Final Report

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System Overview:

Our system comprises of 2 main mechanical components.

- The Robot which is meant to traverse the frame.
- The frame itself.

The robot houses 2 dc motors with differential gears to drive 2 axels. It has an IR sensor, an h-bridge to drive the dc motors and a mbed to control it.

The frame contains 2 full rotation servomotors to control the gate setup at the bottom and 2 servomotors to control the flaps on the top. There are also IR transmitters placed throughout the frame to locate the position of the robot within the frame. One mbed is used to control the servo and another is used to transmit frequencies on the IR transmitters.

ZigBee modules were used on the servo controlling mbed and the mbed on the Robot for communication.

Construction guide:

The solidworks files provided can serve as an assembly guide to construct most of the mechanical parts of the frame and robot. All the parts in the solidworks assembly can be laser cut out of ¼ inch acrylic. The holes in the frame are the spots where bolts can be used to keep the frame stable. We have also taken advantage of 5-inch metal rods that can be placed such that it passes through the entire frame at certain locations. This can act as a brace to keep the frame together.

The gates at the bottom of the frame are attached to the rest of the construction by a hinge on one side and a helical spring on the other in such a way that the gate can be pulled open and will snap back into position when released. Threads can be used to connect the gate to the servo motor in such a way that when the servo rotates the gate is pulled open. Servos can similarly be placed to pull the flaps on top of the frame up and down.

IR transmitters can be placed on each level that the robot will need to stop in the frame. The mbed code provided can be compiled and bin files produced can be copied onto the appropriate mbed.

Things learnt and future work:

Our first main iteration was almost twice as big as the model represented in the solid works files. We stacked ¼ inch acrylic parts on top of each other to make thicker parts. For example initially rack in our rack and pinion setup was almost one inch thick which we accomplished by stacking 4 of the same part on top of each other. We realized that our structure was too big to effectively keep stable. We also realized that our stacking technique resulted in tolerance issues. With the increasing number of individual parts, a slight misalignment in any one can cause the robot to get stuck.

With our main iteration we downsized the entire structure and we also decided not to stack acrylic pieces to make thicker parts instead we decided to use ¼ inch thick parts. The stacking technique however did provide a greater amount of traction between moving mechanical parts (rack and pinion). While we had more success with this new model there are still some inconsistencies in the way the robot moved along the frame. However, we have been able to demonstrate that in this model the robot is able accomplice the basic movement along the frame.

If we were to take this project forward, in the next iteration, we would consider implementing the following ideas:

- Construct a large exoskeleton (possibly using 8020) which would allow you to bolt and position different parts of the frame. This would enable you to make slight adjustments in the distances between parts to ensure that the robot is able to move perfectly.
- Use thicker acrylic (or even thicker metal) to make the rack and pinion. This way stacking of parts is not required and there is more traction.
- Moving to a 1 motor design for the robot possibly using a set of gears or a simple belt.
- Making the frame wider to accommodate a conveyor belt on the robot to deliver goods. We were not able to accomplish this because the axel provided with the differential gear was too short. With a one motor design this may no longer be a constraint.