UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION

JUNIOR ACADEMY OF SCIENCES OF UKRAINE UNDER THE AUSPICES OF UNESCO

OLEKSANDR YUDAKOV
Simulation of autonomous vehicle driving systems

Ukraine

ABSTRACT

Nowadays technological advancements spread with increasing speed to all spheres of human life, and the best example of it is artificial intelligence. Over the last decade, this technology has become one of the most important in the transport field, and huge companies started to produce their own autonomous models of the market. However, along with the benefits of using these technologies, there are a number of threats and dangers for the lives of passengers and pedestrians when testing such vehicles. An accurate driving simulation is a best way to ensure the safety and economy of the development of intelligent vehicles.

RELEVANCE

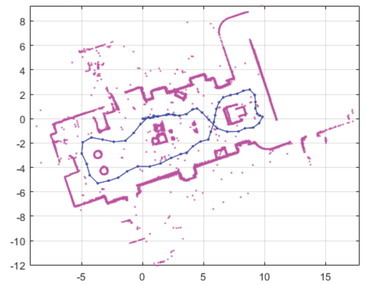
The relevance of the project is to cut expences of testing and training of autonomous transport, as well as providing the opportunity to test autonomous vehicles in any conditions, and reduce the risk of testing such vehicles in the real world.

OBJECTIVES

- to investigate analog programs;
- to develop a flexible basis of simulation with the possibility of detailed adjustment of its properties;
- to research the working principle of key electronic sensors;
- to achieve high accuracy of implementation of sensor algorithms in the Unity environment;
- to reach the maximum performance of algorithms;
- to provide a possibility of creating an autonomous operation of the vehicle besed on the received sensor data.

SOFTWARE THEORY

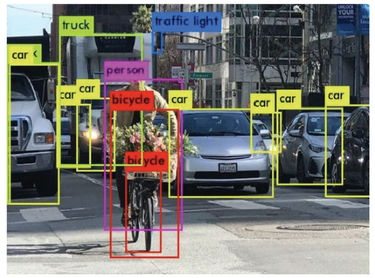
Figure 1. *SLAM example*



Note. From *Image Detection, Recognition, And Classification With Machine Learning* by MathWorks, 2018

SLAM is a method for simultaneous localisation and mapping of vehicle's position, which solves the problem of visualising a map of unknown environment with on-time placing a vehicle on it.

Figure 2. *Object detection example*

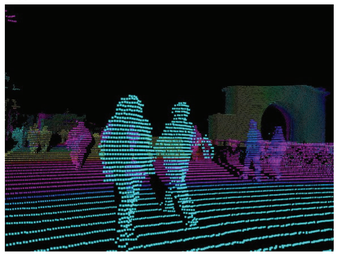


Note. From *Image Detection, Recognition, And Classification With Machine Learning* by Azati Team, 2020

Object detection is a technology that is connected with computer vision and image processing, which tries to guess the object on image or video.

HARDWARE THEORY

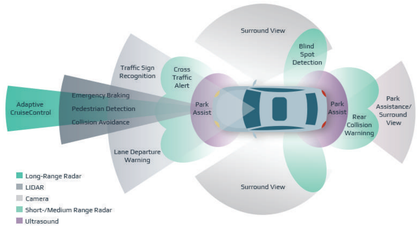
Figure 3. *LiDAR example dataset*



Note. From *Different Types of LiDAR Tech and How They Support Autonomous Driving* by YiningChen, 2019

LiDAR (Light Detection And Ranging) is a device for receiving and processing the data about distant objects with the usage of laser beams.

Figure 4. *Autonomous vehicle's vision*



Note. From *How Sensor Fusion for Autonomous Cars Helps Avoid Deaths on the Road*, 2018

Up to 50% of autonomous transport vision is taken by multidirectional cameras than can support a surround view for a vehicle.

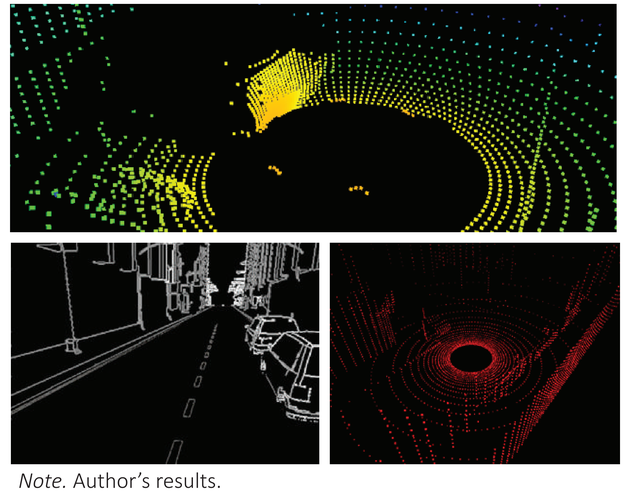
MAIN TOOLS

Figure 5. *Software logos(left to right: Unity, OpenCV, VisualStudio)*

Unity is a multi-platform tool for developing two- and three-dimensional applications. The Unity editor includes a number of tools that speed up the work and increase the performance of various processes.
OpenCV is a library of functions and algorithms for computer vision and open source image processing.
Microsoft Visual Studio - IDE from Microsoft, used in the development of computer programs and compilation of DLL-libraries.

RESULT

Figure 6. *Results of the research*



Note. Author's results.

The tool simulates the operation of LiDAR with a refresh rate of 0.1 s at the specified angles and step and returns the coordinates of each tracked point. The performance of all sensors is perfected and most of them work with a large number of updates. On average, you can get from 3,600 to 64,800 points per update of LiDAR. The tool is designed to avoid frame loss. The simulation speed can be changed for more detailed analysis.