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WATER LEVEL SMART MONITORING APPLICATION FOR ATMOSPHERIC WATER GENERATOR TANK USING ARDUINO

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ABSTRACT

In this age of globalization, many advanced technologies have been invented and are rapidly growing in Malaysia. Everything we do involve computer technology to simplify our daily work. The company Solace Skywater's Atmospheric Water Generator tank system require frequent monitoring by the technicians. Water in the tank will overflow when full because the existing system does not control the flow of the water into the storage tank. This problem can be solved with the help of smart monitoring and automation technology by developing an application. This application aimed at facilitating existing water level monitoring using MATLAB software is more interactive, effective, and has a lot of benefits to users. The application will store the data of the water level in the tank for every 10 minutes. This app will display several warning messages in case of water shortage, or water has overflowed from the tank and the technicians will also be alerted with changes in water status based on the data stored in the database. The Matlab software is used to develop this application. It is hoped that this application will be able to assist Solace Skywater in its day-to-day work by applying smart technology to its tools in their company.

1.0 INTRODUCTION

Smart monitoring makes it easy to monitor using devices known as a monitor or probe. The use of smart monitoring systems in the industry is very important in improving quality production, productivity, and reducing costs. Water is most important resource which needs to be managed smartly. Managing water supply in a society consisting of water tanks, motors, and pumps automatically is an important task for efficient consumption of water [1]. In this project, the water level can be monitored by users smartly. Additionally, users can generate tank reports from this app to increase the productivity of water production. This project uses a more modern and innovative technique with the use of the Internet of Things (IoT).

The most abundant source of freshwater is the earth's atmosphere. When atmospheric moisture condenses, it falls like rain. Solace Skywater Company replicates this natural preservation process using AWG machines. This AWG simulates the dew point, which allows it to make water by itself and continued even in the low humidity condition. This is Skywater's patented adiabatic distillation process. Again, mimicking natural processes, AWG produces ozone to purify water. Ozone (O3), a natural gas which produces by nature when it rains, binds with water to eliminate bacteria and other impurities. AWG

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machines accomplish this by pumping ozone through the water when they are collected. Unlike other water treatment methods such as chlorine, ozone does not leave a taste. In this application, pre-treated water storage tanks are being studied to develop a more efficient tank water level monitoring system. The current demand for automation in systems are very high in the current industries where the focus is to reduce human workload and maximize profits. While the current issues of water overflowing from a tank is possible to manage with continuous observation and scheduling an appropriate shift for a person to monitor from time to time. Thus, making a proper system is crucial. In this paper, there will be an elaborate discussion on how to make the system autonomous where it will automatically shut off the water tank when it is full or enable it when it is empty. Not only capable in an autonomous aspect but also enable an interface to help with the monitoring.

2.0 LITERATURE REVIEW

Generally, the current system widely used in the applications of water level controlling. The process of switching on the pump and switching it off after the tank is filled is a manual process, i.e., someone has to check whether the tank has enough water filled, then he has to turn the pump ON to fill the tank up, then he also needs to see if the tank is filled up or if the water is overflowing, and turn the pump OFF accordingly [1]. After a tank is filled up, lots of water is wasted before turning the pump off. System will stop the water source when it reaches the desired level. The current state of water level in a tank cannot be seen without opening the tank. Therefore, automated applications are very necessary to control water levels to prevent water wastage. Internet of Things (IoTs) plays a vital role in energy sector which introduces a smart metering and monitoring system. The smart monitoring focuses on incorporating smart meters and control techniques which requires smart equipment control, bidirectional communication, integration of network and users [2]. Apps have made daily life more convenient. From information sharing through instant messaging to payments of all kinds of bills is just one touch away. By taking smartphone as the basic tool and as a step ahead towards Digital India, this paper shows a way how to prevent the water wastage using Smart Pump Controller app for Android based platform [1]. Based on literature studies conducted, it can be concluded that the main features of smart monitoring applications are to have automatic features, smart equipment as well as bidirectional communication, integration of network and users. All equipment specified in Table 1 must be present in the development of this application. Each has its function and needs to be integrated to enable this application to function perfectly.

Table 1. Hardware devices used

Devices	Function
Arduino	Arduino UNO is an open-source single-board microdevice. Built on a platform, designed to facilitate electronic use in many fields. Arduino has an Atmel AVR processor and uses the language of its computer program. Today, the Arduino is very popular around the world. Many users who are learning about robotics and electronics love to use Arduino because it's easy to learn. This app connects the Arduino to the interface, sensors, and water pumps which are used to control the water level in the tank. For this application to succeed, Arduino also stores data in the database and transmits data between interface to display the state of the tank's water level [3].
Water level sensor	Water level sensors are used to detect the level of a flowing substance. These include liquids, slurry, granular materials, and powder. The sensor is used to identify the point at which the fluid falls below the minimum level or ascending when exceeding the maximum level [4]. The sensor used in this application is a water level sensor. The readings obtained by the sensors can be used to determine the volume of material in sealed containers or water flow in an open channel. The application developed is dedicated to the use of water level sensors connected to an Arduino device such as a microcontroller. The sensor will be installed inside the water tank to get the reading of the collected water.
DHT22 Sensor	The DHT22 is a low-cost digital temperature and humidity sensor with a single wire digital interface. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin. Every 2 seconds, the sensor gives out new readings.
Ethernet Shield	Ethernet shield functions are to establish a communication system over

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Devices	Function
	ethernet which connect the Arduino with another Arduino or Arduino with a web server. Ethernet shield is a module used to connect Arduino with the internet using the RJ45 straight cable. Arduino ethernet shield is made based on the Wiznet W5100 ethernet chip. Wiznet W5100 provides IP for TCP and UDP, which support up to 4 sockets at a time. Ethernet module shield needs to be mounted on an Arduino board for it to function. Additionally, Ethernet Shield also has a micro-SD reader slot that can interact with micro-SD.
Water Pump	Water Pumps are commonly used to increase system pressure so that fluid for the system can be transferred to another part such as to move water from a well to the ground level, from a river to a house, and from a mine pumped to a farm area or to a reservoir tank. The main function of the pump is to send fluid supply from low to any higher ground. This is different for water delivery from high areas to low areas because it does not require to use a water pump as the water will be dispersed by gravity pressure. The water pump is a mechanical device used to add liquid energy to move from one location to another [5]. This application uses a water pump to send the generated water to the tank.

2.1 Circuit Diagram

Figure 1 below shows the drawing of the Arduino circuit used in the application. All tools play an important role in the success of this application. Featured appliances are water level sensors, water pumps, relays, and Arduino. When the sensor detects water, the water pump is controlled to stop the flow of water in the tank with the help of a relay.

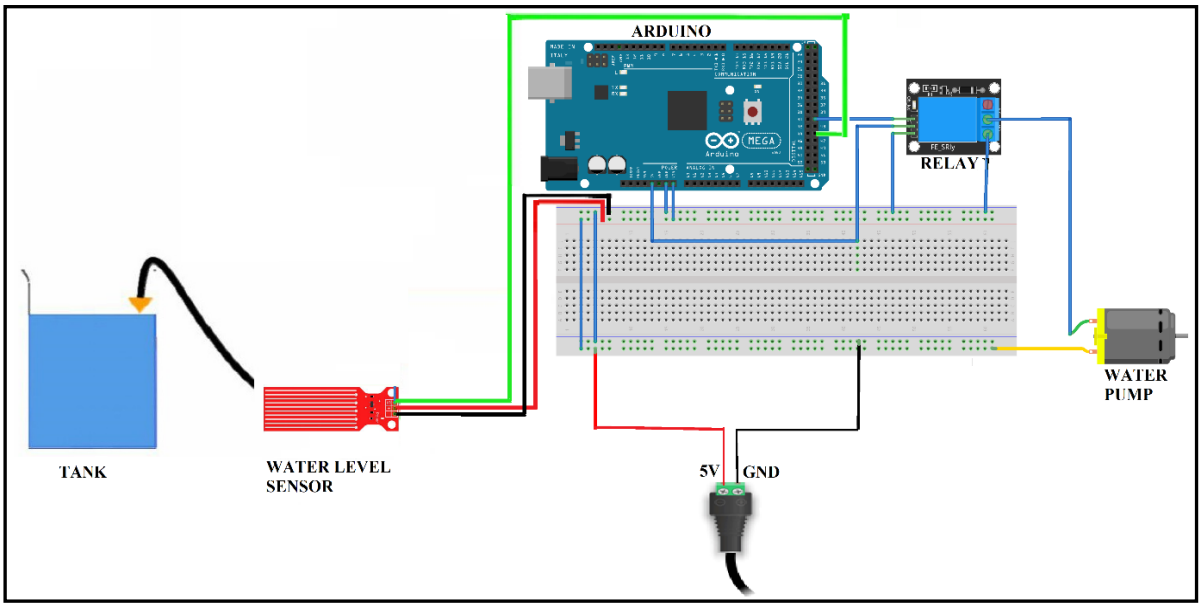

Figure 1. The Arduino circuit drawing used in the application

In Water Level Smart Monitoring System, Arduino Uno is used as a controller and Ethernet Shield is used for connecting to the internet. The water sensor is used to collect water level signals and the mini water pump is used to control the water which flows into the tank. The general structure of the proposed system is shown in Figure 2. The system consists of Arduino Uno, Ethernet Shield, computer, mini water pump, water sensor, tank, the application build using Matlab software and Xampp software.

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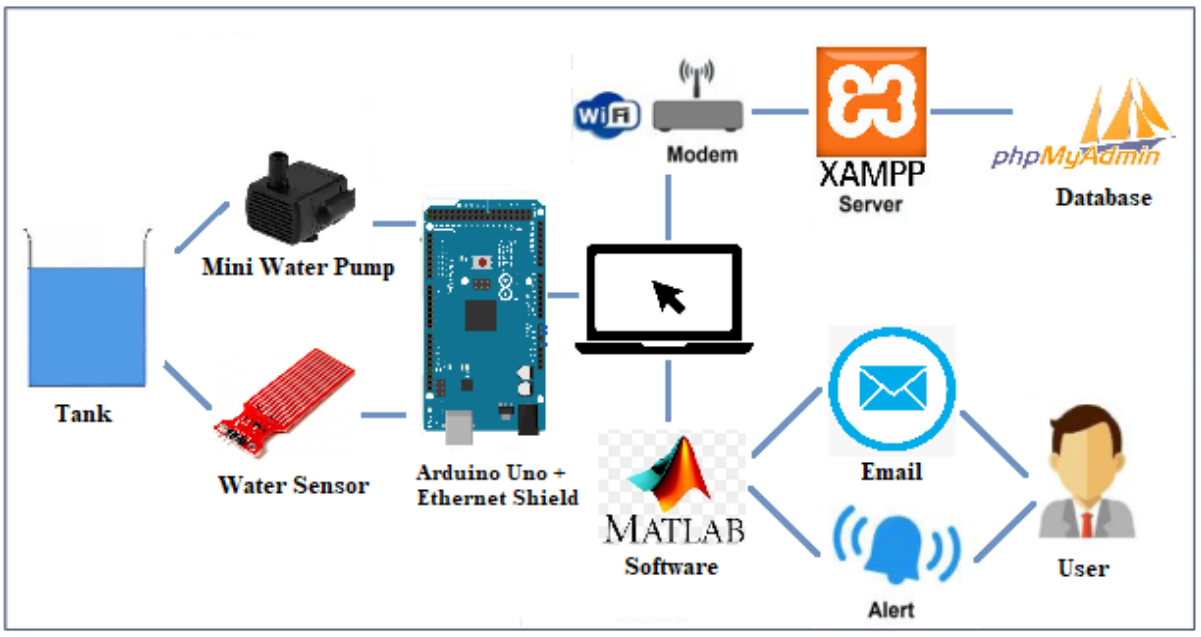

Figure 2. The general structure of the proposed system

Figure 3 shows the circuit diagram of the Water Level Smart Monitoring System built with the Arduino Uno controller. The water sensor measures the water signals that allow the reading of the water level. This sensor is connected to the A3 analogue input which converts 12 bits of the Arduino Uno controller. The single channel 5V relay acts as a switch that opens and closes the circuit of the mini water pump. This is crucial to control the flow of water into the tank. The relay is connected to the D7 digital pin.

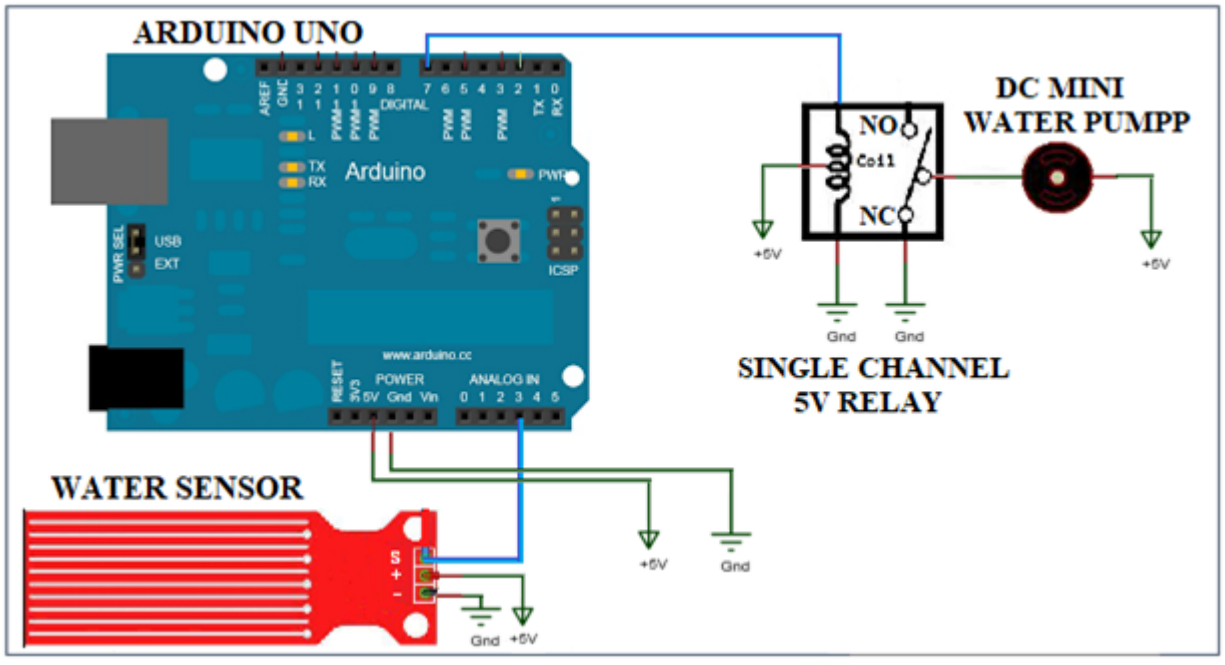

Figure 3. The circuit diagram of the water level smart monitoring system

3.0 SYSTEM ARCHITECTURE

The Prototype Model has been selected to use for the development of this system. The prototyping model is a system development method in which a prototype is built, tested, and then reworked as necessary until an acceptable outcome is achieved from which the complete system or product can be developed [6]. This model

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works best in scenarios where not all the project requirements are known in detail ahead of time. It is an iterative, trial-and-error process that takes place between the developers and the users.

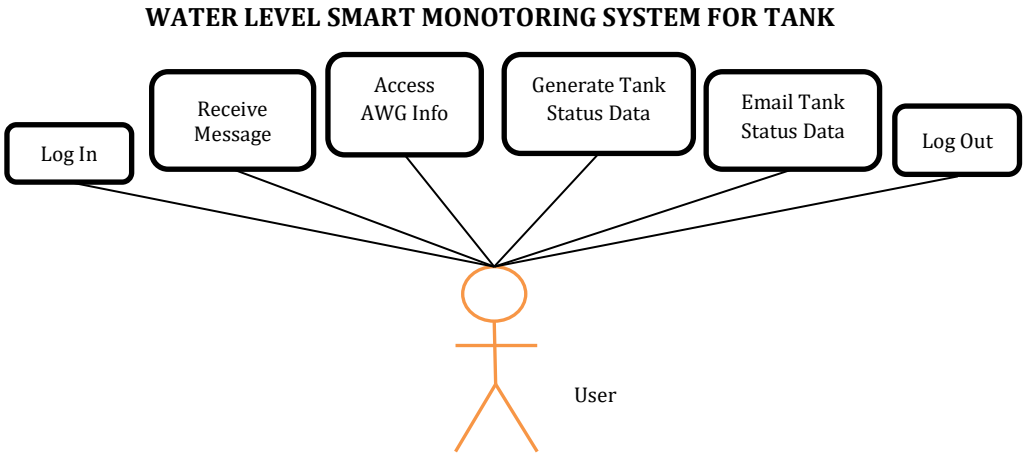

Figure 4. Use case diagram

This System has been designed through the Unified Modelling Language (UML), as depicted in Figure 4. This system comprises one main user, namely, the technician. He or she needs to log in to the system using their username and password. The Use Case Diagram illustrates how a technician interacts with the application that is to be created. Use CaseDiagram also depict all the process such as log in, receive messages, open AWG info, generate tank status data from the database, email the data, and log out. In Figure 5, the Sequence Diagram shows how objects operate with each other and in which order. The diagram shows the interaction of objects arranged in sequence [7].

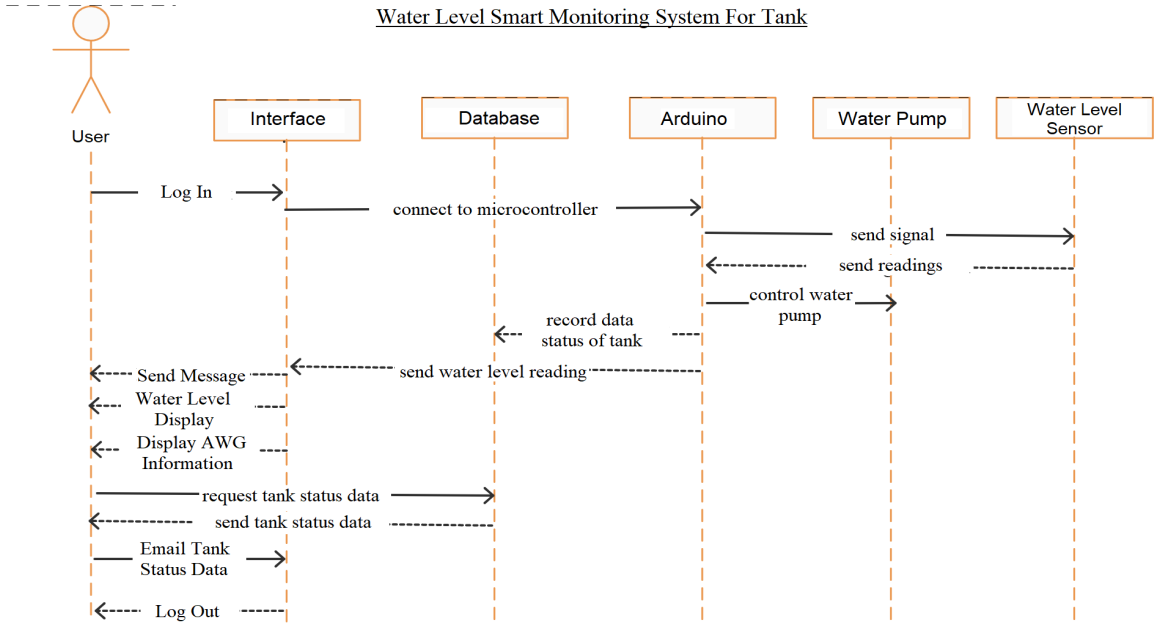

Figure 5. Sequence diagram

Figure 5 shows the user is the employee who can access the application after signing in. After clicking the Sign In button, the Employee will gain access to the System Interface by entering the user ID and password. The interface was connected to an Arduino microcontroller which connected to a water level sensor and a water pump. The sensor reads the tank's water level and then responds to the Arduino signal with readings obtained [8]. The water pump will be controlled according to the status of the tank whether it is full or not. Arduino will store the tank's status data in the System Database. Also, the Arduino can send water level reading data to the Interface and subsequently display the water level to the

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employees for monitoring purposes. Employees will receive a message from the Interface stating that the water is ready for use. Additionally, the info or info button will display information related to the AWG machine. Employees can also generate tank status data stored in the Database and then email that data. Finally, workers can sign out of the application [9].

4.0 SYSTEM DEVELOPMENT

This Water Level Smart Monitoring System has been developed through the Matlab while the Matlab Guide package was used to develop the interface of the system. Figure 6 shows the algorithm for the process of determining the water level automatically. For the process of determining the water level, the water sensor detects the water level in the tank in percentage. If the water level is above 80%, the maximum water level message will be displayed. However, if the water level is detected at 20% or below, a minimum water level message will be displayed. If the water level is between 80% and 20% then the filling message will be displayed [10].

```
Press the water level display button on the menu interface;
Process 1; If 80% water level above;
Display of maximum water level message;
Else
if 20% water level below;
Minimum level water message display;
 Else
The water level is between 80% and 20%;
Water message display is being filled;
```

Figure 6. Algorithm for determining the water level automatically

5.0 SYSTEM IMPLEMENTATION

System implementation will be shown through the system interface below.

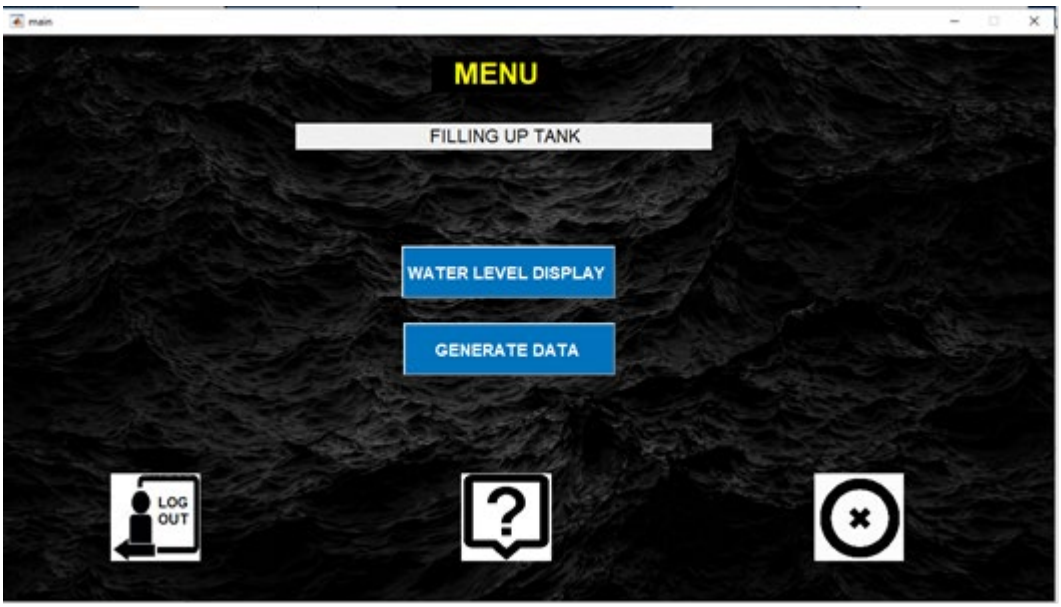

Figure 7. The main menu

Figure 7 displayed the main menu in the application. In this interface, users will always get a flashing message on the TEXT BOX column based on the current level of water in the tank. If the water in the tank is at its maximum, the TEXT BOX will display the message fully. Available water for use 'is blue. When the water level is below the minimum, the TEXT BOX will display a red 'WATER UNDER MINIMUM' message. Whereas when the water level is between the maximum and the minimum, the TEXT BOX will display the message 'WATER NOW.' The first button under the MENU header is the SHOP button that connects the Menu interface to the Water Level View interface. Next, it appears the CREATE DATA button that connects

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the Application Menu interface to the Tank Status Data interface. The INFO button opens the Info or info interface. After that, the user can press the OUT-LOG button which will open the Home interface again. There is also a CLOSE Button that works to close the application.

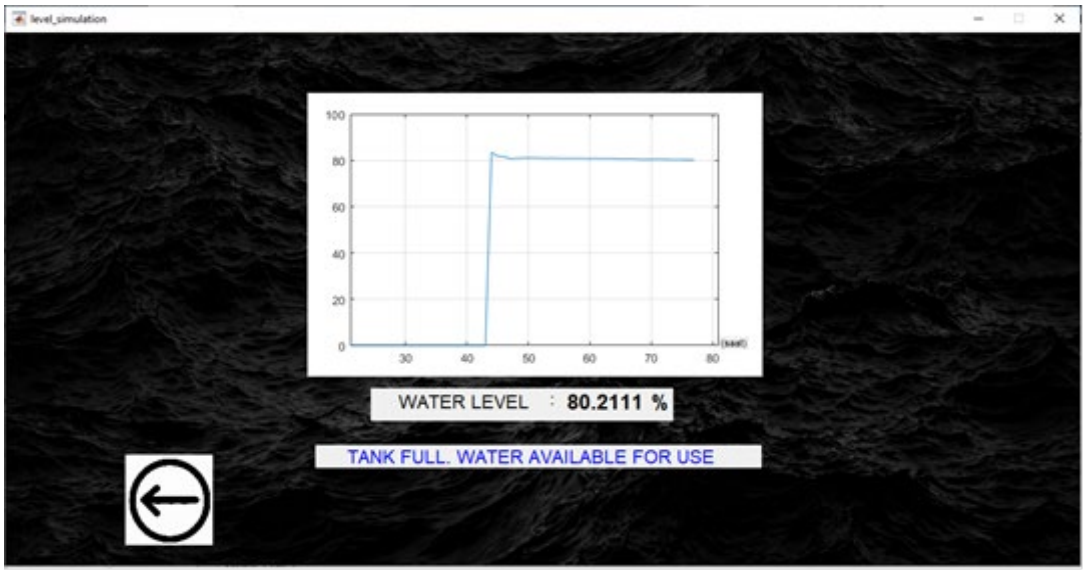

Fig 8. Water level view interface

Figure 8 displays the Water Level View interface. This interface gives an overview of the percentage of water levels in the form of graphs. This water level display is the current reading detected by the sensor. The percentage of water in the tank is also visible to the user in the column below the graph. Similar to the Menu interface, if the water in the tank is at its maximum, the TEXT BOX will display the message 'FULL UP. Available water for use 'is in blue colour. When the water level is below the minimum, the TEXT BOX will display a red 'WATER UNDER MINIMUM' message. Whereas the water level is between the maximum and the minimum, the TEXT BOX will display the message 'WATER NOW.' Next, a RETURN button appears which will close the Water Level View interface and bring the user back to the Application Menu [11-12].

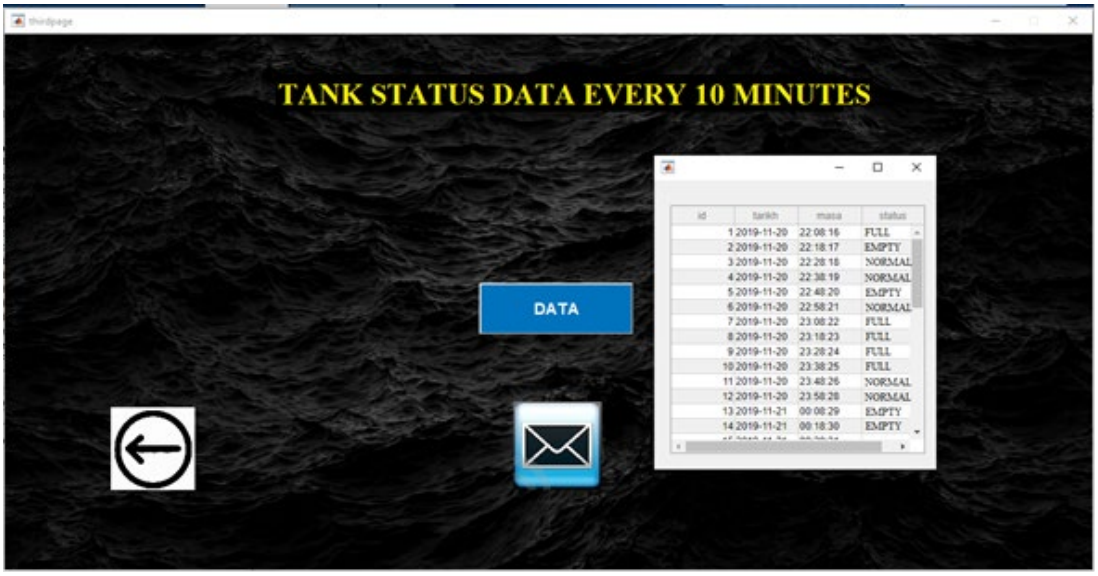

Fig 9. The tank status data interface

Figure 9 shows the Tank Status Data interface. This interface provides users with full tank frequency reports. Arduino always keeps tank status data in the database every 10 minutes. By pressing DATA, the application extracts data from the database and displays the data in a table format. The EMAIL button opens an Email interface that allows the employee to email the tank status data. Next, a RETURN button appears which closes the Tank Status Data interface and brings the user back to the Application Menu.

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6.0 CONCLUSION

In conclusion, the applications are built to be the basis for the development of better tank water monitoring and improvement of existing systems. The uniqueness of this system is that it requires two-way integration of two different software, Arduino IDE and MATLAB to fully function. After reviewing the achievements of this system, it is possible to conclude that the main problem of the overflow in the water tank has been solved. Remote monitoring is also possible because the current water level and messages about the use of the water tank are always displayed on the application interface using MATLAB software. Besides, the system is also able to store the status of water level data in the database for user reference. In principle, the objective of the system has been achieved. The existence of this application has proven to be successful in facilitating Solace Skywater's operations to remotely monitor AWG engine tanks and to record the status of the tank. This Atmospheric Water Generator Water Level Monitoring application was developed to facilitate Solace Skywater's AWG tank water level monitoring by applying smart monitoring elements. Some of the benefits of applications to users are firstly, easy-to-use, attractive, and user-friendly interfaces. Secondly, can be used on all types of laptops. Thirdly, this application requires users to sign in, so, this application has a security feature to prevent this system from being compromised by others. Fourthly, this application can always send messages about water usage based on the level of water in the tank. Finally, this application able to store tank status data every ten minutes.

7.0 ACKNOWLEDGEMENT

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