**Product Specifications**

|  |
| --- |
| **Δ**  **Modest Triangle** |

The robot which has the ability to navigate with limited sensor is Modest Triangle. This robot has the ability to map and localize in a warehouse environment by utilizing existing SLAM techniques. This robot is being designed specifically for driving forklifts in warehouse. This robot can detect and avoid obstacles. It moves by using multiple local points.

|  |  |
| --- | --- |
| Intel NUC | The NUC is a mini desktop PC, used for mobile robots which has single-board computing system   * Processor: Dual-core Intel Core i75557U CPU with multi-threading * Speed: 3.10GHz * RAM: 16 GB * Power requirement: low (28 W) * Size: small (10 x 10 cm) |
| Sensors | * LIDAR * Real-Sense * QR code Scanner |
| Essentials | * Product Collection[Intel® RealSense™ Cameras](https://ark.intel.com/products/series/85364/Intel-RealSense-Cameras) * Code Name[Products formerly Double Springs](https://ark.intel.com/products/codename/81563/Double-Springs) * StatusDiscontinued * Launch DateQ3'15 * Depth TechnologyActive Stereo |
| Operational Specifications | * Operating Range (Min-Max)0.5m - 3.5m * Depth Resolution and FPS480 x 360 @ 60fps * Depth Field of ViewH: 59, V: 46, D: 70 |
| Input | * Pre mapped data of the warehouse * Giving the robot global start and goal points * Sending the robot local destination points when required |
| Power Supply | Watt-hr |
| Area coverage | Square-meter |
| Performance | * The operation speed of the robot is same as walking speed * It can be used continuously with appropriate continuous power supply |
| Environment | * Manufacture: The components required to make this robot is being manufactured by different companies separately. Hence an electronic lab or specialized workshop will be the best place for assembling the robot * Storage: Because this robot is majorly made of electronic components, the storage area should definitely have very low humidity. It should be stored at room temperature. This robot should not be stored in places which has high magnetic or electric fields * Use: This robot is designed for warehouse environment. |
| Mapping | * Maplab: It is an research oriented visual inertial mapping framework. It is written in C++ language. It is ready to use. Since we require a map of the area, we need to map the area multiple times so that the results can be compared and maximum of errors can be eliminated. Maplab allows multi session mapping and also loop closure. * RTAB * RViz |
| Localization  https://cloud.githubusercontent.com/assets/966785/6546069/2a4ce0b2-c5a4-11e4-8613-ddcf5e8b0591.png | ROVIOLI: research oriented visual inertial mapping and localization framework.  This ROVIOLI using maplab has great features:   * Robust visual-inertial odometry with localization * Large-scale multisession mapping and optimization * Dense reconstruction * A research platform extensively tested on real robots |
| Citation for ROVIOLI and Maplab | @article{schneider2018maplab,  title={maplab: An Open Framework for Research in Visual-inertial Mapping and Localization},  author={T. Schneider and M. T. Dymczyk and M. Fehr and K. Egger and S. Lynen and I. Gilitschenski and R. Siegwart},  journal={IEEE Robotics and Automation Letters},  year={2018},  doi={10.1109/LRA.2018.2800113}  } |
| * Dependencies of Robust visual-inertial odometry with localization | * ros * kindr (<https://github.com/ethz-asl/kindr>) * lightweight\_filtering (as submodule, use "git submodule update --init --recursive")   #!command  catkin build rovio --cmake-args -DCMAKE\_BUILD\_TYPE=Release |
| Install maplab with opengl scene | * [Installation on Ubuntu 14.04 or 16.04](https://github.com/ethz-asl/maplab/wiki/Installation-Ubuntu) * [Introduction to the maplab framework](https://github.com/ethz-asl/maplab/wiki/Introduction-to-the-Maplab-Framework) * [Structure of the framework](https://github.com/ethz-asl/maplab/wiki/Structure-of-the-framework) * [Running ROVIOLI in VIO mode](https://github.com/ethz-asl/maplab/wiki/Running-ROVIOLI-in-VIO-mode) * [Basic console usage](https://github.com/ethz-asl/maplab/wiki/Basic-Console-Usage) * [Console map management](https://github.com/ethz-asl/maplab/wiki/Console-map-management) |
| Citation for Localization | @inproceedings{lynen2015get,  title={Get Out of My Lab: Large-scale, Real-Time Visual-Inertial Localization.},  author={Lynen, Simon and Sattler, Torsten and Bosse, Michael and Hesch, Joel A and Pollefeys, Marc and Siegwart, Roland},  booktitle={Robotics: Science and Systems},  year={2015}  } |
| Additional citation for ROVIOLI and maplab | @article{bloesch2017iterated,  title={Iterated extended Kalman filter based visual-inertial odometry using direct photometric feedback},  author={Bloesch, Michael and Burri, Michael and Omari, Sammy and Hutter, Marco and Siegwart, Roland},  journal={The International Journal of Robotics Research},  volume={36},  number={10},  pages={1053--1072},  year={2017},  publisher={SAGE Publications Sage UK: London, England}  } |
| Quantity and Manufacture | The robot has to be made as individual items as they have many important components and the number of requirement of this robot is less. |
| Materials | The materials required for making the robot depends on the environment it is exposed to. The frame of the robot is made with good quality plastic material. The major materials in this robot are NUC, motor, LIDAR, Real-Sense, motor driver, battery. LIDAR and Real-Sense are the two major sensors. NUC is the processor of the robot. |
| Quality | The quality of the robot is good. It contains quality products for its sensors and processor. |
| Standards | While designing and operating robots safety standards has to be followed such as:   * **American National Standards Institute (ANSI)** U.S. Standards Body including CSA, BSI, DIN, AFNOR, JISC and more * **International Organization for Standardization (ISO)** International Standards Body * **International Electrotechnical Commission (IEC)** International Standards Body |
| Packaging and shipping | The components of this robot are very delicate and are costly. So while packing this robot precautions are to be taken so that the robot does not get damaged while shipping. The robot should not be tilted and perfect cushion should be provided as well. And instruction manual should be in the packing as well.  High quality shipping should be made as the item is costlier and unique. |
| Aesthetic | The product is easy to use with user manual and some computer knowledge. |
| Ability of the product | * High Quality:   The product is made with high priority of quality   * Safety:   As the product is used in forklift workshops the product is designed in such a way that it is safer for operator and workers.   * Reliability:   With less percentage of error the reliability is high. |
| Limitations | * This robot has to be properly handled * Rough handling is not advisable * Service and maintenance has to be carried out only by professionals and it is advisable to contact the company service centre * This robot is not suitable for other types of environment as it is being designed specifically * This robot cannot be used continuously for longer period |