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AUTONOMOUS CAR BASED ON SLAM WITH NEURAL NETWORK FOR HOSTAGES DETECTING

Abstract: On the introduced scientific article, was considered SLAM method which will combined with convolutional neural network for hostage detecting. We also take into account the optimal solution with minimal costs. Our solutions are directly applicable in different cases to detect humans and build the map of area.

The purpose of this project was to create a solution that will allow robots to navigate autonomously in an unknown place, to realize their location in it and to create map of close space.

This decision can be applied in different areas. Within the framework of our project, the found solution will be used to detect hostages in a confined space and fix their location on map in real-time.

To achieve our objective was selected SLAM method on which further will based neural network for hostages detecting.

Tesla, Google and other companies are already using SLAM in various tasks. For example, for orientation in the space of unmanned vehicles, their approaches use a set of different sensors due to which the car determines the obstacle and itself regarding these obstacles.

We found two ways to implement SLAM: with the help of a Lidar, or Microsoft Kinect 360. Based on the goal of our project to achieve the lowest cost of realization – we stopped using Kinect. Because the Lidar costed over 400$ while Kinect cost only 40$, but Kinect has also a minus in viewing angle, it has only 60° whereas Lidar has 360°.

The principle of SLAM is as follows. Obtaining a number of observations o_t for a time with a data acquisition step t, we calculate the location estimates x_t and the environment map m_t. These values are probabilistic and the objective of the problem is to calculate: (1.1) Applying Bayesian rule, we get the basis for sequential position update taking into account the map and transition function (1.2), [4]

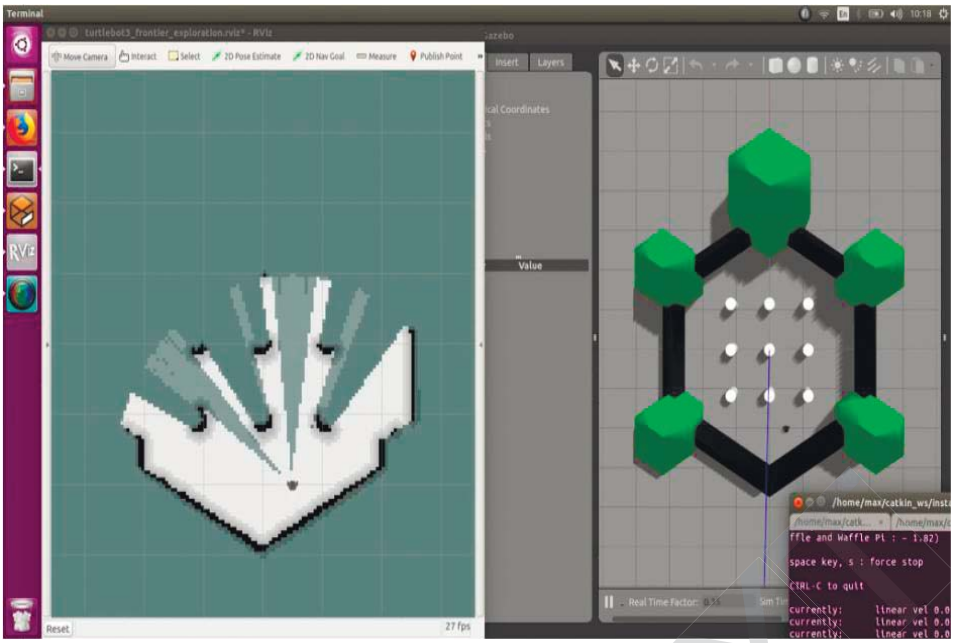
$$P(m_t, x_t | o_{1:t}) \quad (1.1)$$

$$P(x_t | x_{t-1}) \quad (1.2)$$

$$P(m_t, x_t | o_{1:t}) = \sum_{mt-1} P(o_t | x_t, m_t) \sum_{mt-1} P(x_t | x_{t-1}) * * P(x_{t-1} | m_t, o_{1:t-1}) / Z \quad (1.3)$$

The complexity of the process for determining the current location and the construction of the map is due to the low precision of the instruments involved in calculating the current location. The method of Simultaneous Localization and Mapping (SLAM) is a concept that connects two independent processes into a continuous series of consecutive calculations. In this case, the results of one process are involved in the calculation of another process. [4]

As an algorithm for reconnaissance and mapping, we used Frontier based exploration. This method is based on the fact that the robot is on the boundary between open and unexplored space. When the robot crosses the border, he sees an unexplored area in front of him and adds it to the map. As a result, the known territory expands, and the boundary of the unidentified area is moved away. Moving to the borders, the robot expands its knowledge of the world (img. 1). This strategy is called frontier exploration. Any path that partially lies in an unknown territory will cross the border. When a robot moves to this boundary, it will include more space spanning the displayed territory. If the robot does not include the entire path at a time, the new boundary will always exist further along the way, separating known and unknown segments and providing a new direction for exploration. Thus, a robot using cross-border intelligence ultimately examines all available space in the world.



Img 1. Frontier based exploration

Conclusion. At this development stage we have realized methodology of SLAM (Simultaneous Localization and Mapping) using Kinect with building and saving the map in real time. We reached such results: building map and recognition speed 3m/s in unknown room. And the mapping accuracy 95%. At the following development stage, will be learned the convolution neural network. After that, we plan to combine SLAM and neural network for recognition of hostages and recording their location in real time in the closed space.

LIST OF USED SOURCES

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