ADVANCING AQUABOT DEVELOPMENT FOR AQUARIUM CLEANING

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ABSTRACT: Fishkeeping is one of the traditional hobbies that remains popular today, involving maintaining various species of fish and beautifying their habitat. This hobby not only provides personal enjoyment but also can attract sustenance, according to the specific beliefs of the Chinese community. Research shows that fishkeeping provides numerous benefits for human well-being, especially for enthusiasts, although its popularity can fluctuate with changing trends. However, the significant time and effort required to maintain an aquarium, especially its cleanliness, can be challenging for busy individuals. To address this problem, research has been undertaken that focuses on developing aquarium robots with automation features that can reduce manual intervention by fish keepers. This innovation aims to simplify the maintenance process, making fish keeping more accessible and enjoyable for everyone

KEYWORDS: *Aquarium Cleaning, Aquarium Robot, Mechanical Design, Fish Keeper, Aquarium Robot Dimensional and Prototyping*

1.0 INTRODUCTION

In today's world, people are constantly entangled in a multitude of daily obligations Whether it's fulfilling roles as parents, spouses, employees, or active members of society, the weight of these responsibilities can be overwhelming. Consequently, many individuals, particularly those in committed relationships, often sacrifice their leisure pursuits in favor of attending to familial and professional duties. A Public Health Physician at the International Islamic University of Malaysia (UIAM) emphasized the importance of pursuing a hobby or engaging in activities that spark personal interest. Such efforts have the power to free individuals from the limitations of their daily routines and thus reduce stress.

Many activities that can be used as a hobby for example keeping ornamental fish. Keeping ornamental fish is one of the most popular hobbies in the world [1]. This practice has been prevalent for centuries because of the fish's attractive shape, size, and color, making it suitable for a variety of environments and relatively easy to care for. In addition, the care of decorative fish also does not require a large storage space, instead only using an aquarium which is easy to fit in a certain space in the house. Furthermore, it is also said that keeping fish in an aquarium can give a greater perception of relaxation and mood [2]. Spending time watching pets swim can be a great way to relax after a stressful day [3]. Apart from that, having an aquarium at home also offers many advantages for human well-being and health. These include reducing cardiovascular problems, improving overall well-being, fostering happiness and relaxation, stimulating neurotransmitter activity in the brain, helping hyperactive children, and fostering cognitive development [4]. Furthermore, the presence of fish in the home environment not only supports educational opportunities but also enhances the aesthetic appeal of the household, promoting a sense of inner beauty and tranquility. According to the specific beliefs of the Chinese community, keeping any type of fish including ornamental fish can also attract sustenance. According to the magazine, The Japan Times, there has been a significant increase in the sale of aquarium fish and reptiles in Japan since June 2020. This demonstrates that farming fish can boost one's health while also providing a source of money.

However, it is acknowledged that most fish farmers merely keep fish as a pastime in their spare time since they have other pressing obligations. Due to time constraints, many of them neglect aquarium fish care and upkeep. Although many people feel that decorative fish housed in aquariums are simple to care for, the truth is that they require more careful attention and upkeep to keep the aquarium clean and safe for the fish to live in. Caring for pet fish needs close monitoring and cleaning. Due to time constraints, many fish owners avoid cleaning their aquariums. Cleaning fish aquariums should be done at least once every two weeks or twice a month to keep fish from dying due to water contamination. Manual cleaning procedures are more time-consuming and less comprehensive. Inadequate cleaning might harbor germs, fungi, viruses, and other hazards to fish, causing them to die quickly [5]. As a result, a proactive approach has been taken to solve this issue by designing robotic aquariums with features that make aquarium maintenance easier, faster, and less expensive for carers.

3.0 METHODOLOGY

Developing an aquarium cleaning robot involves a multi-step approach to ensure a comprehensive and efficient solution. Initially, a needs analysis was conducted to identify the specific cleaning requirements for aquariums. Based on the needs analysis, the mechanical design phase focuses on creating a robust and adaptable structure capable of underwater operation and navigating confined spaces. The design of components for efficient movement and debris collection is considered. Next, the electronic systems, including sensors and actuators, were integrated to detect debris and clear it. Software development then creates algorithms for real-time sensor data processing, navigation, and cleaning patterns. After that is the prototype phase where this phase involves repeated cycles of testing and refining to deal with any performance issues. Tests are conducted in aquarium environments to ensure the robot can handle different cleaning scenarios effectively. The final phase of the research design focused on evaluating the robot's performance against predetermined criteria such as cleaning efficiency, operational reliability, and safety. Based on the evaluation results, further improvements are made to optimize the robot's functionality and ensure it meets the required standards to maintain a clean and healthy aquatic environment.

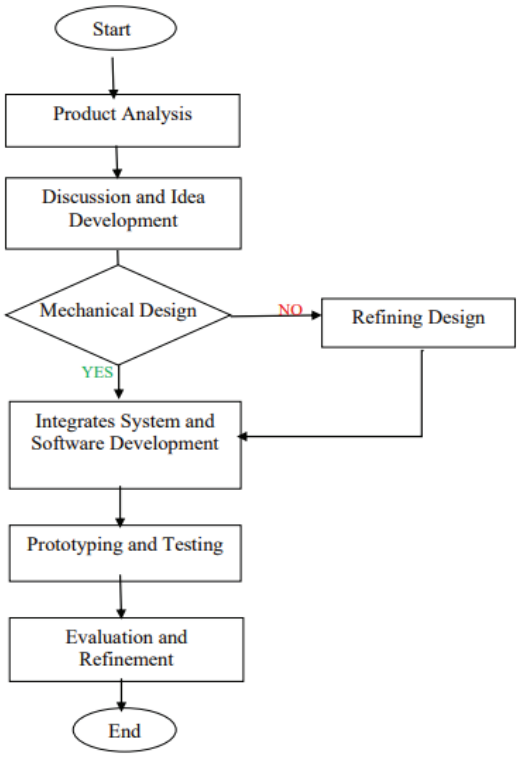

Figure 1: A flow chart of the development process for aquabot

2.1 Design Concept

The design concept for creating an aquarium cleaning robot focuses on developing a robust, efficient, and user-friendly device. Key aspects include ensuring autonomous operation with effective cleaning mechanisms to remove debris. In the development of this aquabot, Solidworks software was used in designing the aquabot structure. There are three parts of the aquabot which are main body, filter cover, and control cover. The aquabot main body was divided into two part which are for electronic circuit space and pump space for debris suction. The dimension of the aquabot is 150mm (l) x 100mm (h) x 100mm (w). The Solidworks images of aquabot parts can be seen in Figure 2.

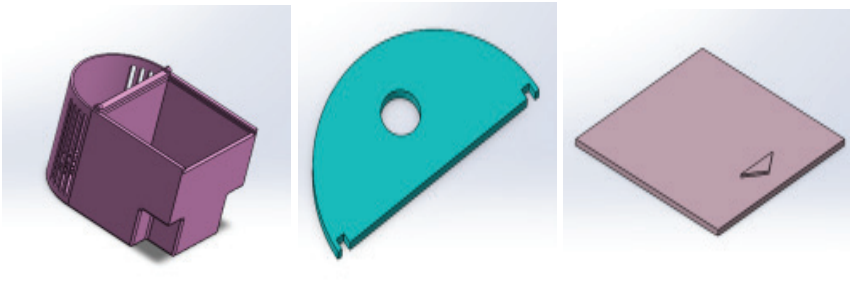

Figure 2: SolidWorks image of aquabot parts

2.2 Integration of Electrical System

Electrical systems integration refers to the process of combining different electrical systems and components into a single, cohesive system. This can involve connecting different devices, sensors, and equipment to ensure that they work together seamlessly, efficiently, and safely. The integration of the electrical system for this aqua robot is a critical step in ensuring that the robot functions effectively, reliably, and safely. A block diagram of the aquabot was created to provide a functional view of the system. The block diagram shows the solar power supply system which uses solar panels to generate DC electricity. The solar charge controller regulates this electricity to safely charge the battery. The battery stores the DC electricity and supplies power to the voltage regulators, which adjust the voltage level for the appliances from 12V DC to 3.6V DC. The ESP8266 controls the entire system and can use sensor data, such as from an IR sensor, to detect any obstacle. Figure 3.9 shows the full system connected with an IoT monitoring setup. The ESP8266 microcontroller is key to remote management; it connects to the internet via the Blynk app on your smartphone, allowing for real-time monitoring of system performance. The device can optionally include an optional infrared sensor to activate actions based on obstacle detection. A water pump can also be controlled using a motor driver and a relay module

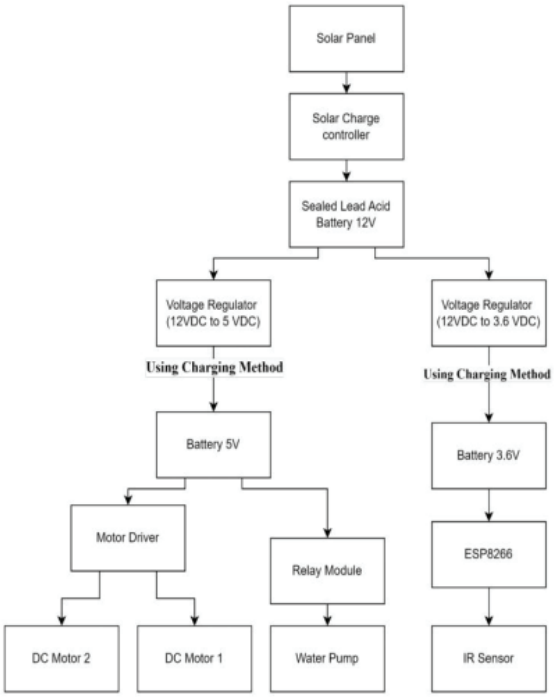

Figure 3: Aqua robot solar power supply system

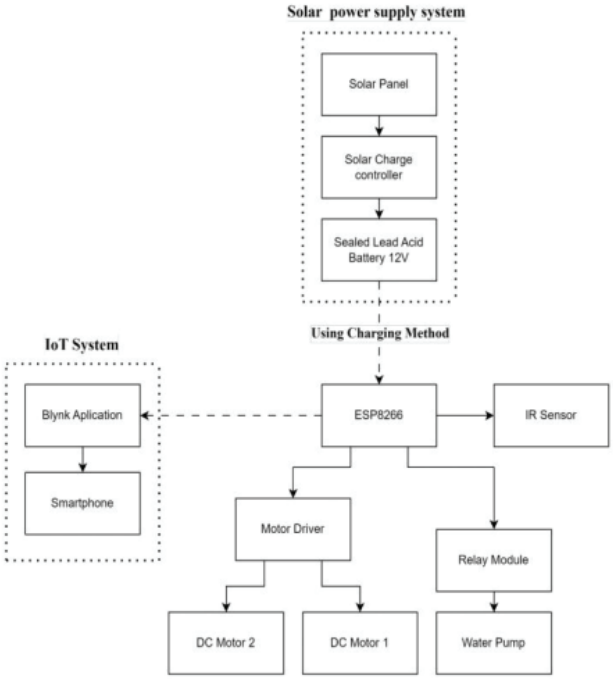

Figure 4: Block diagram of aquabot full system with an IoT system

4.0 PRELIMINARY RESULT

The aquabot parts were assembled and equipped with wheels to facilitate its movements as shown in Figure 5. After that, before creating electrical circuit on printed circuit board (PCB), the electrical circuit will be generated through simulation to ensure that there is correct arrangement of the electrical component to ensure it work well. Simulations are made using Proteus software which is used to capture schematics simulation and verify its functionality before transferring to the PCB. This electrical system will power and control all aspects of the aquabotbot's functionality. Integrating electrical circuits into the aquabot significantly increases its automation capabilities, reducing the need for manual intervention by fish

keepers. This will make aquarium maintenance easier and more efficient, ensuring consistent cleaning and monitoring. The arrangement of connecting electrical components is shown in Figure 6.

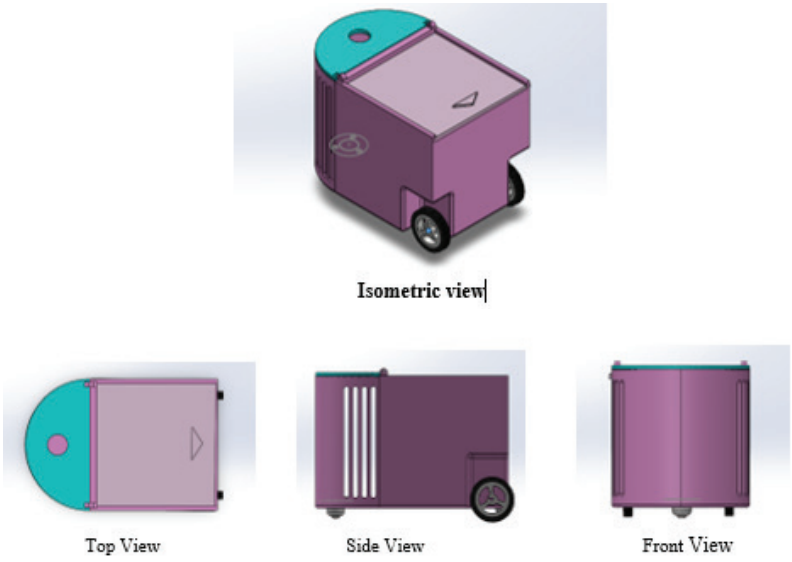

Figure 5: Isometric view of rendering aquabot body with wheels

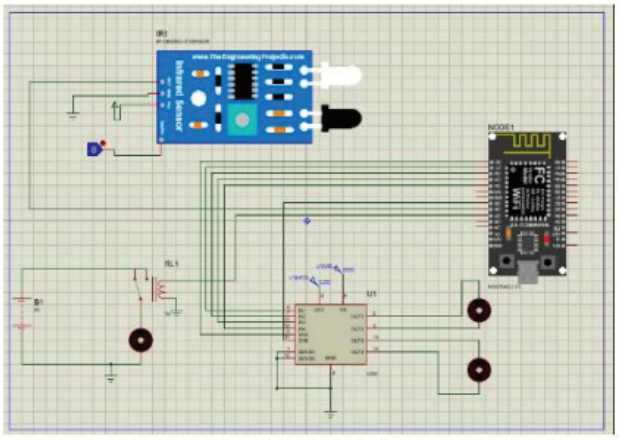

Figure 6: The circuit diagram for aquabot

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