University of Florida

Dept. of Electrical and Computer Engineering

EEL5666C

Intelligent Machine Design Lab

RIDLAR
(Reliable Intelligent Domino Laying Autonomous Robot)

Special System Report

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Abstract

RIDLAR will have domino-laying mechanism on it. It consists of a tower, a tower arm, a slide, a slot, and a slot door. Each works in a sequence that pushed the domino out of the tower, down the slide, and into the slot.

Introduction

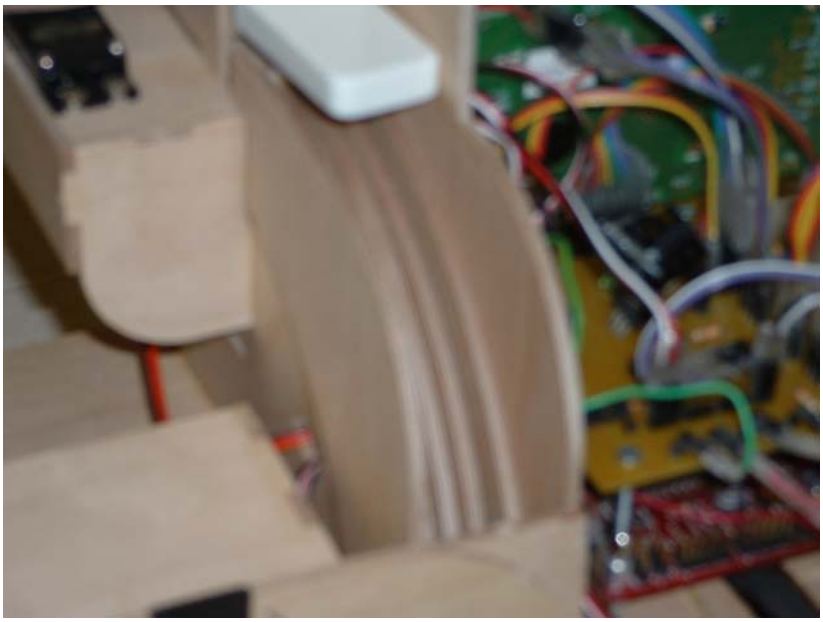
For RIDLAR to lay dominoes it needs a precisely engineered mechanism to place dominos on the ground. This is a great challenge as dominos standing on their ends are somewhat unstable and could fall over.

Components

Tower/Tower Arm

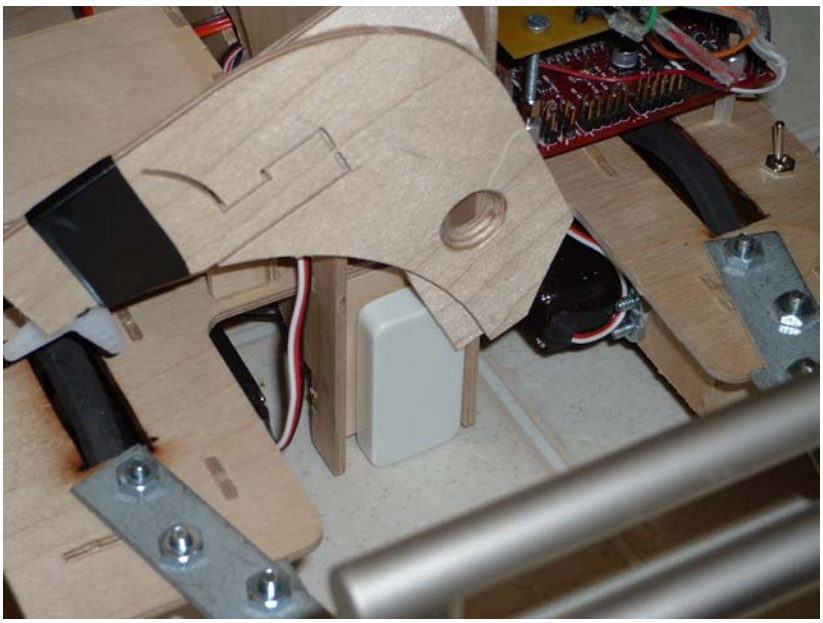
The tower arm had to be position so that the arm goes directly into the space where the bottom domino sits. I had to measure how high the servo arm sat off of the case and design the tower so that the space sits at exactly that level. The tower was designed after the tower arm servo was placed on the side of the slide. The above picture shows the servo arm pushing a domino out of the stack and onto the slide. The challenge in designing the arm was created by the shape of the space. Since the servo can only rotate, the arm had to be circular for maximum reach. The tower stands roughly 12 inches up from the slide and the actual space for the stack stands 11.5 inches. It can hold 31 dominos and is also removable from the slide. It has two planes that slide into the gaps in the slide to provide stability. The tower has yet to fall out of the slide under normal operation even with a full load. Finally, the tower has one wall that is held on only by rubber bands and its tabs. This is to make the loading of dominoes easier.

Slide



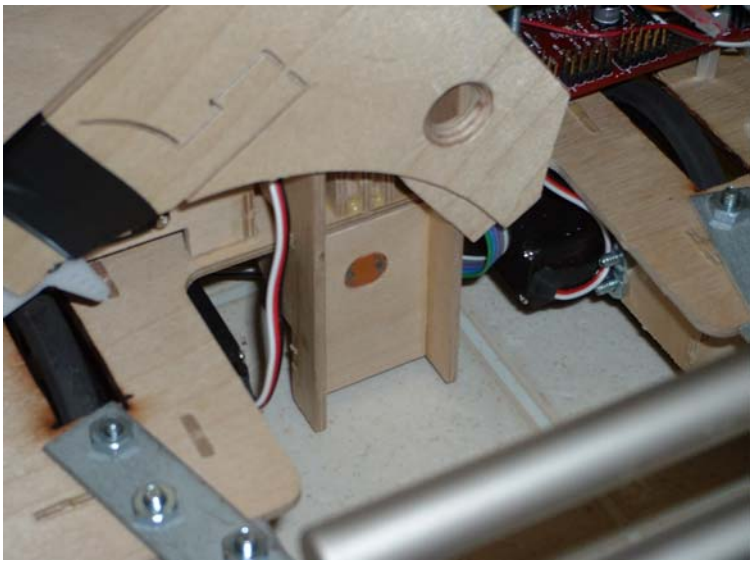
The slide provides a path for the domino to take from the stack down into the slot. It is made of several pieces of wood cut to exact circular segments. The were then spaced evenly and glued together to create a flat surface that is rounded and smooth for the domino to slide down. I had to make the slide slightly wider than the actual width of the dominos so that they wouldn't get jammed.

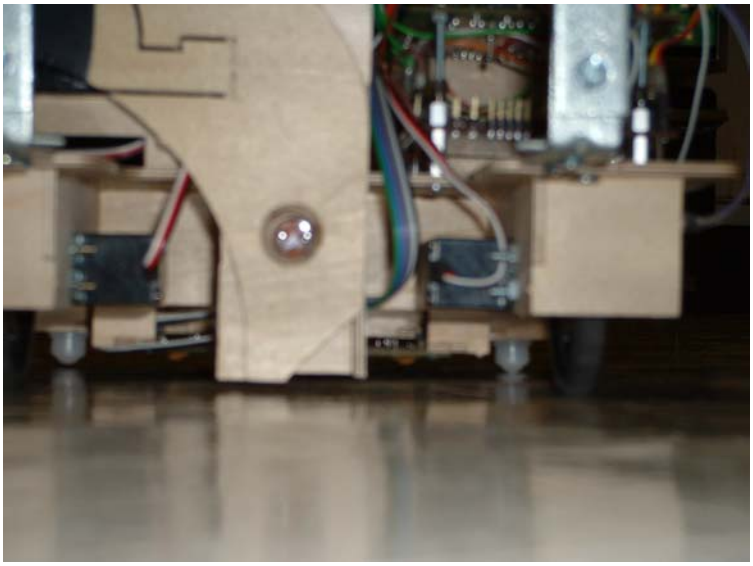
Slot/Slot door



The slot (as shown in the previous picture) doesn't fit the domino like a glove. This is so that the domino doesn't get jammed. It is important to not leave too much space because you don't want the domino to be leaning against one of the walls when the door opens and the robot moves forward. The slot has a CdS cell built into it facing out towards the light. The slot door has a

hole in it that lines up with the CdS cell which lets light in. The next two pictures show the slot door open with no domino in it and the slot door closed and how the hole lines up with the CdS cell.





Programming

Programming the domino laying is as easy as setting output compare registers (OCR) and adding delay loops and checking for a domino in the slot. To lay dominos you first close the slot door; that is setting the OCR associated with that servo and then using a delay loop. Then you move the tower arm to push a domino out of the stack. This is done just like the slot door, with an OCR register and a delay loop. At this point the domino should be in the slot and the slot door is closed. Then you poll the voltage divider of the CdS cell and determine whether there is a domino in the slot or not. If there is, then continue as usual by opening the slot and moving forward and repeating the entire process. If there isn't, then output and error message and wait until the program is reset.

Experimental Layout and Results

The mechanical aspects of RIDLAR work just as I had imagined at the beginning of the semester. The only thing holding it back is bad programming. Looking back on the programming I can see why it would lose the line and sometimes not move anywhere between dominoes. Sometimes it would lay one domino on top of the other, and this was all due to bad programming and not the mechanical design. The standard torque servos have no trouble with the weight of the stack and pushing the domino out. I bought a high torque servo from the Mark III robot store but it was too powerful for its own good. It broke its own gear set and snapped the plastic rotation guards right off. I don't recommend buying those servos. Standard servos work fine.

Conclusion

I am very pleased with RIDLAR's domino laying behavior. He sometimes gets jammed up but that could easily be avoided with larger guard rails in the slide or perhaps a roof that goes all the way down the slide. Perhaps in another design I will create a way for there to be more than one stack that can feed the slot. This would be quite a challenge, but would make the robot more interesting. I would also use geared motors as my drive instead of servos. Geared motors will last longer than servos and allow RIDLAR to last a longer time.