**Senior Project Justification Fall 2021**

**Autonomous Wheelchair**

**Team Members:** Max Bronson (leader), Denny Mannakulathil, and Oscar Montealegre

**Project Description:** Using the previously constructed Smart Wheelchair, this project will implement image processing & SLAM software & hardware to achieve point to point autonomous navigation.

**Project Selection:**

1. Structure

The base structure of the mechanism is a wheelchair with two electric motors, which provide rear-wheel drive. The wheelchair will retain a joystick for manual maneuver and will implement 3D printed clamps and brackets that attach wiring, an Arduino mega, and a mounted laptop. Corresponding mounts will attach a Microsoft Kinect (model 1520) and a LiDAR scanner to the backrest of the wheelchair, positioning both above the user’s head, at an adjustable height.

1. Sensors

The goal is to implement the video camera & the infrared sensor in a Microsoft Kinect and a LiDAR scanner. The team has chosen to implement the Kinect because it bundles an infrared sensor, a video camera and a microphone into a single device. Both the infrared sensor and the LiDAR scanner facilitate obstacle recognition and 3D mapping. The video camera will facilitate image processing.

1. Actuators

The wheelchair will retain its current motors, used to move the wheelchair as indicated by the joystick and/or the sensors.

1. Computer System

This project implements mounted laptop and an Arduino mega. The laptop will receive the inputs from the video camera, the infrared & LiDAR sensors, compute such inputs, and give the Arduino Mega instructions on how to energize the motors for desired mobility.

**Specifications and Requirements**

1. Clear definition of system specifications

The wheelchair requires a DC battery that will power all sensors & computers required for autonomous navigation, as well as the motors on the wheels. There will be a mounted laptop used for the user input of the target location. The sensors will include but not be limited to a Kinect Camera, LiDAR module, and sonar sensors.

1. Clear definition of technical requirements

This wheelchair will have the ability to autonomously navigate from a start location to the desired target location while avoiding any obstacles it may encounter. It will accomplish this using a combination of Python, ROS, rviz, and SLAM.

1. Clear definition of minimum success criteria

The minimum success criteria is that the wheelchair powers on, receives a target location from the user, and navigates to that location without user assistance. The wheelchair must be capable of maneuvering around objects that interfere with the desired path to the target.

**Required Quality & Work**

1. Technical coverage, merit, learning, etc.

The technical areas that will be covered are mechanical and electrical design, obstacle avoidance, and path planning.

1. What engineering works are involved?

This project will cover programming, 3D modeling, mechanical & electrical system design, and robotic automation.

*Design*: The mechanical aspects will require the design of mounting hardware and selection of mounting locations for a series of sensors on the wheelchair.

*Electrical and Programming*: The electrical work will involve the wiring of sensors including the Kinect Camera and LiDAR Module. The programming will require development of a program that allows for a user to define a target location that the wheelchair will navigate to while avoiding any objects that may prevent a direct path to the target.

*Test:* The test will require telling the wheelchair to go to a certain point in our physical world without user assistance.

**Feasibility Test**

The project is expected to be completed in a semester. The project budget will be ~$100 and will be self-funded by the team. The project mentor is Chris Voicu and there is additional support available from the MTRE staff at KSU if needed.