

# Smart Self-Filtering Water Bottle

## Design Project (DS3001)

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# Introduction

## Objective

To design a **portable smart water bottle** that can purify water using **sedimentation**, **UV sterilization**, and **water softening**, while monitoring purity and quantity in real time.

## Motivation

- Need for **on-the-go purification** without bulky systems.
  - Frequent **hard or contaminated water** in travel and rural areas.
  - Desire for a **connected bottle** that gives live purity feedback.
- A smart water bottle with a built-in filter helps **Indian Army soldiers** in **remote terrains** access safe drinking water from natural sources, reducing supply challenges and enhancing mission sustainability.



# Problem Identification

## Challenges with Current Solutions

- Most bottles only **store** water; they don't purify it.
- Manual purifiers are **slow** and lack real-time feedback.
- UV-only bottles **don't handle sediments or hardness**.
- No integrated system offers **smart monitoring + purification** together.

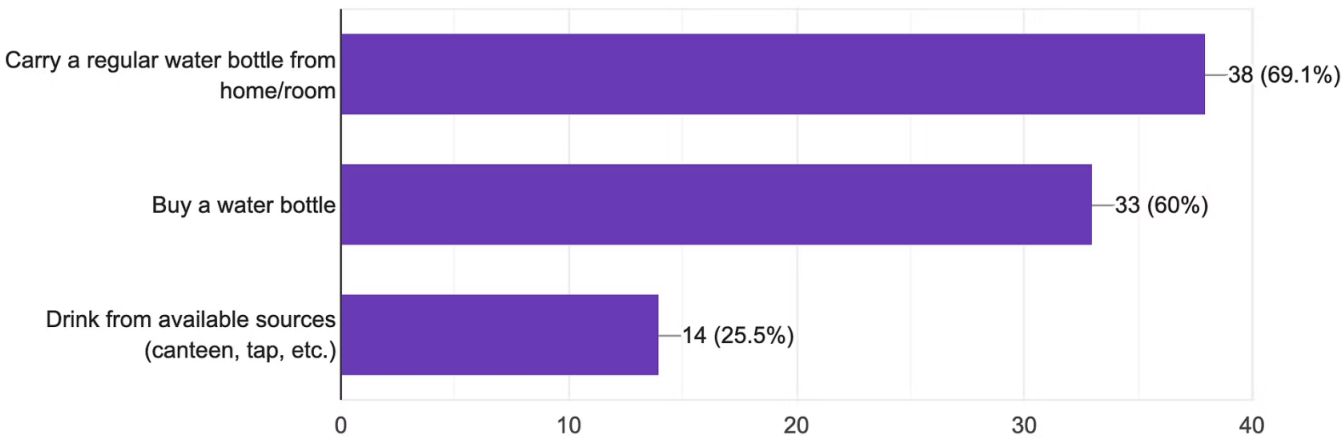
## Design Goal

Create a **cost-effective, portable water bottle** that performs **sedimentation + UV purification + water softening**, and provides **TDS & quantity tracking** via mobile app.

# User Study

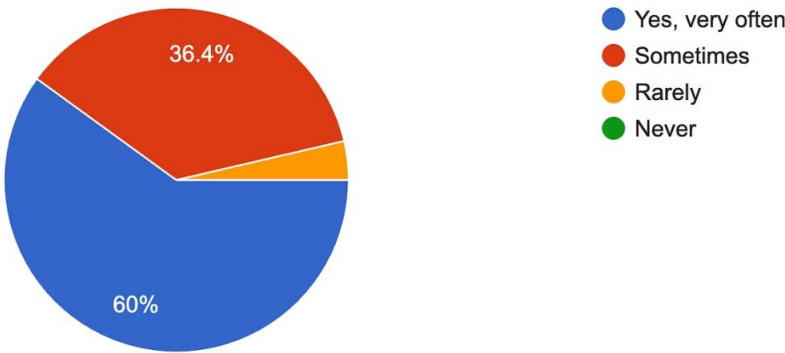
How do you usually get drinking water when you are outside (college, travel, etc.)?

55 responses



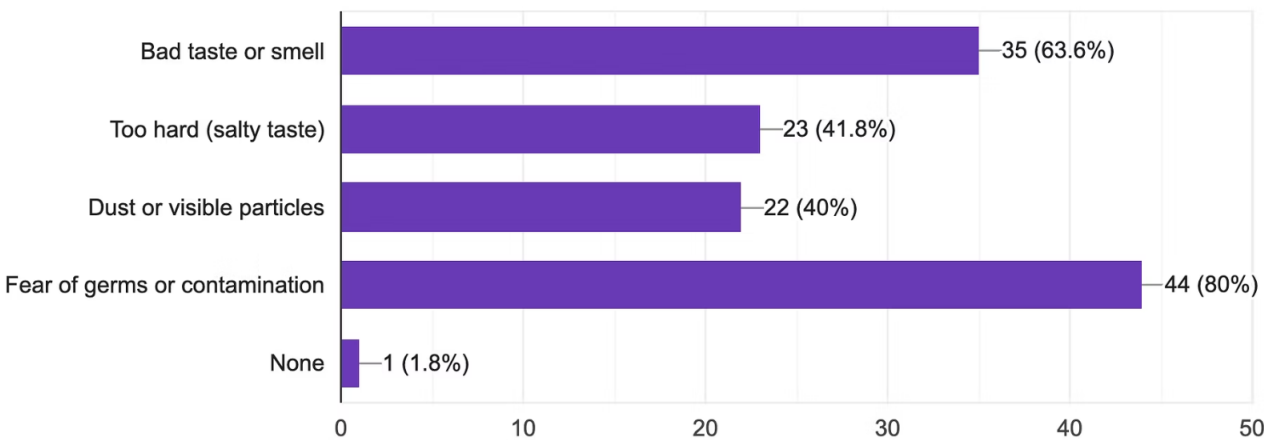
Do you often face problems with the quality or taste of drinking water at hostel or during travel?

55 responses



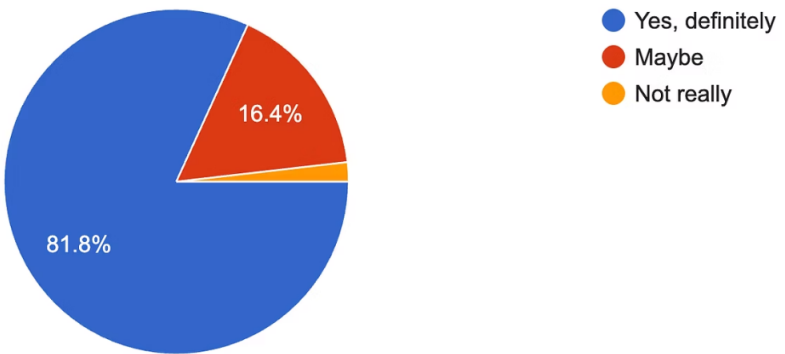
What kind of problems have you noticed in drinking water?

55 responses



Do you think a bottle that itself purifies water when you fill it - either tap or river water, would be useful to you?

55 responses

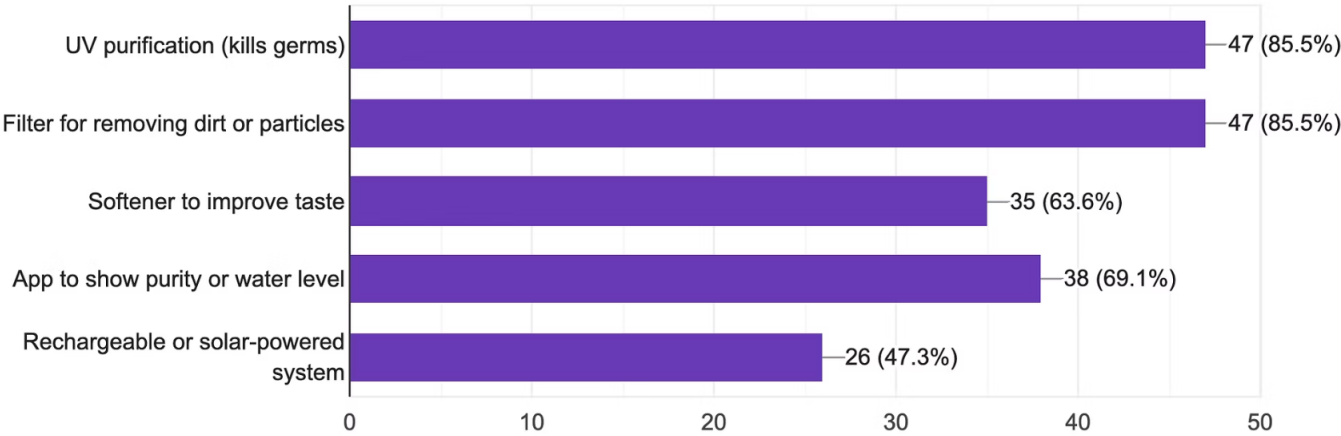




# User Study

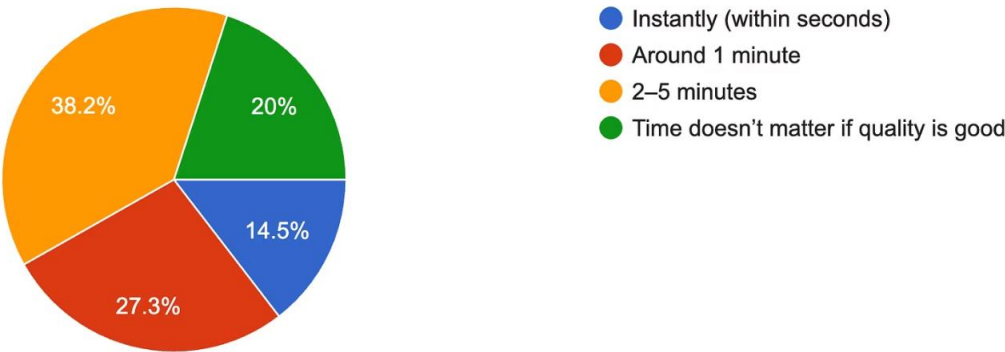
## Which features would you like in such a bottle?

55 responses



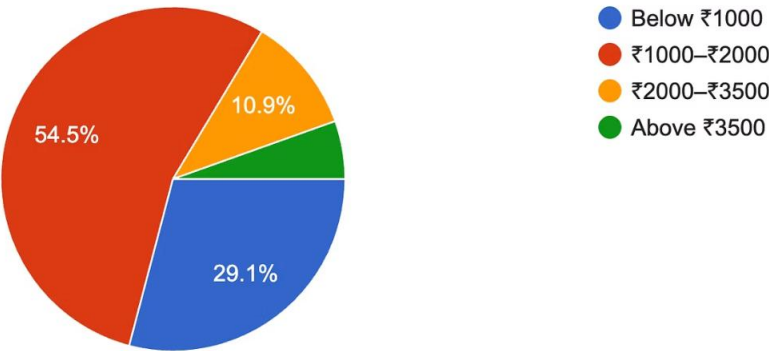
## How much time would you expect it to take for purification?

55 responses



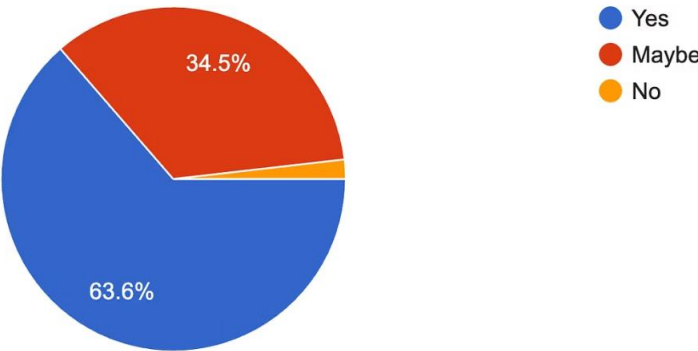
## What price range would feel reasonable for a smart purifying bottle?

55 responses



## Would you actually consider buying such a bottle if it works well?

55 responses



# Data Analysis & Insights

## Survey Insights

- Users prioritise **portability, reliability, and quick purification**.
- Users prefer **automated monitoring** over manual testing.
- Desire for **eco-friendly, rechargeable** designs.

## Design Implications

- Integrate UV + water softener + sensors in one chamber
- Use IoT-based mobile app for purity, filtration control and quantity logs



# Concepts Generated

## Concept 1

Basic sedimentation bottle with replaceable filter.

## Concept 2

UV-only purification bottle (no sensors).


## Concept 3

Smart purification bottle (**selected final**).

## Concept 4

Solar-powered version for off-grid use.

## Final Choice

-  ☒ **Sedimentation + UV + Water Softener + Smart Sensing.**
- ☒ **Real-time TDS & water quantity tracking via app.**



# Final Product Design

## Key Components

### Sediment Filter

Removes suspended impurities.

### Water Softener Chamber

Reduces hardness using resin beads.

### UV-C LED Steriliser

Kills bacteria and viruses.

### TDS & Flow Sensors

Measure purity and volume in real time.

### Detachable Electronics Module

Battery and microcontroller are Detachable.

### Mobile App

Displays TDS, water quantity, and filter health.

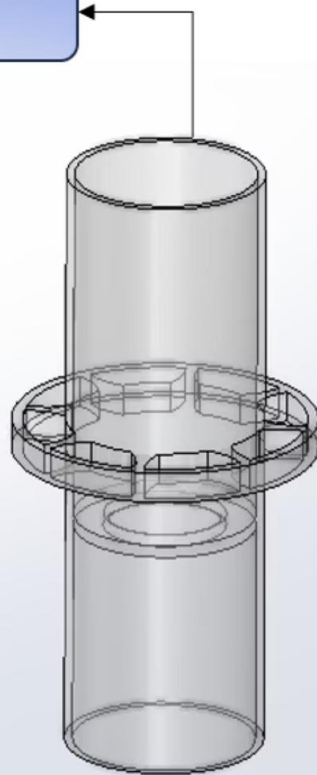
### Material

PETG filament offers excellent strength, durability, and UV resistance, making it watertight, food-safe, and ideal for outdoor use. It is easy to print, has low moisture absorption, and ensures long-lasting performance.



## 3D Model Of Water Bottle

Filter stand and  
Water divider



Semi-permeable  
Membrane

Hardwater Softening Unit

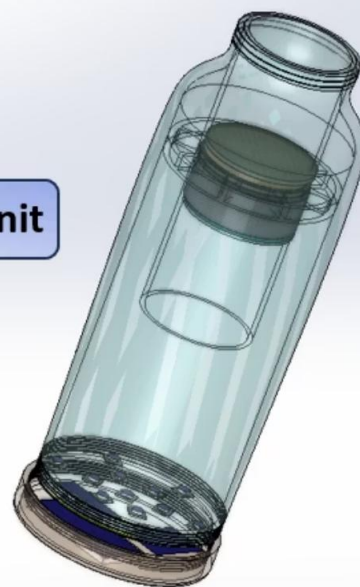
Sedimentation  
Filtration Unit

Macro Filtration unit

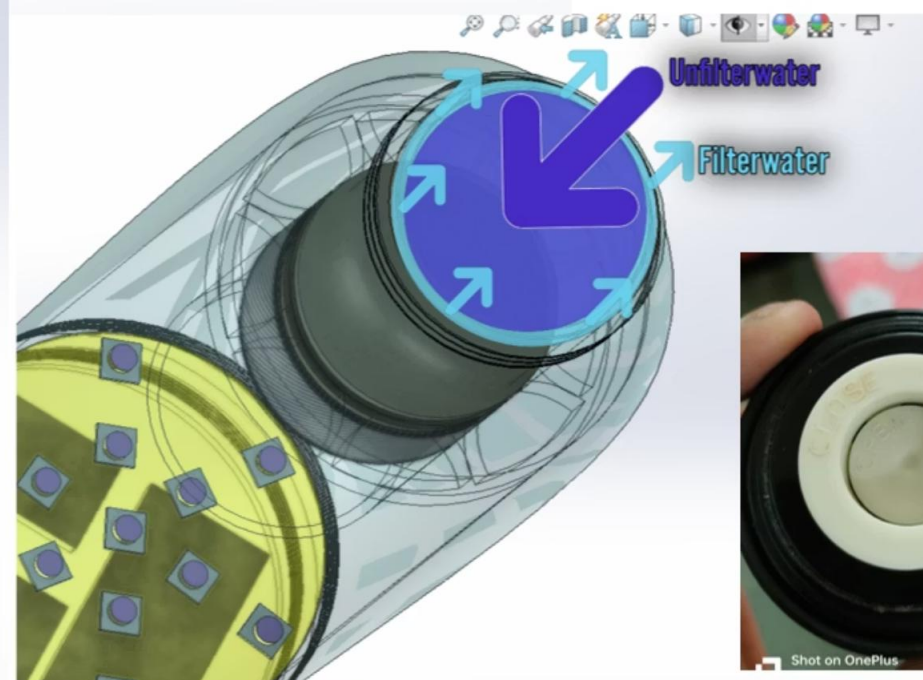


UV Filtration Unit

Power Supply  
And Processing  
Unit  
(rechargeable)

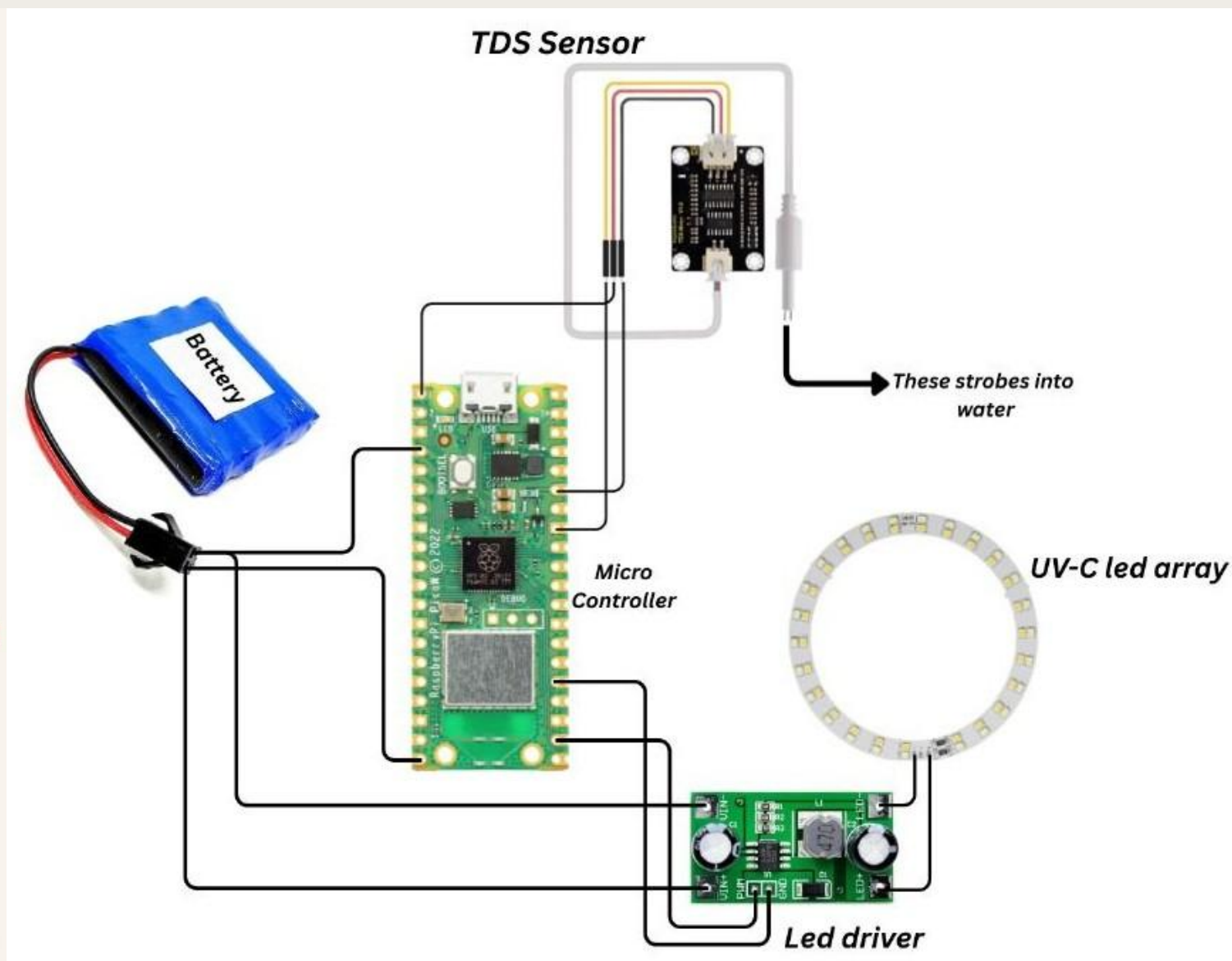
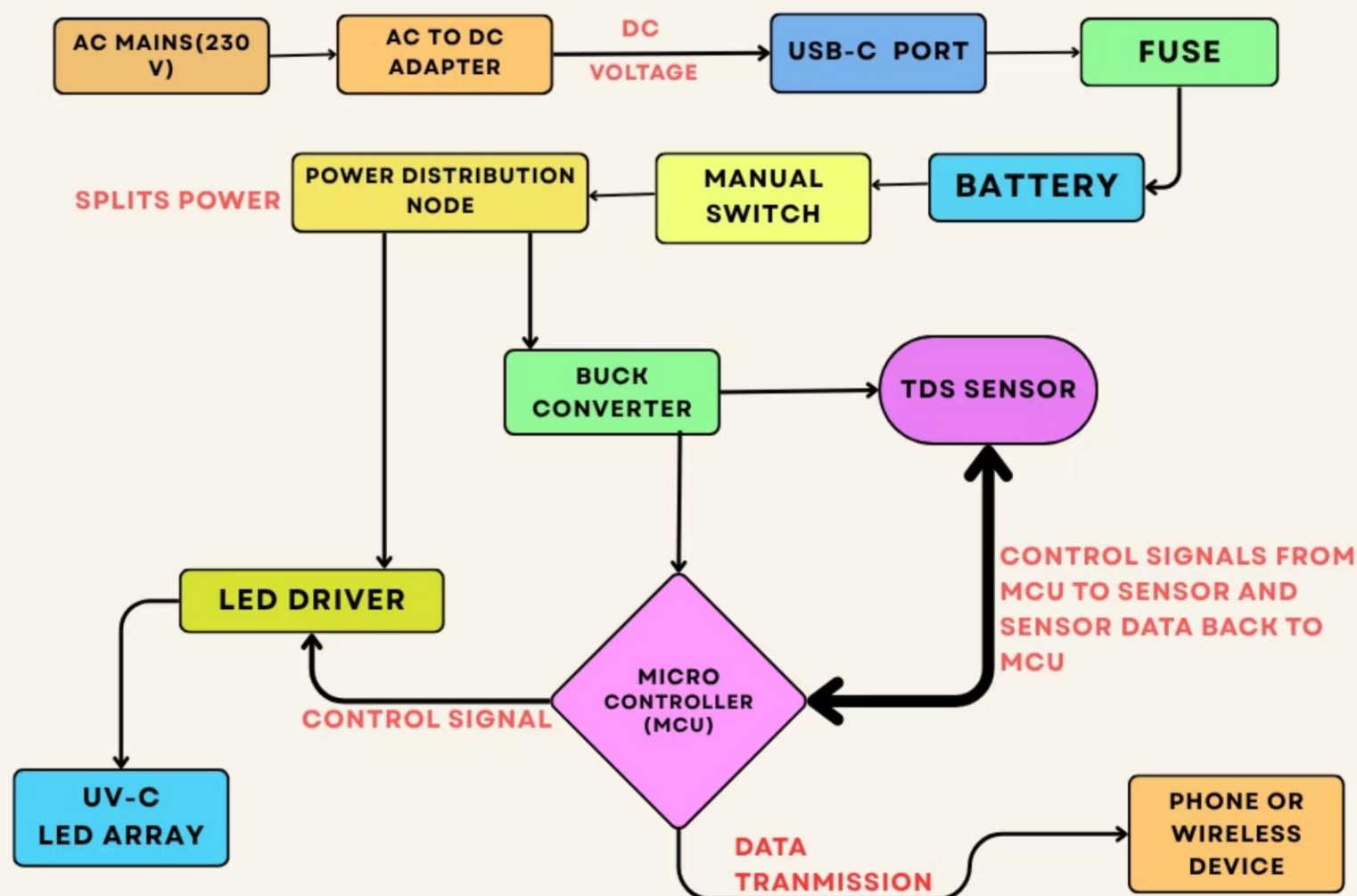


Bottle Cap



# Circuit Flow & Electronics Design

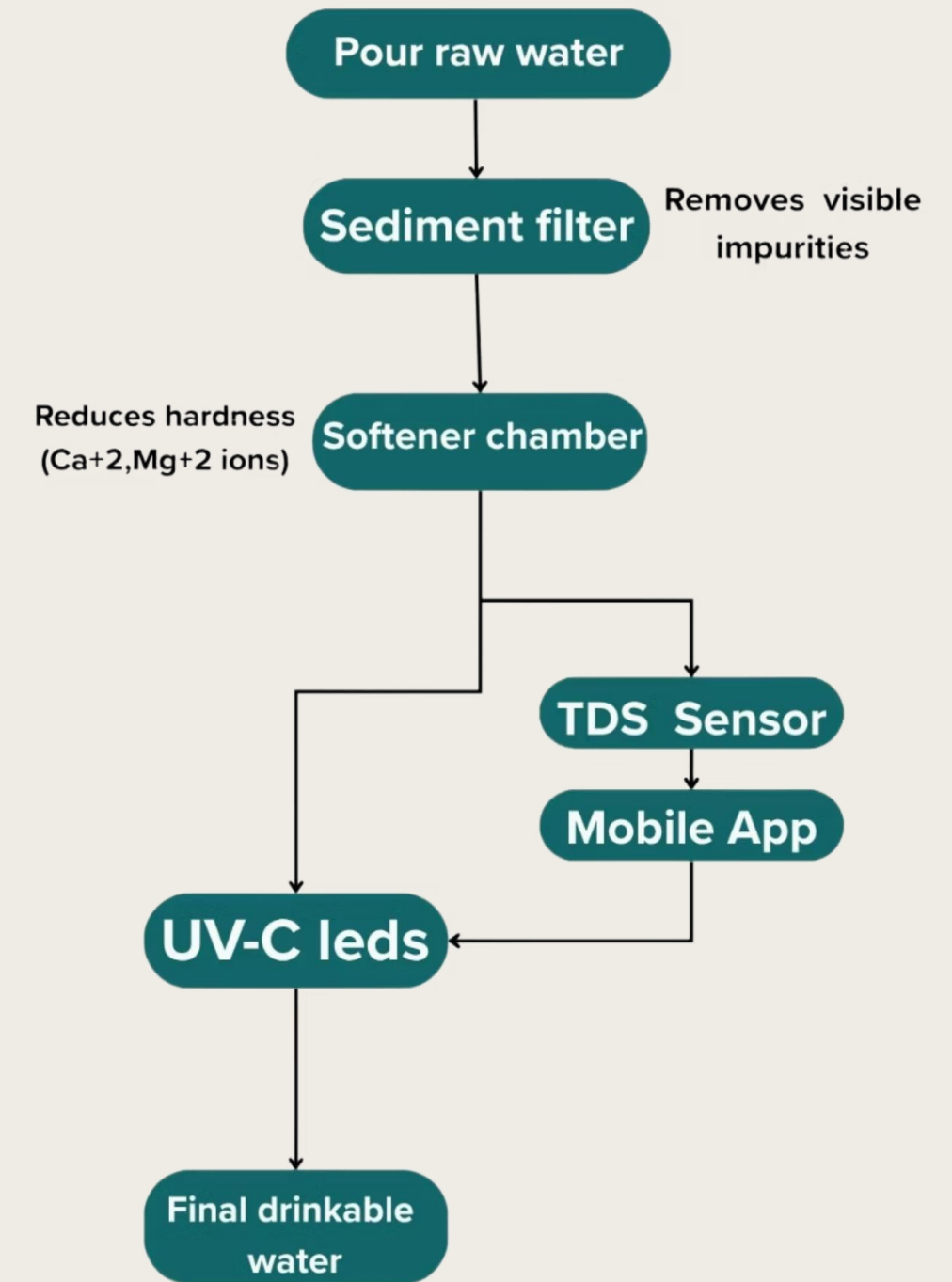
## Circuit flow



# Working Principle

- 1 User pours raw water into the top chamber
- 2 Water passes through the sediment filter → removes visible impurities → fast filtration → charcoal removes chlorine, pesticides, fertilizers, VOCs, bad taste/odour (musty, rotten, metallic, plastic-like), heavy metals (lead, mercury, copper), fine dust, and thin oil films.
- 3 Softener chamber reduces hardness ( $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ) → Amberlite IR-120 (between Nylon Polyamide Mesh), food-grade → treats 100–150 mg/L hardness; ~20 L softened per cycle → no precipitate forms → regenerated using brine ( $\text{NaCl} + \text{H}_2\text{O}$ )
- 4 UV-C LEDs sterilise the water
- 5 Sensors track TDS & Filtration control via mobile app
- 6 Data is sent to the mobile app for user display

Cycle Time: 2 -5 minute per purification.





# Product Specifications

Parameter	Specification
Capacity	750 ml
Filtration	Sedimentation + UV + Softener
Sensors and microcontroller	TDS sensor + Raspberry Pi
Connectivity	Bluetooth / Wi-Fi for App
Material	PETG (Polyethylene Terephthalate Glycol)
Power	3.7V Rechargeable Li-ion Battery
Charging	USB Type-C
Purification Time	2-5 minutes
Estimated Cost	₹2500 – ₹3500

# Conclusion & Future Scope

## Conclusion

- Designed a **smart, non-pump water bottle** with built-in **purification and tracking**.
- Combines **UV purification, water softening, and real-time quality sensing**.
- Portable, rechargeable, and suitable for everyday or outdoor use.

## Future Scope



Integrate solar charging for field usage



Add AI-based water quality prediction



Include voice alerts for hydration reminders



Expand design for 1L capacity and modular filter replacement