A Disappearing A pillar

FINAL REPORT

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List of Definitions

A pillar: A-pillars are the two pillars at the front of the vehicle holding up the windscreen. Pillars are the vertical or diagonal supports located at the window areas of a car. A car usually has four pillars, namely A, B, C, and D from the front to the rear. In this project, we are going to focus on the A pillar.

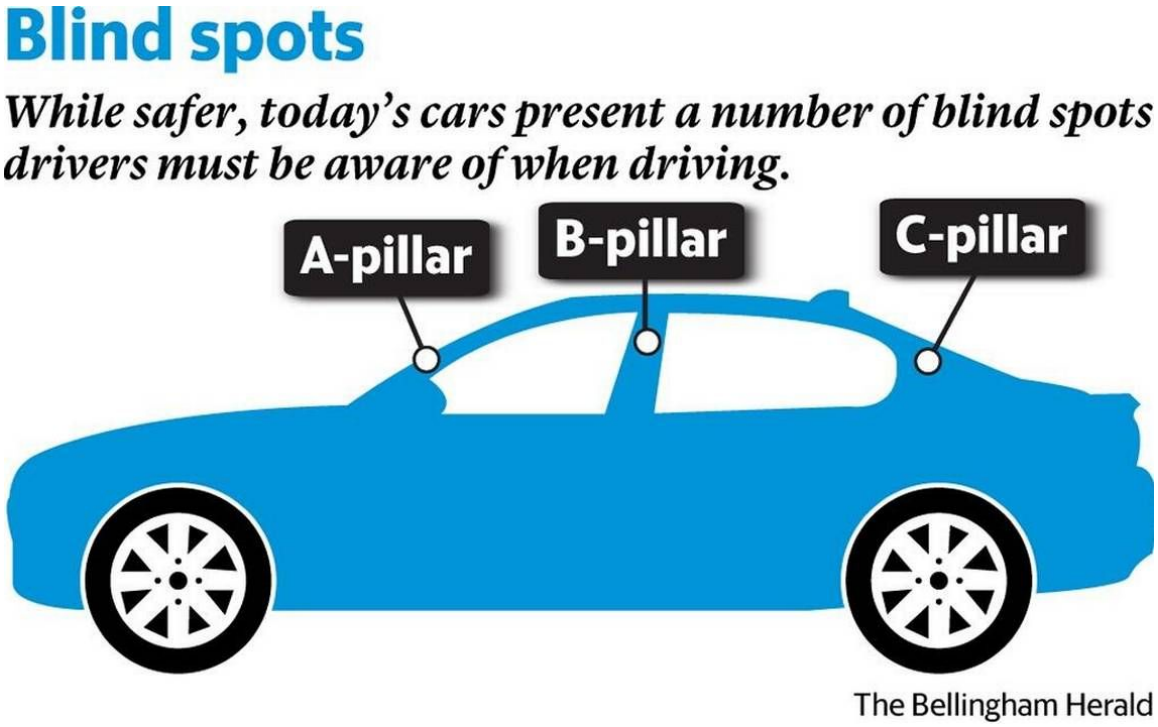


Fig. 1: Pillars in a vehicle.

1 Introductory Material

1.1 Acknowledgement

The purpose of our project is to find a way to improve a driver's vision field while making turns or going in reverse. To be more specific, we are going to achieve this by minimizing the impact of A pillar on what the driver can see. A pillar is the vertical or near vertical support of a car's window area, and a car usually have four pillars, named A, B, C, D moving from the front to rear. In this project, the most difficult part is how to transfer image onto a tablet and make drivers feel like they are actually looking through the A-pillar.

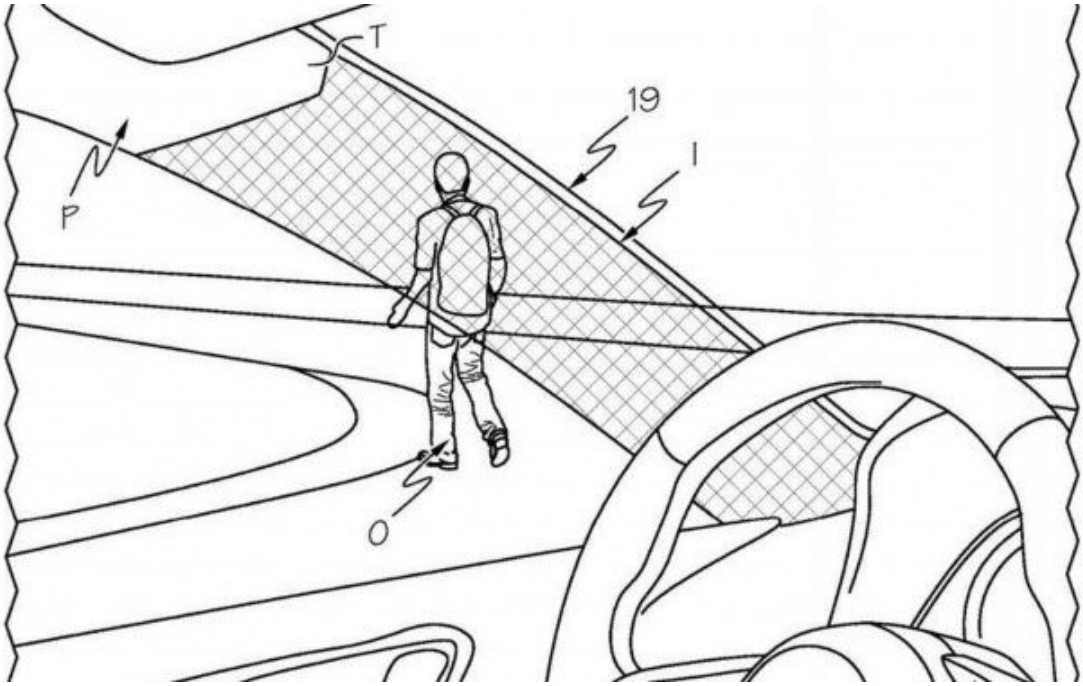


Fig. 2: Illustration of what is to be achieved.

1.2 Problem Statement

Based on accident statistics for 2014, there were 3,401 seriously injured cyclists and 113 fatalities. For the same year, there were 5,289 severely injured motorcyclists and 339 fatalities. Despite being only 1% of all road traffic, motorcyclists accounted for 19% of road traffic fatalities. According to Motoring News, The number of crashes caused by blind spots has even increased by 50% over the last two years. Road users such as, motorcyclists, cyclists and pedestrians are most at risk to this blind spot because they lack the protection that a car provides. A specific example would be when drivers are waiting to make a turning at an intersection, they are unable to see what is hidden behind the A

pillars, be it pedestrians or cyclists, due to this blindspot. Our project serves to provide a remedy to this problem by increasing the peripheral vision range of the driver.

In order to achieve this goal, we are going to use the camera of a tablet to capture what is going on around the car, especially the region that is obstructed by the A pillar. The images captured are then displayed on the screen of the tablet which is attached to the A pillar, so that the driver can "see through" the A pillar and avoid accidents. The most fundamental part of our project would be to transfer the image from camera to the tablet, because this is the main part and we need to write code using Android Studio and upload it onto our device. Due to the fact that we were previously unexposed to using Android Studio and image processing, these are going to be the most challenging portions of the project. As for the final outputs, we hope that our clients, motorists for example, they can use our tablet to render the A pillar "invisible" and see what is going on behind the A-pillar and avoid oncoming accidents.

1.3 Operating Environment

Our product is a software that is designed to be used in a tablet operating with an Android OS, the usage of this product is to assist drivers to get a wider peripheral view. Since this tablet will be affixed to the A-pillar inside the car, we don't need it to be waterproof. However, we need to ensure the tablet is securely fixed onto the pillar so it wouldn't rotate or fall off while driving, which would be potentially hazardous for the motorist and other road users alike.

Since the battery on the tablet is limited, we need to consider charging the tablet's battery while users are using the product. Therefore, the tablet must be continuously charged via a cable connected to the USB port in the vehicle.

1.4 Intended Users and Intended uses

Our target user base for this project are motorists whose vehicles have wide A-pillars, due to the fact that vehicles with wider A-pillars will obstruct more of the driver's' field of vision. This blind spot will be further exacerbated and ameliorated depending on the size of the A-pillar which differs from vehicle to vehicle. For our project however, it is assumed that the user base mainly drive Sports Utility Vehicles(SUVs) since these cars generally have wider A-pillars.

The motorists can attach the tablet onto the A pillars of their vehicles. The region outside the vehicle obstructed by the A pillar will be displayed on the screens of the tablets, giving the illusion of it being transparent. The section of the camera screen displayed will be parallelogram shaped, mirroring the shape of the A pillar. The angle, width, and height of the parallelogram display can be adjusted by the user depending on the width of the A pillar and the height of the driver.

1.5 Assumptions and Limitations

Assumptions:

1. The A-pillar should be as wide as possible but no wider than the tablet width.
2. Our product can be easily attached and detached on the A-pillars of any vehicle, so that different users with different vehicles will be able to use this App.
3. The product can be used for all kinds of cars in the world, and our app will store the data of the A-pillars of different cars after people input these information in our database.
4. The images acquired by camera will be cut into a parallelogram shape. They will also be magnified but the image quality and clarity will be as good as pre-magnification, and the cropped out parts will be opaque/blacked out.

Limitations:

1. The cost to produce the end product shall be as low cost as possible, no other external devices are required excluding the tablet.
2. The camera used in this project is the built-in camera on the Nexus 7 2013, with outdated camera specifications in comparison to the state-of-the-art UHD cameras available today.
3. The system used is the Android OS, therefore the application will be unusable on IOS devices.

1.6 Expected End Product and other Deliverables

The end product will be an application installed on a Nexus 7 2013 device. So the item delivered to client is just the tablet. The tablet is rechargeable when it runs out of power.

Functions:

1) Customizable width and angle of block size in accordance to that of the A-pillar in different vehicles.

2) Zoom in/out functions to provide magnification of images if needed.

3) Touch adjustable block shape by dragging the red dots at the 4 edges of the parallelogram as shown in **Fig. 3** below.

Fig. 3: UI of App with a parallelogram shaped block.

2 Proposed Approach and Statement of Work

2.1 Functional requirements

The aim of our project is to reduce the impact of the blind spot caused by the A pillar. We need to develop an android app to do way with the A pillar through the use of a tablet. The screen of the tablet will display the region outside the car through a real time camera, working as an aid to improve the driver's peripheral field of vision obstructed by the A-pillar.

First of all, we need to use the android studio to develop our app, which means that we need to know how to programming on android studio first. In order to develop an app, we need to create an interface. This interface is able to show the real time sight of the outside pillar, and enhance the drives' judgment to the outside. So the camera interface should have a real-time image transmission function.

In addition, the app will provide some other auxiliary functions, such as user can customize the angle and width of the image according to their own vehicles. this function is convenient to use. it will ask two input data form users, angle and width. And it will automatically produce the shaped screen corresponding to the number entered by users.

Since we do not expect every customers will be able to measure their vehicles. So we will collect some most common brand vehicles, provide 30 or more measurement information for users to choose directly. We are going to implement this in "Pillar category".

2.2 Constraints considerations

In terms of the constraints of our project, because the image quality of our tablet and the setup issue with model car, our project could not totally make car pillar transparent. And because of the aim of this project is to provide an affordable method to increase the viewability of driver, we may not choose to use some high quality equipments, like go-pro camera. The image that we provide might not be that clear. But as time goes by and when we learn more, we hope to solve the setup issue with model car and make it as close to transparent as possible. As for the non-functional requirements, I think it would be how to setup our tablet perfectly on the model car and find the correct angle to fix it, so that the view that driver get will be more close to the real situation.

2.3 Technology considerations

What we are using right now is the Nexus 7 Tablet from ASUS, released in 2013 which has a built in camera. We are trying to use this embedded camera to capture images and display them real time to the driver's eyes through some image processing in order to make the pillar appear transparent. Since the camera specifications are fairly outdated, the images displayed may have its quality slightly compromised.

There is an alternative way however, we can use an external camera with better specifications such as higher megapixels, connected to our tablet to capture images with a better resolution. This would also be much easier for users the adjust the direction of the camera and the angle of the images. But this would bring up the overall cost of our project, defeating the purpose of this being a low cost project.

2.4 Safety considerations

Since our project is an App, all of our safety consideration is about driver. Sometimes, there may be a time delay between the transferring of images from the camera to the tablet screen then to the eyes of the driver. With that being said, the driver cannot be completely reliant on the application when they are driving.

2.5 Previous Work and Literature

Jaguar Land Rover's 360 Virtual Urban Windscreen

Jaguar released this new technology in late 2014, which can make the pillars of the vehicle look "transparent" in order to eliminate the effects of blind spot caused by all three A,B and C pillars. Screens are embedded onto the A,B and C pillars which show live feed from cameras located outside the vehicle, with the motorist having virtually no blind spots at

all. It uses a heads-up display (HUD) to give the user a warning when there is an object in the front of the car blocked by the pillars.

Fig. 4: Jaguar Land Rover 360 Virtual Urban Windscreen

Although there are some differences between our project and this technology from Jaguar, we all have same goal in mind, which is to eliminate the impact of the blind spot caused by the pillars of a car. This product by Jaguar and Land Rover will undoubtedly have exorbitant costs as everything was the state-of-the-art technology back in 2014, including transparent pillars, a "ghost car" mode, a heads-up windshield display etc.

Our solution is to use an inexpensive and convenient to achieve the same goal, getting rid of blind spots; our project in particular is focused on the A-pillar only. With only a Nexus 2013 tablet in hand and Android Studio, we strive to achieve the same result of making the A-pillar transparent. All the driver needs to do is attach a tablet onto the pillar and use our app to make the pillar look "transparent" no matter what type of vehicles they are driving. Not everyone can afford a luxury vehicle and most people nowadays are able to afford an inexpensive tablet which can provide a similar solution to the same problem.

2.6 Possible Risks and risk management

There are no huge risks associated with this project since it is mostly coding based and indoors. One significant risk it when we are actually testing out our prototype on the roads, since one malfunction with the application or the tablet may cause road accidents

if we are not being careful. Thus, in order to mitigate this risk, we need to test it somewhere where there aren't many cars.

Another risk would be during sunny days, where there might be garish sun rays. Drivers might be unable to look at the screen of the tablet directly since it is glaring to the human eyes. A solution might be to install an anti-glare screen protector on the screen of the tablet.

2.7 Project Proposed Milestones and evaluation criteria

There are several key milestones in our project. The first one is having our user interface ready and sync it onto the tablet, this progress is significant since we can actually see it on the tablet which shows that we are making progress. The second milestone is having the real time image capture in our app with the built in camera. Now, next milestone would be finishing the adjustable image size function and then attaching it on the A-pillar of the model SUV to test it out.

2.8 Project tracking procedures

Since our project is to develop an app, we can easily track our progress. We need to test our project after every major milestone. On top of this, we need to use android studio monitor to emulate the results every time when we have some new progress. Using the emulator is good enough for minor changes since it is time consuming to sync it onto the tablet after every small development.

2.9 Objective of the task

Our goal of this object is to remove the blind spots on the A pillar. We need to use a tablet to display the images hidden by the a pillar, so that drivers can see pedestrians or other road users hidden behind the A-pillar. If this can be achieved, the accidents caused by this blind spot can be drastically reduced.

2.10 Task approach

Fig. 5: Process diagram of the project

Fig. 6:Conceptual Sketch of Project

2.11 Expected Results and Validation

The desired outcome is to eliminate the A pillars in the car via digital means, so that the blind spots are completely "see through", thus rendering the A pillars essentially transparent. If the images displayed on the tablet is a mirror image of what is being blocked by the A pillar, our project is a success.

1) Customizable width and angle of block size in accordance to that of the A-pillar in different vehicles: User will be able to input the angle and width of the A-pillar and the block shape will reflect the A-pillar of that particular vehicle.

2) Zoom in/out functions: User will be able to zoom in/out by pinching in an inward/outward motion.

3) Touch adjustable block shape by dragging the red dots at the 4 edges of the parallelogram : User will be able to adjust the block shape manually using his/her fingers.

2.12 System Block Diagram

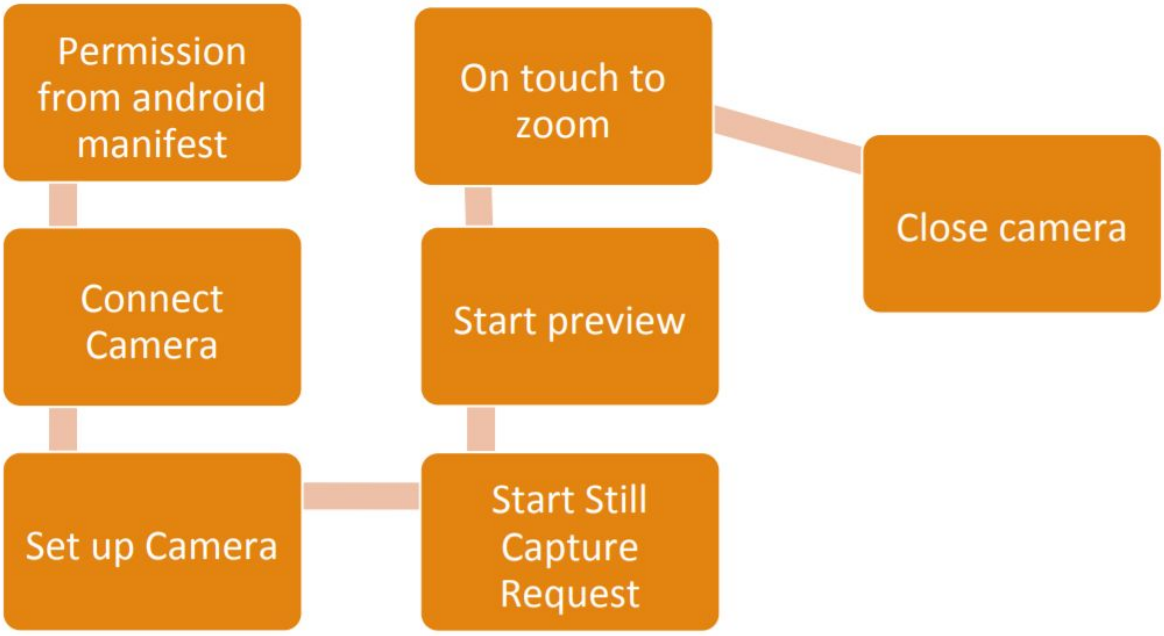
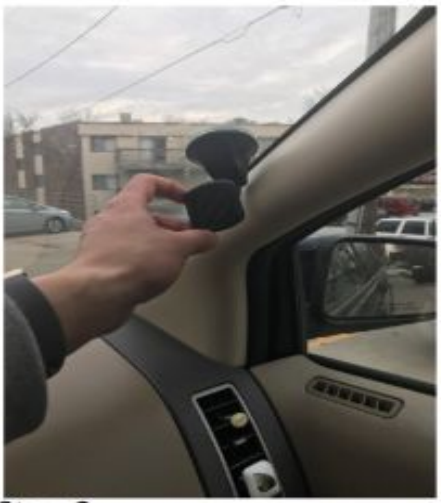


Fig. 7: Detailed design of the camera function of the App

2.13 Test Plan

Step 1:
Test car(Ford Edge) and tester



Step 2:
Affixed magnetic holder onto the windscreen to hold the tablet

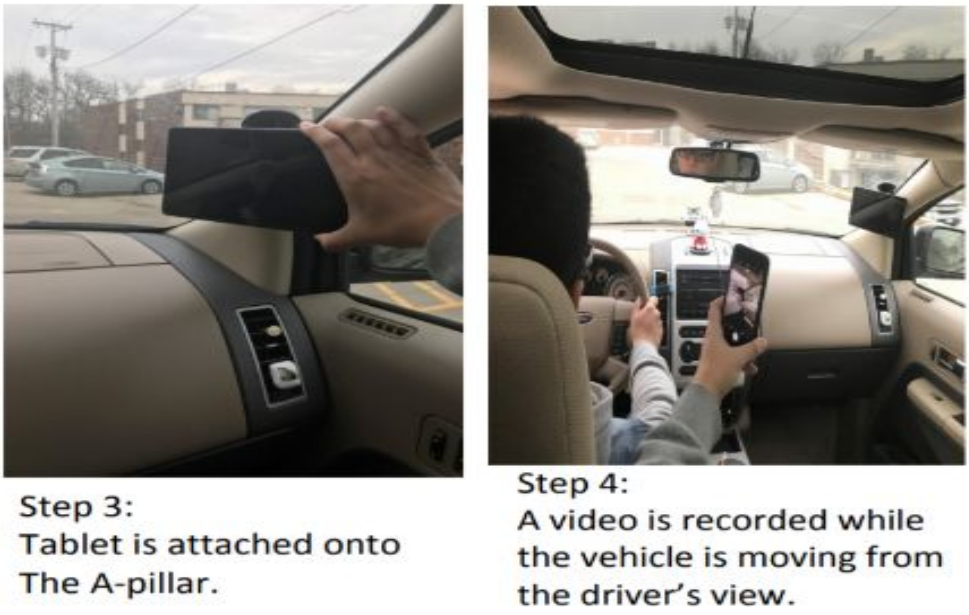


Fig. 8: Testing process

Fig. 8 depicts a step by step testing process of the App. Firstly, the tablet mount is affixed onto the windscreen. After making sure the magnetic mount is firmly attached to the windscreen, we placed the tablet onto the mount to hold the tablet in place. We then recorded a video of what is displayed on the tablet screen while the vehicle is moving from the driver's point of view. For the testing, we made sure it was in a location with little to no vehicles in sight since safety is our first and foremost priority.

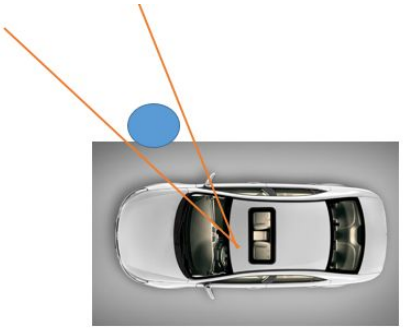
2.14 Test Results

Fig. 9: Screenshots of demo video

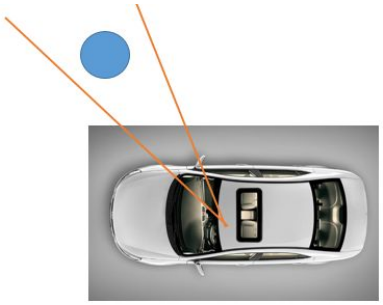
https://www.youtube.com/watch?v=n_R3KoJnTXc/

Fig. 9 are screenshots from the demo video showing that we have achieved our goal of making the A-pillar "see through".

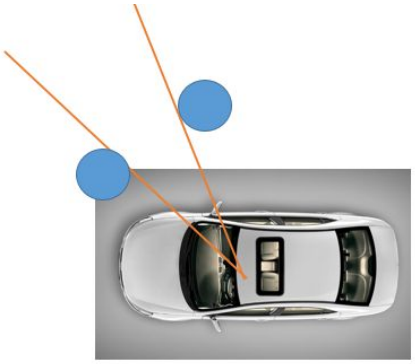
The specific visible distance and the angles are shown below:



Distance: 1.2m
Up boundary 1.275m
Bottom boundary 1.02m



Distance: 4.2m
Up boundary 1.5m
Bottom boundary 0.17m



Visual Angle
Left: 70 degrees
Right: 30 degrees

2.15 Standards

Since our work is mostly computer science/software engineering related, the standards we will need to adhere to are the ISO/IEC software engineering standards. Standards emphasize communication and shared understanding which not only important in a global development environment but also among small groups of people. Standards avoids repetition of past mistakes and involves checking standard compliance.

3.1 Other resource requirements

Our project is mostly coding based, so the required sources are just the tablet and the software we are using called Android Studio.

Hardware(tablet): Nexus 7

Software(development platform): Android Studio

3.2 Financial requirements

Our project does not have any financial requirements since we are attempting to solve this project at the lowest cost possible.

3.3 Challenges

The major challenge faced by all of us is the lack of knowledge about Java and Android Studio due to the fact that all six of us are Electrical Engineering students. Our knowledge in programming is fairly rudimentary so we had to self-learn everything not taught in class. It was interesting to us as we were learning things outside of our field, opening up a path for possible future endeavours.

4 Closure Materials

4.1 Conclusion

We have completed the primary goal of our project in accordance with the wishes of our client/adviser, which is to make the camera capture real time images and then crop the images obtained into a size that would fit the size of the A-pillar. This is because we need to show the real time sight of the area outside obstructed by the A-pillar in order to enhance the driver's' visual judgement outside the car. So the camera interface should have a real-time image transmission function.

We have managed to implement a function which can magnify the images on the tablet if needed. We have also managed to implement an auxiliary function which allows users to customize the block size according to the width and angel of the A-pillar in their vehicles. Lastly, we have also added some touch functions on the camera interface such as the ability to increase or decrease the height of the display just by pinching your fingers outwards or inwards and also the ability to cut the size of image in the screen.

4.2 References

Blind spot crashes increase Telegraph:
http://www.telegraph.co.uk/motoring/news/8779153/Blind-spot-crashes-increase.html

Jaguar Land Rover 360 virtual urban windscreen uses heads-up display:

https://www.designboom.com/technology/jaguar-land-rover-360-virtual-urban-windscreen-12-16-2014/

A-pillar accident statistics:

https://www.drivingtesttips.biz/driving-test-tutorials/a-pillar-blind-spots.html/

Appendix I – “Operation Manual”

Step 1:
Having a testing car with wide a-pillar

Step 2:
Affixed magnetic holder onto the windscreen to hold the tablet

Step 3:
Attach the table onto the magnetic holder horizontally

Step 4: Open this button on your Tablet to start using this application.

Step 5:

Set up the screen on the tablet. There are two different ways to set up the application:

(1). Use your finger to move the block shape to fit the pillar and use the zoom in/out buttons on the left bottom corner to adjust the picture:

(2). Use customize page to set up the screen:

Appendix II: Other Considerations.

1. Our App cannot work at the speed of the car over 10 MPH
2. In sunshine day, driver cannot see screen due to the reflection.
3. Cannot recognize the things that are very close to car.
4. Sometimes the tablet might drop off from the window.