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IoT Enabled Boat for Cleaning Water Surface

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Abstract - This project introduces an IoT-enabled boat designed for the purpose of cleaning water surfaces. The system utilizes two gear motors to drive a conveyor belt for efficient collection of floating debris. An Arduino Uno, in conjunction with two IR sensors, provides precise control over the conveyor system, ensuring effective garbage collection. Additionally, the boat's overall movement is managed through a controller employing two gear motors and an Arduino IoT Cloud platform. The conveyor system, powered by the gear motors, facilitates the seamless collection of debris present on the water surface. The Arduino Uno, acting as the central processing unit, interprets signals from two IR sensors strategically placed to optimize the efficiency of the garbage collection process. This intelligent control system allows for the autonomous navigation of the boat and precise maneuvering around obstacles.

***Key Words*:** IoT (Internet of Things), Water Surface Cleaning, Gear Motors, Conveyor System, Arduino Uno, IR Sensors, Boat Controller, Arduino IoT Cloud, Garbage Collection, Autonomous Navigation, Remote Monitoring, Environmental Cleanup, Sustainability, Pollution Control, Scalable Solution, Real-time Feedback, Smart Technologies, Automation, Water Pollution, Adaptive Systems**.**

1.INTRODUCTION

In the past, removing floating garbage from water surfaces was a dangerous and timeconsuming task that involved small boats or brave individuals. Unfortunately, disposing of the collected particles on river or lake banks only added to pollution. Maintaining clean water is not only important for humans, but also for the surrounding flora and fauna. While many non governmental organizations have taken on the responsibility of keeping our water clean, it is up to individuals to ensure that our environment remains a suitable habitat for all living creatures. Our project aims to make this task easier by incorporating an Internet of Things (IoT) controlled operation. The benefits of clean water are numerous, as it is essential for both humans and the aquatic ecosystem. Our goal is to develop an affordable, wireless water quality monitoring system that can provide continuous measurements of water conditions. In India, the population is high and pollution has become a major issue. Due to the lack of available space for waste disposal, people have resorted to using water bodies as dumping grounds. This is a concerning reality that must be addressed to prevent future problems. Our system collects data from sensors and stores it in a cloud platform, allowing for easy access at any time. We have also integrated virtual buttons into the Arduino IoT Cloud Application, which enables real-time monitoring of the project's movements through an IoT connection. By utilizing this technology, we hope to make it easier for individuals to adapt to this new system and maintain the cleanliness of our water. It is our duty to ensure that our environment remains a healthy and sustainable habitat for all living creatures. The IoT-controlled operation involves a floating device equipped with sensors that can detect and collect floating garbage. The device is powered by solar panels, making it environmentally friendly and cost-effective. The collected garbage is then transported to a designated location for proper disposal, reducing the amount of pollution in our water bodies. This data can be used to identify areas that require immediate attention and to prevent the spread of harmful pollutants. Our project aims to create awareness about the importance of clean water and encourage individuals to take responsibility for their actions. By incorporating IoT technology, we hope to make the process of maintaining clean water more efficient and accessible. In conclusion, our project is a step towards creating a sustainable environment for future generations. It is our responsibility to protect our water bodies and the living creatures that depend on them. By utilizing IoT technology, we can make this task easier and more effective. We hope that our project will inspire others to take action and contribute towards a cleaner and healthier planet.

2. LITERATURE REVIEW

Keeping our waterways clean is of utmost importance. It is extremely troublesome that massive quantities of trash end up in bodies of water each year. Monitoring the condition of the water in these bodies is also critical today. Groups called Catchment Management Authorities keep track of changes in the environment, providing real-time daily updates on environmental protection and tracing pollution sources. An affordable wireless aquatic monitoring system would enable cost-effective water quality measurement by gathering data and aiding catchment managers in sustaining aquatic ecosystems. Our work aims to address the uncertain effects of floating debris by reducing the harm caused by floating objects like trash and obstacles. Our project seeks to create a garbage collection device to monitor lakes and ponds while also measuring water conditions by tracking various parameters. Additionally, it helps understand water pollution through data analysis. The main feature is collecting floating objects from the water's surface into a trash receptacle. The secondary objective is measuring water quality using sensors by tracking water quality parameters, which can help predict adverse conditions for aquatic life. pH and turbidity sensors are used to measure water acidity/alkalinity and turbidity levels. The overarching goal is to clean the water's surface and check its quality to assist the aquatic ecosystem. Clean water is a fundamental requirement for all living things. Life on Earth is not viable without water. Water covers roughly 70% of the Earth's surface, with only 3% being pure water. Water becomes contaminated for various reasons like industrial waste, sewage waste, garbage waste. Thus, it is crucial to maintain the cleanliness and hygiene of water. We see this water pollution as a serious problem and have started working on a project to address it. We decided to use technology to accomplish the work efficiently and effectively. Our project is designed to collect waste floating on bodies of water. In today's world, most people are familiar with robots. We plan to design a very interesting robot that is RF controlled. It is important to monitor the pH of a water body. A change in the normal pH of a water body can indicate increased pollution or other environmental factors. Therefore, the solubility and bioavailability of the chemical components of water are determined by the pH sensor.The issue of waterlogging due to plastic, thermocol and metal is causing problems for development and it promotes diseases like malaria, typhoid etc. Cleaning the waste manually would be inadequate as it often covers large areas of work and puts people at risk of contracting diseases from infectious bacteria present in the sewage during manual cleaning. This study highlights a proposed design for a garbage collection system that is effective and efficient for cleaning up waste from rivers, canals and lakes. The trash collection system is specifically designed for collecting a wide variety of debris, including floating litter, garbage, logs, discarded tires and more. The integrated system utilizes IoT technology to monitor and control the entire process. Given the need and interest to clean up pollutants in waterways, the vessel has been designed to operate in areas besides just offshore, providing more options for using it to clean garbage and waste from water environments.Whenever a person hears about pollution, more frequently than not, the first study that comes to their mind is air pollution. One of the most under- mentioned and underdiscussed pollution encyclopedically is that caused by thenon-biodegradable waste in our water bodies. In the case of India, there's a lot of plastic waste on the face of gutters and lakes. The Ganga River is one of the 10 gutters which regard for 90 of the plastic that ends up in the ocean(Source Sky News) and there are major cases of original ‘ naalas ’ and lakes being defiled due to this waste. This limits the source of clean water which leads to major reduction in water sources. From 2001 to 2012, in the megacity of Hyderabad, 3245 hectares of lakes dissipated. The water recedes by nine bases a time on average in southern New Delhi. therefore, cleaning of these original water bodies and gutters is of utmost significance. Our end is to develop a water face drawing bot that's stationed across the reinforcement. The bot will descry scrap patches on its way and collect the scrap therefore making the water bodies clean. This result employs a surveillance medium in order to warn the authorities in case anyone is set up contaminating the water bodies. A further sustainable system by using solar energy to power the system has been developed. Computer vision algorithms are used for detecting trash on the face of the water. This trash is collected by the bot and is disposed of at a designated position. In addition to drawing the water bodies, preventative measures have been also enforced with the help of a virtual fencing algorithm that cautions the authorities if anyone tries to contaminate the water demesne. A web operation and a mobile app is stationed to keep a check on the bot’s movement and reinforcement surveillance independently. This complete result involves both preventative and restorative measures that are needed for water care. This document presents the creation and development of a prototype robotic boat called Aquayaan, which can mount colorful detectors and conduct field checks in inland bodies of water. Aquayaan can be operated ever over the internet so it can travel long distances without losing contact, and its position can be tracked in a WebGIS system. Aquayaan's compact size allows for high portability, and its design can hold up to 4 kg of cargo. The report discusses the housing and frame design, rudder and propeller configuration, electronics and motors perpetration, communication interfaces, and software integration. Aquayaan's cost-effective strategy is intended to perform field checks in inland waters like gutters, budgets, lakes, backwoods, tanks, ponds,etc. to collect water samples and measure colorful parameters with add- on detectors.

3. METHODOLOGY

Building on this idea, the Conveyer Belt is Controlled by the Arduino UNO with the feedback provided by the IR-Sensors. When any two of the IR-Sensors are LOW then the Belt will be in Motion when both of them are HIGH i.e the boat is filled with trash such that the conveyer Belt will be stopped and the boat can be reversed back to the bank with the help of the remote control provided in the Arduino IoT Controller Application. In, that application we can see that the Debris are filled in the boat or not. When we realease the boat in the water we will control it from the Arduino IoT Remote Application and thw Conveyer belt will be starts rotating until the boat is filled with debries. When the boat is filled with debries then the IR Sensors will Send the information to the Controller ,such that the Conveyer Belt will be stop rotating and the feedback will be sent to the Arduino Application With the help of the application we can control the directions of the boat when ever we want. The IoT-enabled car project involves the integration of Arduino and the Arduino IoT Cloud platform to create a web-based dashboard for controlling the car's movements in four directions: forward, backward, left, and right. The hardware setup includes connecting motors and wheels to the Arduino using a motor driver module for each direction, ensuring the proper power supply for the motors. On the software side, an account is created on the Arduino IoT Cloud, and a new "Thing" is set up to define Boolean properties corresponding to each directional movement. The Arduino sketch is then written to read the state of directional controls from the IoT Cloud, incorporating, motor driver functions to execute movements based on the received commands. In the Arduino IoT Cloud Dashboard, controls such as buttons or switches are added for each direction and linked to the specific properties defined for the car. Upon uploading the Arduino sketch to the board, the web dashboard on the Arduino IoT Cloud platform becomes the interface for testing and controlling the car, providing a user-friendly and accessible means to navigate the vehicle in various directions

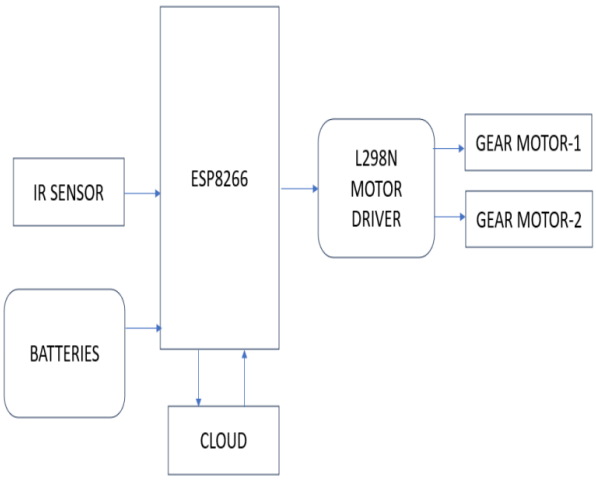

Fig -1: Block Diagram of Boat Controller

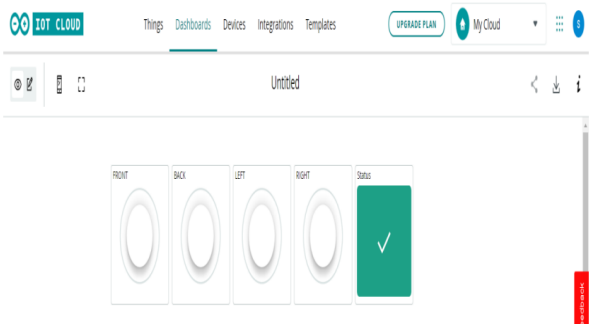

Fig-2: Web Dash Board

4. HARDWARE COMPONENTS

NODEMCU ESP8266: The NODEMCU ESP8266 is a low-power Wi- Fi and Bluetooth microcontroller board that serves as the core of the point attendance system. It's responsible for landing point images, recycling data, and communicating with other factors.

ARDUINO UNO R3 BOARD: The Arduino UNO is a standard board of Arduino. Here UNO means 'one' in Italian. It was named as UNO to label the first release of Arduino Software. It was also the first USB board released by Arduino. It is considered as the powerful board used in various projects. Arduino.cc developed the Arduino UNO board.

IR SENSORS IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation .

MOTOR DRIVER (L298N) : This L298N Motor Driver Module is a highpower motor driver module for driving DC and Stepper Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator. L298N Module can control up to 4 DC motors, or 2 DC motors with directional and speed control.

GEAR MOTORS :A gear motor with a 60 RPM output speed is a combination of an electric motor and a gearbox. This setup is designed to provide a controlled output speed of 60 revolutions per minute.

JUMPER WIRES: Jumper wires are extremely handy components to have on hand, especially when prototyping. Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboard and other prototyping tools in order to make it easy to change a circuit as needed. Fairly simple. In fact, it doesn't get much more basic than jumper wires.

Hi-Waote 9V Battery: It is the most commonly used and portable 9V battery. It is non-rechargeable and is a high

capacity and low-cost solution for many electronic devices. It is based on Zinc Carbon Chemistry and can be used easily replaced if discharged just like any standard AA and AAA batteries. The battery can be used to power LEDs, Toys, Flashlight and Torch, electronic equipment like multimeter, wall clocks, or other devices with a 9V system.

Micro USB cable :The Micro USB cable is a type of USB (Universal Serial Bus) connector that was developed to replace the Mini USB connector, offering a smaller and more compact design. The Micro USB standard was introduced to meet the growing demand for smaller and more portable devices.

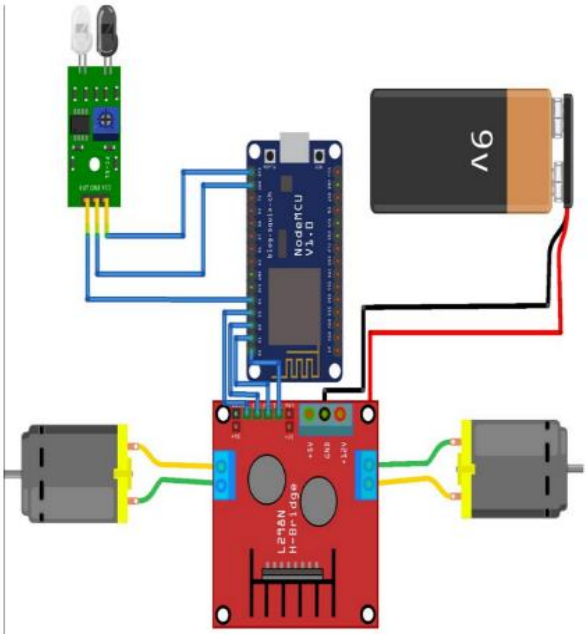

Fig-3 Circuit Diagram of Conveyer Belt

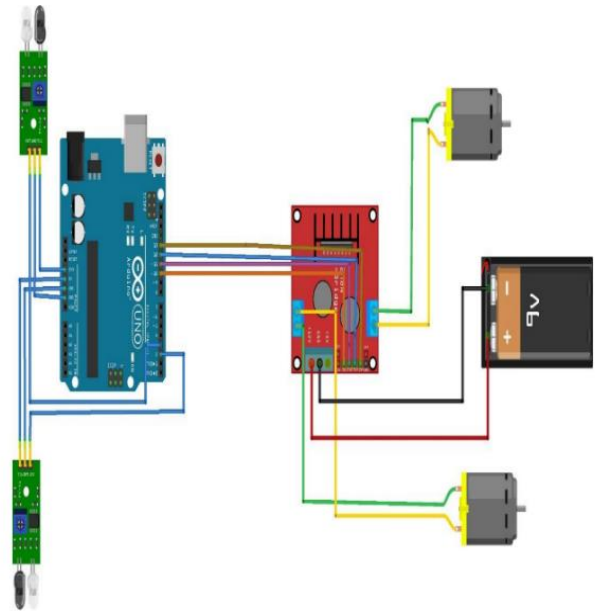

Fig-4 Circuit Diagram of Controller

5. SOFTWARE TOOLS

Arduino IDE: The Arduino IDE is an intertwined development terrain(IDE) for jotting and uploading law to Arduino boards. It's used to program the ESP32WROOM-DA microcontroller board to handle tasks like point image processing, communication with the point detector, and data storehouse.

Arduino IoT Cloud : Arduino IoT Cloud simplifies IoT project development by offering a user-friendly platform to connect devices to the internet, visualize data, create dashboards, log information, and enable remote control, making it accessible for beginners and professionals alike.

6. RESULTS

When we release the boat in the water we will control it from the Arduino IoT Remote Application and the Conveyer belt will be starts rotating until the boat is filled with debries. When the boat is filled with debris then the IR Sensors will Send the information to the Controller ,such that the Conveyer Belt will be stop rotating and the feedback will be sent to the Arduino Application With the help of the application we can control the directions of the boat when ever we want.

Fig-5 Water Surface Cleaning Boat

7. ADVANTAGES

Efficiency: Water surface cleaning bots efficiently remove debris, pollutants, and floating waste from lakes, ponds, or other water bodies, maintaining cleanliness without manual intervention.

Environmental Impact: They help in preserving the ecosystem by preventing contamination and preserving the habitat for aquatic life, ensuring cleaner water for flora and fauna.

Time-Saving: Automating surface cleaning tasks reduces the time and effort required for manual cleaning, allowing for regular maintenance without extensive labor.

Versatility: These bots can navigate various water surfaces, adapt to different debris types, and operate in diverse conditions, offering a versatile solution for multiple environments.

Cost-Effectiveness: Over time, the use of water surface cleaning bots can lower maintenance costs, as they reduce the need for frequent manual clean-ups and help prevent potential damage caused by accumulated debris.

8. APPLIATIONS

The proposed Water Cleaning Bot is suitable for a wide range of operations, including :

Ponds and Lakes Maintenance: These bots are employed in ponds, lakes, and reservoirs for routine cleaning to remove debris, algae, and pollutants, preserving water quality.

Swimming Pools: Automated cleaning bots efficiently remove leaves, insects, and debris from the surface of swimming pools, ensuring a cleaner and safer environment for swimmers.

Marinas and Harbors: They help in maintaining the cleanliness of marinas and harbors by removing floating debris, trash, and oil spills, preventing water pollution.

Water Treatment Facilities: Bots aid in maintaining intake areas and reservoirs at water treatment facilities, ensuring the water quality before the treatment process.

Recreational Water Bodies: In recreational areas such as water parks or public beaches, these bots help in keeping the water surfaces clean for activities like boating, kayaking, and other water sports.

Industrial Applications: In industrial settings like cooling ponds or tanks, these bots aid in removing surface debris or contaminants, ensuring smooth operations and preventing equipment damage.

Environmental Conservation: Used in natural reserves or ecological habitats to maintain the cleanliness of water bodies, preserving the ecosystem and protecting aquatic life.These applications showcase the versatility and importance of water surface cleaning bots in maintaining cleanliness, preserving water quality, and supporting various industries and environments.

9. Feature Enhancement

Advanced Sensory Technology: Integration of more sophisticated sensors to detect and identify various types of debris, pollutants, or contaminants on the water surface with higher accuracy.

AI and Machine Learning: Implementation of AI algorithms and machine learning models to enhance the bots' decision-making capabilities, enabling them to adapt and optimize their cleaning strategies based on real-time data.

Improved Navigation Systems: Enhanced navigation systems utilizing GPS, computer vision, or other technologies for better path planning, obstacle avoidance, and more efficient coverage of larger water surfaces.

Autonomous Fleet Management: Development of systems allowing multiple cleaning bots to work collaboratively and autonomously in a coordinated manner to cover larger areas or respond to cleaning requirements more effectively.

Energy Efficiency: Integration of more efficient power sources or renewable energy options, such as solar or kinetic energy, to increase the bots' operational autonomy and reduce environmental impact.

Modularity and Scalability: Designing bots with modular components to facilitate easier upgrades, maintenance, and scalability, allowing for customization based on specific cleaning needs and different water body sizes.

Environmental Monitoring Features: Inclusion of additional sensors or capabilities to monitor water quality parameters (such as pH levels, dissolved oxygen, etc.) alongside surface cleaning, providing comprehensive environmental data.

Smart Maintenance and Diagnostics: Implementation of self-diagnostic systems to identify and address technical issues proactively, reducing downtime and enhancing overall reliability.

Regulatory Compliance and Safety Features: Integration of features ensuring compliance with local regulations and safety standards, enhancing the bots' suitability for various environmental conditions and settings.

CONCLUSIONS

In conclusion, the development of a river-cleaning boat using Arduino technology presents a promising solution to the issue of water pollution. By incorporating various sensors and actuators, the boat can efficiently navigate through water bodies, detect and collect debris, and contribute to the overall cleanliness of rivers and other water sources. The use of Arduino allows for a cost-effective and customizable solution, enabling individuals and organizations to build and deploy these boats in different locations with varying requirements. The boat's ability to autonomously operate, powered by Arduino's programming capabilities, reduces the need for constant human intervention and makes it a sustainable solution for long-term river cleaning efforts. Furthermore, the integration of Arduino technology opens up opportunities for future enhancements and advancements. For instance, the boat's capabilities can be expanded to include water quality monitoring, allowing for real-time data collection and analysis. This information can be used to identify pollution sources, track the effectiveness of cleaning efforts, and implement targeted strategies for water conservation and pollution prevention. Overall, the river cleaning boat using Arduino technology holds great potential in addressing the global challenge of water pollution. It combines the power of innovation, automation, and sustainability to make a positive impact on our environment. By harnessing the capabilities of Arduino, we can work towards cleaner and healthier rivers for the benefit of both ecosystems and human population

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