Irish Interdisciplinary Journal of Science & Research (IIJSR)
Volume 8, Issue 2, Pages 61-70, April-June 2024

Hybrid Power Source in Fish Farming With Help of IoT Technology

Ragavi R.[1*], Ramya A.[2], Sowndharya G.[3] & Sunmathy S.[4]

[1-4]*Department of Electronics and Communication Engineering, E.G.S. Pillay Engineering College, Nagapattinam, Tamil Nadu, India. Corresponding Author (Ragavi R.) Email: e20ecr058@egspec.org*[*]

DOI: https://doi.org/10.46759/IIJSR.2024.8207

Article Received: 05 March 2024 *Article Accepted: 09 May 2024* *Article Published: 13 May 2024*

ABSTRACT

Fish farming is a difficult, task that involves growing fish without risk. Maintaining the pond's water quality allows for safe fish production. This will go over the creation of a real-time water quality system to monitor fish farms. The water quality monitoring system includes a dissolved oxygen sensor, a pH sensor, and a water temperature sensor. The Arduino Nano microcontroller is linked with the Internet of Things (IoT) platform to provide real-time remote water monitoring. The system is intended to efficiently monitor water quality in freshwater fish farms, specifically water parameters suitable for fish. Instead of testing the system in the real fish farm, it is tested using water that is simulated to the water quality for the fish farm. If the water was above and below the fixed parameter it gives us an alert and water exchange mechanism get started by remove the dirty water from the pond through the solenoid valve and provide the fresh water into the pond. By measuring the dissolved oxygen level if is any deviation occurs water circulation mechanism should be established and circulate the water for increasing the oxygen level by using the padding wheel which all these done automatically. It also done the automatic food feeding at the periodic interval time without the manual involvement sometimes it may cause a manual error such as underfeeding and overfeeding which may affect the fish health to reduce such stuffs we use this automatic food feeding system.

Keywords: Fish farming; IoT; Solar energy; Solar PV.

1. Introduction

Hybrid power source in fish farming with help of IoT technology using a combination of renewable energy sources like solar or wind power, along with traditional power sources, to create a more sustainable and efficient system. With IoT, sensors and devices can be used to monitor and control various aspects of fish farming, such as water quality, oxygen levels, and feeding systems [1]. This helps optimize the farming process and reduce energy consumption. It's a great example of how technology can benefit the environment and improve productivity in fish farming. IoT technology can be used to monitor and control the feeding process.

Imagine a system where sensors are placed in the fish tanks to measure factors like water temperature, pH levels, and oxygen levels. These sensors can send real-time data to a central control unit, which can then analyse the information and determine the optimal feeding schedule for the fish. The control unit can also be connected to an automated feeding system that dispenses the right amount of food at the right time, ensuring that the fish are well-fed and healthy. This not only improves the efficiency of the feeding process but also reduces waste and ensures that the fish receive the right nutrients. the need for sustainable and efficient power solutions is crucial. That's where hybrid power sources come into play [2].

By combining renewable energy sources like solar or wind power with traditional power sources, fish farmers can create a more environmentally friendly and cost-effective system. With the integration of IoT technology, fish farmers can take their operations to the next level. IoT allows for the seamless connection of various devices and sensors, enabling real-time monitoring and control of important factors in fish farming, such as water quality, oxygen levels, and feeding systems. By leveraging IoT, fish farmers can optimize their operations, reduce energy consumption, and improve the overall health and growth of their fish [3]. It's an innovative approach that not only benefits the environment but also enhances productivity in fish farming.

The demand for sustainable and efficient power solutions has become increasingly important. That's where hybrid power sources come in. These systems combine renewable energy sources, such as solar or wind power, with traditional power sources like electricity or diesel generators. By integrating these different power sources, fish farmers can achieve a more environmentally friendly and cost-effective approach to powering their operations. But here's where it gets even more exciting! With the integration of IoT technology, fish farmers can unlock a whole new level of control and optimization [4,5]. The Internet of Things allows for seamless connectivity between devices and sensors, enabling real-time monitoring and management of critical aspects in fish farming. Imagine the sensors placed in fish tanks can measure parameters like water quality, temperature, and oxygen levels [6]. These sensors can then send data to a central control unit or a cloud-based platform through wireless communication. The control unit analyses the data and provides valuable insights to fish farmers, helping them make informed decisions about feeding schedules, water circulation, and other environmental factors. Not only that, but fish farmers can remotely access the system through mobile or web interfaces. This means they can monitor their fish farm, receive alerts, and make necessary adjustments from anywhere, anytime [7]. By leveraging hybrid power sources and IoT technology, fish farmers can optimize energy consumption, reduce operational costs, and improve the overall health and growth of their fish. It's a win-win situation for both the environment and productivity in fish farming. So, picture a future where fish farms harness the power of renewable energy, combined with smart IoT systems, to create sustainable and efficient fish farming practices. It's an exciting prospect that holds great potential for the future of aquaculture [8].

2. Literature Review

The system is detected the turbidity and PH level of water. The system is controlled by Arduino Uno board between two input sensors and the output liquid crystal display. The turbidity sensor is determined the water quality by using photometric technique [9]. The PH level sensor is tested the acidity and alkalinity of a solution. The results are displayed on Liquid crystal display screen. The program is written by Arduino programming language. Basically, the PH value is a detection how water is hard or soft. The pH of pure water is 7. Liquid with a pH lower than 7 is acidic, and with a pH greater than 7 is basic. Alkalinity is a measure of the ability of the water to resist a change in pH that would tend to make the water more acidic. The measurement of alkalinity and pH is needed to control the corrosiveness of the water. Turbidity is the cloudiness of a fluid caused by large numbers of individual particles that are generally invisible to the uncovered eye, similar to smoke in air. The measurement of turbidity is a main test of water quality [10,11].

Water pollution is one of the most serious problems with green globalisation. And we all know how dangerous the Coronavirus Pandemic is. In such cases, water monitoring is critical for human survival. To maintain the safe supply of drinking water, its quality must be measured and monitored. This paper describes an Arduino-based Internet of Things (IoT) water quality measurement system. The system consists of several sensors that are used to measure the characteristics of the water [12]. Temperature, pH, turbidity, and the water sensor can all be measured. The Arduino core controller can process the measured values from the different sensors. These sensors communicate with Arduino to measure water quality factors. Finally, the user can view the sensor data over the internet using the WIFI Module.It was discovered that the system works dependably, although it is dependent on human intervention and prone to data inconsistencies. However, the system provides a solid foundation for future expansion works of an equivalent category to elevate the system to being Internet of Things (IoT) friendly, so the purpose of this paper is to investigate the feasibility of implementing an Arduino-based sensor system for water quality monitoring.

India leads other countries in agricultural production and is one of the world's major milk producers. Agriculture and livestock support a large proportion of India's population. As a result, there are a large number of cattle and dairy farms throughout India. In addition, there are a huge number of poultry [13]. According to a 2019 survey done by the National Dairy Development Board, India has over 192 million cattle, with at least one worker required for every ten animals. Massive dairy farming requires a lot of workers, and the processes are exceedingly difficult and time-consuming. The employment of automated equipment allows for the control of the required manpower while avoiding financial loss. The time required to complete the process is also lowered. The primary goal of the project mentioned in this paper is to present a laboratory model for automation in the animal food feeding process using instrumentation and control technologies. It is anticipated that the implemented model mentioned in this study will be used with AMS (automatic milking system) in the future [14].

We visited the fish farming pond in the fisheries college to analyse detailed about the fish farming thus may help us to know about the parameters like TDS must be maximum 1000 ppm. we have to monitor or maintain the waste of fish (ammonia) is the very must process to avoid the toxic formation in the pond the ammonia content must be less than 0.1 to 0.2 then Nitrite level must be at 0.1 ppm if we place the fish farm in open space thus nitrate is required the ranges upto 500ppm. Salinity level has to be maintained between 0.5 to 1 [15,16]. From that survey they strictly illustrated not to use chlorine and then pond depth should be minimum 1metre. Food contamination must be 10% of its body weight per day and protein level should be around 24%. Mainly focus on water PH level that should be maintained at 7.4 to 8 then Temperature is to maintained at 18-32 degree Celsius. To maintain the water with the correct PH level is mandatory in case there may any change dolomite and quicklime are used to increase the PH level. carbon-di-oxide is used to decrease the PH level. Figure 1 shows the filed visit details for this research work.

Figure 1. Case study at Fisheries Engineering College

3. Types of Fish Farming

3.1. Cage System

Cage system in fish farming method is where fish are raised in netted enclosures in natural bodies of water like lakes or oceans. These cages keep the fish contained while allowing water to flow through. This helps in controlling the fish's environment, protecting them from predators, and making it easier to manage their feeding and growth. It's a popular method because it maximizes space and helps promote sustainable fish farming. Figure 2 displays the cage system.

Figure 2. Cage system

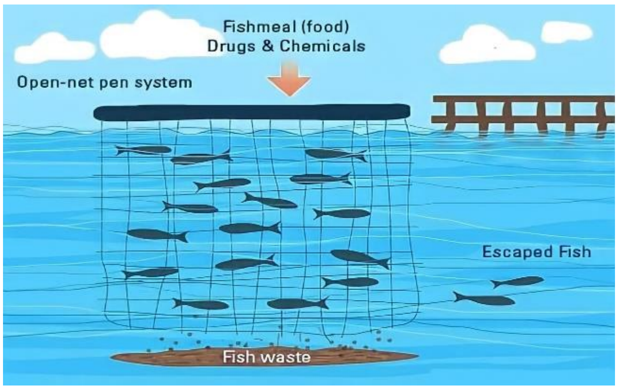
3.2. Open Net Pen System

The open net pen system in fish farming. It's a method where fish are raised in large, floating net enclosures placed directly in natural bodies of water like lakes, rivers, or coastal areas. These net pens are made of sturdy mesh material and are secured to the seabed or anchored in place. In the open net pen system, the fish are contained within the nets, allowing them to swim and interact with the surrounding water. This system takes advantage of the natural environment while still providing some control over the fish farming process.

4. Existing System

In the existing model of the fish farm management system, we often see that the dedicated individuals feeding the fish throughout the day which may cause an human error such as overfeeding and underfeeding which can affect the health and fish growth. people has to regularly observe the fish and keeping the close eye on their behaviour and health due to the inconsistent monitoring this could lead to delayed responses to changes in water quality or fish health maintaining tasks like cleaning the tank and debris removal are performed by hand where the farm requires a dedicated workforce to perform various tasks this can result in higher labour costs. Manual management may lack the ability to collect the detailed data on parameters such as feeding patterns, growth rates, and water quality which can be the hinder optimization and decision making.

An irrigation ditch is a channel that is used to divert water from a water source, such as a river or a reservoir, to the fish farm. The water flows through the ditch and can be directed into different areas of the farm to provide water for the fish. These ponds are usually dug into the ground and lined with a waterproof material to prevent water from seeping into the soil. The ponds are filled with water and stocked with fish. The advantage of a pond system is that it allows for better control over water quality, temperature, and feeding practices. Both irrigation ditch and pond systems have their own benefits and considerations. The choice depends on factors like available resources, farm size, and the type of fish being raised. It's important to consider factors like water source, land availability, and local regulations when deciding which system to use. Figure 3.a and 3.b shows the open net pen system and irrigation ditch system.



(a)

(b)

Figure 3. (a) Open net pen system, and (b) Irrigation ditch or pond system

5. Proposed System

In fish farming, the demand for sustainable and efficient power solutions has become increasingly important. That's where hybrid power sources come in. These systems combine renewable energy sources, such as solar or wind power, with traditional power sources like electricity or diesel generators. By integrating these different power sources, fish farmers can achieve a more environmentally friendly and cost-effective approach to powering their operations. With the integration of IoT technology, fish farmers can unlock a whole new level of control and optimization. The Internet of Things allows for seamless connectivity between devices and sensors, enabling real-time monitoring and management of critical aspects in fish farming. sensors placed in fish ponds can measure parameters like water quality, temperature, and oxygen levels, salinity, PH and toxic subtances. These sensors can then send data to a central control unit or a cloud-based platform through wireless communication. The control unit analyses the data and provides valuable insights to fish farmers, helping them make informed decisions about feeding schedules, water circulation, and other environmental factors. Not only that, but fish farmers can remotely access the system through mobile or web interfaces. This means they can monitor their fish farm, receive alerts, and make necessary adjustments from anywhere, anytime. By leveraging hybrid power sources and IoT technology, fish farmers can optimize energy consumption, reduce operational costs, and improve the overall health and growth of their fish.

5.1. Block Diagram

Figure 4 shows the block diagram of the proposed system. Figure 5 shows the circuit diagram of the proposed work. Flow chart for working of the proposed work is shown in figure 6 and figure 7 in two different stages.

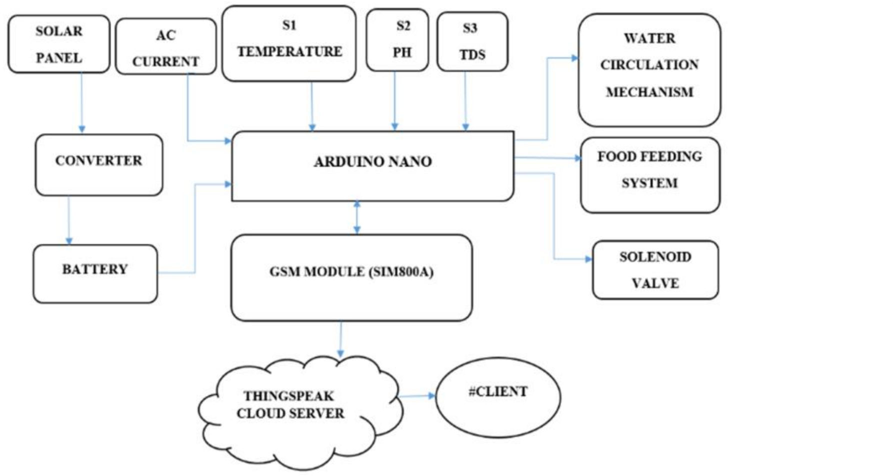


Figure 4. Block diagram of the proposed system

5.2. Circuit Diagram

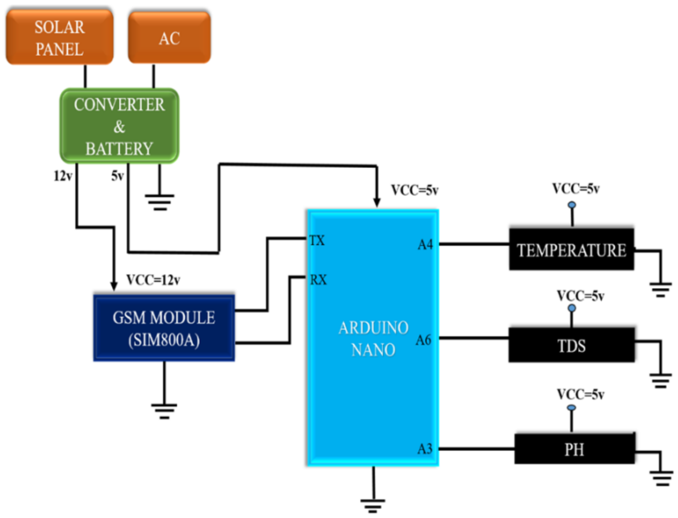


Figure 5. Circuit diagram of the proposed system

5.3. Flowchart

Stage – 1:

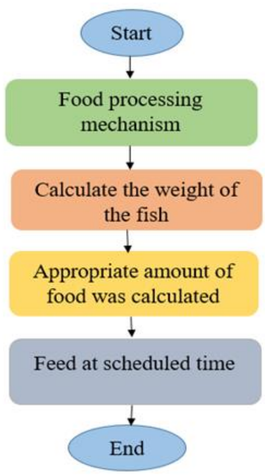


Figure 6. Flowchart - Stage 1

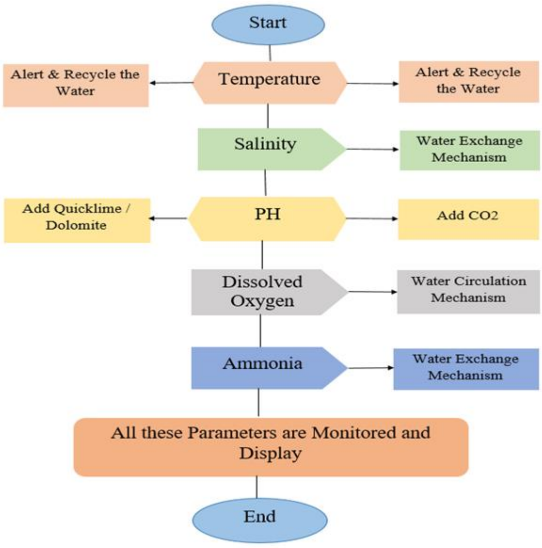


Figure 7. Flowchart - Stage 2

Protype of the proposed work is shown in figure 8. Outputs of the proposed system is shown in figure 9, figure 10, and figure 11.

Figure 8. Proposed system prototype

5.4. Output Waveforms

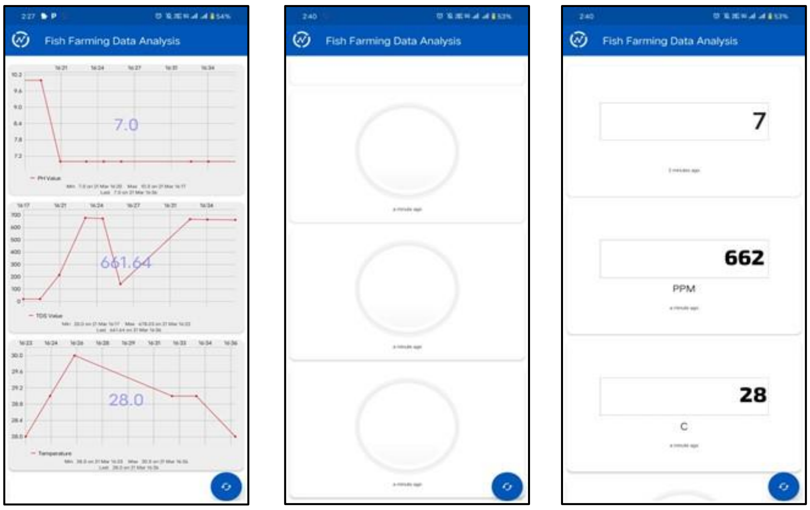


Figure 9. Output Waveform 1

Irish Interdisciplinary Journal of Science & Research (IIJSR)
Volume 8, Issue 2, Pages 61-70, April-June 2024

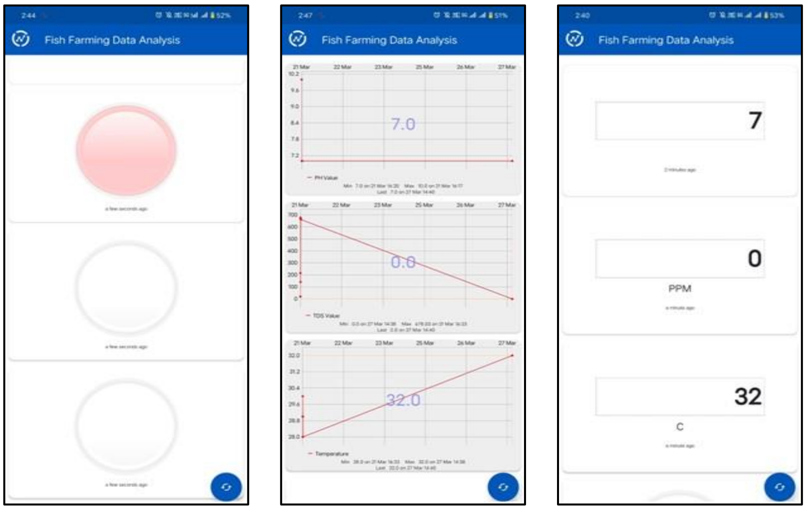
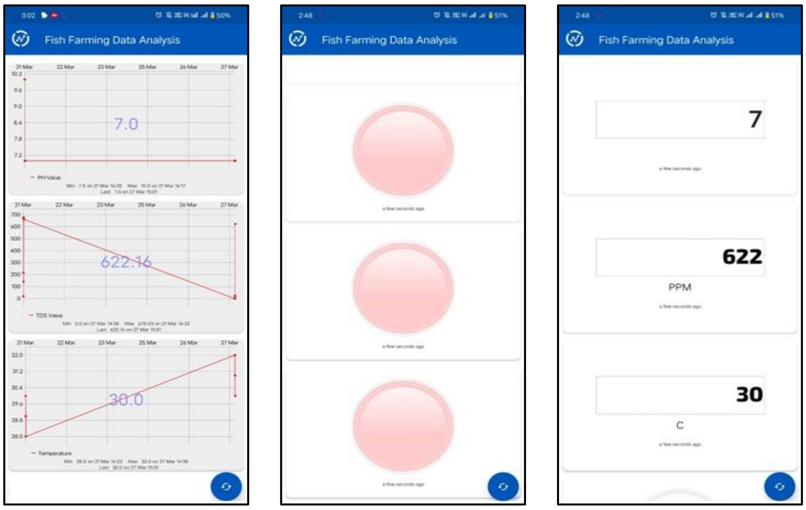


Figure 10. Output Waveform 2



Figures 11. Output Waveform 3

6. Conclusion

Maintaining water quality is a big issue for most fish farms today since it produces a large fish kill, resulting in a significant loss of income. It is hard to totally eliminate fish death, but in most cases, there are warning signals that farmers can recognise and address before it is too late. This is because most of them must manually check the water quality in their farm, which is inefficient because it requires repeated human involvement to collect and test a sample of water from the fish farm, which takes a long time and is expensive. This is where real-time monitoring comes in handy, as it provides continuous data on water quality that farmers can quickly access using their smartphones or tablets for efficient water quality management. This development has both advantages and downsides, as demonstrated by the results presented in this research. Overall, the parameters required for monitoring and maintaining water quality are explored, making it easier to pick appropriate sensors for measurement. This creation consists of water quality monitoring sensors connected to an Arduino Nano, which is then combined with an IoT platform to collect data. In short, this project is successfully designed to monitor the water quality in the fish farm by collecting data from sensors and sending it to a cloud server via Wi-Fi, where it can be accessed by the user using a specific IP address for monitoring purposes via the data displayed on the user interface.

Declarations

Source of Funding

This study did not receive any grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing Interests Statement

The authors declare no competing financial, professional, or personal interests.

Consent for publication

The authors declare that they consented to the publication of this study.

References

[1] C.N. Udanor, N.I. Ossai, E.O. Nweke, B.O. Ogbuokiri, A.H. Eneh, C.H. Ugwuishiwu, et al. (2022). An internet of things labelled dataset for aquaponics fish pond water quality monitoring system. Data in Brief, 43: 108400.

[2] Atish Shinde, Prashant Thakare, Nikita Gilbile & M.A. Maindarkar (2016). GPS/GSM Enabled Personal Tracker. International Journal for Scientific Research & Development.

[3] J. Kurnik, M. Jankovec, K. Brec & M. Topic (2011). Outdoor testing of PV module temperature and performance under different mounting and operational conditions. Solar Energy Materials and Solar Cells, 95(1): 373–376.

[4] L. Ramachandran, S.P. Mangaiyarkarasi, A. Subramanian & S. Senthilkumar (2024). Shrimp Classification for White Spot Syndrome Detection Through Enhanced Gated Recurrent Unit-based wild Geese Migration Optimization Algorithm. Virus Genes, 60(2): 134–147. doi: https://doi.org/10.1007/s11262-023-02049-0.

[5] L. Ramachandran, V. Mohan, S. Senthilkumar & J. Ganesh (2023). Early detection and identification of white spot syndrome in shrimp using an improved deep convolutional neural network. Journal of Intelligent & Fuzzy Systems, 45(4): 6429–6440. doi: 10.3233/JIFS-232687.

[6] L. Manjakkal, S. Mitra, Y. Pettilot, J. Shutler, M. Scott, M. Willander, et al. (2021). Water Quality Monitoring using Connected Sensors Innovative Sensor Deployment and Intelligent Data Analysis. IEEE Internet of Things Journal.

[7] S.U.N. Goparaju, S.S.S. Vaddhiparthy, C. Pradeep, A. Vattem & D. Gangadharan (2021). Design of an IoT System for Machine Learning Calibrated TDS Measurement in Smart Campus. 7th IEEE World Forum Internet Things WF-IoT 2021, Pages 877–882.

[8] KVDP Piston_vs_Plunger_pump.png, May 2010, [online] Available: Widipedia.org/wiki/piston_pump.

[9] Senthilkumar, S., Lakshmi Rekha, Ramachandran, L., & Dhivya, S. (2016). Design and Implementation of secured wireless communication using Raspberry Pi. International Research Journal of Engineering and Technology, 3(2): 1015–1018.

[10] Iang Yang, Liu Hong Yi, Tian Honghai & Huang Yang (2019). Integrated control study on testing system of solenoid valve. Journal of NortheasternUniversity (Natural Science), 31(1): 103–106.

[11] Gilbert M. Masters (2020). Renewable and Efficient Electric Power Systems. John Wiley & Sons, Inc.

[12] D. Renner, P. Jansen, D. Vergossen, W. John & S. Frei (2016). Optimization of a 12V Dual-Battery-System for Applications in Mild-Hybrid Vehicles. AmE 2016 - Automotive meets Electronics, 7th GMM-Symposium, Pages 1–6.

[13] M.A.G. Maureira, D. Oldenhof & L. Teernstra (2018). ThingSpeak–an API and Web Service for the Internet of Things. World Wide Web.

[14] K. Nandakumar, M. Aravind., S. Dinesh, A. John Milton, S. Manikandan & S. Senthilkumar (2023). The efficacy of ultraviolet radiation for germicidal purposes. International Journal of Research -Granthaalayah, 11(4): 13–19. https://doi.org/10.29121/granthaalayah.v11.i4.2023.5121.

[15] K.Vembarasi, Vishnu Priya Thotakura, S. Senthilkumar, L. Ramachandran, V. Lakshmi Praba, S. Vetriselvi & M. Chinnadurai (2024). White spot syndrome detection in shrimp using neural network model. 11th International Conference on Computing for Sustainable Global Development, New Delhi, India. DOI: 10.23919/INDIACom61295.2024.10498722.

[16] S. Senthilkumar, N. Prathap, T. Senthilkumar, V. Parthasaradi & D. Devarajan (2023). Energy Saving Solar Powered LED Street Lights with Automatic Intensity Control. Iconic Research and Engg. Journals, 6(10): 1–4.