Sustainable Drinking Water Purification Device

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Overview

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Background

•Many drinking water sources throughout the world are contaminated by various Pathogenic Bacteria, Turbidity and/or Heavy Metals

•Failure to provide safe drinking water to all people has been noted as one of the greatest development failures of the 20th century[1]

[1] Gleick, P.
"Dirty Water: Estimated Deaths from Water-Related Diseases 2000-2020" *Pacific Institute for studies in Development, Environment, and Security*, 2002

Problem Formulation

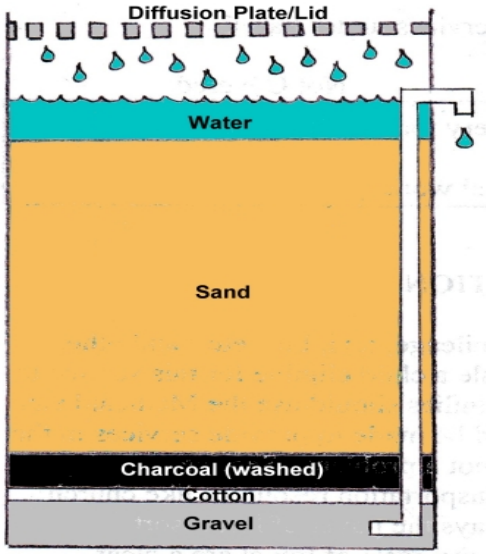
- It's estimated that as many as 135 million people will die from the diseases caused by waterborne contaminations by 2020[1]
- 1.1 billion people lack access to improved drinking water supply[2]
- "Currently studies focused on optically based transduction methods aim to achieve a more robust, easy-to-use, portable, analytical system[4]."

[2] World Health Organization
"Combating Waterborne diseases at the Household Level",*WHO Library Catalouging-in-Publication Data*,2007

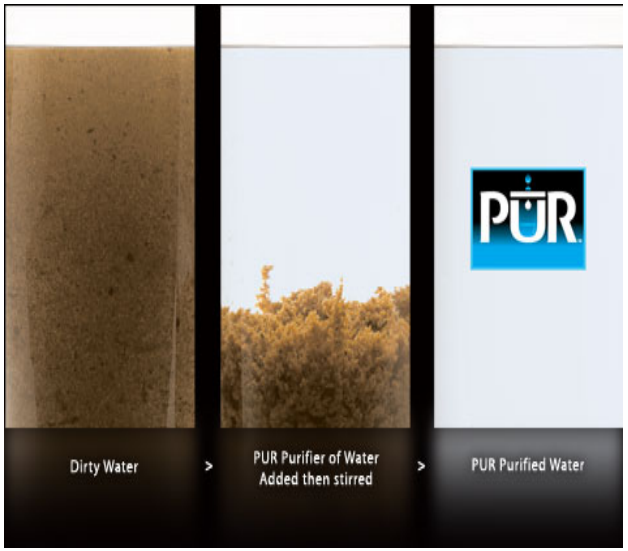
[3] Leonard, P., Hearty S., Brennan, J., Dunne, L., Quinn, J., Chakraborty, T., O'Kennedy, R.
"Advances in Biosensors for detection of pathogens in food and water", *Enzyme and Microbial Technology 32*, 2003

Current Status of Art

Solar Distillation



Biosand Filters



Chemical Tablets

Drawbacks:

Biosand Filters - Timely process, Limited to the amount of use per day
Solar Distillation -Water bottles have to be present
Chemical Disinfection- Supply of chemical tablets must be present

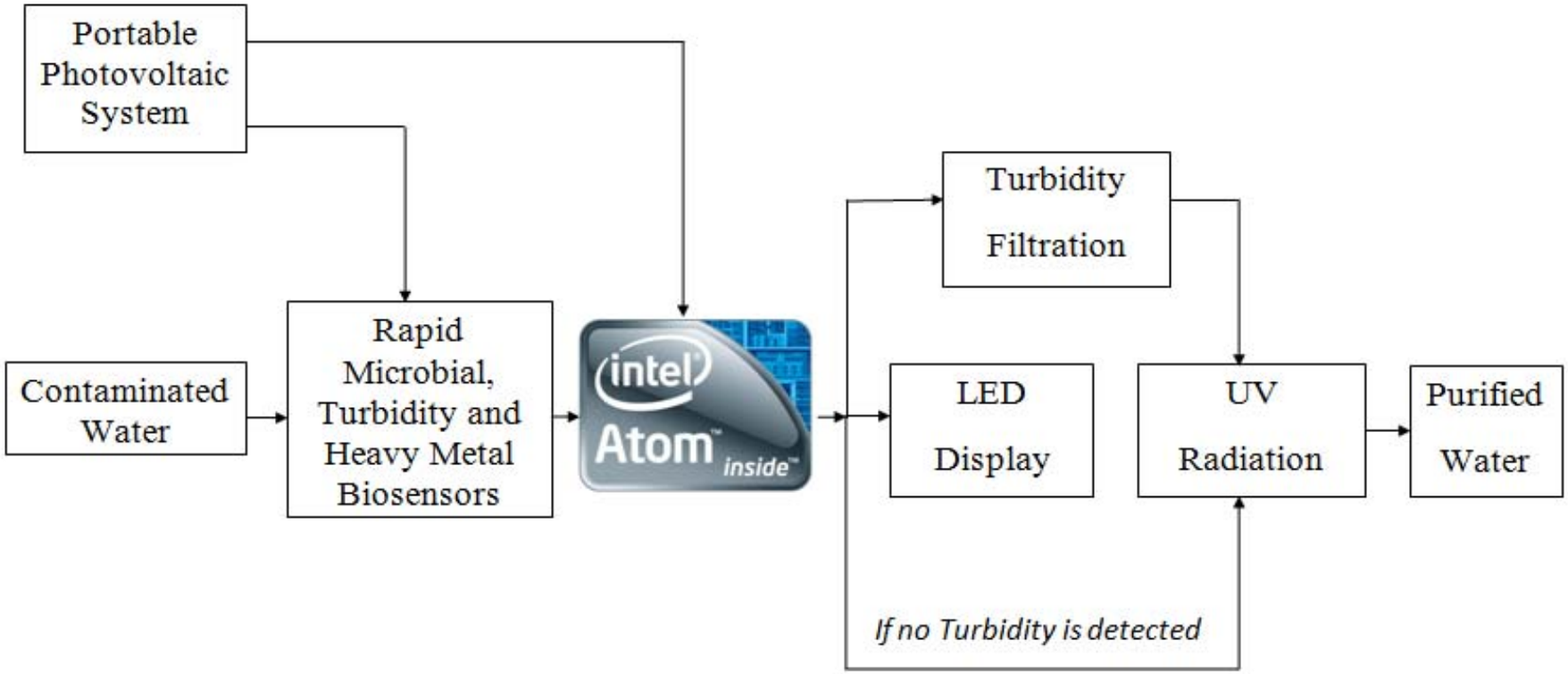
Methods do not use a technical approach

Solution Approach

DEVELOP A STATIONARY, SUSTAINABLE AND TECHNICALLY APPROPRIATE DEVICE THAT CAN DETECT AND PURIFY CONTAMINANTS IN 2 LITERS OF DRINKING WATER WITHIN 10 MINUTES

- Sustainability – Portable Photovoltaic System
- Technical Appropriateness – One-button/Color Coded LED Display
- Detection – Biosensor Circuits
- Data processing – Microprocessor
- Purification – Ultraviolet Radiation

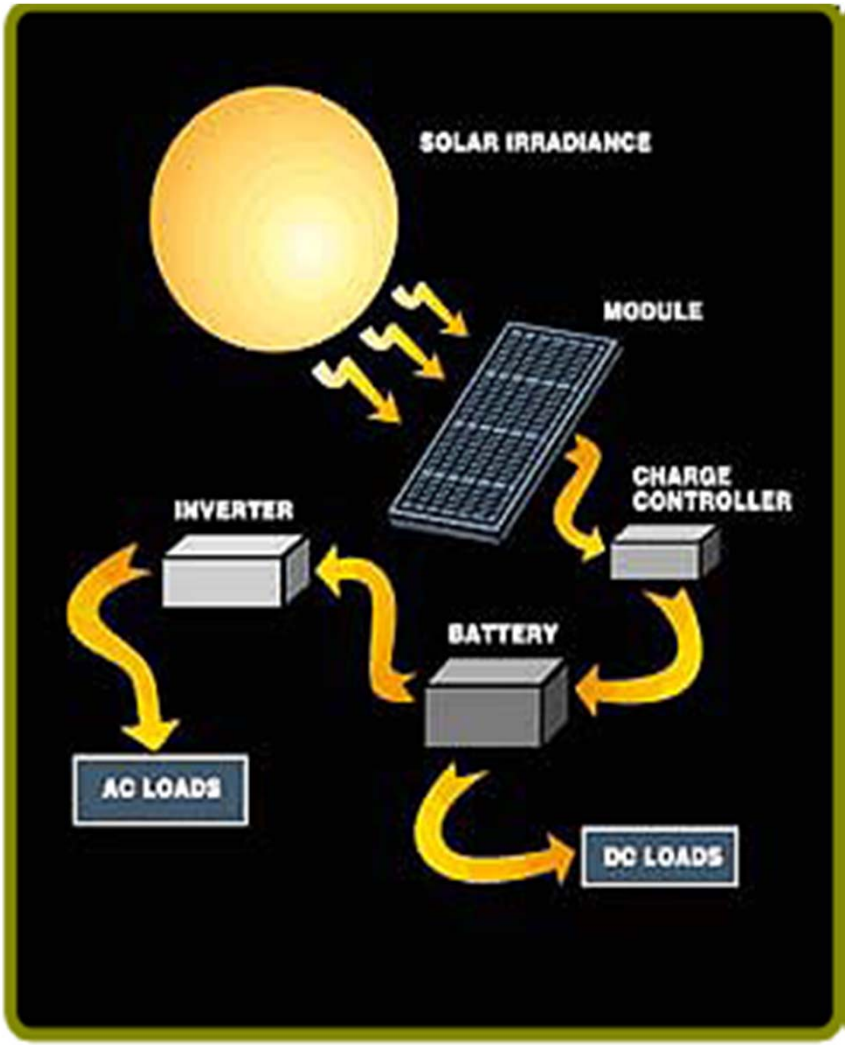
Solution Approach



Portable Photovoltaic System

Role: Sustainable Power Source

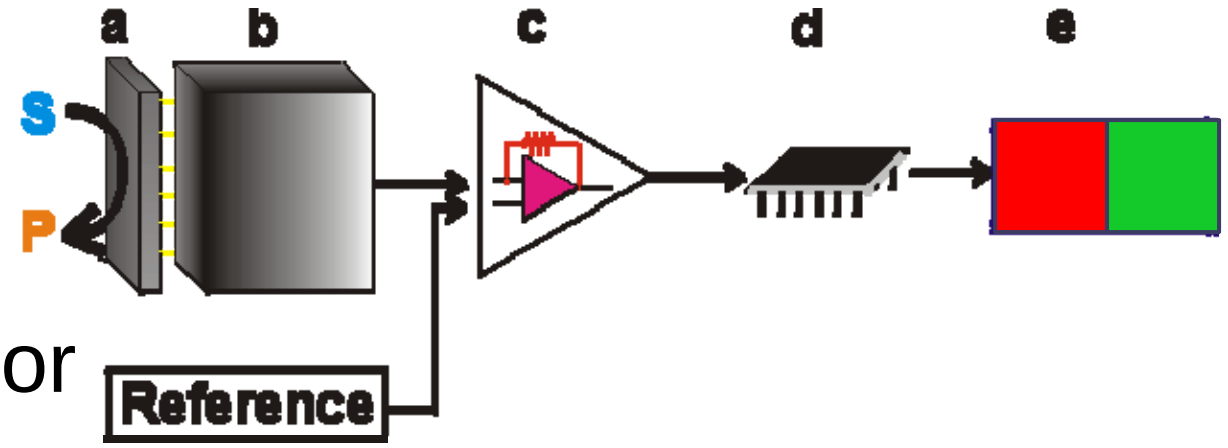
(a) PV array
(b) Charge Controller
(c) Battery
(d) DC load
(e) Inverter
(f) AC load



Biosensor Circuits

Role: Detect Pathogens, Heavy Metals, Turbidity and Acidic Water

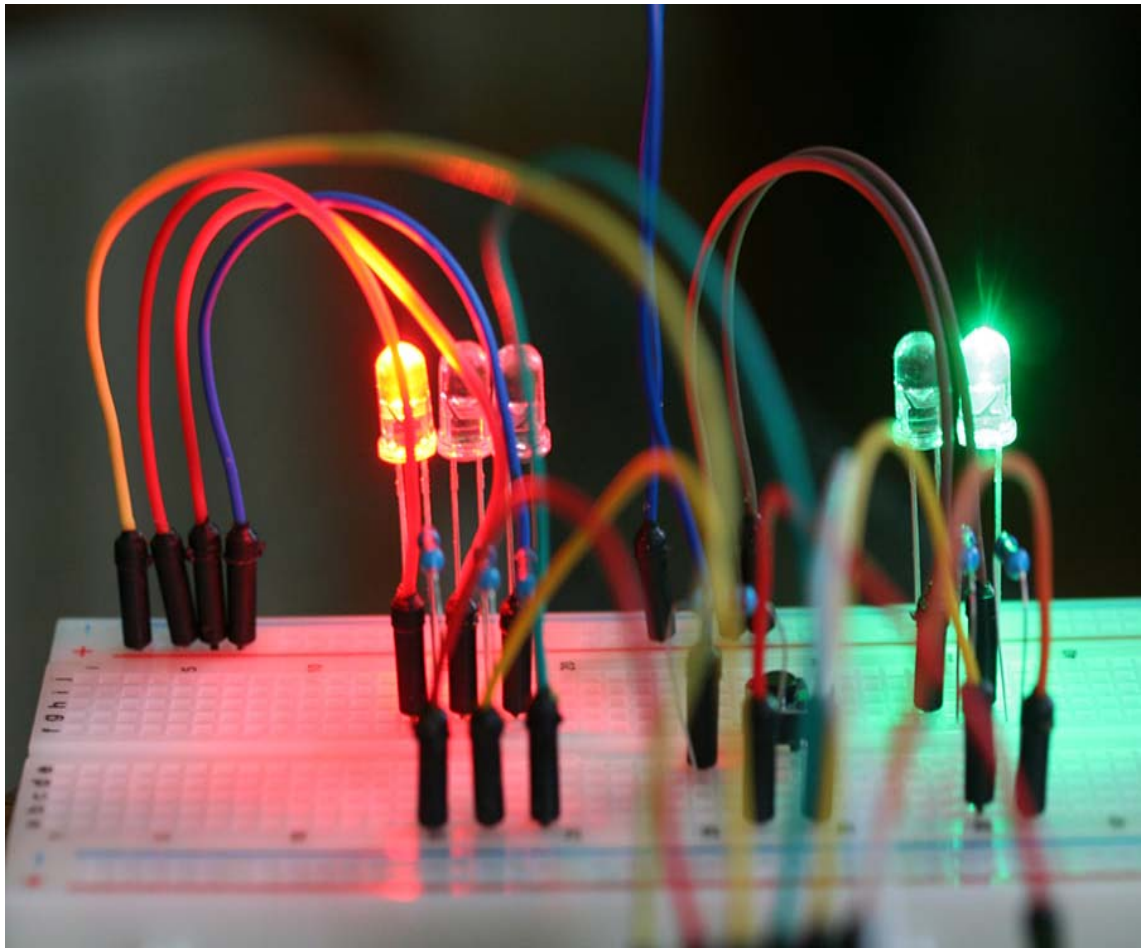
(a) Bioreceptor
(b) Transducer
(c) Amplifier
(d) Microprocessor
(e) Results



LED Display

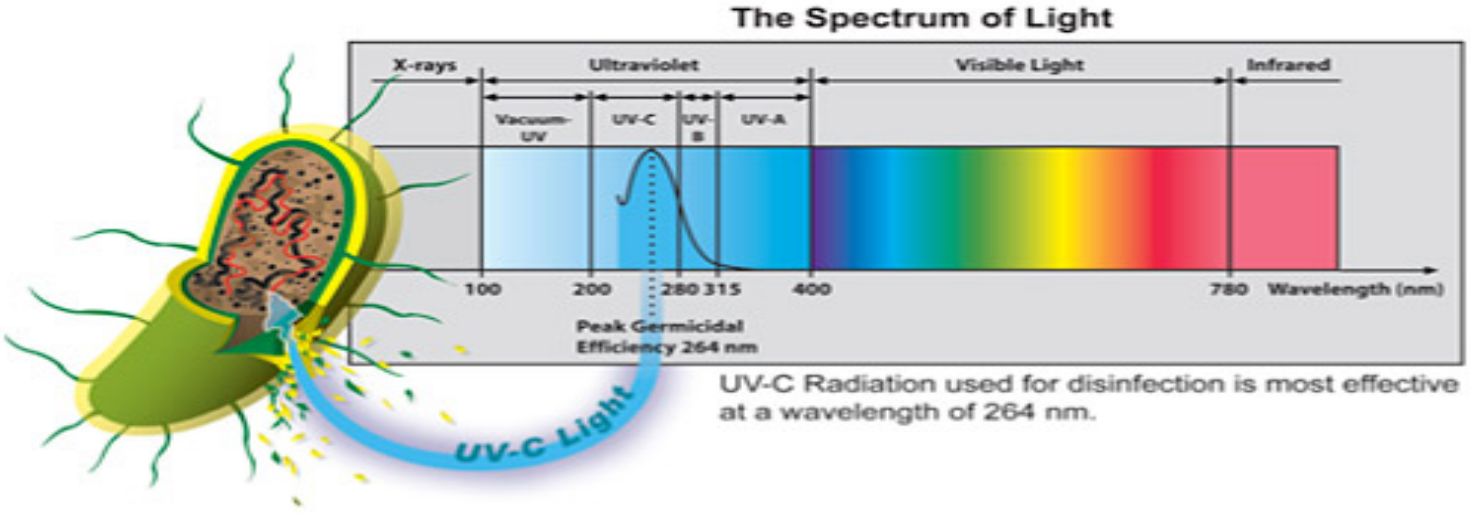
Role: Display a red if contaminants are detected and a green light if not

(a) Intel Board
(b) Jumper link
(c) 10K resistors
(d) Red LEDs
(e) Green LEDs
(f) Breadboard



UV Radiation System

Role: Purify Water



(a)UV-C radiation attacks bacteria DNA directly
(b)Bacteria loses its ability to reproduce and is destroyed

Design Requirements

Function	Requirements
Power	•The battery should be recharged by solar energy
Detection	•Red LED should light upon detection •Green LED should light when nothing is detected and after proper purification
Selection	•The device should go directly to UV radiation if no Turbidity is detected
Time	•Purify 2 liters of water within 15 minutes
Quantification	•Test with known contaminated water and known purified water
Size	•3’x3’

Tasks and Project Management

Timeline	
November 2012	Learn Atom board, components and submit initial proposal
December 2012	Purchase parts and components
December 2012/January 2013	Build device
February 2013	Test device
February/March 2013	Make necessary modifications
April 2013	Demonstrate device on ECE day

Costs and Resources

Budget: $2500

Product	Resource	Price
Portable PV Cell	AliExpress	$200.00
Rechargeable Batteries	AliExpress	$80.00
Biosensors	DigiKey.com	$80.00
LED Lights	Radio Shack	$5.00
Turbidity Filtration System	Budget Water International Inc.	$399.87
UV purification system	Atlantic Ultraviolet Corporation	$327.25
		Total -$1092.12

Conclusion

Our aim is to develop a technical device:

That is sustainable, robust, time-efficient and easy-to-use for people in developing countries who do not have access to purified water

Questions