NCSC-2022

KV No.1 Saltlake

Focal Theme- UNDERSTANDING ECOSYSTEM FOR HEALTH AND WELL-BEING.

Subtheme- Technological innovation for ecosystem and health

TOPIC--- AEWPD: AUTOMATED AND ECOFRIENDLY WETLAND PRESERVATION DEVICE

Group Members- **Mentor-** Mrs. SUMANA CHATTERJEE

1) Aditi Anil (Team-Lead)

2) Arnab Biswas (Co-Lead)

3) Disha Dutta

4) Sharabati Bose

5) Archita Dutta

6) Dipjyoti Halder

7) Aman Lama

ABSTRACT

The project focuses on the preservation of aquaculture in natural wetlands.

Healthy Fish Cultivation requires good quality of water in set of parameters. Behavior, growth and reproduction of fishes mainly depends upon dissolved Oxygen %, algal/plankton bloom, pH of water (focusing on these parameters in our project). When O2 levels decrease, it can be brought to normal by aeration. Algal bloom can be detected with respect to chlorophyll concentration in the waterbody and be brought under control by physical methods like netting. Optimum pH levels for fish farming are 6.5-9.0. Increase (>9, basic) or decrease (<6.5, acidic) can be brought to desired levels by addition of mild acids or bases accordingly. Our project aims at combining all the features in one smart device in reasonable costs and simple design for the fish farmers. **We are aiming to make aquaculture ecofriendly and provide temporary solutions against water quality degrading factors.**

CONTENTS

INTRODUCTION

Wetlands are areas where water covers the soil or is present either at or near the surface of the soil all year or for varying periods of time during the year. Wetlands are one of the most productive ecosystems in the biosphere and play a significant role in the ecological sustainability. The main functions are water filtration, water storage, biological productivity, and habitat for wildlife. Animals use wetlands for part of or all their lifecycle.

Aquaculture is breeding, raising, and harvesting fish, shellfish, and aquatic plants. Basically, it’s farming in water. Aquaculture is an approximate aquatic equivalent to agriculture—that is, the rearing of certain marine and freshwater organisms to supplement the natural supply. It is important because it is used to produce food and other commercial products, restore habitat and replenish wild stocks, and rebuild populations of threatened and endangered species.

Aquaculture in clean wetlands is helpful in a way that the fishes cultured have less or no micro plastics in their body that ensure low intake of the same in humans thus are safe.

Wetland conservation is aimed at protecting and preserving areas where water exists at or near the Earth's surface, such as swamps, marshes and bogs. Wetlands have historically been the victim of large draining efforts for real estate development, or flooding for use as recreational lakes or hydropower generation. Some of the world's most important agricultural areas are wetlands that have been converted to farmland.

AIM

To design a device to preserve wetlands based on factors affecting its shrinking and degradation.

NEED STATEMENT

1) To design a smart device to control water quality parameters in reasonable costs and simple design to operate.

2) To preserve wetlands for protecting aquatic as well as terrestrial ecosystems.

HYPOTHESIS

- Most of the aquatic die-offs are caused due to ineffective monitoring of water quality.
- Excess nutrients in the water cause excessive phytoplankton/algal blooms and lead to O2 depletion in water.
- Wetland is reducing due to the natural factors (climate change, sediment condition differences) and human activities (agricultural practices, built up, deforestation)..
- Fluctuation in pH of water affects the marine organisms' behavior.
- Artificial Fish food when left uneaten, become harmful in nature, for example, they might enter through fish gills or degrade water quality and make it dense.

WORK PLAN

- Team members were chosen.
- Members were asked for experiments under subtheme chosen and individual ideas were incorporated.
- Questionnaires on the above topics were suggested.
- Thereafter topics chosen: **Preservation of wetland and maximising fish production**
- Factors affecting water quality were studied and researched about.

  1)Dissolved Oxygen% 2)pH 3)Excessive nutrients

  4)Suspended particals and algal blooms

Nearby wetlands were observed individually for reference.

- Wetland areas were surveyed with the help of aerial views of East Kolkata wetland and the change from year 1991 to 2017 were noted in 10 and 6 year intervals.
- Device design discussed keeping the idea of affordability, innovation and simplicity in mind.

METHODOLOGY

1.Factors affecting water quality and wetland shrinkage were determined and their optimum levels were found out.

2. Operatable factors were chosen for the project to maintain simplicity of the model and avoid problems in huge scale deviations, like temperature factor was removed as the change occurs in huge scale which not only depends upon artificial factors but upon seasons too which cannot be controlled.

3. Simple individual detectors of individual factors were searched.

4. Surface Aerator, pH meter, Acid/Base dispenser, Micro controller, Rudder motor, Display screen, Indicators (for high/low pH, low dissolved O_2 and plankton detection), ultrasound sensor are associated constituent devices of our PROPOSED DEVICE. *

5.Computer Program can be written and executed based on the results from the detectors. (eg: If pH is greater than 9.0, release acid. If O_2 % is <5ppm, turn ON aerator.)

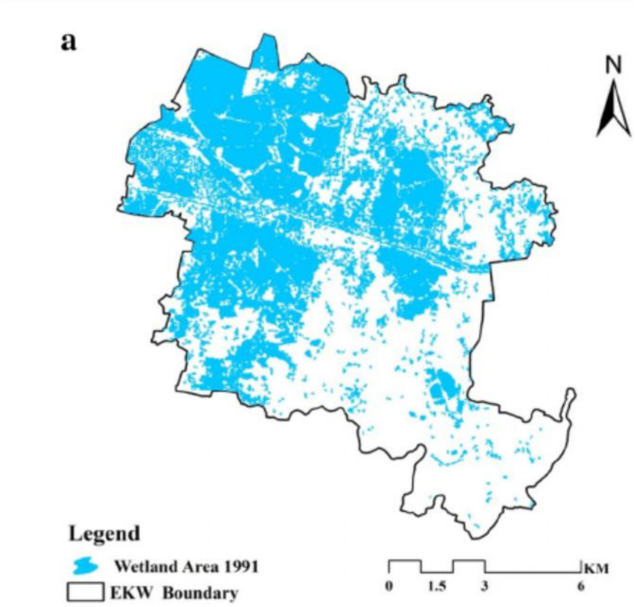
6.Microcontroller (arduino) can be used so that the program can be stored in the chip for further execution.

7.Sensor to measure the depth of water during movement of device, so that it doesn't enter shallow depth waters, avoiding several risks

SURVEY/ DATA COLLECTION

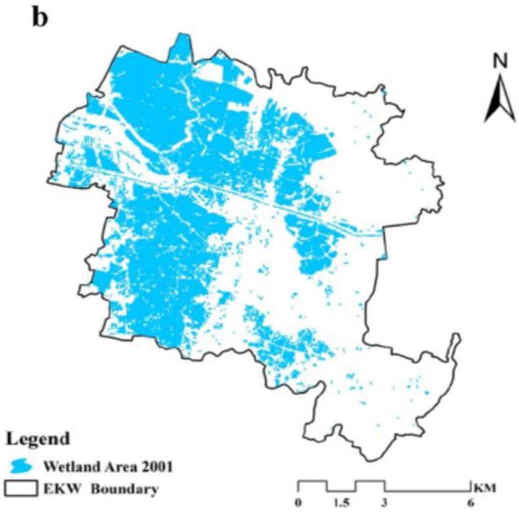
Wetlands are going through rapid degradation and shrinkage, and they need to be preserved. Here's the survey to show how much the wetlands have depleted over time.

LOCATION: East Kolkata Wetland



Year: 1991

Wetland area (km*2): 65.293



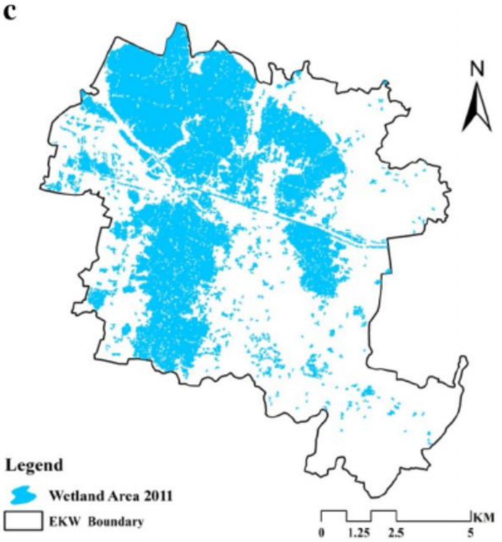
Year: 2001

Wetland area (km*2): 49.914

Change of wetland area (km*2): -3.662

Description: Rapid degradation

c



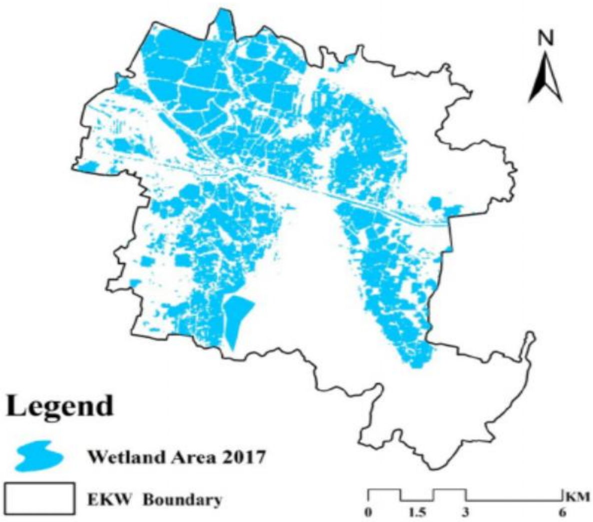
Year: 2011

Wetland area (km*2):46.252

Change of wetland area (km*2): -2.417

Description: Controlled degradation

d



Description: Transforming degradation

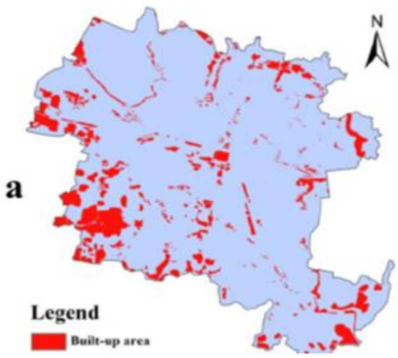
Year: 2017

Wetland area (km*2): 46.252

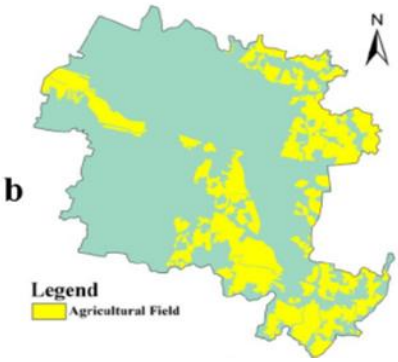
WETLAND RISK MAP

Factors affecting shrinkage and degradation of wetland

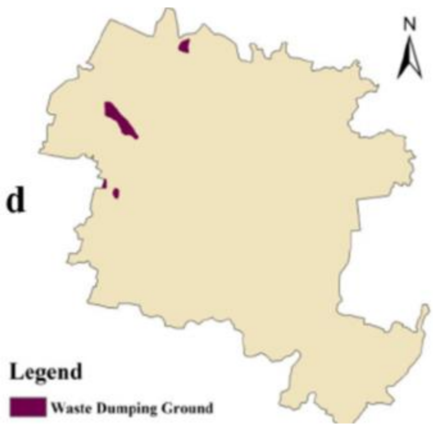
•Built-up area



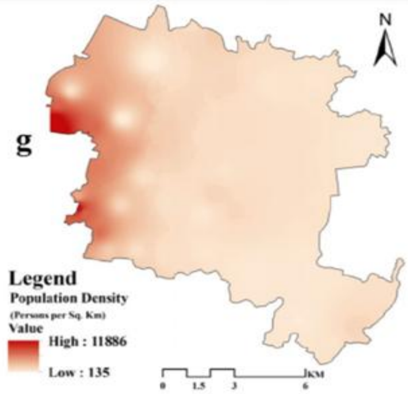
•Agricultural Fields

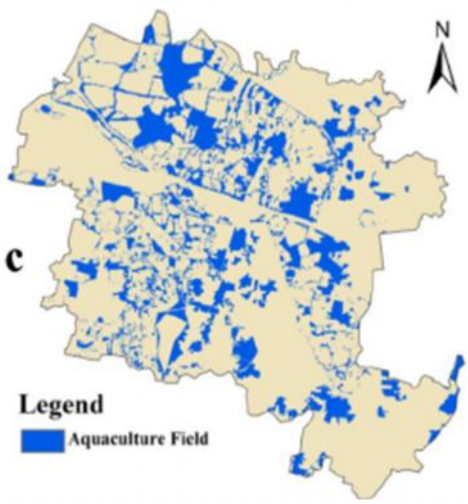


•Waste dumping grounds



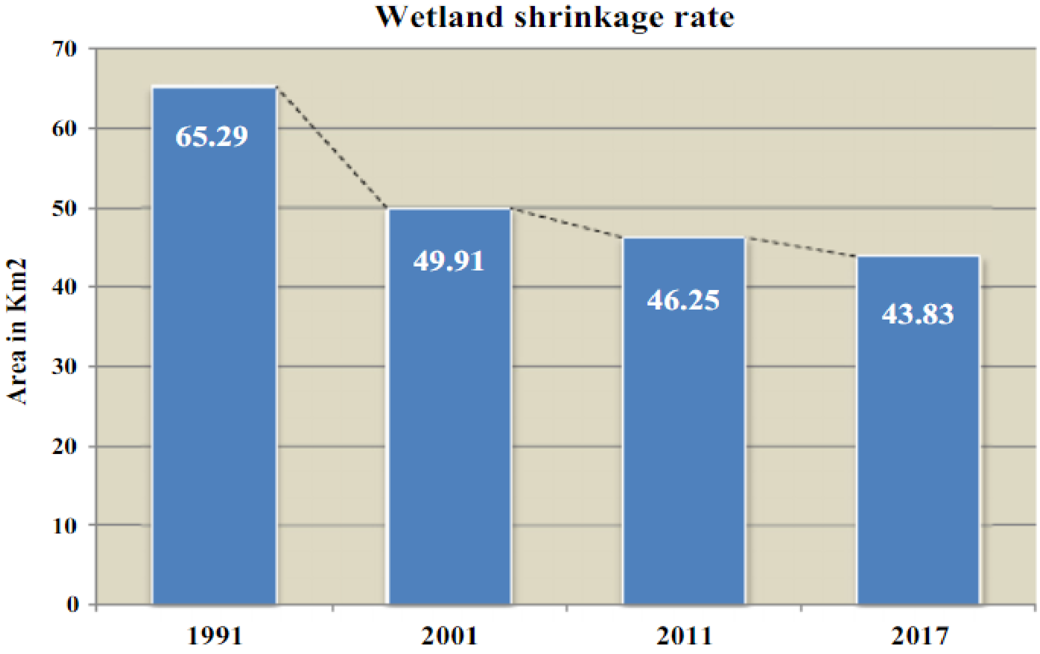
•Population density

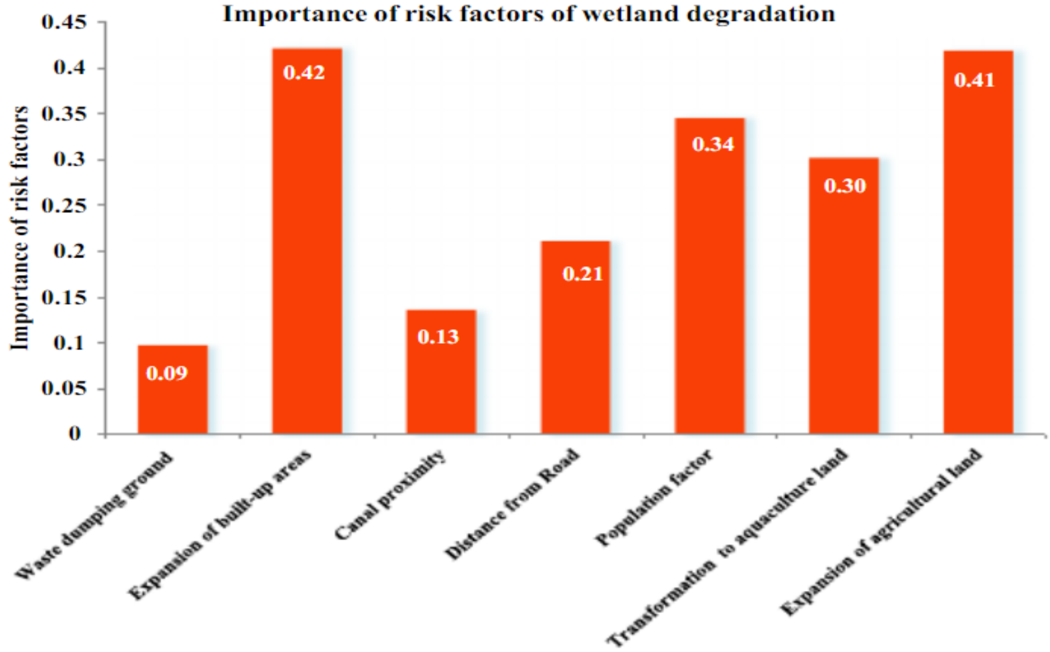




•Aquacultural Fields

DATA ANALYSIS AND INTERPRETATION





Major factors affecting wetland shrinkage and degradation

1)Transformation to aquaculture ponds-It is seen that loss of wetland from 1991 to 2001 was 23.55% where it was 7.34% in 2011 to 2017, mainly due to the result of land transformation for aquaculture activity.

2)Water quality- expansion of built-up area, encroachment of cropland, the transformation of wetland into fishing ponds are responsible for wetland degradation.

3)Population Density and Waste Dumping Area- waste generated by the local people is openly dumped in an area as there is no protection all the wastes mostly transfer by the running water and blowing air. The mixing of this waste degrades the quality of the wetland in many aspects like water quality, land productivity, the life of flora and fauna etc.

CONCLUSION

It was concluded that loss of wetland mainly due to the result of land transformation for aquaculture activity.

SOLUTION

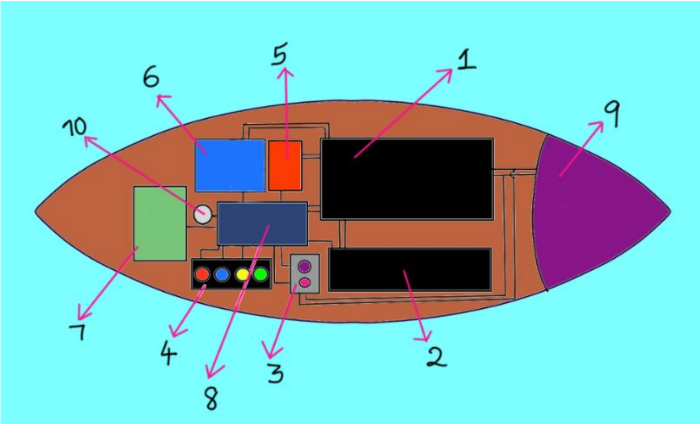
- Maximizing production of existing aquacultural ponds by reducing aquatic die offs (with help of AEWPD) and managing feeding practices by using organic feed to make it eco-friendly.
- Checking water quality parameters of aquacultures with the help of a device and providing temporary solutions to reduce factors like eutrophication which degrade nearby wetlands.

OTHER SOLUTIONS

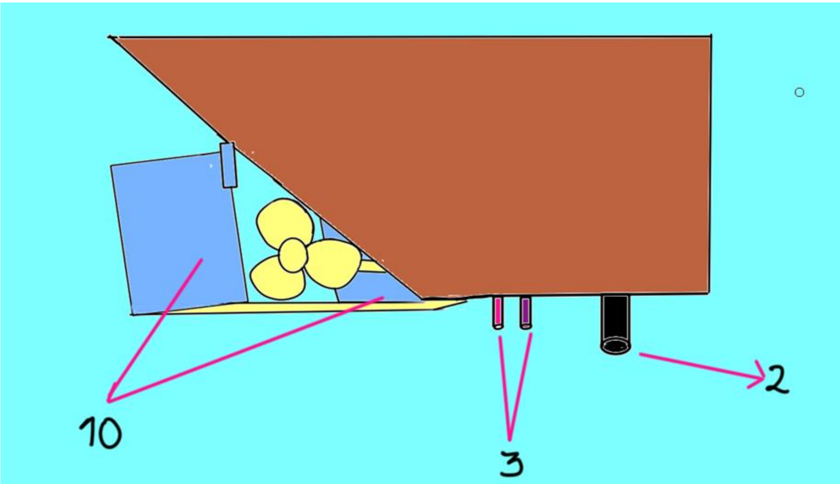
- Implementation of proper laws to decrease build up and waste dumping areas near wetlands.
- Controlling run-off and water logging from agricultural fields without causing erosion with the help of a surface drainage system.

DIAGRAMMATIC REPRESENTATION OF SOLUTION

In order to handle the stated parameters, the design and explanation of our device, **AEWPD,** are as follows-



--top view



--back

1)Battery

2)Surface Aerator

3)electrodes

4)Indicators- give specific-coloured lights according to change in calibrated parameters. Higher pH- blue

Lower pH- red

Change in dissolved oxygen- yellow

Phytoplankton/Algal bloom- green

5)Acid dispenser

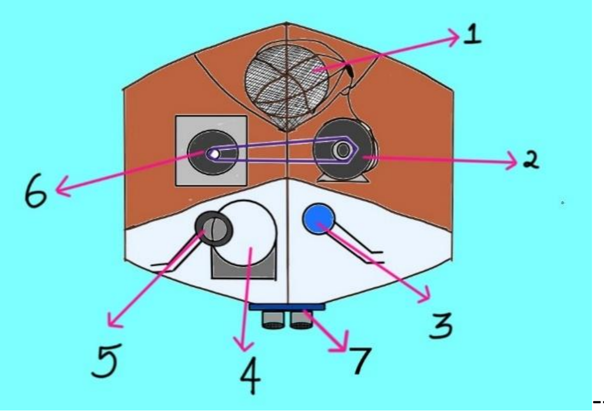
6)Base dispenser

7)Display- displays measurements obtained from sensors.

8)Micro controller- controls and operates all devices.

9) Phytoplankton/Algal bloom controller.

10)Rudder motor- for movement and changing direction of device.



---front view

1)Plankton net

2) Mini Pulley

3)Blue LED

4)Concave lens

5)Silicon Photodiode

6)Motor

7)Ultrasound sensor

INNOVATIVE FEATURES

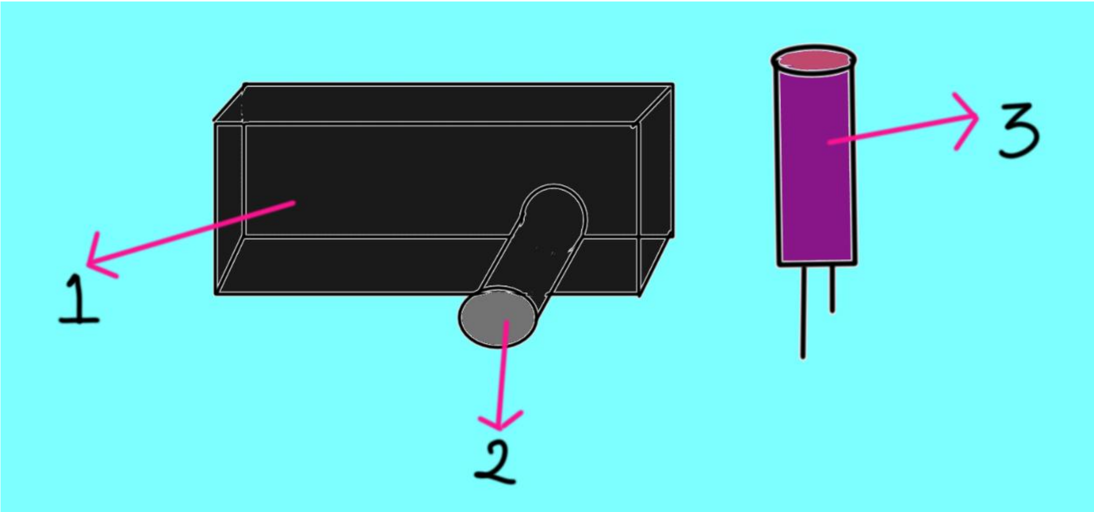
The following are the parts which mainly contribute in solving the problems of

1. Low dissolved O2

2.High/Low pH

3.Algal/plankton bloom

Dissolved Oxygen meter



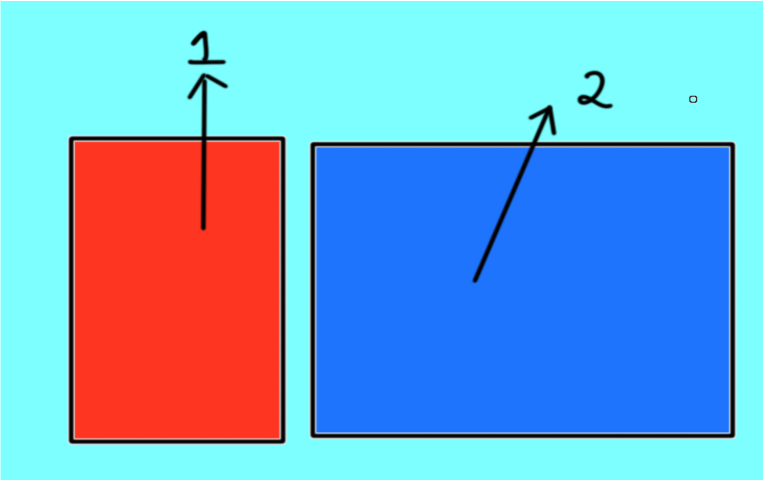
The aerator is turned on when less dissolved oxygen percentage is sensed and works until it comes up to the calibrated level.

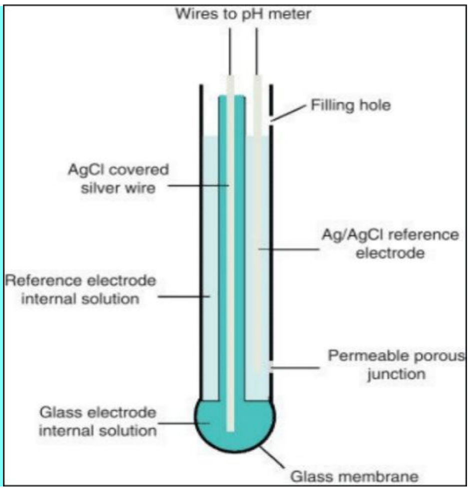
1)**Surface Aerator**- Surface aerators push water from under the water's surface up into the air, then the droplets fall back into the water, mixing in oxygen.

2)**Aeration pump**

3)**Dissolved Oxygen electrode**- The diaphragm electrode method uses electrodes to detect the amount of oxygen as it passes through a highly oxygen permeable diaphragm.

<u>pH meter</u>



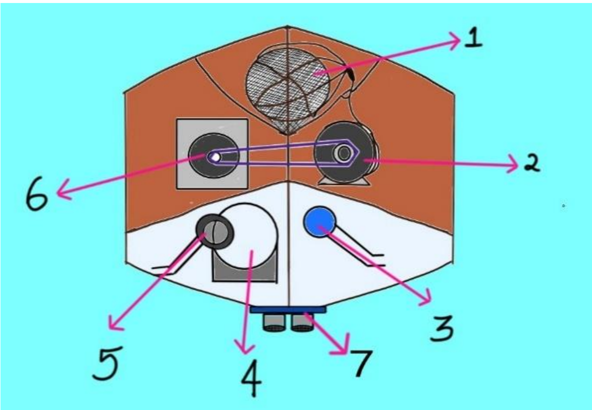


1)Acid dispenser- dispenses strong acid resins if pH is higher than normal.

2)Base dispenser- dispenses nitrogen selective resins and alum if pH is lower than normal.

3)pH Probe- contains two electrodes (a sensor electrode and a reference electrode) that measure the hydrogen-ion activity in a solution. The exchange of ions generates a voltage that is measured by the pH meter converting the voltage into a readable pH value.

<u>Front part of the device (Designed to control plankton bloom)</u>



1)Plankton net 2)Mini Pulley 3)Blue LED 4)Concave lens 5)Silicon Photodiode 6)Motor 7)Ultrasound sensor

Receives signal from microcontroller when both pH decreases and oxygen depletion starts, indicating a phytoplankton/algal bloom and presence of excess nutrients (Nitrogen and Phosphorous) in water.

A blue LED placed perpendicular to the photo diode, excites chlorophyll particles. And a Silicon photo-diode measures fluorescence emitted by chlorophyll. If higher concentration of chlorophyll is found in a particular area, it indicates the presence of an algal/ phytoplankton bloom.

A Plankton net is released, with the help of a spring and lowered with a pulley. After a specific time, the microcontroller signals and the pulley pull the net back and stores it in the storage. Excess Nitrogen and Phosphorous is neutralized with the help of the base dispenser. And aerator restores the depleted oxygen.

To measure the depth of water in which the device is moving, ultrasound sensor is added, so that it doesn't enter shallow waters, avoiding the risk of the device getting stuck in soil or plants near the boundaries of the water body

FUTURE PLAN

We know that here are factors other than pH, dissolved Oxygen levels and plankton blooms that affect aquatic ecosystem (eg: temperature, suspended particles, dissolved gases other than oxygen, poisonous nitrogenous compounds, etc). Our device provides capability of handling 3 factors only to operate on for now. Moreover temperature control in wetlands is out of our hands as :

1) there is temperature contrast of surface water and deep water.

2) seasonal change brings out wide scale temperature variation.

Further modifications in the proposed device can be made. Like, for

Excess suspended particle control: Potash alum can be used in small amounts. It removes impurities from water by coagulation of impurities and helps in the rapid sedimentation of suspended particles in water.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to our mentor, Mrs. Sumana Chatterjee, for her invaluable guidance, constant encouragement, and thoughtful insights throughout the course of this project. Her support played a crucial role in shaping our understanding and execution of the topic, **AEWPD: AUTOMATED AND ECOFRIENDLY WETLAND PRESERVATION DEVICE.**

We are also thankful to our Principal, Mr. S. Karan, for providing us with this incredible opportunity to participate in the National Children's Science Congress. This programme enabled us to explore real-world environmental issues and innovate a sustainable, technological solution.

Lastly, we extend our heartfelt thanks to all team members for their dedication, collaborative spirit, and relentless efforts in bringing this project to life. Through this journey, we gained not only technical knowledge but also a deeper appreciation for ecological balance and teamwork.

REFERENCES

Image Source(East Kolkata Wetlands):

Research Article: Transformation and risk assessment of the East Kolkata Wetlands (India) using fuzzy MCDM method and geospatial technology

Authors: Kanti Mondal, Suchitra Kumari , Arijit Ghosh , Prabuddh Kumar Mishra

www.springer.com

www.fondriest.com

www.earthdata.nasa.gov/

https://organicabiotech.com/

indiawaterportal.org

www.decline.wetland.com

www.researchgate.net

www.ramsar.org

www.sustainabledevelopment.un.org

www.earthdata.nasa.gov

www.wwdmag.com

https://www.ncbi.nlm.nih.gov/