Robocup Notebook

Robocup 2023 – Frederick Sun Yuki Wu

# Design Process

## Composition of Robot

The composition of our robot is extremely important, as it determines how all the components fit together, what software we need to be able to program, and how different things are needed to sustain a closed-loop feedback system for a task as intensive as ours.

### Design Material

When building the robot, the basic material needs to be considered. We are aiming for a material that fits:

* Something strong and not brittle, can handle excessive forces.
* Can be easily modified so many different iterations can be tested.
* How readily available it is to our team, in New Zealand, and the relative cost of it.

The options are:

#### Nylon

Nylon is extremely lightweight and low in density, only just 1.14g/cm^3. This would be advantageous to use in higher quantities as it is extremely light and has no significant impact on the design structure of our robot.  
  
Furthermore, Nylon has a great compressive force resistance, with it's Young Modulus, *E*, at 2.7GPa. This would allow us to hold all the heavy components without issue and 3be able to support varying loads.  
  
However, working with Nylon is hard and dangerous. Using Nylon would usually leave a trace of hard, sharp residue after cutting, which poses serious safety concerns.

#### FibreGlass Boards

Fibreglass is extremely strong with a Young Modulus of up to 87 GPa, significantly more resistant to damages that may occur, such as snapping or cracking when being handled. This is one of the main advantages.

It is relatively inexpensive, and easy to work with. However, the execution of creating small, precise hole cut outs is questionable. Furthermore, it requires the use of a binding material, through resin, which would only further complicate the matter.

Another concern is its density. At roughly 48g/cm^3, this is significantly heavier than that of the other materials, and would create extra strain on the motors, which is unneeded for.

#### PLA – 3D printing

#### abs – 3D pRINTING

### Wheel

### Microcontroller

### Claw Design

### Dump Design

## Line Following

### Closed Loop system

The line following process is a complex one: involving many different techniques. We aim to use a closed-loop information feedback system to accurately control our robot and its position within the course. This will improve its accuracy and reliability.

Given the inputs v, for colour sensor inputs, and t, for time, we can use the PID controller to determine the accurate output as a function of both inputs, o(v, t).



This formula describes how the output given time and the sensor inputs can be determined.

e(v,t) is the error difference between two sides of the colour sensors rack, as an error of 0 would indicate that the colour sensors are reading the same value, therefore the same colour, which is most likely both white.

describes the sum of all errors since the controller has started to run. Gives indication to how long an error has been occurring with respect time, showing how this must be a longer turn. This would only work if the error would go negative, otherwise there would be a systematic error to turn whichever way was described as positive.



describes the rate of change of error, given the smallest change in t, which is the last reading. This would give indication as to how rapidly the error is changing with respect to time, meaning any given turn is sharper, hence needing more power.



To properly implement this into our system, we would need to use modified values, as the raw values are much too large to work with for motors. Through 3 different constants,



### Limitations

Using this method does come with limitations, as this is not applicable for our scenario. Given that the error may range between -400 to 400, suggesting that the integral would change dramatically, this means that there would be a high impact on the performance of the controller. Furthermore, when there are

## Intersection Handling

## Obstacle Detection

## Rescue Kit Detection

## Rescue Zone

# Robot Design Iterations

# Daily Entries