Operation Manual

Project Overview:

Over the last six months, our team has collaborated with Corning, a materials company based out of New York. We met with our sponsors Jeffery Roche and Trent Brush weekly, to create goals for the project as well as get an understanding of what exactly needs to be accomplished. Ultimately, we were tasked with designing an automated system to assist in Corning's current palletization and depalletization process through the placement and removal of pallet toppers and embedded foam layers.

A full-scale model was developed in CAD, but to get an idea of how the device would operate, a scaled model was developed. This scaled device was made using 80/20 aluminum, slider rails, slider bearings, and pneumatic devices to create movement. The scaled model essentially mimics the movement of a gantry robot. It does this by moving side to side and up and down. To pick up scaled pallet toppers, an air gripper was used with tooling extenders that could grab the pallet and embedded foam layer. Ultimately, this device demonstrated how a full-scale model could potentially work if implemented.

Component/Module Description:

The assembly of our system was put together on CAD software prior to its physical assembly. This ensured that our materials would all fit together correctly, and lead to a smooth process of physically assembling our project. In addition, the full-scale CAD model was assembled to see how the project would look if it was utilized within Corning's manufacturing line. The following names are the file names of the most important CAD assemblies regarding this project; "30mm_complete_frame.asm", "asm0001.asm", "full_assembly_1.asm", and “complete_tabletop_1.asm”. In addition, the folder “SD” is the main folder under which every part and assembly is sorted and organized.

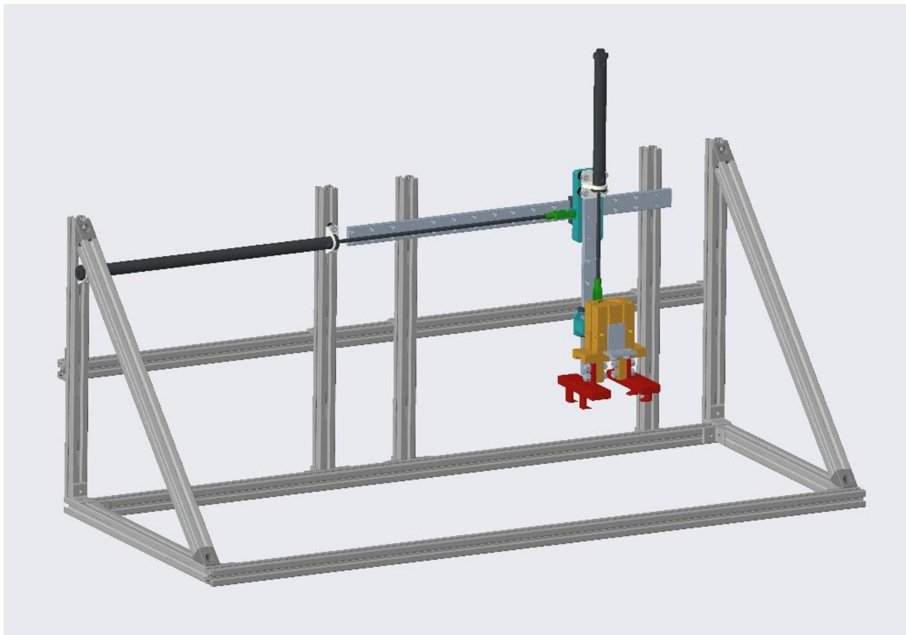

Figure 1: Scaled Assembly

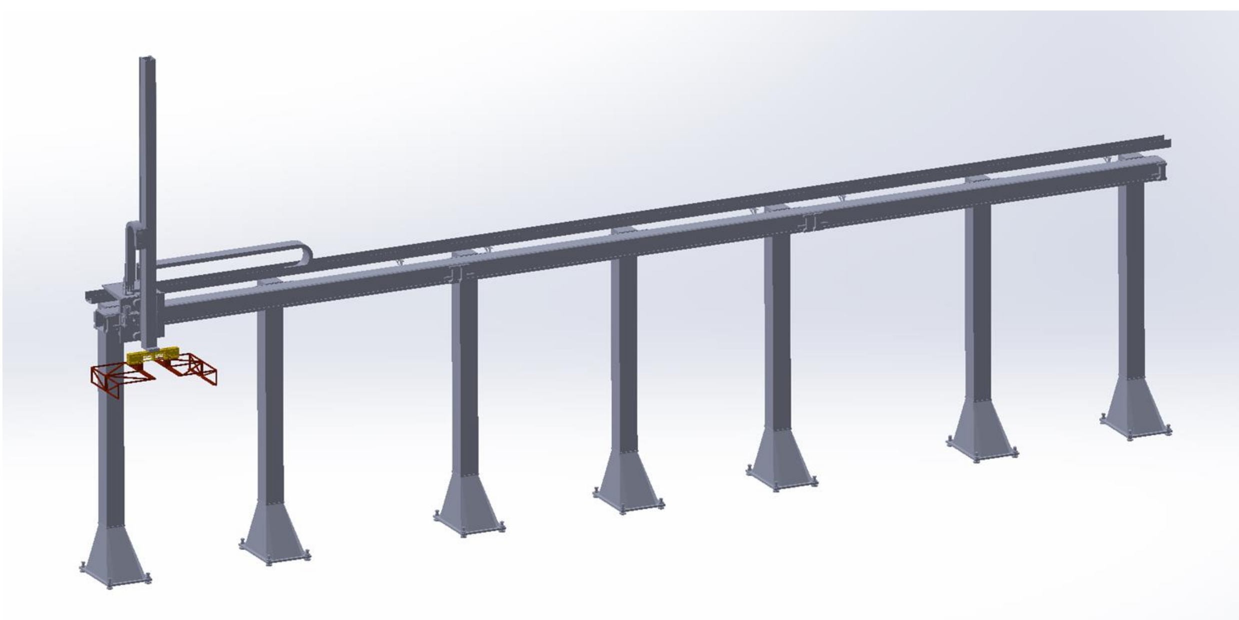

Figure 2: Full-Scale Assembly

Integration:

80/20 Frame and Scaled Assembly:

When assembling this project, the first step should be the assembly of the 80-20 aluminum frame. 80-20 aluminum is a very convenient material, with great adjustability, and hardware for every situation. Expect to adjust some parts later when mounting the system.

Next, the L brackets should be secured to the pneumatic system, in the way they are specified on the CAD assembly. The 16-inch pneumatic cylinder can be mounted to the frame, which may need to be adjusted, using the M6 bolts, M6 T-nuts, and the specified sized spacers. Additionally, a 25-inch length slider rail can also be mounted to the frame, again possibly requiring some adjustments. This is done using M4 bolts, and M4 T-nuts, making sure that the bolt heads are flush with the top of the rail, or sunken below, to not restrict the slider block that will be moving on the rail.

Speaking of the slider block, that can be slid onto the rail from its plastic holding place. This process must be done carefully, as if the bearings fall out it will lead to much more friction, and ultimately failure of the slider block. Once the slider block is on the rail, the larger custom aluminum mounting plate must be mounted to the slider block. Using M4 bolts, and the counter sunk holes, the mounting plates can be attached. At this point the 16-inch cylinder that has been previously mounted can be extended and should line up with the extrusion on the mounting plate. By screwing on the clevis to the end of the pneumatic cylinder, and attaching the other end to the mounting plate, the first axis of motion has been mounted.

Next, the 6-inch cylinder can be mounted to the mounting plate, using the two L-brackets, M6 bolts, the correct spacers, and the top 4 threaded holes on the mounting plate. Then, the 13-in rail can be mounted to the mounting plate, using M4 bolts, and the remaining 4 threaded holes on the mounting plate. Like earlier, the other slider block and be moved carefully onto the rail, and a clevis can be used to attach it to the 6-inch cylinder, creating the second axis of motion.

The second mounting plate should then be mounted to the parallel air gripper, using M8 bolts and the countersunk holes in the second mounting plate. Once the gripper and mounting plate are connected, the mounting plate can be mounted to the slider block using the M4 bolts and the countersunk holes on the four corners. Finally, the 3D printed tooling expanders can be bolted to the finger mechanism of the parallel air gripper using M8 bolts.

At this point the physical prototype should be identical to that found on the CAD file. All that is left is to attach is the pneumatic system to the cylinders and air gripper.

Pneumatic System:

To hook up the pneumatic tubing and supply air to the cylinders, quarter inch tubing was used. This tubing was run from the air compressor to another regulator to regulate the amount of air that is supplied to the system. From the regulator, another hose is run to a three-way splitter so that three different tubes can run to three different valves. From the valves, more tubing is run to the horizontal cylinder, the vertical cylinder, and then the air gripper. Below is a simple diagram of the pneumatic system and how it all hooks up.

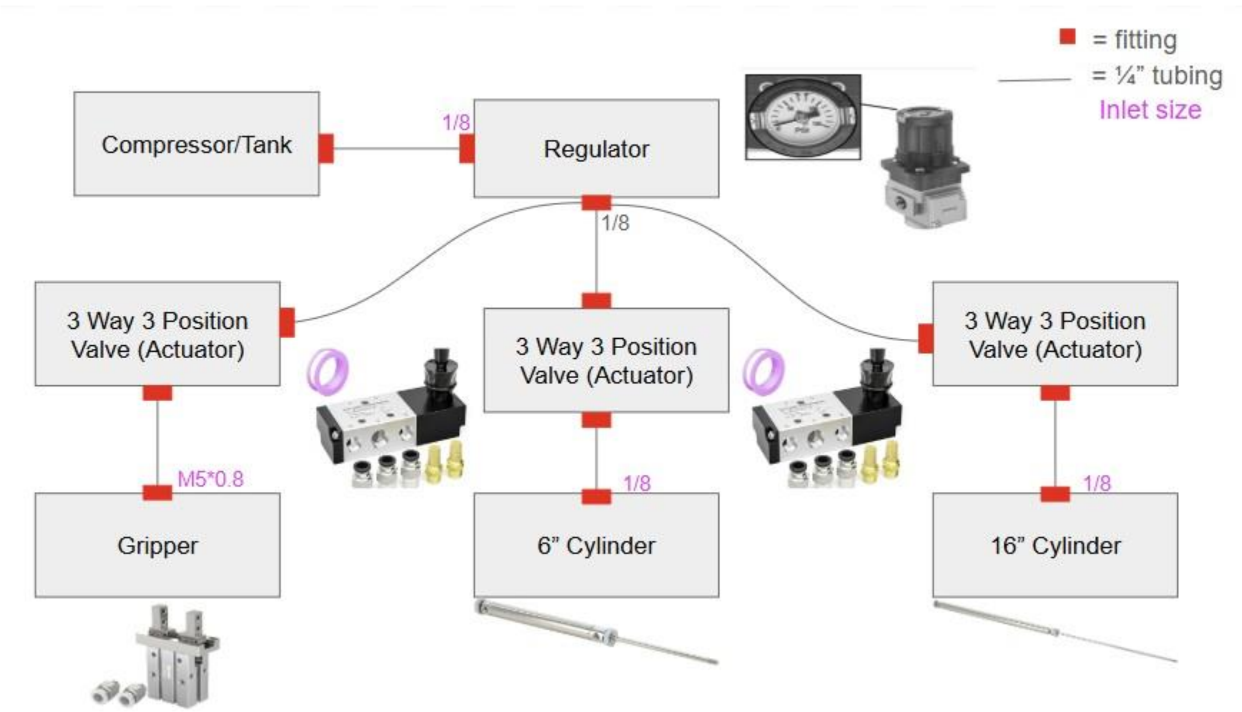

Figure 3: Pneumatic Diagram

Position sensors:

On the frame of the scaled gripper there will be two limit switches and a distance sensor on the air gripper. The distance sensor on the air gripper will be used to determine how far the gripper is away from the pallet topper. Once the gripper gets within a certain range from the pallet, it will then be ready to pick up the pallet. The limit switches will be placed along the slider rails. These switches will be used to determine the position relative to the gantry system. This will allow the user to know when to move side to side or up and down. Below is a quick little diagram for the wiring of these sensors.

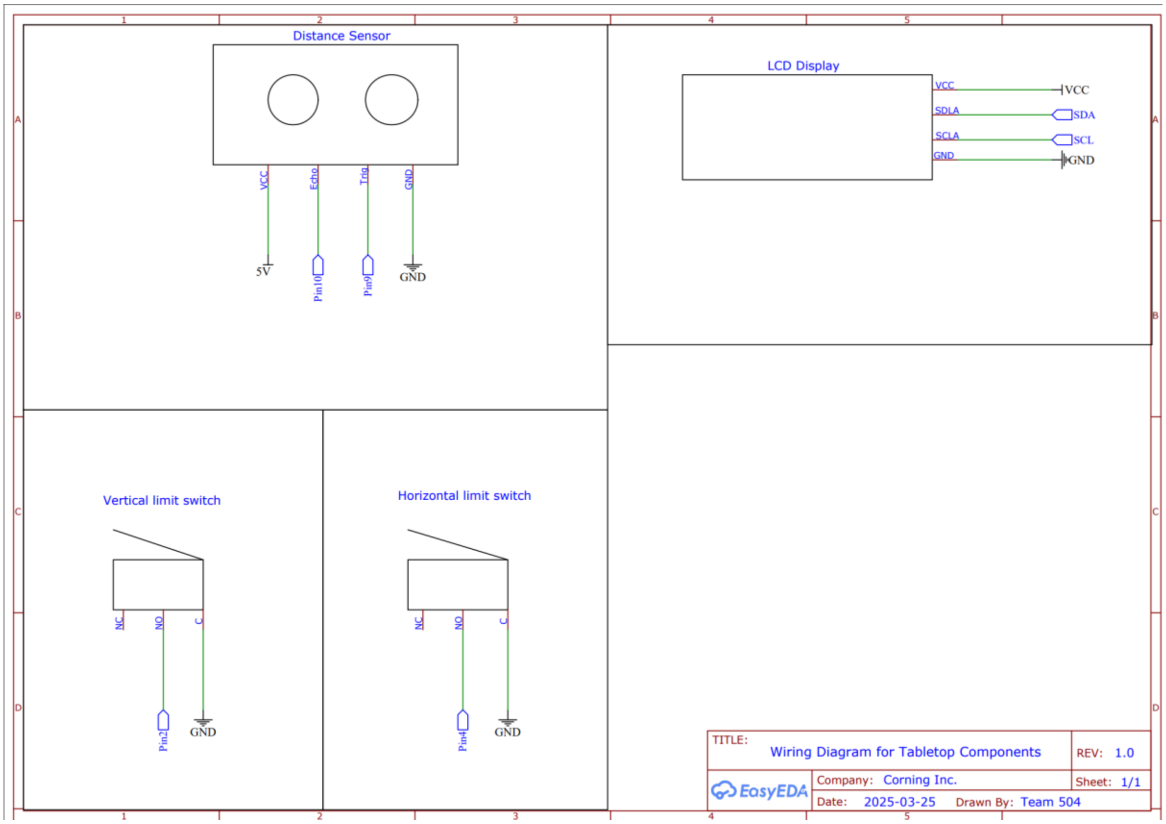

Figure 4: Wiring Diagram

Operation:

To operate the scaled pallet topper model, the user uses the three actuating valves that are located at the back of the 80/20 frame. Each one is mounted to its respective housing that indicates which way to flip the valve lever to move in a certain direction. This is for the left, right, up, down, open, or close motion. These motions allow the user to pick up a scaled pallet topper and move it to its desired location. The cylinders run off 50 psi from an air compressor in the senior design lab. To control this air pressure level, a pneumatic regulator is set to 50 psi. To ensure safe operation, the user must stay towards the back of the 80/20 frame where the actuating valves are. While running the device, keep hands and fingers away from the moving components. It is also important to ensure that spectators have their hands clear of the device while it is operating. The operation of this scaled model serves as a demonstration of how the full-scale model would work.

Troubleshooting:

Assuming assembly goes well and as planned. If the device is not running properly, the first thing to check would be the amount of pressure that is being sent to the air cylinders. If it is found that not enough pressure is being sent to the cylinders, make sure it is set to 50 psi. Another issue to check for is leaks. If any leaks are found, seal them up and try to run the system again.

The slider rails should also be inspected for any debris. If debris is on the slider rails, it could affect how the bearings slide or even keep them from being able to move. Lasty, check all the parts of the assembly and air cylinders. If anything is blocking a component, reevaluate and mount that component in the correct position.

If a cylinder or any other part appears to be damaged/broken, replace it with a new component to get the device functioning. Make sure components are lined up with each other properly, and everything is level. If components are not correctly lined up, the cylinders can bend and deform, slowing the system's movement until it is not operating. If the system is not running properly it is recommended to run one aspect at a time to find out where possible issues may occur.