Template for thesis project proposals

Project Title	Dynamic Objects Detection and Tracking in Warehouses, Using 3D Sensors.
Author(s)	*Student(s) name(s)*
Keywords	3D Sensor, Point Cloud, Obstacle Detection, Obstacle Tracking, Obstacle Avoidance.
Project description	; Concise Description : This project [as a subset of AIMS project], targets the automation of lift trucks in warehouse environments. Operating automatic guided vehicles in this particular environment is challenging due to the high expected throughput and consequently high traffic. Lift trucks are heavy vehicles operating with relatively high speed in an environment where neither the trucks, nor the humans are well protected as a regular urban traffic. This calls for a extra security measure and cautious decisions. Collision avoidance is an essential skill for mobile robots to guarantee a safe operation in a workspace shared with humans. This project focuses on detection and tracking of dynamic objects in order to avoid collision. ; Objective : To reliably detect, segment, and track dynamic objects (eg. humans and lift trucks) from a 3D point cloud, acquired by the means of a 3D sensor mounted on a mobile robot, in a highly structured environment (warehouse). ; Research Questions : What is the optimal sensor configuration to minimize the blind spots, data losses due to sensor deficiency, and consequently improving the detection accuracy? : How to exploit the assumption of structured environment to improve tracking? : How the background knowledge of agent types (humans, manually driven trucks and auto-guided trucks) and their behaviour models could improve the tracking? ; Preliminary Plan * startup: literature review and data acquisition * point cloud manipulation, object segmentation, scene understanding. * filtering and tracking. * [bonus] object recognition ;Deliverable : An implementation and demonstration of the developed method for detection and tracking of the moving obstacle over the real data acquired in a real warehouse. ;Bonus : conference publication (ETFA, ECMR, TAROS)

References	Petrovskaya, Anna, and Sebastian Thrun. "Model based vehicle detection and tracking for autonomous urban driving." Autonomous Robots 26.2-3 (2009): 123-139. Wojke, N.; Haselich, M., "Moving vehicle detection and tracking in unstructured environments," Robotics and Automation (ICRA), 2012 IEEE International Conference on , vol., no., pp.3082,3087, 14-18 May 2012. Moras, J.; Cherfaoui, V.; Bonnifait, P., "A lidar perception scheme for intelligent vehicle navigation," Control Automation Robotics & Vision (ICARCV), 2010 11th International Conference on , vol., no., pp.1809,1814, 7-10 Dec. 2010 Golovinskiy, Aleksey, Vladimir G. Kim, and Thomas Funkhouser. "Shape-based recognition of 3D point clouds in urban environments." Computer Vision, 2009 IEEE 12th International Conference on. IEEE, 2009. Granstrom, K.; Lundquist, C.; Gustafsson, F.; Orguner, U., "Random Set Methods: Estimation of Multiple Extended Objects," Robotics & Automation Magazine, IEEE , vol.21, no.2, pp.73,82, June 2014 Data Association and Tracking a survey RoboEarth. Rusu, Radu Bogdan, and Steve Cousins. "3d is here: Point cloud library (pcl)." Robotics and Automation (ICRA), 2011 IEEE International Conference on. IEEE, 2011. Brostow, Gabriel J., et al. "Segmentation and recognition using structure from motion point clouds." Computer VisionECCV 2008. Springer Berlin Heidelberg, 2008. 44-57. Drost, Bertram, et al. "Model globally, match locally: Efficient and robust 3D object recognition." Computer Vision and Pattern Recognition (CVPR), 2010 IEEE Conference on. IEEE, 2010. Biasotti, S. ; Falcidieno, B. ; Giorgi, D. ; Spagnuolo, M. Mathematical Tools for Shape Analysis and Description, 2014, Publisher :Morgan & Claypool, Edition:1, ISBN:1627053646 Borcs, Attila, et al. "A Model-based Approach for Fast Vehicle Detection in Continuously Streamed Urban LIDAR Point Clouds." (2014).
Prerequisites	Familiarity with filtering techniques (eg. EKF) for mobile robots localization, Image analysis, programming skills (preferably C++ or Python).
Time frame	October 2017 to June 2018, with possible extension to September 2018
Supervisor(s)	Bjorn Astrand, Naveed Muhammad,
Programme	Mobile and Autonomous Systems
Examiner	*Name of project Examiner*
Signatures	*Student(s):* *Supervisor(s):* *Examiner:*