

STUDENT CANDIDATE NUMBER (given by Examinations and available on Portico):	CYXH3
DO NOT WRITE YOUR OWN NAME ON THIS SHEET	
Personal Tutor Name	Daniel Harrison
Module name and code	COMPGC25:Interaction Design
Name of teacher who set this work	Paul Marshall
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Intelligent Zebra Crossing

Recent studies have shown that 16% of all road accidents involve pedestrians and of these, 20% of these occur on or near a pedestrian crossing of some sort. The problems of both zebra crossings design and current rules are part of reason for these accidents.

In this report, I am going to introduce an intelligent zebra crossing. The initial idea, grounded evidence, user research and design method as well as some sketches and prototypes will be introduced in this report.

Intelligent Zebra Crossing is a new kind of urban infrastructure with sensors and other electronic devices to guarantee the safety of pedestrians when they cross the road. It also helps drivers noticing pedestrians clearly and easily after dark. Meanwhile, it can help to improve user experience of both pedestrians and drivers.

Final idea is to design such a product: an automatic inducted, safe insured and good designed zebra crossing.

- Understanding user experience and habits.
- Getting the feedback(satisfaction/dissatisfaction) of zebra crossing.

In order to collect information about zebra crossings, an interview and a questionnaire were designed to have a better understanding of how people use zebra crossings everyday and what kinds of problems with zebra crossings they have. Then, based on current rules of Highway Code, I can have a grounded evidence to ensure the design is realizable, user friendly and aesthetic.

1. Interview

Two students in UK who had driving experience were participating in this semi-structured interview. Participants were firstly asked some questions about using zebra crossings as a driver or a pedestrians. Then they talked about their views on current rules and crossing design.

Example questions include:

- When you drive through zebra crossings, what do you pay attention to?
- How fast do you drive in city after dark generally?
- If pedestrians are ready to cross the road, how much time do you need to stop your car?
- As a pedestrian, have you experienced that cars didn't stop when you went across the road?

2.Questionnaire

According to the user interview, some important problems and a frame of new zebra crossing had been set up. Therefore, questionnaires aimed to collect ideas on use experience and satisfaction/dissatisfaction aspects about zebra crossings.

Questions include:

- As a driver, how long does it take to judge if there would be pedestrians walking on zebra crossings?
- How fast do you drive in city after dark?
- How much time do you need to stop your car when you see pedestrians walking by?
- Tell me about usage of zebra crossings.
- As a pedestrians, when you start to cross the road, what will you do?

Questionnaire link: <https://www.surveymonkey.com/s/99RQKJN>

Finding 1: The rules of how to cross the road is unclear

195

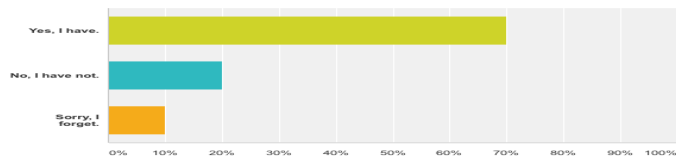
Zebra crossings. As you approach a zebra crossing

- look out for pedestrians waiting to cross and be ready to slow down or stop to let them cross

- Rule 195 requires drivers to stop when pedestrians are waiting to cross the road

As a pedestrian, have you experienced that cars don't stop when you were ready to walk on the zebra crossings?

Answered: 10 Skipped: 0



- 70% of respondents have experienced non-stop when they were waiting

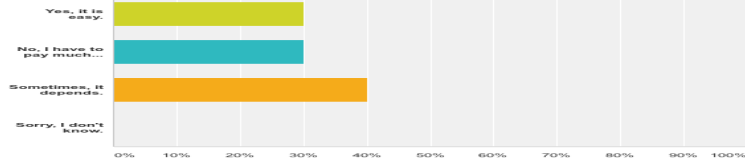
19

Zebra crossings. Give traffic plenty of time to see you and to stop before you start to cross. Vehicles will need more time when the road is slippery. Wait until traffic has stopped from both directions or the road is clear before crossing. Remember that traffic does not have to stop until someone has moved onto the crossing. Keep looking both

- Rule 19 says if there was nobody on the zebra crossings, drivers don't have to stop

When you drive through zebra crossings after dark, is it easy for you to see people who is going to cross the road clearly?

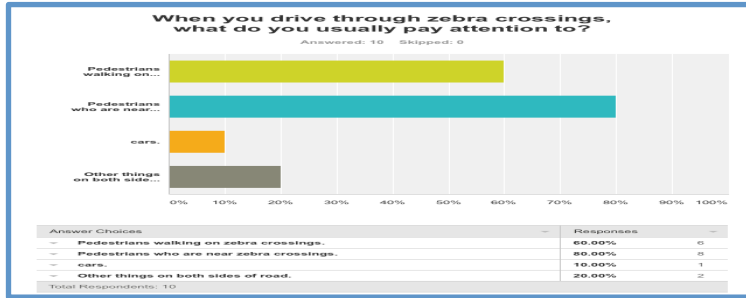
Answered: 10 Skipped: 0



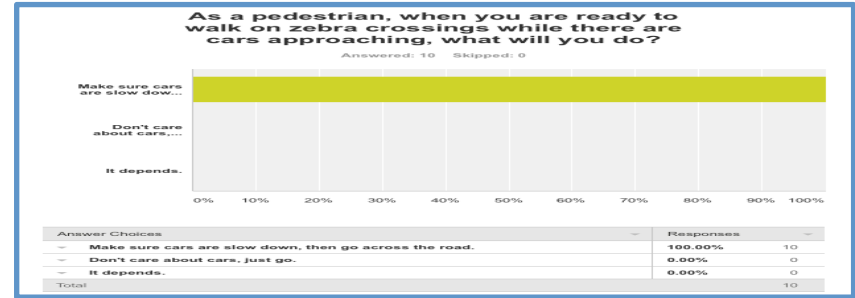
- 70% of respondents feel sometimes it's not easy to see pedestrians clearly at night

Initial User Research: Findings

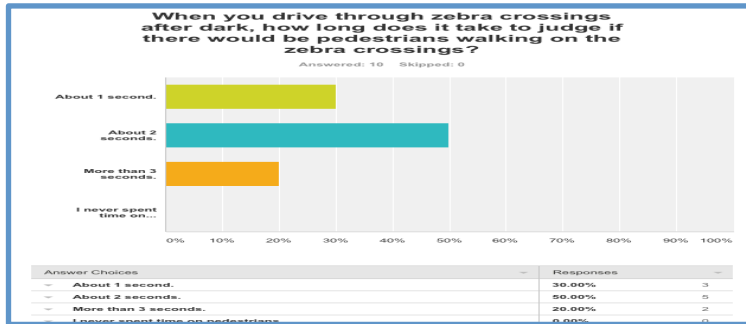
Finding 2: User experience on zebra crossing is not good



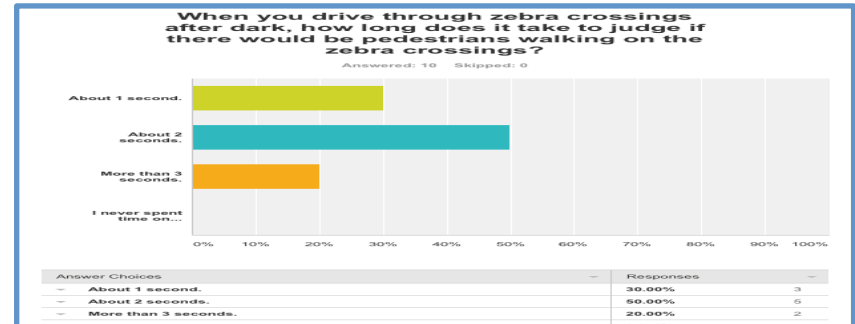
- Drivers always pay much attention to pedestrians



- Pedestrians always pay much attention on cars



- The system should be designed to save drivers' time to notice pedestrians



- Drivers like to be informed by light on the lampstand of sides of zebra crossings

Finding 3: It is necessary to inform drivers to slow down early to ensure safety

How fast do you drive in city after dark generally?

Answered: 10 Skipped: 0

Responses (10) Text Analysis My Categories

Categorize as... Filter by Category Search responses

Showing 10 responses

30	4/23/2014 1:45 AM	View respondent's answers
40	4/23/2014 12:23 AM	View respondent's answers
20	4/22/2014 8:39 PM	View respondent's answers
Not sure	4/22/2014 7:09 PM	View respondent's answers
40	4/22/2014 6:59 PM	View respondent's answers
30mph	4/22/2014 6:22 PM	View respondent's answers
at speed limit	4/22/2014 10:38 AM	View respondent's answers

How fast do you drive in city after dark generally?

Answered: 10 Skipped: 0

Responses (10) Text Analysis My Categories

Categorize as... Filter by Category Search responses

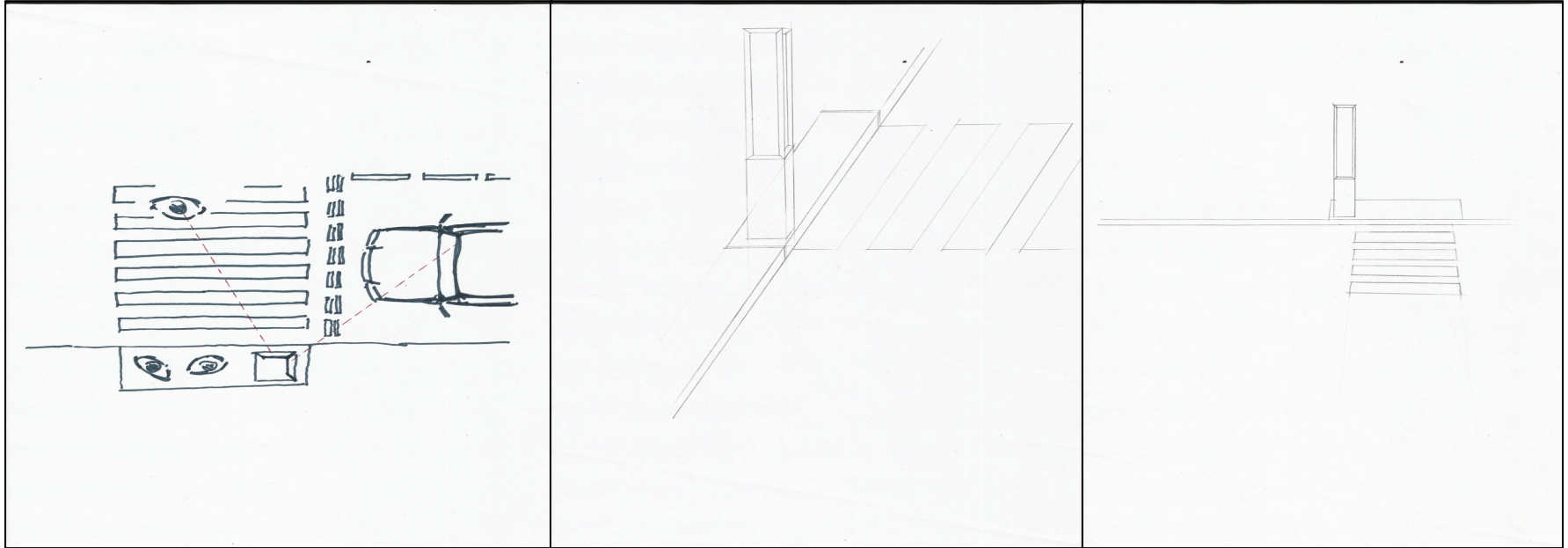
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The average speed at night: less than 40 miles/h The average time for driver to stop at night is 3 seconds

- After calculation we can know that both drivers and pedestrians should be informed when cars are 26.85 metres away. That is safe distance.

Initial design sketches



Evaluation on initial working Process

Initial design on working process

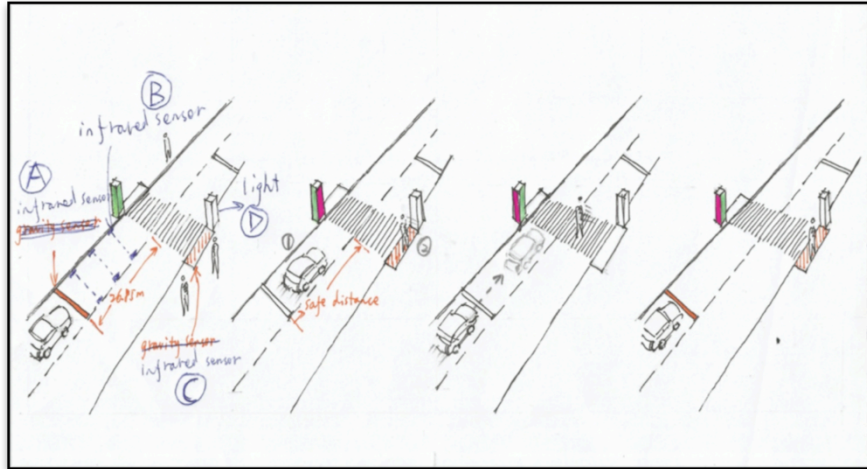
- A pedestrian standing on sides of road and cars are outside the safe distance
- Gravity sensor detects the pedestrian then sends signal to drivers' light
- Drivers' light turns red and the pedestrian begins to cross road
- Gravity sensor detects the pedestrians passed by, then drivers' light turn green



Evaluation on this design

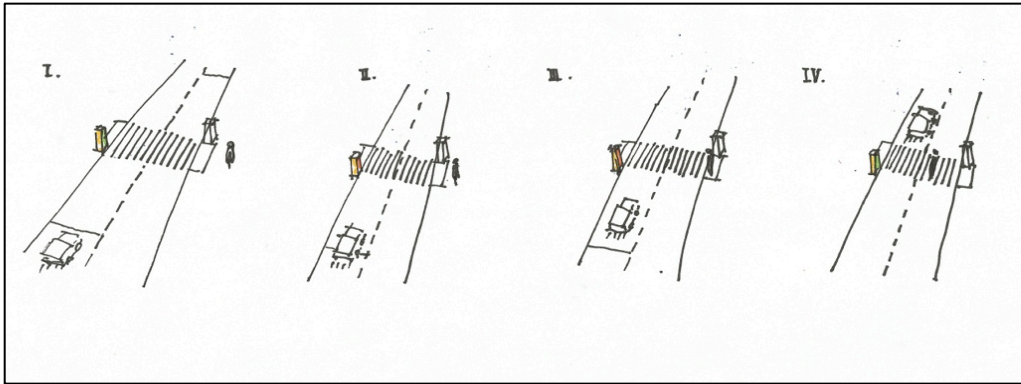
- Cannot cover most of the circumstances that pedestrians and drivers may have.
- Cannot detect if the cars stopped or not.
- Just take one pedestrians as sample which makes the working process too simple.
- The system is not intelligent enough to both keep pedestrians' safe and improve drivers' use experience.

The Intelligent Zebra Crossing is consisted of 4 parts:



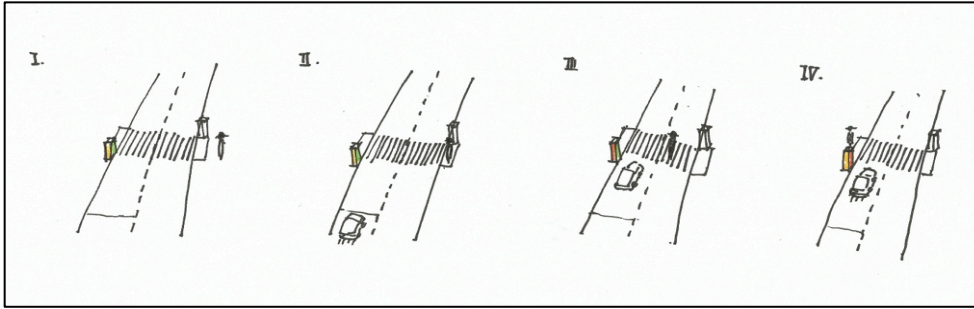
Name	Function
A: Infrared Sensor	<ul style="list-style-type: none">• When cars pull into safe distance, A will transmit to inform pedestrians' light to turn red.
B: Infrared Sensor	<ul style="list-style-type: none">• There are 7 infrared sensors which used to check if cars in this area are stopped.• If cars are not stopped, the pedestrians' light keep red.
C: Infrared Sensor	<ul style="list-style-type: none">• Check if there are pedestrians waiting to cross the road .• Detect the direction pedestrians are heading to.
D: Signal Light	<ul style="list-style-type: none">• Receive the signal infrared sent and change light

The following 3 graphs cover most of the circumstances that drivers and pedestrians may have, all the sensors automatically control the light according to the position of pedestrians and cars.



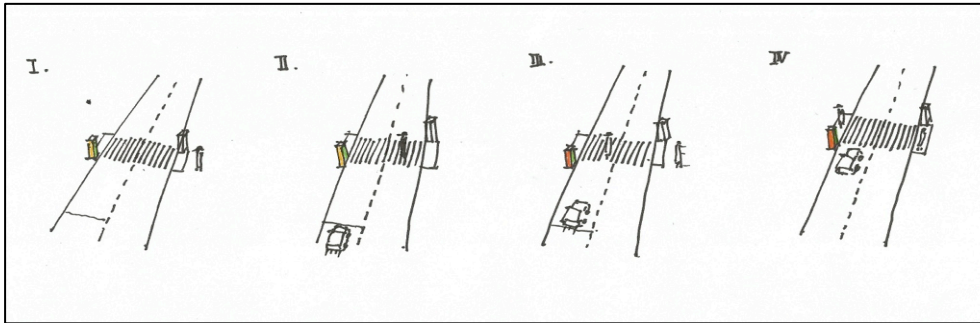
Circumstance 1:

- Cars have passed the safe distance then pedestrians standing on infrared area, cars go first as they can not stop completely in such a distance.



Circumstance 2:

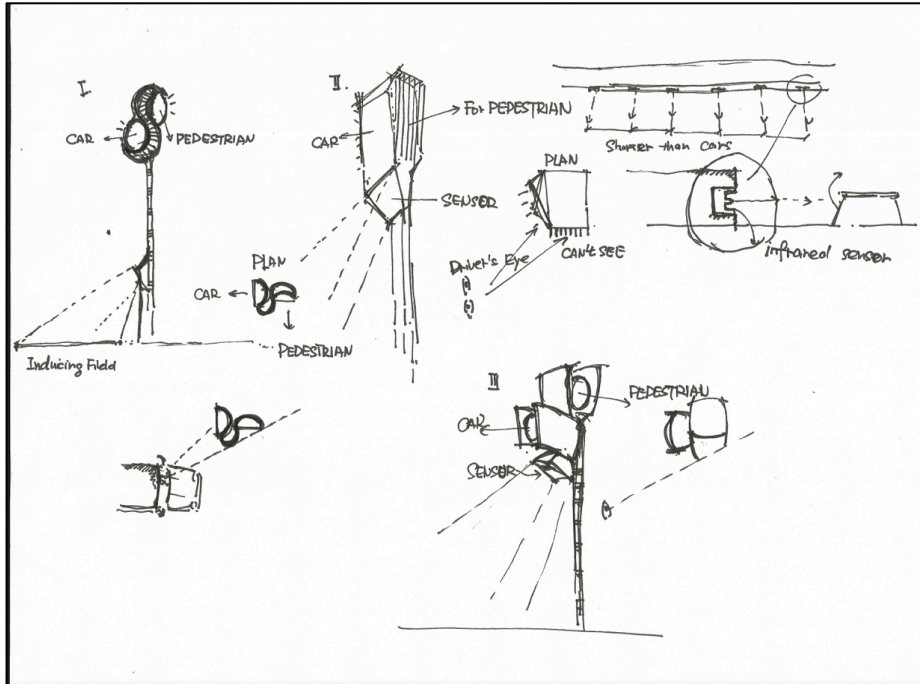
- Pedestrians are walking on zebra crossings then cars reach safe distance, cars should stop.



Circumstance 3:

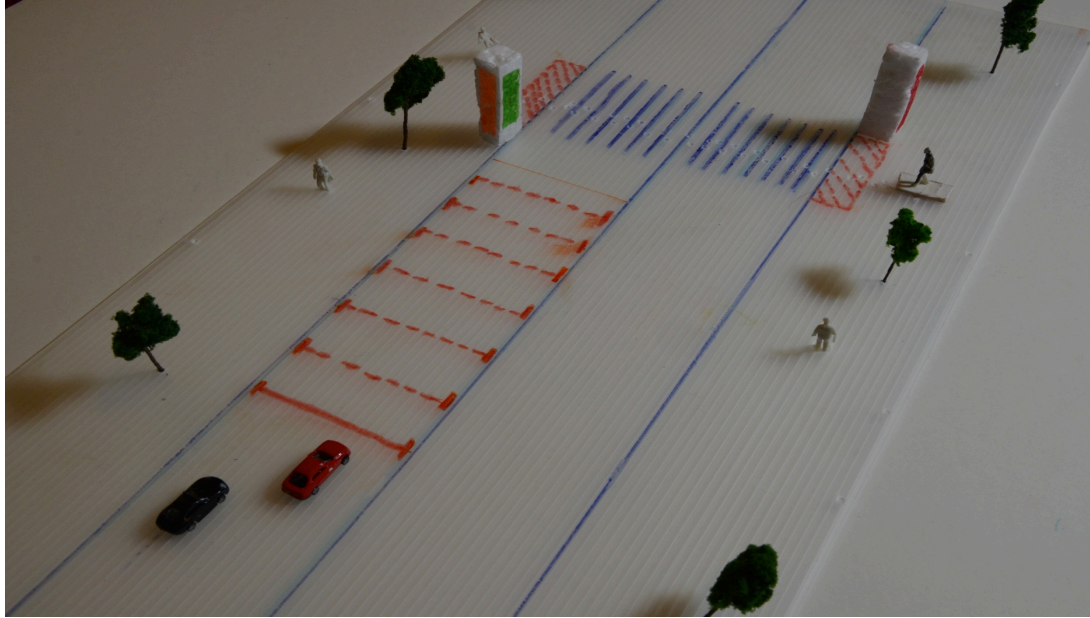
- The first pedestrian is walking on zebra crossings while another one begins to cross, cars will wait till all the pedestrians passed the road.

Physical Product design



Operate Rules:

- Infrared sensor on light can detect pedestrians activity. If they walk into road, the light receive signal to change. If they walk out of road, the light can not receive signal.
- The duration that light lasts is fixed.



As I have set up 3 kinds of circumstances, the prototype aims to simulate and test the process of how sensors and light cooperate in each circumstance. So I have made a prototype which imitates the real road and made a video to present the idea on the working process of Intelligent Zebra Crossing.

- The video is uploaded to YouTube: <https://www.youtube.com/watch?v=LN19vg0uC1A>

Evaluation Aspect	Evaluation Detail	Rating
•Intelligence and Rationality	•Because the behaviour of drivers and pedestrians are unpredictable, so the system can perform well in most of circumstances but not at all time.	•Meet the basic requirement but not perfect.
•User Experience Improvement	•Drivers can easily notice pedestrians at night.	•Good
•Safety improvement	Drivers informed ahead to ensure they have a safe distance to stop.	•Good

- **The intelligent zebra crossing can greatly improve user experience.**
- **Real product is used in a complex environment which requires a more logical and intelligent algorithm.**

Issue 1: Collect more information on drivers' and pedestrians' behavior preference.

Description: Pedestrians and drivers' behavior greatly influences the circumstances near zebra crossings. Therefore, more behavior preference information should be collected to simulate more complex circumstances which can help to perfect the logicity of the system.

For example, when the first car passes by within the safe distance and then the second car passes by, according to the system working process, pedestrians' light turns green that would cause crash between pedestrians and the first car.

Issue 2: A more user friendly design should be made in the future

Description: Based on the research of user behavior preference, a more humanization physical product design should be made to improve user experience and reduce misleading to users.

There is a circumstance that I came up with when I was making video, that when the first car passed by the safe distance and then pedestrians were waiting to cross the road. According to working process, the first car should go through then the second car should slow down. That means the light has to guide both drivers of different activities. So a better interaction design is needed in this kind of circumstances.

Method	Evaluation	Difficulties
•Sketches	•Help to think through ideas in early stage •Stimulate to generate new ideas	•Need some drawing skills •Some process can not be presented by sketches
•storyboard	•Help to think through the whole process of how ideas works	•Many storyboards are needed to describe different circumstances
•Physical prototype	•High fidelity to vividly show my physical product design ideas	•Takes a long time
•video	•Help to check if system's working process is rationale. Tell story from beginning to end	

Conclusion(what have been done)

- Initial user research by user interview and questionnaire
- Sketches of initial ideas including working process design and physical product design
- Physical prototype
- Video to simulate the working process

Further research:

- Further study on pedestrians' and drivers' behavior preference
- Find out all the possible circumstances that pedestrians and drivers may have
- A more intelligent algorithm to control the system to deal with all these circumstances