INSTITUTO TECNOLÓGICO Y DE ESTUDIOS SUPERIORES DE MONTERREY
CAMPUS ESTADO DE MÉXICO

Design Requirements Documents: "Drunk Mixer"

Teacher: Alf Kjartan Halvorsen

Subject: Robotics Project

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I. Problem definition

The world's current situation has limited human interaction in every aspect of our lives. Although humans have dealt with different pandemics before, modern technology has made it easier for people to continue with their everyday activities. Wireless connections and automated services such as grocery shopping without a cashier, car wash, food services, among others help stop the spread of the virus. Taking this into consideration, this project aims to solve the need of a bartender to serve simple drinks. This way the risk of spreading the virus through the glasses is reduced. Also, this project will increment efficiency and reduce time for serving beverages, as well as reducing the cost of having an extra bartender behind the bar. The machine would only need maintenance every amount of time.

It is often a problem that bartenders get wrong orders or spill a considerable amount of liquid while serving large amounts of customers. Unlike a common drink dispenser, Drunk Mixer provides an extra touch for customer experience, adding a lime into your drink and leaving your drink well mixed and ready to be swilled. All this while avoiding any annoying confusion, this machine will always get their order right and there will not be any liquid wasted. Furthermore, this device will keep track of the orders and make an inventory of how many drinks were in total and how much money they made.

Nevertheless, this device does not reduce human interaction completely since it still needs someone to refill the supplies such as the soft drinks, the alcohol and cups/glasses, as well as doing maintenance. Making a machine like this means implementing the infrastructure right on the bar, which costs money and requires appropriate planning. Finally, while it may solve many issues it may raise different problems such as differentiating which drink belongs to which customer, the machine cannot know this. Also, since the amount of liquid per glass will be predetermined, the customer is unable to ask for an extra shot or a reduced amount of something. If it were capable of doing so, it may cause further problems such as a decrease in the amount of beverages expected per bottle. In addition, the robot only has 7 containers, one for ice, 3 for alcohol and 3 for sodas, by doing this you have a restriction on the amount of mixes you can make.

II. Functional Requirements

1. The system shall be able to access our web server and attend the clients' requests.
2. The system shall have an interface to manually select the drink.
3. The system shall store the alcohol and mixer needed for the drinks.

4. The system shall be able to identify if it has enough ingredients to prepare the selected drink.
    a. If it does, start the process shown below.
    b. If it doesn't send a signal and display the ingredients level.
5. The system shall be able to take a glass from a special rack and place it on the start of the preparing sub-system.
6. The system should be able to transport the filled glasses without spilling the drink or breaking the glass.
7. The system shall be able to stop in the right position according to the liquid needed.
8. The system shall be able to pour the exact amount of alcohol and mixer needed for each beverage.
9. The system shall be able to identify when to start the next drink after finishing one.
10. The system shall be able to pick up the finished drink and transport it to the bar.
11. The system shall create a report of the served drinks.

III. Performance Requirements

1. The system shall be capable of serving the required drink in 50 seconds or less.
2. The system shall be able to serve 9 different beverages.
3. The system's server shall be able to receive up to 60 customers' requests per queue.
4. The system shall allow up to 1 customer at a time to use the interface and order as many drinks as available product there is.
5. The system's glass rack shall be able to contain up to 12 glasses.
6. The system's first arm shall be able to take one glass at a time and place it on the start of the preparing sub-system.
7. The system's second arm shall be able to take one glass out of the preparing sub-system and place it on the bar.
8. The system's controller shall handle the process for 1 drink at a time.
9. The preparing sub-system shall have 3 different positions for the 3 different steps of the processes.
10. The system shall pour 100ml of soda and 40ml of alcohol into the glass for any required beverage.
11. The system shall count the number of requests for each drink made in the whole day.

IV. Top-level Technical Requirements

The next image illustrates the expected measurements for the final machine. The measurements are as follows: 100cm for the base, 20cm of length and 65cm of height (100x20x65cm).

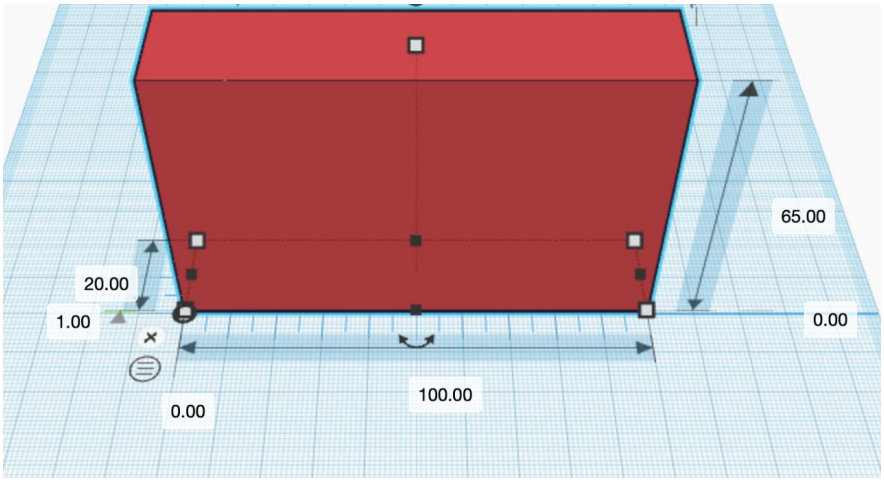


Image 1. Design measurements in cm.

Without considering the weight of the liquid inside the containers and taking into account that the material for the external parts of the machine would be of stainless steel, the expected weight is around 55kg. In the table below it is explained the justification for this numerical value.

Caliber No.	Thickness (inches)	Thickness (Mm)	Weight (Kg/M^2)
⅛''	0.125	3.18	24.963

Table 1. Weight ratio for stainless steel.

Considering the area for each of the walls of the machine we obtain that the total amount of area in square meters is of $1.96\,M^2$. So if the weight of $1\text{Kg}/M^2$ is 24.963Kg, $1.96\,M^2$ is equal to 48.927Kg. The set of tubes, containers and robotic arm is considered to weigh around 5Kg. So the total weight of the machine was rounded up to 55Kg.

The power consumption of the machine is 115 VAC/60Hz, 7.0 Amps.

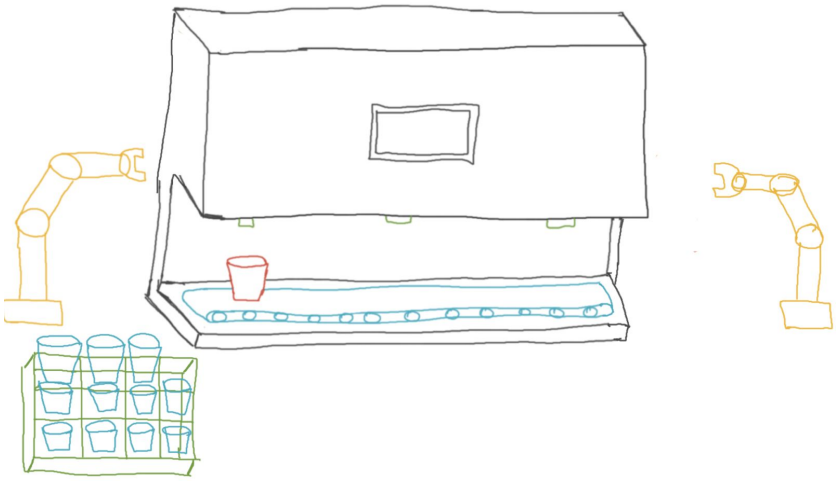


Image 2. Design.

Considering the total cost of the resources required for the creation of the machine, the installation cost and development cost, it is estimated that the final cost for the overall system is $3,000.00 USD. The final cost was obtained considering the following table.

Subtotal	$1,094.00 USD
Profit Percentage	15%
Total	$1,260.00 USD

Table 2. Cost evaluation.

Some safety requirements are: avoid water exposure for any of the electrical components, when it is not being used disconnect from power source, only adults should operate the machine.

Size	100cmx20cmx65cm
Total Mass (Weight)	55Kg.
Power Consumption	115 VAC/60Hz, 7.0 Amps
Cost	$1,260.00 USD
Safety	+18, avoid water, disconnect when not using.

V. Budget

- Conveyor belt
    - Transport belt - $35.00 USD
    - Rollers (x3) - $90.00 USD
    - Stepper Motor - $60.00 USD
    - Motor controller - $40.00 USD
    - Power source - $8.00 USD
- Glass dispenser arm - $335.00 USD
- Containers and valves
    - Plastic 3L container per ingredient (x6) - $240.00 USD
    - Plastic 3L container for ice - $40.00 USD
    - Plastic pipes (5 meters) - $15.00 USD
    - Fluid sensing valves (x6) - $40.00 USD
    - Bypass valves (x6) - $50.00 USD
- Controller
    - PCB with mailing (x5) $79.00 USD
    - Raspberry pi - $55.00 USD
    - Power source - $7.00 USD
- Total Budget: $1,094.00 USD.

VI. Logical Decomposition of Requirements

- The system shall have a robot arm to pick the glass from the rack, turn it around and place it on the beginning of the conveyor belt.
    - The robot arm shall have 6 degrees of freedom
        - 6 Servo motors 12V (MG996).

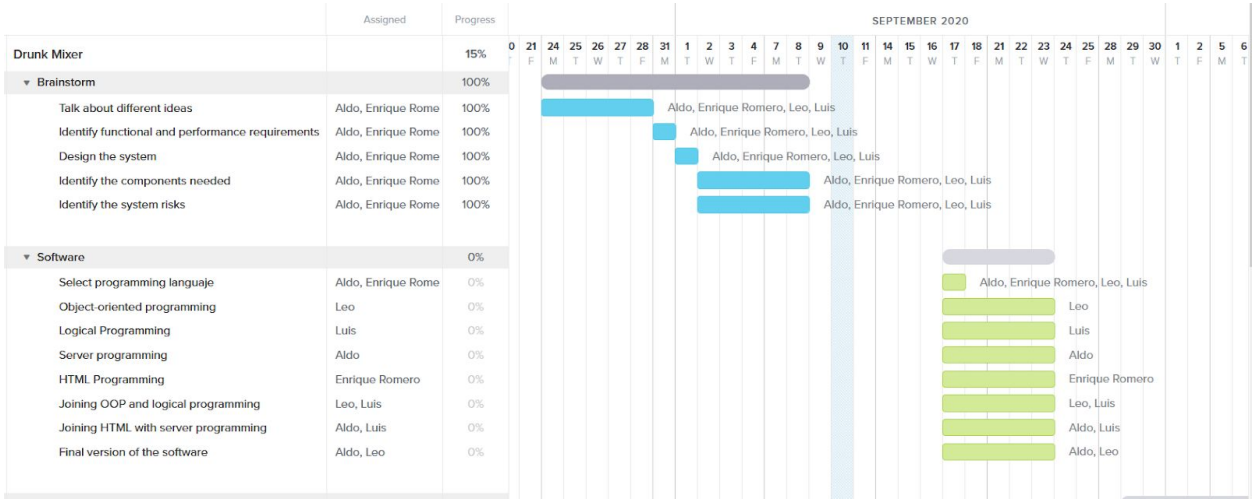
    - The robot arm connecting elements shall be 20 cm long
        - 20 cm connecting element with bracket
    - The robot arm tool shall be a gripper to pick the glass by its side
        - 10 cm opening gripper that operates with one servo motor.
        - 1 Servo motors 12V (MG996).
- The system shall have a robot arm to pick the finish drink of the system and place it on the bar.
    - The robot arm shall have six degrees of freedom.
        - 6 Servo motors 12V (MG996).
    - The robot arm connecting elements shall be 20 cm long.
        - 20 cm connecting element with bracket
    - The robot arm tool shall be a gripper in order to pick the glass by its side.
        - 10 cm opening gripper that operates with one servo motor.
        - 1 Servo motors 12V (MG996).
- The system shall have a control system that prepares beverages.
    - The system shall control three different processes.
        - Each process shall have an electrovalve to pour the liquid.
            - Plastic pipes 1 cm diameter
            - Fluid sensing valves
            - Electric bypass valves
    - The system shall have a microcontroller that implements the control algorithms.
        - PCB (10 x 15 cm)
        - Raspberry pi 4
        - Power source (5V DC 3 Amp)
- The system shall have a conveyor belt to move the glass between each step of the process.
    - The control system shall move the conveyor belt in a way that glasses will not be dropped or spill any liquid.
        - The system shall roll the belt using sliders.

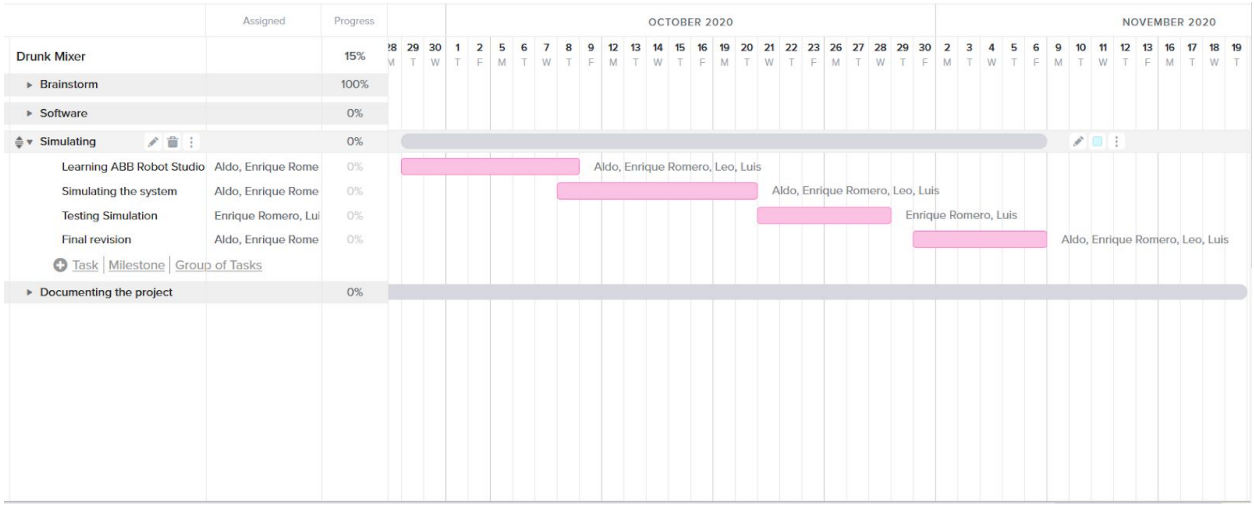
- The system shall be moved using a DC motor.
- The system shall be energized using the power source used for the whole system.

- The system shall have plastic containers to stock the ingredients.
  - The system shall have seven different containers, one for each ingredient (ice, 3 sodas, 3 alcohol).
    - Seven 3 cm^3 plastic containers.
    - One 9 cm^3 plastic container.

VII. Design, implementation and testing plan

- **Gantt Chart**

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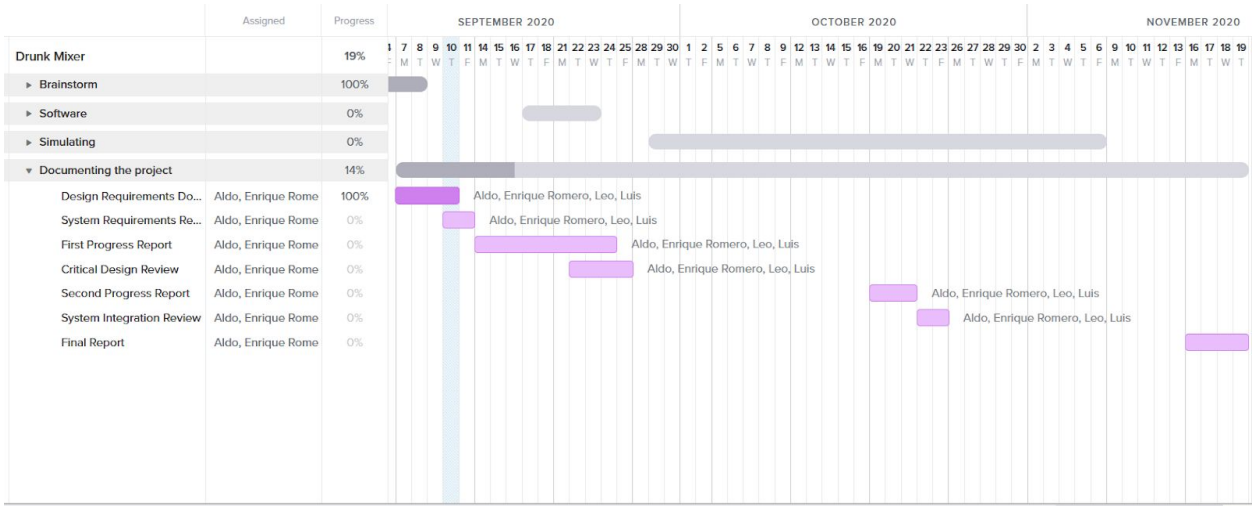
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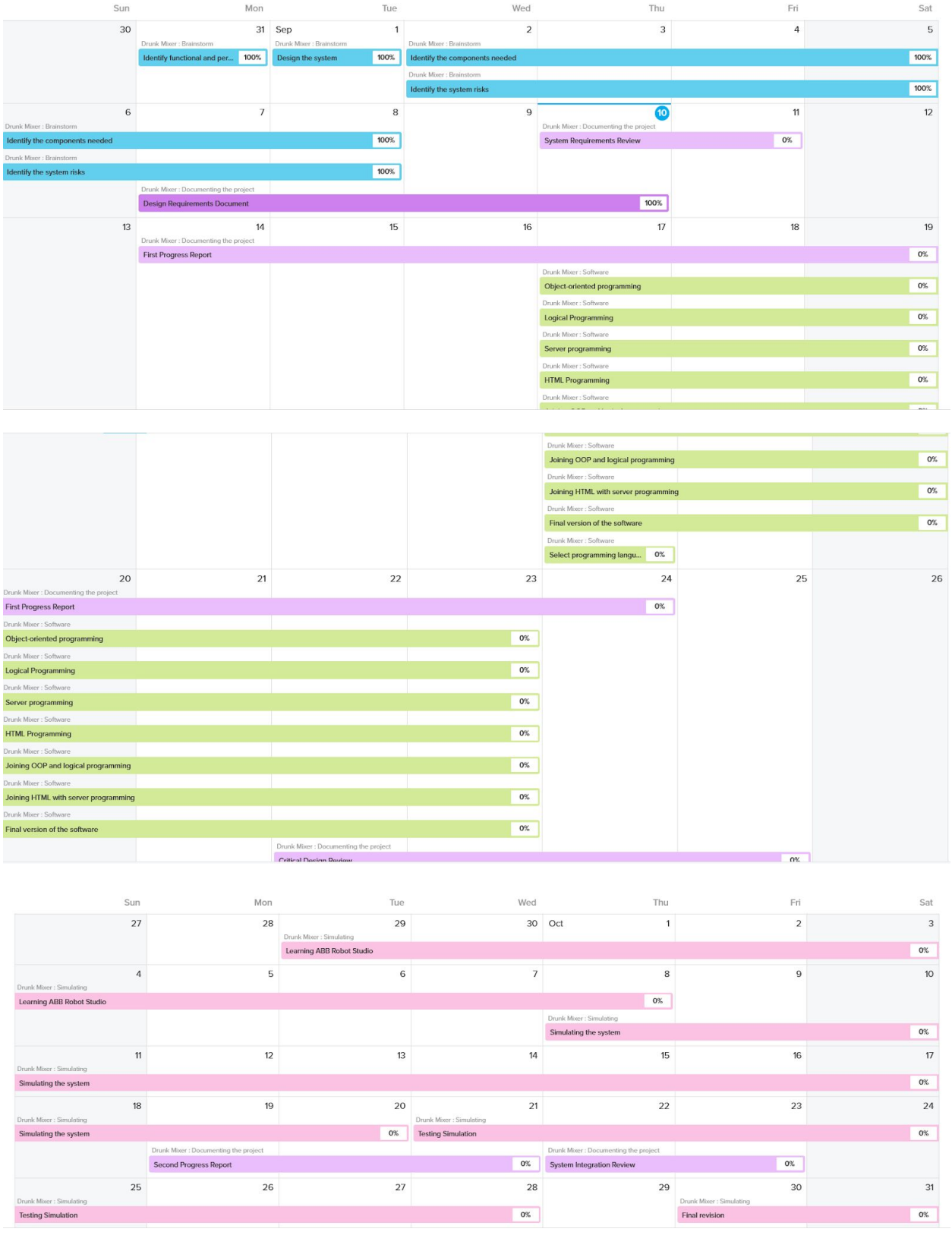
- **Calendar**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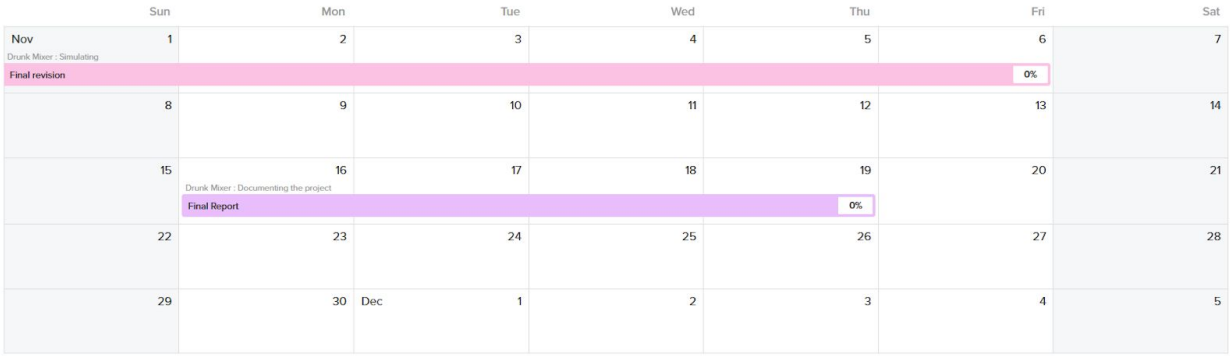

VIII. Definition of interfaces

External

- Web page.
- Manual 5 in touch screen displaying the web page.

Internal

- Motor controller to control the speed and position of the conveyor belt
- Electro valves and sensors to measure and allow fluid.

IX. Identified System Risks

1. Problems with the software license.
2. Not learning the correct functionality of the simulation software.
3. Problems when buying the Raspberry Pi.
    a. Delivery time
    b. Not being able to run the server
4. Problems when running the simulation on any of the members computer.
5. Not having the materials needed to use the Raspberry Pi (monitor, cables, memory, mouse, keyboard)
6. Team member falling ill in Covid and could not do his part of the project.
7. The material is not delivered on time.
8. Unable to find a suitable place to install the robot and test it.
9. Not having enough money to buy the materials.
10. Not keeping up with the planned schedule which can result in the project not being finished.