PORTABLE WATER FILTER

Mayank Mishra

ABSTRACT

The quality of water flowing through the faucets for drinking is gaining attention from the public. There are still microorganisms and minerals that exist within the water that may damage human health. Hence, the target of this work is to develop a personal, moveable twin functions handy filter to supply a neater thanks to getting a safe, clean, and healthy drink for humans where they're going. The designed system is often employed in filtering water taken from public drinking fountains or alternative public water sources. The work is started by conducting preliminary analysis. First, the constraints and criteria of the matter are known and mentioned in detail. Analysis of the model's performance is conducted as inputs for calculation, modelling, testing, and alternative coming up with ways.[1] Finally, several possible solutions to the issues are generated.

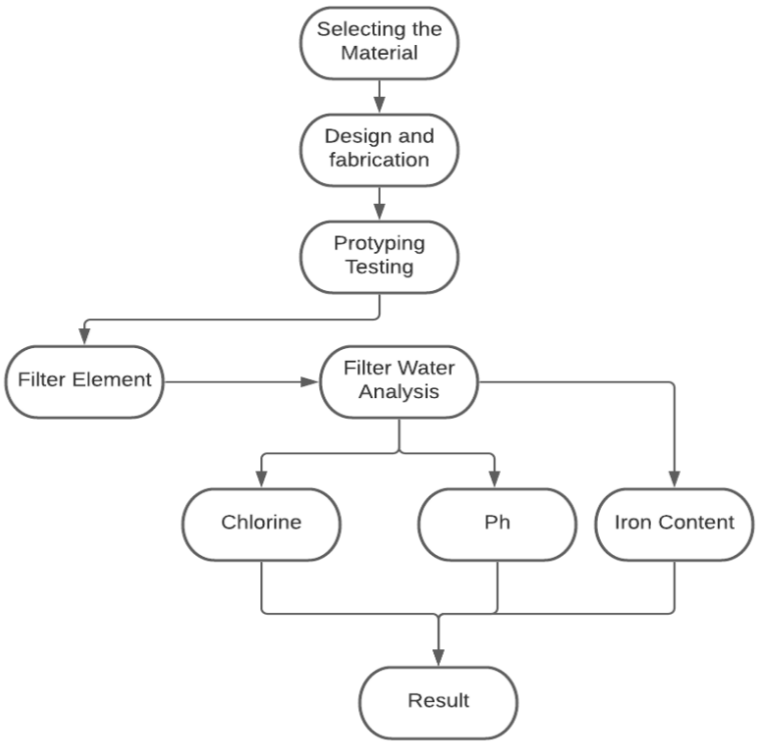
Keywords: Water quality, water filter, Testing effect.

INTRODUCTION

Water is that the main element in our body. creature body consists in the main of water (on average concerning 70%). creature liver, for instance, is concerning ninetieth water, brain 85%, blood eighty-three and even the bones thirty fifth. Therefore, consuming enough water in
our way of life may be a should to remain hydrous and healthy. H2O is that the major provider of our drink however it's really not safe to consume it frequently because it contains high level of halogen, leads, fine microscopic that causes cloudiness, dangerous style and smell,
and additionally small bacteria. [2] The used water is being treated to be reused which
suggests great deal of halogen is employed so as to cleanse it. H2O that's consumed every day is
not safe because it contains high level of halogen, leads, fine microscopic that causes
cloudiness, dangerous style and smell, and additionally small bacterium. However, this
matter will be encountered by initial, filter the water and then boil it. Filtration operates entirely on particle or driblet size (and, to some extent, shape), specified particles below a
definite size can tolerate the barrier, while larger particles area unit maintained on or within the barrier for later removal [3]. There area unit a number of H2O filtration
systems accessible within the market, however not all of them are of fine quality. The technology is greatly improved and therefore the water made by these filters is way safer and cleaner than ever before. However, recently it's onerous to find a
conveyable filter wherever shoppers will carry it anyplace and used it for more than one purpose. Hence, we've got pop out with an answer to style a
portable filter with additional feature, that is that the element to boil the water. meaning the filter may be use for cold and quandary. In terms of scientific point of read boiling would be able to kill all the germs and being within the tap water. There area unit a couple of aspects
that required to be thought of within the style process that area unit economical, convenient and user friendly.

Different areas have completely different issues and resources, and one answer cannot be applied to all or any. Water is usually tense from a close-by lake or from groundwater, which can contain varied pathogens, carcinogens, dissolved impurities, mineral ions, and particulate. Conventional water purification ways are proving to be too little to supply clean water because the demand keeps growing. Moreover, current methods of water purification are energy intensive and thus may be installed solely in specific areas. To tackle these issues, we aim to create
a filter that doesn't need energy input. additionally, to the physical purification aspects, we tend to shall affect the microorganism aspects too. mistreatment leaves of plants that are simply on the market, we intend to assess and utilize the antimicrobial properties that these leaves possess.

Many types of transportable water filters accessible, with varied degrees of effectiveness, may be used at the side of chemical purification. transportable water filters area unit sometimes tiny, transportable and light-weight (0.5-1.0 kg) and typically filter water by working a mechanical pump, though some use a siphon drip system to force water through whereas others area unit engineered right into water bottles.
There area unit many ways of water purification. the most ones are:
• Distillation,
• natural process
• Reverse diffusion
• Microporous filtration
• Ultra-filtration
• Photo-oxidation



PROMINENT GROWTH FOR THE NEED FOR SAFE DRINKING WATER

- Increased pollution levels, has led to contamination of freshwater sources all around the world
- Global warming, increase in water levels of the sea, decrease in freshwater
- Lack of purification technology around the world leads to several deaths due to water poisoning
- Spread of diseases, due to tap dirty water, in third world countries
- Unavailability of drinking water for people who often are on the move.

Problem Statement

To design a portable water filter that can be used in any water bottle and which would help in instantly purifying the contents of the bottle to the extent where it is potable. The system should be portable, user-friendly, safe & eco-friendly.[4]

This should be efficient enough to be used in bottles with a variety of necks and produces drinkable water with a concentration of up to or less than 300 ppm, prescribed safe drinking limit for water.

Idea Generation

The idea is generated by the identification of the problem. In our case, the problem was the unavailability of drinking water during travels/treks, availability of pure water to businessmen on the move, and another was the lack of a proper water filtration system in third world countries.

RESEARCH METHODOLOGY

Once the problem was identified a solution was to be found. Appropriate research was done to find out the kind of solutions which were previously proposed. One similar solution was the Nirmal bottle filter. [5]

We plan on deducing the most cost-effective, long-lasting, and practical design for our project. We will make use of Fusion 360 and SolidWorks for this purpose. We will also deduce the kind of material to be used in the prototype to fulfil all the requirements.

A survey will be conducted to help us make an informed decision regarding the factors, materials, and uses.

KEY FACTORS DETERMINING THE IMPORTANCE OF THE FILTER

- Low concentration of contaminant, less than 300 ppm
- Cost affordability
- Easily replaceable parts
- Long-lasting Portability
- Aesthetic
- No toxicity in the resultant water

Creativity

We aim to use the existing technologies to create a new product which will prove to be better and affordable than the previous ones.

We have iterated on our water filter which is built around a working turbine, which will be illustrated in the CAD model.

CUSTOMER NEEDS

To get proper drinking water during travel/treks **Essentials**

- Portability of the filtration system.
- Ease of use.
- Efficient filtration process.

Desirables

- Changeable filters
- Water concentration of about 300 ppm
- Can be used in multiple setups

DESIGN PROTOTYPES

The prototype is built by making several iterations, and deciding the best one based on the features provided. Some of the original concepts, built around a working turbine, are as follows:

Shown further are 2 prototypes of the design based on each of their advantages.

PROTOTYPE 1 Rectangular Casing, Turbine

The rectangular casing, while having more space, will not house a turbine, cutting corners.

PROTOTYPE 2 Pyramid **Casing, Single filter**

The pyramid casing provides a faster flow rate, lower volume, and difficult turbine housing.

PROTOTYPE 3

Deriving from the first two iterations, we opted for a dome-shaped turbine holder, with a tapering circle, containing grooves for the filters.

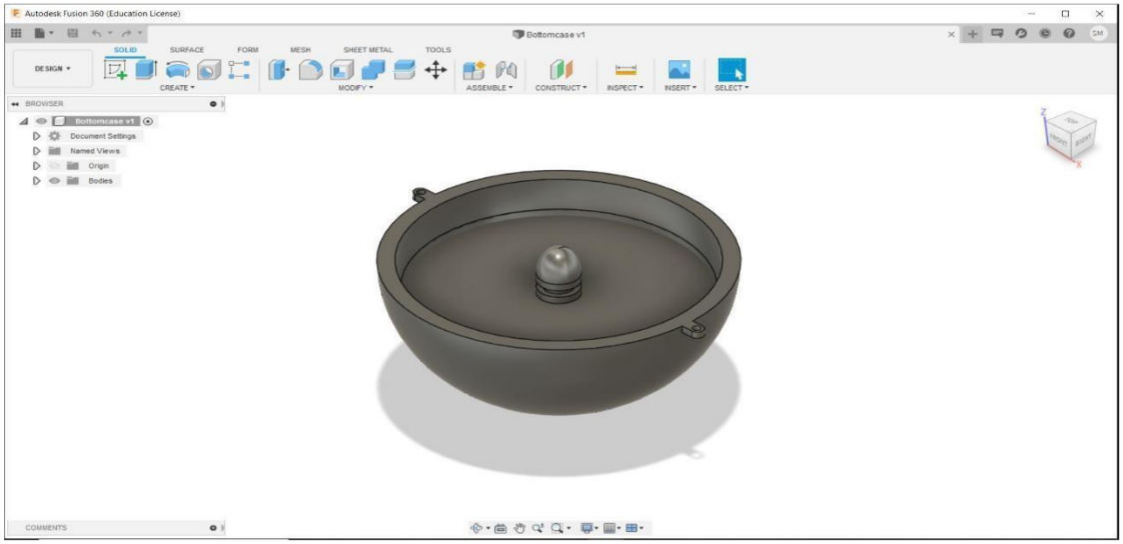
The components are:

1) Bottom case
2) Filters (2)
3) Turbine
4) Casing

Concept Screening & Scoring

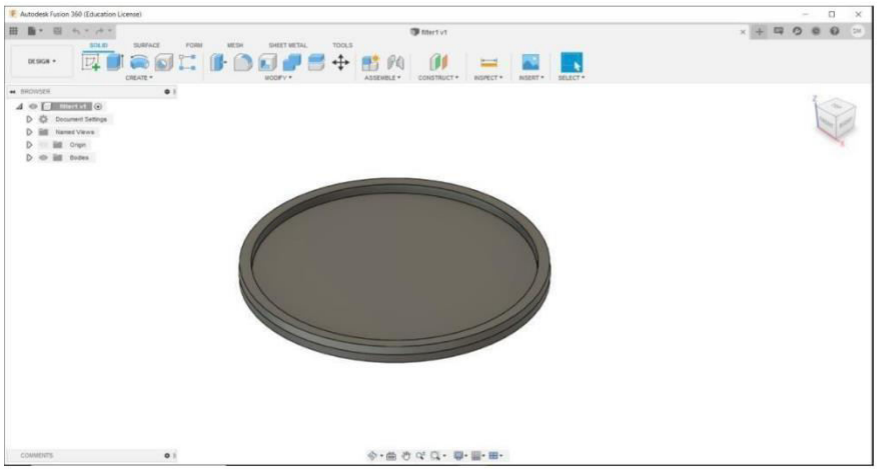
	Concepts		
Selection Criteria	Rectangular casing	Pyramid Casing	Dome casing
Ease of handling	3	4	5
Flow rate	2	4	4
Ease of use	3	3	4
Volume	5	2	4
Manufacturing ease	4	4	4
CONTINUE?	NO	NO	YES

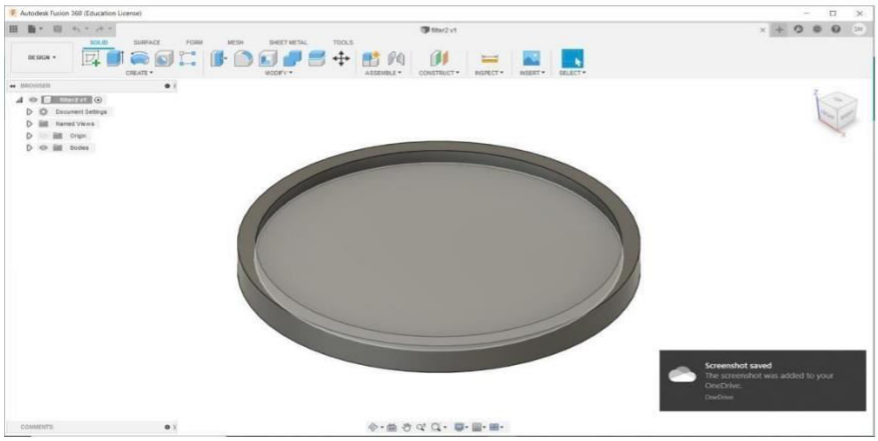
Screenshots of all the parts of the Water Filter



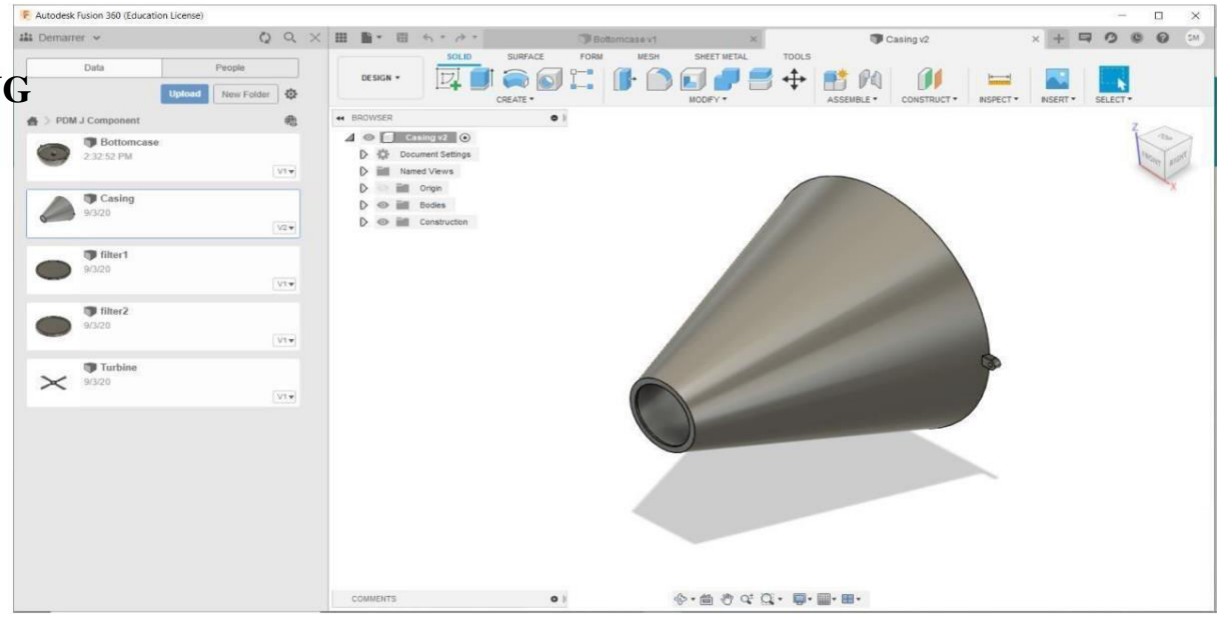
BOTTOMCASE

FILTERS

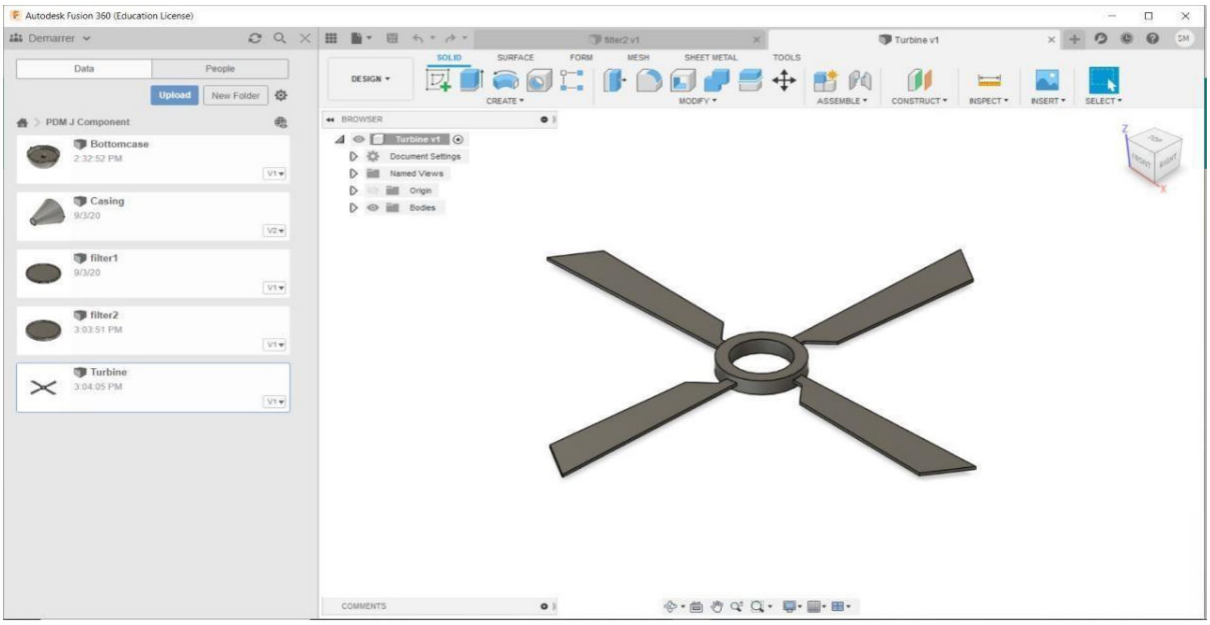




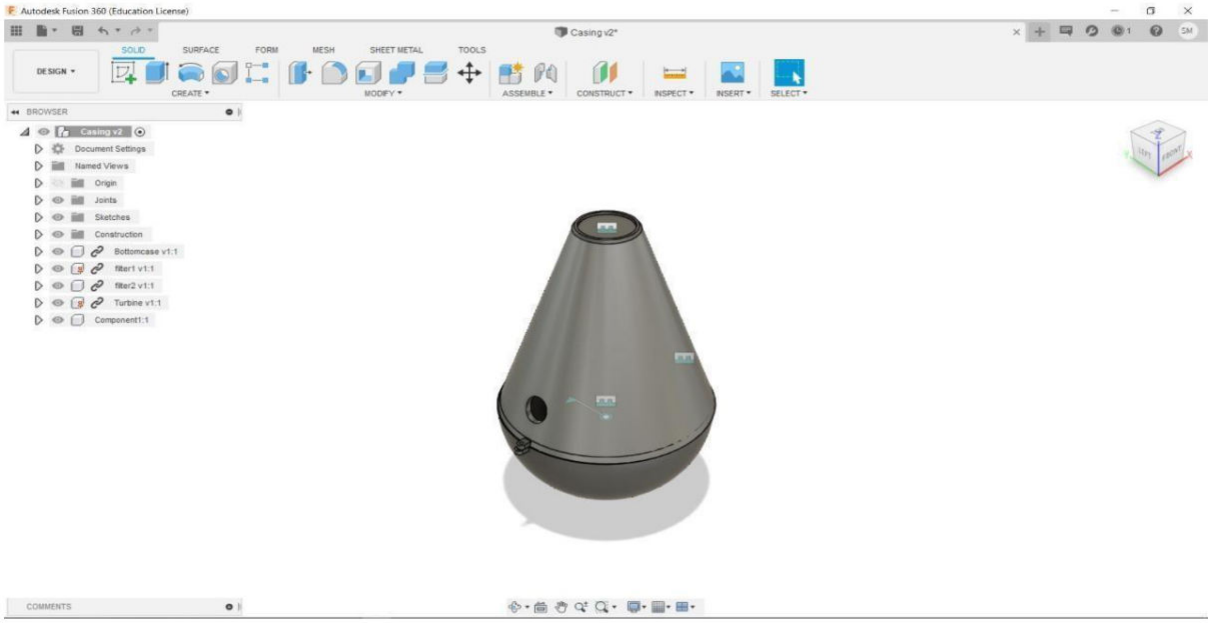
CASING



TURBINE



Assembly of all the parts



MANDATORY REQUIREMENTS

- Water must have a concentration of less than 300 ppm
- Changeable filters
- Long usage
- The structural integrity of the casing

PERFORMANCE REQUIREMENTS

- Components are 3D printed
- Replaceable parts
- Portability
- Filter sheet of up to 0.45 microns
- Cost-effective

ATTRACTIVE FEATURES

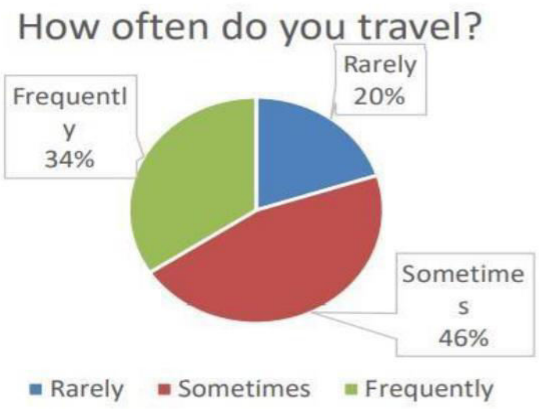
- Various infills in various parts of the filter for right weight to strength ratio depending on the stress and strain
- Aesthetics of the casing
- Presence of alum pockets if settling time is provided
- Elastic necks to adapt to bottle caps of different diameters

TARGET MARKET

Aspiring Adolescents	Mimic Beginners	Newbie Shopaholics	Responsibly Spendthrift	Cautious Spenders	Relaxed Indulger
14-17yrs	18-21yrs	22-25yrs	26-30yrs	30-40yrs	40-45yrs
Financially depend on their parents	Highly aware of the options and trends College students	Either enrolled in PG studies or just entered their professional careers.	High focus on professional growth and may have recently married	Have financial and social commitments, usually towards their growing children and ageing parents	Full-filled their financial and social responsibilities

USER GROUP

The product is geared towards people who travel frequently as a sample group, as well towards hostel students, who may be faced with unforeseen circumstances.[6]



USER STUDIES

PROBLEMS

- Lack of drinking water, often on the move for travelers, such as businessmen, merchants, attendants, drivers, etc.
- Lack of clean drinking water in 3rd world countries
- Poisoning, the spread of diseases due to water contamination
- Cost Affordability
- Ease of finding safe drinking water during travel
- Portability of the water purifiers

- Availability of substitute material
- Toxicity due to poisoning of the drinking water, due to lack of filter change

BATTERY & PUMP SPECIFICATIONS

Inlet Dimension: r_1= 5mm

Outlet Dimension: r_2= 10mm

Battery specifications: Ni-MH, 9V, 180-250mAh

Water Pump Specification: Mini submersible pump motor

- Operating Voltage: 6V
- Operating Current: 220mAh
- Flow Rate: 100 lt./hr
- Continuous Working Life: 500 hours
- Driving Mode: DC

FLOW CALCULATIONS

Given: Inlet radius = 5 mm = 0.005m

Outlet radius = 10 mm = 0.01

Motor flow rate = 0.0278 lt./sec

We can use the relationship between flow rate and speed to find both velocities. We have, Q= Av

$v_1 = Q/A_1 = Q/(pi)r_1^2$ =

$0.0278/ (pi)*(o.oo5)^2$ v_1 = 353.96 m/s

From equation of continuity, v_2 =

$(A_1/A_2)*v_1$

Thus, v_2 = 88.49m/s

BATTERY

Battery Recharge Calculations:

Hours = (Battery size (in mAh) / (Charger Output)

For a 500mA charger, we need approximately 1 hour for complete charging of the battery.

(Accounting for all the energy losses) Battery

Discharge Rate:

Given: Voltage of battery = 9V

Rated capacity of battery = 0.25 Ah = 2.25 Wh

Current = 0.22A

Discharge time = Capacity / Current

= 0.25/0.22

= 1.1367 hrs = 68 mins

EXISTING SOLUTIONS

Nirmal

A flexible portable water filter device is provided that includes an approach for filtering unfiltered ground/ tap water within the bottle. This device has a porous housing containing activated carbon, ultra-filtration & other filter materials (such as polypropylene cotton, filter paper, colloidal silver, etc.) in it, which device can be attached and removed from a water bottle as a unit. The portable water filter device is fluid tightly attached to the bottleneck such that water does not pass through the bottleneck.

Etekcity Portable Water Filter Filtration Straw Purifier

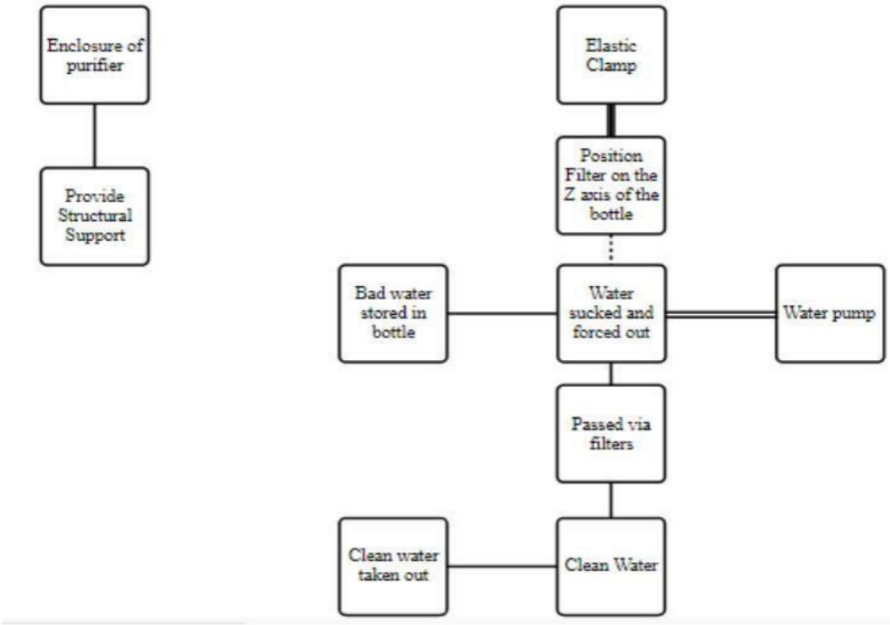
This filter offers you not 1 but 3 stages of filtration. It has a pre-filter, a carbon filter, and a 0.01-micron hollow fibre UF membrane. It is very unlikely that all those parts will let anything harmful in your water. This little device is safety tested. Now a small disadvantage is that sometimes the water will be hard to draw out of the unit.

LifeStraw Personal Water Filter

The LifeStraw personal water filter is a great device that will serve you very well on your travels. And its price is affordable. The characteristics of this product are satisfying enough. It removes up to 99.9% of waterborne bacteria and parasites.

The material used to prevent contamination has holes that are smaller than bacteria and parasites.

ARCHITECTURE



WATER TOXICITY METER

HITECH LAB INDIA (PORTABLE) DO METER

- 3½ digit LED display
- ABS plastic body
- **Range:** 0 – 20 ppm ● **Resolution:** 0.1 ppm ● **Accuracy:** ±0.1 ppm

- **Temp. Range:** 0 – 50 °C ● **Power:** 9V, DC
- **Battery Dimensions:** 160 x 85 x 25 mm (L x B x H)
- **Weight:** 500gm ● **Product Dimensions:** 15 x 5 x 2 cm

SWOT ANALYSIS

Strengths

- Portable
- Affordable
- Environment Friendly
- Easy to Clean
- Low Cost of Production

Weakness

- Can not run for longer time continuously
- Need to change the filter after every 100 litres of water
- Need to clean often.

Opportunities

- Raising attention to quality of living
- Surging Tourism
- Rising health awareness in Tier 111 city
- The noticeable increase in water pollution.

Threats

- More and more companies devote to portable water purifiers
- Portable Water filters features are upgrading
- Substitutes
- Competitors.

COST ESTIMATION

- Ni-Mh 9V 220mAh battery: Rs.145
- Mini submersible pump: Rs. 400

- 20 Micron cloth: Rs. 10
- DO Meter: Rs. 4400
- Filter 3D printing cost: Rs. 700
- Battery charger: Rs. 370
- Total cost: Rs. 1625 (W/O DO Meter) Rs. 6025 (With Do meter)

LEARNINGS

- Learned how to make a basic filtration system
- Learned that the design process in a start-up is very iterative as compared to academics
- Learned how user's survey improvises on micro-level detailing

CONCLUSION

The design of twin functions handy filter provides progressive information on the practicableness of victimization this technology and on style, construction, and operations to best reach desired production and performance.[6][7][8] An economical and straightforward thanks to build little sized twin functions handy water filter has

been projected during this paper. [9][10][11]The filter contains a cylindrical container for holding an amount of liquid to be treated together with, a filter tube to filtrate the water and element to heat the filtrated water. [12][13][14]The filter tube is

connected to the higher finish of the cylindrical case and therefore the element is connected to the lower finish of the cylindrical instrumentation.

The designed filter provides a neater thanks to get safe, clean, and healthy and hot water. [15][16][17]The water from this twin purpose handy filter has been tested victimization.[18][19][20]

various tests to prove that the standard of water is meeting the standards.

- Achieving drinkable quality of water on the move (<300 ppm) [21][22]
- The economical product achieved with easy manufacturability [23][24]
- Cost-effective compared to some other existing solutions [25][26]
- Easy to carry and use [27][28]
- Robust design [29]

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