Functional Specification

Year: \_\_2017\_\_\_\_ Semester: \_\_\_Spring\_\_\_\_\_ Team: \_\_8\_\_\_ Project:\_\_\_\_\_\_\_\_\_Barbot\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Assignment Evaluation:

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| --- | --- | --- | --- | --- |
| **Item** | **Score (0-5)** | **Weight** | **Points** | **Notes** |
| **Assignment-Specific Items** | | | | |
| **Functional Description** | 5 | x3 | 15 | Good work |
| **Theory of Operation** | 4 | x3 | 12 | Lacking in detail |
| **Expected Usage Case** | 5 | x3 | 15 | Good work |
| **Design Constraints** | 4 | x3 | 12 | Be more specific |
| **Writing-Specific Items** | | | | |
| **Spelling and Grammar** | 3 | x2 | 6 | Some minor spelling errors |
| **Formatting and Citations** | 4 | x1 | 4 | Follow the IEEE format |
| **Figures and Graphs** | 5 | x2 | 10 | Good work |
| **Technical Writing Style** | 4 | x3 | 12 | Good |
| **Total Score** | 86/100 | | |  |

5: Excellent 4: Good 3: Acceptable 2: Poor 1: Very Poor 0: Not attempted

General Comments:

Good work! But some sections need more work. You have not mentioned about how the web interface would communicate to the Barbot. A wifi module can add some complexity to the project. Make sure you decide fast and start working on it!!

1.0 Functional Description

Barbot is an automatic bartender that could prepare drink for users. User will be provided a web interface as drink menu which will allow users to select their desired drink. In the drink menu, there are two sections, one section is for drinks with build-in recipes, and the other section allows user to mix up their own drinks. The web interface communicates with Raspberry Pi through wifi module. In addition, this machines is built to mix between 8 alcohol or drinks. The information about the current status of machine (what kind of drink is it making and whether it is finished) will be displayed on a LCD screen on the device. A slidable platform will carry the cup move along the metal rod to the target position and the target drink will be poured down into the cup. After several times of move, the desired drink will be ready for users.

**2.0 Theory of Operation**

The purpose of Barbot is to allow user to mix their own drinks without the help of bartender. The goal of the barbot is to save money and time for user and let user enjoy the drink anytime as they want.

The stepper motor on the conveyer rod helps to determine the movement of the cup, by measuring speed in the one axis. By the distance formula, d = s \* t, the measure of distance is directly proportional to speed, given that the stepper motor’s speed is constant. So, we can control the time to let the cup stops at required position.

The capacity linear actuator on the cup holder is to controller the valve of the drink dispenser by moving up and down. As the cup arrives the desired position, the capacity linear actuator will move up until open the valve of drink dispenser, and wait for dispensing the drink. Hydraulic actuator is based on Pascal’s law[1]. The law states that as the pressure in the system is the same, the force that the fluid gives to the surroundings is therefore equal to pressure × area. In such a way, a small piston feels a small force and a large piston feels a large force.

3.0 Expected Usage Case

The project will be used indoors so there will be no environmental constraints. The project will be used in a stationary setting. The product will be placed on table and users interact with productthrough the web interface. The Barbot will be processing one user request at a time, so one user will use the machine instance of the project one at a time. However, other users can use the web interface of the project to order the drink at the same time when our machine is working on previous user’s order. So multiple users can use the web interface of the project at the same time. Since our project involves alcohol, all users are expected to be above the age of 21 and non-allergic to alcohol beverages.

4.0 Design Constraints

4.1 Computational Constraints

The primary computational functions of the Barbot are focused around how to make the cup stop at required position. The stepper motor will control the cup holder moving in a constant speed. The main arithmetic calculations is to compute time needed to run the motor based on the distance between every drink. Besides, the time to run the capacity linear actuator needs to be calculated based on the speed of capacity linear actuator and the distance between the cup holder and the drink dispenser valve. The total waiting time for dispensing one drink will base on the the time of capacity linear actuator need to reach the valve and the time that the valve dispenses the liquid. The microcontroller will also need to be able to interface Raspberry Pi via SPI protocols, LCD screen, and performing all the operations.

There is no need of external memory for this project. All the data will be stored in the Raspberry Pi.

4.2 Electronics Constraints

The major components the Barbot will utilize are as follows: LCD screen, stepper motor, Raspberry Pi, and Linear Actuator. LCD screen will communicate through standard serial protocol to save output pins. Stepper motors and linear actuator will be controlled by the PWM protocol. Both motors require 12-volt[2] to operate, thus, we might need external voltage sources or amplifiers for desired behavior. Microcontroller receives the alcohol information from Raspberry Pi via the SPI protocol. Microcontroller can process the info to operate motors to create pre-designed drinks or custom drinks.

4.3 Thermal/Power Constraints

Because the project will be used to make the drink at any time, it is expected that the device be plugged in for power during all the time. Power consumption should fall within a typical range of stepper motor (approximately 1-1.5A). Additionally, since the project is a device that can be directly handled by the user, it is important to make sure that none of the device components overheat to the point where it could injure a user.

4.4 Mechanical Constraints

One of the mechanical constraints of our product is that the slidable platform need to be able to move a fully filled cup and a light duty linear actuator along with the metal rods. The weight of our selected actuator is 2.5 lbs and a cup filled with drink is approximately 1 lb. So our motor is supposed to move a 4-lb object with a decent speed. Another constraint that we may have is setting up the belt that will drive the platform. Since the platform and the items placed on it are relatively heavy so that the friction that belt needs to provide is supposed to be big enough. The control of stepper motor also needs to be accurate since the cup needs to be stopped right at desired position to get unspilled drink. The other constraint is the size of the whole product. We decided to use metal or wooden frame to pack our product. The eight dispenser has dimension of 10x10x16 inches, which requires very the horizontal frame to be 20 inches long and vertical frame to be 15 inches long. As electrical engineers, we lack carpentry experience. To hand make the frame with such big size is a challenge for us.

4.5 Economic Constraints

The major cost of our project is the metal frame and hydraulic linear actuator. These two will cost around $400. Other than those, the other components would be cheap and thus make the project total cost around $600. There are quite a lot of similar products in the industry with an average price range from $1000 to $3000[3]. To ensure our project is moderately priced, the price should be higher than the cost while lower than the average price of the similar products in the industry. Thus a price of $700 - $800 can still make our product competitive in the industry.

4.6 Other Constraints

The height of the cup shouldn’t be over 15 cm, and the radius of the rim of the cup shouldn’t be larger than the distance between two dispensers.

5.0 Sources Cited:

1."Pascal’s principle and hydraulics," in National Aeronautics and Space Administration, 2014. [Online]. Available: https://www.grc.nasa.gov/www/k-12/WindTunnel/Activities/Pascals\_principle.html. Accessed: Jan. 20, 2017.

2."Zowaysoon 50mm/2inch Electric Linear Actuator". [Online]. Available:

https://www.amazon.com/Zowaysoon-Electric-Linear-Actuator-Controller/dp/B00SAXKYPA/ref=sr\_1\_6?s=industrial&ie=UTF8&qid=1484935226&sr=1-6&keywords=linear+actuator. Accessed: Jan. 20, 2017.

3."PartyRobotics,". [Online]. Available: http://www.partyrobotics.de/?post\_type=product. Accessed: Jan. 20, 2017.

**Appendix 1: Functional Block Diagram**

