Basic Product Research for Simulation Product for self-driving Industry

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1 Product Goals – Why Simulation?

1.1 Provide more diverse data for training models

Self-driving algorithm, from computer vision to behavior decisions, require ***a large amount of diverse data***, which is difficult to capture in the real world.

It's hard to capture a large amount of data with a specific requirement. For example, if we want to test an algorithm for recognition which requires buses, pedestrians, and several different types of cars appear in the same frame, we need to select the data manually. It's not efficient. And usually, we can't get enough data for training and testing by this way.

On the other hand, some testing data should include many abnormal scenarios, which is hard to get from the real world but essential for the validation of safety of self-driving cars. It includes:

- Abnormal vehicle behavior
- Abnormal pedestrian behavior
- Extreme weather condition, such as fog rain and snow
- Other dangerous conditions

From the above two points of view, simulation is very helpful for generating required data.

1.2 Test and validate in a safe virtual environment

Unlike software, safety is the first concern for robot products. It's dangerous to directly test the self-driving car on the road without any validation in simulation. We need simulation to help us test the integration of the following software:

- Control algorithm
- Path planning algorithm
- Sensing algorithm
- Behavior decision algorithm
- Other software and algorithm

Once all the code works well in the simulation, can the test be brought to real roads. Simulation is helpful for software and algorithm integration.

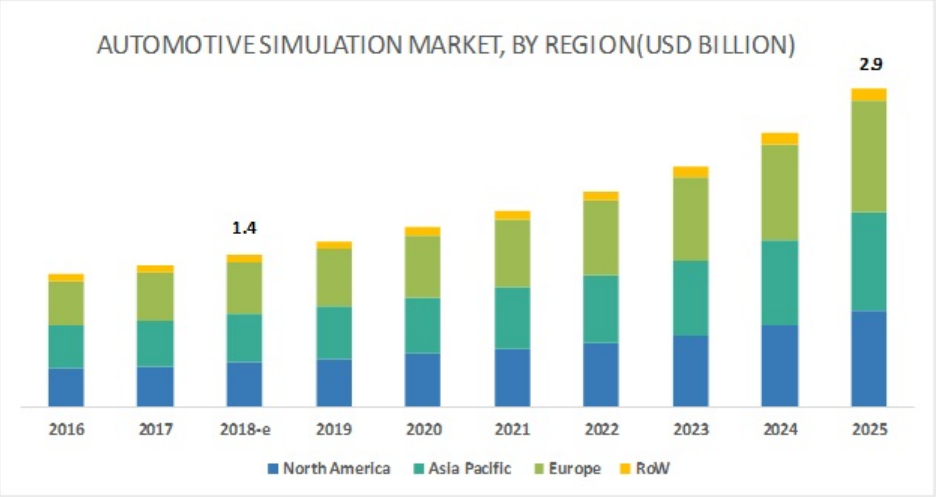
2 Market Estimation - Who's the customers?

2.1 The target customer includes the following:

- Self-driving companies
- Automotive companies
- Computer vision focused AI companies

Usually, big companies develop their own engines. As we all know, Waymo has its own simulation platform. But medium and small companies can't afford the demanding development resource. These companies, along with those traditional automobile manufactures who are stepping into the AV industry may the main customer of the simulation platform.

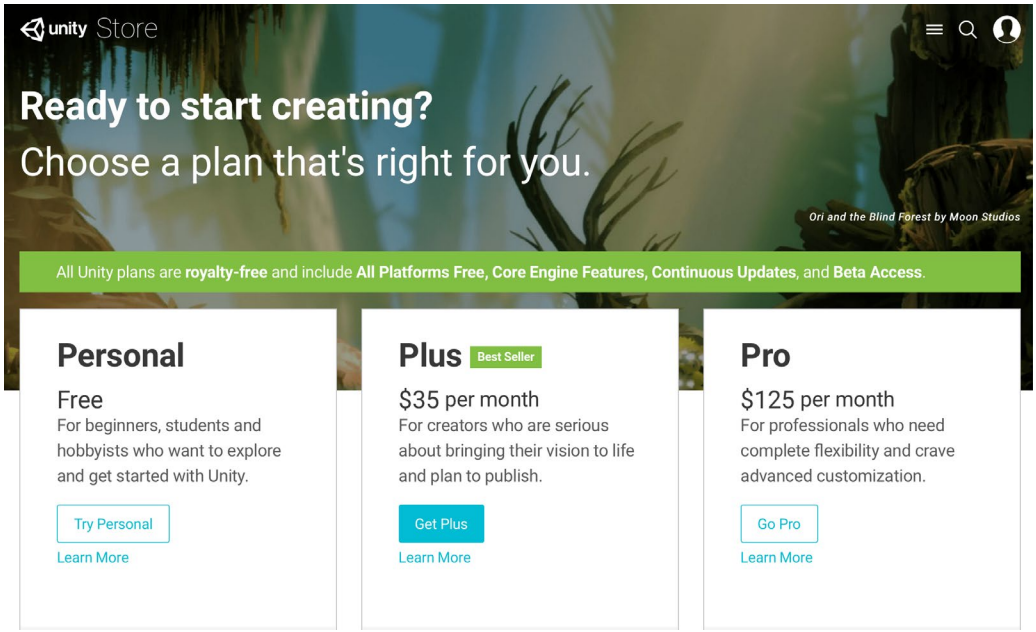
2.2 The market scale of automotive simulation estimation is as following:



The testing application segment will grow at the fastest rate as simulation software are widely used in the automotive industry at this stage. Simulation software helps in testing the designs and validating the findings with desired results. Moreover, the simulation software significantly reduces the efforts of OEMs during lab testing and on-road testing apart from their go-to-market time for new products and technologies. (reported by MarketAndMarket, Report code: AT 675)

3 Business Model – How to make simulation product profit?

Simulation is necessary for every self-driving company and related AI company. However, develop a full-functional simulation platform can be resource consuming. That's the market opportunity for simulation platform. For the business model of the simulation platform. We can look up to some game engine as a reference



Similarly, the pricing of the simulation platform can be divided as:

- Free : Non-commercial use, educational use.
- Middle price : Limited function and freedom of simulation.
- Top price : Full function and freedom of simulation

*The tiered price is mainly designed for business customer other than personal user

4 Product Metrics - How to evaluate a simulation product?

When evaluate the value of the simulation product, the following content should be considered:

- How many valuable data the software create for the business customer?
- To what percentage the product is used before on-road test?
- How many development resources the product saved for the business customer?

When evaluate the usability of simulation product, the following content should be considered:

- Compatibility with various automobiles (Control Model)
- Compatibility with various sensor (Sensing algorithm)
- Easy to edit and create data for training
- API is easy to read and use
- Different engineers should be able to cooperate in the platform

5 Technical Limitation – What's the constrains of Simulation?

5.1 Never be the same as real image

Though the rendering technology is advanced now, we still can't create exactly the same image as the camera. There is no guarantee that the algorithm (especially recognition and tracking algorithm) work for the simulation image will also work for the real image

Probably, it's wiser at first to get enough real image test data. Then test the model trained with "fake" image using "real" data to ensure safety

5.2 Difficult to learn "abnormal" behaviors

Though the simulation platform is used to simulate some abnormal vehicle and human behaviors. It's still difficult to know what will be all the "abnormal behaviors" and test them.