WASTEWATER DISPOSAL PROBLEM

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Abstract

Industrial wastewater must be properly treated before it is released back into the environment. Factories would ideally analyse the wastewater and treat it accordingly, however this requires the use of expensive equipment. Consequently, many factories in the developing world forgo this and dump copious quantities of cleaning chemicals into the wastewater, or even simply discard it untreated.

This causes great harm to the environment as well as putting millions of lives at risk. This project proposes solving this issue by creating an affordable device that can analyse wastewater allowing factories to correctly treat it. Although there are already solutions available on the market, these can cost over $30,000 second-hand, and require lots of specialist training [7]. By creating a more affordable and simpler system, the harmful impacts of waste water can be reduced.

1. Proposal

Industrial wastewater being discharged into natural water streams after undergoing minimal or no treatment at all is the biggest source of water pollution on the planet since it causes irreversible damage to the surrounding ecosystems and increasing the risk of water borne diseases [1].

This has been identified as a major threat not only because a natural resource is being used in unmoderated quantities without proper treatment, but also because it puts life on the planet at risk making this situation, an issue of global significance. Even in the current global scenario, getting water fit for consumption as well as domestic uses is a major hardship, primarily in the less economically developed parts of the world.

A: Problem Statement

A study found that in Africa, the chemical oxygen demand of water from ponds exceeds 2000 mg/L, which crosses the limit for safe usage by a significant amount [2]. This is just one study focusing on one geographical location, however the problem also extends to the other parts of the world. The sheer scale and implications of the statistics lead us to believe that this is a subject matter with a real need for innovative solutions.

B: Market Research and Business Case

Market research shows a 7.1% compound annual growth rate expected between 2016 and 2025, and a valuation of 23.8 billion USD in 2016 [3]. Another source predicts a market valuation of 674.72 billion USD by 2025 [4]. Given the size and exponential growth rate, the market reflects the extent of the societal need for wastewater treatment solutions. Through this project, a tangible difference will be made to the quality of the life, while benefitting the economy as well.

C: Competitor Analysis

According to the research conducted, the major companies dominating this market include Thames Water Utilities Ltd, Suez Water Technologies, American Water Works Co, Xylem and Nalco Water [6]. Even though all these companies design highly specified large-scale solutions, this problem can be solved using a more cost-effective method.

2. Project Development

A: Objectives

Through extensive planning and discussion, the following objectives of this project were defined:

- Prevent the spread of any communicable diseases which are water borne
- Aim to monitor the level of chemical toxins and similar pollutants and come up with relevant treatment solutions
- Aim to minimize the quantity of chemicals supplied by the lab, to treat waste water, and consequently, create a more cost-effective solution.

B: Resources and Expertise

For this group project, the following facilities and resources will be used –

- *Robotics Lab* – In order to come up with a robust and reliable structure for this project, 3D printing facilities at the Robotics Lab will be of great use
- *Electronics Lab* – Since the Electronics Lab at the department is very well equipped, all the circuits and prototypes will be built and tested in the lab
- *Advanced Hackspace* – The design and prototyping sub-group will use the Advance Hackspace to come up with the best possible design.
- *Enterprise Labs* – To be used for brain storming and group meetings
- *Chemical Engineering and Chemistry Department* – To enhance the knowledge about water treatment

C: Technical Mapping

Circuit Analysis, Analogue Electronics and Control Engineering: Firstly, concepts of Circuit Analysis will be used extensively to connect sensors to each other. Furthermore, the integrated concepts of Circuit Analysis and Analogue Electronics, such as the ones explored in the Microelectronics Labs in Year 1 will be heavily used. For instance, op-amps will be used to amplify weak signals and other signal processing skills be useful.

Software Engineering and Communication Systems: For the purposes of data collection and analysis, further techniques from Computing and Signals and Communication systems will be explored.

Control Systems Engineering: The fundamental concepts of control engineering will be used to a very significant extent for the purposes of product designing and prototyping.

Algorithms, Data Structures and Digital Electronics: The concepts from the two modules will be used in conjunction with software engineering module to implement logic.

D: Project Planning

The group of eight members have been allocated into roles as follows:

Project Manager: Sanjana
Module Sub-Group 1 - Circuit Design and Implementation: Sanjith, Raj, Yinzi, Ammar
Module Sub-Group 2 – Software Engineering: Kanav
Module Sub-Group 3 – Product Prototyping: Sanjana, Snehil, Linghzi
Secretary and Treasurer: Raj

The group uses WhatsApp for instant messages along with Google Drive for a file sharing system. Additionally, regular meetings will be taking place every week with each one lasting for an hour. For the purposes of decision making, the matrix method learnt in EDP in the first year will be employed. Finally, module sub-groups overlook each other's progress to ensure the progress is on track.

E: Timelines

The following timelines have been defined by the team:

- Beginning of Autumn Term; Weeks 2 – 6: Feasibility Study, Response, Research, Learn Skills
- Middle of Autumn Term; Week 7: Define Engineering Design Criteria and Product Design Specification
- End of Autumn Term: Preliminary Report
- Beginning of Spring Term: Stage 1 - Circuit Design and Implementation, Arduino Programming and Product Prototyping
- Middle of Spring Term: Implementation of PDS, ordering parts, and Stage 2 of Prototyping
- End of Spring Term: Final Stage – Testing, Poster Print, Demo, Poster Presentation and Final Report
- Beginning of Summer: Portfolio, Peer Assessment

3. References

1) https://www.iccr.org/our-issues/water-stewardship-and-sustainability/corporate-water-impacts/factory-farms-water
2) https://onlinelibrary.wiley.com/doi/full/10.1002/clen.201300208
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