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Skills Urban Search and Rescue Engineering Design Notebook

Team \_\_\_\_ with Sulphur Springs High School

Table Of Contents

Engineering Design Process- page \_\_\_\_

Planning and Designing- page \_\_\_\_

Create- page \_\_\_\_

Electronics- page\_\_\_\_

Testing- page \_\_\_\_

Changes- page \_\_\_\_

Pictures- page \_\_\_\_

Resumes-page\_\_\_\_

Engineering Design Process

Our team decided to follow this process when designing and building our robot.

Plan-

Format a plan to the contest day

Design-

Draw out ideas

Define-

Know what is needed

Improve-

Make changes to improve design

Test-

Check for problems and solutions

Create-

Build Ideas

Finalize-

Finish the robot and produce it

Define-

Before we started creating ideas for the robot, we looked at the score sheet to see what parameters that we need to strive for in our final product. We came up with the following based on the score sheet.

|  |  |
| --- | --- |
| Drive | System assembly demonstrates excellent design, construction, and durability. |
| Electrical components | Excellent effort given to wire routing and safety management |
| Robots Movements | Robot chassis powers up and performs all four basic control functions. |
| Technical Drawings  Accuracy of Drawings | Drawing detail and quality are excellent  Technical drawing matches all major and all minor components of the assembled drive train. |
| Notebook | Notebook is outstanding and goes above and beyond format/guidelines and demonstrates understanding of task.  Team’s documentation of project demonstrates an effort that goes above and beyond. |
| Arm Abilities | Arm mechanism functions reliably and is well constructed and engineered.  Arm is very secure and clears the robot drive chassis at all points  Ordnance fits into arm end effector with sufficient freedom to allow transport and exceeds the amount of ability/strength to effectively dispose of the ordnance. |
| Technical Accuracy | Technical content (descriptions, sketches, drawings, tables, and figures) matches robot project build with outstanding detail and clarity. |

The robot needs to have well-made controls that allows for well controlled movements and success during the contest. The robot also needs to have a well-built structure and design so that no flaws come about during the competition. Our robot must also fit into the size parameters of 18’ by 18’ by 18’. With this information we created a plan that we will follow until the day of the competition.

Plan-

Here lies our plan for how we will prepare for the competition.

Start Date- November 10th, 2021

End Date- February 4th, 2022

November 10th – 12th – Going over rules and making sure we have all of the data that we need to have for the competition.

November 15th – 19th – Design the multiple components needed for the robot. Do testing if needed.

Thanksgiving Break November 22nd – 26th

November 29th – December 17th – Build the combined designed parts so testing and fixing can be done after break.

Winter Break December 20th – January 4th

January 5th – 7th – Finish any thing left from before the break and/or start adding wiring to the robot

January 10th- 14th – Start testing and make improvements as we go

Covid Break School Shut Down 14th- 18th

January 17th -28st – Make final improvements and final touches on the notebook and on the robot

January 31st- February 3- Pack all materials make adjustments once arrived at the competition.

February 4th- Make sure to have everything in place for the competition and compete.

Snow Break 3rd-4th Competition moved to 24th of February

February 7th- 23rd- Continue making improvements to the robot and re pack.

February 24th - Make sure to have everything in place for the competition and compete.

Design-

Now that the plan is written out we need to design the base, wheel mechanism, arm, and claw.

On the following pages we have drawn out and labeled our designs and plans for each part of the robot. With these designs we should know exactly what we will need and how we want to build the designs.

**Designs For Model Excalibur**

1. Base
2. Wheel mechanism

Create- Base

To build the base we made a list of the possible parts we may need based on the design we had drawn out. The list is on the page before.

Step\_\_\_\_ When making the base we took the 2x 288mm Channel (288mm) and the 2x flat building plate and connect them like so by using \_\_\_\_ Keep nuts(KN) and \_\_\_\_\_ Socket head screw 6-32x1/2”(SHS). One on the top and one on the underside.

Step\_\_\_\_ We added the motor mounts at the very back of our base on the underside of the base. And then placed the 160mm channel (160mm) across the two ends like so attaching it to the 2x 288mm using \_\_\_\_\_ KN and SHS to get this.

Create- Base

Step\_\_\_\_ After we added the 160mm we began constructing the towers for the servos we placed one 32mm Channel \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from the end of each 288mm using \_\_\_\_\_KN and \_\_\_\_SHS.

Step\_\_\_\_ We then placed the 96mm Channels (96mm) on top of the 32mms using \_\_\_\_KN and \_\_\_\_SHS.

Create- Base

Step\_\_\_\_ After we placed the 96mm we put one 32mm on the underside towards the very front connecting it with \_\_\_\_ KN and \_\_\_\_ SHS. This is for the omni wheels.

Create- Arm

We began construction on the arm off of the base to tweak anything before placing it on the robot.

Step \_\_\_ We took the 2x flat brackets (flatsB) and connected them to 2x of the 32mm. We took a 100mm Axle (Axle), 2x bushing, and 2x Axel set collar (collar) to connect the flatsB like so to create the bottom of the arm.

Create-Arm

Step \_\_\_\_ Once the flatsB are set we did the same process with the Inside C connecter (C) and the flat 160mm x 27mm (flat160) to make the top of the arm. After both are made we will connect them at the C and 32mm with \_\_\_\_KN and \_\_\_SHS.

Step \_\_\_\_ After those are connected we will build the claw with the instructions given and connect it to the arm as so.

Create- Arm

Step \_\_\_ After arm is connected we will place one servos in each of the 160mm and connect the top arm to the servo with 1 KN and 1 SHS on both sides like so.

Step \_\_\_\_ After that we took 2x 32mm and connected it to the base on the top flat and connect the bottom arm to them the same way we connected in step \_\_\_\_.

Create- Arm

Step\_\_\_\_ After both top and bottom arms were built, we connected them together by placing the C’s on top of the 32mm and fastening them together with \_\_\_\_KN and \_\_\_\_ SHS.

Step\_\_\_ Here we connected the claw to the arm just by using \_\_\_\_ KN and \_\_\_\_SHS in the locations drawn below.

Create- Wheels

Step\_\_\_ now that we have all of the base and arm put together and attached, we need to build the wheel mechanism/drive system. The first thing that we need to do is make sure the wheels have the gears so then the chain can turn smoothly with the wheels. The gears we have chosen are the larger 40 tooth gears we will connect these to the motors and the wheels by using motor shaft hubs, axle hubs, and axle set collars like so.

Create-Wheels

Step\_\_\_\_ Now that the gears are set on the wheels, we need to add the extra gear that we plan for by using axle, bushings, axle hub, collars, 32mm and the med sized 40 tooth gear. We connected them like so to the base.

Step\_\_\_ now that the gears are all in place we need to get the two chains the right size and right placement on the wheels.

Create-Electronics/Power

Step\_\_\_ after the chains are completed, we need to get the motors ready for use we soughtered them and connected them to the brain like so.

Step\_\_\_ after the motors are connected to the brain, we need to place the brain on the robot. We placed it on the bottom flat so then it would be closer to the servos and motors.

Create-Electronics/Power

Step\_\_\_ Now that the brain is on the robot we can start plugging in the servos and securing the motor controls.

Testing Stages

Now in these stages we will drive the robot and take note of any problems that arise.

We will be testing the robot based on these parameters. . .

1. Can it drive for long periods of time?
2. Can it drive up and down a ramp (using the wheelchair ramp at school)?
3. Can the claw and arm pick up the “bomb”?
4. Can the claw open the mailbox?

Feedback- After all of these tests we will redesign and make improvements to the robot.

* When we started testing, we began with testing the movement of the robot and the controls on the remote. In doing these tests we figured out that our motors were different and were turning opposite directions.
* We then tested the arms servo movement and strength. During these the arm was able to move up and down with the “bomb” in the claw. We made sure that this worked by making the arm move up and down at least 30 times before switching to another test.
* We switched to the testing the claw on the mailbox and the ability to pick up the “bomb”. During these tests the claw could open the mailbox, but the mailbox lid got in the way of collecting the “bomb”. We tried to run the robot up the mailbox to grab the “bomb”, but the arm ended up being too high.
* The chains slipped off of the gears and wheels when we were driving.

Testing Stages

Changes to be made plan

Here is a list of the things that we decided to change on our robot

* Fix the motors connections so then the wheels can move in the same direction.
* Make the arm longer by changing the bars out.
* Switching the location and how the connection place of the servos with new ones so then we have more power to the arm and claw when we make the changes to the arm’s length.
* Add grip tape to the Drive tires.
* Remove the chains and its components because fixing and replacing them will take too long and may not be done before competition.

Design Changes

Here are the changes made to the wheels and chain.

Design Changes

Here are the changes made to the servos.

Here are the changes made to the arm length.

Design Changes

Here are the changes we made as we were rebuilding the robot

* We got rid of the bottom arm because it was not allowing the arm to move as well as it was before.
* We moved the brain further back.
* We moved the battery to the top of the robot on the bottom Flat

Here are images of these changes below.

Pictures