

Development of hardware system and motion planning analysis for a Quadruped mobile robot

Dzmitry Tsetserekou

Skoltech supervisor

Student

Egorov Anton

Program: Space and Engineering Systems

Ivan Kalinov, Grigoriy Yashin

Company supervisors

Background

Robots with four legs from decennium have gained considerable attention in various research and development sectors. The robots like Quadruped can fit through and locomote within tightly packed volumes that may be encountered in a collapsed building or a pile of rubble. They are used in search and rescue operations, space applications (Mars exploration), industries for lifting purpose containing solenoids). Robots are able to rove, sense and respond in a given environment and are able to perform assignments and explore without human intervention.

Objectives

1. Prepare reliable and stable hardware electronics for legs and flying systems of the Quadruped mobile robot: Develop: A printed circuit board (PCB) for connecting Arduino Due microcontroller and peripherals: dynamixels, encoders, and IMU sensors , Power supply system for the whole legged robot
2. Motion planning analysis of the drone with four legs
3. Real time simulation on a quadruped mobile robot

Process

During the project, the drone engineering process was followed. Parallel designs of electrical component was made in Altium Designer software product respectively. Fig.1 illustrates the final version of the mechanical and electrical design of the quadruped mobile robot. At the step of manufacturing Skoltech equipment were used that were possible because of the internal collaboration between Space center and Telerem company.



Fig.1 Quadruped mobile robot with: (a) Flying system, (b) four-legged drone whole body

Results

I implemented reliable hardware electronics of the drone with arm and with four legs. The project includes making a power supply for this robot. Moreover, I developed a printed circuit board (PCB) (fig.3) for connecting Arduino Due microcontroller and peripherals: dynamixels, encoders, and IMU sensors. Furthermore, motion planning analysis for a Quadruped mobile robot were conducted. This part includes configure and calibrating the robot with new mechanics design and electronics using MATLAB tool and further made changes to the environment for programming Arduino. The final step includes real time simulation on a quadruped mobile robot (fig.2). For the robot locomotion coordinates selection, I carried out four stages of testing. One of them, has to define the stable positioning of the robot on three legs. To achieve this, I tested different combinations of the distance between side legs and distances between point A and supporting leg during the robot tilting on this leg from the initial position.

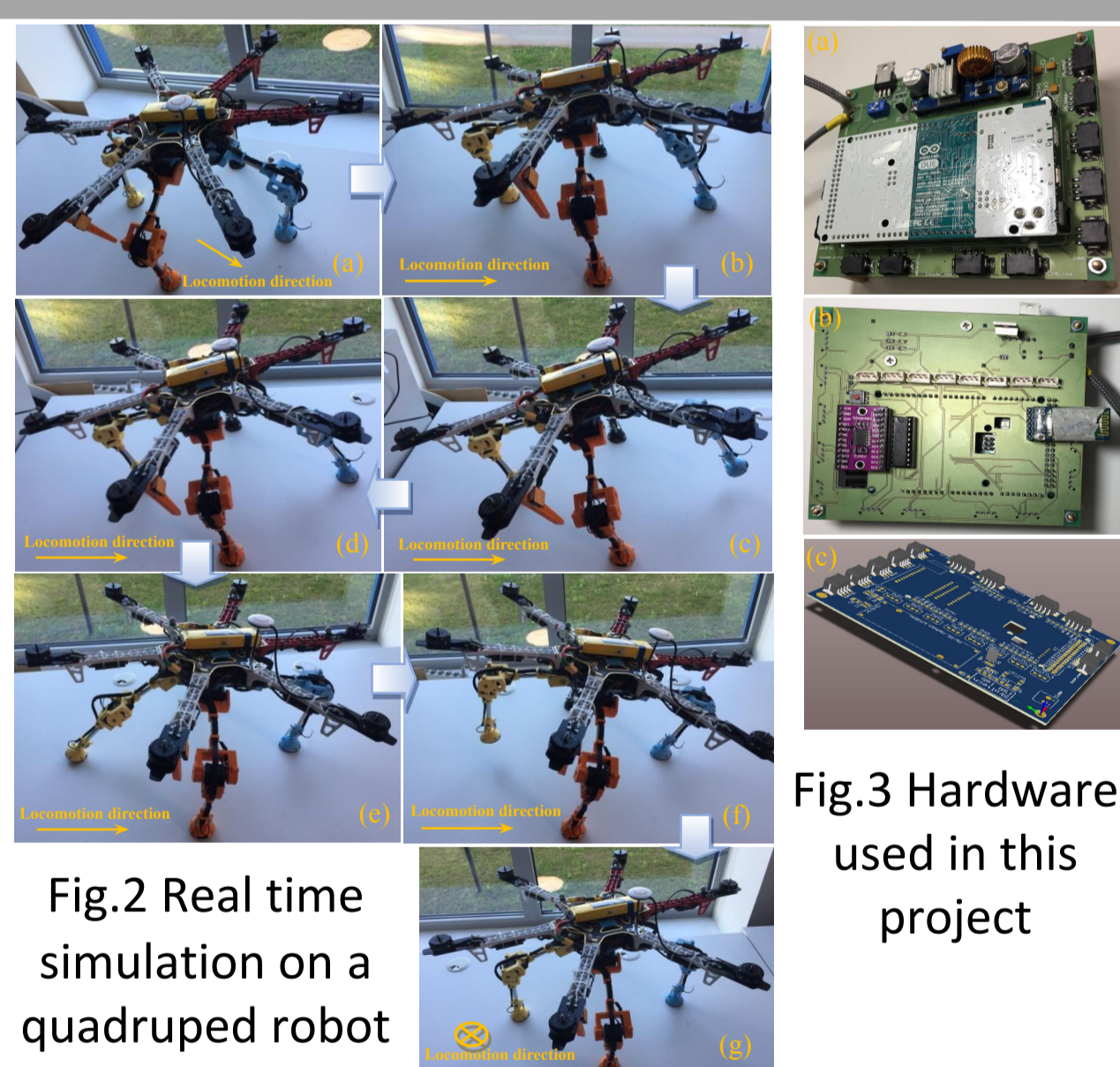


Fig.3 Hardware used in this project

Conclusions

The investigation of hardware system and motion planning analysis for a quadruped mobile robot was conducted. The overall work was divided into several steps. First, I carried out a locomotion robotics search. I have fully prepared drone with arm and another one with 4 legs and reliable hardware; I also designed perfectly configured robot motion algorithm

These results will not allow me to stay on issues of problems with electronics. Based on this I will be able to work with no problems on locomotion algorithm for climbing down from uneven terrain and algorithm of obstacle avoidance based on the embedded optical torque sensors at knee joint of the legs.