Progress Report for Week #4

The Device:
The automated syringe loading device is an aid for diabetes patients who live with common conditions typical of the disease. These conditions include, but are not limited to, arthritis, hemiplegia, Parkinson’s disease, tremors, neuropathy, and vision and hearing impairment. The device will assist these patients by filling syringes with their required dose of insulin. To operate the device, the user will input the amount of insulin required, and the device will then fill the syringe to that amount within a tolerance of 1/1000th mL. To make the device more user friendly, it will hold any size insulin bottle, store up to 10 syringes for loading, and alert the user when the current bottle of insulin is near empty. For the doctor’s records, the device will also maintain a time stamped account of the volume of each syringe filled.

Work Done:
The work performed this week included a lot of redesign. First of all, it has been noticed that the height of the device depends mostly on the syringe and the motor/lead screw. The original design placed the lead screw on top of the motor, and the plunger claw directly on the screw (figure 1). Kathryn suggested a new plunger claw design, in which the claw snaked around to the side of the motor (figure 2). During the week, this idea was contemplated and a finished design was formed.

However, during a team meeting, it was also noted that the layout could be reduced to a simpler plan. If the lead screw was removed from the motor, set beside it, and turned with gears, the plunger claw would not need to be adjusted. The size of the motor and lead screw would allow a full range of motion, and the height of the device could be reduced. This idea was also formed into a complete design (figure 3), and considered as an alternative to the original.

Scott proposed a new means of grabbing between the claw and the plunger. The original design involved moving the motor, mechanical potentiometer, lead screw, and plunger claw, all contained in a box, to the syringe plunger. The movement was to be carried out by a servo moving the mentioned components along tracks in the case. Obviously, it would have been better to just extend the plunger claw, but putting a linear actuator or equivalent on the plunger claw would have been difficult, expensive, and bulky. The original movement would have accomplished the task, but it was deemed that too much energy was needed and waisted by this movement. To fix this, Scott suggested two electromagnets be placed on the plunger claw (figure 4). These magnets would push or pull the plunger claw the required distance. Over the past week, methods and materials for making this piece were researched, and a prototype has been made to explore the concept. Using the prototype, and information about the potential materials, a design of the magnet-controlled-claw was completed. The materials for this will be ordered on Tuesday.

Using the new plunger claw design and the revised motor/lead screw layout, the potential motor assembly was considered. It was decided that the motor will now sit alongside a lead screw,
rotate it using gears, and the plunger claw will sit on the lead screw. The claw will also include the electromagnet controls. The ultimate design is seen in figure 5, and construction of this design has commenced. So far, the housing for the lead screw has been built, and the connections between the motor, lead screw and their gears have been made.

Due to unsteady hands and a lack of experience in welding the first syringe cartridge fell apart. The aluminum used to make the cartridge melted when an accident caused too much heat to be applied to it. Since the accident, the first cartridge was scrapped, and a new one is under construction. The second cartridge has been made with a thicker piece of aluminum, and the means of construction uses one sheet (rather than 2) with more bends, requiring less welding than the previous model. Also, most of the welding has been performed with the help of Serge, an experienced welder working in the shop. So far, the cartridge is almost finished. All pieces are cut, and the remaining welding should be finished Tuesday afternoon.

Future Work:
Several parts will be ordered on Tuesday. Shipping times are short, so most ordered materials will be available for use during the same week. For the week following the parts orders, more construction will be accomplished. First, the cartridge should be finished. Provided the gears arrive, the motor assembly will continue construction. After the parts for the electromagnets arrive, the plunger claw’s construction will be finished. Also, a final design and a model of the retractable cartridge and guide rod should be complete. Right now, the team is still waiting on the digital potentiometer. When this arrives, the team will replace this in the model double-check circuit. Testing and programming will follow. Lastly, a case will be obtained, and a model of the device layout will be built. The case may change during the semester, but the internal structures will be used in the final product.

Project Review:
The device is coming along as well as can be expected. Several set backs have held up the team, and there will probably be a few more as the weeks progress. Team 2 is working hard, though, and any delays are being made up with elbow grease.

Hours:
Discussion: 2
Research: 2
Design: 5
Machine Shop: 6

Total hours worked: 15