CSC372 – Lab 4

Introduction

Embedded software involves handling several devices “at once”, meaning that the human observer can detect no evidence that the devices are not being serviced simultaneously. This lab will give you the opportunity to generate such software.

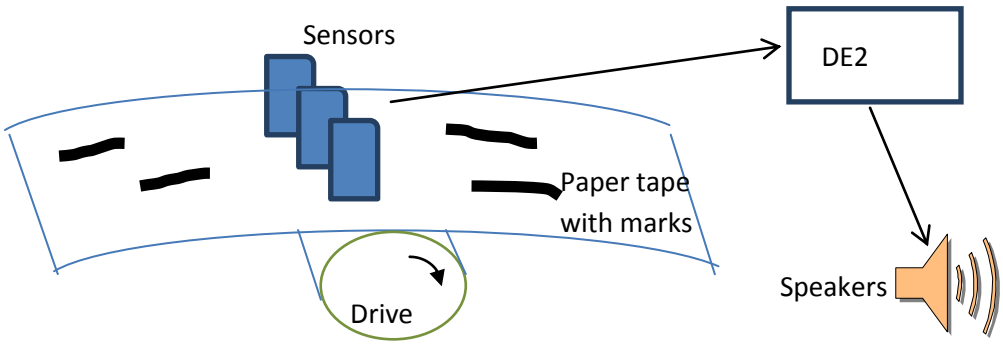
The project you are going to build is a “player organ” along the lines of a player piano. The player will read a paper tape and, based on markings on the tape, will output musical notes.

Directions

You will build the player out of Lego attached to the DE2, so you will have to get a Lego kit from Norm Baccari in BA3110. Specific directions on acquiring a kit will be given in class. You will also need to get an extra set of sensors at the same time. The player can use any form of tape, but you will be provided with tape 57mm (2.25”) wide which can be marked with marker to form the information to read.

Other Specific Requirements

1. Your player must handle all devices through some level of operating or sequencing software. Ideally you will use the system you have built in the other labs, but you may produce a simple timer-based RTOS if you did not have luck with that.
2. The paper tape reader must have a motorized feed.

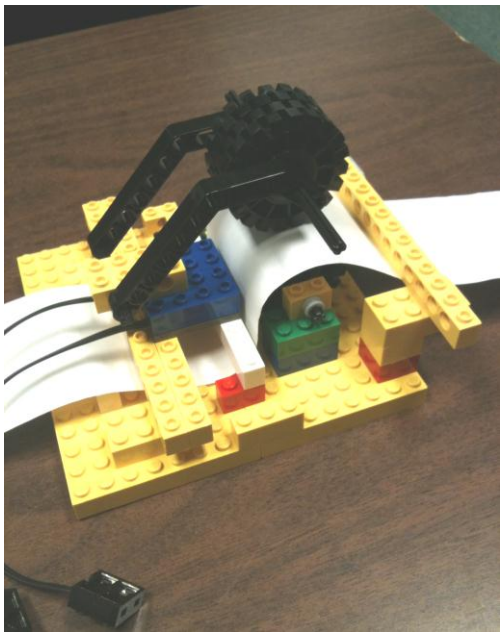


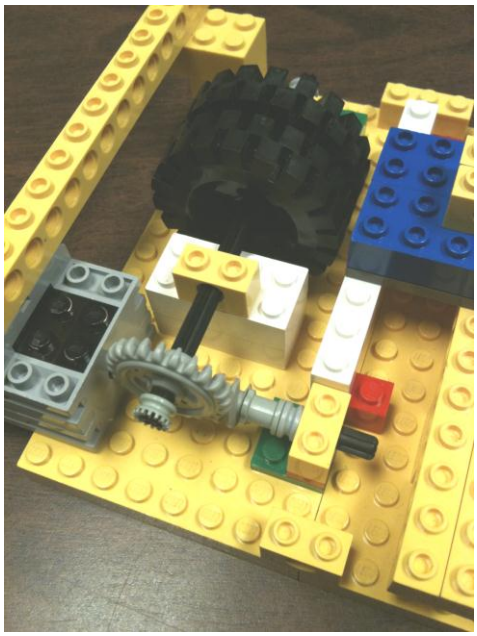
Suggestions (see pictures)

1. Construct the Lego platform and write the program beforehand. This may take a while.
2. The motors turn very fast. You will need a reduction to get the speed you want for the paper tape. A worm gear will reduce speed the most for its size. You can also use other gears or chains or belts over wheels of different sizes.
3. Bring up the pieces of software separately then integrate them individually. If you try to bring up the whole thing at once it will take longer to get working.
   To do this will require some built-in test facilities. For example, you might want to build an audio output that runs from the panel switches, LED indicators of what is being read from the sensors, a connection to a button to run the motor when pressed, and so on.

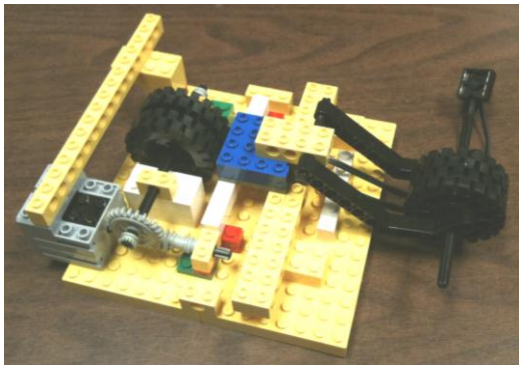
4. Consider starting and stopping as well as when you are underway.
5. The audio outputs have a tradition of being “tricky”. Follow the directions on the website and deviate as little as possible.

The following pictures are of a reader that can be duplicated. (This lab is not a test in how well you do Lego!) Note the free-wheeling weight to keep the paper tape on the motorized lower wheel. The middle pictures have this weight pulled back. Tape feeds from left to right in the first picture. Two sensors are in blue. Paper goes under the wide yellow bar, under the white positioning bar, up past the sensors, over the driven wheels (and under the free weight wheels), then exits under the narrow yellow bar.

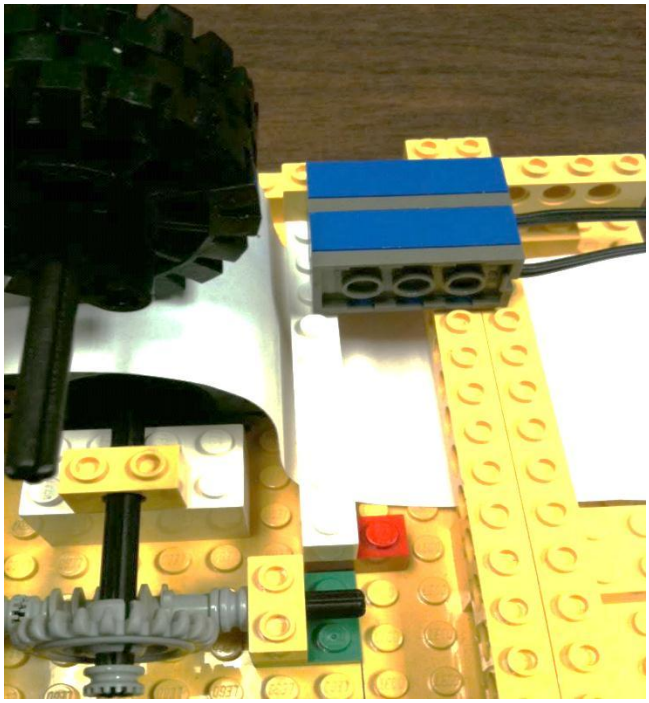




The motor drives a worm gear, driving the crown gear that runs an axle through the drive wheels. This is shown in the second and third pictures where the free-wheels are pulled back.



The last picture shows an alternate sensor and freewheel arrangement. The sensors are mounted on their sides, using a specialized lego bar. You will want to use



more sensors to make your device more versatile.

Prelab: (2-4 are intended to just allow your program to be understood)

1. Lego mechanicals constructed. This can be done in pieces and reassembled in the lab.
2. A system diagram, showing how the modules interact.
3. Module descriptions: Describe the method of invocation, the processing and outputs of each module.
4. A timing / priority diagram, showing the hierarchy of the modules and the timing involved with each.
5. Your strategy for bringing the device up.