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ENGR 1182
Dr. Herak 8:00
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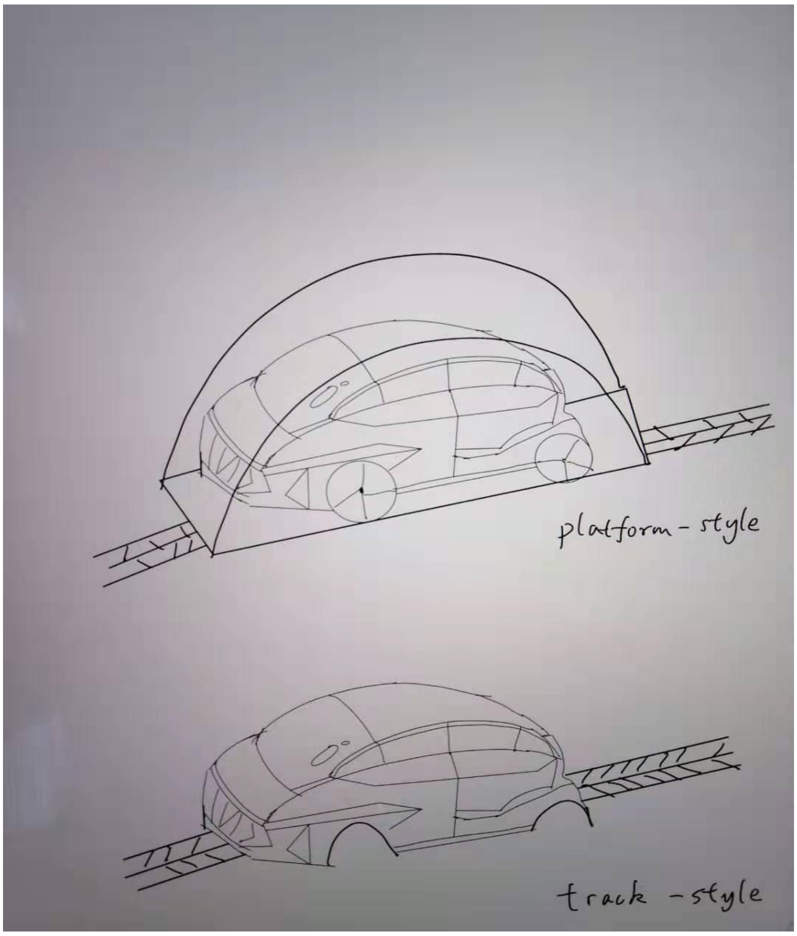
A15--System Requirements

1.Revised Pugh Scoring Index:

		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	8	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
Environment friendly	2	1	2	3	6	4	8
Total score			84		121		156
Rank			3		2		1
Continue			no		no		yes.

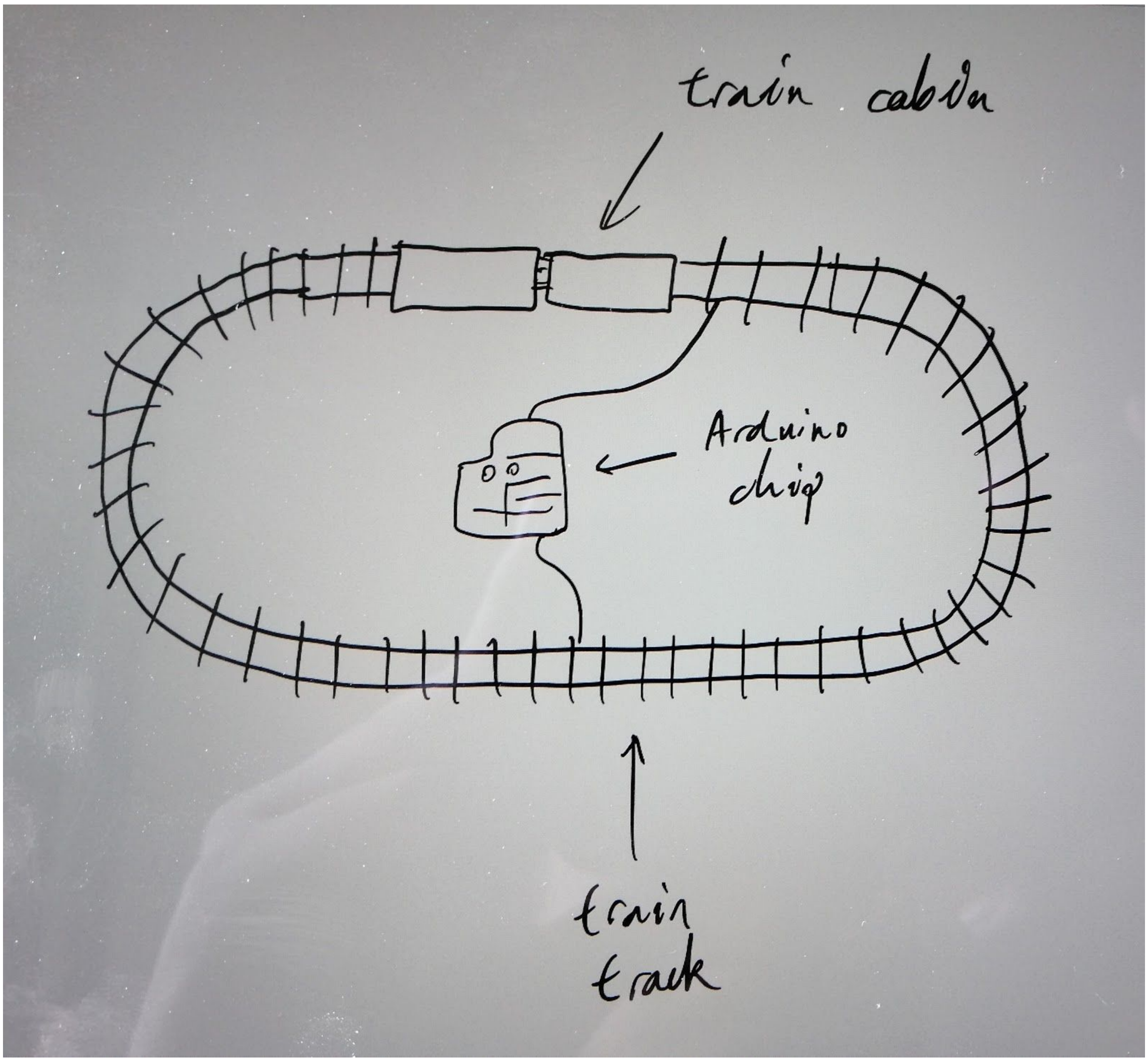
2.Final concept sketch:

The real world system is presented as follow:



We have chosen the track-style as our real-world concept.

The scaled concept is presented as follow:



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.

3. End-user feedback and design:

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.

4. Model-system design requirements:

Requirement	Range	Ideal
Time compiling and sending code	<15 seconds	<=10 seconds
Time to complete a full loop with max possible power	12-13s	< 11s
Mean braking distance from full power	2.5-3 in	<= 2.2 in
Acceleration to full speed	<3s	<2.5s
Maximum power of passing bend safely	65%	80%
Stop precision	Range of braking distance fall in +- 0.3 inch from mean braking distance	Range of braking distance fall in +- 0.2 inch from mean braking distance
Time to stop the train when experiencing electricity cut-off	2-3s	1.5s
Power consumption	100-120W	< 95 W

Time of sending and compiling code reflects the need of “always ready”. The end users need our product’s preparation to be as short as possible, which is mapped to the time of starting the model train.

Time to complete a full loop and acceleration to full speed reflects “Fast commute”. average speed of the cars are definitely crucial to shorten commuting time, but acceleration is also important, especially when you need to stop for many times.

Mean braking distance from full power reflects reliability and safety. The system must be reliable to protect users’ safety in an emergency, and braking in short distance leads to lower probability of crush.

Maximum power of passing bend safely reflects safety and fast commute. When cars are able to pass bends with faster speed (higher power), end users could save more times. Also, it leaves more space for safely passing the bend.

Stop precision reflects internet connectivity. While connecting to the internet, users could utilize GPS on cars, which has an accuracy of several meters. A precise stopping of model train can reflect this point.

Time to stop the train when experiencing electricity cut-off simulates the real-world situation of natural disasters such as earthquakes. When such a disaster happens, cars on the track should stop as soon as possible. Equivalently, when electricity supply is stopped, model train should stop as fast as possible.

Power consumption is equivalent to “environmentally friendly” requirement in the real-world system. When the power consumptions are lowered, the emission of harmful gas was decreased. Therefore, our downscaled system was designed to have lower power consumption.