Development and implementation of autonomous features of a Hexapod robot

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***Abstract*—Using a six-legged-robot, called Hexapod, as a development platform this thesis aimed to have a fully autonomic robot capable of navigating and rendering previously unknown terrain in three dimensions. During the project both hardware and software upgrades have been made such as implementing another computer on the robot and enabling wireless communication via Wi-Fi. Experiments were performed on a test track that challenged both the speed of the algorithms and desired accuracy of the rendered map. The results was satisfying, the robot is well capable of traversing an unknown environment and describe the environment with an accurate obstacle map.**

I. Introduction

Autonomous robots are today a large field of research and rightfully so for many reasons. Today many places where humans safely cannot travel such as hazardous environments, collapsed buildings, interplanetary travels etc, however to still explore such environments robots can be of great use and even more so if the robots could be partly or completely autonomous. If the robot is to explore unsafe environments it would in many cases be useful to enable human machine interface and have a partly autonomous robot. One way of doing so is to let the robot send images of the surroundings and receive directions on where to explore next. This article summarizes the work done in a master thesis performed at the department of Automatic Control at Lund university.

A. Previous work

The theses was performed at Combine Control Systems AB which has used the Hexapod as a development platform for two previous master thesis projects. The first project designed the robot and provided necessary locomotive movements for the robot to walk around smoothly [1]. The scope for the second thesis was to enable autonomic navigation capabilities for the hexapod robot. To enable such capabilities a RGB-D camera, which determines the distance to objects facing the robot, was implemented to enable virtual feedback. Navigational features worked really well in simulations however not as much in real world. This is due to the lack of computational power available on the hexapod [2].

II. Method

Computational power restricted previous students in how they could use the camera, consequently this thesis investigated several solutions to the problem. After careful consideration it was found that the most suiting solution would be to implement another computer on the hexapod and by compute the most demanding functions on an external PC. To exchange information between the peers a wireless solution was found using Wi-Fi. By dividing the workload between different computers several processes can be run simultaneously which decreases the execution time for the system. Sending images from the robot to the PC, with large amount of processing power, a virtual environment could be created. To prove the concept one captured image converted to 3D is presented in figure 1.

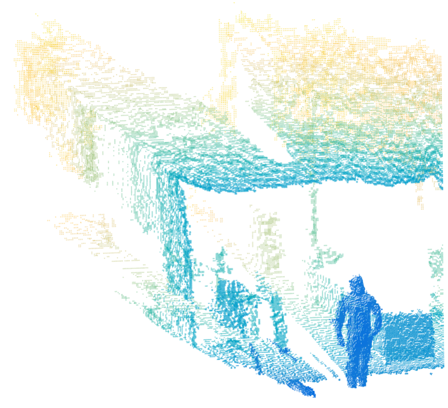

Fig. 1. Captured image of the obstacles facing the robot

To keep track of the position of the robot in the virtual map locomotive motions determines how far in different directions the robot has traversed, providing a position. Both the virtual map and the tracked position are visualized in figure 2. Together with navigation algorithms developed by previous students each feature was validated on the real robot by testing and a working prototype was created [3].

III. Conclusion

This thesis enabled several new features on the hexapod. Wireless communication was successfully implemented and enabled the robot to transmit images of the surrounding environment, and the user to explore an virtual reality based on these images. If obstacles appear in front of the robot it will avoid the obstacle to reach its goal. The project achieved most of the goals that was set out in the beginning with good results. Some issues with the robot not keeping the body in

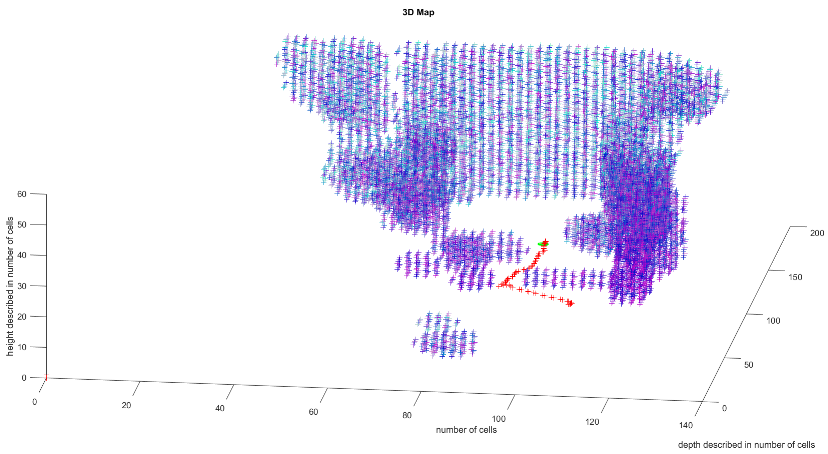

Fig. 2. Snapshot of the virtual environment created by the walk illustrated with red markings

balance while walking caused quite a lot of problems, however they are being solved by another thesis that worked in parallel with this thesis [4]. There are always room for improvements and the robot will surely be used as a platform for many future thesis-projects to come.

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