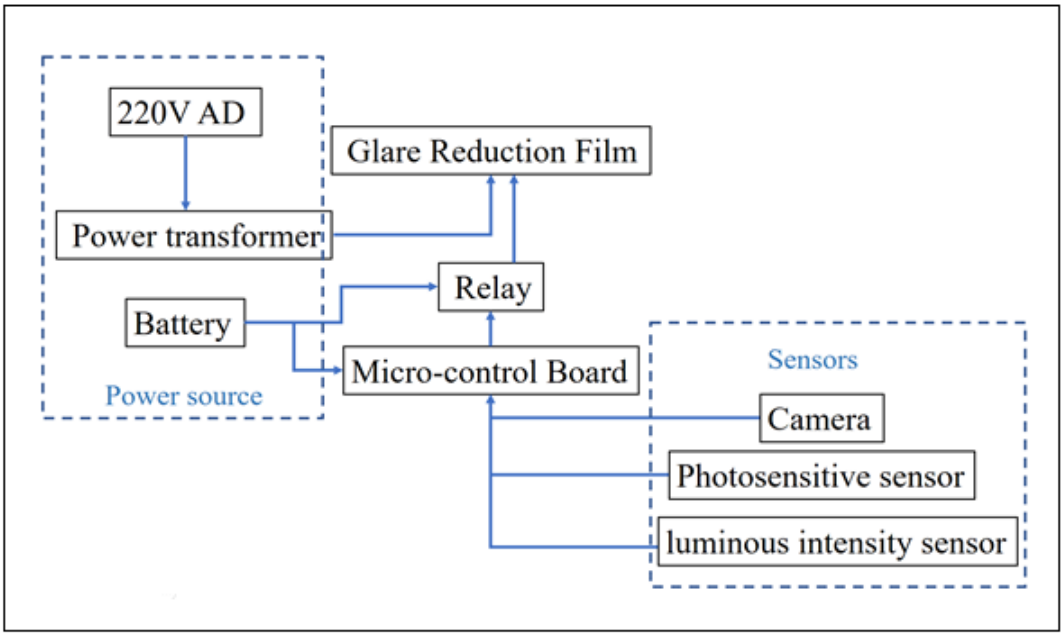

Figure 4. Concept of design

220 V AD motor, power transformer and Batteries compose the power source of our device. They provide power for Micro-control Board: Arduino Mega, glare-reduction film and OpenMV camera.

OpenMV camera, photosensitive sensor and luminous intensity sensor are the sensors composing the glare-detection part. They detect the existence, size and position of the strong light and transform the information to Arduino Mega.

Arduino Mega is the controlling part of our device. It receives the information of the detected strong glare and makes the glare-reduction film to make responses timely.

6. Solution

A glare-reduction device that can reduce the glare for the vehicle drivers who are driving at night is designed. This kind of new device will achieve the following goals:

1). Detection of glare from another vehicle on the opposite lane.

2). A glare reduction film will transform from transparent to semi-lucent.

3). The location of the glare reduction part will be altered and changed as the corresponding light source changes.

6.1 Design Description

Since the device aims at reducing a specific area of the windshield of a car, the concept design picture is made base on the framework of a windshield.

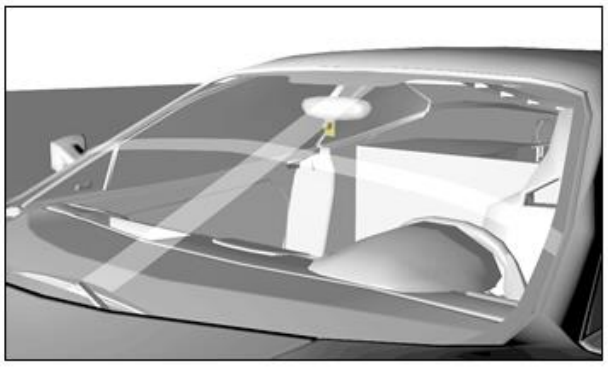

Figure 5. Concept diagram of glare reduction device

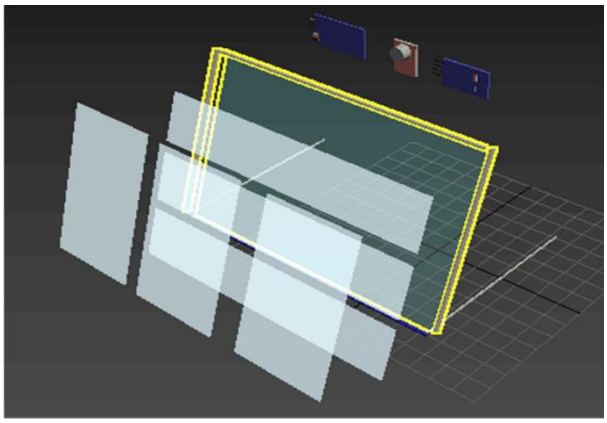

Figure 6. Explored view of glare reduction film

Our device is divided into several parts, the power source part, the glare reduction part, and main control part and the sensor part.

1). The power source part

The power source part is mainly in charge of providing electricity to all the other parts of the device. Including 220V AV and 12V batteries.

2). The glare reduction part

Glare reduction film.

3). The main control part

Arduino Mega and relays

4). The sensor part

a. Camera

b. Photosensitive sensor

c. Luminous intensity sensor

6.2 Working Mechanism

The camera is placed at the same position as the photosensitive sensor. It is used to identify the position and the size of the light source when the photosensitive sensor detects the glare, and transform the data to Arduino Mega. The glare-reduction part is made up of Arduino Mega and the glare-reduction film driven by servos. All the window shield is filled with the glare reduction film. When the Arduino Mega receives the position and the size of the light resource and take driver's position to account, it reduces the voltage of the corresponding piece of film to make it vague. The glare is reduced because of the vague piece of film.

6.2.1 Working Mechanism for the camera

Camera is needed to take picture to locate the position of the glare. The camera is working when the micro control board has asked the camera to do so. Based on the picture taken by the camera, it will analyze the glare spot of this picture, by a template previously prepared, the camera will automatically compare the pictures taken and the previously prepared template to see if the picture taken matches the template. If they are mostly the same, the camera will read the position of the glare in that picture and through a series of calculations, the corresponding row and column that need to be blocked can be found. So the camera will send back a single figure to the micro control board so that the micro control board can conduct the order.

6.2.2 Working Mechanism for the Luminous intensity sensor and photosensitive senor

The luminous intensity sensor and photosensitive senor are mainly in charge of the environmental detection. The photosensitive sensor is needed to find if there is a light, so that to determine whether the device will work, and the luminous intensity sensor is needed to find out how intense the glare in front of the car.

6.2.3 Working Mechanism for the glare reduction film

The glare reduction film is needed to block the glare for the driver. When there is no voltage applied to it, it is non-transparent. When there is a 48V voltage applied to it,

it will become semi-transparent. When there is a 60V voltage applied to it, it will become completely transparent. So the majority of the time, the most part of the glare reduction film is non-transparent.

6.2.4 Working Mechanism for the power supply part

The 220V AD applied to the power transformer is changed into 60V AD so that the voltage suits the glare reduction films' need. Other 9V batteries are used for the power supply of the micro control board.

6.2.5 Working Mechanism for the micro control board

Micro control board: Arduino Mega is in charge of the control of the relays and controlling the camera to take pictures of the glare.

6.2.6 Working Mechanism for the Relays

The relays receive the command from the micro control board and control the open or close of the outer electrical circus.

6.3 Component Fabricating

6.3.1 Construction of the frame of the glass

By establishing a connection between four aluminum alloy, and put the glass that stands for the windshield in the frame, the simulation frame for windshield is completed.

Figure 7.: Frame that simulate windshield

6.3.2 Construction of the power transformer

Figure 8. Side view of the power transformer

1). First we remove the cover of the Conductive plug

Figure 9. Front view of power transformer

2). Then we connect wire to the conductive plug

Figure 10. Power transformer with wires connected

3). Last we put back the power transformer

6.3.3 Construction of the plug

1). We first open the plug with screwdriver

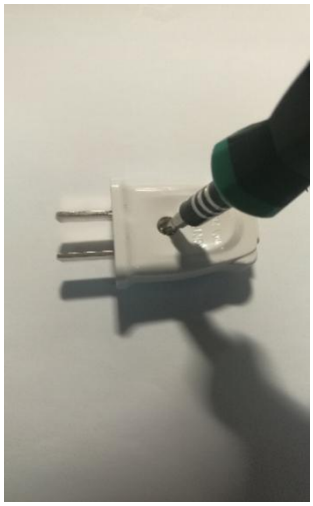

Figure 11. Open the plug

2). We then connect wires to the two ends of the plug

Figure 12. Inside view of the plug

3). We next close the plug by screwdriver and screw the screw back

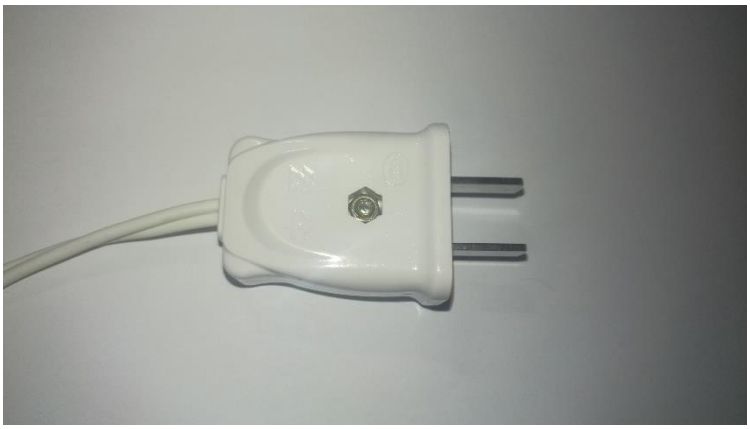

Figure 13. The plug

6.3.4 Construction of the glare reduction film

1. We stick the film to the glass on the frame of the prototype
2. We connect wires to the glare reduction film

6.4 Assembling Components

6.4.1 Connect the wire to the glare reduction films

Figure 14. The wires

6.4.2 Connect the plug and the power transformer

6.4.3 Connect open MV camera to the micro control board

6.4.4 Connect the power to the micro control board

6.4.5 Connect the relay to micro control board and power source

6.5 Theoretical Feasibility Test

Using flash light to simulate the glare from the cars, the device will recognize the glare and make corresponding change of the glare reduction film to make it semi-lucent to the light.

7. Tasks

This tasks part is going to introducing the main tasks we have to complete in order to achieve our objectives and finish our prototype. The following is the flow chart.

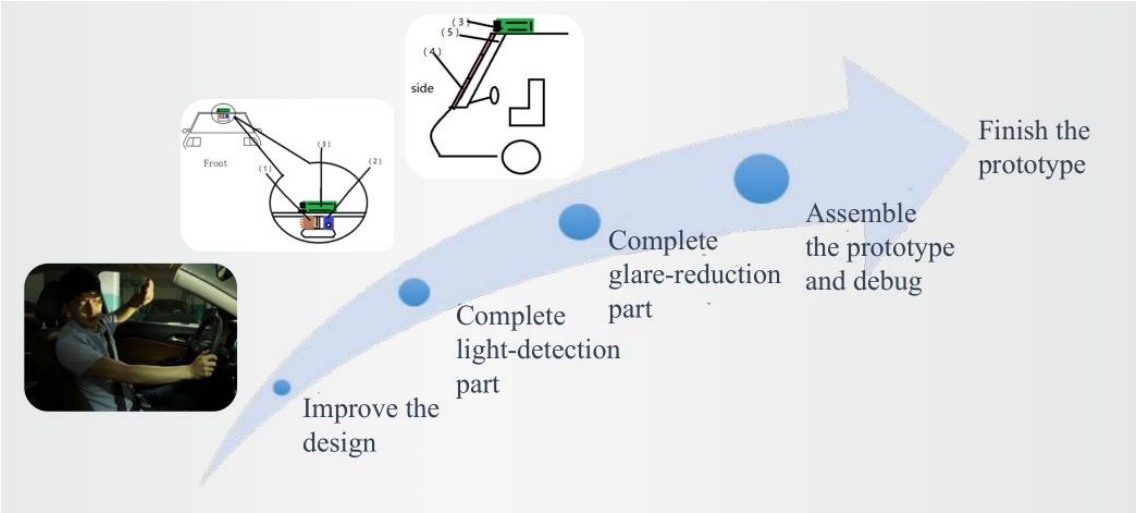

Figure.15 Task flow diagram of the glare reduction device

We divided our task into four main parts, to improve the design, to complete the light-detection part, to complete the glare- reduction part and assemble the prototype.

7.1 Improve the design.

We first want to use mechanical system to put the light-shielding film onto the right place. However, we find it is too slow to reach the glare reduction target. Therefore, we shift our idea into a kind of special film which can change its transmittance with different electric voltage.

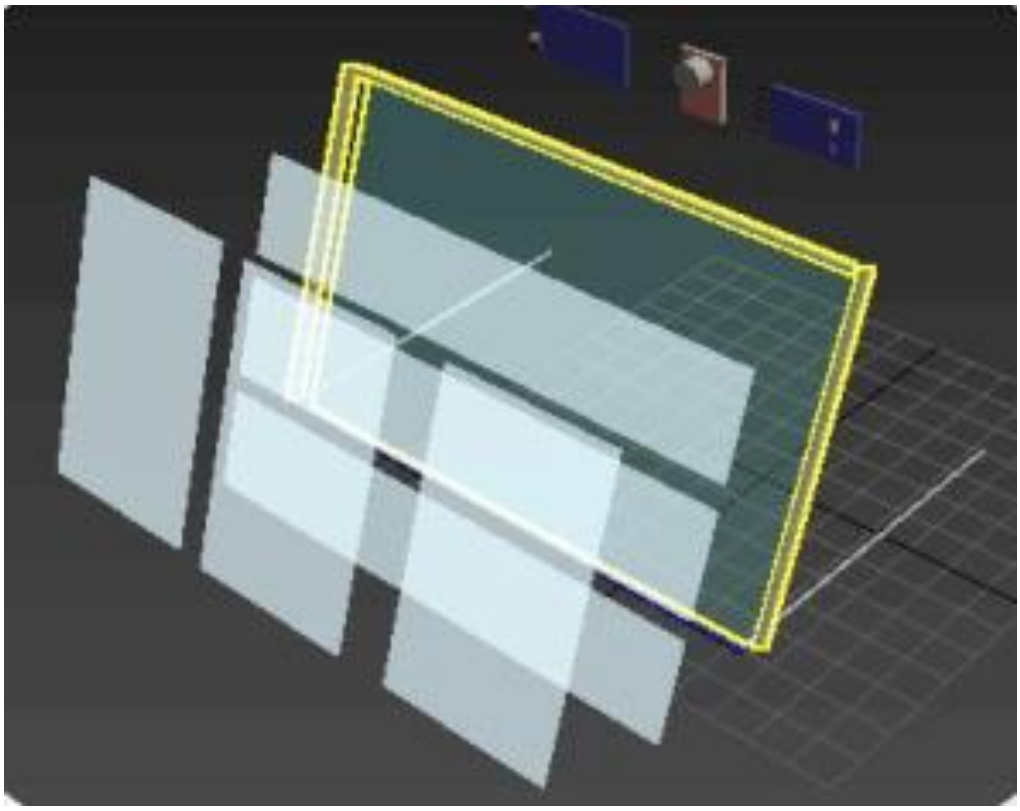

Figure.16 Transmittance changeable film

7.2 Complete the light-detection part

To sense the strong light, we use photosensitive sensor to detect the light. We test and define the critical light intensity at which our glare reduction device will start to work.

The camera will start to work when the photosensitive sensor senses the strong light which light intensity is beyond the critical light intensity. Our target is to find the intersection between the diver's sight line and the light on the windshield. We choose open MV to be our camera so as to identify the light spot and after calculating, we can find the light spot on the wind shield. After that, we communicate the camera with the Arduino board.

Figure.17 Light-detection part

7.3 Complete glare-reduction part

We choose a special film which can change its transmittance with different electric voltage. To realize our reduction function, we divide the windshield into n vertical strips and n horizontal strips. When the camera find the location of the light spot on the windshield, the area of the light spot belong to is one of the intersection area of a vertical strip and a horizontal strip. Therefore, the vertical strip of film and the horizontal film the intersection area belongs to will change its electric voltage so as to change the transmittance of the intersection area greatly enough to reduce the glare.

We first construct the frame of the film. We put 3 horizontal strips of film in front of the windshield and put 3 vertical strips of film behind the wind shield. After that, we communicate the film with the Arduino board.

We test and decide how much electric voltage to change, because the transmittance of the film will change with electric voltage. Therefore, we find the electric voltage with which the film will not affect other area and reduce the glare at the right area.

Figure.18 Glare-reduction part

7.4 Assemble the prototype and debug

In the last part, we assemble all the parts and the Arduino board and test the final effect to see whether the device can reduce the glare as our expectation. We test whether the camera will locate the area exactly and whether the glare reduction film will reduce the glare at the right place.

After that we improve and finish our prototype. We still have to discuss the improve device to consider the future plan.

8. Schedule

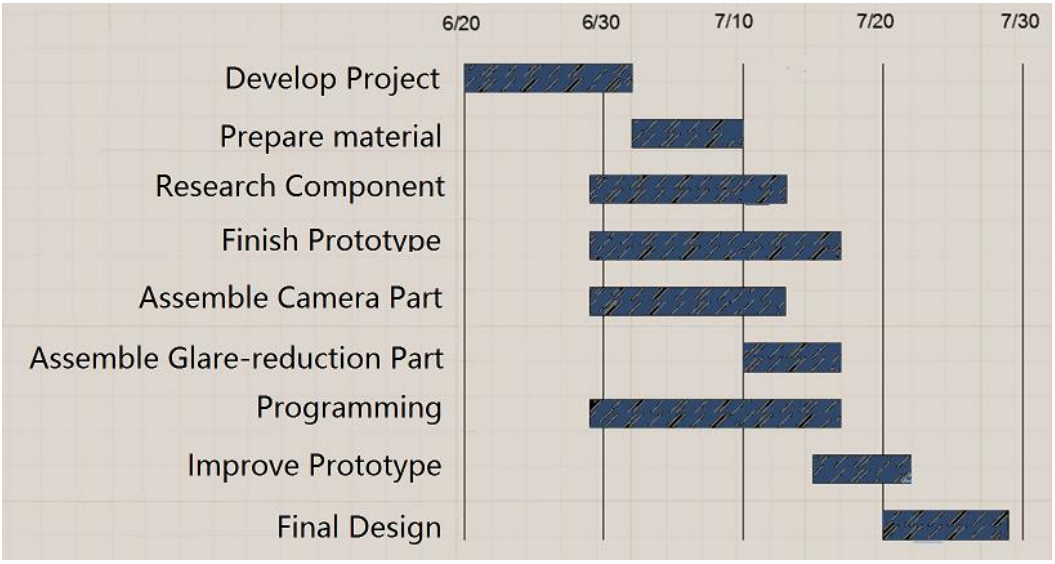

Chart 3. Gantt chart

As shown in the Gantt chart, our project can be generally divided into three parts. From 6/20 to 7/5 is the preparing stage, from 7/6 to7/26 is the executing stage and from 7/27 to 8/9 is the improving and adjusting stage.

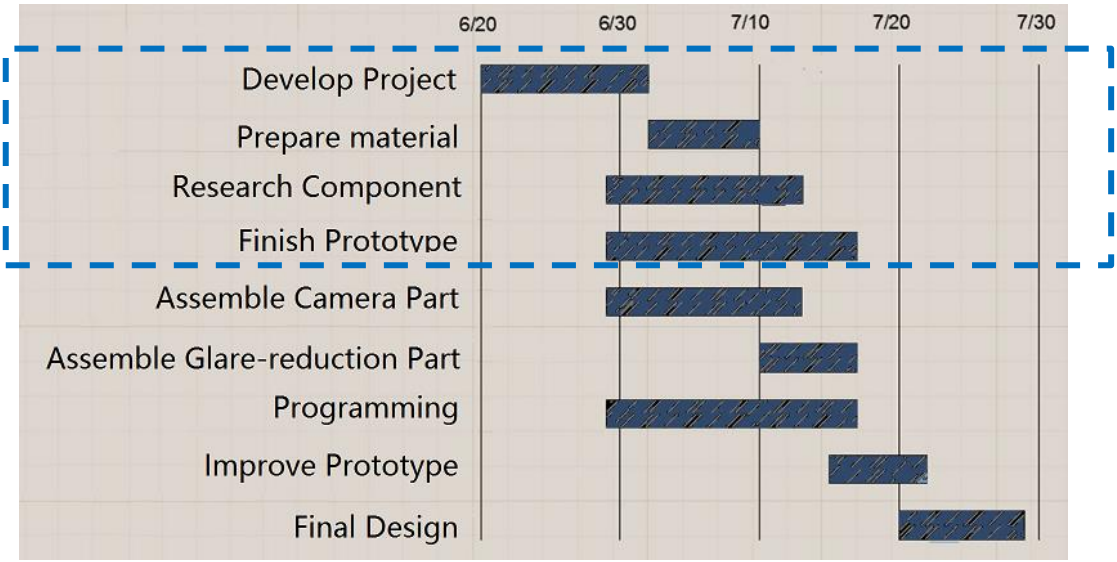

Chart 4. The first part of Gantt chart

For preparing stage，we mainly focused on designing the construction of the project. We changed our plan of using mechanical system to put the film for its low efficiency. We decided to use glare reduction film to solve the problem of efficiency. We did some research on the materials and finally purchased all the things we needed. In the first part, we designed and prepared the materials needed for this project. It took us about a week to find the best solution for our project. We spent another week waiting for the

components to be delivered and learning how to use the components that we will use in the prototype.

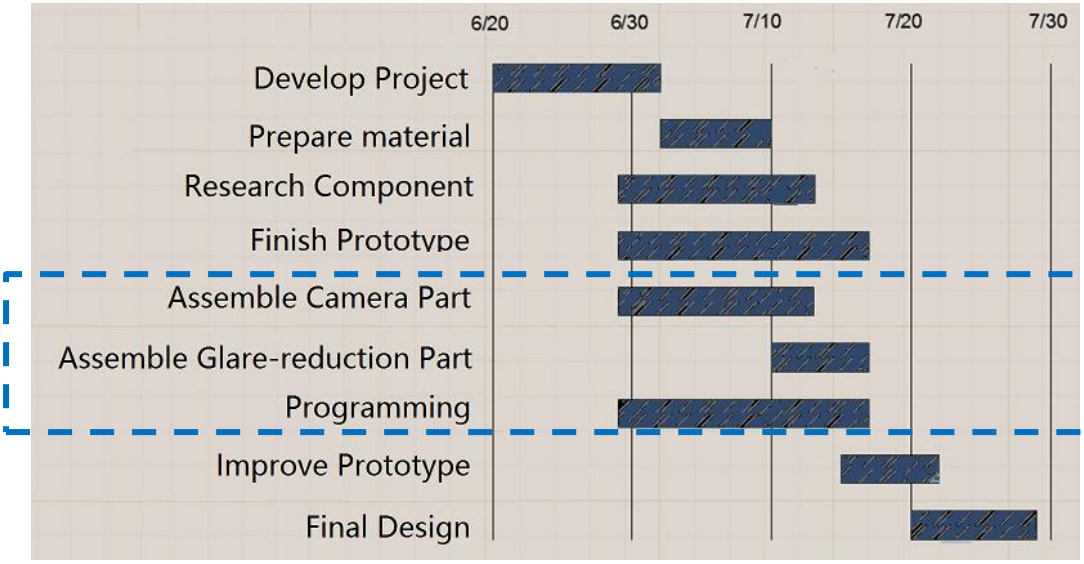

Chart 5. The second part of Gantt chart

For executing stage, we mainly focused on two separate part, the light detection part and the glare reduction part. We coded for the camera and photosensitive sensor. We constructed the glare reduction film and the frame. We communicated light detection part with glare reduction part. We tested how our system behaved according to the real situation. We adjusted the threshold. The second part is the most time consuming part, in this part, the major task is coding for camera and micro control board and assembling the device. It took us about twenty days to finish the tasks.

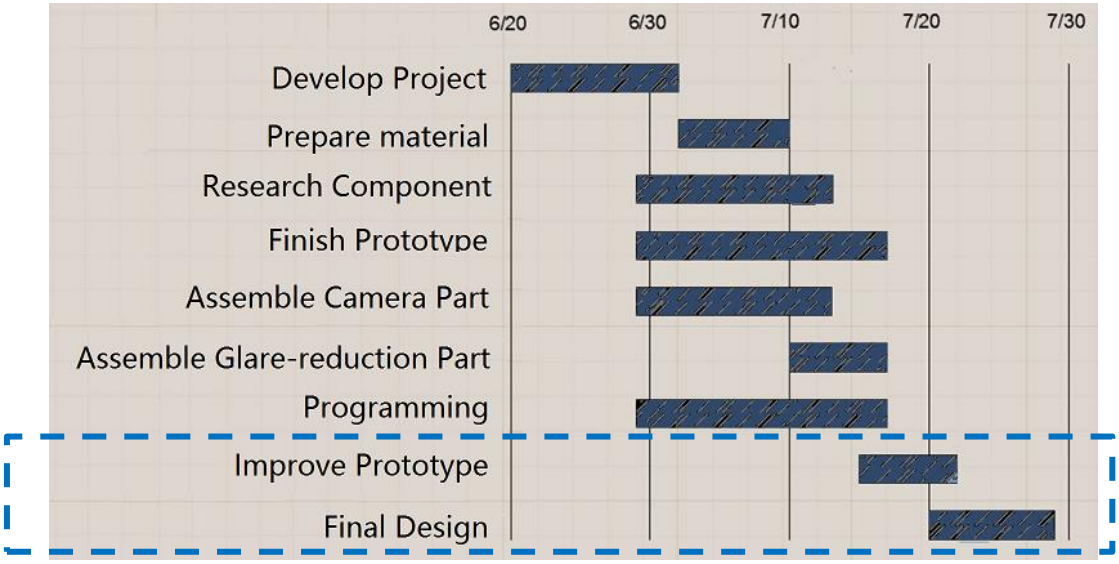

Chart 6. The third part of Gantt chart

For improving and adjusting stage, we mainly focused on the improvement of our system. We set more threshold for different kind of lights for the camera so as to teach

our project to recognize more lights. We tried to solve the problem that appears if the driver changed his or hers view. And finally, we stuck all the film on the glass. The final part is to make several minor changes and improve the prototype, which lasts two weeks

9. Budget

The total budget of our project is about 2500 yuan. The main part of the budget is the glare reduction film. We bought six separate films. For each film, the cost is calculated as $0.3m^2$ since the merchant regarded $0.3m^2$ as the smallest unit of measurement. The total cost is calculated as follow: 0.3*6*820 yuan/m^2 =1400yuan. Although our budget is not so cheap, but it is affordable for almost all drivers is relatively cheap enough compared with the price of cars.

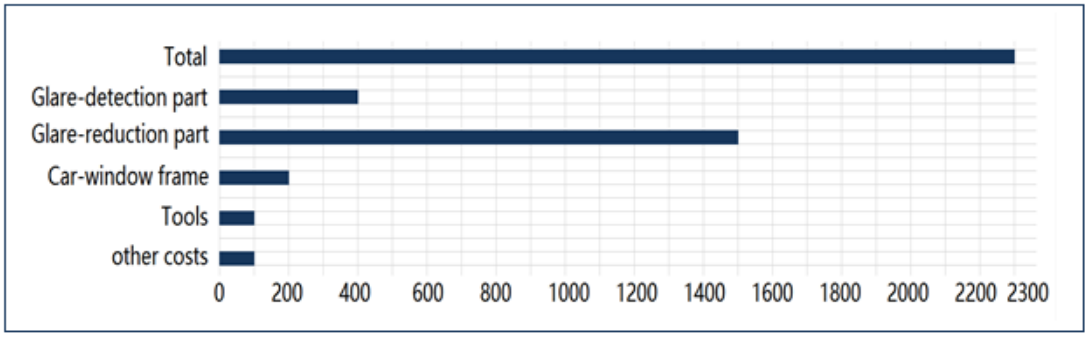

Chart 7. Budget

No.	Item.	Quantity	Unit Price	Total
Glare Reduction part				
1.	Glare reduction film	6	¥250	¥1500
2.	Transformer	1	¥200	¥200
3.	Glass and frame	1	¥200	¥200
4.	Relay	6	¥14	¥84
Light Detection part				
5.	Openmv	1	¥299	¥299
6.	Photosensitive sensor	1	¥13.9	¥13.9
7.	Luminous intensity sensor	1	¥22.9	
Sundry				
8.	Dupont thread	120	¥6.8/40	¥25.2
9.	Arduino Mega 2560	1	¥127	¥127

Chart 8. Budget Table

10. Risks

10.1 Unexpected loss of power

The first risk is unexpected loss of power. Since the glare reduction device of our product needs constant power supply, when there is no power applied to it, the material will become non-transparent, which can be extremely dangerous for a driver driving on the road. The solution to this risk is that we will prepare emergency power supply along with regular power source for the device.

10.2 Week water-proof

The second risk is that this kind of glare reduction material can be damaged by liquid. And it is placed on the outside of the windshield, so if it rains, the device will be damaged. And its corresponding solution is that we will use plastic film to shield it so that the material won't be damaged by water.

11. Key personnel

Hu Zechen: Team leader; Code Designer; Concept Diagram Drawer
Liu Zhouge: Mechanism Designer; Glare-reduction part Manufacturer
Liu Ziwei: Technical Communicator; Glare-detection part Manufacturer
Shen Yeqin: LOGO Designer; Paperwork Mender

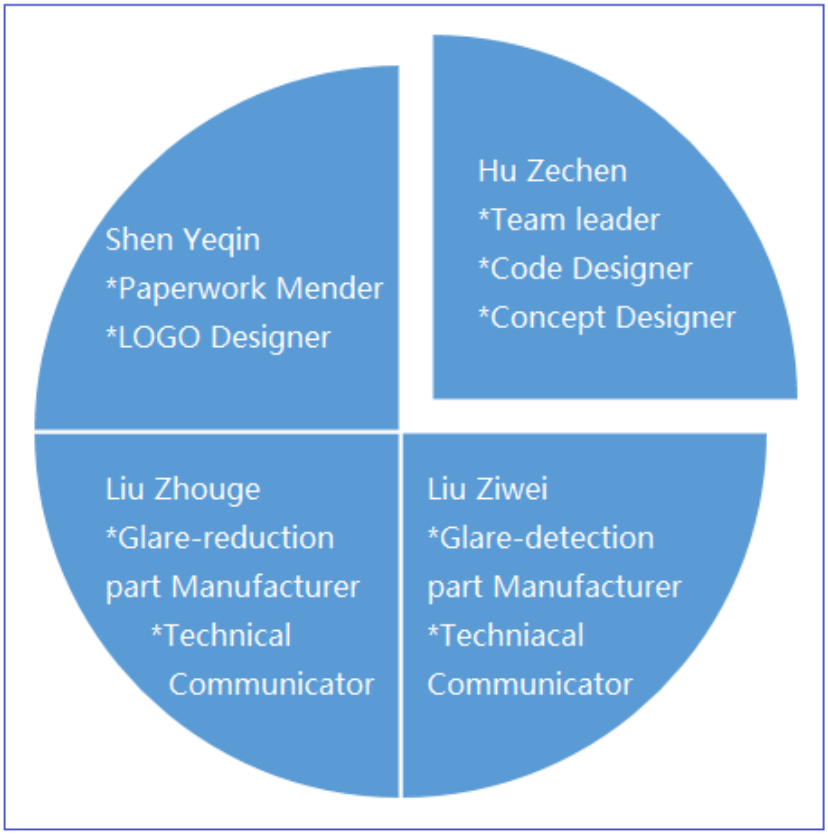

Chart 9. Key personnel

12. Conclusion

12.1 Results

We have accomplished those objectives. By using camera, we can accurately detect the position of the glare, and this kind of material can efficiently reduce the glare for those drivers driving at night. The reaction speed is greatly improved after we optimize our programming code.

12.2 Experience sharing

In this process, there is something that can be improved. For example, the design progress can be improved. The total cost for this project is about two thousand and three hundred yuan. It can be seen from the chart that the most expensive part is the glare-reduction part. The glare-reduction part we use is a kind of material that when voltage is applied to it, it will become completely transparent, or semitransparent, if there is no voltage, it is in non-transparent state. This kind of material is quite expensive so it takes a large percentage in our total cost.

Initially, we thought this kind of material is sold based on square meter, so our original budget plan was about one thousand, which is acceptable for us. However, when we were about to purchase it, the seller told us that, though the total area of the material we needed to buy was not large, but the number of pieces of this material that we needed was very large, this will make the cost of one single piece very high, reached about 250yuan per piece, and that if we stuck to our initial plan, the total cost would reach about seven thousand yuan, which was not affordable to ordinary drivers. Therefore, we had to simplify our device from twenty one columns and eleven rows to 3 columns and 3 rows in total. But still, we can achieve our objective with simplified design, so we bought it. And now the cost is about one thousand and five hundred yuan.

12.3 Future Improvements

In the future, we may make several improvements.

Firstly, since different cars have different kind of glare, so it is necessary to optimize the code for the detection for various glare.

Secondly, with budget constrain, we now can only make a low resolution glare reduction system. If possible, with more pieces of the glare reduction material, we can have a higher resolution.

Finally, the concept of user-base is very important, drivers of different heights need different areas of the windshield that needs to be blocked by the device. To solve this problem, we may need another camera to detect the position of the drivers' eyes, so that the reduction area can be changed accordingly.

13. Reference

1. Open MV
http://singtown.cc/openmv/
http://doc.celerstar.com/index.php?s=/7&page_id=416
http://doc.celerstar.com/index.php?s=/7&page_id=317
2. Arduino Mega
https://detail.tmall.com/item.htm?spm=a230r.1.14.1.ebb2eb2nU7yTS&id=38816270178&cm_id=140105335569ed55e27b&abbucket=12
3. Glare-reduction film
https://item.taobao.com/item.htm?spm=a230r.1.14.19.ebb2eb2Wp8AyA&id=528494201118&ns=1&abbucket=12#detail
4. Electric rely
http://www.dfrobot.com.cn/brand-8-c0.html
http://www.dfrobot.com.cn/community/portal.php
5. Photosensitive sensor
https://detail.tmall.com/item.htm?id=521238059334&ali_refid=a3_430583_1006:1104520036:N:%E5%85%89%E5%BC%BA%E4%BC%A0%E6%84%9F%E5%99%A8:560d9908e3a5b7d37f164f4f8e2896ed&ali_trackid=1_560d9908e3a5b7d37f164f4f8e2896ed&spm=a230r.1.14.1.ebb2eb2d8t40d
9.https://detail.tmall.com/item.htm?id=41268788418&ali_refid=a3_430583_1006:1109983619:N:%E5%85%89%E6%95%8F%E7%94%B5%E9%98%BB:e260d4c0896970ac847293079c4a3c6e&ali_trackid=1_e260d4c0896970ac847293079c4a3c6e&spm=a230r.1.14.1.ebb2eb2J5KM2V
6. Luminous intensity sensor
https://item.taobao.com/item.htm?spm=a230r.1.14.1.ebb2eb2mRoYOQ&id=552026903801&ns=1&abbucket=12#detail
7. Survey “About the glare reduction device for night driving”
https://sojump.com/jq/15489281.aspx

14. Appendix

14.1 Code for camera

```
import time
import sensor, image, time

sensor.reset()                      # Reset and initialize the sensor.
sensor.set_pixformat(sensor.RGB565) # Set pixel format to RGB565 (or GRAYSCALE)
sensor.set_framesize(sensor.QVGA)   # Set frame size to QVGA (320x240)
sensor.skip_frames(10)              # Wait for settings take effect.
clock = time.clock()                # Create a clock object to track the FPS.
```

```
while(True):
    clock.tick()                            # Update the FPS clock.
    img = sensor.snapshot()
    colorwhite=(95,100,-10,2,-8,7)
    white=None
    white=img.find_blobs([colorwhite])
    if white:
        for b in white:
            img.draw_rectangle(b[0:4])
            img.draw_cross(b[5],b[6])
        print(b[5],b[6])
        if b[5]<60 & b[5]>0 & b[6]<60 & b[6]>0:
            ans=1
        if b[5]<120 & b[5]>60 & b[6]<60 & b[6]>0:
            ans=2
        if b[5]<180 & b[5]>120 & b[6]<60 & b[6]>0:
            ans=3
        if b[5]<60 & b[5]>0 & b[6]<60 & b[6]>0:
            ans=4
        if b[5]<60 & b[5]>0 & b[6]<60 & b[6]>0:
            ans=5
        if b[5]<60 & b[5]>0 & b[6]<60 & b[6]>0:
            ans=6
        if b[5]<60 & b[5]>0 & b[6]<60 & b[6]>0:
            ans=7
        if b[5]<60 & b[5]>0 & b[6]<60 & b[6]>0:
            ans=8
        if b[5]<60 & b[5]>0 & b[6]<60 & b[6]>0:
            ans=9
    uart.writechar(ans)
```

14.2 Code for micro control board

```
int hen1 = 8;
int hen2 = 9;
int hen3 = 10;
int shu1 = 11;
int shu2 = 12;
int shu3 = 13;
void setup(){
pinMode(hen1,OUTPUT);
pinMode(hen2,OUTPUT);
pinMode(hen3,OUTPUT);
pinMode(shu1,OUTPUT);
```

```
pinMode(shu2,OUTPUT);
pinMode(shu3,OUTPUT);
}
void situation1(){
digitalWrite(hen1, HIGH);
  digitalWrite(shu1, HIGH);
  digitalWrite(hen2, LOW);
  digitalWrite(hen3, LOW);
  digitalWrite(shu2, LOW);
  digitalWrite(shu3, LOW);
}
void situation2(){
digitalWrite(hen1, HIGH);
  digitalWrite(shu1, LOW);
  digitalWrite(hen2, LOW);
  digitalWrite(hen3, LOW);
  digitalWrite(shu2, HIGH);
  digitalWrite(shu3, LOW);
}
void situation3(){
digitalWrite(hen1, HIGH);
  digitalWrite(shu1, LOW);
  digitalWrite(hen2, LOW);
  digitalWrite(hen3, LOW);
  digitalWrite(shu2, LOW);
  digitalWrite(shu3, HIGH);
}
void situation4(){
digitalWrite(hen1, LOW);
  digitalWrite(shu1, HIGH);
  digitalWrite(hen2, HIGH);
  digitalWrite(hen3, LOW);
  digitalWrite(shu2, LOW);
  digitalWrite(shu3, LOW);
}
void situation5(){
digitalWrite(hen1, LOW);
  digitalWrite(shu1, LOW);
  digitalWrite(hen2, HIGH);
  digitalWrite(hen3, LOW);
  digitalWrite(shu2, HIGH);
  digitalWrite(shu3, LOW);
}
```

```
void situation6(){
digitalWrite(hen1, LOW);
  digitalWrite(shu1, LOW);
  digitalWrite(hen2, HIGH);
  digitalWrite(hen3, LOW);
  digitalWrite(shu2, LOW);
  digitalWrite(shu3, HIGH);
}
void situation7(){
digitalWrite(hen1, LOW);
  digitalWrite(shu1, HIGH);
  digitalWrite(hen2, LOW);
  digitalWrite(hen3, HIGH);
  digitalWrite(shu2, LOW);
  digitalWrite(shu3, LOW);
}
void situation8(){
digitalWrite(hen1, LOW);
  digitalWrite(shu1, LOW);
  digitalWrite(hen2, LOW);
  digitalWrite(hen3, HIGH);
  digitalWrite(shu2, HIGH);
  digitalWrite(shu3, LOW);
}
void situation9(){
digitalWrite(hen1, LOW);
  digitalWrite(shu1, LOW);
  digitalWrite(hen2, LOW);
  digitalWrite(hen3, HIGH);
  digitalWrite(shu2, LOW);
  digitalWrite(shu3, HIGH);
}
void situation0(){
digitalWrite(hen1, LOW);
  digitalWrite(shu1, LOW);
  digitalWrite(hen2, LOW);
  digitalWrite(hen3, LOW);
  digitalWrite(shu2, LOW);
  digitalWrite(shu3, LOW);
}
void loop(){
situ=analogRead(5);
situation1();
```

```
        delay(1500);
        situation5();
        delay(1500);
        situation9();
        delay(1500);
        situation3();
        delay(1500);

        situation5();
        delay(1500);
        situation7();
        delay(1500);
        situation2();
        delay(1500);
        situation4();
        delay(1500);
        situation8();
        delay(1500);
        situation6();
        delay(1500);
        situation0();
        delay(2000);

}
```