Vision System for a 6-legged Robot

(Snake Monster)

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INTRODUCTION

Figure 1. (a): Image showing various scenarios in which search and rescue operations are performed . Some with human assistance and some with mobile robots.

- Legged robots can be used for search operations in regions which are inaccessible for humans.

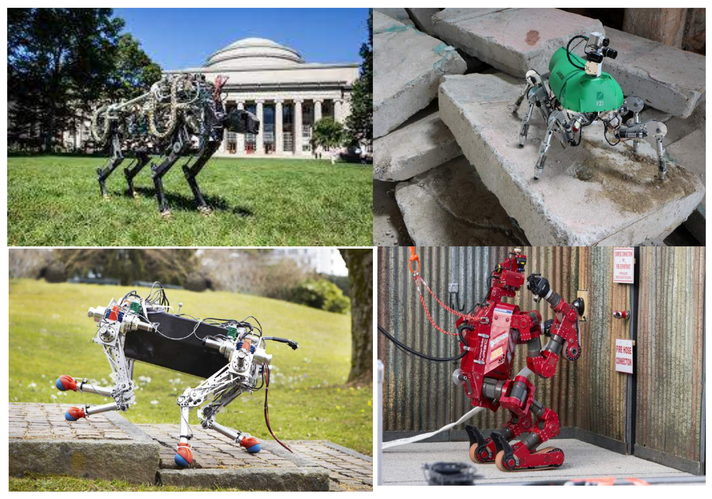

Figure 1. (b): Different legged robots, that have been developed to efficiently navigate in challenging terrains for search and rescue operations .

MOTIVATION

- The Snake Monster navigates either using Central Pattern Generator Or Compliance.
- The modules in the robot are capable of providing torque and Inertial feedback.
- Environments having varying heights (Stairs) are difficult to perceive just by using the torque feedback (Compliance).

Figure 2. (a):
Snake Monster
without vision system.

Figure 2. (b):
Modules present in the
Snake Monster.

APPROACH

- Using an Integrated system consisting Monocular camera, 2 IR cameras, and a Fish-Eye camera, we can perceive the environment.
- On board processor dedicated for the vision sensors
- This reduces the computational effort that the robot needs to put-in, while perceiving the environment.
- The snake monster communicates with this processor using Wi-fi .

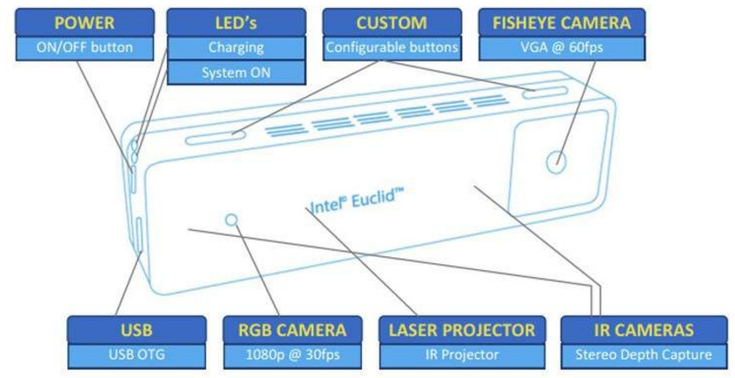

Fig. 3. (a).
Intel Euclid
development kit

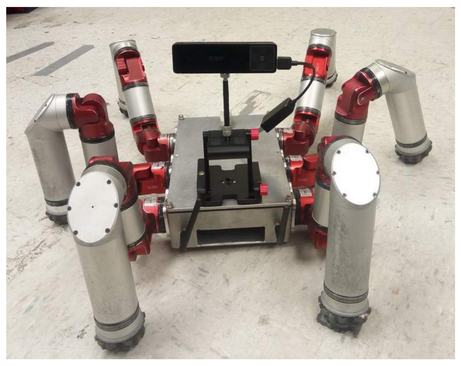

Fig. 3. (b). The Snake Monster along with it's Vision system mounted on it .

RESULTS

SLAM (Simultaneous Localization And Mapping)

- Point clouds of the environment generated using Large Scale Direct Monocular SLAM algorithm[1].

Figure 4. (a):
RGB image of the terrain

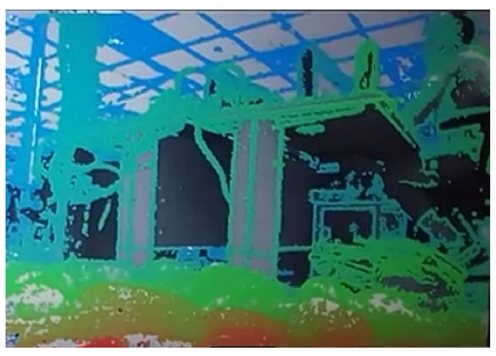

Figure 4. (b):
Disparity map of the terrain

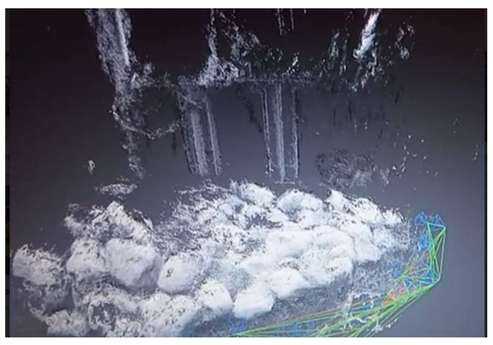

Figure 4. (c): Grey scale point-cloud of the terrain.

Person Tracking

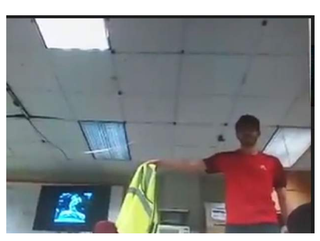

Figure 5. (a): Person without the rescue jacket, is not being tracked by the robot.

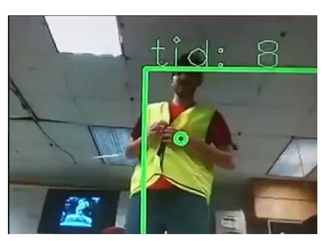

Figure 5. (b): Person wearing the rescue jacket is tracked by the robot

FUTURE WORK

- Height estimation, for stair climbing, using height maps.

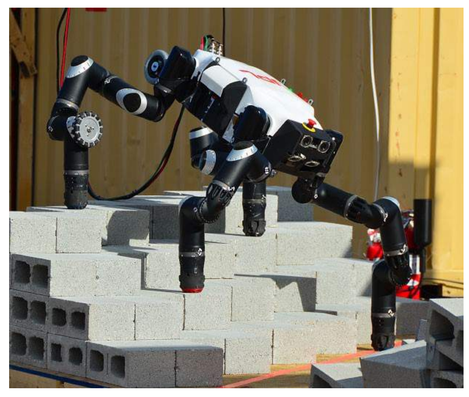

Fig. 6. (a). A Legged robot performing stair climbing.

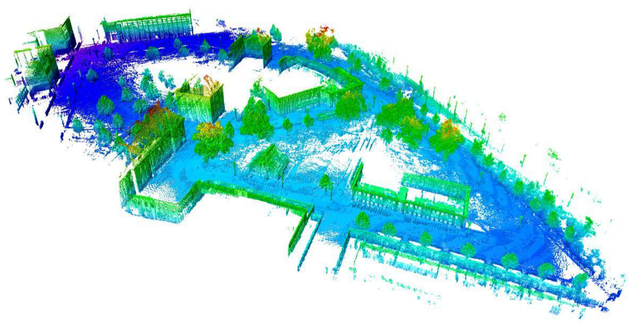

Fig. 6. (b). A complete 3D Occupancy grid of an unknown environment.

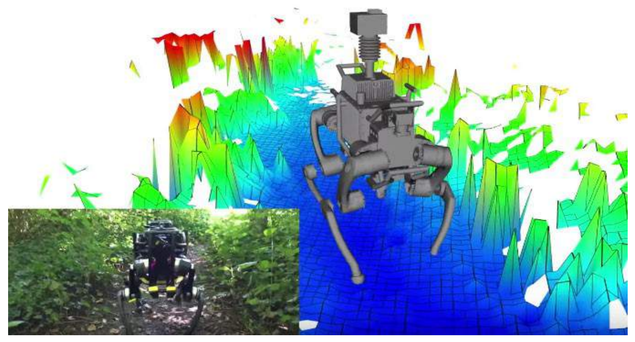

Fig. 6. (c). A Legged robot navigating in unknown environment[2]

REFERENCES

[1] Engel J., Schps T., Cremers D. (2014) LSDSLAM: Large-Scale Direct Monocular SLAM. In:Fleet D., Pajdla T., Schiele B., Tuytelaars T. (eds) Computer Vision ECCV 2014. ECCV 2014.

[2] M. Hutter et al., "ANYmal - a highly mobile and dynamic quadrupedal robot," 2016 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Daejeon, 2016, pp. 38-44.

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