Conceptual Design Review

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ENGR 1182
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Brainstorming Full System Design
Process description

Our team incoporated many methods to create our full-system concept ideas.

First and foremost, the teamwork method is very important for our cooperation. We made a regulation specifying each group member’s position and responsibility. Andrew Wilhelm manage the R&D, Chenjie Wu takes the responsibility of Marketing, Siwei Zhang takes Human Resources, and Aaron Cox takes business manager.

Then, we brainstormed our raw ideas of full-system that relates to idea of transportation. We talked with each other and created sketches on the paper to describe in detail. When there were many ideas appeared, some analysing methods were employed to determine which one is superior, including listing user needs and rank their importances, creating Pugh scoring matrices and even conducting primary search (directly contact potential end-users) and secondary researches (find scholarly articles online to support/ reject ideas). Finally, we decided to choose the hook-style of our two choices.

Brainstorming result

Urban sprawl brings many problems to modern society. One of the most important issues is to move people from suburbs to urban centers in a safe, efficient and minimal way. So a new solution came into being - Intelligent High Speed Railway.

Our brainstorming focused on how to design energy-efficient and environmentally friendly system of rail and vehicle that the vehicles could hook on the rail or drive on the rail, so that users can get a good experience. In terms of materials, we chose carbon brazing, which is a very light and environmentally friendly material. It would not only make the vehicle more energy-saving, but also save the cost of manufacturing.

Secondly, in terms of power, we have designed it as a hybrid electric and solar power. If we rely solely on solar energy, the efficiency of vehicle operation will be greatly reduced in bad weather. In addition, we catered to the aerodynamics on the front part of the car, which could greatly speed up the speed of the car and make the user commute more efficiently.

Update needs and ranking

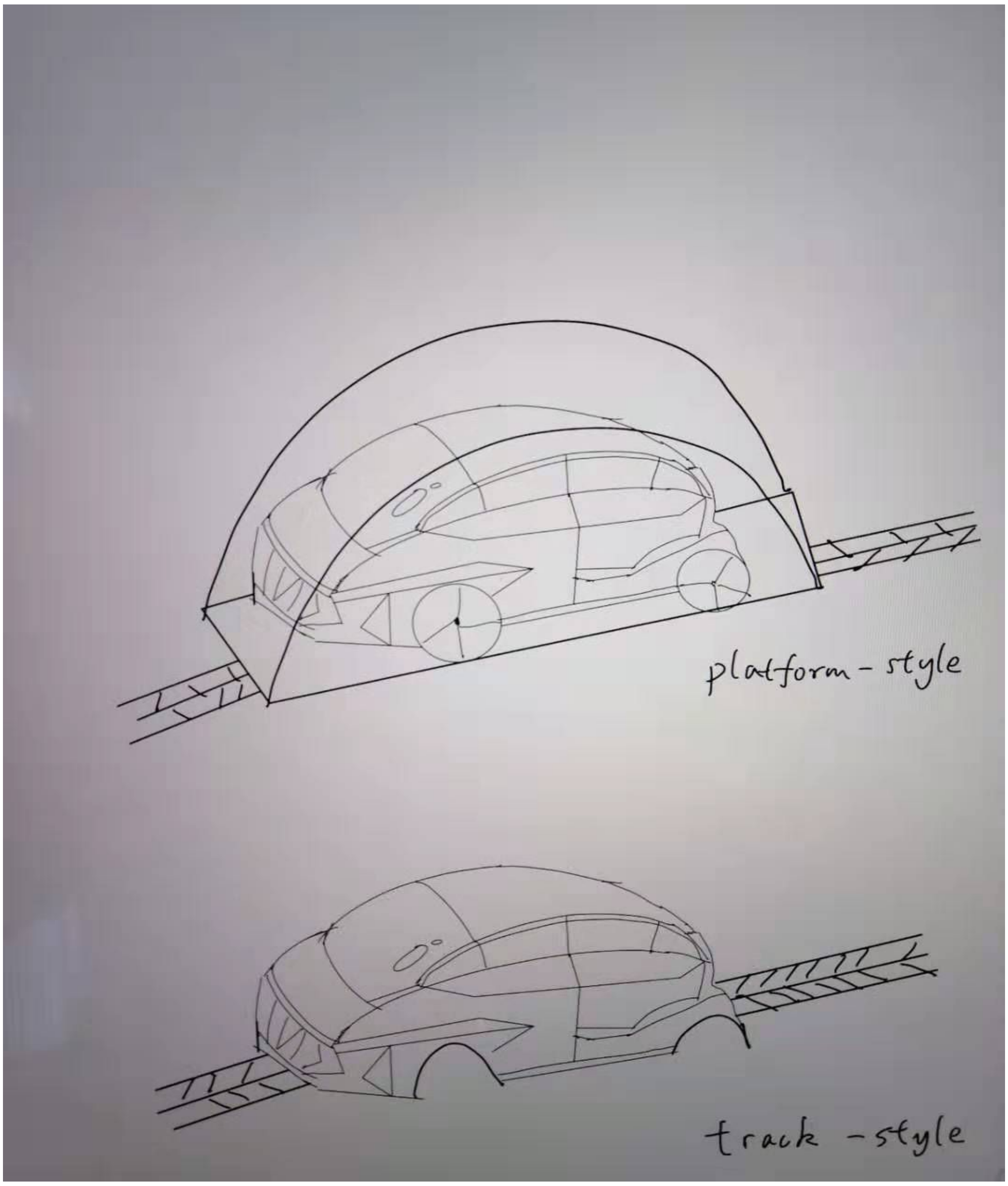
To get the feedback from the potential end users, we conducted primary research to received their ideas.

The main form of primary research for this project has been the online Google Forms survey. The results of the survey have been consolidated into an average in order to generate the pairwise comparison seen below. The results came from 13 respondents to the survey. Additional primary research was conducted by searching online discussion boards for conversations about traffic and commuting in Columbus, as well checking traffic maps. Examples are available in the appendix. This research allowed us to get a feeling about what]people think are the pains in their commutes. Care must be taken because there is an inherent bias towards online postings being about bad experiences because few people take the time to post about how easy and uneventful their commute was.

Two concept descriptions with sketches

Concept 1: Highway track system to cut down on traffic time. Similar concepts but the main difference being that cars drive up onto a platform and lock in which is what takes them around. The computerized system that controls it is centralized, then a localized system, then an emergency system. All systems whether public or private are connected

Concept 2: Highway track system to cut down on traffic time. Will have customizable pods/cars that hook onto the tracks when entering the highway and when getting off the highway, wheels will deploy and allow the driver to drive normal. System is automated so it can easily move past each other with no traffic and/or accidents.


platform-style
track-style

Full-System Concept Selection

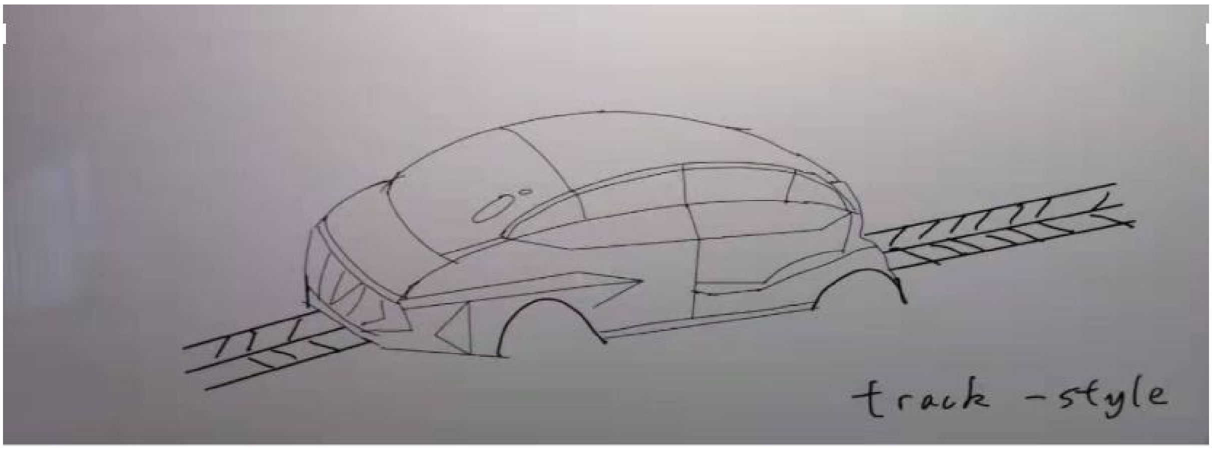
Pugh Scoring Matrix.

		Reference		Concept 1		Concept 2	
Needs	Wgt	Rating	Weighted score	Rating	Weighted Score	Rating	Weighted Score
Ease of Use	4	4	16	4	16	5	20
Fast Commute	4	2	18	4	16	5	20
Safe	5	3	15	5	25	5	25
Private	3	4	12	4	12	4	12
Always Ready	4	3	12	4	16	5	20
Reliable	4	2	8	3	12	4	16
Low Cost	4	1	4	2	8	4	16
Internet Connectivity	1	1	1	4	4	4	4
Customizable	2	3	6	3	6	3	6
Environmental Friendly	2	1	2	3	6	4	8
Total Score			84		121		156
Rank			3		2		1
Continue?			No		No		Yes

Due to the Pugh Scoring Matrix, we know that safety is always the first consideration of a train, followed by whether it can bring more convenience to people, which is usually reflected in whether it is reliable, efficient and easy to use. Instead, whether it caters to individual needs or is good for the environment is often not a matter of public consideration.By comparing the two models we designed, platform-style and track-style, we can clearly find that model 2 is not only more reliable in terms of safety, but also more convenient for the public.Therefore, we will choose track-style train as our experimental model.

Description and sketch of final selected full-system concept

As the graph below shown,in the real-world track-style system, the car is hooked on the track and the computerized system of the track help manage the traffic. In our scaled design, we would not use the equipment provided by instructional team, but we use one small model train and a arduino-chip-connected train track, all of them would be purchased by a group member. The train cabin drew electricity from track, and an arduino chip in the track controls the train. This is an equivalency of that central computerized system control all vehicles in the real-world concept. The cabin simulates the cars hooked up on the track, and the arduino chip simulates the centralized controller. Unfortunately, there are some limitations of this downscaled system. Firstly, the track is not long and complex enough to hold many cabins. This is due to the small place to do the experiment. Also, though the track tows the cars in the real-world system, we decided to implement a delimitation of putting the motor into train cabin, because a track with movable components are too complex, heavy and also expensive. However, the power supply and controlling would still come from the track.



User feedback on final full-system concept selection.

We received some feedback from our end users. On one hand, people generally agree the safety of the system is always the most important so we prefer to keep its weight like before. However, based on our end-user feedback, people generally agree that “always ready” and “easy to use” are less important than safety, so we decided to change their weights to 4. Also, many of them say that private is actually not as important as a cheap price. Therefore, in our pugh scoring matrix, we swap weight of low cost and private. Obviously, simply hooking on a track is cheaper than building a lot of movable platforms. Based on these feedback, we have finished our revision and updated our pugh matrix, showing that concept 2, the track-style design, has even more advantage than before revision. Also, we decided to add some inclination at the bends of our real-world design. This can increase the speed of passing the bends safely. Therefore, the rating of safe in concept 1 and 2 increased.

We finally chose concept 2 and we downscaled it to the train model described in the final concept sketch.

Full System Design Requirements

Full system design requirement table:

Requirements	Range	Ideal
Fast to learn	1-3 weeks	1 week
Reach downtown in relatively short time	25-55 min	25 min
Reduce traffic accidents rate	20%-40%	40%
The time required for assistance	3min-8min	4min
Possibility of influenced by bad weather	5%-15%	5%
Minimize failure rate when preparing	0.01%-0.08%	0.01%
Reduce fuel cost	18-40 mpg	35 mpg
Have precise GPS guidance system	accuracy within 1-5 meters	0.5 meters
The kind of the vehicles could be supported	5-8	5
Emission minimized Carbon Dioxide	3-8 metric tons	3.4 metric tons

For the requirement “Reach downtown in short time”, we would design our downscaled model car to be fast, because faster speed usually means shorter travel times. Also, we would design a straight rail instead of bending one because a straight line is always shorter than bending line connecting identical two points.
To reduce the traffic accident rate, our design would focus on minimizing braking distance and installing a backup power supply. These two designs simulates ordinary measures in the real life. To reduce the possibility of influenced by bad

weather, we would use a backup power supply mentioned before. Therefore, if extreme bad weather destroy our power supply, we would have another one.

In order to minimize the failure rate when preparing, we would optimize our arduino code to make it more robust, avoiding compile-time error. Also, we would use a better PC for coding to increase speed of compiling. To reduce fuel cost and emission of Carbon Dioxide, we would buy and use a power supply with high energy efficiency. To simulate the requirement “Have precise GPS guidance system”, we would try to increase the braking precision of our model car.

Prototype Concepts

Prototype Requirements Correlation Matrix

	Time compiling and sending code	Time to complete a full loop with max possible power	Mean braking distance from full power	Acceleration to full speed	Maximum power of passing bend safely	Stop precision	Time to stop the train when experiencing electricity cut-off	Power consumption	Maximum allowable height of train cabin
Ease of Use	1	1	3	3	0	1	0	0	0
Fast Commute	0	9	0	9	3	0	0	0	0
Safe	1	0	9	0	9	0	9	0	1
private	0	0	0	0	0	0	0	0	3
Always Ready	9	0	0	0	0	1	0	0	0
Reliable	1	0	3	0	3	3	9	0	0
Low cost	0	0	0	0	0	0	0	9	0
Internet Connectivity	3	0	0	0	0	9	0	0	0
Customizable	0	0	0	0	0	0	0	0	3
Environment friendly	0	0	0	0	0	3	0	9	0
Total	**15**	**10**	**15**	**12**	**15**	**17**	**18**	**18**	**7**
Top req.	false	false	false	false	false	false	true	true	false

According to the model system requirements correlation matrix, It can be inferred that power consumption and time to stop the train when experiencing electricity cut-off are the top requirements. Stop precision is the second most important, and mean braking distance, time of compiling and max power of passing bends are all the third important ones. Therefore, In our model system design, we would focus more on the braking system of our model train, because it relates to three important system requirements. Also, we would buy a power supply that has high transfer efficiency (ideally 80%+) to meet the important requirements of power consumption. In contrast, we would not focus too much on maximum allowable height of train cabin, as it only scores 7.

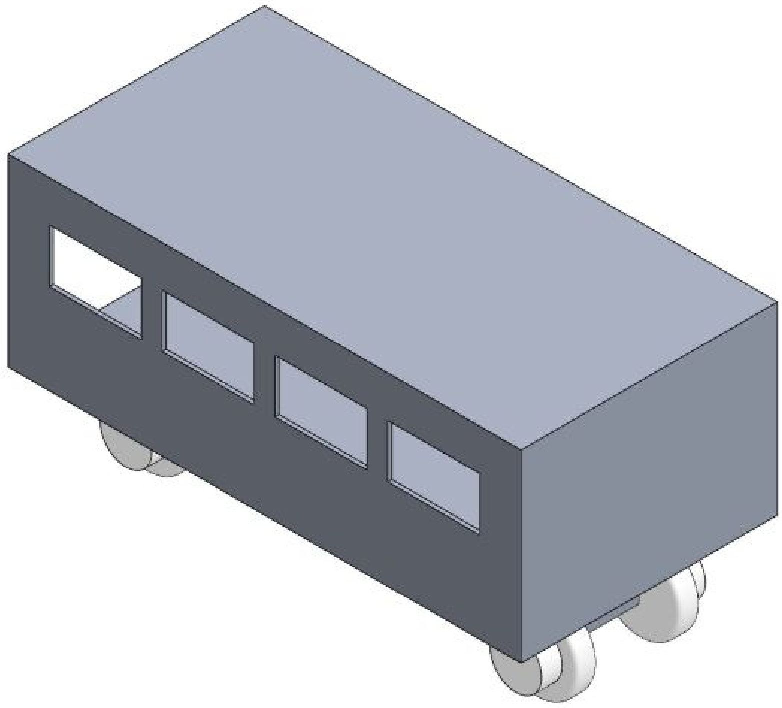
Prototype Design Requirements

System requirements	**Range**	**Ideal**	**Vehicle Requirements**
chip processing speed	1.2GFlops-2.4GFlops	2.4GFlops	2.4GFlops
power supply efficiency	72~80%	80%	80%
regenerative brake energy recovering efficiency.	55~75%	83%	83%
backup electricity system reaction time	1s - 5s	1s	1s
Train cabin's weight	0.8-1.2	0.8kg	0.8kg
Mean braking distance	2.5-3 in	<2.2 in	< 2.2 in

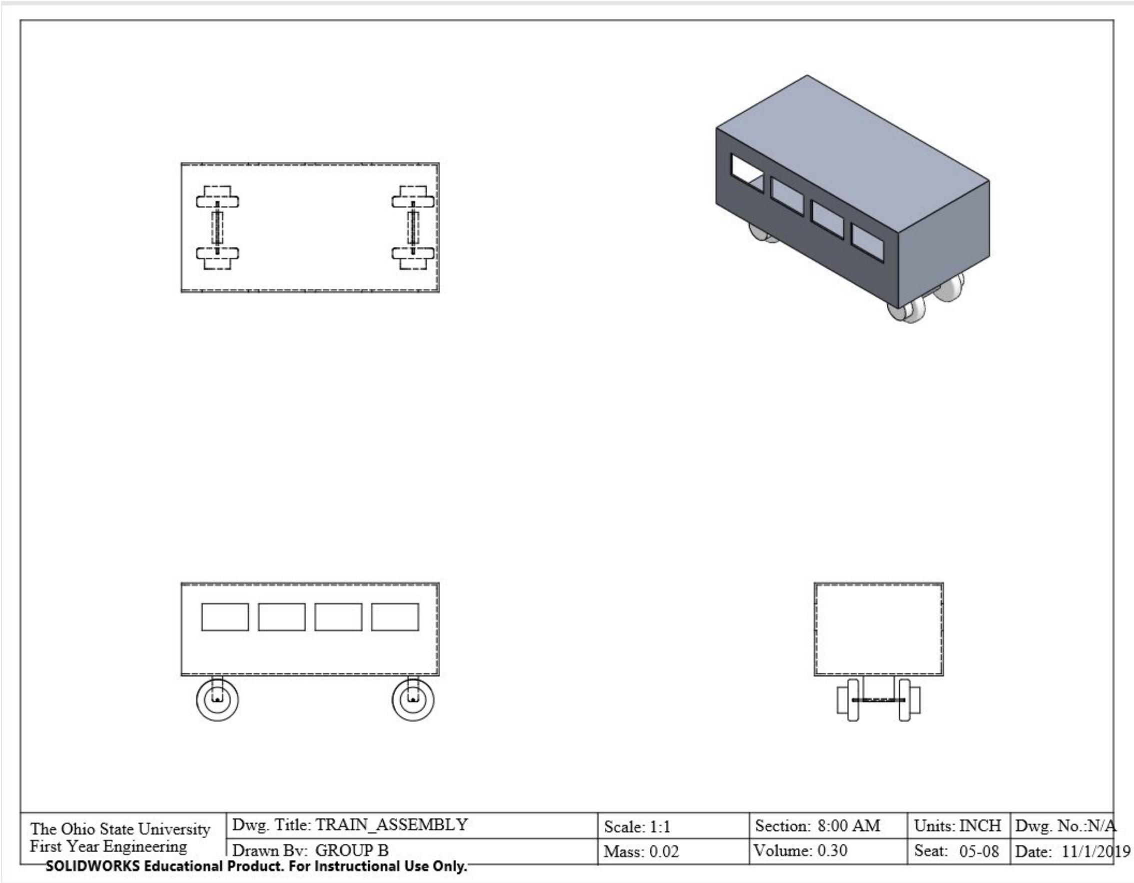
The requirement table illustrates that we need to purchase a good arduino chip that has a good calculation capability. Also, we may consider using the 3D printer in Hitchcock hall to make our train cabin, since the 3D printed components are usually lighter than traditionally made. In addition, we need to add some capacitors on the train to temporarily store the electricity generated by regenerative brake.

Prototype Detail Design

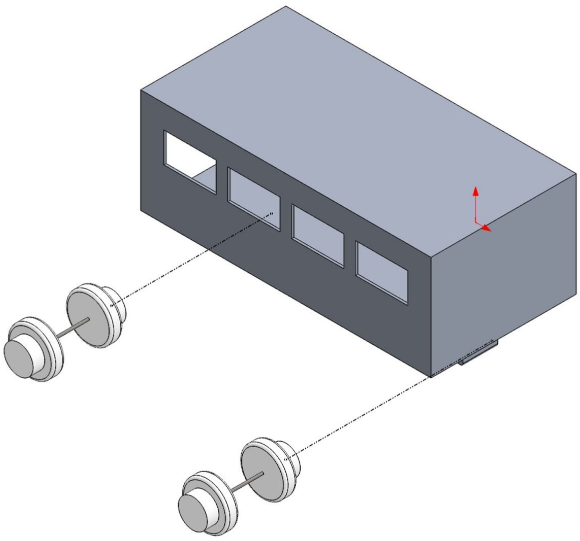
Assembly



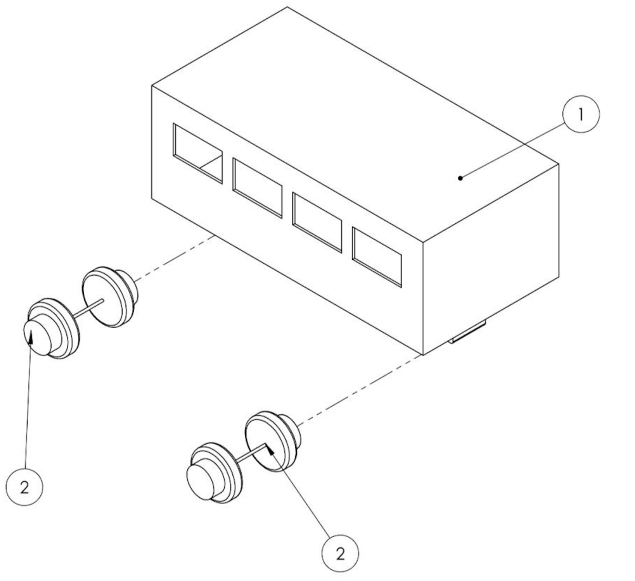
Orthographic drawing



Exploded view



Bill of materials



ITEM NO.	PART NAME	MATERIALS	QTY.
1	cabin	1060 Alloy	1
2	wheel_and_shaft	N/A	2

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	Drawn Bv: CHENJIE WU	Mass: 0.02	Volume: 0.3	Seat: 05	Date: 11/13/201

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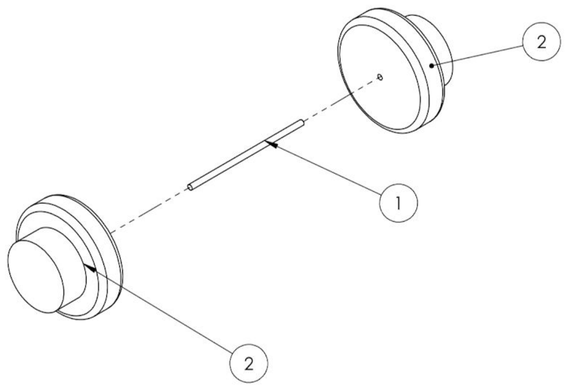

ITEM NO.	PART NAME	MATERIALS	QTY.
1	shaft	Cast Stainless Steel	1
2	wheel	ABS	2

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	Drawn Bv: CHENJIE WU	Mass: 0.03	Volume: 0.91	Seat: 05	Date: 11/13/201

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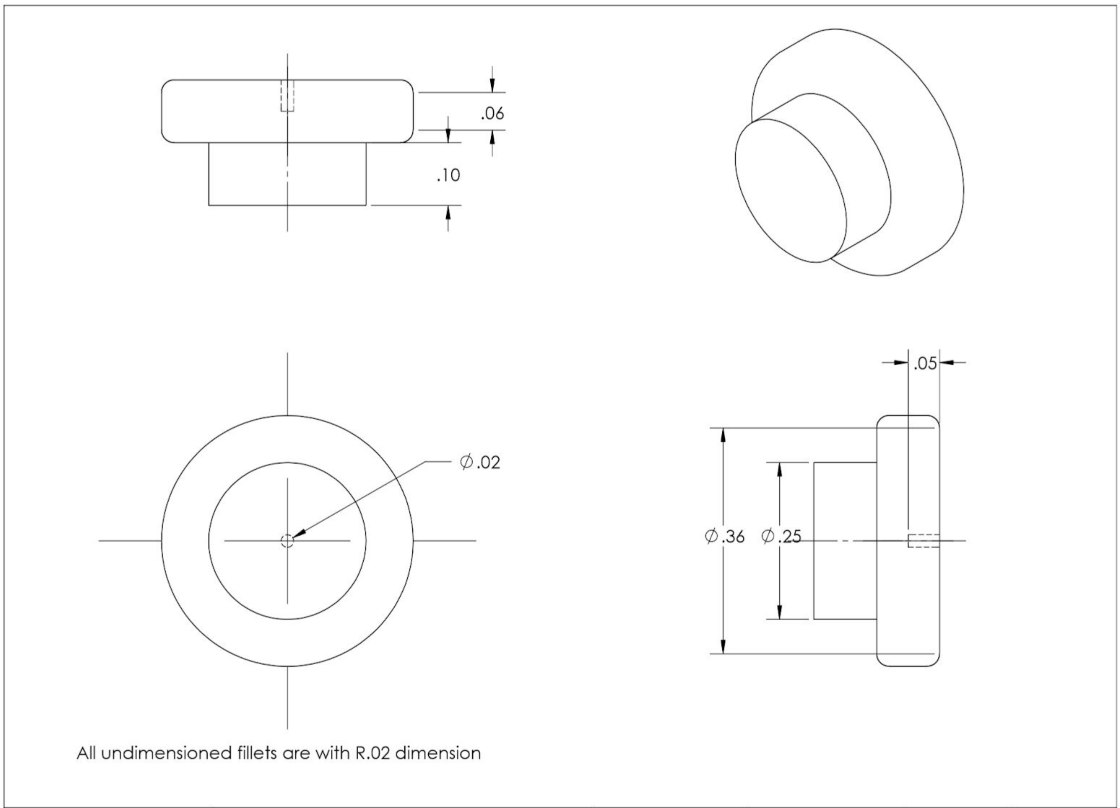
Custom parts detail drawings



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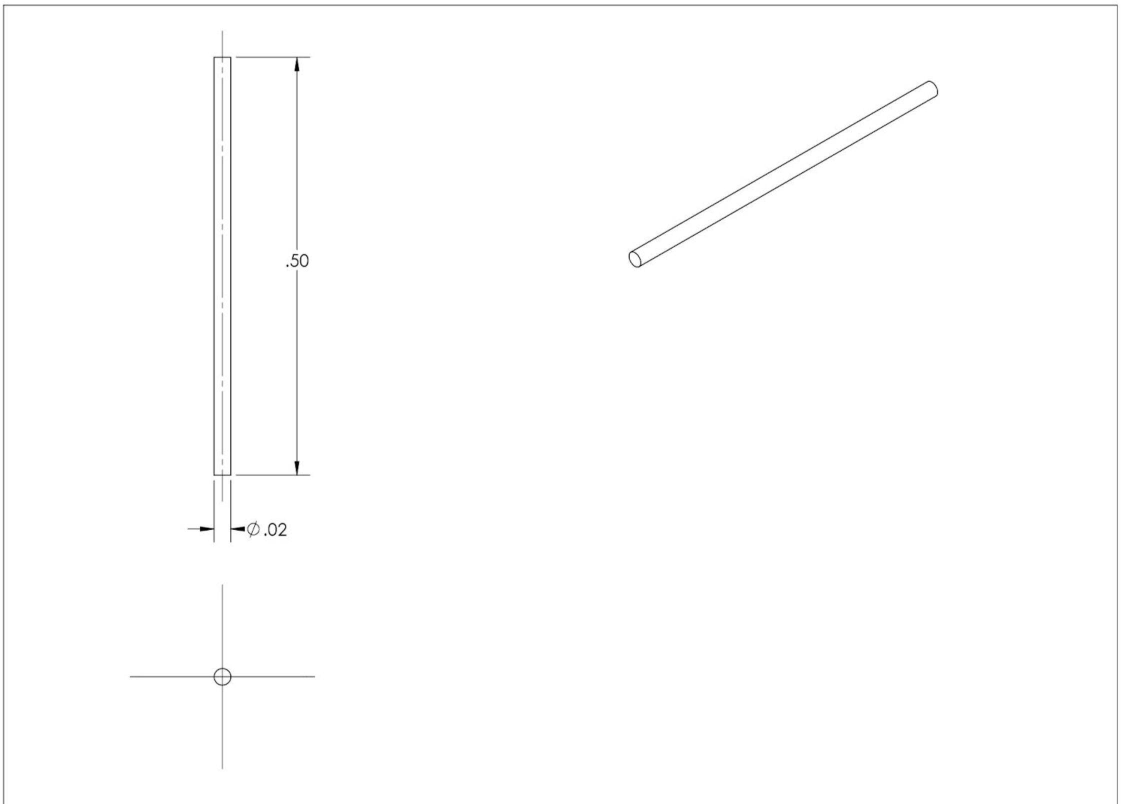

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Verification Plan

Detailed descriptions

In the verification, we define full mark to “success”. That means, the system requirement, which means that the related to user need, is satisfied.

i. Chip processing speed.

The processing speed of our arduino chip indicates how many instructions the processor can execute in every second. If the processing speed is too low, it may not be able to execute the binary codes on time (the compiling of source code is finished on PC), and there may be some problems in the running of our model system.

Directly measures the flops value is difficult, so we can measure the time it complete a chunk of code. There is a software available on github: https://github.com/PaulStoffregen/CoreMark that can “Measures the number for times per second your processor can perform a variety of common tasks: linked list management, matrix multiply, and executing state machines.”, according to its readme.md file. For a reference, the Arduino Due chip has a core mark of 94.95. Therefore, we would set 94.95 to full mark. We would load this code into our arduino chip and receive the benchmark score, and compare it with Arduino Due’s score. We would test 3 times with interval of 5 minutes to prevent overheating, and take the average.

ii.Power supply efficiency

The power supply efficiency means how much energy could be used by us appropriately . When the ratio of the efficiency goes higher, it indicates that more energy could be used to drive the train. Of course,the lower power supply efficiency means the waste of resources.

We can directly measure the the power supply efficiency by using a wattmeter and a resistor. Simply connect resistor with a large resistance to power socket and use watts meter to measure its power W1. Then, connect a small-resistance resistor behind the power supply and measure its power W2. The efficiency can be gotten by W1/W2. The goal is 80 %, which is the ideal requirement and is set to full mark. The zero score is set at 72%.

iii. regenerative brake energy recovering efficiency.

It measures how many percents of kinetic energy can be recovered back to form of electricity by the braking system.

We would buy a power meter and a small bulb. Firstly, we would calculate model train’s speed at full power by measuring the time of finishing 1 loop. Then, its kinetic energy can be calculated by Ek = (1/2)m*v^2. Then, we would stop the power supply but do not apply braking, and measure how long it takes for the friction to stop the train. The acceleration can be known by a = v/t. Then, the frictional force is known by f= ma. Then, we would let the train to run in full power, and apply full braking after stopping power supply, while recording the distance s used for braking. Then, we connect our bulb to the battery in the cabin, and measure the power of our bulb. We would record the time and wait until power run out, and the energy is w*t. Lithium-ion batteries' discharging efficiency is surprising high so we only need to take into consideration of friction. Ek-fs is input of our regenerative braking system, and w*t is energy recovered. output divided by input is our convert efficiency. The goal is 83%, which is set to full mark. 55% of efficiency is set to zero. We would test 3 times and taking average.

iv. backup electricity system reaction time
It indicate the time between main power supply fails and backup power supply take over the responsibility.

Simply measure the time between unplugging main power supply and when backup power supply take over. The ideal requirement is 1s, which is set to full mark. Every second more than 1s results in -25% score. We would test for 3 times and take the average.

v.Train's cabin's weight
It's literally the factor shows us the weight of each cabin of the train. As we all know, the lighter cabin help as to save more resources and the appropriate material makes the cabin become harder. So how to choose the material and control the weight of the train is a big deal.

Aluminium alloys are widely used in engineering structures and components where light weight or corrosion resistance is required. So we choose aluminium alloys to be the material of the cabin's weight.Then we just need to prepare a weight and compare the volume of our train and outdated trains. To be more detailed, we can keep the volume of our train as the outdated version, and calculate the weight of our model.

The full mark is set at 0.8kg. Every 0.1 kg exceeds results in -25% points.

vi. Braking distance.

It refers to the braking distance of our train from full speed. It relates to user need of safety. The full mark is set at 2.2 inch. The range of score linearly spans over 2.2-3 inch.

To marsure the mean braking distance, we need to set a mark in a specific position. And when the train arrive the point with full speed, we should press the stop button. Then we need to mark the parking place. After repeating 10 times. we can calculate the mean barking distance by the 10 results.

Verification Score Card

A. Verification score card (first pass)

System Requirements	Vehicle Reqs	Score Rubric	Score
chip processing speed	1.2GFlops-2.4GFlops	-1% for each benchmark score less than 94.95	10
power supply efficiency	72~80%	-12.5% for each 1% less than 80%	10
regenerative brake energy recovering efficiency.	55~83%	-3% for rach 1% less than 83%	10
backup electricity system reaction time	1s - 5s	-25% for each second longer than 1s.	10
Train cabin’s weight	0.8 - 1.2kg	-25% for each kilogram more than 0.8 kg	10
Mean braking distance	2.2~3 inch	-12.5% for each 0.1 inch longer than 2.2 inch.	10

B.

	chip processing speed	power supply efficiency	regenerative brake energy recovering efficiency.	backup electricity system reaction time	Train cabin's weight	Mean braking distance	**weight**
Ease of Use	1			3	3		4
Fast Commute							4
Safe	3			9		9	5
private					3		3
Always Ready	9			3			4
Reliable	1		3	9		3	4
Internet Connectivity	3						1
Low cost		3	9		3		4
Customizable					3		2
Environment friendly		9	9		3		2
Importance	17	12	21	24	15	12	

Determine scaled points:

	Unscaled	Scaled	Rounded	Points (100)
chip processing speed	10	16.8%	17%	17
power supply efficiency	10	11.9%	12%	12
regenerative brake energy recovering efficiency.	10	20.8%	21%	21
backup electricity system reaction time	10	23.4%	23%	23
Train cabin’s weight	10	14.9%	15%	15
Mean braking distance	10	11.9%	12%	12
		100%	100%	

Verification Score Card (Updated)

System Requirements	Vehicle Reqs	Score Rubric	Score
chip processing speed	1.2GFlops-2.4GFlops	-1% for each benchmark score less than 94.95	17
power supply efficiency	72~80%	-12.5% for each 1% less than 80%	12
regenerative brake energy recovering efficiency.	55~83%	-3% for rach 1% less than 83%	21
backup electricity system reaction time	1s - 5s	-25% for each second longer than 1s.	23
Train cabin’s weight	0.8 - 1.2kg	-25% for each kilogram more than 0.8 kg	15
Mean braking distance	2.2~3 inch	-12.5% for each 0.1 inch longer than 2.2 inch.	12

Realistic Test

Based on our determined scaled point matrix, we determined 3 most important requirements: backup electricity system reaction time, regenerative brake energy recovering efficiency and chip processing speed. Of course,We have designed a verification plan and show the process to three users we invited. We setup the devices we need and began to verify the first requirement: backup electricity system reaction time. Siwei compiled a chunk of code that instruct the model train to run at 100% power. It takes a few seconds for the PC and arduino chip to process the code, then the train started. After it reached full speed, Chenjie unplugged the power supply. The train was dragged fiercely by regenerative brake. However, within 1 second, backup power took over the control and the train started to accelerate.

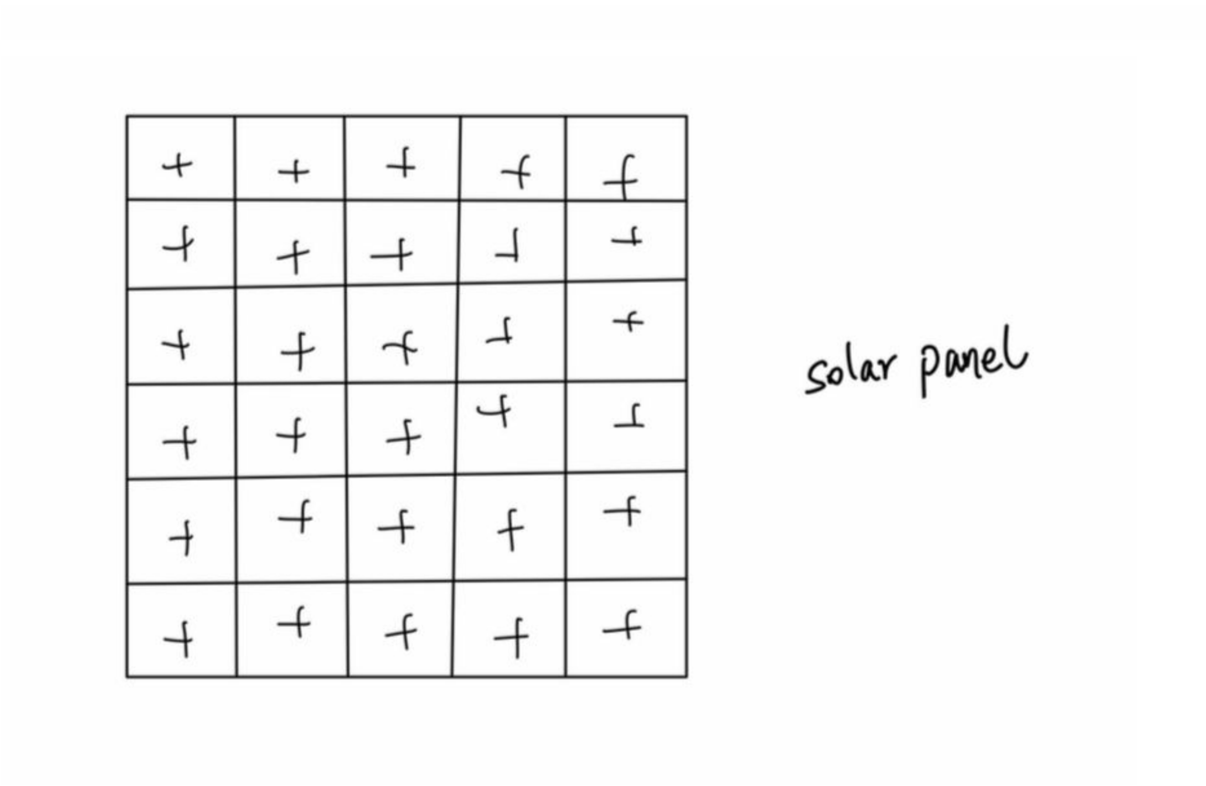
Then, we demonstrated high energy efficiency of regenerative braking system. We started the train and made it stop without brake. Aaron measured the stopping distance, and calculated that the frictional force was 0.2N. Then, another stop was performed with full break. Andrew connected a bulb with battery, and connected a power meter onto it. We waited until the battery ran out, and the time was 136s. We performed calculations and demonstrated that the efficiency was 82.7%, which is almost ideal. .

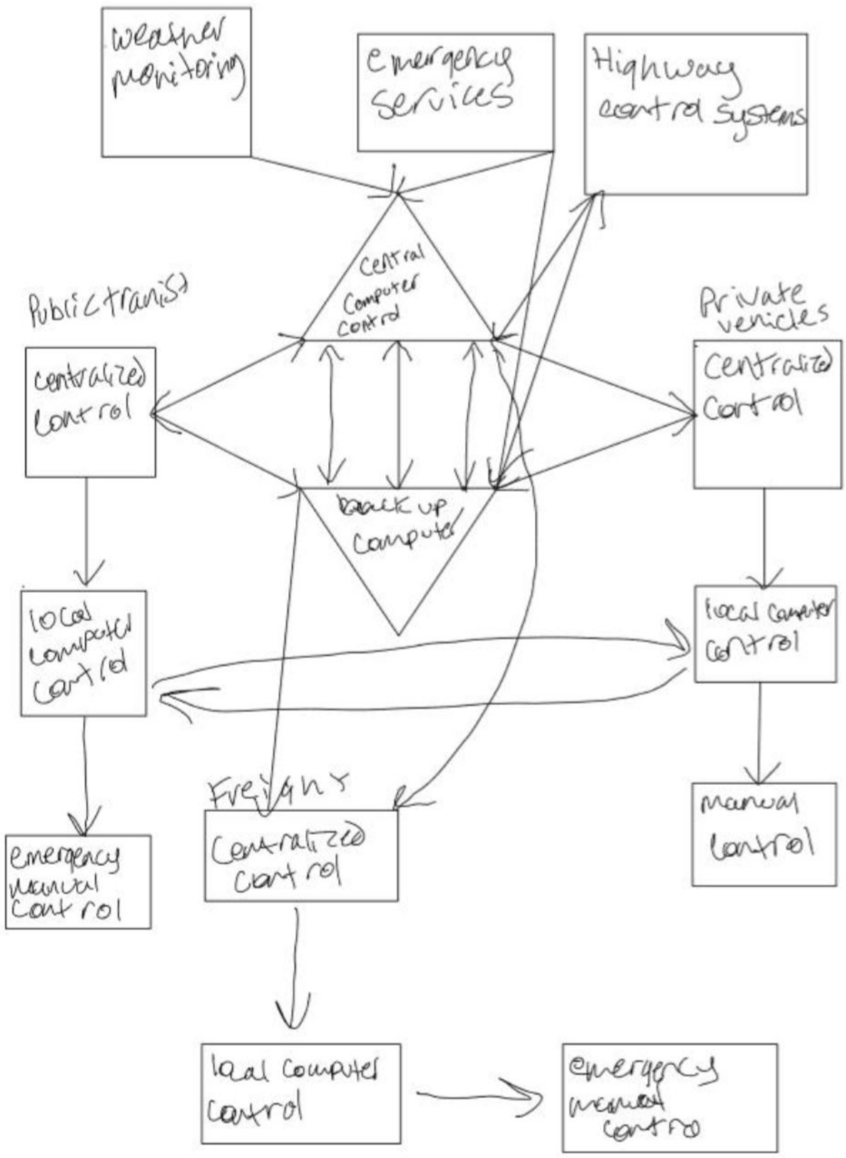
At last, Chenjie pulled the benchmark code from github and sent it to Siwei, who sent it into Arduino chip. The chip began to automatically perform intense calculations. After nearly 5 minutes, the software showed a 92.11 score, which is high enough.

The users appreciated our achievements of our model system

Appendix.

Brainstorming details:




weather monitoring
emergency services
Highway control systems
central computer control
Public transist
centralized control
Private vehicles
centralized control
back up computer
local computer control
local computer control
Freight
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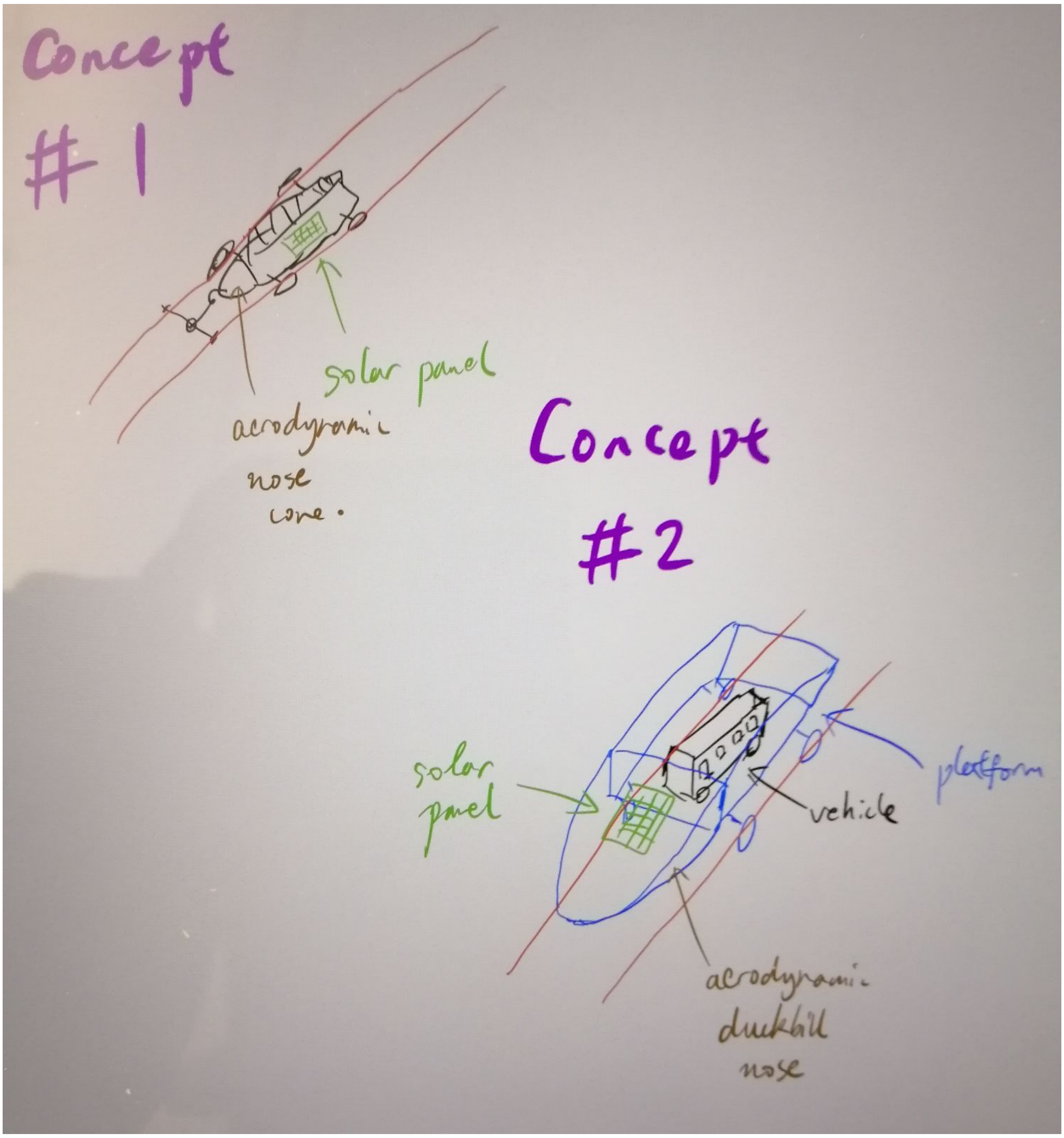
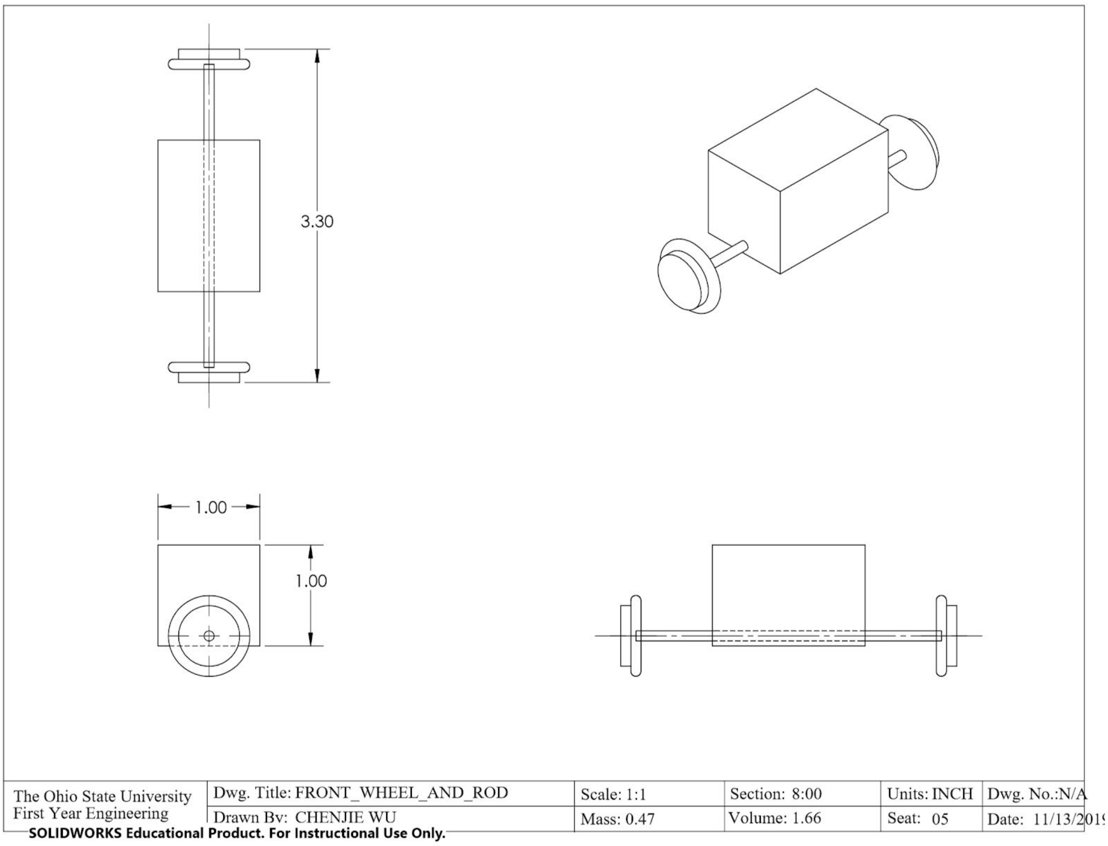
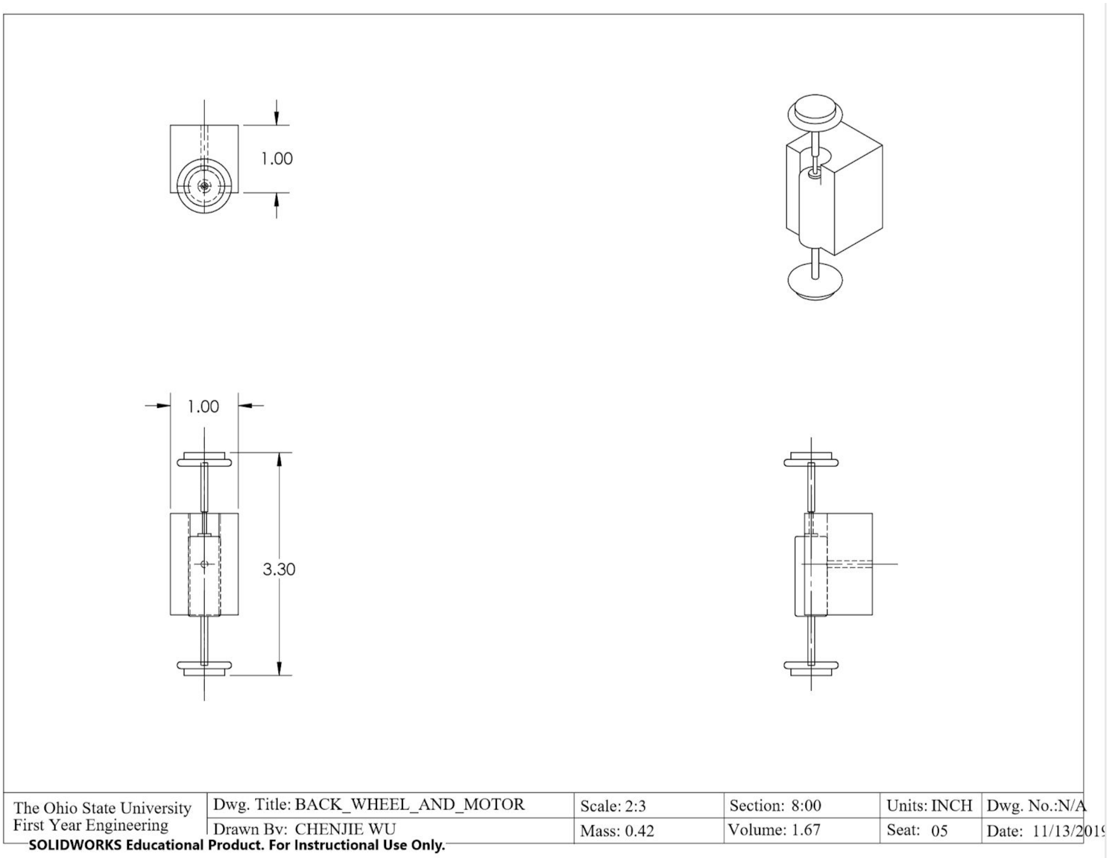
manual control
local computer control
emergency manual control

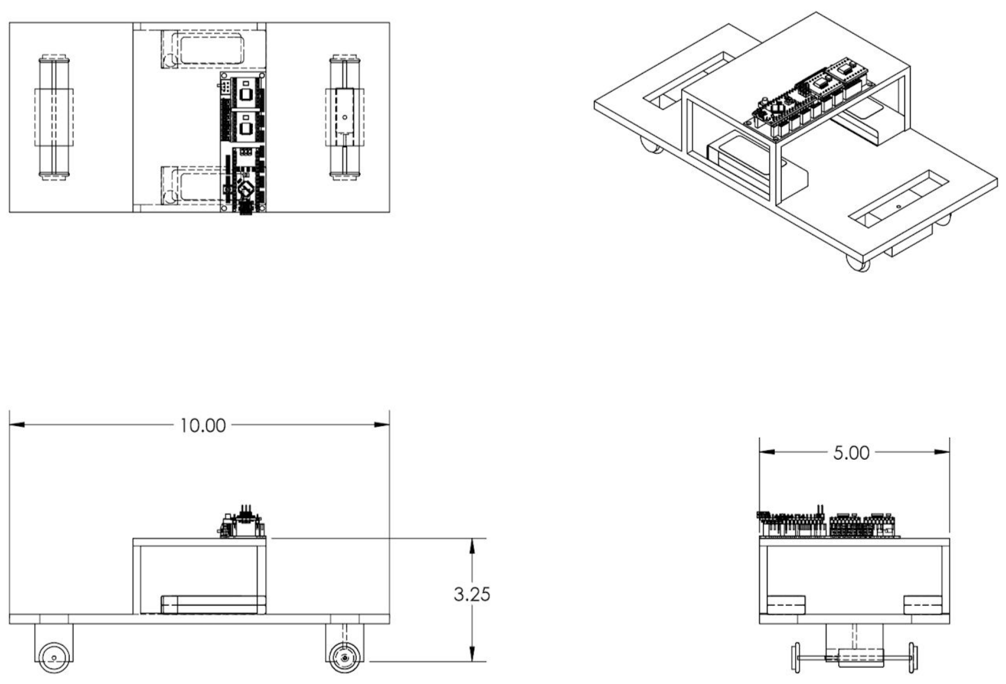

Concept #1
solar panel
acrodynamic nose cone.
Concept #2
solar panel
platform
vehicle
acrodynamic duckbill nose

Detailed design documents

a. Assembly multiview drawing







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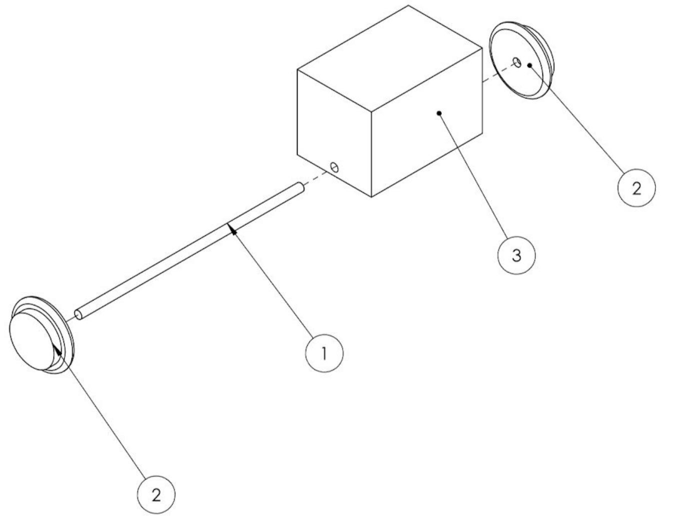
	Drawn By: CHENJIE WU	Mass: 1.59	Volume: 22.09	Seat: 05	Date: 11/11/2019

b. Exploded assembly drawing with BOM



ITEM NO.	PART NAME	MATERIALS	QTY.
1	steel_rod	Cast Stainless Steel	1
2	front_wheel	Alloy Steel	2
3	front_wheel_fixer	1023 Carbon Steel Sheet (SS)	1

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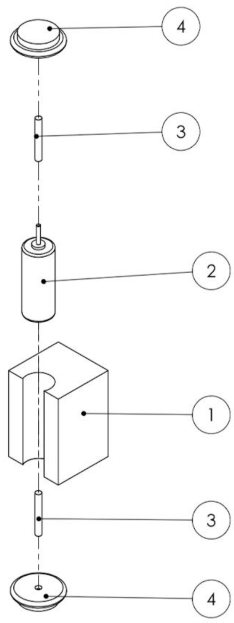

ITEM NO.	PART NAME	MATERIAL	QTY.
1	motor_fixer	1023 Carbon Steel Sheet (SS)	1
2	AEV Motor	N/A	1
3	steel_rod_short	Cast Stainless Steel	2
4	front_wheel	Alloy Steel	2

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	Drawn By: CHENJIE WU	Mass: 0.37	Volume: 1.3	Seat: 05	Date: 11/11/2019

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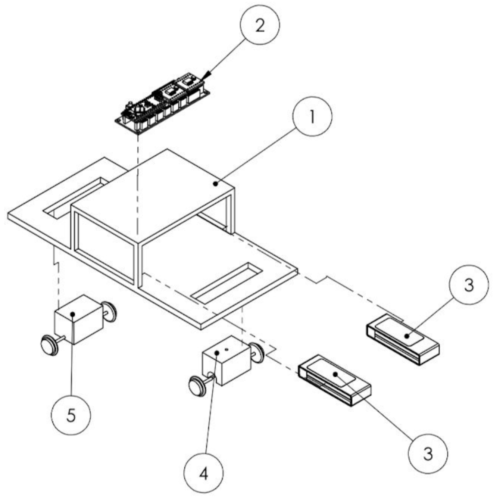
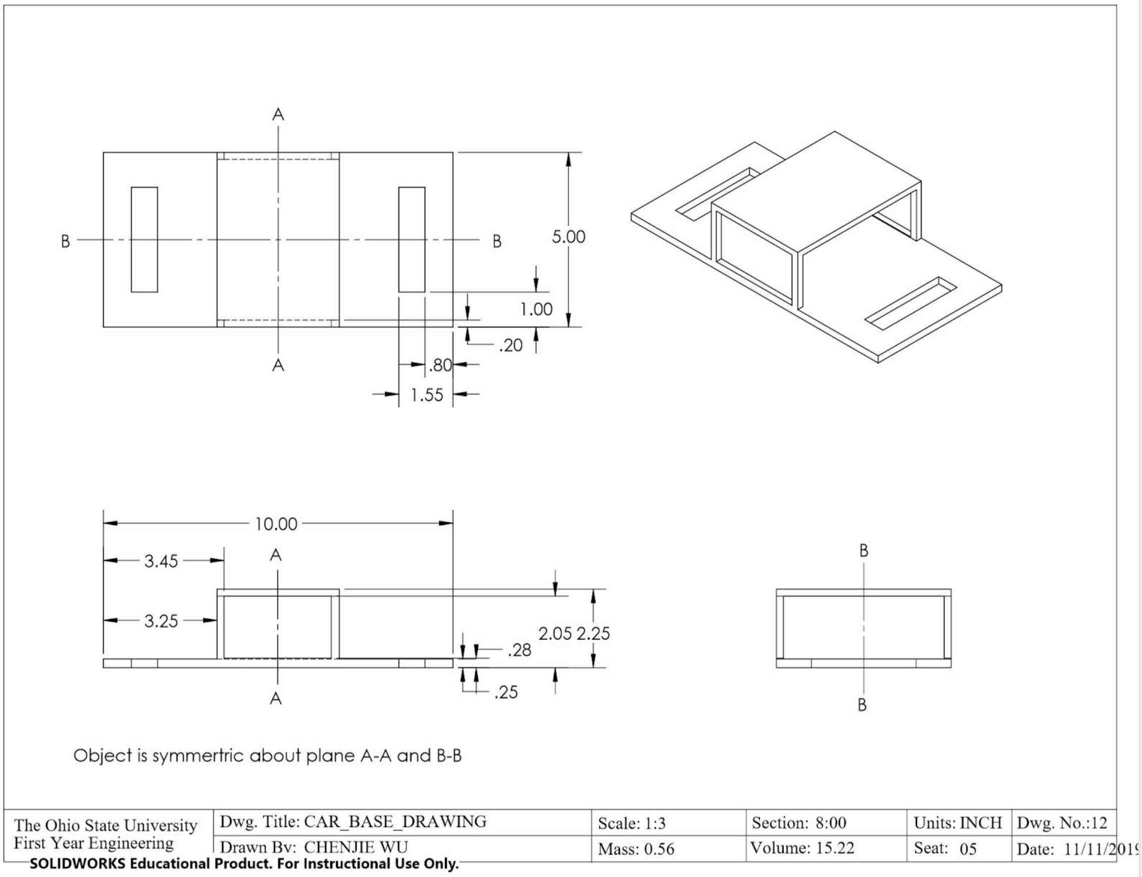
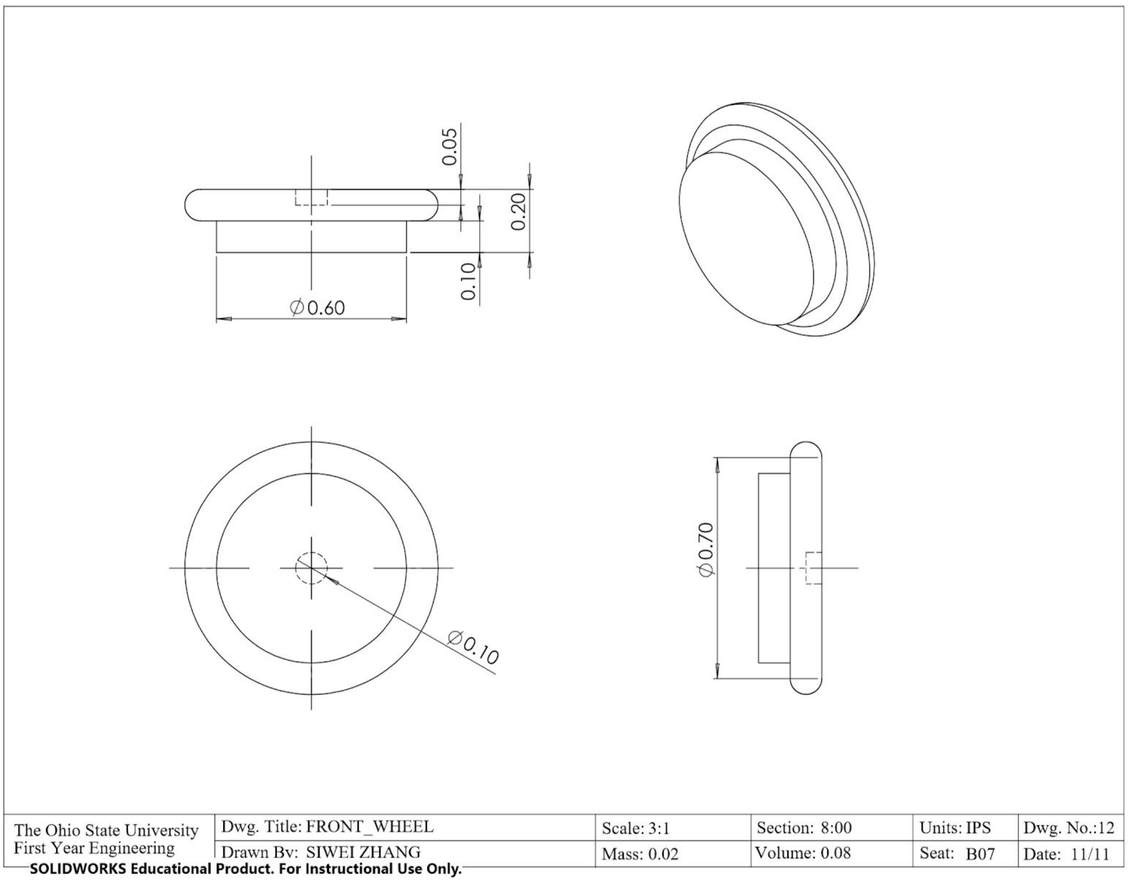


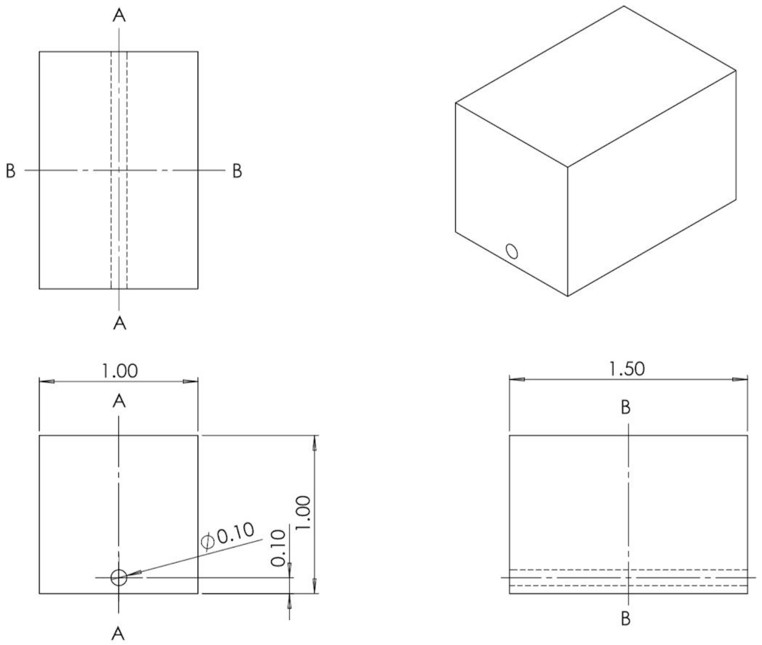
ITEM NO.	PART NAME	DESCRIPTION	MATERIAL	QTY.
1	Car_base	The main frame of vehicle	ABS	1
2	AEV Arduino Assembly	N/A	N/A	1
3	Battery Pack	N/A	N/A	2
4	back_wheel_and_motors	Including wheel, motor and rod	N/A	1
5	front_wheel_and_rod	Including wheel and a long rod	N/A	1

The Ohio State University First Year Engineering	Dwg. Title: CAR_ASSEMBLE_EXPLODED	Scale: 1:4	Section: 8:00	Units: INCH	Dwg. No.:12
	Drawn By: CHENJIE WU	Mass: 1.59	Volume: 22.09	Seat: 05	Date: 11/11/2019

c. Detailed drawings for fabricated parts

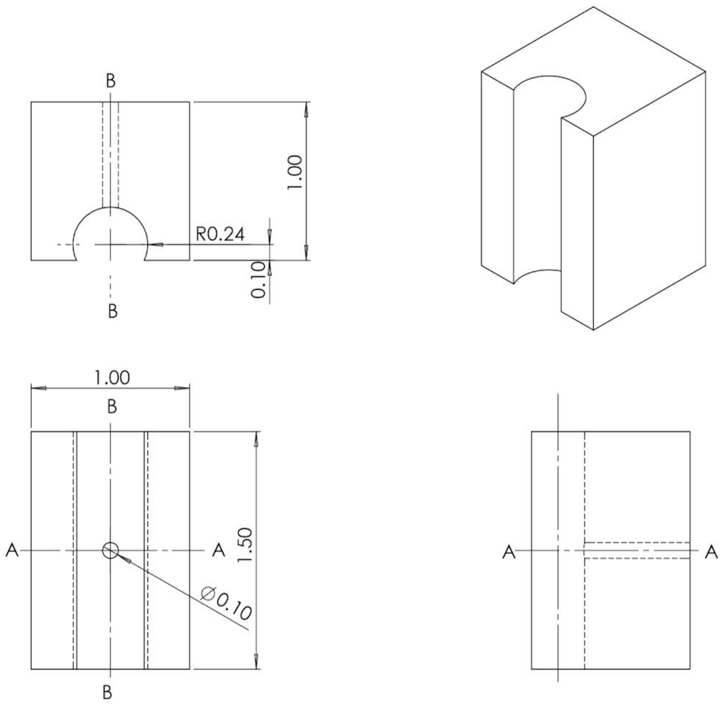






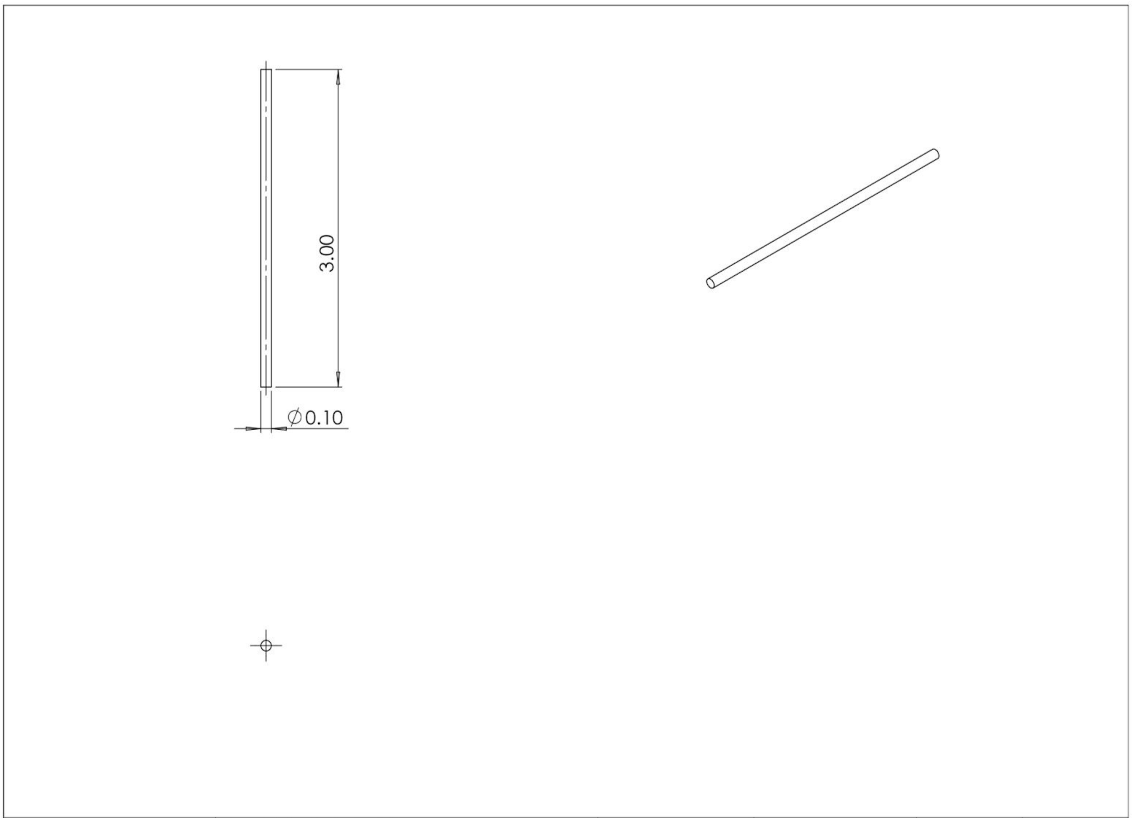
Object is symmetric with plane A-A and B-B

The Ohio State University First Year Engineering	Dwg. Title: FRONT_WHEEL	Scale: 1.5:1	Section: 8:00AM	Units: IPS	Dwg. No.:12
	Drawn Bv: SIWEI ZHANG	Mass: 0.42	Volume: 1.49	Seat: B07	Date: 11/11

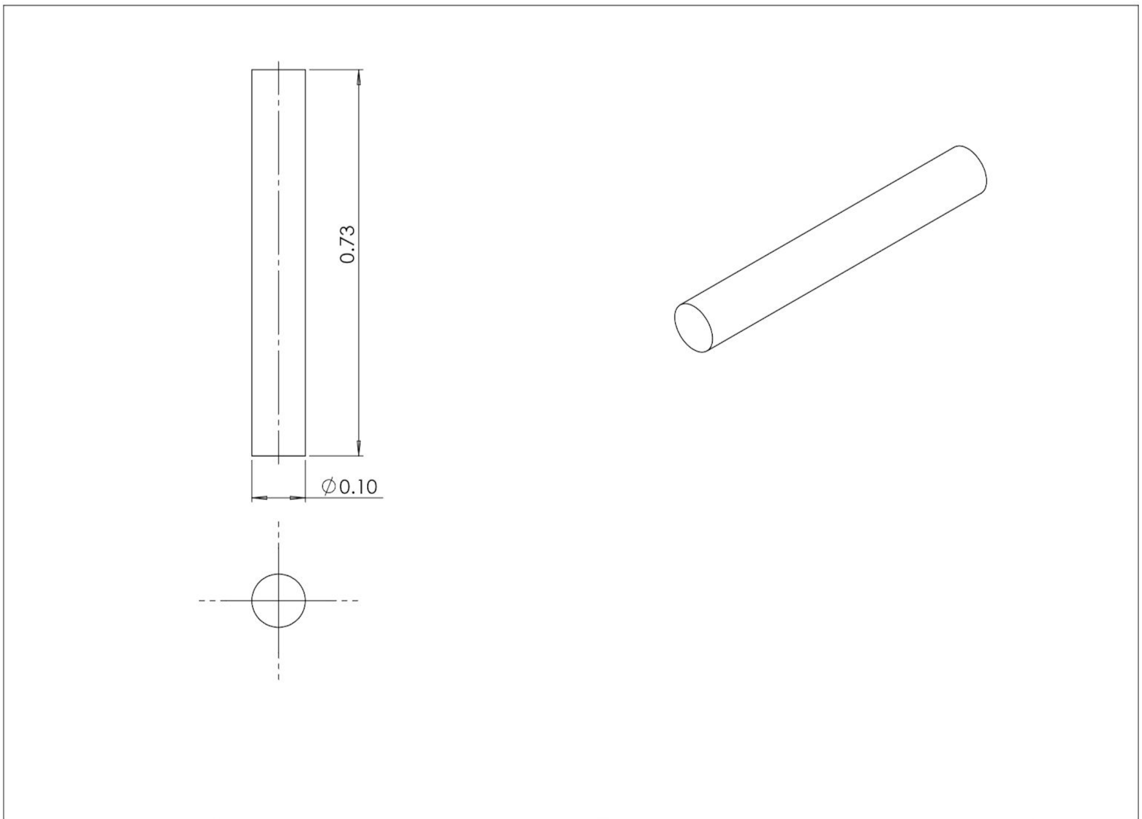


Object is symmetric about plane A-A and B-B

The Ohio State University First Year Engineering	Dwg. Title: MOTOR_FIXER	Scale: 1.5:1	Section: 8:00AM	Units: IPS	Dwg. No.:12
	Drawn Bv: SIWEI ZHANG	Mass: 0.37	Volume: 1.3	Seat: B 07	Date: 11/11



The Ohio State University First Year Engineering	Dwg. Title: STEEL_ROD	Scale: 1:1	Section: 8:00AM	Units: IPS	Dwg. No.:12
	Drawn By: SIWEI ZHANG	Mass: 0.01	Volume: 0.02	Seat: B07	Date: 11/11



The Ohio State University First Year Engineering	Dwg. Title: STEEL_ROD_SHORT	Scale: 5:1	Section: 8:00	Units: IPS	Dwg. No.:12
	Drawn By: SIWEI ZHANG	Mass: 0	Volume: 0.01	Seat: B07	Date: 11/11

Prototype Plan

Chip speed -- write a C++ program or find it online that measures the time used to process a series of codes.
Power supply efficiency: use a power meter to measure the electric power on the end side, and comparing it to the power on the beginning side.
Brake energy recovering rate: measure the speed and mass of train before braking. Then brake, and measures how much electricity is generated. Convert to standard energy unit and divide by kinetic energy of the train, and get the convert efficiency.
Backup electricity system reaction time: simply unplug the power supply and measure the time.
Train cabin's aluminum content: measure train cabin's weight, then put it into water to measure its volume, and we can get density.
Mean braking distance: set too full power and apply full brake, measure distance.

Ohio State Engineering

First Year Engineering

Team-Working Agreement

GTA: Alexia Leonard

Team Working Agreement

Autumn 2019

Created Date: 9/1/19 Revised Date: 9/26

1. Group Information

Lab Section #9307

Table Letter: B

Instructor: Dr. Patrick Herak

GTA: Alexia Leonard

2. Contact Information

Preferred Method(s) of Contact

Expected Response times (s)

Table with Name and Contact Information

	Email	Cell Phone
Aaron Cox	cox.1223@osu.edu	440-728-8193
Siwei Zhang	zhang.9039@osu.edu	571-484-7754
Andrew Wilhelm	wilhelm.124@osu.edu	614-561-8276
Chenjie Wu	wu.3976@osu.edu	614-316-7793

3. Team Goal What are the team's expectations of quality level? Top goals? Minimum acceptable goals?

Top goals would be A level work that is polished and thorough. Minimum acceptable level would be a B+ level.

4. Meetings Frequency – How often do you plan on meeting to achieve your goals? (Do you anticipate this changing throughout the semester?)

Once a week

Primary Meeting Day/Time/Location

Hitchcock on Tuesday after graphics lab

Secondary Meeting Days/Times/Location

18 Ave. Library

Individual(s) in charge of agenda(s) Andrew

Individual(s) in charge of reminders(s) Siwei

Individual(s) in charge of minutes(s) Aaron

5. General Team Member expectations

What are team member expectations regarding attendance?

Attend all classes if possible, if not let other members know

How are team members expected to behave during lab/class periods?

Focused and participating

How are team members expected to behave during team meetings? (What are the norms?)

Focused and participating

What are acceptable/unacceptable types of interaction?

Always respectful

What are team members meant to do between classes? Lab/class preparation?

Complete all assignments and preparation for upcoming classes.

How are team members meant to ensure the team stays on track?

Complete their portion of the assignment and assist other group members as needed

How are documents expected to be shared? (e.g. Buckeye Box?)

Carmen

How many days before an assignment is due should everybody have their portion completed for review? 3 days

When should team members first notify the group if they are struggling?

4 days, or as soon as possible

6. Individual Team Member Responsibilities/Deadlines?

What roles do team members have?

Siwei- Marketing, Aaron-HR, Andrew-CFO Chenjie-R&D

What tasks are team members in charge of?

Varies from assignment to assignment.

How often will these roles/task rotate?

Varies from assignment to assignment.

7. Conflict Resolution

Once the team goals, general member expectations, and individual team member responsibilities have been established, candid, non-threatening discussion must be held when the group or individuals are not meeting the agreed upon terms. How will team members above be held accountable?

First be approached by the other team members and if that doesn't work, notify the instructor.

How will team members that are not meeting expectations (not contributing to the team effectively) be addressed?

First be approached by the other team members and if that doesn't work, notify the instructor.

How will team members that are not interacting appropriately with team members be addressed?

First be approached by the other team members and if that doesn't work, notify the instructor.

When is it okay to redefine goals, expectations, and responsibilities?

Whenever is felt necessary by the team.

When will UTAs, GTAs, or the instructor become involved?

Only if a team member falls way behind in their work and is affecting the whole group.

8. Expectations of Faculty and GTAs

If a team member fails to live up to this agreement, the situation may be reported to the staff, but the team will still be responsible for submitting a completed assignment. Staff will be available to meet with teams to resolve issues.

9. Team signature

________Aaron Cox_________

_________Andrew Wilhelm__________

_________Siwei Zhang_________

_____________Chenjie Wu___________