GNG1103

Design Project User and Product Manual

Raft Cleaning

Submitted by:

The Algaephobes, A20

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Table 1. Acronyms

Acronym	Definition
B.A.A.R.F	The Bryan.Abdul.Ari.Robin.Faress machine
IM	Input mechanism
OM	Output mechanism
UPM	User Product Manual

Table 2. Glossary

Term	Acronym	Definition
Hydroponic	N/A	The process of growing plants in water, as opposed to traditional soil.

1 Introduction

This User and Product Manual (UPM) provides the information necessary for clients of Growcer (users of hydroponic farming installations) to effectively use the ***Bryan.Abdul.Ari.Robin.Faress (B.A.A.R.F)*** and for prototype documentation.

2 Overview

- The problem was that it was taking too long and a large amount of labour for the users that grow produce on board rafts in the Growcer farms is directed to cleaning the algae and debris that build up after each growing cycle. As the boards sit in the water, algae starts to build up on the surfaces of the board. Currently customers clean the raft by hand using scrubbing brushes and the hose.

  This is important because it allows us to take away the important information leading up to the problems experienced by the customers and create our concept and solution around those problems that have been identified by the client

- The product is fully automated as stated by the client so that the user can be able to do other tasks while the boards are being cleaned.
- The product is self-sustainable. It doesn't require a large amount of resources to function, there wouldn't be a need for the user to rely on external resources to function
- The product is user friendly as it has simple control systems that the users are able to easily follow
- The product is safe for users to use, no bodily harm would come to them.
- The product has straightforward troubleshooting, if it ever stops working the users would be able to easily identify the issues and perform the necessary steps to get it back working.
- The product is safe for produce growth, the users should not worry about the cleaning of the boards leaving any chemical residue that might potentially affect the water or the other produce.
- The user won't have to worry about the boards cracking on the surface leaving any types of scratches because the product is safe for the boards.
- The product is less physically taxing, reduces physical effort required by the user to use the product

- Our product differentiates from the others by many different aspects. One of them being its simplicity, it's a very simple product that is fully automated that doesn't require complicated components or mechanisms to make it function. Another aspect that we strongly believe makes our product stand out from the others is the ability to make it easily fixable by troubleshooting itself. Users would know exactly what to do if it ever stops working, they would be able to identify the issues thanks to the products own troubleshooting and perform the necessary troubleshooting steps to get it functioning again. Lastly, a key aspect that makes our product better is that it cleans much better than the others within less time. Because we utilize multiple powerful cleaning brushes and powerful water nozzles that make sure everything gets cleaned, taking only 5 mins to clean while producing a 92 % cleanliness effeciency .

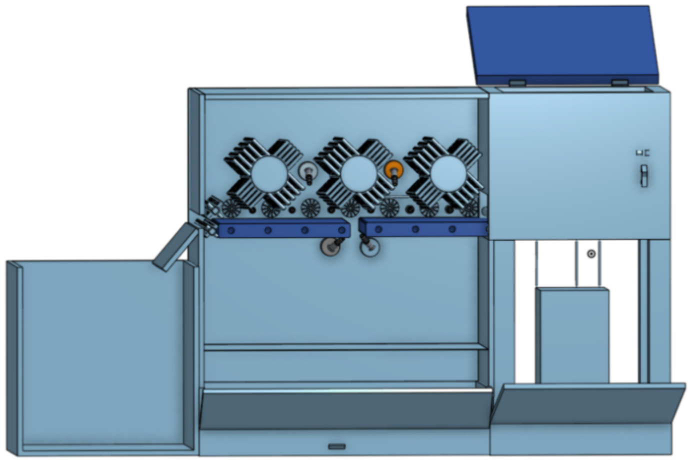

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Figure (a) The BAARF

- Three big powerful circular brushes at the top that rotate to really clean the debris and algae on top of the boards. On top of that, we have multiple circular rotating brushes on the sides to get the sides of the board, at the end of the cleaning system we have medium sized brushes to finish off any debris or algaes left at the bottom and the top. We also utilize powerful water nozzles that spray water from all directions to get all sides of the boards. Finally we implemented an input mechanism that utilizes a motorized arm that uses a pushing motion to get the boards that are stacked inside to the conveyor belt.

- It is built with metal frames, from the input mechanism to the body of the cleaning system. Uses an arduino board and a stepper motor for the wiring. Has an ON/OFF button for easy use.

3 Getting started

3.1 Configuration Considerations

This system needs no setting up before use. The controls are simple, only an ON/OFF switch has to be pressed by the user to start the machine.

3.2 User Access Considerations

- This machine is made specifically for Growcer, therefore the users that will be using this product are Growcer employees.
- No technical training is required.
- The only complication or issue that might arise is the boards sticking together if the user faced the boards wrongly while inserting them into the system. Even then, the system can separate the boards by itself.

3.3 Accessing/setting-up the System

1) Check the waste tray: make sure it is empty before you BAARF your boards. If it is not empty, simply pull it out and throw out any waste inside of it and place it back again. Close the tray.

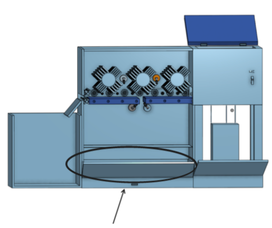


Figure (b) Waste tray

2) Open the lid of the input mechanism and insert the boards one by one on top of each other. Have them placed in such a way that the first board on the bottom is facing upwards, the

one on top of it facing downward. Do this for every 2 boards till you fill the input mechanism. Make sure that the lid is closed.

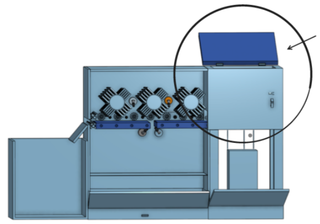


Figure (c) Input mechanism

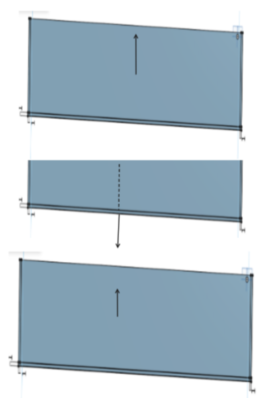


Figure (d) Board placement

3) Push the ON button on the front of the input mechanism.

3.4 System Organization & Navigation

1) The input subsystem:

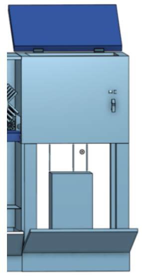


Figure (e) Input subsystem

This is the first part of the machine. It holds the ON/OFF switch on its front wall, and it is where the user inserts the boards.

2) The main cleaning subsystem of the BAARF:

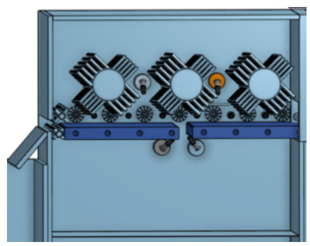


Figure (f) Cleaning subsystem

This is the middle part of the machine. It takes the boards in from the input subsystem, and carries them through the brushes, that will clean every side of the boards, to the other side where they go out into the output subsystem.

3) The output subsystem:

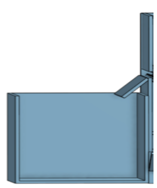


Figure (g) Output subsystem

This is the last part of the machine. It receives the boards from the cleaning subsystem after they are done, and stores them here till the user picks them up.

4) Waste tray:


Figure (h) Waste tray

This is the bottom part of the machine. It stores all the waste like algae and dirt that falls off the boards while they are cleaned, and drains the water. The user needs to empty the remaining waste found in it before and after every use.

3.5 Exiting the System

1) Take the boards out of the output mechanism and turn the machine off.
2) Wait for the water to drain from the machine and empty the waste tray.

4 Using the System

The B.A.A.R.F has three main components that the users interact with on a day-to-day basis: the input mechanism, the cleaning tray, and the output mechanism.

4.1 Input mechanism (IM)

The input mechanism of the B.A.A.R.F. is the unit that the user is interacting with the most.The input mechanism has a lid that the user can lift open to gently drop the boards into, and can physically see the boards piling up when looking down into it. Once the user has exhausted their supply of boards, or the IM is full, they can close the machine by the handle and press the "on button" switch.

Figure (i) Input mechanism

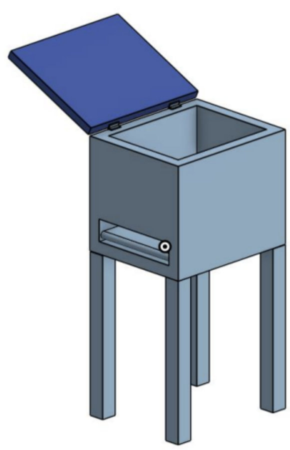
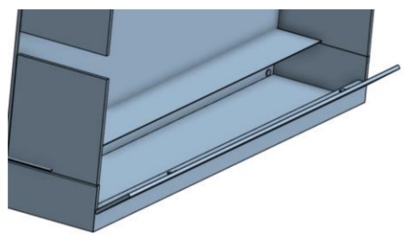


Figure x: The Input Mechanism

4.2 Cleaning Tray

Once the client has inseminated the rafts into the machine, the machine does most of the cleaning autonomously from the user. The only feature that the user interacts with is the cleaning tray at the bottom of the main body. Inside the machine there's a filter, so when the B.A.A.R.F. by pumping out water it can catch the algae before it clogs the pipes. Once the filter for the algae get's full an beeping alarm will sound alerting the client to clean the filter. To clean the filter the user simply has to bend down, slide out the tray, and scap the algae into the garbage. When the filter is sufficiently clean, they simply slide it in once again.

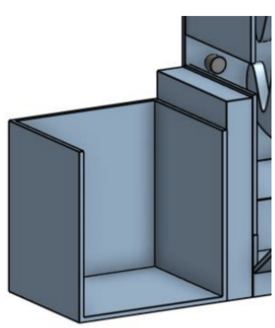
Figure (j) Cleaning Tray



4.3 Output mechanism (OM)

Once the boards are clean, they simply slide out of the machine onto a tray. The OM has been designed so up to five boards can pile up, and whenever is most convenient for the client they can pick them up.

Figure (k) Output mechanism



5 Troubleshooting & Support

5.1 Error Messages or Behaviors

There are two possible error messages:

- If the motorized arm in the input mechanism can no longer move, meaning there is a blockage within the system, an alarm (long beep) will alert the user of a malfunction
- If the waste tray is full, an alarm (short consecutive beeps) will alert the user to clean the waste tray before starting the cleaning process

5.2 Maintenance

In order to keep the system running without failure, the waste tray should be cleaned after every use of the B.A.A.R.F. Users should make sure there is nothing obstructing the path of the rafts before engaging the cleaning process. Conveyor belts should be lubricated when necessary (using household lubrication products such as WD-40).

5.3 Support

For emergency assistance and technical, contact Faress Madhoun (fmadh090@uottawa.ca) who will be able to fix your issues and assist you with your troubleshooting.

6 Product Documentation

6.1 Prototype 1: Cleaning mechanism concept

6.1.1 BOM (Bill of Materials)

Cardboard, hot glue, door brush tape, cardboard rolls, straws (all household items, no price)

6.1.2 Equipment list

Hot glue gun, box cutter, ruler

6.1.3 Instructions

- Cut out two identical rectangle pieces of cardboard
- Divide the length by 8 (using 8 straws) and measure equal distances to make holes on each piece of cardboard
- Make holes
- Put straws within cardboard rolls, and stick them in the holes of both pieces of cardboard
- Hot glue them to a third piece of cardboard
- Cut two pieces of cardboard to the same width and length of the box
- One will serve as the "board" and attach door cleaner tape to the other along the width of it (serving as the closed top of the system)
- Attach door cleaner tape on both sides of the conveyor system

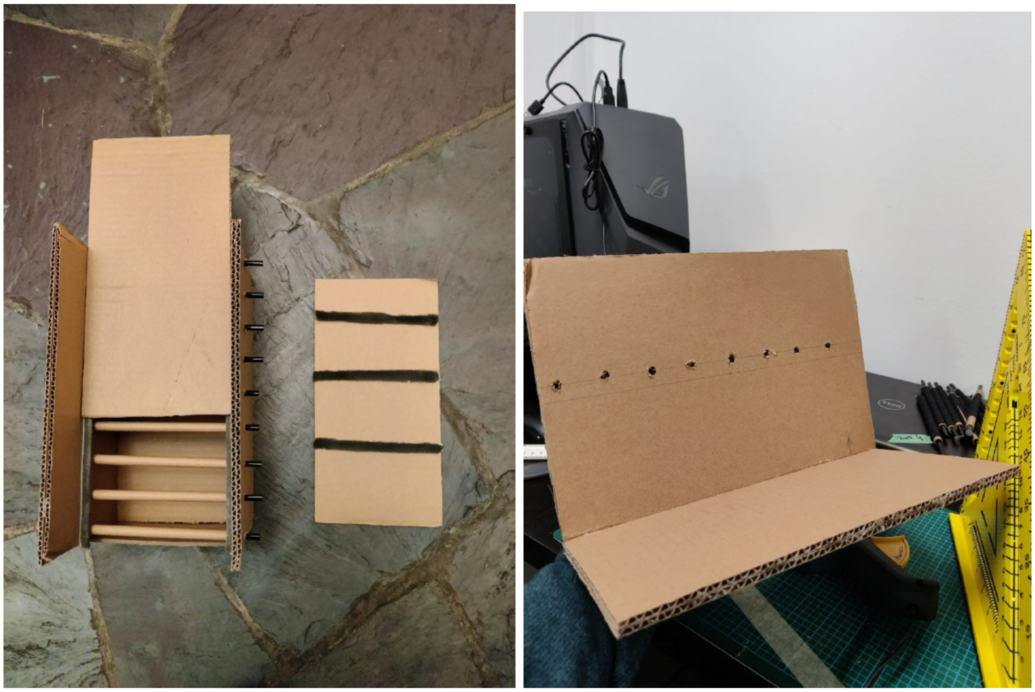


Figure (l) Prototype (1)

6.2 Prototype 2: Motorized brush

6.2.1 BOM (Bill of Materials)

Arduino UNO (9$), motor shield (35$), jumper cables (1$), breadboard (2.50$), brush (3.50$), stepper motor (15$), hot glue, 9V battery

6.2.2 Equipment list

Hot glue gun, Arduino IDE

6.2.3 Instructions

- Connect the stepper motor to the motor shield
- Attach the brush to the stepper motor arm (securing it with hot glue)
- Run an infinite loop code that makes the motor shield spin

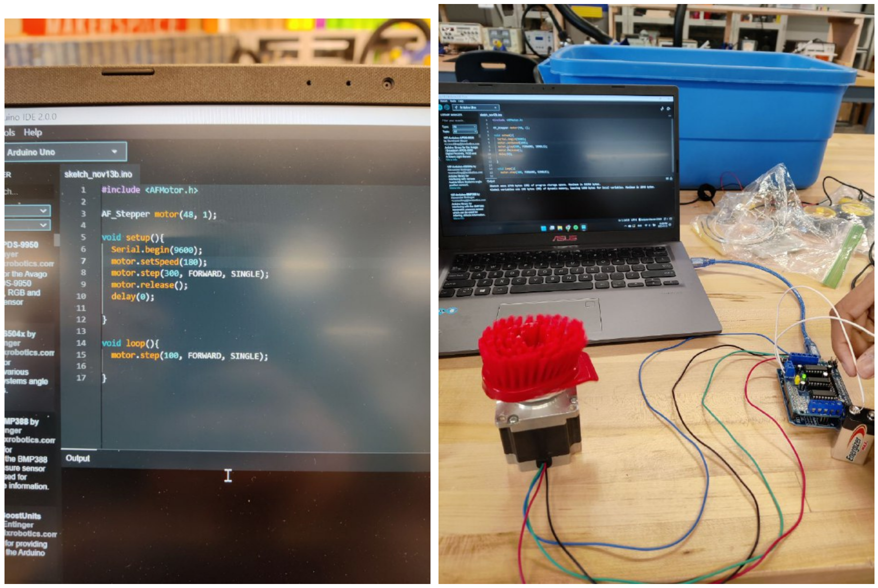


Figure (m) Prototype (2)

6.3 Prototype 3: Input System

6.3.1 BOM (Bill of Materials)

sheet metal (20x32 cm) (20$), wood blocks (8x8x1 cm^3), metal rod (⅛”)

6.3.2 Equipment List

sheet metal bender, metal scissors, spot welder, drill press, ruler

6.3.3 Instructions

- Cut sheet metal (see sketch below)
- Drill hole (see sketch below)
- Make bends using sheet metal bender (dotted lines see sketch below)
- Weld sides together to secure the prototype

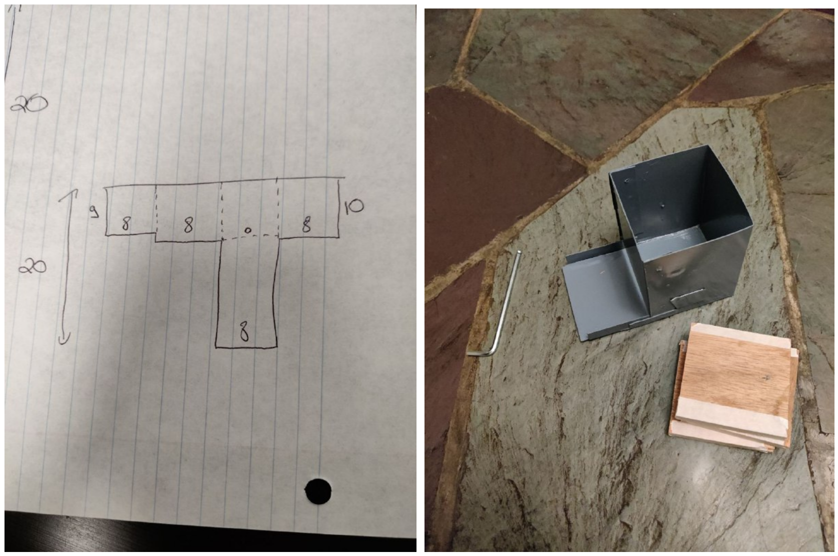


Figure (n) Prototype (3)

6.4 Testing & Validation

6.4.1 Prototype 1

We would like to see if the stationary brushes in our concept reached sufficient surface area to clean the hydroponic rafts.

To test the prototype, water was added to the brush bristles and a cardboard cut out was propulsed by the conveyor belt through the system to see how much area they would mark

After testing the brushes have marked the whole length of each side of the cardboard where the brushes are placed. This means the whole surface of the cardboard (where there are brushes) comes into contact with the brushes. We can now measure the whole surface area of each face of the cardboard and find the estimated surface area that came into contact with the brushes. We can then measure a ratio: (area that came into contact)/(total area)

To measure the surface area in contact with the brushes, we will take the width that was marked by the ink on the brushes and multiply it by the total length of the cardboard (we assume the whole length is in contact since it is a linear, straight motion)

Total surface area of cardboard test piece where brushes are projected to clean: (7 * 11.75) + (0.125 * 11.75) = 83.7 in^2

Total surface area in contact with brushes: (6.75*11.75)+(0.125 * 11.75)= 80.8 in^2

<u>Results and conclusion:</u>

We have a ratio of 96.5% of the targeted surface area in contact with the brushes.
Since most of the surface area of the cardboard has been in contact with the brushes, the prototype is successful in showing that a conveyor belt coupled with stationary brushes can reach most of the surface area targeted to clean.

6.4.2 Prototype 2

We would like to understand and determine efficiency of motorized brushes in cleaning a surface. An individual motorized brush will be placed on a surface to be cleaned (piece of plastic with dried spinach caked on it) with water and soap and the cleaned surface area will be measured.
After testing:
Area to clean: 5.7 * 4.6 = 26.22 cm^2
Area left after test: 1.6*1.4= 2.24 cm^2
Area cleaned: 26.22-2.24= 23.98 cm^2
<u>Results and conclusion:</u>
The cleaning efficiency of the motorized brush is: (23.98/26.22)*100 = 92% (rounded up)
We can conclude that motorized brushes can adequately clean a surface after 30 seconds of contact. The prototype therefore proves that the brushes in our concept will adequately clean the algae off of the boards.

Figure (o) Testing prototype (2)

6.4.3 Prototype 3

We would like to understand and determine efficiency of the motorized arm when pushing the boards out. This will be tested using wooden blocks imitating the boards, and a small metal stick imitating the motorized arm. We then manually push the wooden blocks using the metal stick and record yes or no if it's able to push them out one by one. It is successful if there is no blockage.
<u>Results and analysis:</u>

As shown in the following pictures, the prototype works as intended. Each “board” is dispensed in a controlled, accurate manner, with only one “board” dispensed at a time. None of the “boards” got stuck, meaning the input mechanism not only works as intended but is also reliable and provides stable performance.

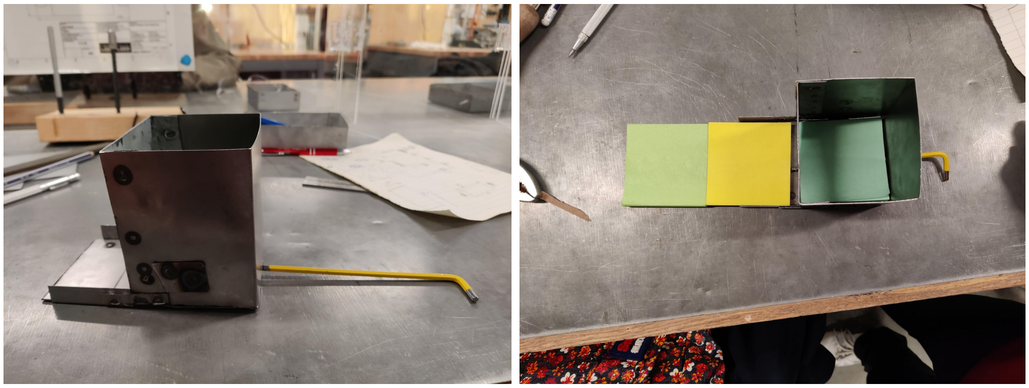


Figure (p) Testing prototype (3)

7 Conclusions and Recommendations for Future Work

We have proved the individual functionality of each element and subsystem of our concept. We've learned that a simple approach, using brushes and water is a very good solution to Growcer's problem. We recommend building a scaled down version of the concept, grouping the three individual prototypes to now prove the feasibility of implementation and prove that these subsystems work well one after the other.

APPENDICES

8 APPENDIX I: Design Files

The following documents are all related to the final design concept as well as the prototypes detailed within this user manual. CAD files, sketches as well as BOM (for prototypes) are all indexed in the following table.

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
BRUSHES.x_t	https://makerepo.com/FaressMadhoun/1238.algaephobes-a20	03/12/22
Assembly 1.x_t	https://makerepo.com/FaressMadhoun/1238.algaephobes-a20	03/12/22
Part Studio 1.x_t	https://makerepo.com/FaressMadhoun/1238.algaephobes-a20	03/12/22
Hand drawing 1.png	https://makerepo.com/FaressMadhoun/1238.algaephobes-a20	03/12/22
Hand drawing 2.png	https://makerepo.com/FaressMadhoun/1238.algaephobes-a20	03/12/22
Hand drawing 3.png	https://makerepo.com/FaressMadhoun/1238.algaephobes-a20	03/12/22
Handrawing 4.png	https://makerepo.com/FaressMadhoun/1238.algaephobes-a20	03/12/22

Hand drawing 5.png	https://makerepo.com/FaressMadhoun/1238.algaephobes-a20	03/12/22
Bill of material Invoice - Yasser	https://makerepo.com/FaressMadhoun/1238.algaephobes-a20	03/12/22
bom a20.pdf	https://makerepo.com/FaressMadhoun/1238.algaephobes-a20	03/12/22