HOUSE HOLD

AQUAPONICS SYSTEM

Project by :
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M.Des (Industrial Design) 2012-2014
IDC, IIT Bombay

Guide:
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IDC, IIT Bombay

Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsifi ed any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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(Signature)

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(Name of student)

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(Roll number)

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(Date)

Approval Sheet

Industrial Design Project 02
Household Aquaponics system

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M.Des Industrial Design 2012-2014
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is approved as a partial fulfilment of requirement of post graduate degree in industrial Design.

Professor R. Sandesh:
(Project Guide)

External Examiner:

Internal Examiner:

Chairperson:

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I would like to sincerely thank my project guide Professor R. Sandesh for his time, support and guidance throughout my project.
I am also thankful to Professor B.K Chakravarthy (Head of IDC), Professor A.G Rao, Professor U.A Athavankar, Professor Purbha Joshi, Professor P. Kumaresan for their valuable feedback during the stage presentations.
Special thanks to my friends and my classmates for their great help and support.
Great thanks to IDC for providing me with all kind of infrastructure and opportunity.

CONTENTS

ABSTRACT

The project is aimed at studying aquaponics, implementing it in urban context and promoting the technology through this urban home product. The urban population has less access and opportunity to farming due to space, resources and time constraints.

The Aquaponics technology has been in existence for over the last 3 decades, yet it is not so common to the masses. In a developing country like India, where the balance between the rural and urban population, is rapidly shifting towards the latter, issues like food insecurity becomes a major concern. Urban farming is the one answer to solve this problem and it takes conscious effort for that. The product could be used as a serious farming as well as a hobby/destressing element in the urban homes.

INTRODUCTION

INTRODUCTION TO PROJECT

"House Hold Aquaponics System" is the major project in third semester. The main intension of this project is to bring aquaponics into the urban home environment context to promote aquaponics technology as well as inspire the people to understand the value of farming.

Aquaponics is an idea that has been developing over the last 30 years and is becoming more and more well known. It is not that famous in India and it has plenty of reasons why a country like India needs this technology for future food security. Aquaponics can provide a constant supply of fresh greens and protein with less amount of farming effort.

Food insecurity increases when people shift to cities. Since India already faces a high population issue, this technology will provide a means to feed entire future population.

INTRODUCTION TO AQUAPONICS & HOW IT WORK

Aquaponics is the combination of the words aquaculture and hydroponics. Aquaculture is the process of intensive fish farming and hydroponics is the growing of plants without soil. The water used for growing fishes, would be filled with natural fertilizers from fish excretions. This water can be used for growing plants. The plant absorbs the nutrients from the water and makes the water purified. The bio-purified water can be re-circulated as fresh water source for the aquatic system. Hence the fishes and plants co-exist in a symbiotic relationship. The growth of useful bacteria in the system promotes the proliferation of microbial processes. The ecosystem created by coexistence of these two sub systems can be an example of a bio-mimicry of a real life sustainable ecosystem. It ensures less pollution of water due to aquatic waste and healthier plant growth as there are only organic fertilizers.[1]

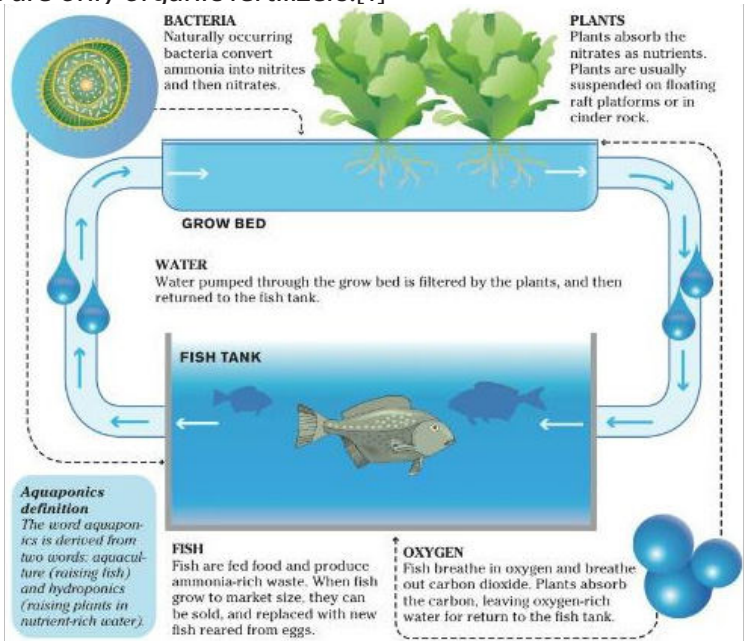


Image.1.Aquaponics cycle

The Nitrogen Cycle in Aquaponics

As living beings, fish excrete waste products and ammonia. When in higher concentrations, these are harmful to the fish themselves. Aquaponics uses water from the fish tank to grow plants in a bed. This water uses the huge number of naturally occurring micro-organisms which help in breaking down ammonia into nitrite and then nitrates.

Ammonia →NO2-→ NO3-

These are absorbed by plants for their uses, thus cleaning water in turn. The solid particles waste are filtered by the grow bed or an external add-on device.[2]

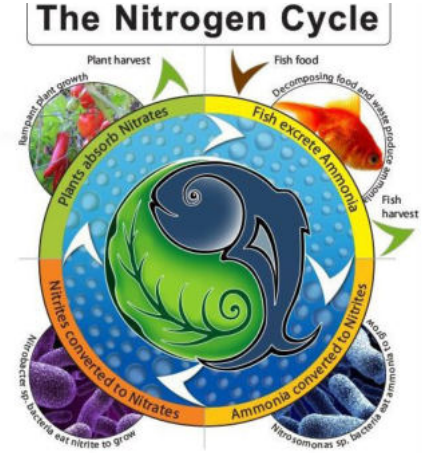


Image.2.Nitrogen cycle

Ref:[1] http://googl/8xHteY
:[2] http://goo.gl/oQPuLg

image.1: http://goo.gl/c9eq59
Image.2: http://goo.gl/0X8JnH

Comparison of Aquaponics with Traditional approaches

Soil-based Gardening	**Hydroponics**	**Intensive Aquaculture**	**Aquaponics**
The problems with traditional soil-based gardening are: • There will be weeds in the system • Comparatively large amounts of water required, at regular intervals. • Required good understanding regarding applying water, fertilize, and composition of the soil; • Needs heavy digging. The bending and back strain involved are also relatively large •There will be soil-borne insects; •Pests.	The problems with hydroponics are: • It requires the careful application of expensive, man-made nutrients made from mixing together a blend of chemicals, salts and trace elements; • The pH values and the concentration of this mixture needs to be carefully and constant¬ly monitored, using expensive meters; • Periodic change of water is required as the salts and Chemicals in the system builds up and becomes toxic to the plants. This is both problematic; • The system is Prone to a disease called “pythium” or root rot.	The problems with intensive aquaculture are: • The water in the tank becomes polluted due to the high concentration of ammonia which comes with wish wastes. • This unhealthy environment makes the fishes prone to disease and should be treated with medicines, including Antibiotics, frequently. • Water has to be cleared at around 10-20% of total volume, daily. Thus consumption and wastage of water is high. • The waste water which is released into neighbouring systems will also pollute that environment.	The advantages of aquaponic systems are: • Very cheap means of fish culture, the food required for them and also allows hydroponics. • Careful monitoring of the system is necessary during the first month, when the system is established, only occasional pH and ammonia levels check is required, and stress levels of plants or fish. • Water is never replaced, it is only required to top-up as the water evaporates. • The chances of the fishes being infected by “Pythium” is very narrow in aquaponic systems. • Fishes are less prone to diseases in this system relatively.

Ref: Table. http://googl/8xHteY

HISTORY OF AQUAPONICS

Aztec Indians have recorded growing plants on rafts as far back as 10th century AD. They were a nomadic tribe, before building a huge empire in Central America. They used to be camp in various places back then, including today's Mexico. They used to settle near marshy shores of Lake Tenochtitlan. The fresh water lake was surrounded by marshy areas and hilly terrains. Because of the terrain, they were forced to grow plants in an ingenious way to cater to their food needs The islands they planted plants on in their lakes were called 'chinampas'.

They had large rafts made up of reeds and rushes which they found near the lake. These rafts were floated on water. They were covered with soil which were taken from the bottom of the lake. Vegetables and various crops were grown on these floating chinampas. The roots of the plants used to grow down through the soil and dangle in water. The remains of these are still found in Mexico.

Even though soil less culture and fish farming existed as separate events in the ancient times, the combination of these two is a new phenomenon. The research in this are began in 1970's and is widely spread across many institutions today. The remarkable works are of St. Croix, under guidance of Dr. James Rackoy at the agricultural experimental station at university of the Virgin Islands. He has earned world-wide recognition for over 25 years of work in refining the aquaponics system.[3]

Ref: [3]http://goo.gl/sjgVS6

TYPES OF AQUAPONICS SYSTEM

The last 30 years have seen the growth of different aquaponic systems varying from commercial to household backyard system. All aquaponic systems fall into three categories as discussed below.. [5]

Media Filled Growbeds

This is the simplest form of aquaponic system. The system comprises of containers filled with materials like expanded clay balls, gravel, pumice stone. The system works when the media filled beds gets the water pumped from the fish tank. The plants are grown in the rock media. There are two ways for growing plants in this aquaponic system. One by running a continuous flow of water over the rocks and the other by flooding and draining the grow bed through a flood-drain cycle. [4]

Image 3: Home Systems Small Commercial Hybrid Systems

Nutrient Film Technique

Initially, the water is made nutrient rich and is pumped down to small gutters. The water reaches the gutter as a small thin film. The plants which are kept in small cups absorb the nutrients from the small gutters through their roots. However, this technique is much better for the hydroponics system.

Fig 4: Small Commercial Hydroponic Conversions Hybrid Systems

The disadvantage of NFT is that it supports only for a particular set of plants such as leafy greens and herbs. The large plant system having a bigger root system is heavy and bulky and cannot fit into the small gutters where the thin film of nutrient water is pumped. [5]

Deep Water Culture

Image 5: Deep Water CultureCommercial system

In this technique, the plants are floating over the nutrient rich water and their immersed roots can absorb the nutrients. There are lot of ways in which this method can be practiced and this is much used for the commercial purpose.

One technique is to float a foam raft over the fish tank. But a better method is to grow the fish in the fish tank and the filtered water from the tank is pumped to long channels where the plants are grown over a floating raft. These plants absorb the nutrients from the water. Studies shows that the grow bed should be about 12'' deep for the best plant growth and an ecosystem in which the plants and fish are mutually depended. [6]

Ref: [4, 5&6], Fig[3, 4&5]http://goo.gl/BuQ5C0

COMPONENTS OF AN AQUAPONICS SYSTEM

Basically, there are two parts for the aquaponic system. One in which the aquatic animals are raised (aquaculture) and the other part in which the plants are grown (hydroponics). In aquaculture, aquatic effluents are generated from the uneaten food given to the aquatic animals like fish and this gets accumulated in the water. This is because closed type recirculation is followed in most of the aquaculture systems. The effluents so accumulated become toxic for the aquatic animals. Interestingly, these effluents are rich in nutrients that are essential for plant growth. Other than these basic parts, the aquaponic system is also grouped into several sub-systems like the system which is important for the effective removal of solid wastes, system which adds base to neutralize acid or the system which is responsible for water oxygenation. [7]

Fish tank: Generally made from glass or plexi-glass for aquaponics in small scale. Other solutions are containers to store water like plastic tub, bucket, barrel etc. The commercial tank size varies from 500 to 10,000 gallons whereas the desktop units are of size 5 to 50 gallons. For the best results, 2 square feet of growing area is used for every 10 gallon of fish tank water.

Pant trays: Plastic storage containers, buckets or rain gutters are best suited for this. And this should be strong and deep enough to hold medium of 6-12 inch deep. The medium are clay, gravel or rocks..

Medium: This is where the plant grows. As soil is not used for growing plants, the medium serves the purpose of proving support for roots and plants and also to store some water when no water is running through the system. [8]

Water pump: it is for recycling the water in the system. It pumps water from the fish tank to the plant trays and then the water drains from the tray back to the fish tank.

Timer: If water runs throughout to the roots, the plant never gets oxygen from the atmosphere and this result in root-rot. So to avoid such problems, a timer is used for switching the water pump and this is typically done for a half an hour increments in a home system

Air pump: It pumps the atmospheric air to the water for aeration. Fish consumes oxygen from the water and it is much necessary to aerate the water for the better oxygen balance.

Air stones: The purpose of an air stone is to break the air bubbles apart that come out from the air tubing. These are plugged into the tube ends.

Tubing: Tube is connected to the water pump to run the water to the plant trays. Black tube is preferred because it restricts algae growth. ½ inch tube is generally used for this purpose.
The tube used for the air pump is ¼ inch tube which is a common aquarium tube. ¼ inch tubes used for drip irrigation system can also be used for this purpose. This has better durability are cheap when compared with the tubes that are sold in the aquarium stores.

Bio filter:It colonizes the bacteria. It provides large surface area and proper temperature, pH and dissolved oxygen levels. A separate bio filter is not preferred in raft and media filled system because the raft, media and the tank walls and the other surfaces are much enough for the bacteria. It is best suited in NFT system because there is very much less surface area in the channels for the growth of bacteria.. [9]

[7]http://goo.gl/RhQoXW]
[8]http://goo.gl/8OyFt8
[9] http://goo.gl/KeOEFC

Fish

Fishes are the power source of the aquaponic system. Depending on the local climate and the available supplies, there are a wide range of fishes that can fit into an aquaponic system. Some of the most commonly used ones are the following:

Image.6 Barramundi

Image.7. Catfish

Image.8 Carp

Image.9 Goldfish

Image.10 Jade Perch

Fig.11 Murray Cod

Fig.12 Koi

Fig.13 Silver Perch

Fig.14 Tilapia

Fig.15 Trout

Plants

Studies has found around 300 different species of plants that will be best for the aquaponic system. Root vegetables are one of the foremost category that are not appropriate for the aquaponics system.Some of most commonly grawing plants are:

Image16. Lettuce

Image17. Mint

Image18.Strawberries

Image19. Watercress

Image20. Tomatoes

Image21. Cabbage

Image22. Chillies

Image23. Basil

Image.Ref. [6,7,8,9,10 ,11, 12, 13, 14&15]:http://goo.gl/9dy7Zg
Ref. [16, 17, 18, 19, 20, 21, 22 &23] Fig.11, 12, 13 &14:http://goo.gl/CdTbkB

Why this project ?

According to the study conducted by aquaponicsindia.com, In 2008, the world's urban population exceeded the rural population. However, 30% of the Indian population live in cities, while 70% are still in rural areas. But as India grows and people flock to cities for better employment prospects and infrastructure, that balance is rapidly shifting. In anticipation of the outcome of this trend, there is a dire need for urban agriculture in India.

Food insecurity only increases as people shift to cities and already India is facing problems trying to feed its growing population. The demand for food is increasing, while resources are being depleted and people are moving away from agrarian lifestyles. Urban agriculture is one of the answers to this problem that is why this project is essential. Even though the technology is well researched upon and developed, a large mass is unaware of this. This project is meant to promote the use of aquaponics in the urban homes.

A study in Promotion

Promotion

A form of communication which adopted by a company or a business organization to enlighten, inform, persuade or remind masses about their products and to improve its image. Promotion is a primary element in marketing strategies. Promotion should be in all stages of product planning such as marketing, pricing and distribution to the target customers. While creating a promotional plan, generally one or more strategies involved in it viz. personal selling, advertising, sales promotion, direct marketing and publicity. [10]

Purposes of Promotion

Promotion has many roles depending on the requirements of the company. It can raise awareness of people about the brand or the product. Highlight its advantages and attract sales or help in a facelift. The important purposes of promotion are

- Describe important features and highlights of the products.
- Specify the Store or service location.
- Sales rate improvements through Advertisements.
- Gathering feedback from customers.
- Introduction of an entirely new project.
- Creating a desired image of the project.

Types of promotion

- Advertising
- Sales Promotion
- Personal Selling
- Publicity/ Public Relations
- Visual Merchandising

Advertising:
The means of communications to people using mass media to deliver the message. The various means include TV, Newspaper, Magazine articles, Internet and outdoor posters, billboards, buses.

Sales Promotion:
Involves the use of techniques such as giving small techniques etc. to customers, to encourage their response to products or undertake some activity. (Example, flyers, discount coupons, samples, special events etc.)

Personal Selling:
The company representative gets involved in personal contact with the consumers and those making purchase decisions. Sales happens mostly over one-on-one conversations either face to face or through the telecommunication medium.

Public Relations:
Third party recourses such as news media etc. are used in this method, to offer a favourable mention of the marketer's products without direct payment to the publisher of the news.

Visual Merchandising:
The laying out of attractive sales displays, the retail floor and packaging to emphasise the highlights of the products are part of visual merchandizing. In this method the products are sold on the basis of how they are displayed or how visually appealing.[11]

Ref: [10] http://goo.gl/g7sfNV
:[11] http://goo.gl/uO5UxB

Mind map

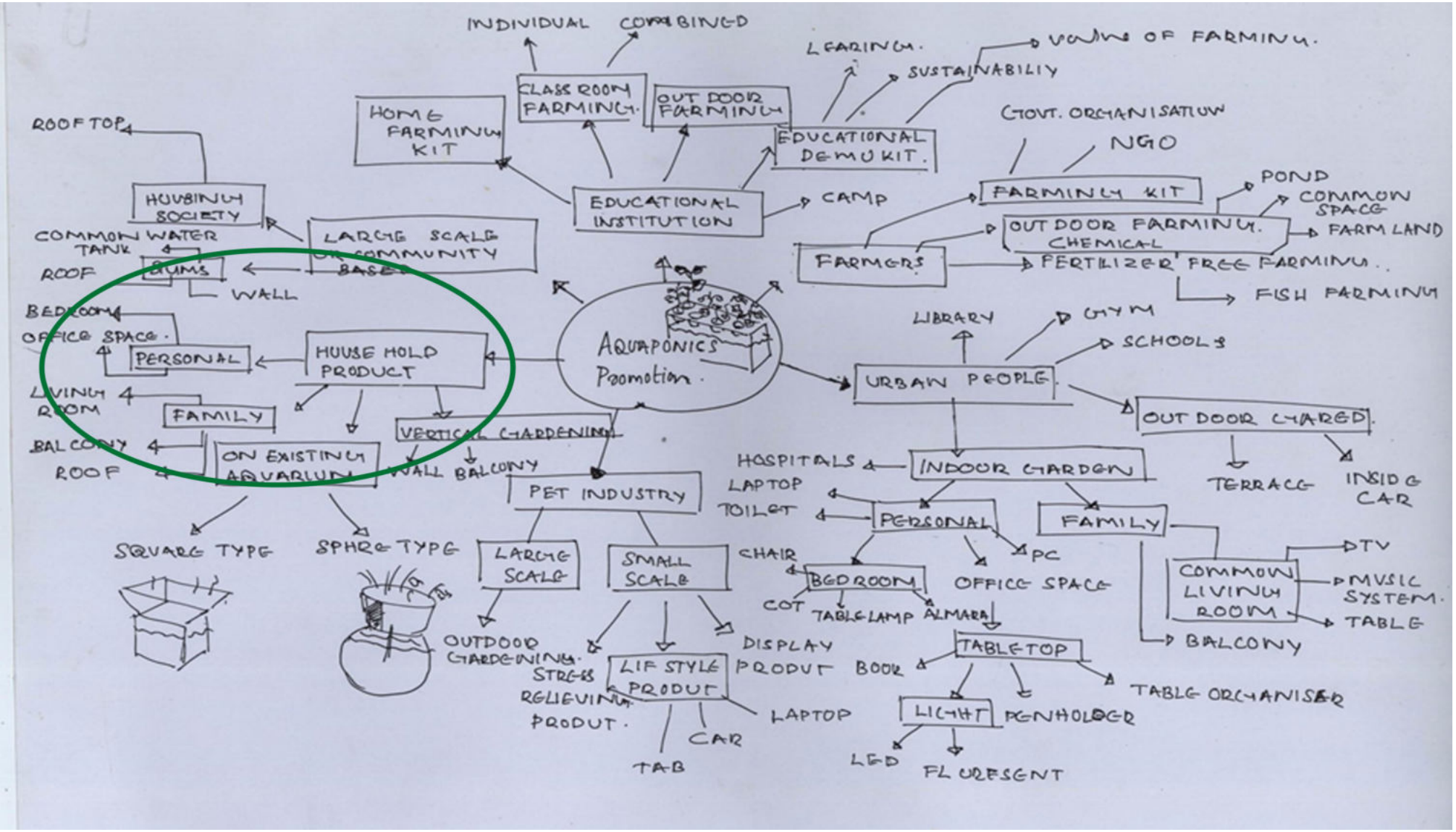


Image24. Mind map

I have done mind map for aquaponics promotion and fixed my area of work as marked above.

Design Brief

Based on the literature survey, secondary research and inferences from the research I prepared a design brief. This design brief gives a complete reference to what should be looking for while developing the product.

Design a house hold Aquaponics system in urban context which should be:

- Promotional
- Inspirationa
- Accessible
- Informational
- Destressing

Existing product study

Image25.

Image26.

Image27.

Image28.

Image29.

Image30.

Image31.

Image32.

Image.25: http://goo.gl/XJcp4L
Image.26: http://goo.gl/UqN4oP
image.27: http://goo.gl/tOF6YL
Image.28: http://goo.gl/Nm0me1
Image.29: http://goo.gl/jwlyW0
image.30: http://goo.gl/oByKO7
image.31: http://goo.gl/eh9Khf
image.32: http://goo.gl/cc5Aik

A study in new technology in aquarium & aquarium accessories

Vinyl Aquarium

Vinyl aquarium is mainly the use of a Clear vinyl and flexible acrylic to support the structure. The viewing window will not hinder the integrity of the structure because of the flexibility of the window material. There are two ways of creating the frame structure.

Plywood frame
Pipe frames.[12]

Advantages

- Affordable
- Knockdown assemblage

Disadvantages

- Distorted view (fish eye lens distortion)
- Unsuitable for indoor aquariums
- Difficult to maintain

Image33.Vinyl Aquarium

Aquarium Stands

Collapsible aquarium stands- One of the major plus points is the knockdown aquarium stands. It has strength parameters which cater to standard as well as whale stands along with the convenience of compact hassle free transport and storage, which is valid for all sizes. It has a flat pack storage and easy to assemble advantage in it.

Advantages

- Frame material: Durable steel square tubing
- Added strength through welding
- Rust protection through black paint
- Available in a variety of sizes
- Available in two types: Standard and Whale
- Available in two types -Standard and Whale [13]

Image34.Assembled Aquarium

Image35.Collapsed Aquarium

Ref.[12], Image.33: http://goo.gl/OAvLDC
Ref.[13].image.34, 35: http://goo.gl/rGeU4R

Study of collapsibility

- Collapsibility is an elementary design principle applied in everyday objects, from telescopes to umbrellas, newspapers to Venetians blinds to perambulators. Collapsibles are by definition also expandables. But to qualify as a true collapsible, an object must also be repeatedly collapsible and expandable.
- Collapsibles are thus smart man-made objects with the capacity to adjust in size to meet a practical need. They have dual and opposite functional states, one folded and passive, one (or more) unfolded and active. They grow and shrink, expand and contract, according to the functional needs.
- In hindsight man is himself a collapsible being. His physical and psychological needs and wants can be considered as varying between two extremes and thus collapsible.
- Man-made collapsibles are not coincidental. It is the result of conception and creation where in somebody first sees an advantage in reducing the size of tool when it is not in use. And second, it must be mechanically possible to reduce the size of tool.

Image36.

Image37.

Image38.

Image39.

Image40.

Image41.

Image.36: http://goo.gl/dlV16O
Image.37: http://goo.gl/4NvTha
image.38: http://goo.gl/mTcKVN
Image.39. http://goo.gl/aJ7JtY
Image.40: http://goo.gl/IZHQTY

Image.41: http://goo.gl/8DchLY
Book ref.Collabsibles byPer Mollerup

Study of Collapsible Home furniture

Image42.

Image43.

Image44.

Image45.

Image46.

Image47.

Image48.

Image49.

Image.42, 43, 44: http://goo.gl/FdNQJ8
Image.45: http://goo.gl/lsSk4t

Image.46: http://goo.gl/uaCiyR
Image.47,48,49: http://goo.gl/FdNQJ8

INITIAL IDEATIONS

Initial ideations

Ideation-1

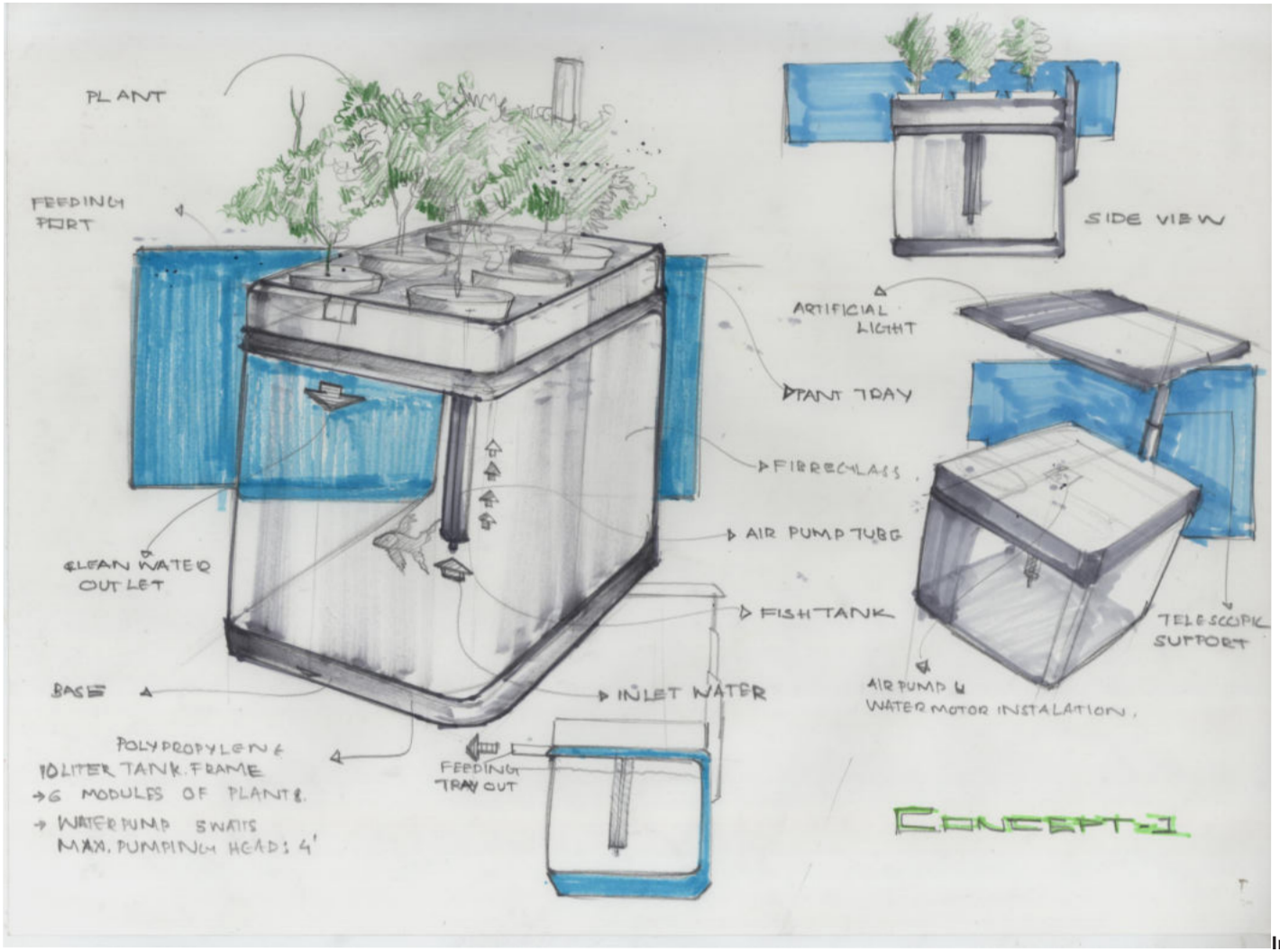


Image.51

Table top aquaponics concept (top plant and bottom aquarium) which transfer water from bottom aquarium to the plant tray at the top by using air lifting principle.

I have considered telescopic LED lighting for the plants considering the less availability of sun light for urban homes.

The concept also supports the easy manufacturing with less number of components.

Ideation-2

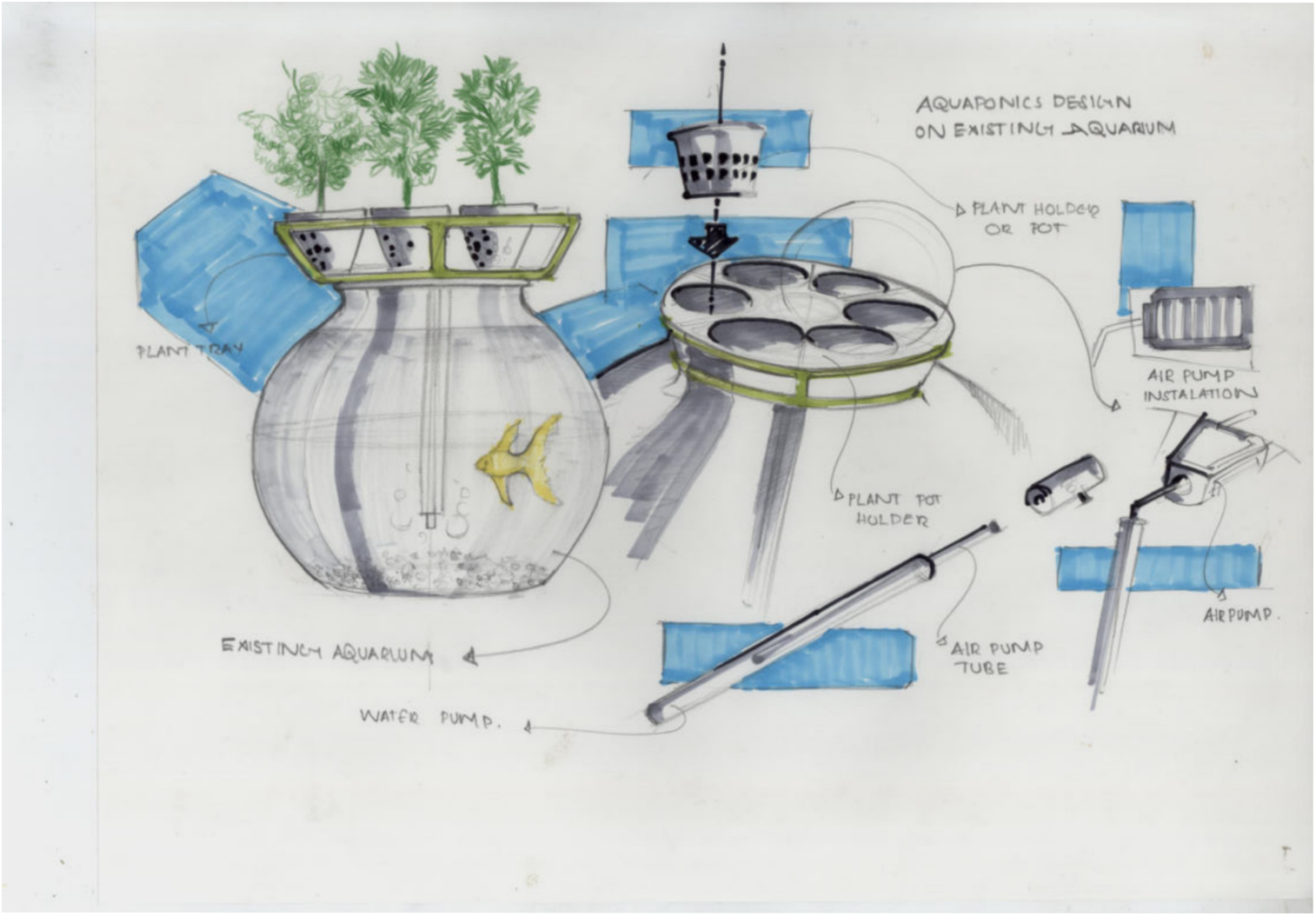


Table top aquaponics concept (top plant and bottom aquarium) which transfer water from bottom aquarium to the plant tray at the top by using air lifting principle.

This concept is designed for existing glass bowl type aquarium which is readily available in the market. The system works by keeping the plant tray at the top of the aquarium.

This is simple and low cost solution for a home aquaponics system.

The existing bowl aquarium keepers can easily convert their aquarium in to an aquaponics system using this concept in very less investment.

Image.52

Ideation-3

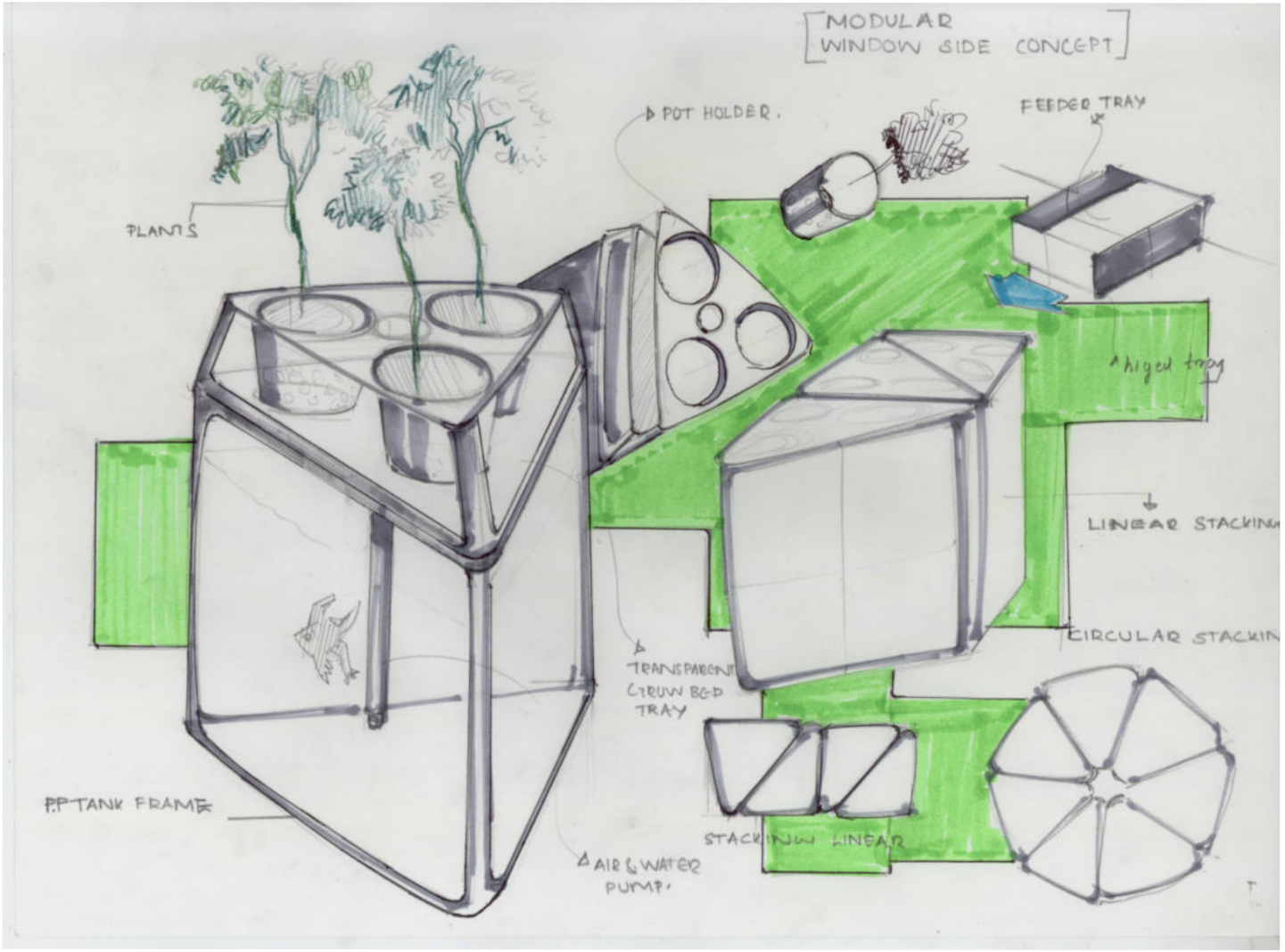


Image.52

Table top aquaponics concept (top plant and bottom aquarium) which transfer water from bottom aquarium to the plant tray at the top by using air lifting principle.

Modularity is also considered in this design. The advantage is that, it can be stacked linear and circular pattern thus the user can personalize his product.

FINAL IDEATIONS

Direction for Ideation

Direction for concepts:

1. Upper plant system lower aquarium type
    - Table top Aquaponics system
    - Tower type aquaponics system
    - Wall mountable aquaponics system
2. Upper aquarium and lower plant type
    - Tower type aquaponics system
3. Aquarium surrounded by plant system type

IDEATION-1

Table top Aquaponics system

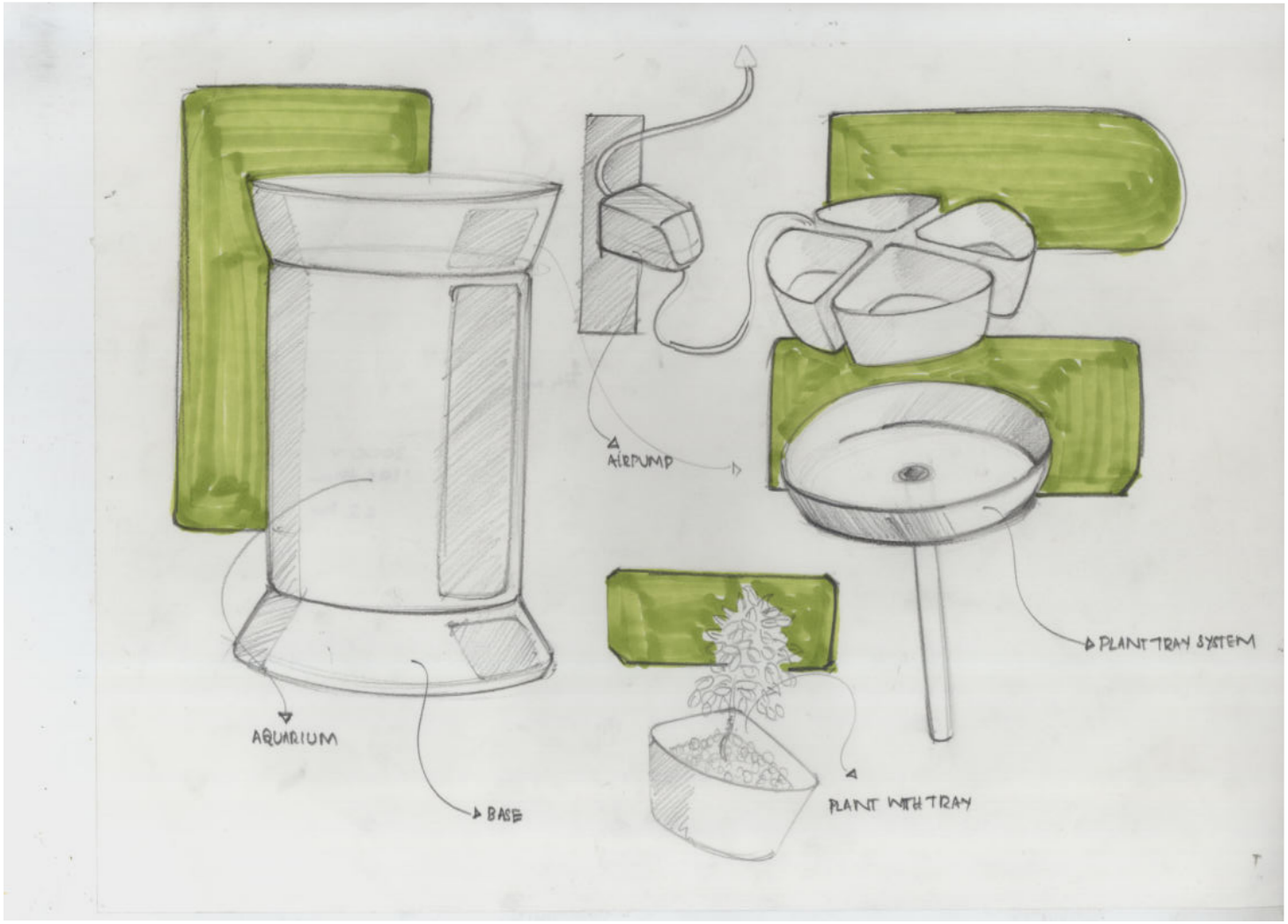


Table top aquaponics concept (top plant and bottom aquarium) which transfer water from bottom aquarium to the plant tray at the top using air lifting principle.

Cylindrical Aquarium design will provide more visibility into aquarium as well as base of the product can store the essential products which are using for maintaining the aquarium and plant system.

Image.54

Ideation-1Detail

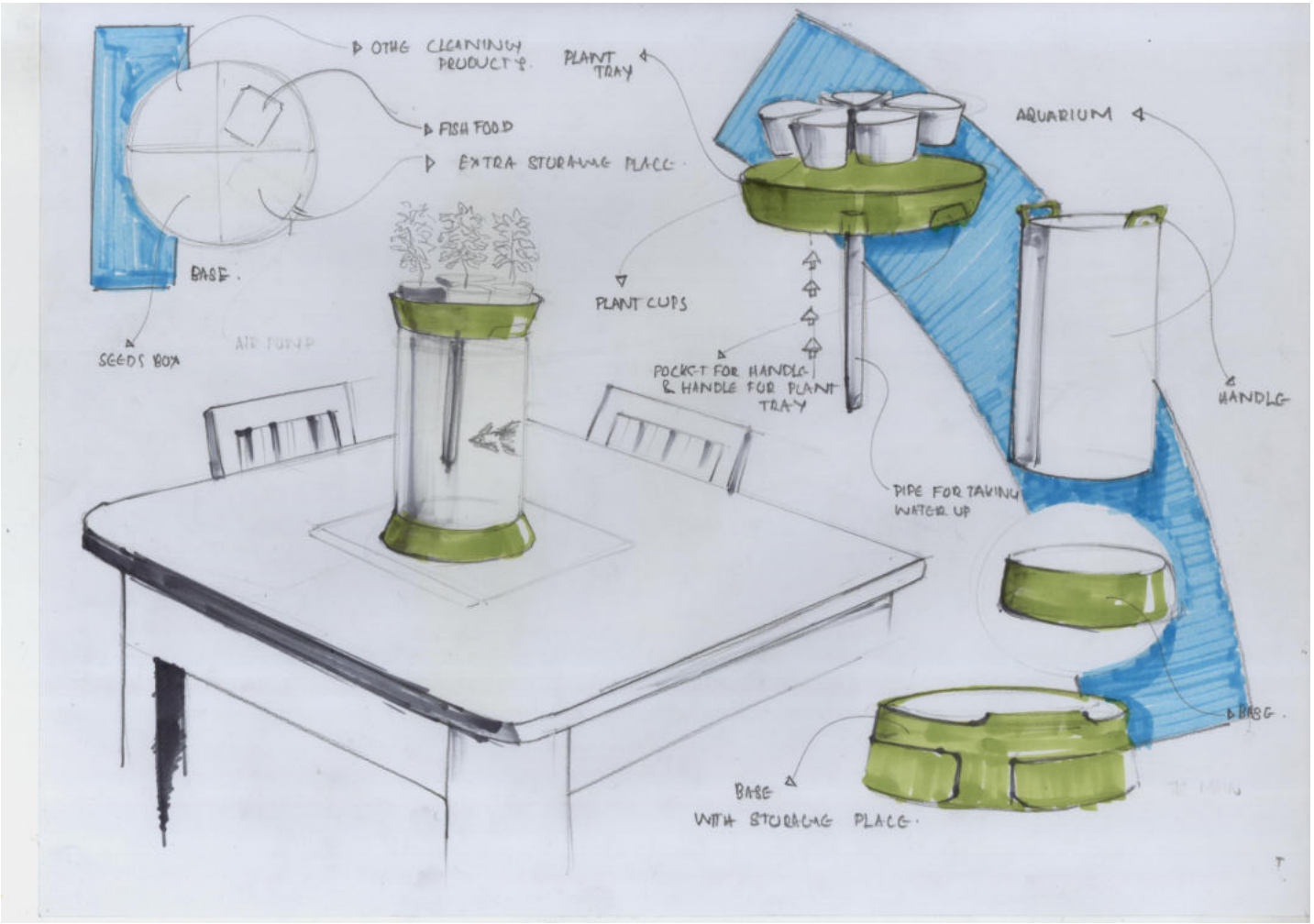
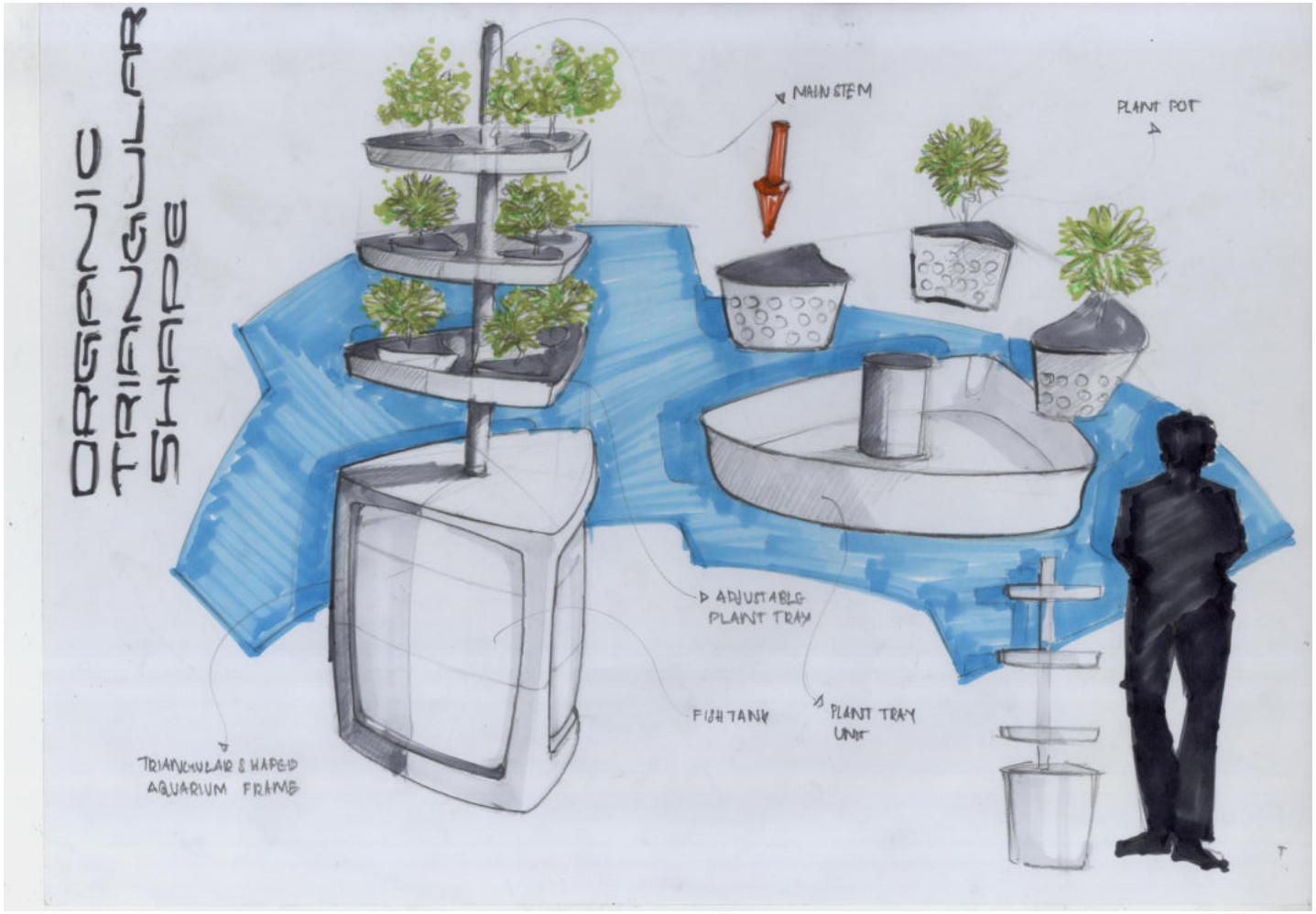


Image.55 Concept -1 in context and part details

IDEATION-2

Tower type aquaponics system



This Tower type aquaponics system concept has an upper plant system and lower aquarium. This concept is a medium scale aquaponics system which carries triangular shape plant pots.

Ideation-2Details

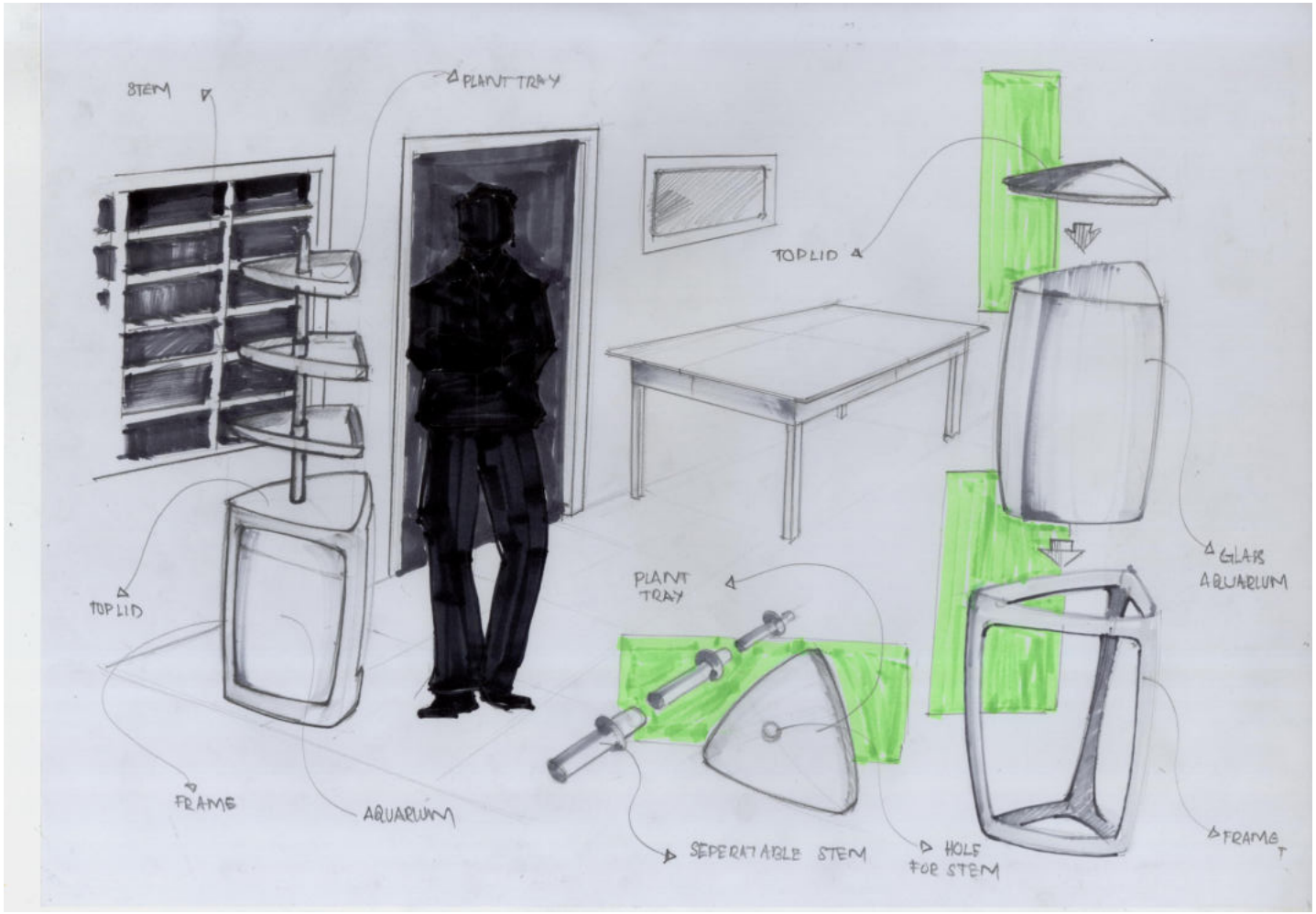
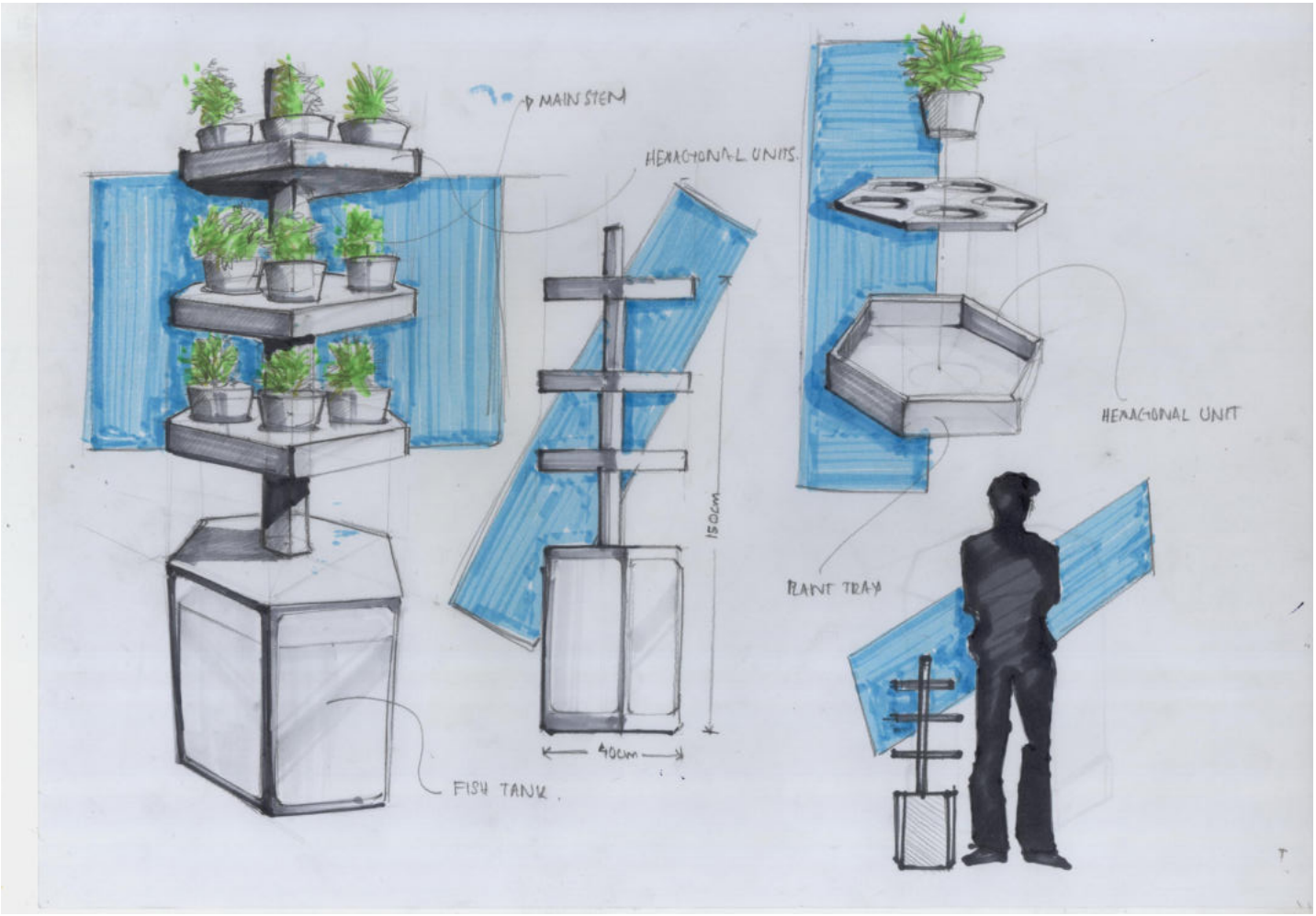


Image.44 Concept -3 in context and part details

Form variation for Ideation-2



Lower type aquaponics system concept has an upper plant system and lower aquarium. This concept is a medium scale aquaponics system which carries hexagonal shape plant trays. It can stack linear and circular way and thus system will not lose the overall form.

Image.56

Form variation for Ideation-2

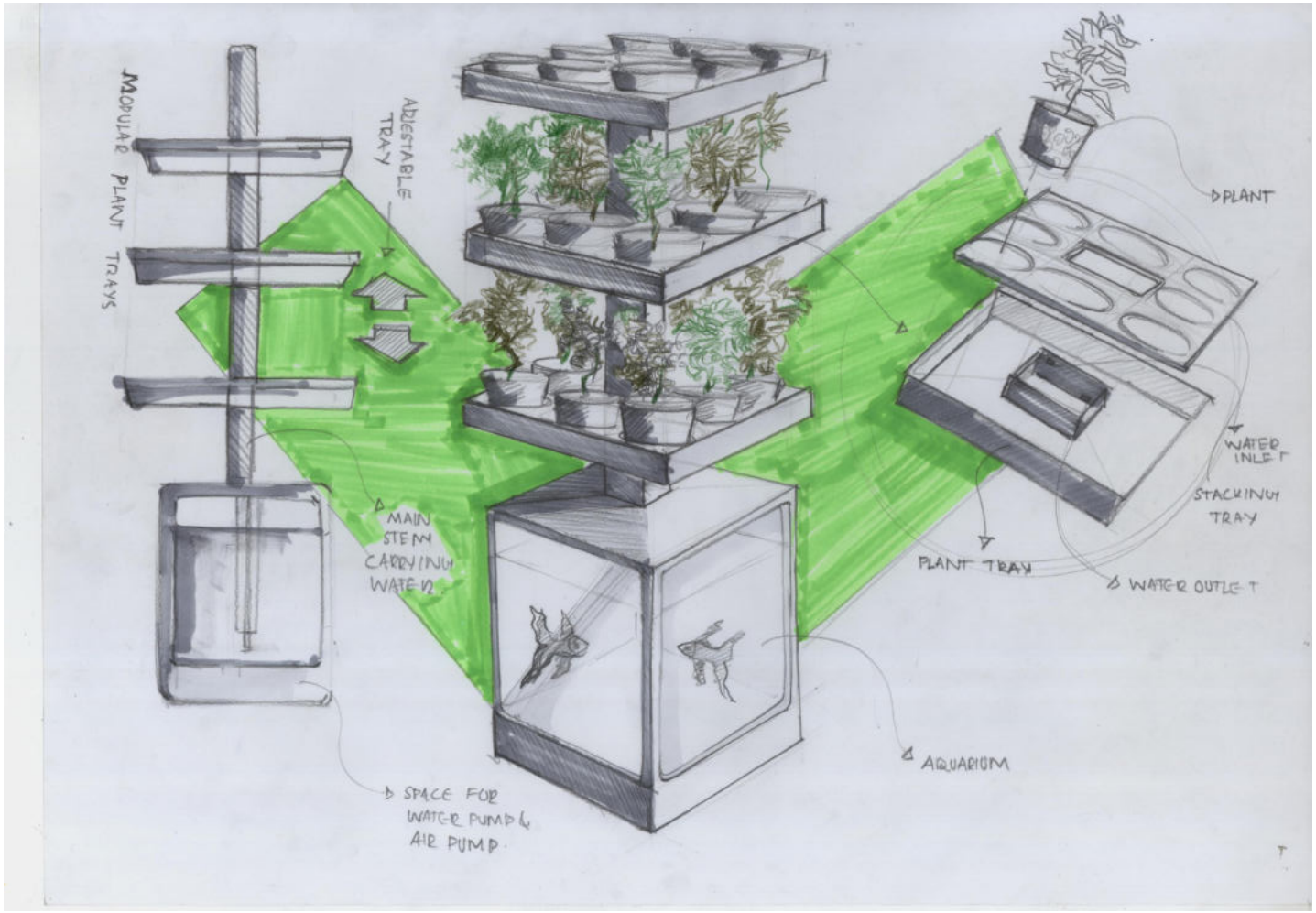
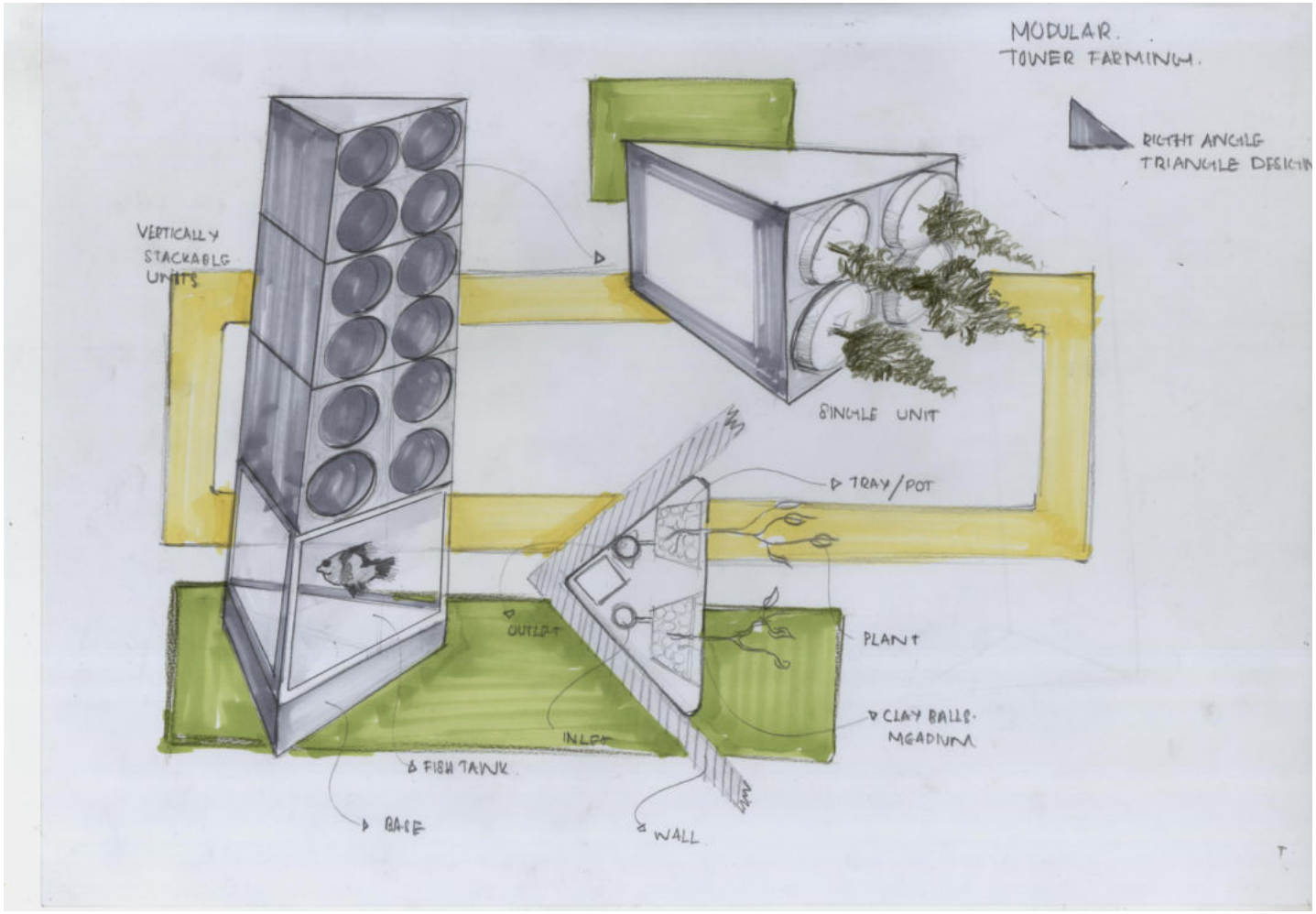


Image.57

This variation of the Lower type aquaponics system concept has an upper plant system and lower aquarium. This concept is a medium scale aquaponics system which carries square shape plant trays.

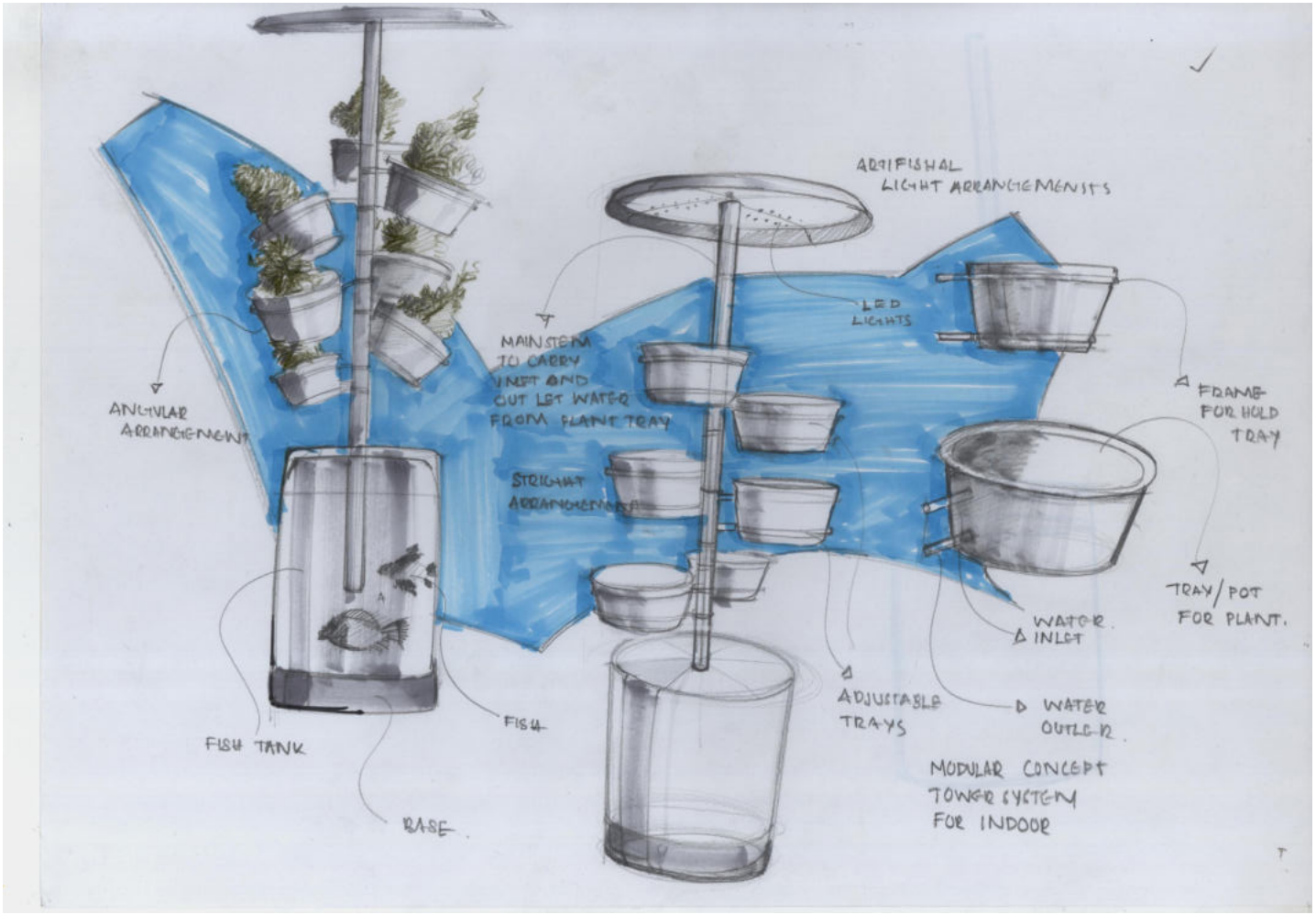
IDEATION-3



Tower type aquaponics system concept which has an upper plant system and lower aquarium. This concept is a medium scale aquaponics system which having right-angle triangle shape. This shape enhance the product to stack in the corner which usually not using. Plant can stack horizontal to the floor in this concept and each four units of the plants can act as a single module.

Image.57

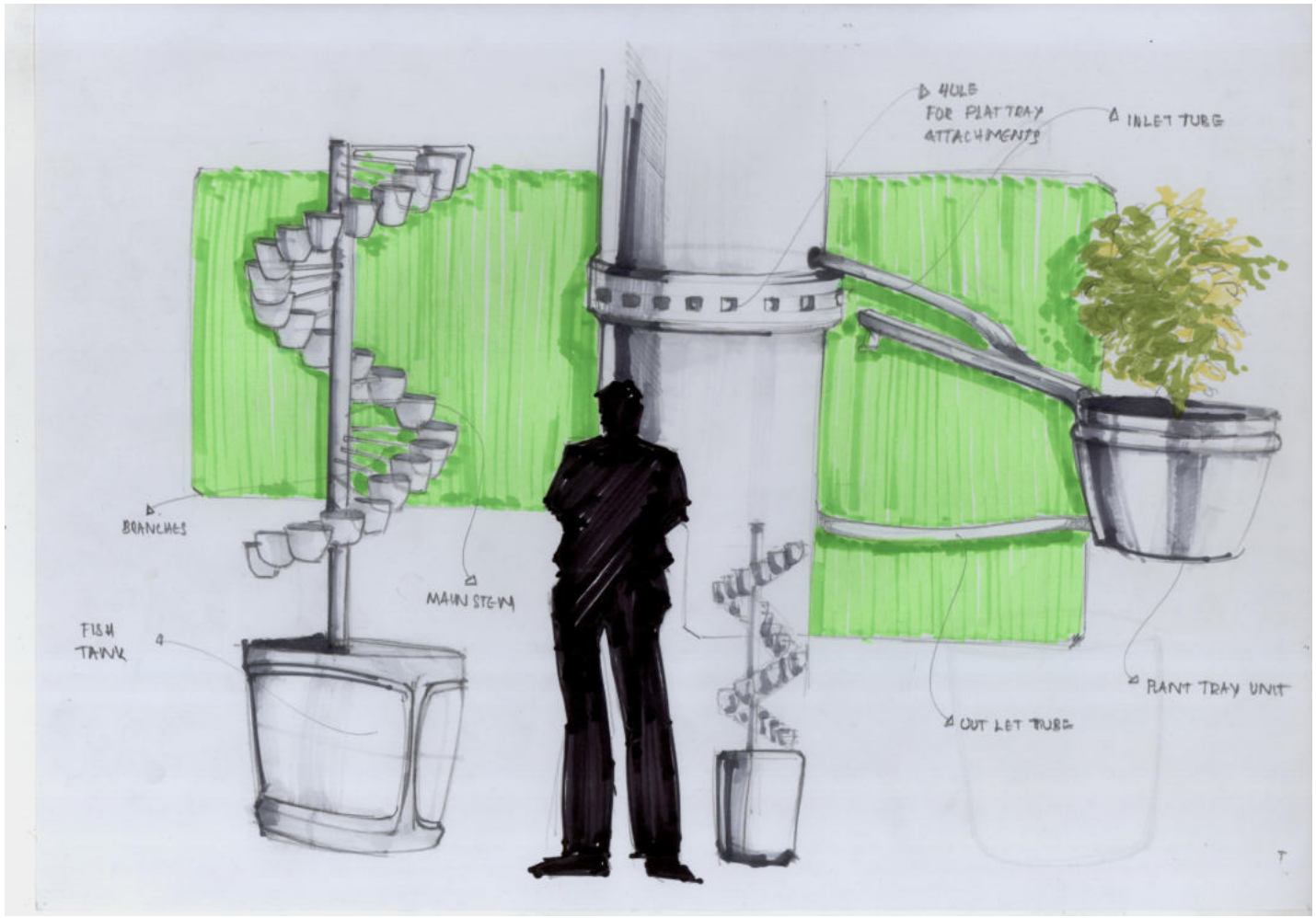
IDEATION-4



Tower type aquaponics system concept which has an upper plant system and lower aquarium. This concept is a medium scale aquaponics system in which each module is carrying a plant and that can easily separated from the system for maintenances as well as while collecting the vegetables.

Image.58

IDEATION-5



Tower type aquaponics system concept which has an upper plant system and lower aquarium. This concept is a medium scale aquaponics system in which plant pot can arrange in several ways and it can be more interactive with people. In this design each pot can detach easily from the system for several uses.

Image.59

IDEATION-6

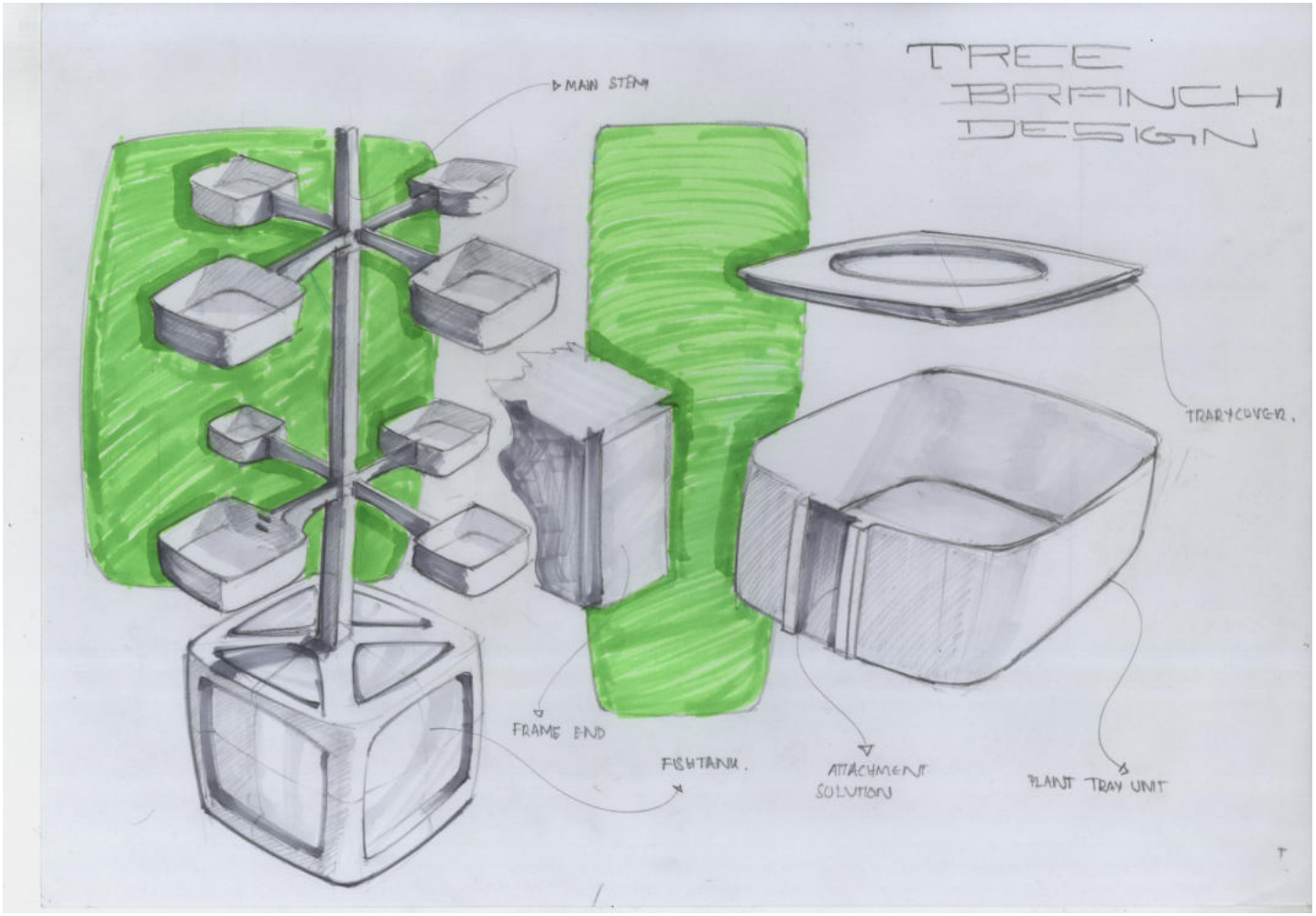


Image.60

Tower type aquaponics system concept which has an upper plant system and lower aquarium. This concept is a medium scale aquaponics system in which each plant trays carries four units of plants and the plant trays including the handle can easily detach from the system. The direction to derive this form maily came from a thought of having "a tree inside the home" This concept resembles the tree that can provide the food.

IDEATION-7

Wall mountable aquaponics system

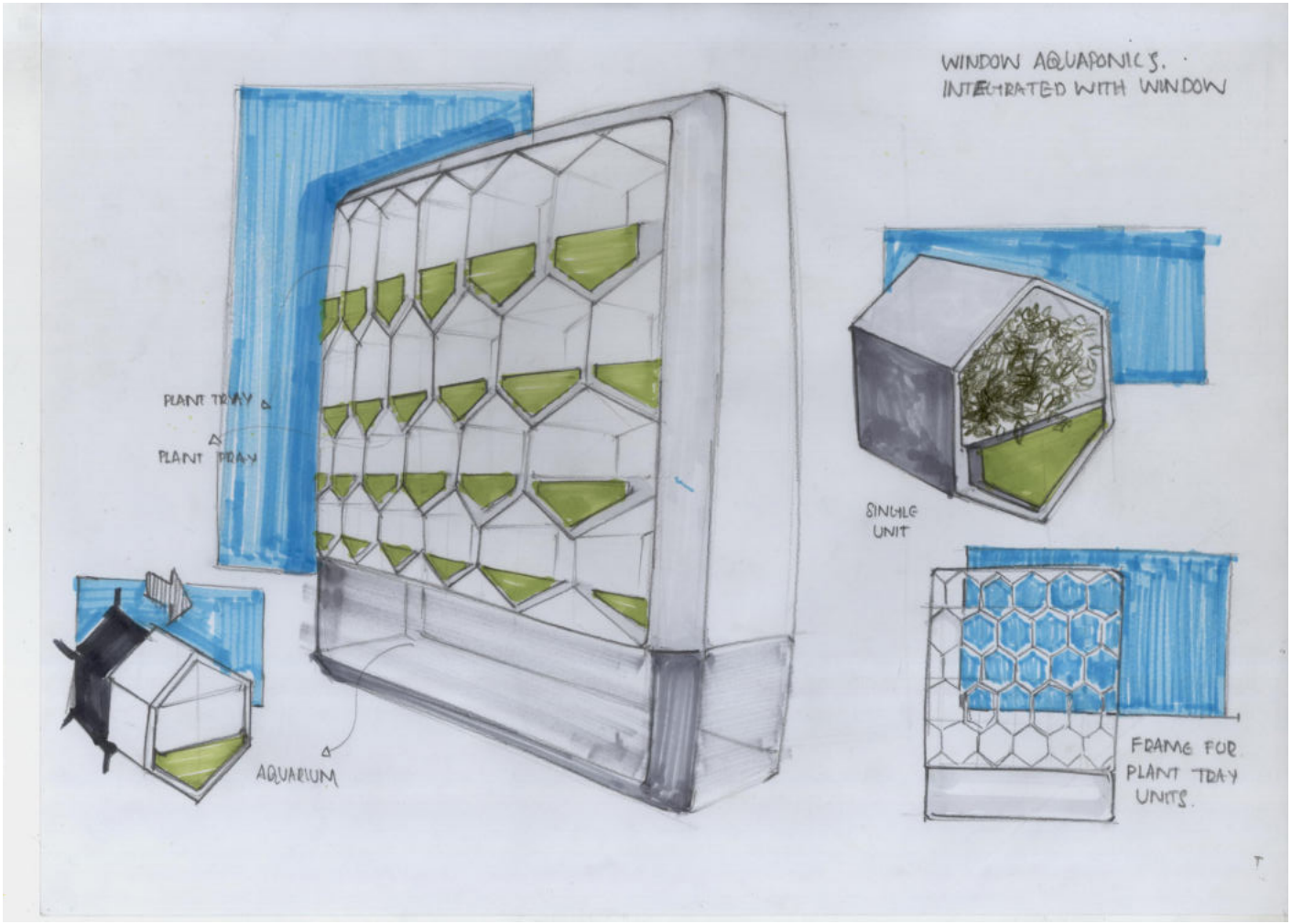
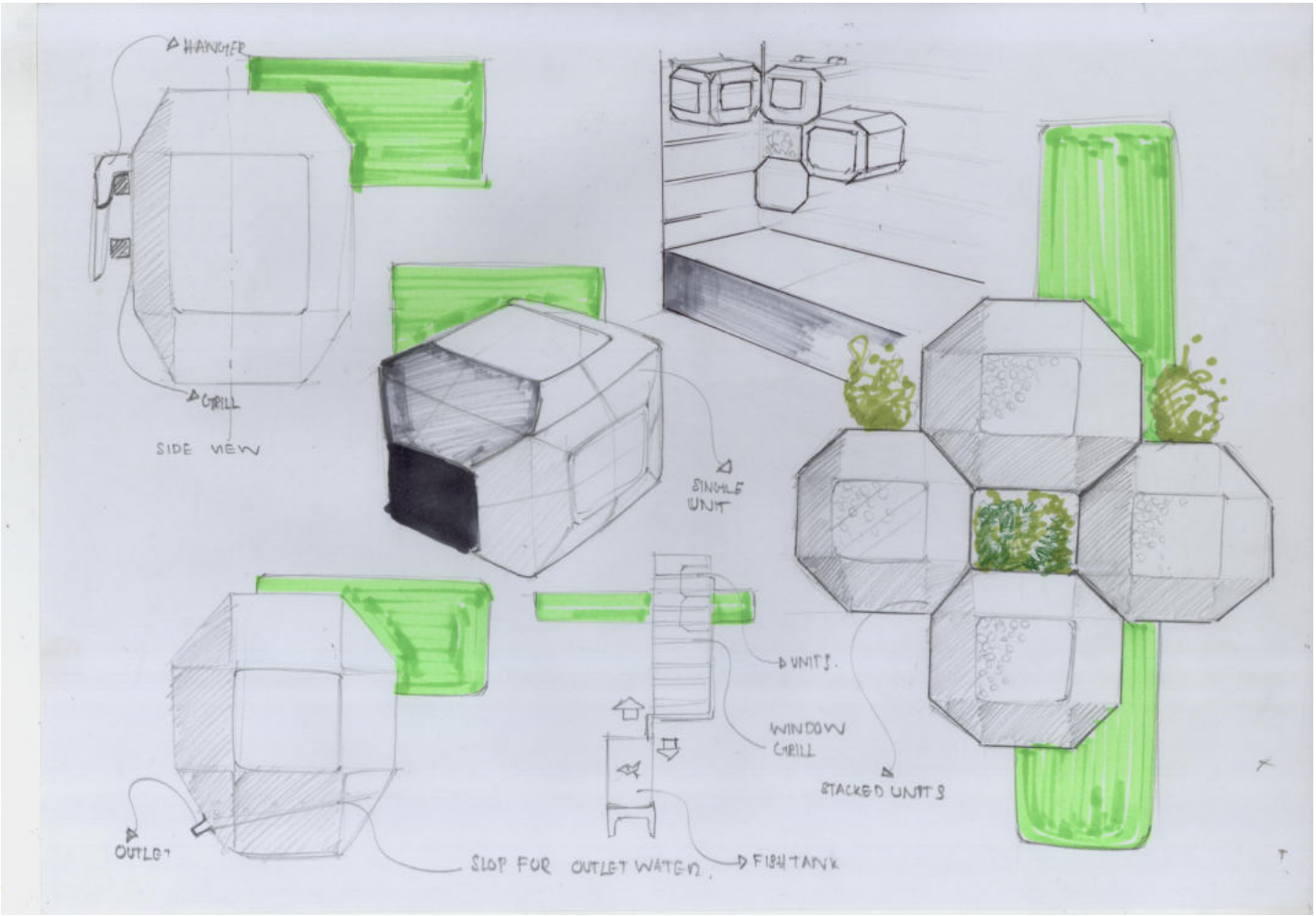


Image.60

Wall mountable type aquaponics system concept which has an upper plant system and lower aquarium. This concept can also act as window as well as a partition wall for urban home.
This concept is a medium scale aquaponics system which carries numbers of plant tray units.

IDEATION-8



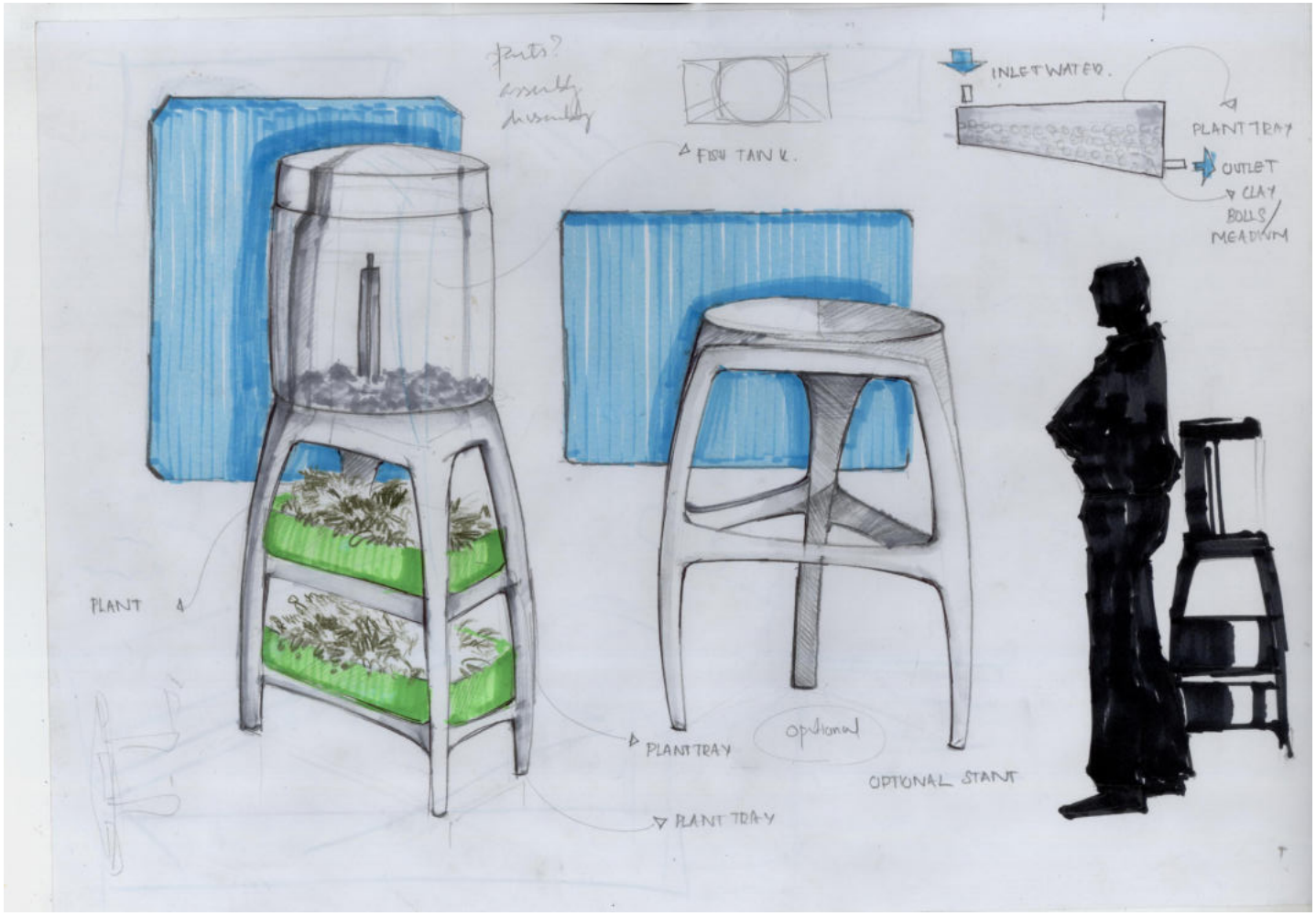
Wall mountable type aquaponics system concept which has an upper plant system and lower aquarium. This concept can also fix on the window grill which is popped out. In this idea plant system placed outside and aquarium kept inside the house. By using some external force water from the aquarium can pump into plant system.

The concept is modular design in which each plant units can attach and detach very easily

Image.61

IDEATION-9

Upper aquarium and lower plant type



Tower type aquaponics system concept which has an upper aquarium and lower plant system. This concept places the aquarium into eye level thus the user gets more visibility into aquarium. This idea also keeps the conventional way of placing the aquarium.

Image.62

Ideation-9 Details

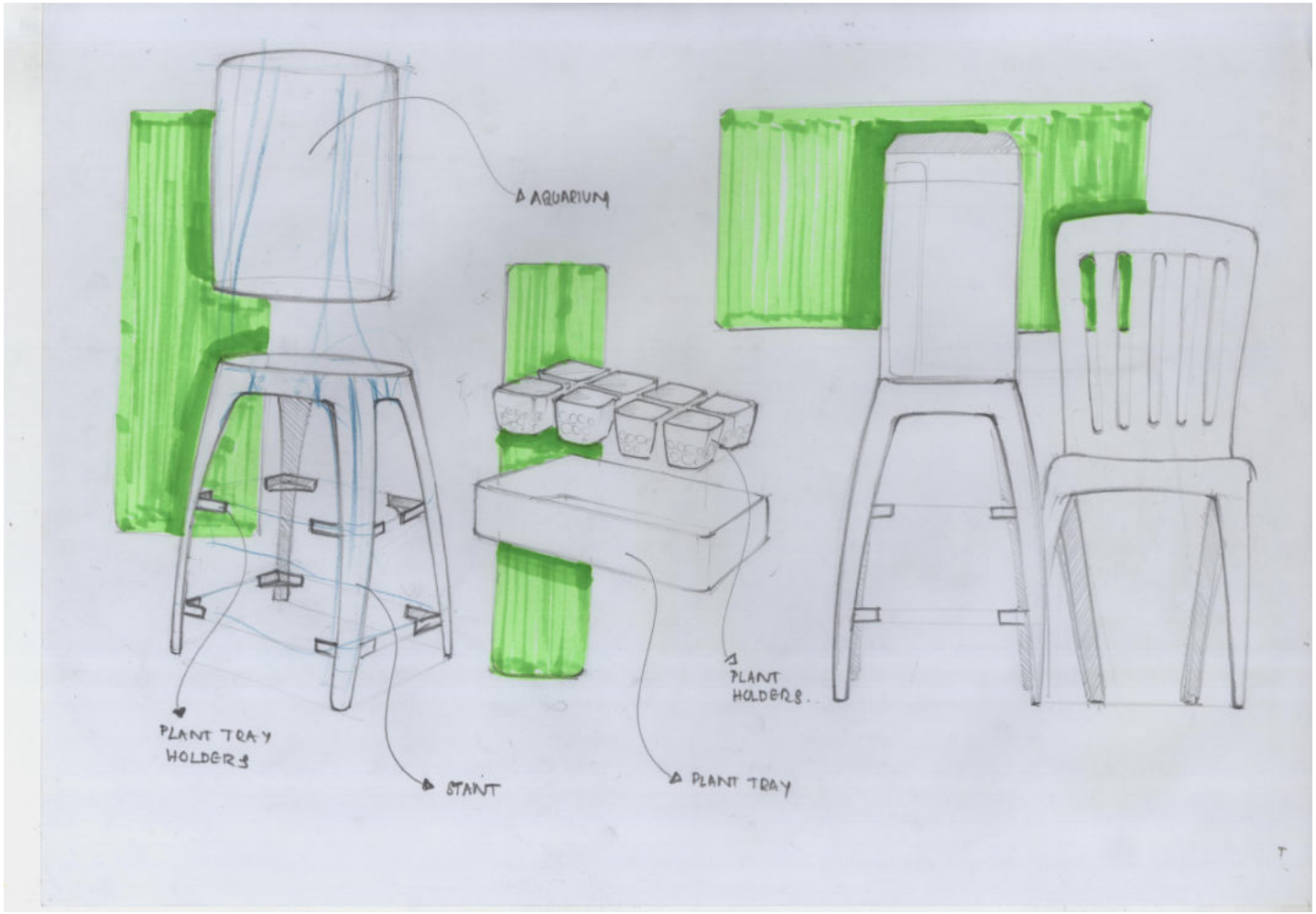
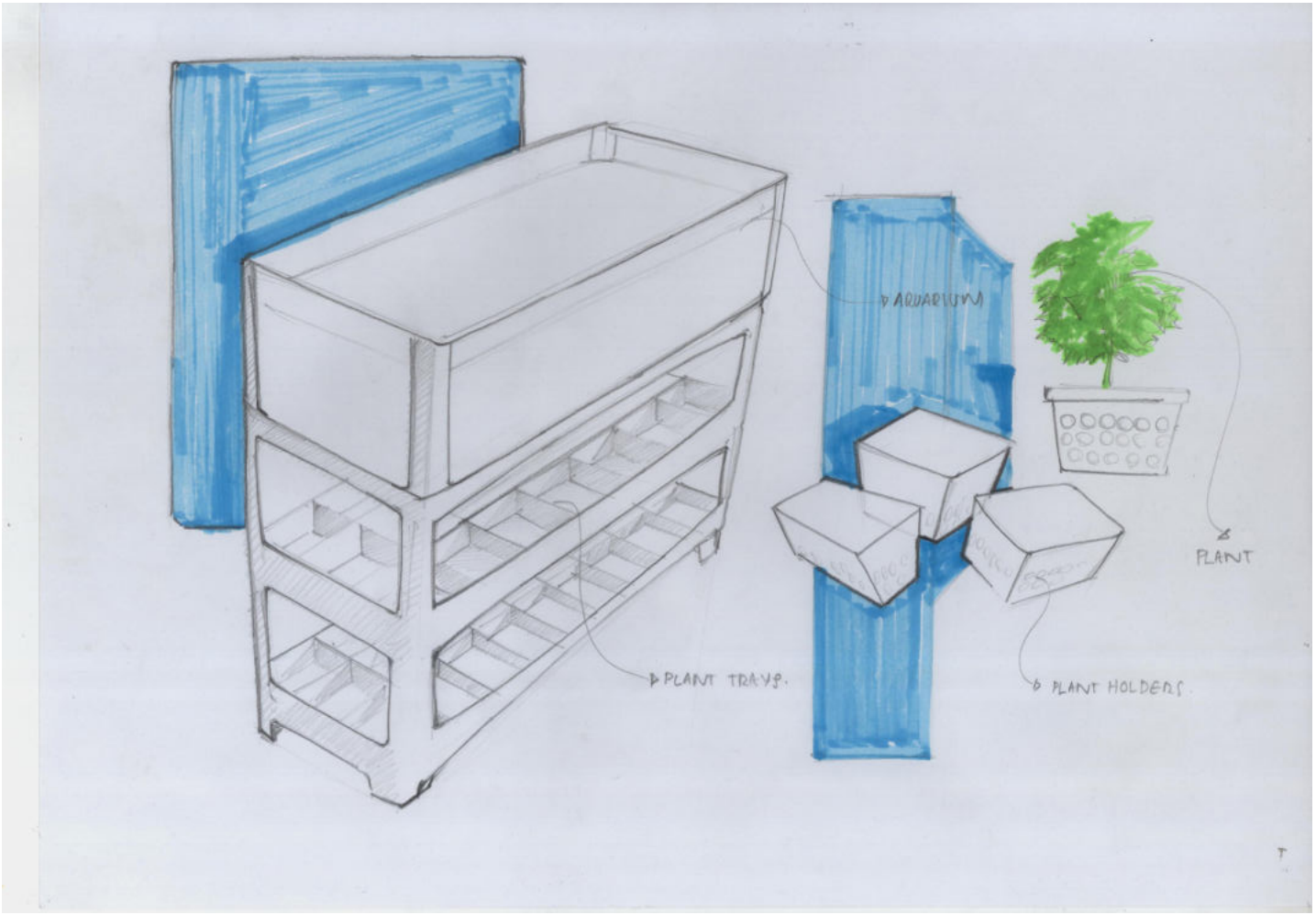


Image.63 Concept -9 in context and part details.

IDEATION-10

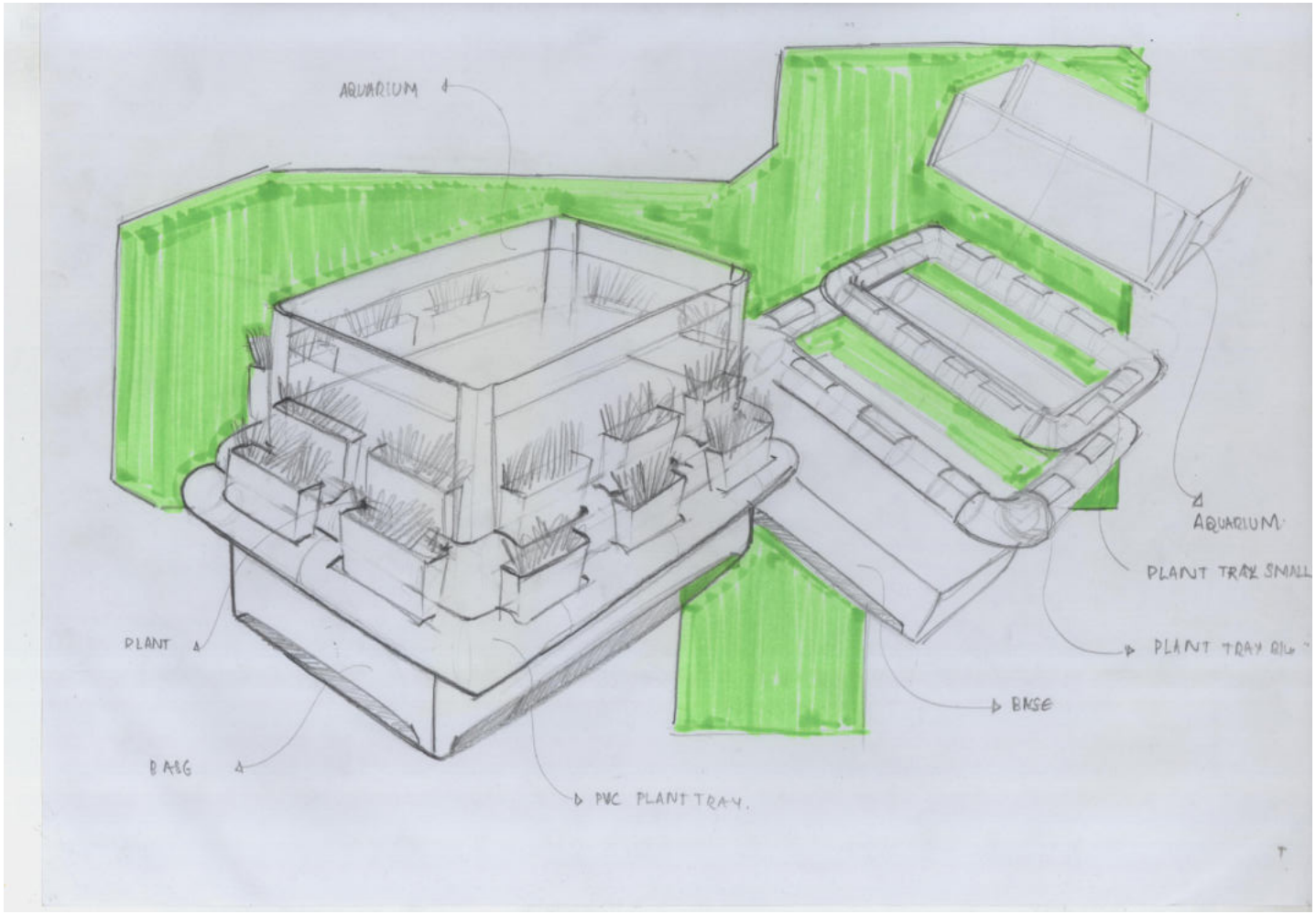


Tower type aquaponics system concept which has an upper aquarium and lower plant system. In this concept places the aquarium into eye level thus user gets more visibility into aquarium. This idea also keeps the conventional way of placing the aquarium.

Image.64

IDEATION-11

Aquarium surrounded by plant system type



Floor mountable aquaponics concept in which aquarium is surrounded by plant system. In this idea users will get a top view of the aquarium which is basically having a "pond inside home".

Image.65

Ideation-11 Detail

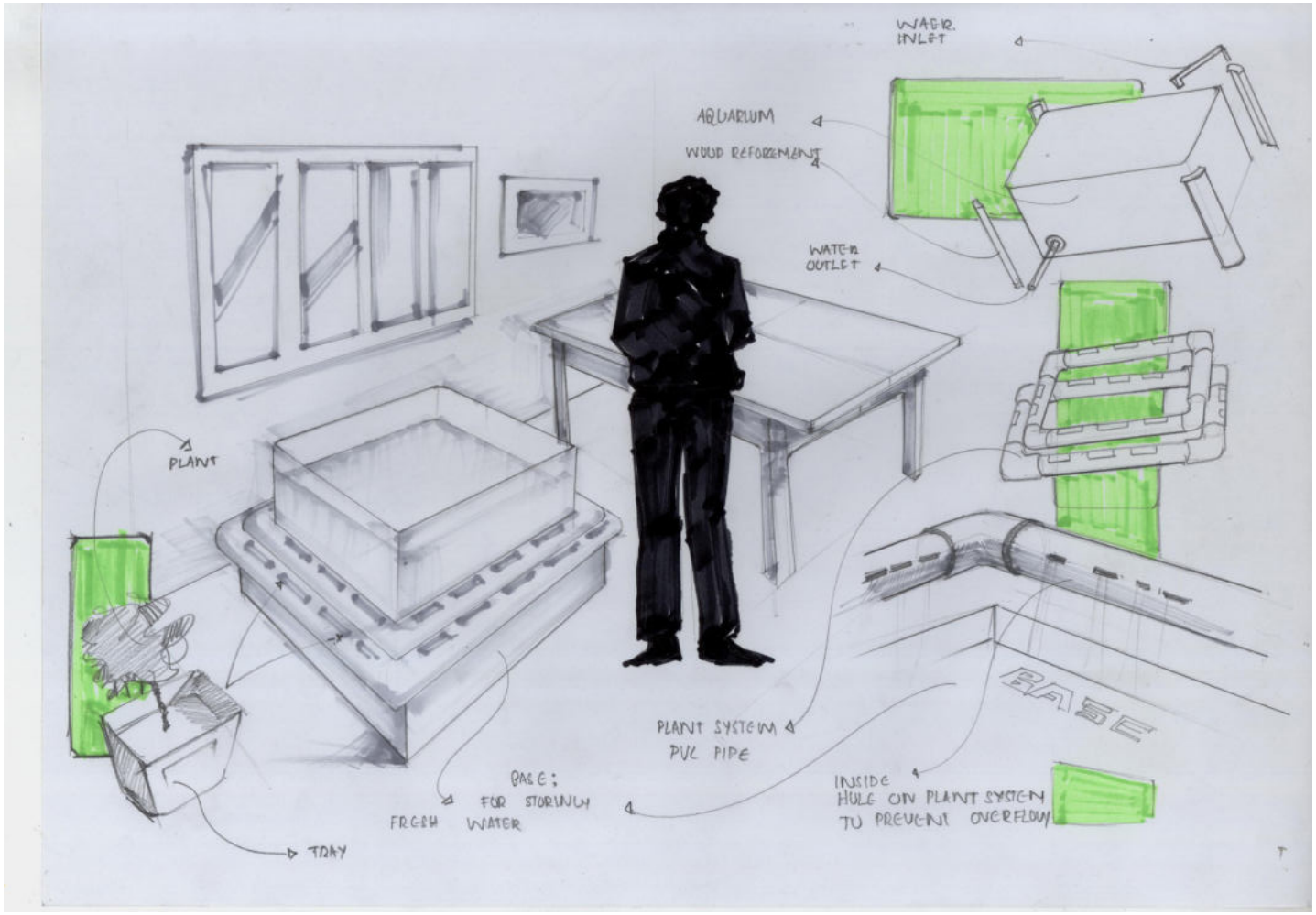
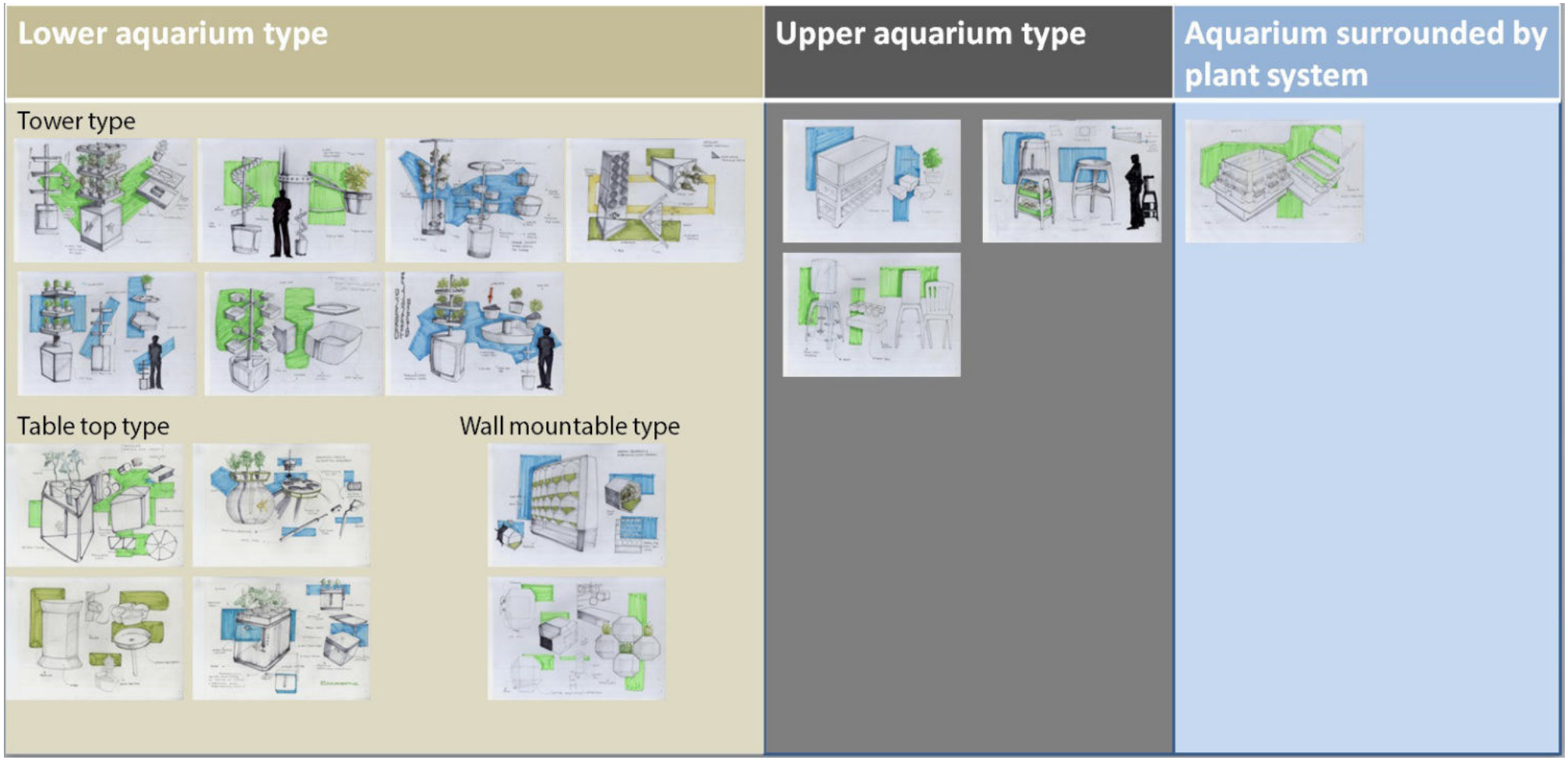


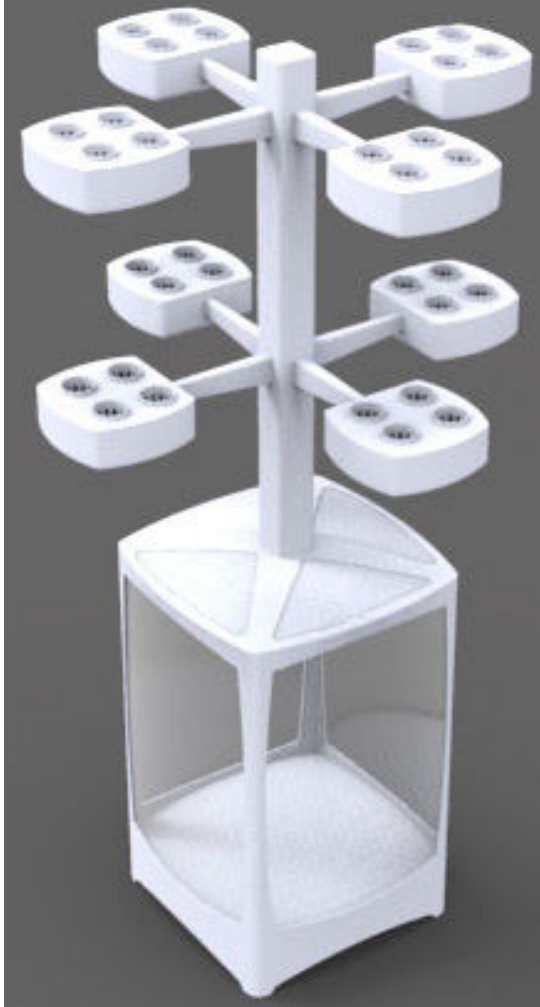
Image.66- Concept -11in context and part details.

OVERALL VIEW OF IDEATIONS



CONCEPTS AND CONCEPT EVALUATION

Concept-1



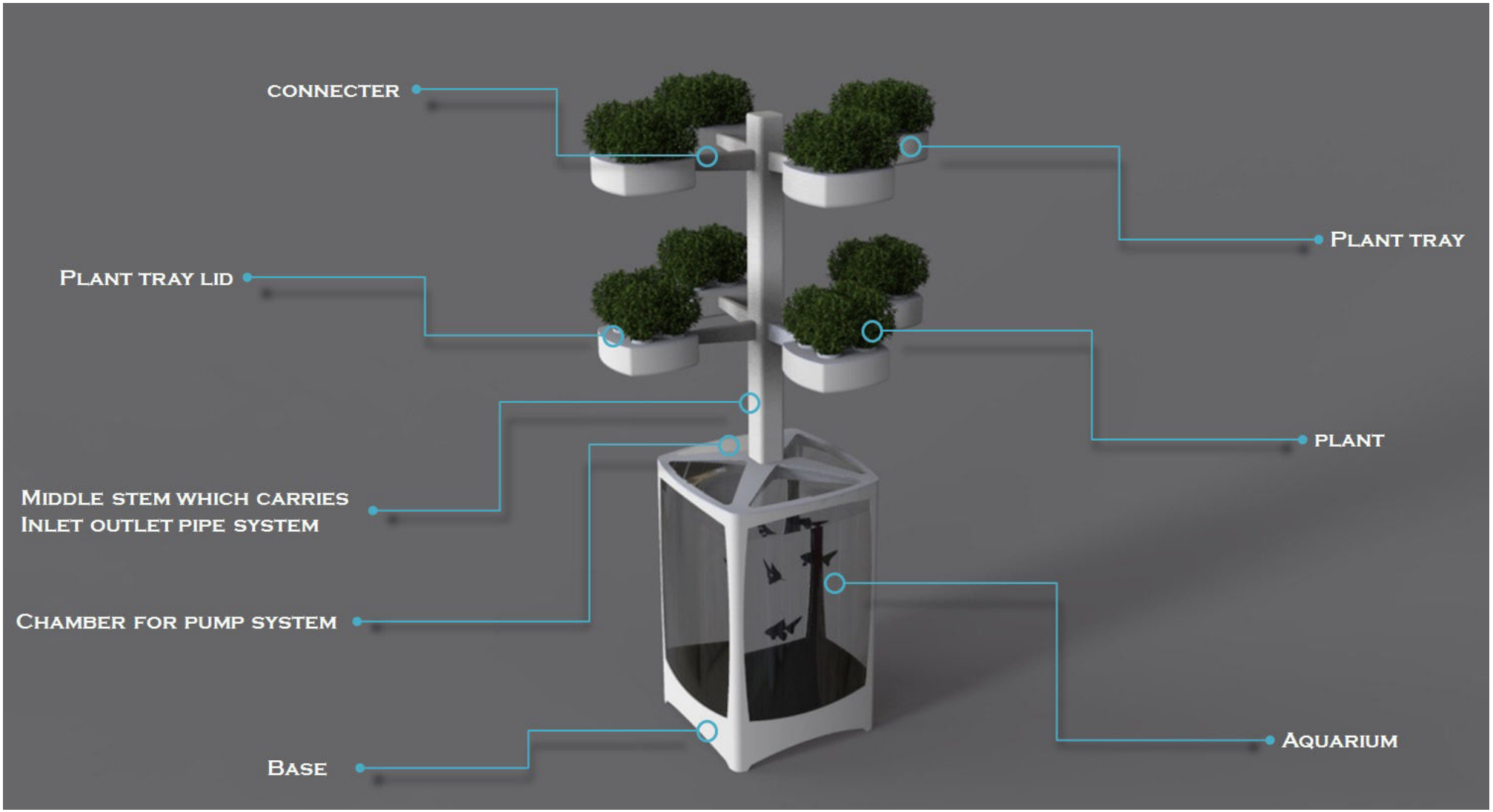
Advantages

- "Tree inside home" concept which can actually provide food.
- Modular design which other parts can stack inside aquariumand transport easily, that is aquarium can act as a packagingof the product.
- Medium scale Aquaponics system unlike table top system
- Form resembles the three which is more destressing
- Lower aquarium type design which is more stable than other iterations
- Different trays for different type of plants
- Transparent aquarium top lid which provide more visibility into aquarium
- No need of extra duct for collecting fresh water
- More suitable to window side because plants will get more light and fish will get less amount of light

Disadvantages

- Need more space to occupy
- Less visibility into aquarium than other concepts

Components in the concept



Concept in living room context

Concept-2

Advantages
- Upper Fish tank concept gives more visibility
- No obstacles on the fish tank which act as normal aquarium
- Collapsible design; so easy to transport and install
- Need less space than tower type design
- Keeps typicality in aquarium design
- Blend with other living room furniture

Disadvantages
- Need extra sump to collect fresh water
- Lesser stable as compare to bottom fish tank type
- Fishes gets more sunlight which is harmful
- Also the plants doesn't get sufficient sunlight

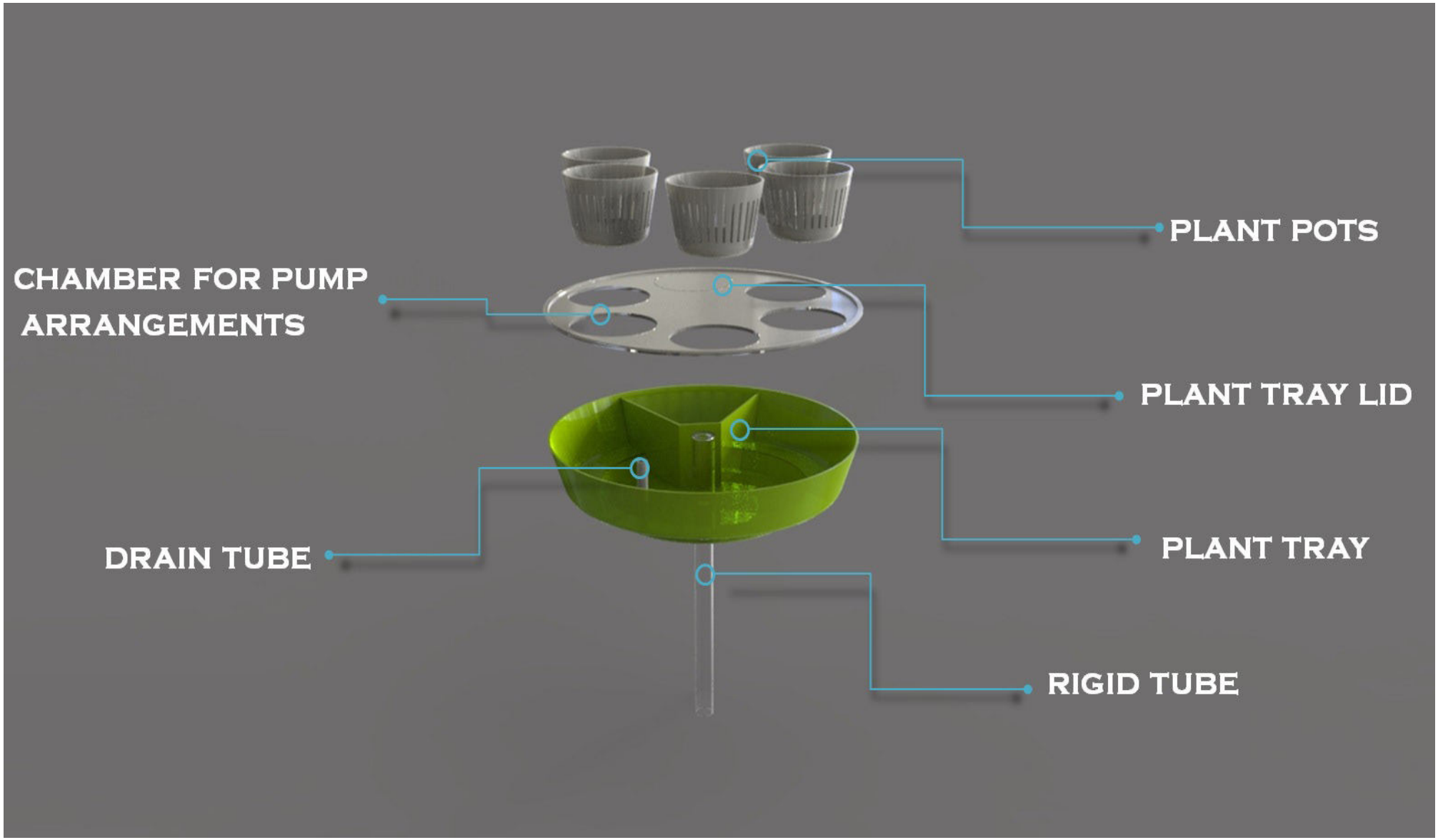
Concept in living room context

Concept-2

Advantages
Plant system on existing aquarium
Easy to install and transport
Provide more visibility into aquarium
Less number of components in the system
More blend with kitchen and living room context
No need of extra pump for circulating water

Disadvantages
Less number of plants
Limited number of fishes

Components in the concept

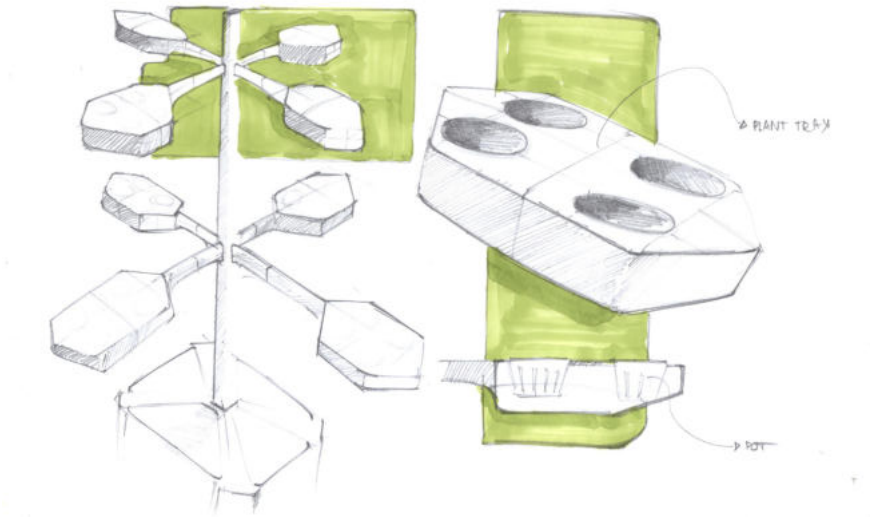


FINAL CONCEPT

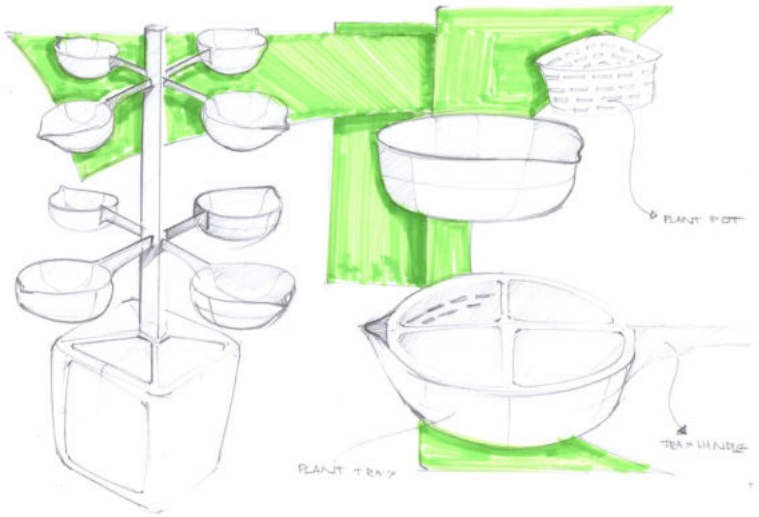
Advantages over other concepts

- More destressing as compared to other concepts
- Framing more number of plants as compared to other concept
- More suitable to window side farming system
- More number of fish, more number of plants
- Easy to access plant system
- Separate tray for separate type of plants
- Collapsible kind of design, easy to transport
- Showing more integration of plant system and aqua system
- Resembling the tree, which is more inspirational
- Grab more attention as compared to other concept, so which is more promotional

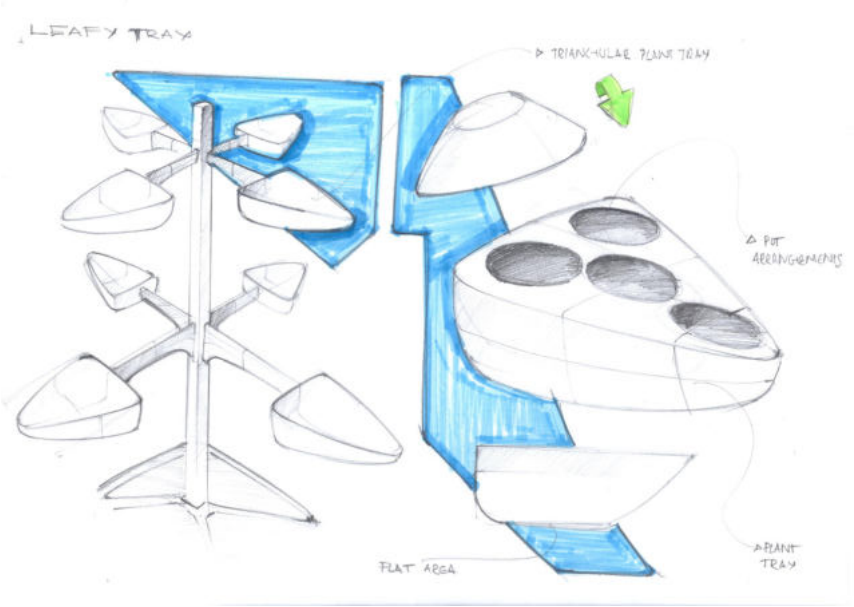
Final concept form exploration



Exploration.1



Exploration.2

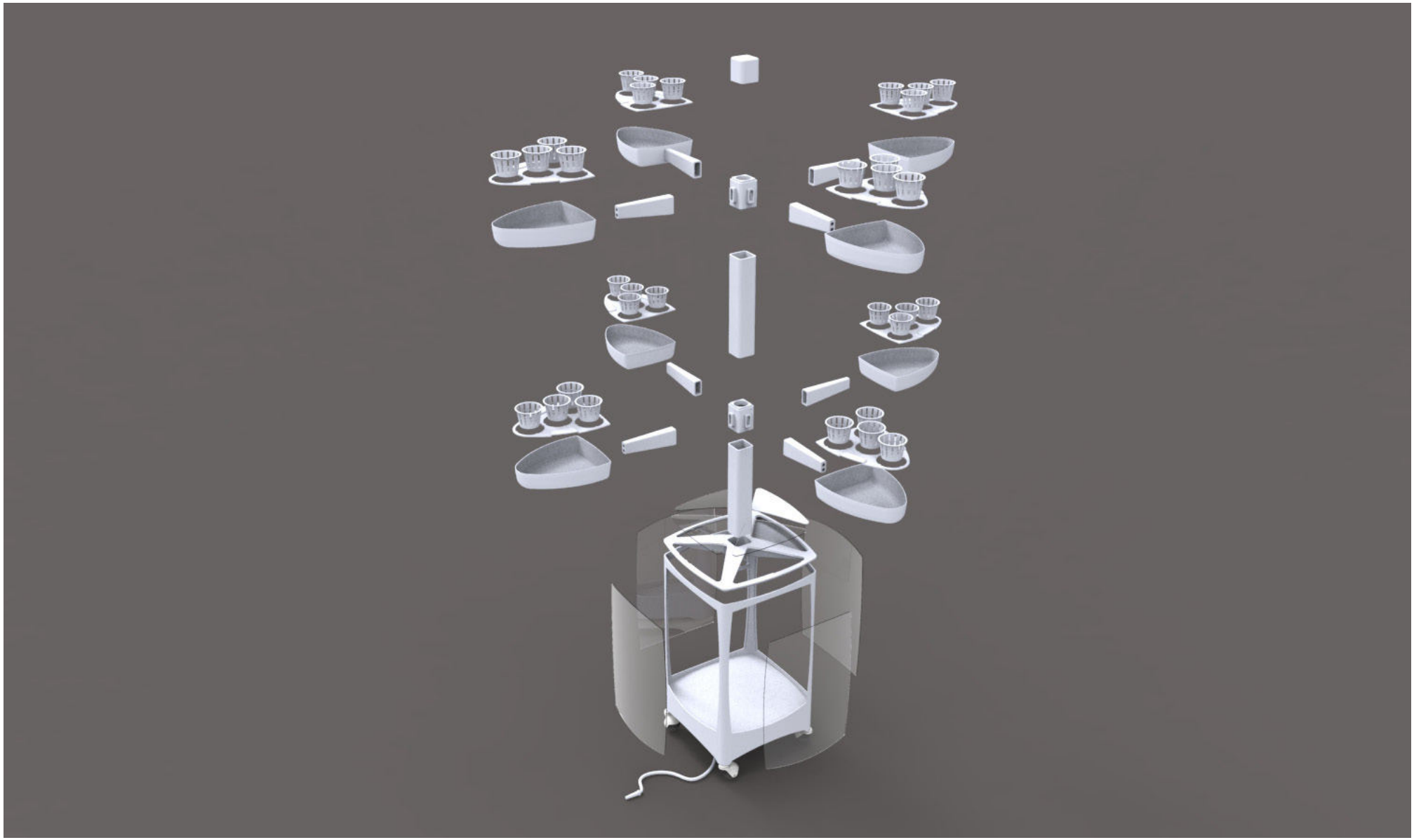


Exploration.3

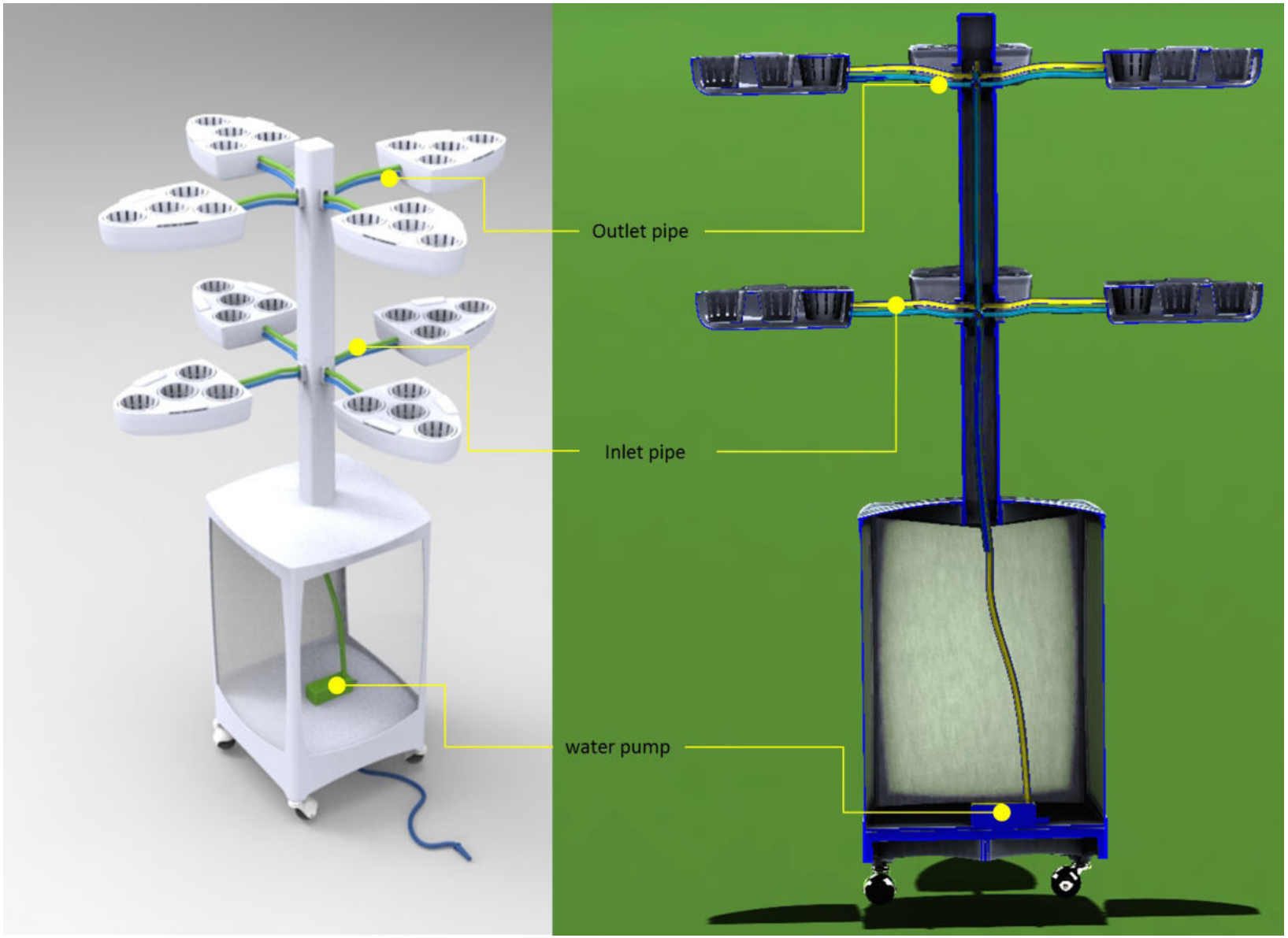
Variations in forms, for the plant carriying parts, were explored. The direction for this was to make this element appear more like a leaf and thus enhance the tree concept.Exploration 3 is selected as a final form for the product, which resembles more like the form of a tree.

FINAL DESIGN

EXPLODED VIEW OF FINAL DESIGN

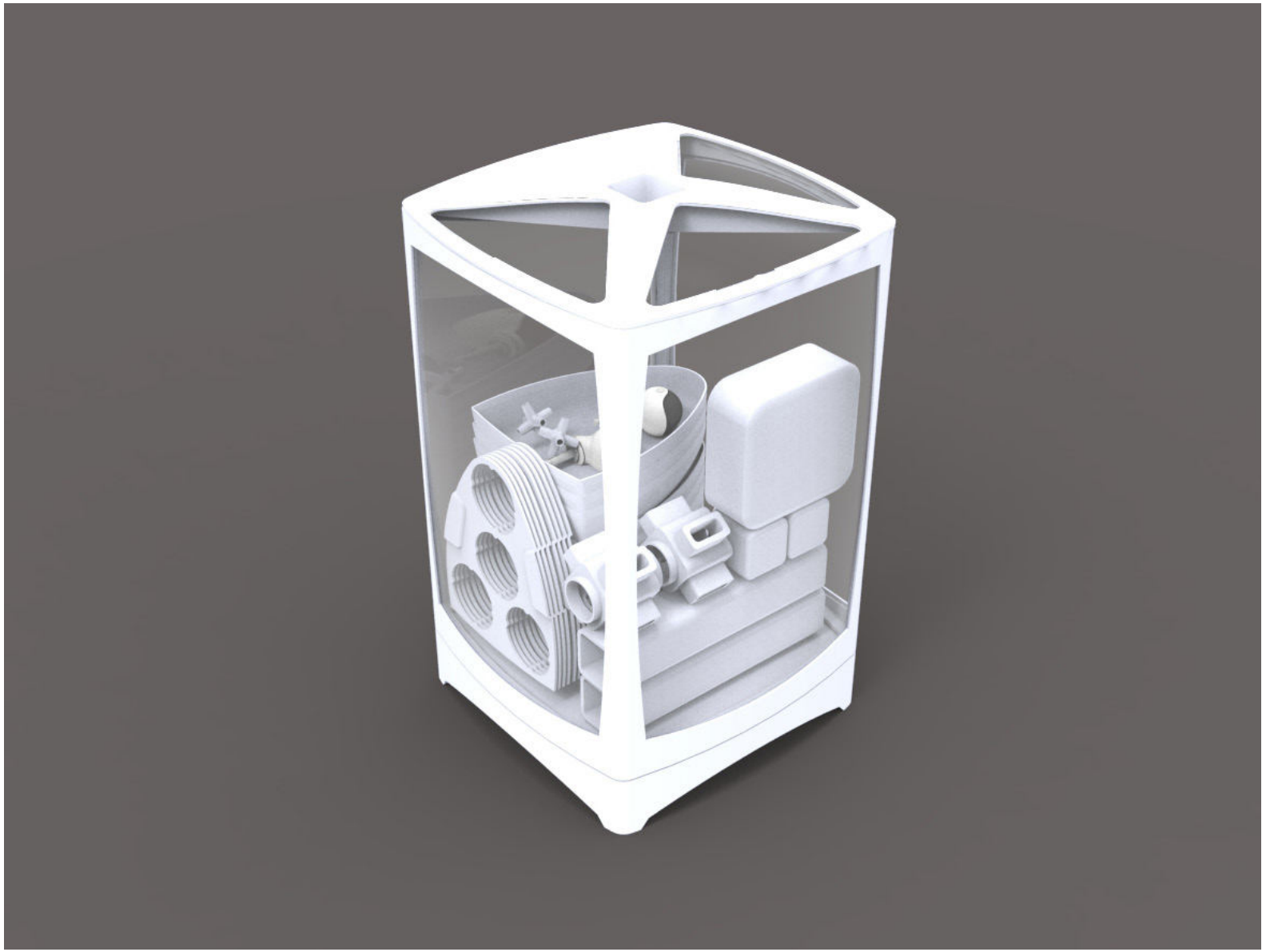


PIPE SYSTEM



Immersed water pump pumps out the water from fish tank to plant trays. Excess water from plant trays drains out by gravity through out let pipe.

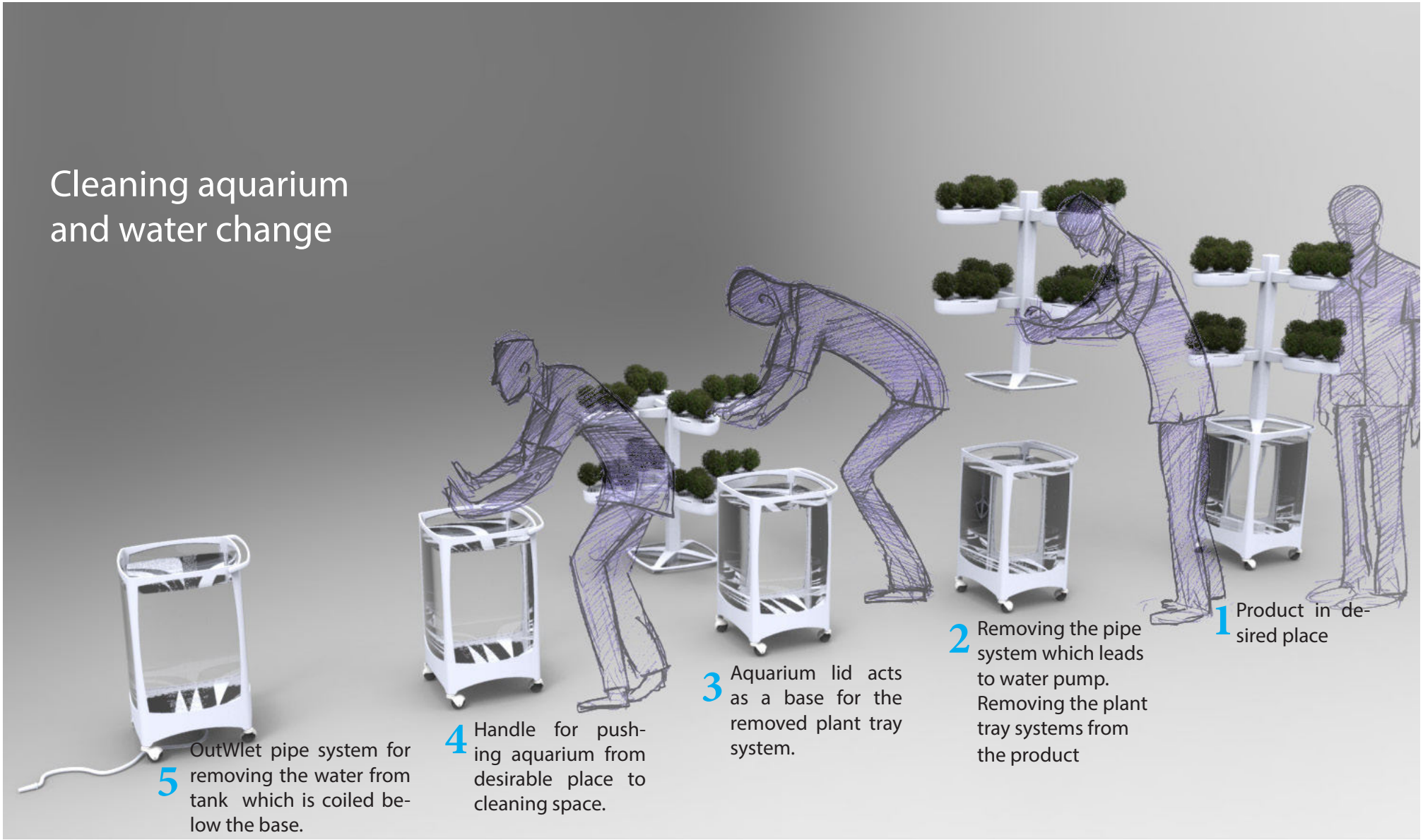
PACKAGING & TRANSPORTATION



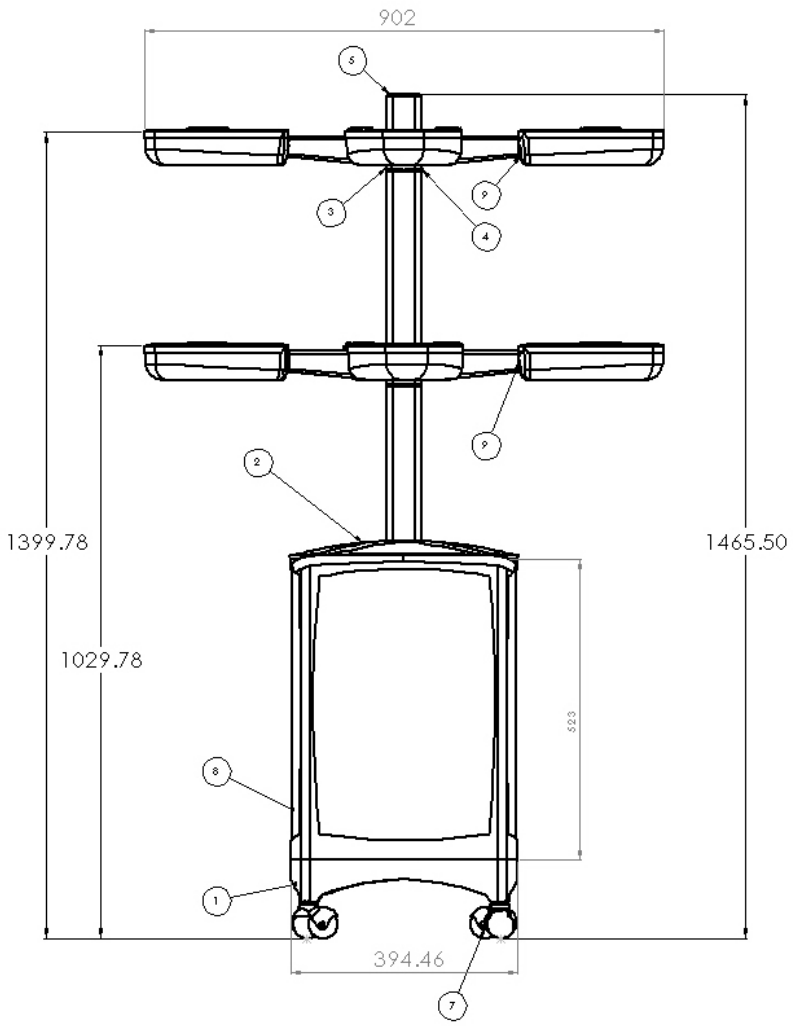
As a value addition to the product and convenience to the user, the design is made in such a way that all the components are collapsible. These parts are also made to stack on to each other and hence can be neatly arranged inside the larger aquarium unit. Therefore the aquarium itself acts as the packaging for the whole product. This provides ease of transportation and handling.

COLOUR OPTIONS

MAINTENANCE



PRODUCT DIMENSION
& BILL OF MATERIAL



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	aquariumBASE		1
2	aquarium_lid		1
3	stemconnector		2
4	Stem assy		2
5	TOP_LID_ASSY		1
9	Pipe_assy		2
7	Caster Wheel	Brass Caste Wheel	4
8	aquarium_1		1
9	Plant Tray Assy		8

detail assy_4

FINAL DESIGN ITERATION

This idea is generated on aesthetic perspective alone and this design iteration is without considering manufacturability.

MOCK UP MODEL

A mock up model was prepared for getting hands on experience. The working model was set up on the bowel type aquarium, the other main components which are used for setting up the model was 1.5cm pipe, plastic container, pipe threaded reducer, rubber flanged connector, plastic pot, clay pebbles , seeds & water pump.

Components in the mock up model

Pipe reducer

Water pump

Clay pebbles

Finished mock up model

Pot

Pipe

Plastic container

Time lapse of plant growth

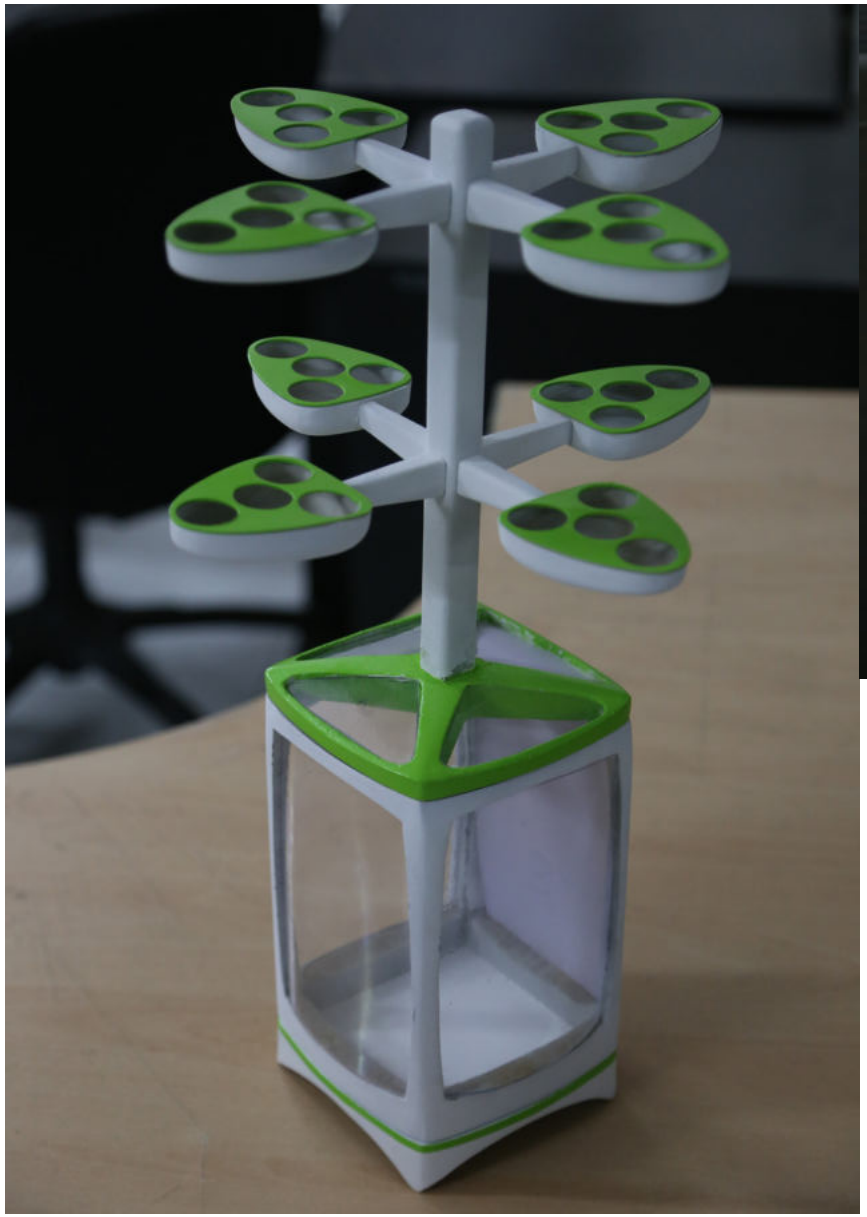
Day-2

Day-4

Day-6

Day-8

FINAL PROTOTYPE



Model has been made in 1:3 scale by using material like MDF, styrene, acrylic etc.
The following process has been followed while making the model.

- Preparing the cad assembly model
- Preparing the two dimensional cad drawing
- Scale down cad drawings printouts
- Shaping up the MDF material for each parts
- Making wooden mold for Plant tray and transparent area
- Vacuum forming the parts using styrene and acrylic sheets
- Applying putty and painting
- Assembling the parts