1. **Greeting**

Good morning ladies and gentlemen, welcome to my graduation project defense. I am Vo Tran Trung Hieu, study at 1st generation of Advanced Automotive Engineering. In this project, I will build a self-driving car model applying image processing technique. The completion of this project is supported by professor Pham Minh Tuan and it is assessed by professor Pham Huu Tuyen.

1. **Introduction**

My presentation is divided into four main sections: introduction to the project, design the car model, design the algorithm and in the last part, I will run the model and make some conclusions.

**Reason for choosing this topic:**

Let’s start with the reason why I choose this topic. You know that over the past decade, the pursuit of self-driving cars has excited society imagination about a world of riding a car without having to know how drive it. As a student in faculty of automotive engineering, I choose to build an autonomous car model because it is a way for me to actually apply what I have learnt in the university and an opportunity to take the first steps in the field of autonomous driving.

**Project summary:**

The main objective of this project is to build a car model that can automatically run on the pre-defined road. I will use bright paper as the road and placing it on the dark ground.

I don’t implement object detection technology and precise control method such as PID. I want to save them for future development of this project.

1. **Main contents**

**Physical design:**

I want to start with number 8 first, it’s just a plastic plate but it carries the weight so for short, I will call it chassis. Four wheels, number 5, are connected with four motors, number 11, through shafts and they are attached the chassis by jigs, screws and bolts, number 9 and 10.

Next, we have the center of information number 1, the computer. It receives images from the camera number 12, try to detect the lane curve from the images and send instructions to motor controller, number 4, to control the motors.

In term of power supply, I use a 12V battery which can be used directly to power the motor controller but because the computer uses only 5V, I added a voltage regulator to convert 12V to 5V for computer power supply.

The camera needs to be high on the ground so as to take quality images so I design and 3D print the camera case and the camera pillar, number 13.

**Computer vision pipeline:**

It is a series of steps that most computer vision applications go through and I will apply this pipeline to build my own lane detection algorithm. So, after the image is taken, it goes through a process of cleaning: converting to greyscale, resizing and correcting lightness. Next steps are selecting areas of interest by thresholding and warping, feature extraction by finding curve, making prediction by optimizing curve and taking action by controlling the motors. I want to elaborate on these steps in a few seconds.

**Image thresholding:**

To isolate the road with other objects, I will create a threshold for the brightness value. Pixels that have lower brightness value will be turn into black, the other pixels are kept unchanged. The result is shown in these images.

**Image warping:**

Image warping is a method of mapping the location of each pixel in the original image with a function to create a new image. I use this method to change the perspective of the received image. After warping, the output image looks as if we look at the road from the top as you can see in the right figure.

**Finding curve:** (Free to say)

**Optimizing curve:**

You know that the lane curve values at a period of time are closely related. Let’s say the detected lane curve value is 30 then the next value cannot be too far from this value, it should be somewhere around 30. So to express this relation, I use queue. In this example, at time T, we have values of 1, 2, 3 and the average is 2. At time T + 1, the algorithm detects a new curve value 4. Instead of directly use this value to control the motor, I put it in the back, pop the value at the front and output the average, which is now 3. This allows smooth motion and avoid any dramatic movements of the car model.

**Controlling the motors:**

Two right motors are connected in parallel, so they have the same speed. Same with two left motors. The car model is kept running at a steady speed. When it detects lane curve, let’s say right lane curve with a value of 50, then it will keep the right motors at the same speed but increase the speed of the left motors. The added speed is calculated in the formula shown in the slide.

**Conclusions:** (Free to say)

1. **Conclusion**

This is the end of my presentation. With limited time and expertise, my project certainly has many shortcomings that I cannot cover. I am willing to receive any advices from all professors in this council so that I could be able to do better in the future. Thanks for listening.