

LazyBots

McMASTER UNIVERSITY

System Requirements

SE 4G06 & TRON 4TB6

GROUP 9

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|------------------|-----------|
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1 Revisions

Table 1: LazyBots Revision Table

| Date | Revision Number | Authors | Comments |
|--------------------------------|-----------------|--|----------|
| October 6 th , 2017 | Revision 0 | Karim Guirguis David Hemms Marko Laban Curtis Milo Keyur Patel Alexandra Rahman | N/A |

2 Project Drivers

2.1 The Purpose of the Project

The purpose of this project will be to create an autonomous robot that will navigate to and serve the requested drink to the user who requests a drink. Currently in an office setting, workers must leave their offices to get their own drinks. Also, in restaurants, drinks are served by waiters and waitresses, which hinders them from doing other work at that time. Alfred will be designed to make the serving drinks autonomous.

Alfred will allow users to request drinks. These requests will form a queue which Alfred will serve in order using a FIFO protocol. Alfred will go to the table of each user and pour the drinks ordered from that table. Alfred will also have an administrator user which will be able to call Alfred back and override any action that is being taken at the time.

The following document will outline the functional and nonfunctional requirements of Alfred. Other topics that will be covered pertaining to Alfred will include: Scope, Project Constraints, Likely Changes and Project Issues.

2.2 Scope

Include the Scope of the Project

2.3 The Client, the Customer, and Other Stakeholders

2.3.1 Client and Customer

- Restaurant Owners
- Restaurant Staff
- Restaurant Clients
- People who are working in a office environment

2.3.2 Stakeholders

Include Stakeholders

- GM, Project Proposers
- Dr. Alan Wassyng, the Project Supervisor
- Stephen Wynn-Williams and Bennett Mackenzie , The Teaching Assistants

2.4 Users of the Product

This product will be used in a restaurant setting, and the users can be divided into two groups. The first group of users will be the customers of the restaurant, who will be placing drink orders and will be served by the robot. The other group of users will be the restaurant staff, who will ensure that the robot is operating properly and keep the fluid levels topped up.

3 Project Constraints

3.1 Mandated Constraints

The following is a list of constraints that will be followed during the design of this system.

| | |
|------------------|--|
| MC1 | The cost of the project must not exceed \$750 dollars. |
| Rationale | The project must be economically feasible and cannot be an off-the-shelf solution. |

| | |
|------------------|--|
| MC2 | Weight must not exceed what could the motor would be able to move, given torque limitations of motor. |
| Rationale | Robot must be able to move with all drink containers filled. |

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| MC3 | Project must be finished within the course of the academic year. |
| Rationale | Must submit finished project by end of academic year as per project requirements. |

| | |
|------------------|--|
| MC4 | Workload must be achievable by 6 people (size of group) in given allotted time. |
| Rationale | Must be physically possible given allotted manpower and time. |

3.2 Naming Conventions and Definitions

3.2.1 Naming Conventions

Note: The following naming conventions apply to this document specifically.

3.2.2 Definitions

3.3 Relevant Facts and Assumptions

3.3.1 Relevant Facts

- A standard cup size contains 12 ounces of fluid.
- All food or drink should not be served below the height of a table.
- Food Safety and Industry standards state that drinks should be kept at a temperature below 4 degrees Celsius.

3.3.2 Assumptions

Alfred assumptions is tables below.

| | |
|-----------|---|
| A1 | The environment will only be comprised of a one story building with no steps. |
|-----------|---|

| | |
|------------------|---|
| Rationale | Different environment elevations are beyond the scope of the project. |
|------------------|---|

| | |
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| A2 | The width of the walkways will be wide enough to accommodate all people. |
| Rationale | If a table is not accessible to a human, it will not be accessible for Alfred. |

| | |
|------------------|---|
| A3 | Orders will be placed via an Android or iOS application. |
| Rationale | Eliminate the need for human interactions, making Alfred completely autonomous. |

| | |
|------------------|--|
| A4 | The height of a table will not exceed 30". |
| Rationale | This will help simplify the scope of the project and reduce the amount of drink waste. (accidents) |

| | |
|------------------|---|
| A5 | The serving size of a medium sized cup will not vary largely in terms of ounces. |
| Rationale | The standard ounces in a cup will be restricted to 12oz. to accommodate as many users as possible and to limit the scope. |

4 Context Diagrams

Insert images of context diagrams

5 Functional Requirements

Intro sentence

5.1 Alfred Functional Requirements

| | |
|------------------|---|
| ?1 | Alfred shall be able to determine the desired drinks for a table within the restaurant |
| Rationale | It is essential for Alfred to be able receive the order of the drinks to be able to pour drinks for the customers |

| | |
|------------------|--|
| ?2 | Alfred shall be able to identify the table that a specific drink order belongs to. |
| Rationale | This is so that Alfred will be able to able to pour the drinks to the correct tables |

| | |
|------------------|---|
| ?3 | Alfred shall be able to navigate to the table that corresponds to a specific drink order. |
| Rationale | This allows Alfred to be able to move without the help from any person. |

| | |
|------------------|--|
| ?4 | Alfred shall be able to pour the correct drinks corresponding to the specific tables order. |
| Rationale | This is that Alfred will be able to pour the drinks for the customers without the need for any human interference. |

| | |
|------------------|--|
| ?5 | Alfred shall be able to pour the correct amount for the drink based on the size of the cup. |
| Rationale | This is that Alfred will be able to pour correct amount of liquid for the user so it will not be under or over filled. |

| | |
|------------------|---|
| ?6 | Alfred shall be able to determine when liquids within Alfred's Storage are not cold enough. |
| Rationale | In order to ensure that the drinks that will be served will meet FDA food regulations. |

| | |
|------------------|--|
| ?7 | Alfred shall be able to notify the staff that that the liquids within Alfred's Storage are not cold enough |
| Rationale | So that the staff will be able to make the appropriate action to cool the drinks down. |

| | |
|------------------|--|
| ?8 | Alfred shall be able to determine that any of the liquids within Alfred's Storage are not at sufficient level to be able to pour a cup of the specific beverage. |
| Rationale | This is so that Alfred will be able to know when it will need to be refilled. |

| | |
|------------------|--|
| ?9 | Alfred shall be able to notify the staff that that any of the liquids within Alfred's Storage are not at sufficient level to be able to pour a cup of the specific beverage. |
| Rationale | This is so that Alfred will be able to receive aid from the staff so that it can continue to fulfill drink orders. |

| | |
|------------------|--|
| ?10 | Alfred shall be able to stop for when an obstacle is in the way of Alfred |
| Rationale | This is so that Alfred will be able to ensure that the customers will remain safe when around them and that Alfred will not cause property damage. |

| | |
|------------------|--|
| ?11 | Alfred Shall be able to determine when an aspect will no longer be functional due to low power. |
| Rationale | This is so that Alfred will be able to take the appropriate actions so that way if we can ensure that Alfred will return to base before it needs to shut down. |

| | |
|------------------|--|
| ?12 | Alfred Shall be able to navigate back to its home base at any given point in time. |
| Rationale | This is so that it will be able to return if there is any issues with temperature, power and drink levels. It is also so that at the end of the day the staff can request for Alfred to return back to home base |

| | |
|------------------|---|
| ?13 | Alfred Shall be able to Indicate to the user when the drinks is ready for the user. |
| Rationale | This is so that the user will know when the drink is finished and is ready. |

| | |
|------------------|--|
| ?14 | Alfred Shall be complete orders in the order that they were received in. |
| Rationale | This is so that fairness is consistent for the user. |

5.2 Table Ordering Application Functional Requirements

| | |
|------------------|--|
| ?15 | The ordering application shall allow the user to be able to place an order for Alfred. |
| Rationale | This is so that Alfred will be able to bring the beverages of the table. |

| | |
|------------------|--|
| ?16 | The ordering application shall be able to transfer the order to the list of Alfred's drink orders. |
| Rationale | This is so that Alfred will be able to receive the specific order from the application. |

5.3 Administrator Application Functional Requirements

| | |
|------------------|--|
| ?17 | The Administrator Application shall allow the user to create a map of the restaurant for Alfred. |
| Rationale | This is so that Alfred will be successfully be able navigate to the location of specific tables. |

| | |
|------------------|---|
| ?18 | The Administrator Application shall allow the user to insert tables, obstacles and paths to travel. |
| Rationale | This is so that Alfred will be successfully be able navigate to the location of specific tables. |

| | |
|------------|---|
| ?19 | The Administrator Application shall allow the user to view all of the orders that were created by the ordering application. |
|------------|---|

| | |
|------------------|--|
| Rationale | This is so that the restaurant shall be able to make bills based on this information |
|------------------|--|

| | |
|------------------|---|
| ?20 | The Administrator Application shall be able to view the status of Alfred. |
| Rationale | This is so that the restaurant staff shall be able to ensure that Alfred will remain functional |

6 Functional Decomposition Diagrams

Insert Functional Decomposition Diagrams!

7 Functional Requirements Likelihood of Change

7.1 Subsection 1

| Requirement | Likelihood of Change | Rationale | Ways to Change |
|-------------|----------------------|-----------|----------------|
| ?1 | Likelihood | Rationale | Change |
| ?2 | Likelihood | Rationale | Change |
| ?3 | Likelihood | Rationale | Change |
| ?4 | Likelihood | Rationale | Change |

7.2 Subsection 2

| Requirement | Likelihood of Change | Rationale | Ways to Change |
|-------------|----------------------|-----------|----------------|
| ??1 | Likelihood | Rationale | Change |
| ??2 | Likelihood | Rationale | Change |
| ??3 | Likelihood | Rationale | Change |
| ??4 | Likelihood | Rationale | Change |

7.3 Subsection 3

| Requirement | Likelihood of Change | Rationale | Ways to Change |
|-------------|----------------------|-----------|----------------|
| ??1 | Likelihood | Rationale | Change |
| ??2 | Likelihood | Rationale | Change |
| ??3 | Likelihood | Rationale | Change |
| ??4 | Likelihood | Rationale | Change |

8 Nonfunctional Requirements

8.1 Look and Feel Requirements

8.1.1 Appearance Requirements

- (i) Alfred shall have any functional equipment hidden within its containment unit unless the user needs to interact with it.
- (ii) Alfred shall not have any exposed electronic wiring.
- (iii) Alfred shall be at the appropriate table height.

8.1.2 Style Requirements

- (i) Alfred shall be painted friendly colours
- (ii) The drink ordering application shall not be visually cluttered.

8.2 Usability and Humanity Requirements

8.2.1 Ease of Use Requirements

- (i) Alfred shall make it user to grab the users drink.
- (ii) Alfred shall make it so the user to be able to tell when a drink is done within one second.

8.2.2 Personalization and Internationalization Requirements

- (i) Text

8.2.3 Learning Requirements

- (i) The ordering application shall make it that the user can learn to order a drink within 2 minutes of use.

8.2.4 Understandability and Politeness Requirements

- (i) Alfred shall not say anything to offend the user

8.2.5 Accessibility Requirements

- (i) Text

8.3 Performance Requirements

- (i) Alfred shall be able to determine the shortest path within 30 seconds.

8.3.1 Speed Requirements

- (i) Alfred shall be able to pour a drink within 30 seconds.
- (ii) Alfred shall be able to move at human speeds.
- (iii) Alfred shall be able to receive an order within 30 seconds
- (iv) The ordering application be able to send an order to the administrative program within 30 seconds.

8.3.2 Safety-Critical Requirements

- (i) Alfred shall be able to determine when an obstacle is one meter in front of it in order to stop it.
- (ii) Alfred shall not pour a drink for the user if it is not at a safe temperature.
- (iii) Alfred shall not cause property damage from movement.

8.3.3 Precision Requirements

- (i) Alfred shall be able to fill the cup from 75-85 percent full.
- (ii) Alfred shall be able to get within 1 foot of any programmed node table.
- (iii) The system shall not distort the users order at any point.

8.3.4 Reliability or Availability Requirements

- (i) Alfred shall not allow drinks to leak onto electronics.

8.3.5 Robustness or Fault-Tolerance Requirements

- (i) Text

8.3.6 Capacity Requirements

- (i) Alfred shall be able to store 2 Litres of any non perishable drink

8.3.7 Scalability or Extensibility Requirements

- (i) This system shall only require one work week to implement within any establishment.

8.3.8 Longevity Requirements

- (i) Alfred shall be able to keep drinks cold for a typical 8 hour work shift.

8.4 Operational and Environmental Requirements

8.4.1 Expected Physical Environment

- (i) Text

8.4.2 Requirements for Interacting with Adjacent Systems

- (i) Text

8.5 Maintainability and Support Requirements

8.5.1 Maintenance Requirements

- (i) Alfred shall be able to determine if it will not be able to function
- (ii) Alfred shall be able to determine why it will not be able to function
- (iii) Alfred shall have it so its easy for components for be removed

8.5.2 Supportability Requirements

- (i) The order system shall have help documentation for the user
- (ii) The administrator system shall have help documentation for the user

8.5.3 Adaptability Requirements

- (i) Text

8.6 Security Requirements

8.6.1 Access Requirements

- (i) The ordering system shall allow the user to see what they have ordered,

8.6.2 Integrity Requirements

- (i) The system shall use encryption that will not loss information.

8.6.3 Privacy Requirements

- (i) The ordering system shall not be able to show any information about other peoples drink orders.
- (ii) The system shall use secure protocols for any communication.

8.6.4 Audit Requirements

- (i) Text

8.6.5 Immunity Requirements

- (i) Alfred shall have a chamber to prevent drinks from warming up.

8.7 Cultural and Political Requirements

8.7.1 Cultural Requirements

- (i) Text

8.7.2 Political Requirements

- (i) Text

8.8 Legal Requirements

8.8.1 Compliance Requirements

- (i) Alfred Shall follow food regulators
- (ii) Alfred shall not preform any discriminatory actions to the user.
- (iii) Alfred shall not server any alcoholic beverages or prohibited substances.

8.8.2 Standards Requirements

- (i) Alfred shall follow the law of robotics.

9 Project Issues

9.1 Open Issues

- (i) Text

9.2 Off-the-Shelf Solutions

9.2.1 Ready-Made Products

- (i) Bar2D2 - a radio-controlled, mobile bar that features a motorized beer elevator, motorized ice/mixer drawer, six-bottle shot dispenser, and sound activated neon lighting.
- (ii) Laskmi-Do Corporation Table Robot - a robot two wheeled robot that delivers drinks.

9.2.2 Reusable Components

- (i) Text

9.2.3 Products that can be Copied

- (i) Text

9.3 Risks

- (i) Components break over time and due to accidents
- (ii) Alfred gets stuck behind an obstacle (if someone places chair in front as opposed to someone walking by)
- (iii) Alfred spills drinks or has drinks spilled on it
- (iv) User error during interaction with Alfred
- (v) User error during interaction with the client side application
- (vi) Alfred harms someone

- (vii) Alfred is not cleaned properly
- (viii) There is a major roadblock in development/construction

9.4 Costs

The budget for the all components of the robot must not exceed \$750. A breakdown of the individual part costs is as follows: **Make a long table for this...**

9.5 Waiting Room

- (i) Having Alfred being able to recognize objects using image recognition
- (ii) Developing a more robust advanced administrative application to include billing and table availability