Henry Xia
Professor Alshaykh
EC601 A1
September 18, 2022

Project 1 – Detecting 3D Objects

3D detecting uses cameras and sensors to perceive objects and represent them into a three-dimensional area. These devices are usually cameras, LIDAR (Light detection and sensors) and more. The most often used are LIDAR sensors that determines the time when the laser from the device is shot and returned, that way it can measure the distance from the device and the object, then including the camera, a 3D image will be represented on a screen.

The importance of this technology vital. Few years ago, 2D detection has been focused to perceived objects in two-dimensions, but in the real world, everything is in 3D. With this technology, we could capture object's size, position, orientation, color and more, which enable us to implement into more futuristic applications such as self-driving cars, robots that can perceive objects as humans do.

Since the improvement in technology, nowadays, phones can perform 3D detecting, one of the examples is the iPhone 13 Pro, it includes a LIDAR sensor so users can experience the AR environment on their hands. Apple has developed an Augmented Reality called ARKit [1][2], which allows developers to produce AR environments for iPads and iPhones.

Applications on this topic and be extended into different industries. One of them is the automobile industry, as today, a lot of the vehicles have some kind of object detection. One of the most iconic examples is Tesla, their cars have cameras and lidar sensors that detects vehicles, pedestrians, traffic signs and more, these allow the vehicle to drive by itself and sometimes better than humans can do. The architectural industry is also using 3D detection to improve their work, architects can use measurements from the 3D detection device and draw a layout of the room and start designing.

3D detection on cars have safety, mobility, economic and environmental benefits. According to CDC, 1.35 billion people die in car accidents each year [5], this number is reducing thanks to the technology on cars nowadays, that warns the driver to stop or slow down. With less

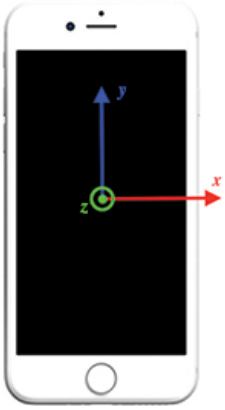
accidents, people will not have to spend that much money on their car for repairs. With the self-driving capability, it could reduce the air pollutants [6].

The main goal of this project is to improve the current 3D object detection and to implement it into different industries to help people with their work and be more efficient. Since everything we see in this world is 3D, with this technology we could recreate almost everything and have infinite applications to help people.

I would like to focus on improving the car industry using ARKit, such as sensing people on the road, prevent accident and overall enhance the driving experience of the user. Using ARKit to detect 3D object and warn the user or maneuver the vehicle to stop any accident on happening, to do that, a program to diagnose the distance between the object and the car will be needed, also the analysis and the prediction of the object's next move. The importance of developing a model using ARKit is to minimize fatality happening on the road.

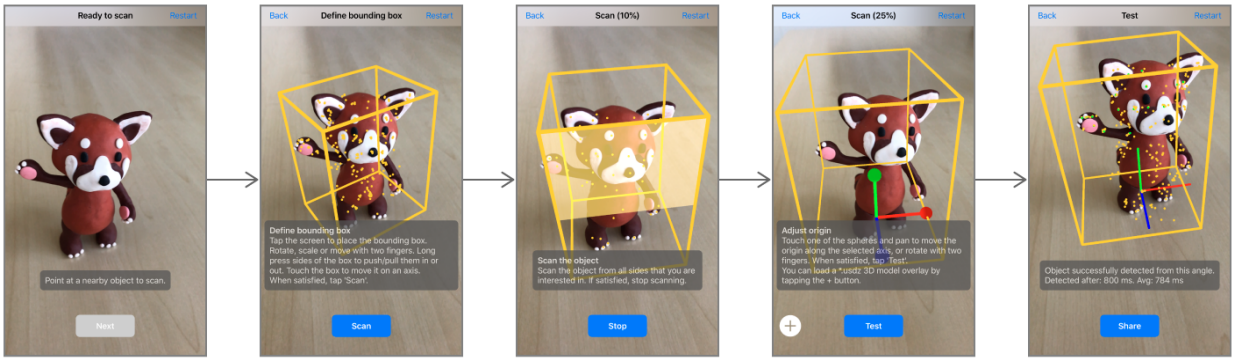
To start with the project, the program will be developed and will use image recognition to recognize a vehicle, pedestrian or any other object preventing a safe drive. This will then measure the distance between the vehicle itself and the object and using some quick math about the speed and the distance to calculate the time these will meet in order to warn the driver to stop the vehicle or decelerate.

Dilek and Erol on their experiment "Detecting position using ARKit" [4] has successfully measure the position of the iPhone on an open room using ARKit. With this, we could then measure the distance between an object and the iPhone position to calculate the space between the objects. One thing to keep in mind is that not all the roads are flat, there are incline surfaces such as mountains or cliffs which will make this calculation and reading more challenging. Therefore, an object detection argument is needed. Jayven Nhan has published a paper "Body Motion Capture" [3] that uses ARKit to capture a person's movement in real-time. Utilizing this into vehicles, can help us monitor the vehicle's movement. Along with Dilek and Erol's experiment, we could implement a software with object detection and crash prevention for automobiles.



Picture 1: Dilek and Erol's experiment using and iPhone 7 and ARKit

Apple also developed an object detection software [7]. It can scan real life objects and put them into a cube. This also measures the size of the object, including the color and shape. Apple has documented this project and has a downloadable demo for users to explore more into this field. Implementing this into the automobile industry will definitely help drivers to be more cautious. However, a downside of using an iPhone is that the camera and the LIDAR sensor has limitations. As one of the Apple's engineer has mentioned [8], the result will be affected if the area is too dark, if the user movement is too shaky (i.e. in a vehicle case, bumpy roads) or if it encounters mirrors or any surface that is reflecting (i.e. water or snow). These are the restrictions of the project.



Prepare to scan | Define bounding box | Scan | Adjust origin | Test and Export

Picture 2: Apple's development of "Scanning and Detecting 3D Objects"

As mentioned above, the main focus of this project is to reduce the mortality happening on the road. This will be applied worldwide as everywhere in the world has vehicles and car accidents can happen anytime when the driver is not focused. The mortality rate will decrease meaning that less people will be affected, therefore, more families will be happier.

Resources:

[1] https://developer.apple.com/augmented-reality/arkit/

[2] https://developer.apple.com/documentation/arkit

[3] https://link.springer.com/chapter/10.1007/978-1-4842-7836-9_21#Sec2

[4] https://iopscience.iop.org/article/10.1088/1361-6552/aaa0e6/meta

[5] https://www.cdc.gov/injury/features/global-road-safety/index.html#:~:text=Each%20year%2C%201.35%20million%20people,on%20roadways%20around%20the%20world.&text=Every%20day%2C%20almost%203%2C700%20people,bicycles%2C%20trucks%2C%20or%20pedestrians.

[6] https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety

[7]https://developer.apple.com/documentation/arkit/content_anchors/scanning_and_detecting_3d_objects

[8] https://developer.apple.com/videos/play/wwdc2022/10127/