Product Specification: Indeterminate Polygon

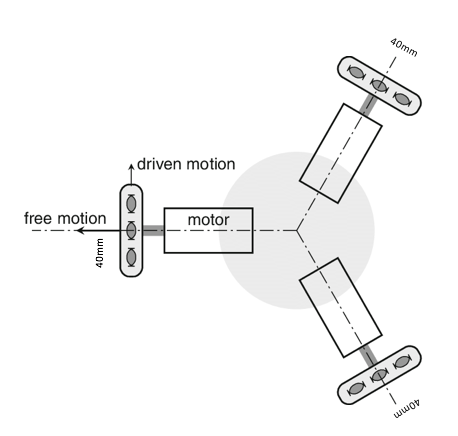
ECEN 430 Team 1 2018 T2

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The Mini Triangle robot platform is able to navigate with sensors inputs. It is capable of semiautonomous operation and fully autonomous movement between waypoints. The platform can detect and avoid obstacles while moving between waypoints. The platform is purposed to be able to map and localise itself within a warehouse environment. Mapping and localisation is done by utilising existing simultaneous localisation and mapping (SLAM) techniques. The platform will be adapted for driving forklifts in warehouses.

The omnidirectional robot can move in all directions without steering its wheels and can rotate clockwise and counter-clockwise with reference to their axis. This affords high mobility and makes the robot useful in a large variety of indoor environment.

The robot uses three Omni wheels that are each driven by a DC motor - Thunder Power Z3R. Each of the motors is connected to a gearbox with a 26:1 reduction gearing ratio; in turn controlled by three motor driver PCBs. Motor drivers are connected to the microcontroller to receive the movement commands. Two LiPo batteries are used to power the robot, each provides 7.4 V and 5000 mAh. The batteries have a series connection, doubling the nominal voltage to 14.8 V. Moreover, the boost converter input voltage is direct from the batteries and provides a constant 19 V supply to the NUC. This guarantees consistent power supply to the NUC as it mitigates voltage drop-off while the motors are running. The high current draw from the motors means that LiPo batteries are the ideal battery technology



In order to perform SLAM, the platform is equipped with following sensors.

* Light Detection and Ranging (LiDAR) unit – Obstacle detection
* Inertial Measurement Unit (IMU) – Reports the acceleration and orientation of the platform
* 3D Depth Camera – Visualises the platform’s surrounding environment
* Odometry???

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| **Locomotion & Power** | |
| 3x DC Motor Thunder Power Z3R | * Status: discontinued * **Type**: Brushless * **Size**: 540 * **# of Turns/Windings**: 17.5 * **Timing**: Adjustable (0-50 degrees) |
| 3x ESCON Motor Driver | [**http://storkdrives.com/wp-content/uploads/2013/10/MR\_enUS\_ESCON-Module-50-5.pdf**](http://storkdrives.com/wp-content/uploads/2013/10/MR_enUS_ESCON-Module-50-5.pdf) |
| 3x Gearbox BB BaneBots??? | * 26:1 Gearing ratio |
| 3x Omni Wheel | * Diameter: 40 mm??? * Number of plates: 2 * Substrate: * Roller material: * Number of rollers: * Load capacity: |
| 2x Turnigy Nano-tech 2S3P Hardcase Saddle LiPo pack | * 5000 mAh * 7.4 V * The nominal operating voltage for motor drivers is 10-15 VDC, hence two 2S in series (14.8 V) or a 3S (11.1 V) or 4S (14.8 V) LiPo is recommended. |
| YH11053A Boost Converter | * 7.4 V to 5 - 42 V * 4 A * A boost converter will step up the voltage to the 19 V required by the NUC |

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| **Operational Specifications** | |
| Recommended Users | The product is recommended for operators with experience in computers and basic electronics. |
| Input | Pre-mapped mapping data of the warehouse. |
| Power supply | Continuous operation is limited by battery capacity |
| Operation speed | Close to walking speed: 1 ms-1 |
| Area Coverage | * Square metres – limited by NUC RAM * The types of SLAM that are viable with this platform are limited by the refresh rate of the LiDAR – see localisation specifications |
| Assembly Environment | The components required to make this robot are manufactured by different companies. Hence an electronics lab or specialized workshop is recommended for assembling the robot. |
| Storage Environment | Because the majority of the robot is electronic components, the storage area should have low humidity. It should be stored at room temperature. This robot should not be stored in places which has high magnetic or electric fields. |
| Operational Environment | Well lit warehouse environment. Free of stairwells or low hanging potential obstacles.   * The robot should not be operated in environments where obstacles are present which are higher than the LiDAR or the height of the RealSense (??? mm) * The environment should not have reflective objects as this may interfere with localisation * The robot should be operated on solid, non-reflective floors * The robot should not be operated on a sloped floor * Autonomous operation should not be used is a room with stairwells * The robot is able to traverses small obstacles, i.e. the saddle of a doorway * The when removing batteries for charging, the sensors must not be unplugged. Doing so will cause the COM ports to reset and will require reconfiguring them. |
| Manufacture and Materials | The chassis of the robot is made of 3D printed ABS parts and carbo fibre tubing. The major components are the NUC, motors and driver units, LiDAR, camera and batteries. The components are sourced from multiple manufacturers to minimise the number of necessary items and cost of the robot.   * The platform is made of high quality, easy to source components. * The platform is designed to be used around forklifts in a way that is safe for the operator and other workers. |
| Transportation | The sensors are delicate and very costly, hence while transporting the robot, precautions should be taken. The robot should not be tilted or jolted at any time, thus a cushioned or padded container should be used. An instruction manual is recommended to be included amongst the packaging. |
| Limitations | * The robot is not suitable for use in environments other than those recommended. * Service and maintenance should be conducted by knowledgeable persons or professionals. It is advised to contact the manufacturer service centre. * The robot must not be roughly or carelessly handled. * Continuous operation is limited by battery capacity. Multiple sets of batteries can extend operation time. |
| Safety Standards | During construction and operation of the robot, safety standards must be followed. Some International Standards Bodies are listed below:   * IEC * ISO * ANSI |

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| **Dimensions** | Width: 280 mm  Length: 320 mm  Ground clearance: 7mm  Weight 2.5 ± 0.05 kg  Turning radius: ??? mm  Wheelbase width: ??? mm  Wheelbase length: ??? mm |

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| **Sensors & SLAM** | |
| Intel NUC6i5SYK | * Status: discontinued * Processor: Dual-core Intel Core i75557U CPU with multi-threading * Speed: 3.10GHz * RAM: 16 GB * Compact size: 112 mcm x 116 mm x 36 mm * Input voltage: 12- 19V * Low power consumption: 28 W |
| Arduino Uno Rev 3 | * Input voltage: 7 – 12 V (pins) or 5 V (USB connector) * The voltage can be stepped down for the Arduino Uno |
| MPU 6050 IMU | * Input Voltage: 2.3 – 3.4 V * Gyroscope sensitivity: 131 LSBs/dps |
| Intel RealSense R200 | * Status: discontinued * 5 V 900 mA * 0.5 m - 3.5 m Indoor operating range * 640x480 Range depth resolution and IR at 60 FPS * 1080p RGB at 30FPS * Connection: USB 3.0 port |
| Hokuyo URG-04LX-UG01 LiDAR | * 10 Hz 5 V * 0.36° Resolution * 240° Range * 20 – 5600 mm Range |
| Odometry??? |  |
| TP-Link TL-802N Wireless Router | * Powered via micro USB Port * External Power Supply: 5 V at 1 A * 300 Mbps data rate * Operating temperature: 0°C-40°C * Operating humidity: 10%-90% non-condensing |
| Cables | * 1x USB A – micro USB * 1x USB A –mini USB * 1x USB A to B * 1x USB 3.0 A to Micro-B Male |