LOCOMOTION STRATEGY SELECTION FOR A LEGGED WHEELED HYBRID QUADRUPED USING DEPTH IMAGES

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Introduction. Three fundamental locomotion configurations recognized commonly are *legged, wheeled, and articulated mechanisms* using which a mobile robot can navigate terrains. Hybrid configurations enable execution of different locomotion types separately and in combinations. Such advantage usually implies complexity and necessity in a robust supervisory controller capable of terrain recognition and locomotion strategy selection. We developed the Nazarbayev University (NU) Hybrid Quadruped (Fig. 1) - mobile robot with four legs and wheels. Project's major novelty is the implementation of the *supervisory controller* which selects a locomotion mode associated with particular terrain types based on its *terrain recognizer* input data.

Materials and Methods. Robot platform was designed in Solidworks and was built using 3D printing and machining. Novel compact RGB-Depth camera was used for implementation of terrain recognizer. The robot was actuated using Dynamixel MX28 and MX106 motors, controlled by CM700 motor controller.

Results and Discussion. Different combinations of classifier and dimensionality reduction algorithms were used for the problem of terrain recognition, finally we achieved the accuracy of 97% with the use of Support Vector Machines classifier and majority voting filtering algorithm. Series of experiments were carried out in NU atrium containing five class terrain recognition problem *(Level Ground, Non-traversable, Stair Down, Stair Up, Uneven* terrain types).

Conclusions. Final experiment consisted of a route across five terrain types and was successfully accomplished. Project showed that depth images can be successfully used for supervisory controller implementation of a hybrid quadruped.

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Figure 1. NU Hybrid Quadruped in legged (left) and wheeled (right) modes.