

The first step was research, we searched about the necessary boards that needed to be fabricated to move and control the sumo bot. We had to design three circuit: a power circuit, a motor driver and a control circuit.

## **The power circuit:**

The power circuit was simple enough on its own, the design included t-blocks for input(from the battery) and output(to the other circuits) and a super mini buck converter, to step down the voltage for sensor inputs. Which brings us to the control circuit.

## **The control circuit:**

In this circuit we had to connect the arduino to all the different components needed to be controlled like the sensors and the motor driver signal. Doing that, we had to import the required PCB layout for the arduino and used PWM clips and data wires to hold the wires in place for the extra security needed during the fight. We gave the sensors their VCC and GND directly from the power circuit with multiple T-blocks in order to simplify the designing process and make it more compact.

## **The motor driver:**

At first we had debate on whether to make a traditional motor driver using transistors or to make it using relay modules but decided to go with the relay modules because it wouldn't generate much heat especially at 24V and our motors are slow so we wouldn't need to control their speed. Rather than that, it was a simple four relay module driver with two inputs 5V for controlling relays and 24V to power the motors. Although it made the PCB design much more complicated but we put optocouplers to prevent any noise that can mess with the arduino and sensors. Another safety precaution was making the traces that supply the motors more than double that what we needed at full load.

# Problems and improvements:

The first problem that we faced was finding an arduino layout on proteus but after some more research we did find it. Which brings us to the second problem, the layout didn't include the extra USB part on the arduino so we had to edit the design after having printed it on glossy paper, it was also flipped and due to some confusion on whether it was flipped or not we fabricated the board as it was and to avoid redesigning and fabricating, we were forced to put the arduino on the bottom instead of the top of the board.

The control circuit was near impossible to design at first because the assigned pins for each sensor were far apart after putting them closer the design was much easier.

The motor driver was hard as well this could've been avoided if the circuit was separated into two different boards.

There were some problems fabricating PCBs because the only workshop we had access to was closed so we had to improvise and buy tools and do it in a terribly less efficient way forcing us to work longer.

Some parts were available on the stores online but not on-site which forced us to salvage them from old unused circuits. This could've been avoided if we had the access to buy components before design or maybe even before fabricating.

While testing the control circuit our sensors weren't giving accurate numbers so we started trouble shooting, the problem was that we didn't unify the ground of the arduino with the sensors because we used the cable as a power source doing that, only one sensor wasn't working well and needed the base to be welded better.

There was another illogical problem, the control circuit produced high signal to the motor driver yet two of the four relays weren't working, turns out two of the pins weren't working well(not giving enough current). The problem was somehow solved by changing the code.

While welding the wire onto one of the motors it stopped working because the lead was over heated.

After testing that everything was working on its own it was time for assembly. The assembly showed much more problems than any other phase.

At first, the body of the robot turned to be larger than competition specifications. They didn't put into account the addition of an extra layer over the wheels for added friction. They didn't add a way to access our circuits. Although we specification asked and warned about these problems.

Leaving the motor unattended, someone had tampered with it and cut the welded wire forcing us to reweld which led to frying yet another motor although we were very careful leading us to believe that this type of motors is too sensitive to heat. On the same day the arduino was fried as well although the reason is unknown.

Turns out the arduino can't operate on 7.4 volts. So we had to add yet another 12 volt battery just for the arduino.

The super mini buck converter was fried without any tampering. Another team who used it suffered from the same problem so I don't recommend using it.

Having assembled the robot, it walked but didn't respond to its surroundings. The batteries were empty and not supplying enough power to the Sensors.