Project summary from team 41721A

Purpose：to design a robot which could climb up small stairs and pick up objects.

Team members:

Project leader: Liyang Wang

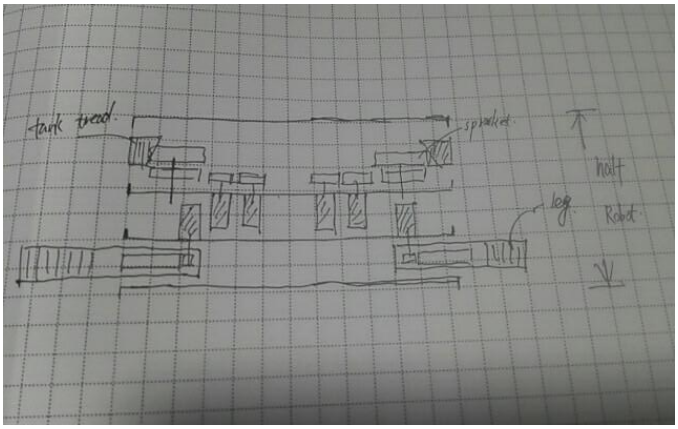
Chief designer: John Han

Constructor: Baker Fang; Liu Lin; Fred

Programmer: Fred

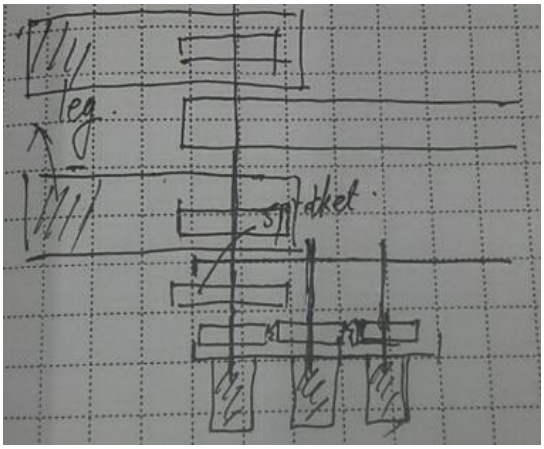
Total working hours: 92 hrs

Our idea is from this robot:

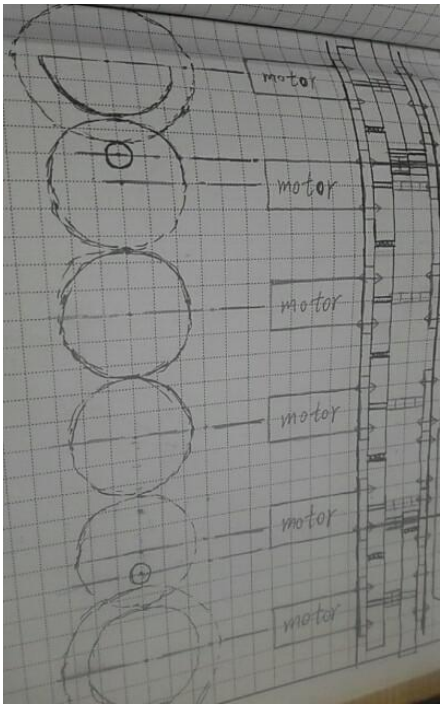


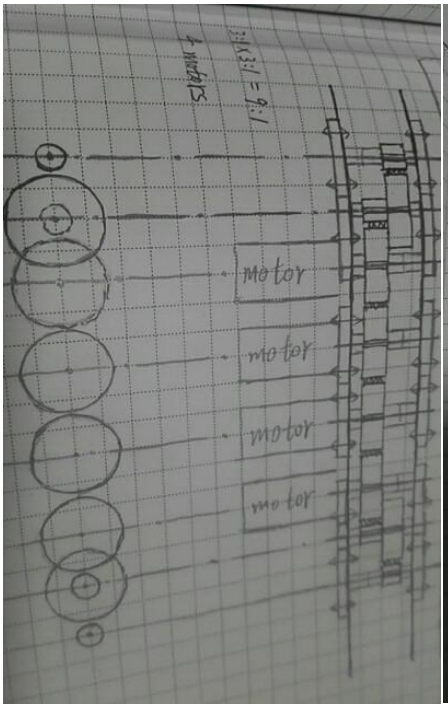
Using this kind of legs could realize climbing. But vex hardware is really hard to design such a robot leg. Because it is really hard to fix the outside legs to the base. What we could think about is to add another panel outside to robot legs and hold them together. We tried to design this kind of feature, but the robot turned out to be way to wide.

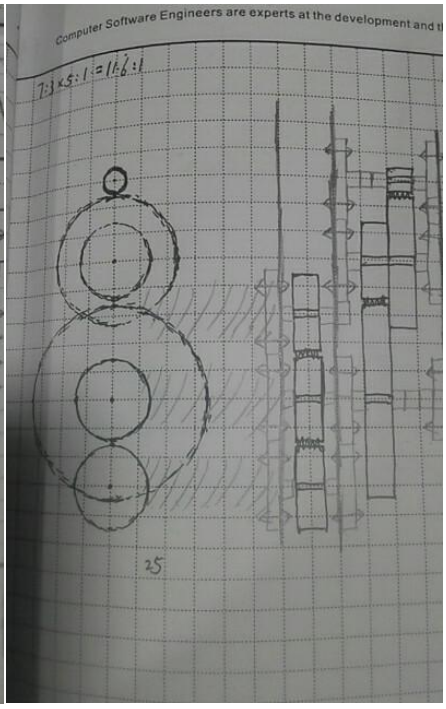
Then we tried to put legs in the middle of the base. And the size is relatively much smaller.

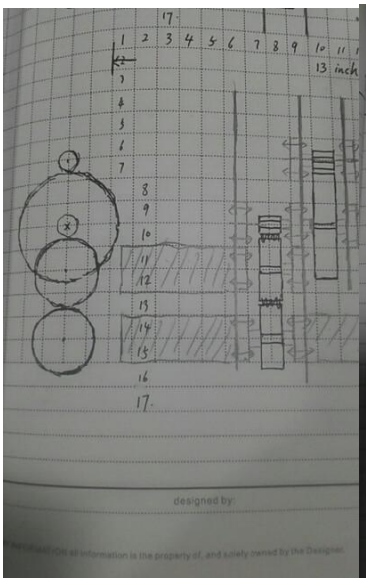


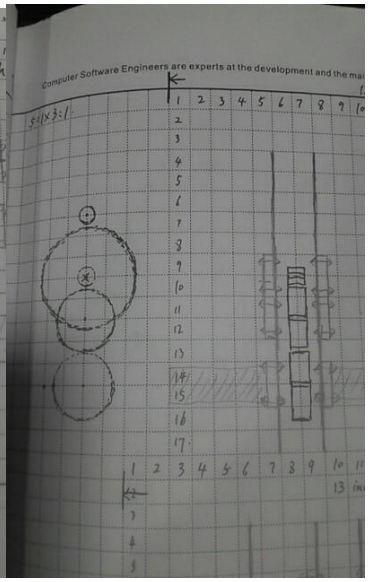
Then we did a lot of work trying to design a fast transmission drive drain and using small sprockets. In this way, the base could be really low and more stable. We struggled a lot with different gear setting and combinations:



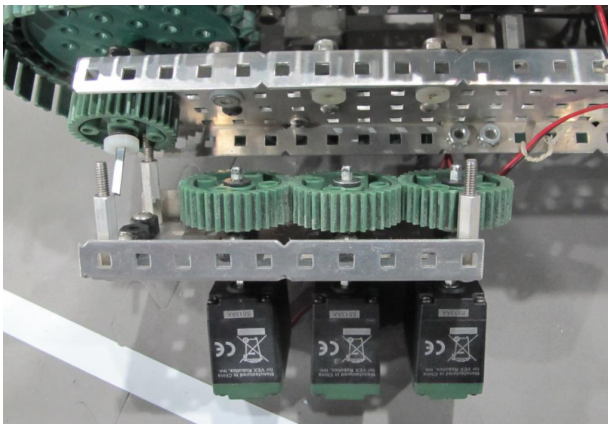




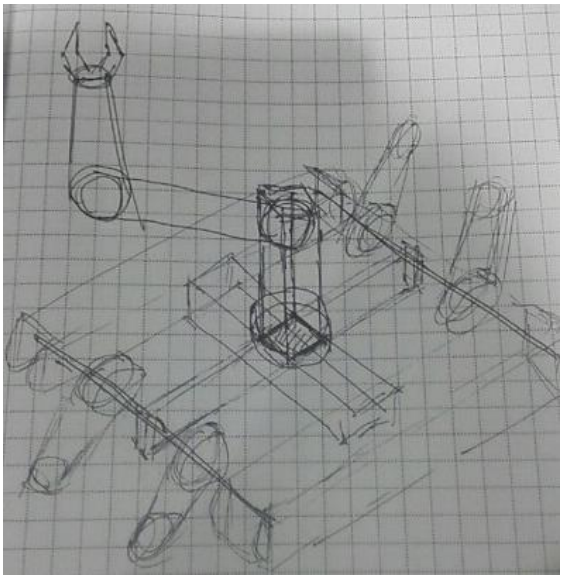


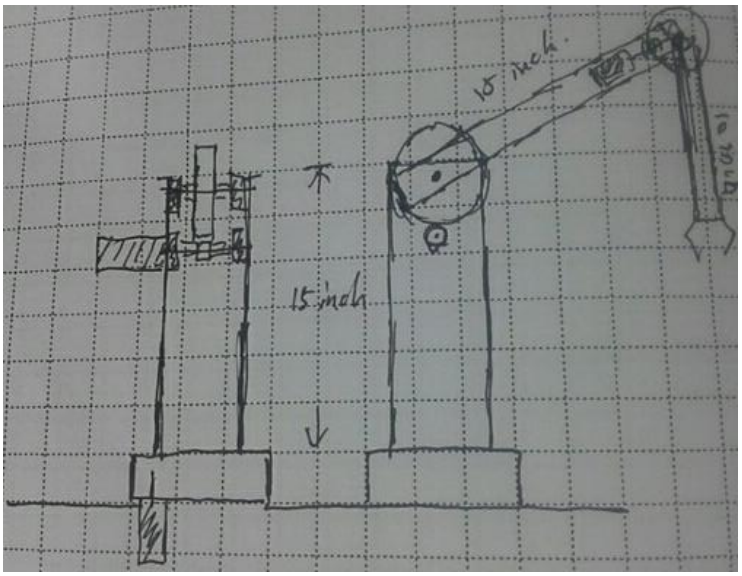


After we got part of our fast speed base done, a lot of problem showed up: back gear of motors are too easy to break; too fast; treads are easy to fall off. And due to design issue, our motor was too hard to repair or replace. That's why we designed an easy taken off gear box.



We found this kind of design, are really useful not only for our program, but also for other VEX teams. We spend a little more time to optimize the design our base, and began to design the manipulator. Since robot has four legs and each of them could rotate 360 degree, so we can not have a big plate right above the base. Our first generation of manipulator design was to have a cross plate on top and use a turntable bearing at the center, connect a vertical pillar and then arm.



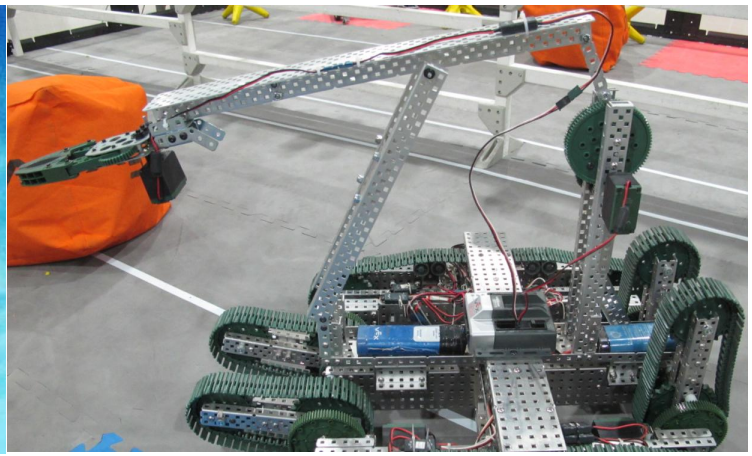


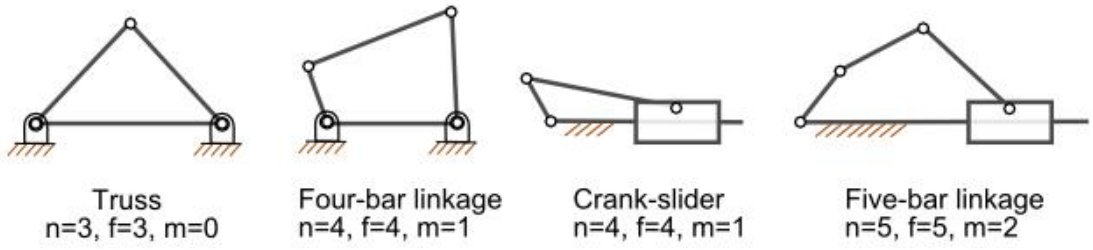
we used a gear ratio of 1:7 to power the main arm, and use worm and gear to power the secondary arm to get a much smaller speed. Turned out, it's very unstable. We think it was

because we used a chain of transmission. Each time the error will cumulate. So after the main arm and secondary arm, the error gets really big. It is also because our arm is too long. One little shake or vibration of the base, the manipulator could have a bias nearly 10 times of the bias from the arm base.

We tried to optimize this problem, but the result was not as good as we expected.

Then we considered the crane-like linkage mechanism.





We used a Four-bar linkage system as shown in this picture. One bar is active, and we have 4 links, 4 joints, the mobility(degrees-of-freedom) is 1.

One great advantage of this system is that the movement of the manipulator is not a linear motion. Traditional arms as we designed before, one motor could only have linear motion. But with this system, the motion of manipulator is actually like a circle. This means our claw could reach much more area without moving the base.

We just started to use this kind of system. We will further develop this kind of mechanism in

the future, so that we can design the most suitable movement we need.

Another great advantage is that, this system really has a much smaller vibration or bias than traditional arm system.

But due to the limitation of size, and the longest vex structure is 17.5 inch, we can not design longer legs which could climb normal stairs. So our robot could only climb small stairs. This is one big issue we have to fix in the following version.

Summary:

This project lasts nearly 2 months, during this period of time, our team member are really working closely, discussing, arguing. Each small step encouraged us, and each failure also frustrated us. But we never thought about giving up. That is because we are really interested in robotics, and really enjoy the whole process of making something outside of the VRC competition. We are doing something different.

The knowledge we used and learned during this program, is more complex than what we studied in school, but we want our robot to run as we designed, so we searched on the internet, read books about mechanical design. I have to say, we changed a lot. Before this program, or even during the first half of this program, we design our robot according to our feelings. We would like to build whatever we thought should working or solving the problem. That's really a waste of time and also not a scientific solution. Now, we are getting used to a design process of our own, that is:

We look at a problem or a given question, then we brain storm, and we also go searching materials and theories, even examples to support our idea, then we discuss, do some calculations, and choose one main solution, maybe several backup solutions just in case the first one is not working. Our efficiency is much higher than before!

At the end, we all think this program is not only a online competition, but also a good way to perform teamwork, and a good chance to learn new stuff out of the VRC competition!

Thank all our team member to make this happen! We will keep developing our robot!

Additionally, there are some drawing shows our design process and the work of our team.