Project 2 Pre

This is the integrated PDF for the **What's If --- Charger**, while only the most important part would be delivered by Presentation. In other words, the slide would be a compact version of this PDF,, in the preparetion stage. However, at the end, you would like to mainly see the Slides and use other files as secondary resource for any unseen part.

For you better experience, we also upload the pre video onto this Youtube channel. **Sorry for the time limitation, we just inlcude the raw MOV Video File inside of submission. We will update the linsk by comments once youtube accepts our vedio.**

Please following this PDF to fill/complete the Slide: Mainly Show Key Words and figures! Do not Copy banches of Sentence!!

- [Yoosup Shin] will assist Puhang Cai to finish the Slides
- [Yoosup Shin] would do all the recording for each part --- based on this PDF and the comments of each Slides --- you would better prepare some drafts. As the finial version of the Slides will be finished by Friday 9 AM, please prepare the drafts now. Tomorrow 9AM-11AM, please do the recording, and send the audio file into GroupMe. Along with the audio recording, we would like to track how you interact with the slides--- but we won't use this interaction as the final video. We mainly looking forward to your clear audio presentation over each part of the Slides.

The Script from [Yoosup Shin]

Cover Slide & Design Name

- Course: MEMS 1029
- Data: Mar 17, 2022
- Assginment title: What If -- Charger
- Team Members Name:
  Ziang Cao: ZIC25@pitt.edu
  Mingze Cai: mic179@pitt.edu
  Puhang Cai: puc4@pitt.edu
  Yuming Gu: yug52@pitt.edu
  Yoosup Shin: yos34@pitt.edu
- explanation of contributions from each team member

For the Member column, the order matters and usually the first author contribute more than 60% of the work load.

Task	Time (hrs)	Member
/// **Overall Managements** ///		
Project Orgnization	5	ZIC
Project PDf Wrtiting	7	ZIC
Professionalism Check	2	MIC, PUC
/// **Presentation** ///		
Pre Slide	4	PUC, YOS, MIC, ZIC
CAD animation	1	YUG, YOS

Video editing	2	MIC, YUG
Video Recording -- All Part	2	YOS
/// **Design Anlysis** ///		
Normal Spring Anlysis	4	ZIC, YOS
Torsion Spring Analysis	3	PUC
Rotor Spring Analysis	10	PUC, YOS
Gear Train Design	3	MIC, ZIC
/// **CAD modeling** ///		
Hand Crank CAD PickUP	1	ZIC
Spring + Gear CAD PickUP	3	YUG, PUC
SolideWorks Assembly	15	YUG
/// **Post-design** ///		
Bill of Material	2	PUC, MIC
/// **Formal Calculations** ///		
Free Body Diagram + sketch	2	ZIC
Spring Calculations	3	PUC
Gear Train Calculations	2	MIC

- A Name for the design: What's If -- Charger
  To show what's would happens if we only use classical mechanism to store the energy in the modern life.
- Will Attach an overview image of the whole assembly!
- [PUHANG CAI] --- Leave the space in Slide
- [YuMing Gu] --- prepare the overall screenshot?

Objectives

- Our device can store 10 Watt-hours of energy.
- We have analysis on 3 types of springs, and finally choose to use the "rotor spring". To deliver an appropriate analysis, we read Chap10-14 to equip ourself with relatant knowledges.
- To minimize the size of the system, we seek to reduce the space for spring by find more stiff spring and utilize the parallel strcutre.
- The focus of hand-crank design is to maxmize the torque that can be given by human, rather than the handle shape. Before it is truly productized, we can incorporate human factor considerations to make the handle grip experience better.
- We also search among the internet to reveal the best shopping resource for bunch of springs.

Design and Analysis

1. How does our design of the device meet the criteria?

- [MINGZHE CAI].

2. Why did you select the gear train ans spring arrangment that you did?

- [MINGZHE CAI].
- Consider the torque that a human can give to the hand-crank;
- Determine the required torque based on the specifications and overall number of the spring.
- Figure out the required torque amplifing ratio between human input and required storing input.
- Break down the amplifing ratio to a gear train, given a few options among the common commerical gears.

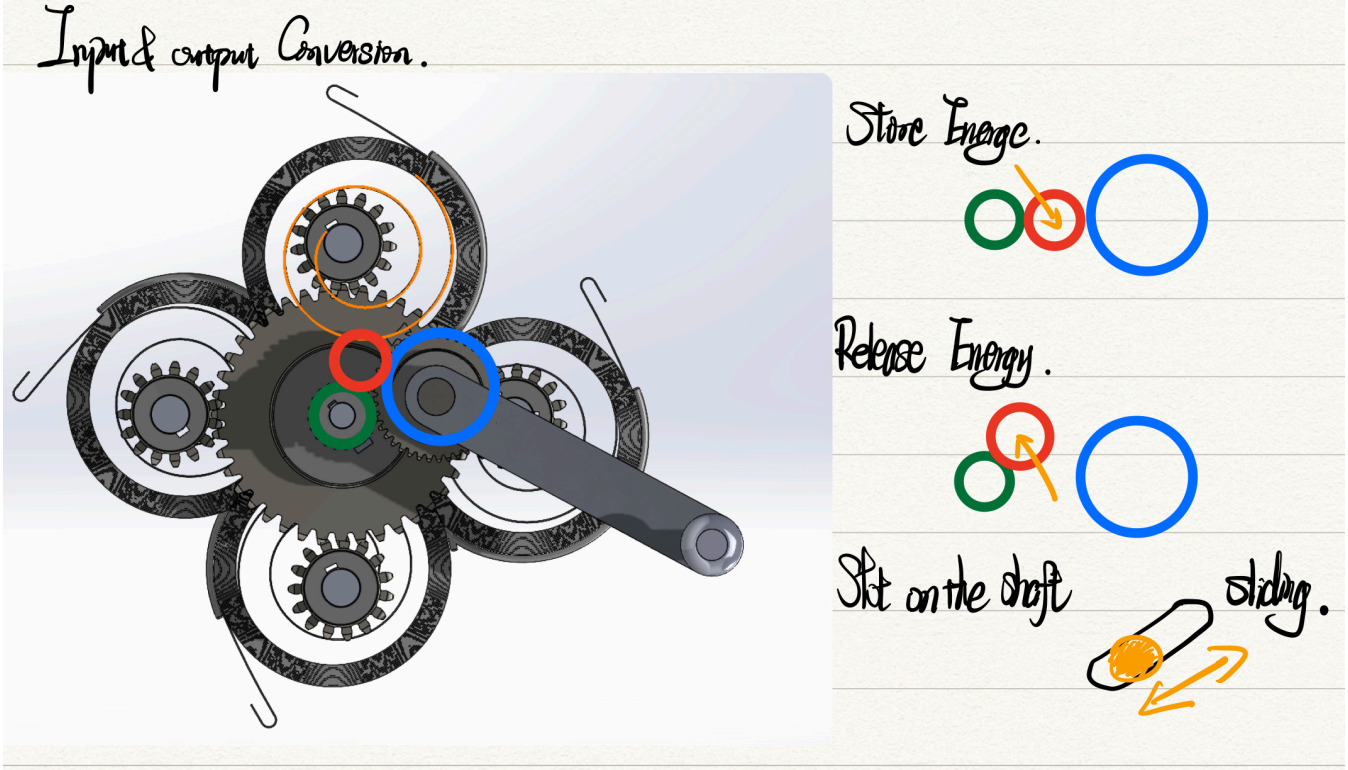
3. Give Detailed Specifications of all design components.

- [YUMING GU]
- Please refer to the Cost

Feasibility

1. What steps did we take to make the device as realizable as possible?

- [Ziang Cao].
- Iteratively refine the spring choice to reduce the required number of it down from 3600 --> 700 --> 100 --> 40 --> 4 (ideally).
- Squeeze the size of our *What If --- Charger*! Take advantage of the parallel structure!!
- Design the Input & Output Conversion relates to the same spring energy reservoir.
  The Key design is that we introduce a moveable gear between the small gear on top of the main shaft and the large gear right behind the hand-crank structure. The inspriation of this control solution comes form this video. We can make the moveable gear slide along a diagnostic slot. But due to this is not the focus of Project 2, we didn't realy implements this in SolideWorks. There is a sketch to show the idea.



2. State whether the client's idea is feasible and provide reasons as to why or why not?

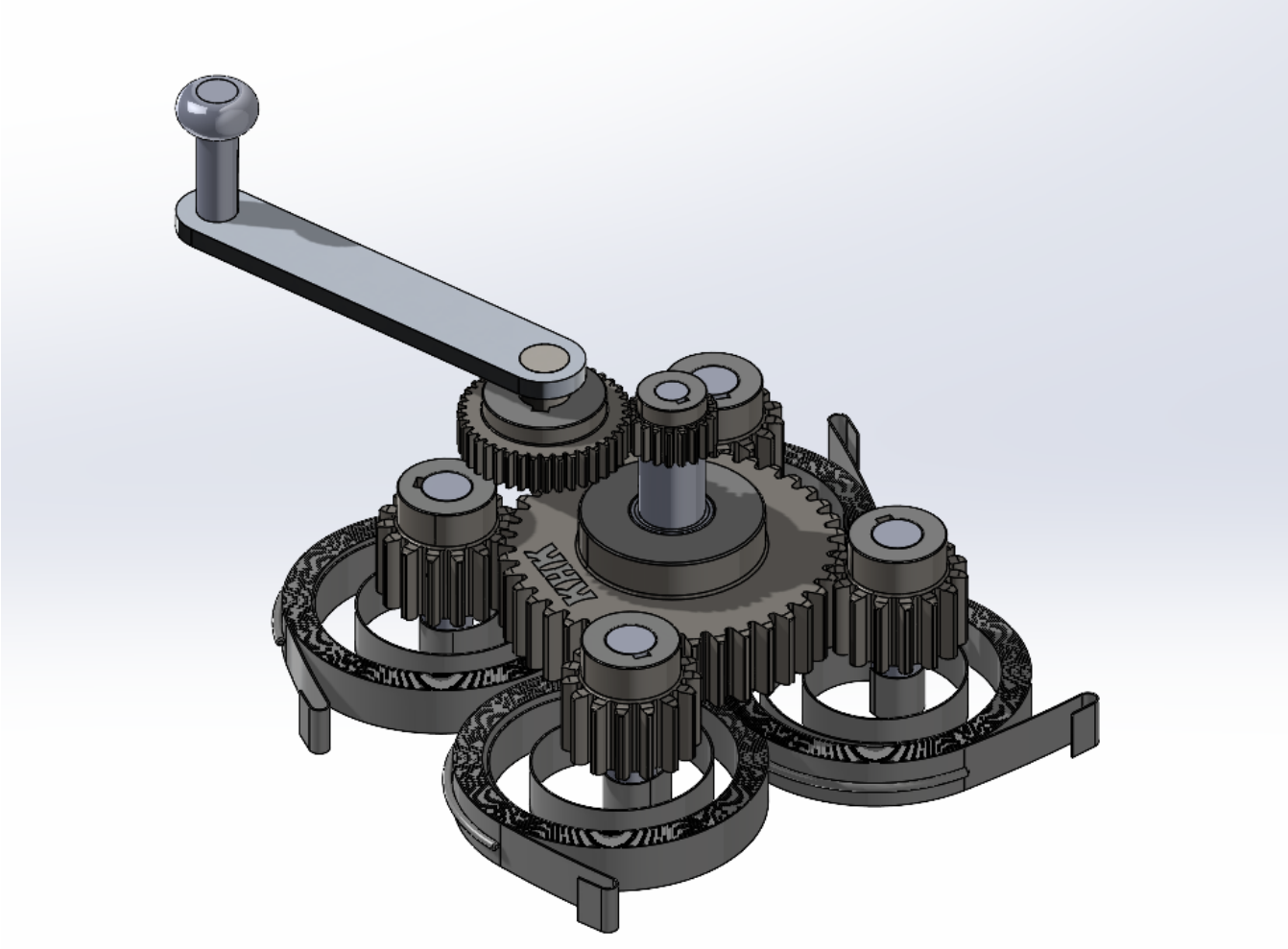
- [ZIANG CAO]
  The interesting part and most meaningful attempt is that: we can have a glance of what would the be world be by merely using mechanical structure to drive the electrical application. Then, start appriciate of the chemistry battery and so on.

Back to the real world business anlysis: This idea is Infeasible!

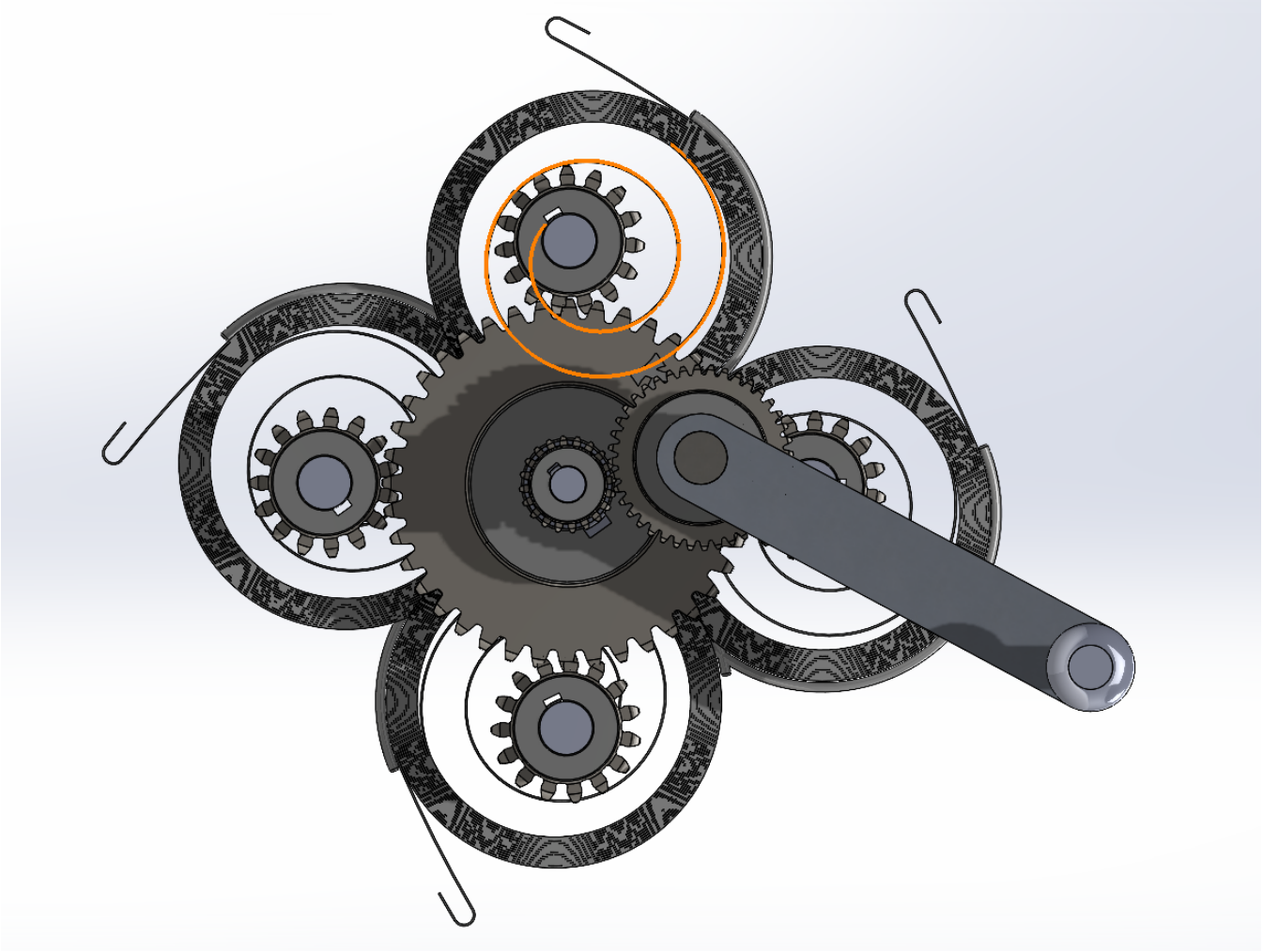
- The engery spatial density is so sparse! No one would realy use it.
- The overall size is so big like a huge traveling suitcase, while it can only charge the phone for a while.
- The price it too high.
- Although the 10 Wh is acceptable for human, it would be better to change hand-crank input to bicycle-like foot-crank input.

Solid Model and Engineering Drawings

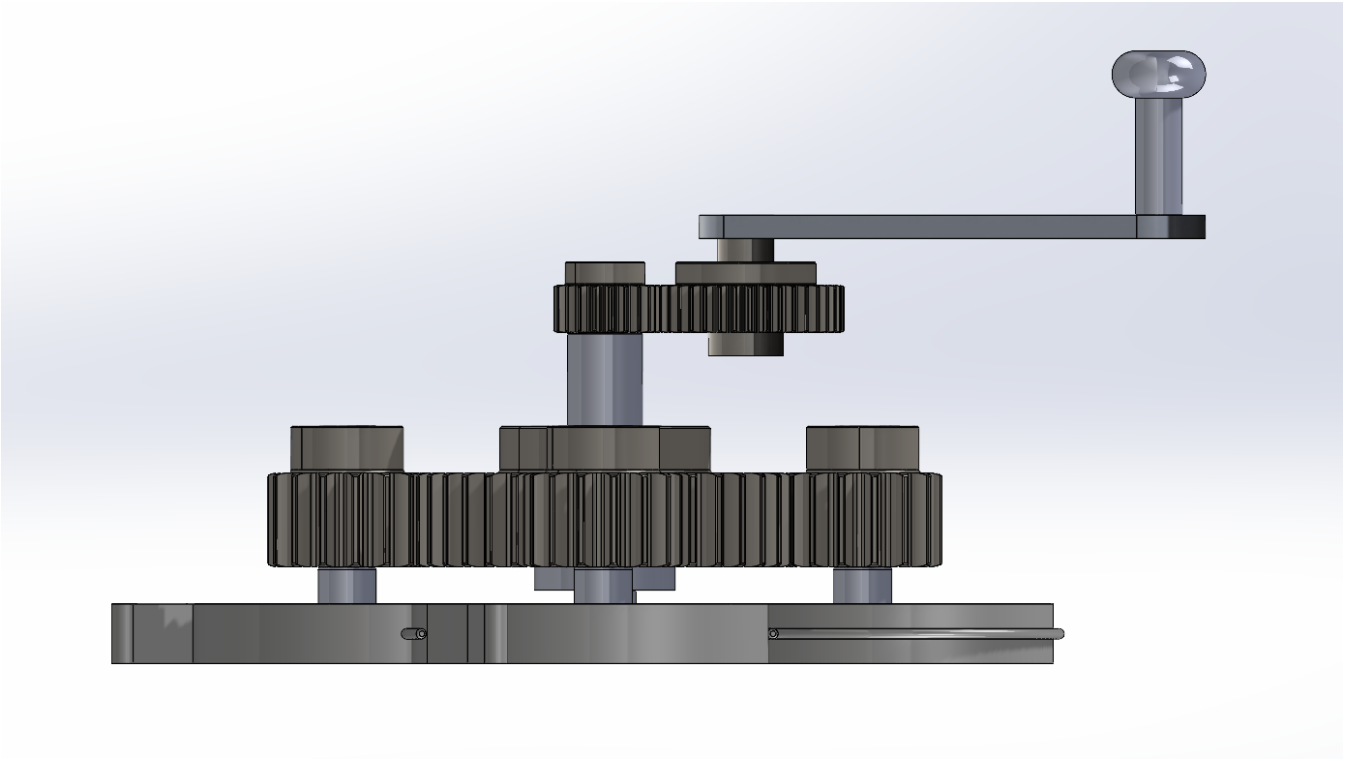
- [YUMING GU]
- **[Still Need to be Completed!!!] 3 Parts!!!! The Hand-crank, gear box, and energy storage setup.**
- Clearly Show 3 different views of the model due to its compact nature. The isometric view:



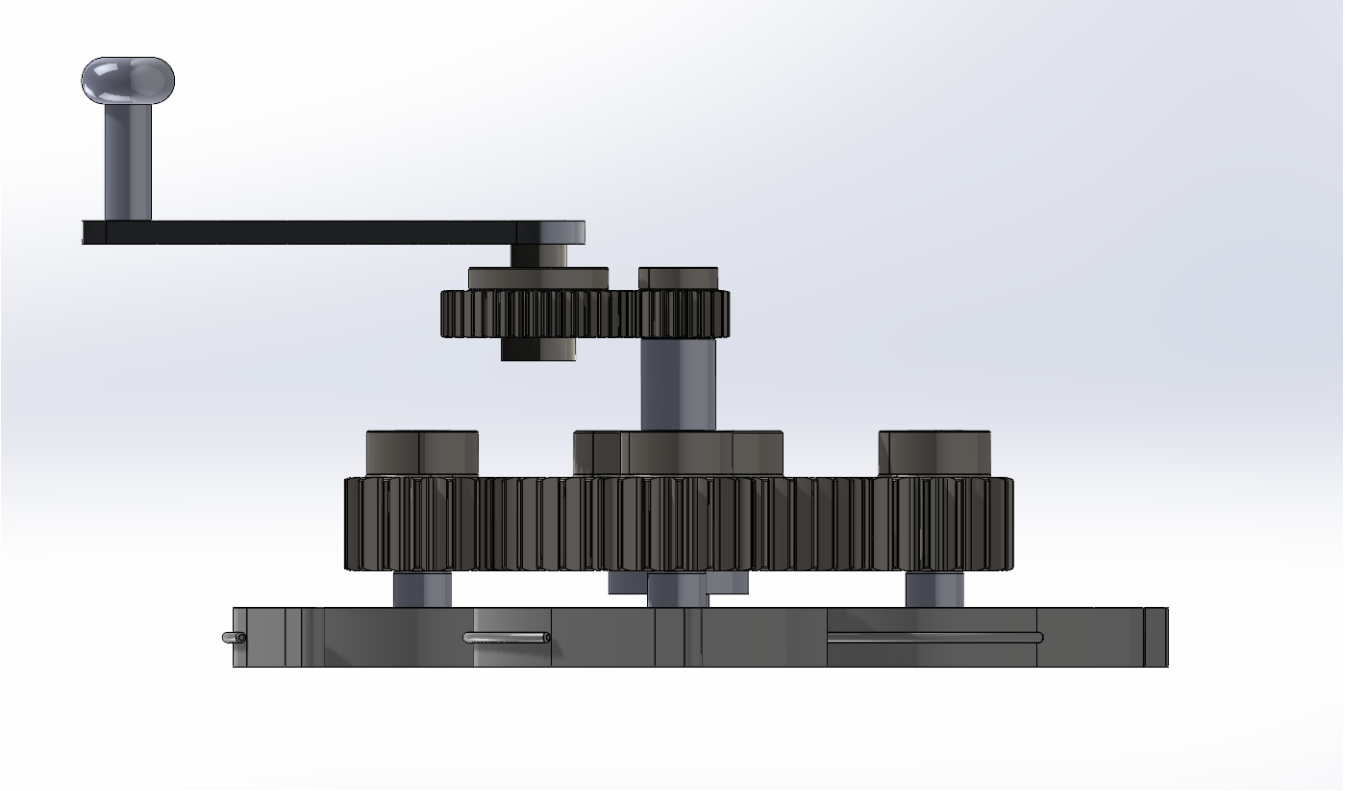
The Top View:



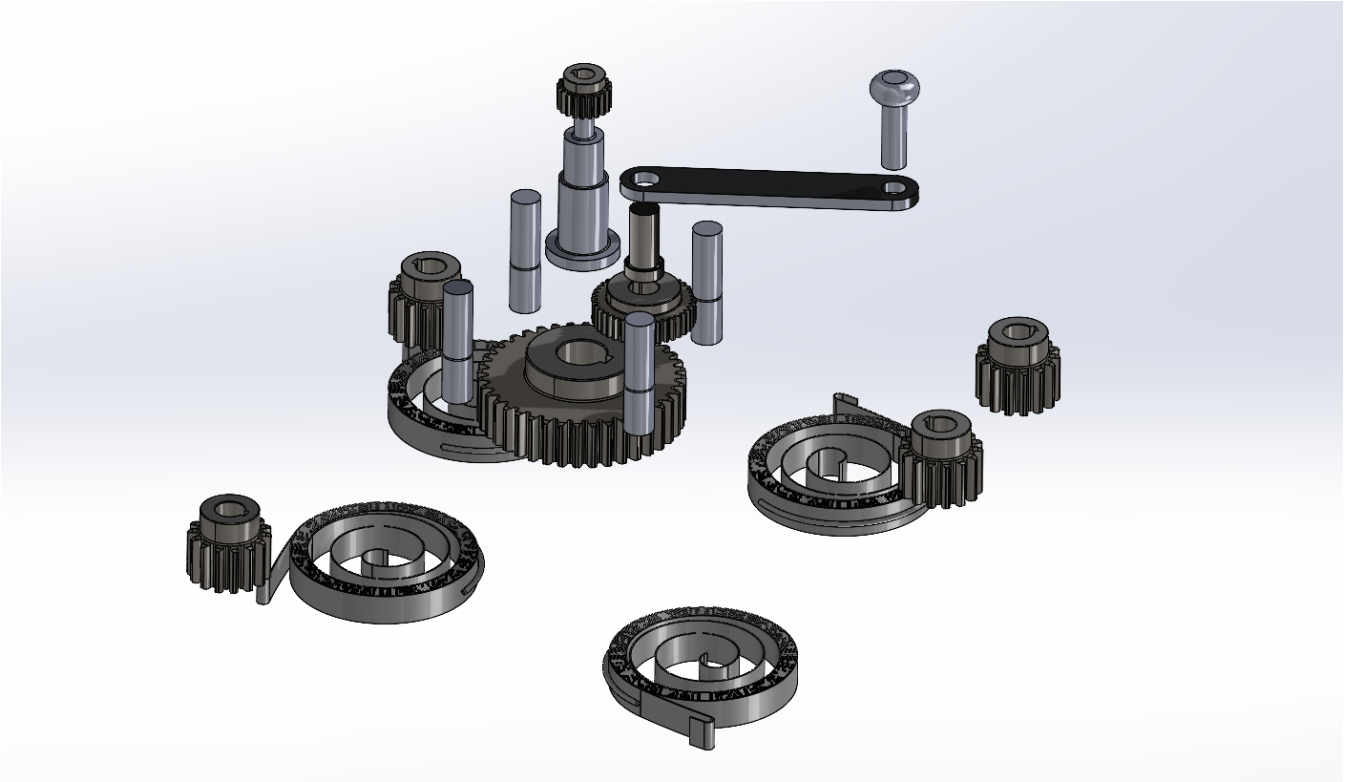
The Front View:



The Right View:



- Use sub-assembly views if necesary to explain the operation and components The Expolse View:



- A video of the gear train in animation would be helpful!
    - Done!

Bill of Materials

- Add a complete Bill of Materials listing all of the components used in your design, with specific vendors and part

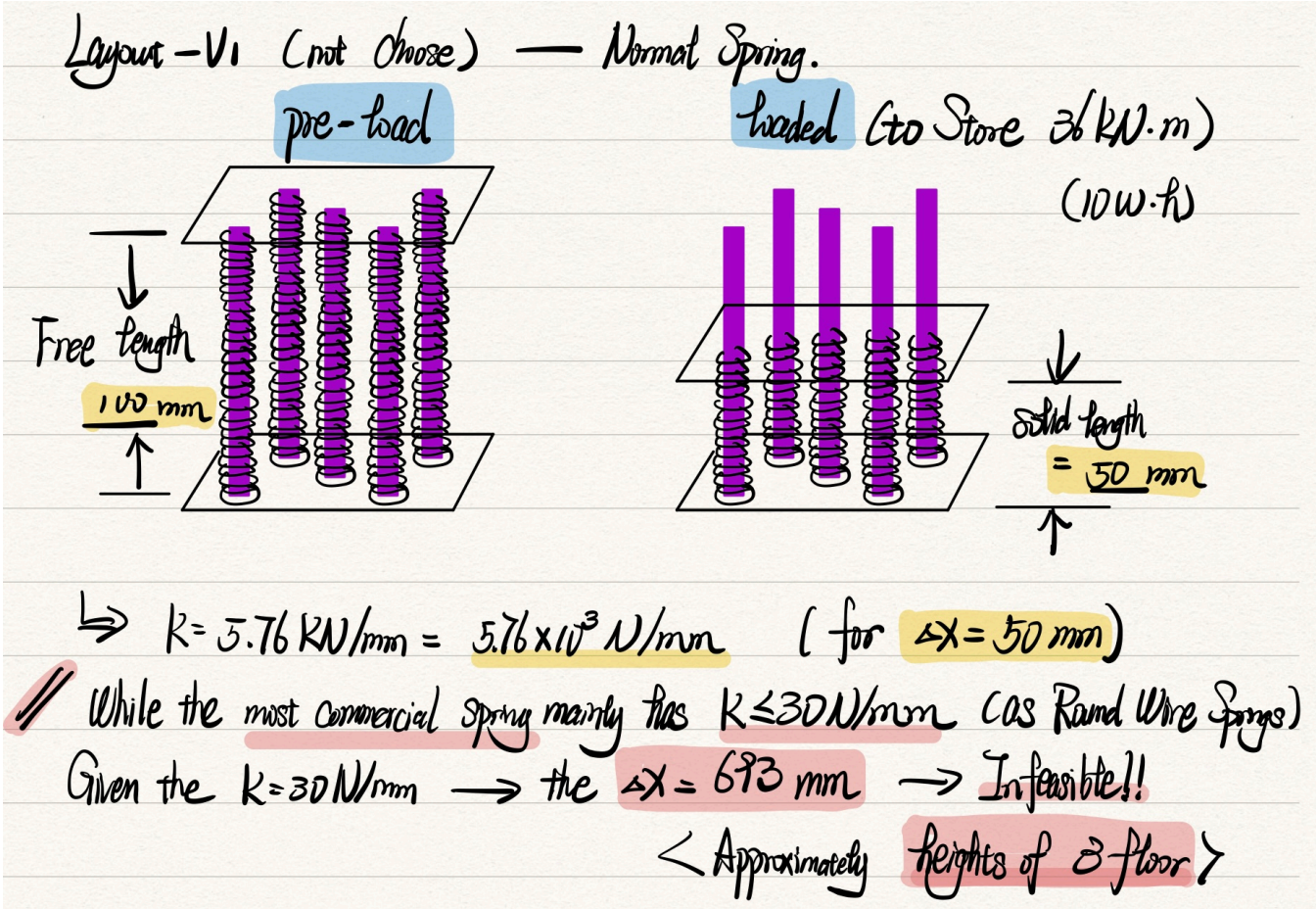
numbers wherever appropriate.

Formal Calculation

Normal (Round Wire) Spring Design

Please refer to the whole anlysis ipynb and PDF for further details!

- [Ziang Cao]
  We start from the round wire Spring. As making a realword-product, instad of solving a textbook question: we simplify the design by applying "Over-a-rob" scenario -- which to get rid of the buckling, we add sticks inside of the wire. However, even with a rob, the round wire Spring would requries 5000 N/mm (a 100 times larger K than most commerical one), or 7m of delta_x (Height of 3 floor) to store the enough energy. The following figure shows the key scenarios.



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Hence, due to the infesibility, we stop the analysis of Round Wire Spring, and switch to "Torque" & "Rotor" Spring.

Torque + Rotor Spring Calculations

- [PUHANG CAI]
- Include your FBD

Gear Train Calculations

- [MINGZHE CAI].
- Include your FBD