A Simple Belt Drive System

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Introduction

This paper describes the creation of a simple belt drive mechanism. This project is intended to be used as a starting point for a prototype that will be reiterated upon in future projects. The system itself takes inspiration from the general belt drive system [1] but the design of the system is original and was created by the sole project team member Justin Smith. A description of the system along with the materials required are in contained in Appendix A.

Novel Contribution

Since the design is original the goal of the system is to be precise and efficient. The system must also be stable and able to continue operation regardless of external forces, within reason.

Motivation

At the University of Regina engineering students are expected to do a capstone project at the end of their studies to demonstrate all that they have learned during their degrees. The purpose of this project is to determine the feasibility of a subsystem in a capstone project designed by the student Justin Smith. Since the project team has no experience with mechanical systems this project will also be treated as a learning experience for the project team.

Milestones

Milestone 0	November 6	All parts gathered
Milestone 1	November 13	Control system assembly with code
Milestone 2	November 20	3d print the rest of the system
Milestone 3	November 27	Assemble the whole system
Milestone 4	December 4	Stretch goal: add code to refine the control of the system

Team Roles

All of the tasks in the project will be assigned to the sole member of the project team Justin Smith.

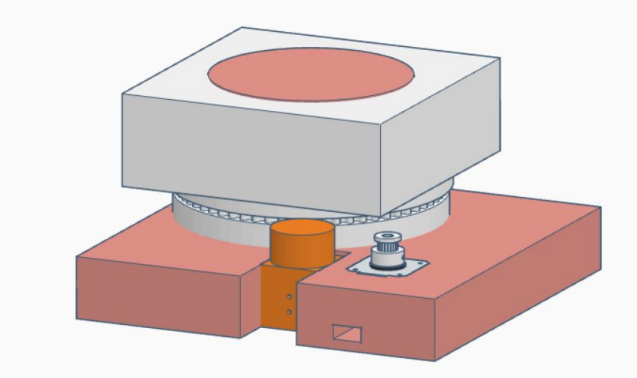
Summary

If this project is successful and the subsystem created is found to have reasonable precision, is stable and is able to continue operation regardless of external forces, within reason, the subsystem will be added to other subsystems created in other classes, which cumulatively will result a prototype for a capstone project which should be completed on April 2019. If this project is not successful the fundamental designs of the capstone project will be changed and a replacement for this subsystem will be created in future classes.

Appendix A

The System

The project itself is simply a belt drive system and is designed to be part of a prototype that will be finished in future classes. The total size of the system is 250 x 250 X 130 mm. The system can be broken down into six main parts: the motor, belt, tensioner, base, gear, and control system. The base, tensioner, and gear is intended to be 3d printed while the belt and motor will be purchased online. The following image shows the system in its entirety.



Motor

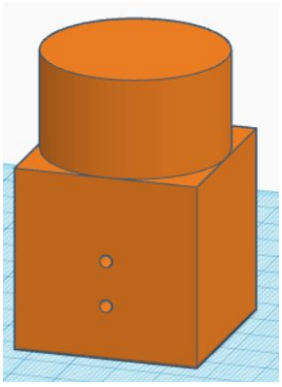
The motor for this project is a four wire nema17 stepper motor. This motor requires 12V to operate and can produce 26Ncm force. A stepper motor was chosen due to its ability to move a predefined step interval which will allow for a more precise control of the system. This motor also produces a reasonable amount of force and is cost effective. The main concern for this product is that it may not have the stopping and operating speed intended for the system but since this is an early prototype this should not be an issue.This product is listed on Amazon at the following link: https://www.amazon.ca/gp/product/B06ZY5KZSJ/ref=ox_sc_act_image_1?smid=AG9C1PTXF2T90&psc=1 .

Belt

The belt is a GT2, 6mm width, 2mm pitch timing belt. It is made out of rubber and is fiberglass reinforced. The belt also required the use of a timing pulley which is the attached to the motor to allow it to attach and move the belt. This belt was chosen for it price and it's small width, since the system requires that the belt itself be under a small amount of tension this lower tier belt was chosen. This product is listed on Amazon at the following link: https://www.amazon.ca/ZQ100WT-Timing-Pulleys-GT2-Belt/dp/B01MZZO8PP/ref=sr_1_1?s=industrial&ie=UTF8&qid=1509216891&sr=1-1&keywords=timing+belt+6mm .

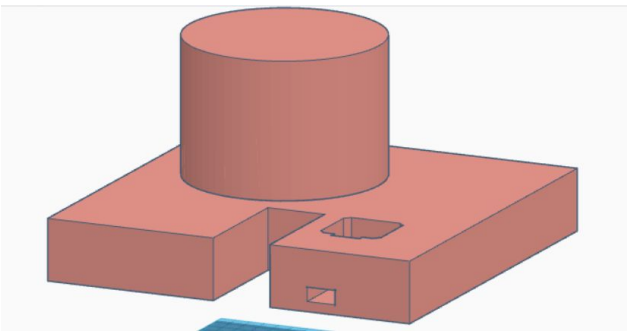
Tensioner

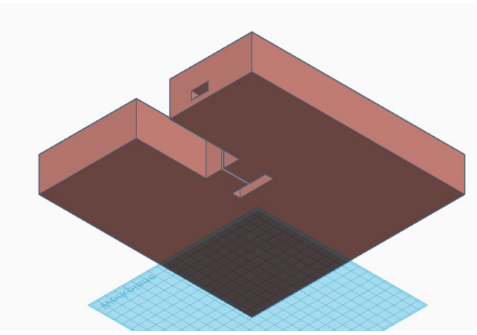
The tensioner has a simple design, its top is circular which will allow it to push on the belt while allowing the belt to still move and it's base is square to reduce horizontal torque. The tensioner also has two holes which will allow it to be bolted in place to the base, have an adjustable position, and reduce vertical torque. A problem that may occur is that the top rounded part of the tensioner may wear away over time due to the material that the part is printed with but since this part is fairly small and simple it wouldn't be a real issue since it can be reprinted as needed.



Base

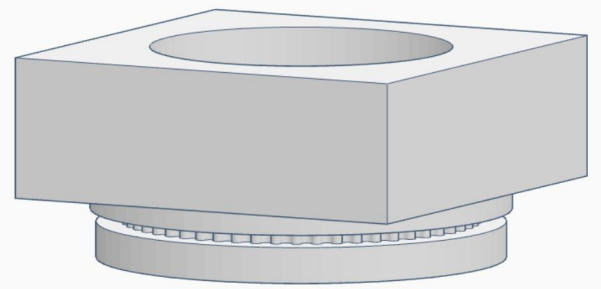
The base is the most important structure of the project since it supports every other part of the prototype. The base has an axis for the gear to rotate around, holds the motor in place and allows the tensioner to be bolted into the system while giving it space to be adjusted it to change the tension in the belt. An issue that may arise with the base is that the 3d printed material that it is using may not be strong enough to withstand all the forces that are applied on it by the motor, tensioner and gear.





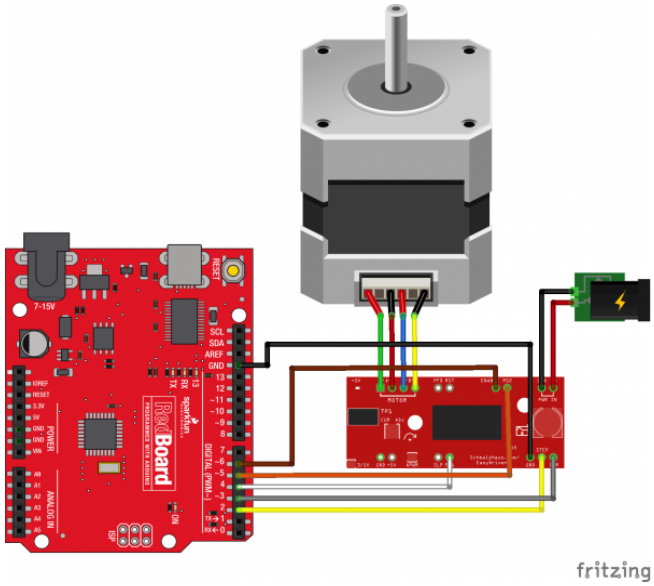
Gear

The gear is rotated around an axis connected to the base and by the belt which is moved by the motor. This part of the system will be attached to a second part of a different subsystem which is intended to be added in future projects. The teeth of the gear are approximated and may not fit the dimensions of the belt, in order to mitigate this, the gear teeth will not be printed on the gear and instead a timing belt will be wrapped around the gear and act as the teeth for the main belt of the system. With this design choice there will be slippage since the timing belt was not designed to replace the timing pulleys but with the right amount of tension the slippage can be reduced. The timing belt teeth will also support the structure of the gear buffering it from the tension of the main belt.



Control System

The system will be controlled using an Arduino Uno and a Gikfun EasyDriver Shield stepping Stepper Motor Driver. It also requires a 12 volt power source for the motor. The following guide ‘Easy Drive Hook-up Guide’ [2] will be used to set up the control system. This image taken from the guide [2] describes a wiring diagram for the system.



The code for the system can also be found on the guide as well. More code will be developed as project milestones are completed to get a finer control of the system.

References

[1] https://me-mechanicalengineering.com/belt-drives/
[2] https://learn.sparkfun.com/tutorials/easy-driver-hook-up-guide