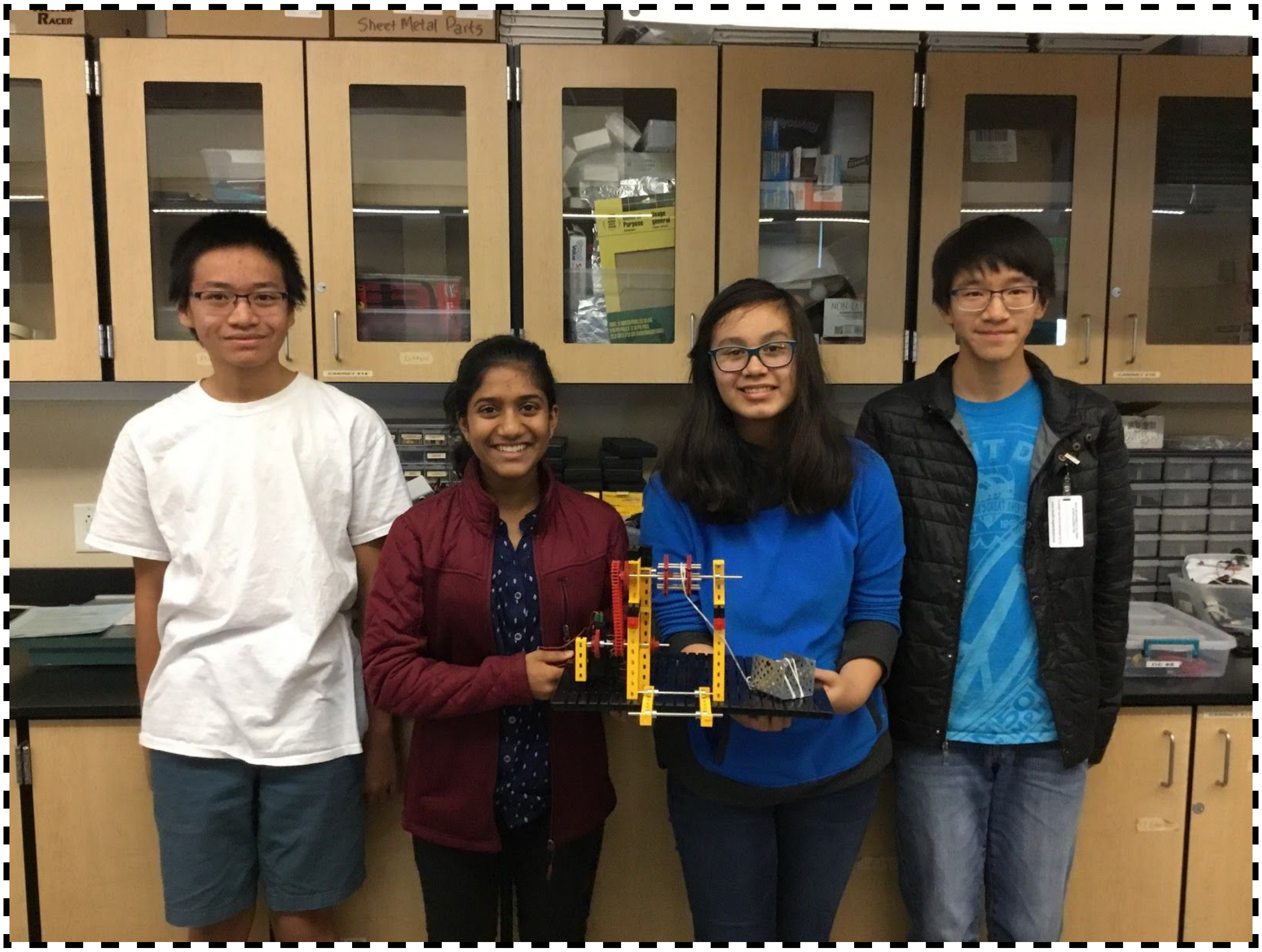
Team JORK



- ★ ★ ★ ★ ★ -

Team Members:

Karina Aguilar

Oswald Dai

Justin Thai

Roshni Vakil

Project 1.2.5 Mechanical Winch System

Principles of Engineering(POE)

Period 7

From:

October 16, 2017 - October 20, 2017

- ★ ★ ★ ★ ★ -

Table Of Contents

Design Brief

- Client:
  - A local construction company who needs small scale prototypes for their models.

- Designers:
  - Karina Aguilar, Oswald Dai, Roshni Vakil, and Justin Thai will brainstorm, prototype and code all of the required materials in this project.

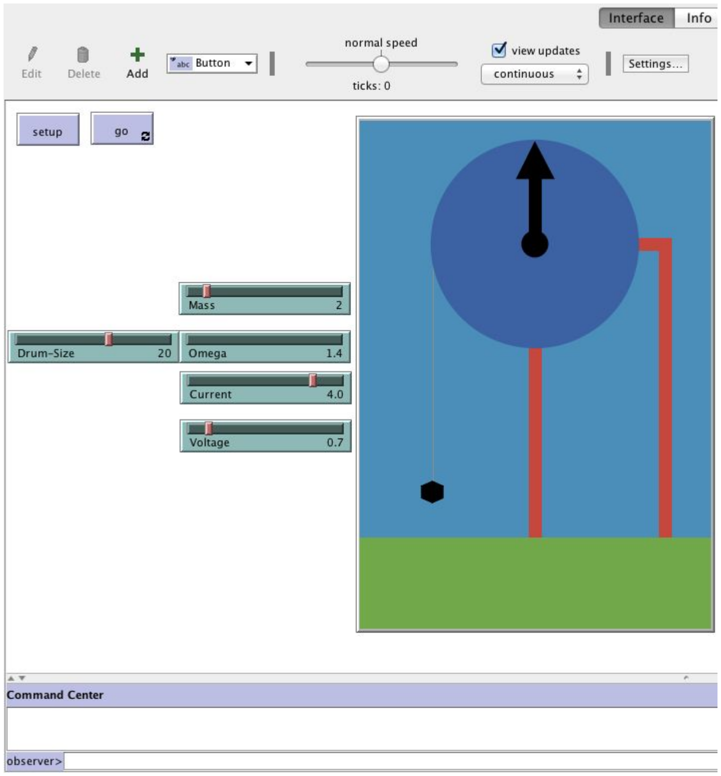
- Problem Statement:
  - It is very hard to find the most efficient design for the winch needed to lift heavy objects over long distances and building the entire structure without any previous testing can be costly if the design fails.

- Design Statement:
  - Our group was tasked to help design a small scale prototype for a winch that will be used to lift heavy objects three stories high, while trying to have the most efficient system possible for the task.

- Constraints:
  - The requirements of this project is that the physical prototype must be powered by a togglable FT vex motor and lift at least 100 grams over a distance of 30 centimeters. The other parts of the prototype however, can be made from either fisher tech or vex parts.

- Deliverable:
  - The required deliverables our team will hand in on the due date includes: a working physical prototype, a netlogo simulation program, an online report, and a project notebook containing: a project log, table of measurements, calculations, and conclusion questions.

Netlogo GUI

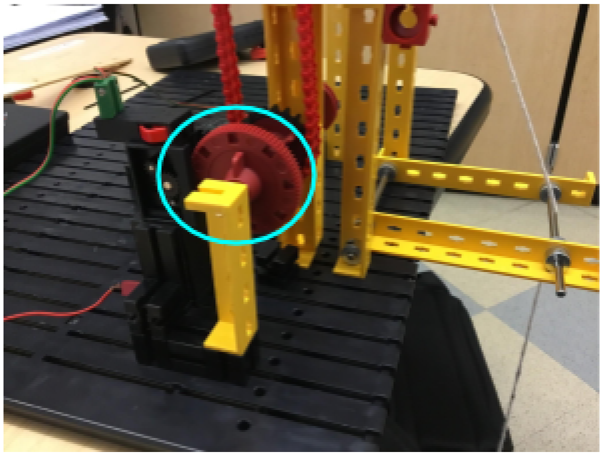


Netlogo Code:

```
;;Netlogo Project World 1.2.6
;;Karina Aguilar, Oswald Dai, Justin Thai, Roshni Vakil
;;POE Period 7
globals [
  delta_t ;;creates a variable named delta_t for the time step that will be used in the program
  Drum ;;creates a variable named drum which will to identify the clock between other turtles
  Weight ;;creates a variable named weight which will be used to change the size of the weight
  Edge ;;creates a variable named edge that will be used to create a connection with weight
  Power ;;creates a variable named power for the stall command that will be used in the program
]
  ca ;;clears everything
  reset-ticks ;;starts a counter called ticks
  set delta_t 1 / 100 ;;sets the variable delta_t equal to 0.01 seconds
  ask patches with [pycor < -12] [set pcolor green] ;;makes the area under y = -12 green
  ask patches with [pycor > -13] [set pcolor sky] ;;makes everything above y = -13 sky colored
  ask patches with [pxcor > -1 and pxcor < 11 and pycor = 10] [set pcolor red] ;;creates a red line between x = 0 and
10 at the height of 10
  ask patches with [pxcor = 0 or pxcor = 10 and pycor < 11 and pycor > -13] [set pcolor red]
;;creates two pillars at x = 0 and 10 from y = 10 to y = -12
  crt 1 [set shape “box” set heading 0 set color black setxy (-3.14 / 8 * drum-size) (min-pycor + 10) set size mass]
;;creates the turtle for the weight
  crt 1 [set shape “dot” set size .1 setxy  (-3.14 / 8 * drum-size) (max-pycor -10)]
;;creates the turtle that will be on the edge of the drum (for connection purposes)
  crt 1 [set color blue set shape "clock" set size drum-size setxy 0 10 set heading 0]
```

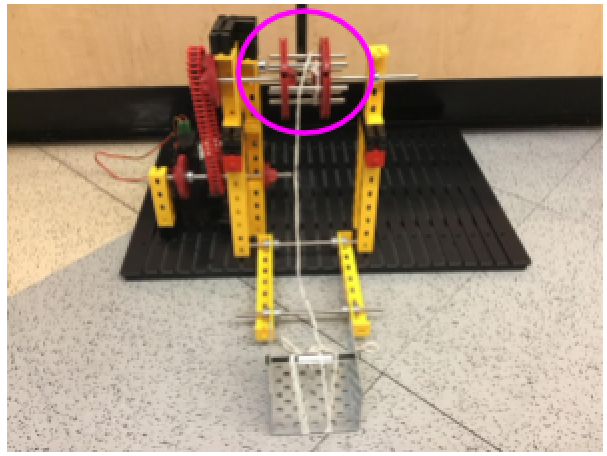
```
 ;;creates the turtle that will act as the turning drum to lift the weight that is colored blue and facing towards '0'
  set Drum one-of turtles with [shape = "clock"] ;;names the turtle shaped as the clock as drum
  set Weight one-of turtles with [shape = "box"] ;;names the turtle shaped as the box as weight
  set Edge one-of turtles with [shape = "dot"] ;;names he turtle shaped as the dot as edge
  ask Weight [create-link-with Edge] ;;creates a link between the dot named edge and the box named weight
  set omega current * voltage / mass ;;sets omega = to (I * V)/mass
  set power current * voltage ;;sets power = to I * V
end ;;ends the setup function
to go ;;creates the setup function for the button we will be using up to turn the clock
  ask Drum [right (delta_t * omega * 360) / 2 * pi] ;;makes the turtle spin according to the angular distance formula
  wait delta_t ;;makes the program wait for delta_t seconds
  ask Weight [fd omega * delta_t * 180 / pi * drum-size / 128 show ycor]
  ;;makes the weight go forward according to the equation, omega * delta_t * 180 / pi * drum-size / 128 while
showing the change in y coordinates
  if [ycor] of Weight > 10 [stop] ;;makes the go function stop when the weight exceeds the value y = 9
  if power < .5 [ask Drum [set color red ask patch (max-pxcor - 10) (max-pycor - 20) [set plabel "stall!"]] stop]
  ;;makes the drum turn weight and stop turning if the power value is less that .5
  tick-advance delta_t ;;advances the tick counter by delta_t seconds
end ;;ends the go function
```

Final Design Descriptions



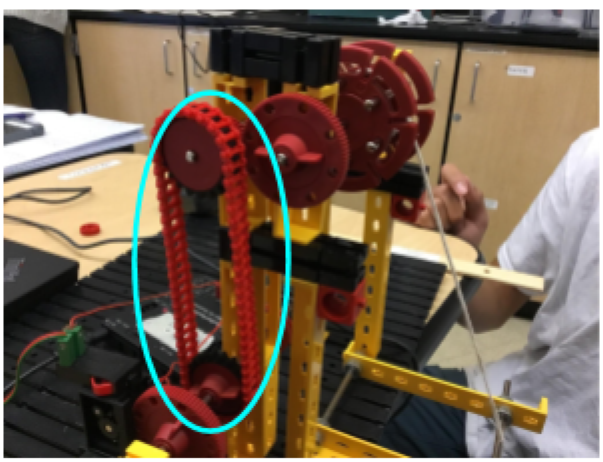
To turn on the machine, the switch (right next to the blue circle) is pressed which allows the electricity to flow into the motor. From there the the motor turns a small built in gear which is meshed a red gear (inside the blue circle) with torque in mind because the built in gear is much smaller than the red gear. Then because the red gear is tightened onto an axle when the gear turns, so does the axle.

Electronic Signatures:
Karina Aguilar 10/20/17
Oswald Dai 10/20/17



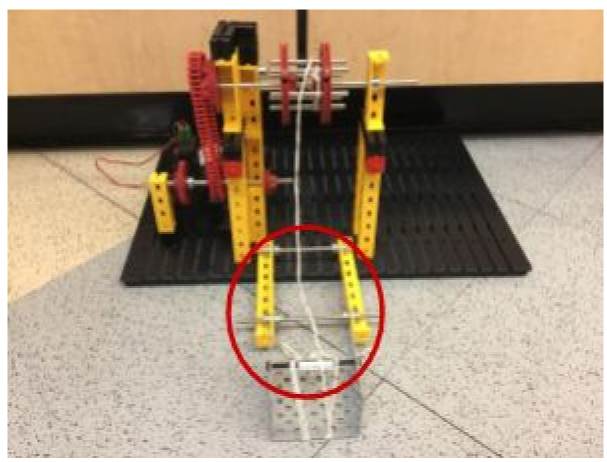
The large red gear, meshed with a small red gear, is on an axle that is in the connected the middle of the cable spool. After the central axle of the cable spool is set into motion, the cable spool begins to turn which winds up a string tied to a part of the spool.

Electronic Signature:
Karina Aguilar 10/20/17
Oswald Dai 10/20/17



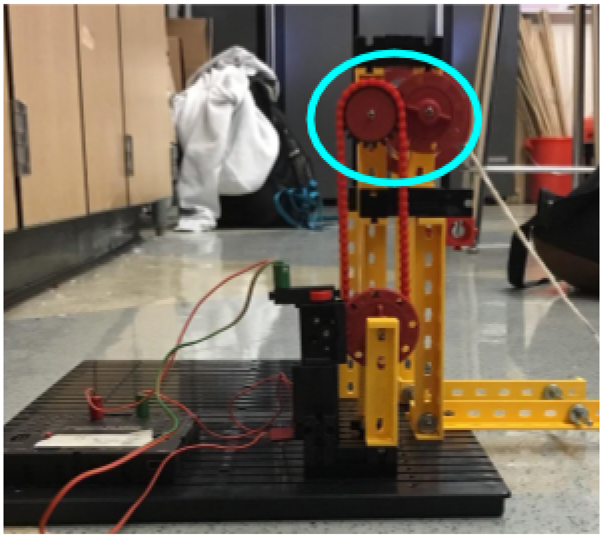
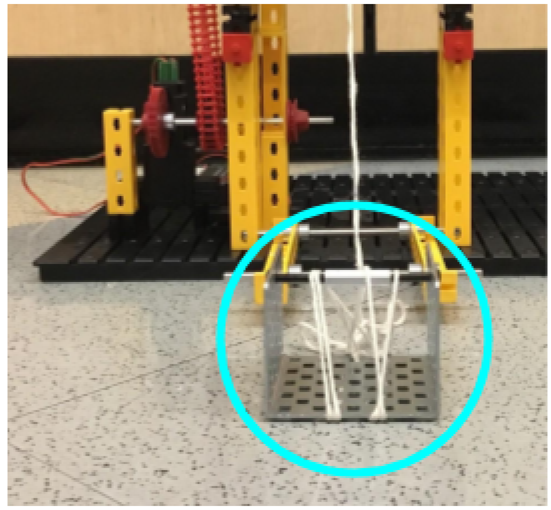
Once the large red gear and the axle rotate, it begins to rotate the black sprocket. Since the black gear is apart of a chain and sprocket system, the top black sprocket and it's axle rotate from the bottom black sprocket's rotation.

Electronic Signature:
Karina Aguilar 10/20/17



As the pulley winds up the string, the outstretched axle (within the red circle) provides an angle for the string. This is to prevent the weighted basket from getting caught on the platform.

Electronic Signature:
Karina Aguilar 10/20/17

 The top black sprocket shares the same axle with a small red gear, so the rotation of the axle rotates the small red gear with it. The red gear with torque in mind is meshed with the small red gear and is spun into motion as soon as the small red gear moves to turn another axle. Electronic Signature: Karina Aguilar 10/20/17	 The weighted basket provides 100 grams of force/ resistance for the spool, as it winds up the string. Electronic Signature: Karina Aguilar 10/20/17

Final Design Description

Our final design is able to effectively reel in an object up to 100 grams in weight. The object being pulled is attached to the untied end of a string which rotates around the barrel of our winch. The Fisher Tech motor is used to power our entire mechanism. It spins the first gear, which generates the torque necessary to lift the object. On this same axle, a sprocket rotates at the same angular velocity of the first gear. This sprocket is attached to another sprocket of the same size higher up on our device generating a one-to-one ratio when connected with a chain. The upper sprocket then rotates the an axle which has another small gear on it. It is meshed with another gear, one larger and with more torque. This gear is on the final axle which rotates the cable spool. It takes our cable spool 41.45 seconds to reel in a 100 gram object from a distance of 30 centimeters, translating to 0.294 Joules. We measured the voltage of our system to be 8.09 V and the current to be 88.7 mA. Given this data, the mechanical power output for our device is calculated to be 0.0071 watts. The electrical power input is 7.176 watts. Overall, the total efficiency of our mechanism is about 1.0l%. Although it seems incredibly low, we lose a great deal of efficiency due to friction. In addition, making our design more inherently sturdy by using VEX parts as opposed to Fisher Tech, we would have eliminated the need to gear for torque and focused on improving the speed instead. However overall, our design functions well constructed with Fisher Tech.