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HYDROPONIC USING WIND POWER

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Abstract

Wind power is the conversion of wind energy into other useful forms of energy as energy could only be transform such as electricity by using wind turbine. Nowadays, on this modern world, there are wind turbines where by the rotation of the turbine blades, wind power been converted into electrical current. The renewable energy such wind power has experienced a significant rise in recent times due to the exhaustion of conventional power generator or non-renewable energy also the increasing of realization of its diverse effects on the environment and nature. The decreasing of plant around the world give the people less oxygen which will lead to stress and also unarrangeable schedule due to sickness and other major diseases. The objectives are to design a prototype of development of wind power monitoring system for hydroponic of urban farming, to produce development of wind power monitoring system for hydroponic of urban farming and monitor using PLX-DAQ of Arduino IDE and to study the relationship between the voltage generated by wind turbine and the closed loop system of hydroponic. The processes of the whole project have to be sketched properly from the early stages so that the project is done systematically towards achieving the objectives. The step has to be systematically plotted and well-oriented in order to avoid any ambiguity of work progression. The power produced will be tested approved when the DC loads could be power up. Both parameters will be display to be monitor using PLX-DAQ. PLX-DAQ is more accurate for collecting data from analog and digital input such voltage and water sensor respectively.

Keywords: Hydroponic; Agriculture; Wind Power; Urban Farming; PLX-DAQ.

1.0 INTRODUCTION

Wind power is the conversion of wind energy into other useful forms of energy as energy could only be transform such as electricity by using wind turbine. Nowadays, on this modern world, there are wind turbines where by the rotation of the turbine blades, wind power been converted into electrical current. The renewable energy such wind power has experienced a significant rise in recent times due to the exhaustion of conventional power generator or non-renewable energy also the increasing of realization of its diverse effects on the environment and nature. Based on statistics, this popularity of renewable energy been estimated to be 20% - 50% contribution to energy consumption in this 21st century.

This project focus more on the implementation of wind power specifically to hydroponic of urban farming. As with the problem encounter where only a few of urban people see the importance of farming even just inside the house or even in their office. There are fewer living things around the urban compared to non-living things where take almost 70% of the land in urban area. By conducting this project, urban people could farm or even just having a plant either vegetables, flowers or just for decorations where the vital concept here is having living things among them.

Wind energy (or wind power) refers to the process of creating electricity using the wind, or air flows that occur naturally in the earth's atmosphere pressure and wind. Modern wind turbines are used to capture kinetic energy from the wind and generate electricity based on the size of the turbines. There are three main types of wind energy;

1. Utility-scale wind: Wind turbines that range in size from 100 kilowatts to few megawatts, where the electricity is delivered to the power grid and distributed to the end user by electric utilities or power system operators.

2. Distributed wind: Single small wind turbines below 100 kilowatts that are used to directly power a home, farm or small business and are not connected to the grid.

3. Offshore wind: Wind turbines that are erected in large bodies of water, usually on the continental shelf. Offshore

wind turbines are larger than land-based turbines and can generate more power.
The core motive of this project is to design and develop a wind power monitoring system for hydroponic of urban farming which effectively uses natural wind energyresource. The aim of this project is to produce voltage from natural wind energy collected by wind turbine and power up a hydroponic closed loop system without using other power supply. By using Arduino Uno and PLX-DAQ, the whole process can be monitor easily.

2.0 EXPERIMENTAL

Project Specification. Project specification is comprised all general development of the project including main process, types of controller, raw material and product at the end of the process. The project specification was shown in table 2.1.

Table 2.1 Project specification

Item	Specification
Main of Project	Hydroponic
Main Process	Water Level, Voltage generated, Closed loop system and monitor using PLX-DAQ.
Operation Mode	Automatic Process and Semi -Automatic Process.
Main Software	Arduino IDE and PLX-DAQ
Main Hardware	Arduino Uno, Centrifugal Pump, Relay, Non-contact water sensor, Charge controller, Voltage sensor Total
Process	Water Level Control and Monitor, Voltage generated and Monitor, Closed loop control system and Monitor.
Product	High quality Water Spinach.

Operating System Overview

Figure 2.1 explains about the operating system. Basically,system of the project is divided into four main parts which is wind turbine, kinetic energy, turbine & generator and electrical energy. For each operating system, the hardwareand software are used to explain the step and procedure.

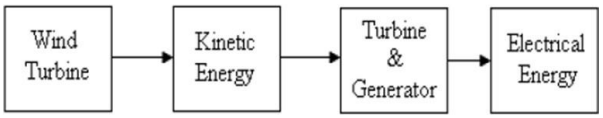

Figure 2.1 Operating System Overview

Controlling System

In this project, there are two types of sensor that will control automatically also known as closed loop process which is Voltage sensor and non-contact water level sensor. Figure 2.2 show the closed loop for non-contact water level sensor.

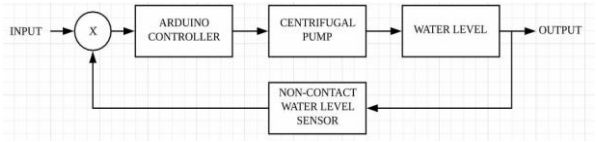

Figure 2.2 Closed Loop for non-contact water level sensor.

Figure 2.2 shows the closed loop for non-contact water level sensor. This non-contact water level sensor will have controlled by sense detects the water level present in the plant tank. The water level will detect 0 for absent of waterand 1 for present of water at the level of non-contact water level sensor been installed. Table shows the description of the elements involved in closed loop system. Table 2.2 is the explanation for non-contact waterlevel sensor closed loop.

Table 2.2 Explanation for Electrical Conductivity Sensor Closed Loop

Element	Description
Set point	Digital value (0 and 1)
Controller	Detection of water level atthe non-contact water level sensor installed.
Final Control Element (FCE)	Centrifugal pump
Process	To detect the water presentat the level non-contact water level sensor installed.
Sensor	Non-contact water level sensor detect the presentof the water at plant tank

Project Workflow

The process of generating power from wind turbine starts with the presence of the natural wind energy source and flow of the wind energy created by natural phenomenon called wind to the blade rotor. The wind energy source is will be captured by the wind turbine causes the blade to rotate which creates kinetic energy. Large blades on the turbine rotor are connected to an electrical generator via a shaft and a series of gears. The kinetic energy created from rotating shaft is then being converted into mechanical energy. The generator will convert the mechanical energy into electrical energy. Generator contains a magnet that create the electromagnetic flux (emf) which produce current and voltage when the rotor of the motor rotates. The electricity produced from the generator is then being store into the battery through charge controller. Charge controller will act as an indicator for the condition of the battery whetherit is in charging mode, low power, full charge mode or not charging mode. Besides, charge controller also will control the flow input/output voltage that have been set by user. Then, the DC loads will be connected to the battery to power up. The process of measuring the output voltage and water level starts by power up the Arduino UNO module with a 5VDc supply. For the upper flow, the water presence sensor is attached to the water tank for the plant.

The sensor will measure the presence of the water level and the measured parameter will be display at the PLX- DAQ. The sensor will detect either the water is at the level of the sensor or not. For the lower flow, voltage sensor is used to detect the output voltage produce by generator and the Arduino UNO will measure the amount of voltage produced. Then the measured parameter will be display at PLX-DAQ according to the voltage produced per second. the project process starts by having the flow of natural wind energy to the blade rotor located at the motor which causes the blade to rotate and create a mechanical energy. The shaft of the generator will be rotate and the voltage sensor will calculate the voltage produced and give signal to Arduino UNO microcontroller for it to display it at PLX- DAQ This process will keep on measuring the voltage. The generator will convert mechanical energy into electrical energy which produce the DC output voltage and current. The battery will be charge as soon as the DC output power is produced and flow through the charge controller. The LCD on the charge controller would show the amount of voltage in the battery. the Arduino Uno would be turned on as it been connected to the charge controller. From the Arduino Uno, the water presence sensor would be on and the LED would turn on when it detects the water on the selected level, otherwise the led would turn off indicating the water is not at the certain level. When that happens, the relay would turn on, giving signal to the pump to turn on. As the pump turn on meaning the water from the fertilizer tank is pump into the plant tank. The digital mode of the water presence sensor would be monitor through PLX-DAQ. Figure 2.3 shows the system workflow of Hydroponic using Wind Power.

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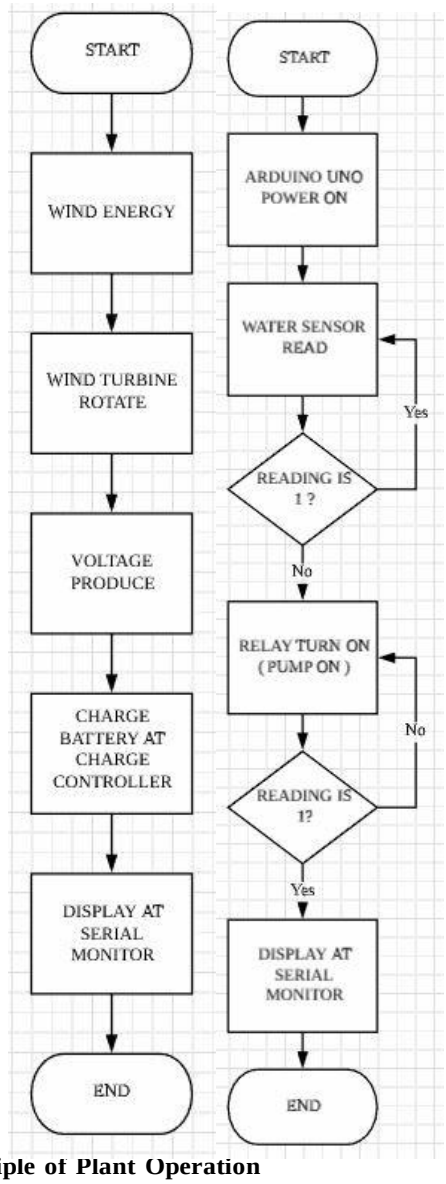

Principle of Plant Operation

This project can be monitored by PLX-DAQ also the amount of voltage inside the battery could be viewed at the charge controller LCD. The user just has to install the non-contact water level sensor in order to activate the whole system. The user also would be notified if the water level is at the level non-contact water level sensor been installed or not by the LED indicators

The working principle of this project is, when the non-contact water level sensor been connected to the hydroponic tank, the system will start. When start the system, directly, the PLX-DAQ would generate the data. At the PLX-DAQ, it would show the water presence mode either it is 1 or 0. Also, it would show the real time of the system been operated. If the non-contact water level sensor detects the presence of water at the level it been installed, the green LED would turn on indicating the pump is off and the water is at the optimum level for the growth of the plant. If the sensor detects 0, the red LED would

turn on indicating the absent of water at the level been installed. By this, the pump would turn on meaning the water from the fertilizer tank would be pump into the hydroponic tank until it reaches the water level. As the water level touches the optimum limit, the pump would stop operating, the red LED would turn on. The container of fertilizer tank consists Fertilizer A and Fertilizer B which are specifically for hydroponic green leaves plant. The fertilizers have the contain of ratio 10 ml fertilizer A, 10 ml fertilizer B and mix with 4 litres of water.

The voltage generated by wind turbine would form a graph at PLX-DAQ. The wind turbine is automatically rotates based on the strength of the wind flow on the wind turbine. The wind turbine turbine would rotate and active the kinetic energy on the generator that would give the voltage to the charge controller. At the charge controller, the voltage produced from the wind turbine would charge up the rechargeable battery. The centrifugal pump would be connected to the rechargeable battery as it is a 12v needed a 12v battery in order for it to function. A 5v relay is connected to the pump and controlled by Arduino UNO.

The connection of all these components, the closed- loop system of hydroponic is complete and would work fully automatic.

Software and Hardware Configuration

This section is about the development of the project prototype which consist the main component and the circuit design of the plant. The main hardware used in this project is Arduino UNO. Software PLX-DAQ and Arduino IDE been used in order to control, show result and maintain the whole system.

Software Configuration

Main software that used in this project is Arduino Integrated Development Environment (IDE). Arduino IDE software makes it easy to write code and upload it to the board. The environment is written in Java and based on processing and other open-source software plus this software also can be used with any Arduino board. I will use this software to upload the coding or program into the Arduino UNO. The correct drivers must be installed according to your programmer. PLX-DAQ also being used as the interface to monitor the system. The water level value in main tank and voltage generated also being featured in this software.

Hardware Configuration

This section is about the development of the project prototype which consist the main component and the circuit design of the plant. The main hardware used in this project is Arduino UNO. Arduino board design uses a variety of microprocessors and controllers. The boards are equipped with sets of digital and analogue input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++.

The “vertical axis wind turbine” has turbine blade designs either vertical or in the shape of an egg beater, and similar in many ways to the wind powered centrifugal ventilators seen on chimney’s and flues. The vertical axis wind turbine blades are attached to a central vertical shaft and which has specific advantages over the horizontal wind turbine designs. Vertical axis wind turbine blades may be of either a drag-driven or lift-driven rotor design. The most common drag-driven vertical axis wind turbine design is that of the Savonius rotor, which has been used for hundreds of years for water pumping and other such mechanical applications. The Savonius VAWT wind turbine has an S-shaped rotor when viewed from above and operates as a drag device, and hence, the angular velocity of the turbine cannot exceed the ambient wind speed. The power from the Savonius turbine design is based on the difference in air pressure across the blades as one set of blades retreat from the wind and the other set of blades advance into the wind. This is in turn related to the difference in the drag coefficients associated with the convex side of the blade and the concave side of the blades. Generally, compared to other forms of wind turbine designs, the Savonius rotors has fairly low efficiencies.

A relay is classified into many types, a standard and generally used is a made up of electromagnets which in general used as a switch. Relay can be defined as the act of passing something from one thing to another, the same meaning can be applied to this device because the signal received from one side to the device controls the switching operation on the other side.

This project uses 12V DC Permanent Magnet Electric Motor Generator as an equipment to produce electricity. For this project, mechanical energy is created by the rotor blade of the wind turbine and they will be changed into electrical energy. This energy conversion is based on Faraday's Laws of electromagnetic induction, that induces an electro-motive force (emf) into generator coils as it rotates. The generator will produce a DC output voltage.

A rechargeable battery, storage battery, secondary cell, or accumulator is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction. Rechargeable batteries are produced in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network.

For electrical parameters, DC Voltage Sensor will be used in order to measure the amount of voltage produced from the VAWT. The parameters would be display at the PLX-DAQ per time. By this, we can see the increase ad decrease of the voltage produced by the wind turbine as the time flows.

This Liquid Water Level Sensor can be used to detect the liquid level in tank/container. Non-contact, works without direct contact with the liquid inside the tank. Tiny in size, easy to install. Size about 30*19*10 mm with the voltage of DC 5V or 12-24 V. This project will use this

water level sensor as to detect level of water.

For this project, Arduino UNO module will be used as the microcontroller to carry out all the software and system works. This Arduino Uno contains a single-board microcontroller. The board contains with sets of digital and analog input/output pins that can be used to interfacewith the hardware part of this project. This microcontroller is an open source IoT platform device which uses C and C++ language with Arduino software Ide. By this, the voltage produced by wind turbine can be monitor on the PLX-DAQ. This makes it the best choice for closed loop monitoring system based projects. Other than that, this module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices. The output of the motor generator will be connected to the input pins of the Arduino board. Then, the board will interface with the set of coding written and will read the output voltages given by the motor generator.

Charge controller or charge regulator will be used in order to limits the rate of electric current flow into the battery or drawn out from the battery. The charge controller would prevent the battery from overcharging and act as a protector against overvoltage. Anovercharging battery can cause the reduction of battery performance or its lifespan which will also can cause a safety risk. The limitation of input and output of the voltage into and from the battery could be set by the user. By using wind turbine charging system, charge controller is a vital hardware for it to takes the electricity produced to flow into the battery for charging process which can beused to power up the DC loads.

Figure 2.5 shows the electrical wiring from the instrument device that used to the Arduino MEGA. Figure
2.6 shows the main circuit wiring diagram consist of all instrument devices used in this project which is contain pump, control circuit and solenoid valve. Figure 2.7 shoesfull View of hardware connection of the prototype. Figure
2.8 shows the Piping and Instrument Diagram (PI&D) which will show the connection of all the instrument and piping of Hydro House. Table 2.4 is the legend of P&ID diagram.

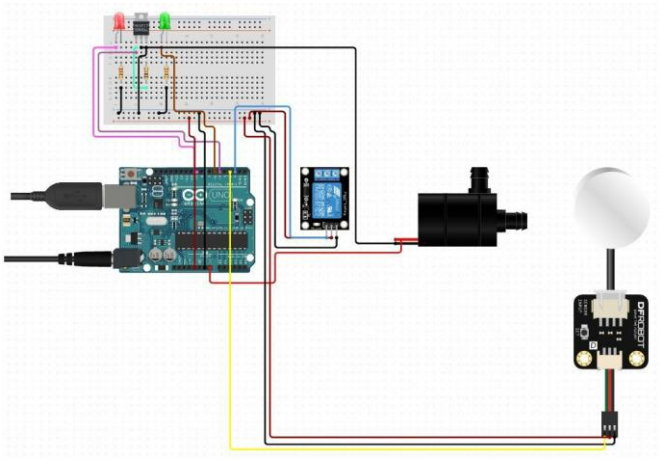

Figure 2.5 Arduino UNO Wiring Diagram

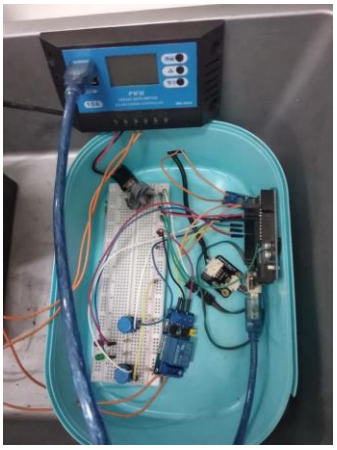

Figure 2.6 Full View of electronic devices connection.

Figure 2.7 Connection of pump and tanks

Figure 2.6 and 2.7 show the prototype of Hydroponicusing Wind Turbine consist of full connection between allthe hardware components.

Figure 2.9 Top view of Hydroponic using Wind turbineprototype.

3.0 RESULTS AND DISCUSSION

Software
Block Diagram

The project run automatically by using some instrument. The water level control process will be controlled by Arduino UNO and will be monitored by software PLX-DAQ as the interface. The instrument that involved in the water level control and monitor is non-contact water level sensor, relay and centrifugal pump. The centrifugal pump is used to transfer water from fertilizer tank to the main tank as the non-contact water level sensor detect the water in themain tank absent at the level it been installed.

As for the water level control involved some instrument that is non-contact water level sensor andcentrifugal pump. The centrifugal pump will open as the water level sensor detect '0' as the water level getting to the low point and need a refill for the main tank. The pumpis on until the water sensor is trigger as water getting to the installed point. Figure 3.1 shows the data gain of the Hydro House in software PLX-DAQ.

The voltage generated also would been collected and been monitored using PLX-DAQ. The graph shown would be voltage over time. The voltage generated is according to the strength of the wind blown to the wind turbine. The higher the strength of the wind, the higher thevoltage been generated.

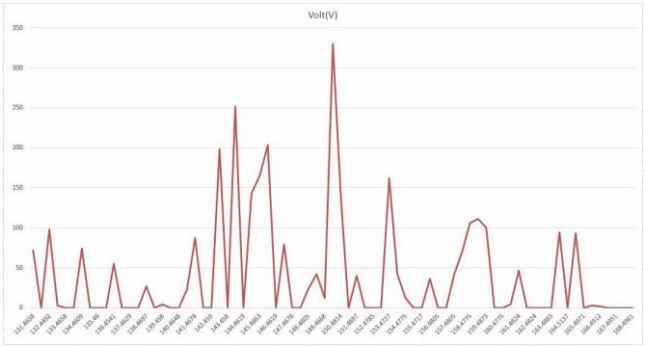

Figure 3.1 Voltage generated over time

3:57:36 AM	159.4873	100	1

Figure 3.2 Data from the PLX-DAQ

Controlling System

Water Level inside Main Tank

Water level is very important need to control in order to maintain the dissolve oxygen inside the main tank. Low level oxygen in aquarium water is a rarely problem if a tank is well maintained and not overstocked (Donald L. Kramer, 2009). However, the root cause of low oxygen level in main tank is overcrowding. Overcrowding is the main root cause for low oxygen level in a main tank.

4.0 CONCLUSION

According to the goals of this project was to monitor and control water level for the hydroponic system. To sum up, this system is to provide an ideal water level for the plant. It is friendly monitored and controlled via PLX-DAQ of the system. An operator can easily let the system to runautomatically without using traditional way. This system also can help to get the ideal condition and continuous water level needed for the plant to growth and produce thebest result of end product. Based on the project objective, the researcher is able to design a complete system for monitoring hydroponic system by using Arduino UNO. Other than that, the researcher is able to measure the level of the water inside the tank in order to maintaining the water level needed by the plant automatically. Non-contact water level sensor is used in this project in order to measure the water level in this project.

Recommendation

Based on the project Hydroponic system, the future recommendation that can be adding in this project is by adding the pH sensor that can control and measure the pH value automatically. In addition is by adding the pest control. Use image processing which can detect the imageof pest then connect with spray. When sense the pest, it will have triggered the relay and sprayer will spray to the pest. This will be the system of pest control automatically. Besides, the future recommendation for this project is adding the dosing pump at for nutrient transfer system to dos the nutrient to the tank and get more accurate reading nutrient level in the water. Next, adding Graphic User Interface (GUI) by using Siemens HMI. In order to creatingthe plant that using or prototyping platform studies such as Siemens S7-1500 or TIA-V15 PLC that enable the students to get the benefits by learning on how to use andapply it on the real time in industry. As well as promoting every individual to be an inventor of different invention in solving different problem by emphasizing the need of a new invention such as through understanding in environmental issues.

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