An autonomous mobile robot (AMR) describes a mobile platform that can complete a series of actions automatically through the use of mechatronic design and programmable logic.

AMR is designed with multiple abilities in mind - most importantly navigation, object avoidance, object recognition, and mapping.

AMR is currently able to be remotely operated, track and follow a line on the ground, generate an accurate 2D map of an environment, and navigate a known map while avoiding objects.

This set of applications can be extended and modified with goals in mind such as: intra-hospital transportation of goods, mapping unknown areas, warehousing etc.

### Introduction

#### Design Goals

- The following design requirements (Table 1) were chosen in order to ensure that the mobile robot will be physically robust and comfortably able to complete anything that is required of it.

#### Mechanical Drive Design

- AMR utilizes what is known as a differential drive control scheme (Fig 2). This design offers simple motion control, and the use of only two motors which limits cost.
- The disadvantage to differential drive robots are that they cannot translate perpendicular to the direction they are pointed which means path plans must be longer.

#### Structural Design

- In order to have predictable smooth motion it is important to have rigidly mounted wheels.
- The wheels are attached to the body of AMR through a motor bracket, which is mounted on the base of the AMR (made from plywood).
- Both the motor bracket and plywood frame of AMR must be analyzed to determine how much they will bend or displace under the maximum payload required.

#### Electrical Design

- AMR relies on multiple sensors for environmental input and actuators for movement.
- The actuators must be able to drive a mass of maximum payload at the maximum required acceleration, and at the maximum speed.
- DC geared motors were selected due to an appropriate RPM to torque relationship for the given application.

#### Actuator Specifications

- AMR uses three different sensors (depth camera, quadrature encoders, and an IMU) to provide odometry data.
- An IMU (Fig. 8) tells AMR what direction it is pointing using an accelerometer, a gyroscope, and an electronic compass.

#### Sensors to Provide Odometry

- Odometry answers the question "where have I been?", displaying an accurate path of AMR's movement history.
- AMR utilizes three different sensors (depth camera, quadrature encoders, and an IMU) to provide odometry data.

#### Results

### Conclusions

- AMR met all described design goals making it suitable for more physically demanding tasks.
- Using a camera and the OpenCV library AMR was able to create an accurate two-dimensional map using its depth sensor. It can autonomously navigate the known space while reacting to newly discovered obstructions.

### Future Work

- With a manipulator mounted on AMR, it would have the ability to interact with its environment – applications could be easily extended towards a warehousing environment where objects need to be sorted.

#### References