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FOREWORD BY DR. NURBAITI WAHID KPP PKE UITMCTKD

Alhamdulillah, all praise to Almighty Allah who made this possible for the editorial team to complete this publication. The Extended Abstracts of Final Year Projects from UiTM Terengganu Electrical Engineering Diploma students have been published since 2018 and e-ISSN was obtained from Perpustakaan Negara Malaysia in 2019. This year, 2021 witnesses the upgrade of this publication through collaboration with Jabatan Kejuruteraan Elektrik (JKE), Politeknik Sultan Mizan Zainal Abidin (PSMZA). We are very honored to work alongside JKE, PSMZA and we hope that this collaboration can be continued in the future. I would also like to thank and extend my gratitude to the management for approving this project and to all editorial team, as well as the contributing authors for this issue. Hopefully, this publication could benefit all the readers.

FOREWORD BY MR. SAIFUL AZIZI ABDULLAH KJ JKE PSMZA

Alhamdulillah, all praises to Allah, for the successful publication of the Extended Abstracts of Final Year Projects in collaboration with UiTM Terengganu Electrical Engineering and the Department of Electrical Engineering (JKE), Politeknik Sultan Mizan Zainal Abidin, Dungun, Terengganu has finally been realised. I congratulate UiTM Terengganu and the JKE PSMZA editorial team, as well as all parties engaged in this publication. The final projects created by electrical engineering diploma students are featured in this publication which will hopefully serve as beneficial resource for all students, particularly those studying electrical engineering, while they work on their final project. Thank you.

Extended Abstracts of Final Year Projects

Volume 2

HYDROPIPE GENERATOR WITH CHARGER CONTROLLER

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Abstract - Renewable energy is the term used for energy generated from the renewable sources such as water, the sun, and wind. This project attempted to utilize the hydro energy from water flow as the main power source to supply power to many electrical appliances. Due to the integration of hydro energy and charger controller to control the power, the project was thus named Hydropipe Generator with Charger Controller. This works by utilizing the water flow in a pipeline to rotate the turbine inside the generator to generate electricity. The idea stemmed from the problem of not having a backup electrical energy during blackouts or when the main source is faulty. This project would be an alternative power source to power up small domestic electrical appliances.

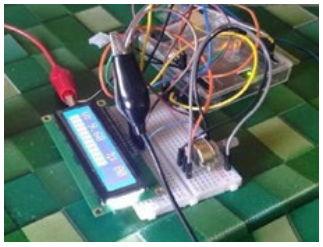
Keywords – Hydro energy, Micro Hydro Generator, charger controller, Arduino UNO

INTRODUCTION

Renewable energy sources are non-polluting and environmentally friendly sources of energy such as solar, hydro, and wind. They can be used to produce electricity [1]. Hydro power generation is one of the most used power supply globally. Hydro generator can be utilized with the presence of flowing water source, naturally flowing from areas of high pressure to areas of low pressure.
The water source from domestic pipeline can also be considered in electricity generation. This is workable via utilizing smaller sized hydro generators [2]. Based on this idea, a hydropipe generator project was carried out to supply electrical energy to basic appliances. Bathrooms or toilets are places with many pipelines and are considered suitable places for the project to be implemented. The energy from the hydropipe generator can be used to supply basic electrical appliances inside the bathroom and can act as an emergency power supply should blackout occurs or when there is fault in the main supply. By generating electricity using the hydro generator, the energy can be stored in a battery for further use. This energy can be used for bathroom electrical appliances such as emergency lights and exhaust fans.

METHODOLOGY

In this project, there are three main components needed for power generation and storage. The first one is the Micro Hydro Generator which generates power from water flow in the pipeline. The second main component is the charger controller, controlling the input power for safe input. The last one is the Lead Acid Battery for storing the electricity. With enough water pressure, the turbine spins an alternator inside the Micro Hydro Generator. Charger controller circuit is designed to control the Lead Acid Battery charging process ensuring the current and voltage from the Micro Hydro Generator are safe for proper charging thus preserving the longevity of the battery [3]. This circuit consists of MOSFET, varistor, capacitor, diode and resistors. The output for this project is are 5V LED emergency light that can be used during emergency or blackouts, and exhaust fan for ventilation. Lead Acid Battery is chosen for this project due to its ability to charge and discharge. Arduino UNO is used as the microcontroller monitoring the battery percentage of the Lead Acid Battery which is displayed on the LCD 1602 display.



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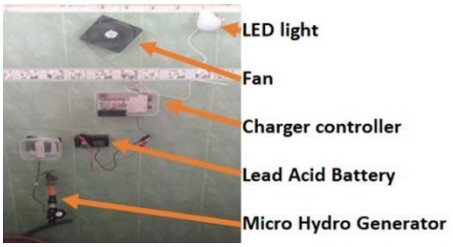

(2)

Figure: (1) The charger controller and (2) The prototype of Hydropipe Generator with Charger Controller

RESULT AND DISCUSSION

Based on the result, the mini hydro-electric generator is capable of charging the battery. The LCD display displayed the voltage percentage of the battery as illustrated in Table 1. Table 2 illustrates the battery condition during charging and discharging. This condition is necessary to prevent the battery from being overcharged and it prolongs the battery life.

Table 1: LCD display show the value of the voltage

VALUE OF VOLTAGE	PERCENTAGE
0V	0%
1V-4V	20%
6V-7V	60%
8V-10V	80%
11V-12V	100%

Table 2: Battery condition for charging and discharging

BATTERY CONDITION	Charging and discharging
<60%	Charging ‘on’, output ‘off’
60%-100%	Charging ‘on’, output ‘on’
>100%	Charging ‘off’, output ‘on’

CONCLUSION

Through the developed prototype, it is evident that it can used as residential alternative electrical supply. Taking advantage of the residential everyday water flow, it can generate electricity for emergency use. It is however recommended to enhance the project to create a better system utilizing this water flow to generate electricity for bigger input such as for the whole residential use in the future.

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INDOOR-BASED AQUAPONIC SYSTEM WITH IoT MONITORING

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Abstract **-** Farming and fishkeeping are among the essential's food producer fields in Malaysia. Nevertheless, as a population grows big, less lands are available for these purposes. To address the mentioned problem, development of a system that could compensate for the shortcoming is necessary. Aquaponic system is a potential system to address the concern. Aquaponic is a symbiotic system that integrates traditional hydroponic systems and aquaculture to produce a sustainable agriculture system with necessary inputs as all the water and nutrients in the system are redistributed in order to grow the hydroponic plants and aquatic life. The purpose of this study is to develop an automatic aquaponic for small-scaled, indoor-based systems by adding electronic technology into the conventional system. Arduino Uno is used as a microcontroller which continuously sends the information of the aquaponics' status and adjusts the state of the actuators if the parameters fall below the optimal level. To enhance the effectiveness of the system, an Internet of Things (IoT) is introduced to monitor the aquaponics' activities such as moisture level inside the hydroponic container remotely and display the status in owners' smartphone.

Keywords **-** Internet of Things (IoT), Aquaponic, Arduino Uno, Blynk.

INTRODUCTION

It is an enormous challenge to ensure food security in the face of continuous urbanization. These significant issues arise, where competition for limited resources occurs as cities are stretched and agricultural land converted into residential or industrial areas as a response to the increase of Malaysia's population [1]. In 2018, Malaysia is among the most developed nations in Southeast Asia's region with a population of 32,385,000 inhabitants (department statistic). With the annual population rate of 1.1 per cent to 2.4 per cent annually since 2010, the necessity of using lands for the sake of city development are larger than the existing land [1]. To maintain the ecosystem and tackle the above-mentioned problems, one of the innovations in plant cultivation technology is adopted namely Aquaponic. This system is a symbiotic system that integrates traditional hydroponic systems with aquaculture to produce a sustainable agriculture system with necessary inputs as all the water and nutrients in the system are redistributed in order to grow the hydroponic plants and aquatic life [2]. Communication and Electronic technologies such as micro controller, actuator and IoT are introduced to enhance the benefits of aquaponic itself. This work focuses on developing automated small-scaled indoor aquaponic systems for single households. Thus, it could encourage people to produce foods from their very own home.

METHODOLOGY

The basic idea of Indoor-based Aquaponic system is an integrated system between hydroponic cultivation techniques and aquaculture techniques using water recirculation systems from aquaculture tank to hydroponic container. The system utilizes the water containing the nutrients from the excess fish's food in the aquaculture tank as a source of nutrition to hydroponic plants. Thus, the effectiveness of feed and plant nutrition could be carried out. Clay pebbles are utilized to trap the moisture in the hydroponic container. The development of the project could be divided into two parts which are the Aquaponic hardware and IoT system.

1) **Indoor-based Aquaponic hardware system**

Two sensors are utilized in this work, which are moisture sensor and water level sensor. The data from those sensors will be fed into the microcontroller (Arduino Uno) to continuously activate the actuator (water pump) in order to make sure the circulation of the nutrient water in the system runs smoothly. Both soil moisture and water level sensors are installed inside the hydroponic container. If the value from the moisture sensor falls below the optimal value, the water pump will turn on automatically and nutrient water from the aquaculture tank will flow into the hydroponic container until the water reaches a certain level and turns off the flow. The excess water from

the hydroponic container will flow back into the aquaculture tank through a small waterway inside the hydroponic container.

2) IoT system

This work also involves integrating the aquaponic system with IoT system wherein the structure is connected by WIFI module ESP8266 and Arduino uno microcontroller collects data from the sensors installed and stores those data in the IoT enable cloud which is Blynk Application. The application will be installed in the owners' smartphone to monitor the real-time sensors status and also allows manual control to the system.

RESULT AND DISCUSSION

Table 1 shows the status of the water pump with regards to the moistures' sensor set point. From the experiment, the water pump will turn ON when the moisture sensors' value falls below 1.96%. Time taken for the pump to completely transfer the water and reach the nominal water level in the hydroponic container is about 2 minutes for every water capacity set point and the water will flow back to the aquaculture tank through the small tiny waterway within 15 minutes. This is an ample time for clay pebbles to absorb the nutrient from the water and keep it moist. The summarized results of the moisture sensors' testing could be found in table 2. Those data are generated from the Blynk application dashboard installed in owners' smartphone. These data collections are carried out in 15 days and 12 hours/day with a time interval of 30 minutes. From the results, 3.6-liter water capacity is chosen as a nominal value since this value is the maximum value of the hydroponic container. The results show that the soil pebble could retain moisture in it up to 12 hours until the next cycle of water transfer occurs.

Table 1. Relationship of soil moisture sensor with water pump

Sensor value	Condition of soil pebble	Water pump (ON/OFF)
If moisture sensor <= 1.96%	DRY	ON
If moisture sensor > 1.96%	WET	OFF

Table 2. Summarize results of moisture sensor testing

Capacity of water poured into the hydroponic container (liter)	12 hours of pebbles' moisture analysis
1	Value lower than 1.96% after 6 hours
2	Value lower than 1.96% after 6 hours
3	Value lower than 1.96% after 12 hours
3.6	Value lower than 1.96% after 12 hours

CONCLUSIONS

In conclusion, aquaponic techniques manage to tackle the problem of limited space in order to produce food from agriculture and aquaculture. Results obtained from the experiment shows that electronics technology could help to improve the performance of the conventional aquaponic system by replacing all the control action with the automated control scheme and enabling remote monitoring for better action.

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IoT BASED HEALTHCARE MONITORING SYSTEM

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Abstract: This paper described the development of the IoT Based Healthcare Monitoring System.Good health is necessary to do the daily work properly. With an improvement in science and technology and development in sensors area, technology to enhance quality of the human life. Health monitoring is the big problem in this world with the current pandemic that happened this year due to the Corona Virus (COVID-19). Healthcare monitoring system can generate awareness related to human healthcare. Other than that, it also can save time and energy. As we know people usually busy with their daily routine until they do not have time to do medical check-up. This project develop an IoT based healthcare monitoring system with the implemented of Node MCU and Arduino Uno as the microcontroller that could monitor and record the patient body temperature and heart beat rate.

Keywords - Arduino Uno, Node MCU, Internet of Things (IoT), healthcare, monitoring system

INTRODUCTION

Healthcare is the maintenance or improvement of health via the prevention, diagnosis, treatment, recovery, or cure of disease, illness, injury and other physical and mental impairments in people [1]. The fundamental purpose of healthcare is to enhance quality of life by enhancing health. A health care monitoring system is necessary to constantly monitor the patient's physiological parameters [2]. The main advantage of this system is the result can be viewed at any time and place and it can be recorded systematically compared than conventional way using manual log book. The system is implementing both the sensors like heartbeat sensor and temperature sensor. Healthcare monitoring system can generate awareness related to human healthcare. Other than that, it also can save time and energy. As we know people usually busy with their daily routine until they do not have time to do medical check-up. Therefore, with the help of healthcare monitoring system, they can save their time and energy. The objective of this project is to develop an innovative system based on IoT technologies that can measure and monitor human health with the integrating of Arduino UNO as the microcontroller that act as the brain to the system with two sensors [3]. This system is also support and suites with the current technology of Industrial Revolution (IR 4.0).

METHODOLOGY

Figure 1 shows the overall flowchart of the IoT Based Healthcare Monitoring System starting with initializing parameter of heartbeat and temperature sensor. The main microcontroller of the system is Arduino and the Node MCU as the second main controller. The server will get the data when a person puts his hand on the sensor and the data will be send directly to the Blynk application and the person will get the result.

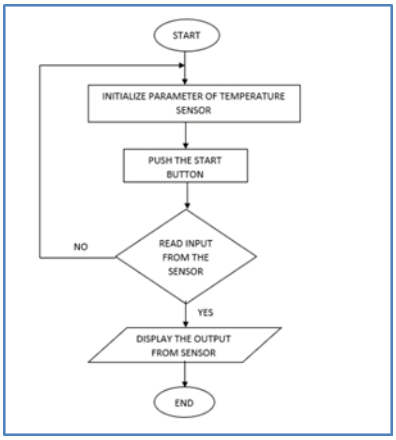

Figure 1: Flow Chart of the overall process

RESULT AND DICUSSION

In the software development, there were three software used in this project which are Arduino IDE, Proteus Design Suite and Blynk. Blynk is a Platform with IOS and Android apps to control Arduino [4]. Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data and visualise it. Figure 2 display the schematic diagram of IoT Based Healthcare Monitoring System.

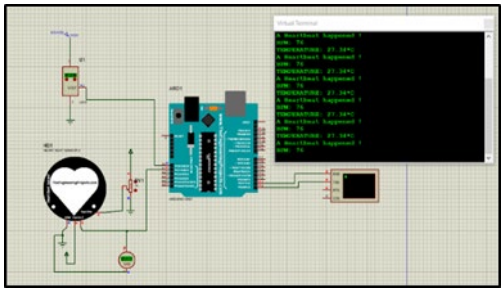

Figure 2: Schematic Diagram of IoT Based Healthcare Monitoring System

CONCLUSIONS

As a conclusion, IoT Based Healthcare Monitoring System Using Node MCU was successfully achieve its objective and goals. The system is able to measure the body temperature of human and sent the information to the Blynk application wirelessly through a Wi-Fi connection.

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PROTOTYPE OF AUTOMATIC REFILL R22 GAS FOR AIR CONDITIONING UNITS

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Abstract: Humans have invented a variety of automatic dispensers and refills. But there is still a lack about the refill of refrigerant in air conditioning units. Most of the refill process is carried out by technicians. Hence, we opted for an automatic refill of R22 gas for an air conditioner for this project. Thus, people no longer need to wait for the technician's refill service for their air conditioner. On top of that, gas wastage can also be prevented through this project because the gas is automatically refilled compared to the usual method where gas replacement is done manually. Thus, it can decrease possible human error. Therefore, the problems encountered by the technicians, such as overfilling, can undoubtedly be overcome by having this project as the new method of refilling the refrigerant for an air conditioner unit.

Keywords - R22 gas, Air Conditioning

INTRODUCTION

An air conditioner consists of an outdoor and indoor unit, where the outdoor unit is the compressor. They are connected through a refrigerant pipe. Refrigerant is a compound that is usually in the form of a fluid or gaseous state used to absorb heat from the environment and provides air conditioning with the help of compressors and evaporators. Without it, there will be no air cooling. Refrigerant is placed inside copper coils, and there are lots of refrigerants available, but we are mainly focusing on the R22 refrigerant for this project [1]. An air compressor always draws an ampere, and it is called an amp draw. Low amp draw is caused by low refrigerant. That is why we are going to use a current sensor to detect the amount of amp draw to detect if it is low in a refrigerant or not. The value of amp draw varies with the type and size the air conditioner use, of which it varies around 7.5A-30A. Since humans conduct the service, they can make mistakes such as spilling the gas or overflowing it in the compressor. This leads to refrigerant waste, consumes more cost and time to get the right amount of gas into the air conditioner, and possibly be cheated by the service technician without knowing. Therefore, this project is developed to overcome those problems. The concept of this R22 gas refill is the same as an automatic water pump control and an automatic water dispenser [2]. It can automatically refill R22 gas without any supervision from anyone as it will sense whether the refrigerant is lower than the supposed value by using a current sensor and sends the data to the microcontroller to decide if the valve needs to open or remain closed. This refiller includes a solenoid valve to control the flow of gas.

METHODOLOGY

Figure 1 shows the block diagram for this project. The input is from the current sensor, and the output goes to the LCD and solenoid valve through a driver circuit. The current sensor measures the current value from the load and sends the data (value) to the microcontroller, Arduino UNO. The Arduino sends the data to the LCD to display the data measured. At the same time, the Arduino will compare the data received with the value programmed in it to decide whether the driver circuit needs to be activated or not. If the measured value does not meet the required value stored or lower measurement, the driver circuit will be activated by Arduino, thus opening the solenoid valve. All of this requires a specified programming code. Figure 2 shows the flowchart of this project. This project starts by initializing the system that senses the current from the load, and the microcontroller will read the current sensor value and display it to the LCD. At the same time, the measured value will be compared with the value set in the microcontroller, which is 3A. If the measured value is lower than 3A, the solenoid valve opens, and gas will flow through. The system will measure the amount of current flow from the load until the measured value reaches the value set in the microcontroller. Then, the solenoid valve will close. If the measured value is already higher or the same as the set value, the solenoid valve will remain close

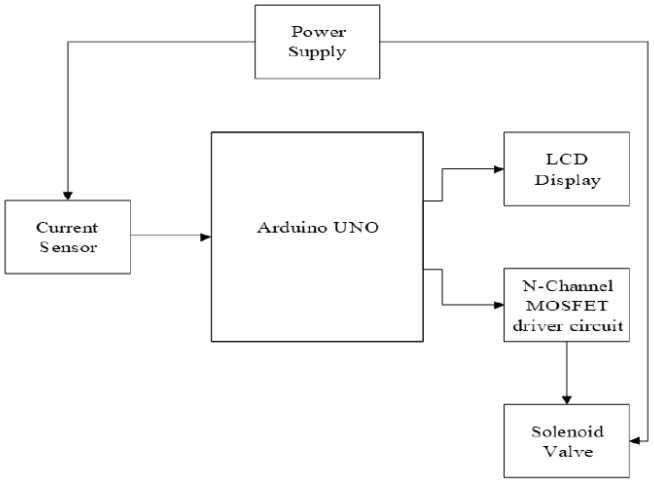

Figure 1. Block diagram of this project

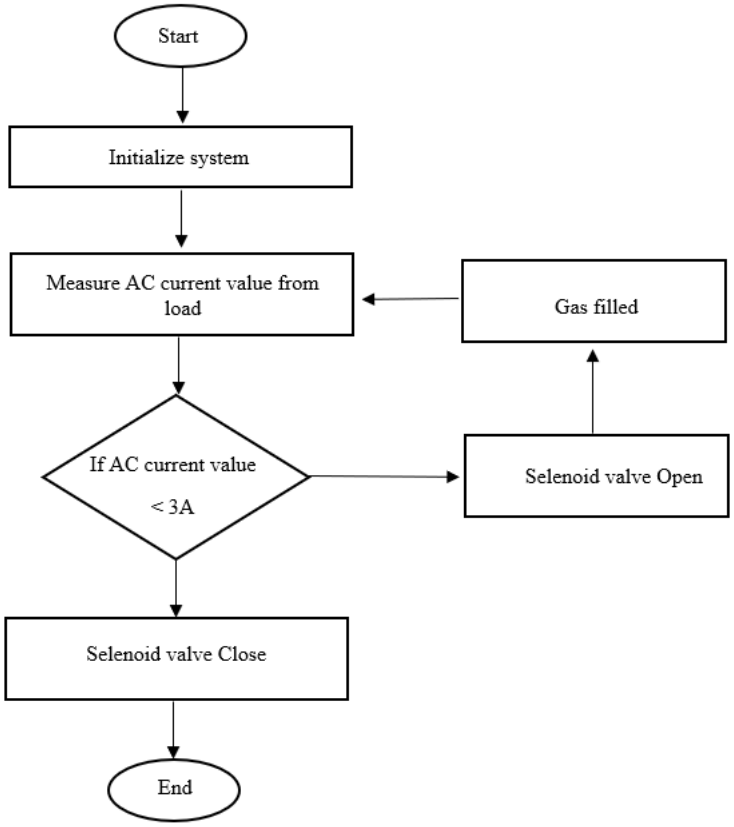

Figure 2. Block diagram of this project

RESULT AND DISCUSSION

Figure 1 shows the prototype of this project. The prototype initiates when voltage is supplied to the Arduino. The AC current is measured, and the value was shown on the LCD screen. The solenoid valve turns ON and OFF according to the measured input. The analysis results from the experiments show that the current sensor was not very accurate as its sensitivity is not high enough [3][4]. The sensitivity can be changed according to our needs. The investigation was carried on, and the results were recorded. Table 1 shows the result of the experiment.

Figure 1. Prototype of this project

Table 1. Condition and Prototype Result

Condition	Result
Solenoid Valve OPEN (Current Sensor Measure Current < 3A)	Gas Tank Filled
Solenoid Valve CLOSE (Current Sensor Measure Current > 3A)	Gas Tank Not Filled
Solenoid Valve CLOSE (No Current Sensor)	Gas Tank Not Filled

CONCLUSIONS

As a conclusion, this project was created to improve filling gas refrigerants in air conditioner systems. It is an automatic system that can control the flow of R22 gas in each unit without spilling the gas or overflowing it in the compressor. This system is cost-effective and cost-efficient since it does not require technician service like it is usually conducted. Overall, it will minimize the wastage of gas and energy while maximizing the accuracy of the desired amount of gas. Furthermore, it is a time-saver, eliminating human error in adjusting the gas value depending on the required amount. This filling system has the same concept as an automatic water pump control and water dispenser, where it can automatically refill R22 gas without any supervision from anyone. Nowadays, the new refrigerant has been introduced to replace R22 gas with concern for the environment, such as global warming and climate change issues. Due to the increasing price of R22 gas, the participation of large companies and the government will play an essential role in the success of this new technology.

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RAINWATER SYSTEM FOR GARDENING USING ULTRASONIC SENSOR

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***Abstract*:** This system is entitled "Rainwater System for Gardening Using Ultrasonic Sensor". The aim of this system is to design a project that functions as an automated irrigation system for gardening. Irrigation system refers to a system that involves water, either collecting water or using water from a source or more to channel them to another place. Thus, this project is referred to building a simple watering system for gardening that can function automatically. This project uses rainwater as its primary source to fill up the water tank. In here, a big water tank will be provided to collect raindrops and use them to channel into another water tank to be able to flow out into the garden beds. This project is mostly used with an ultrasonic sensor, which is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves and converts the reflected sound into an electrical signal. In here, it will apply to how the ultrasonic sensor will scan whether the tank has reached minimum or maximum capacity and inform it by sending an electrical signal which is received by a buzzer and an LED, turning them on in resulting to a buzzing sound from the buzzer and the LED being lighted up. Arduino Nano is using in this project as our main controller to monitor all input and outputs. The water then finally flows out through a pipe in the end and into a sprinkler. This project is mainly used to water the gardens in lawns, backyards, or farm.

Keywords: Rainwater system, Ultrasonic sensor, Arduino

INTRODUCTION

Rainwater is one of the underdogs amongst renewable sources of energy and it is considered as the underrated one, as not many projects happen to fall under this specific field. This project to build a system, specifically a rainwater harvesting system that can collect the quantity of the rain droplets in a preferred choice of variable tank size either small or up to large to reuse the rainwater as the source to water the gardens. By using this project, individuals who own gardens in their households or in the agriculture background, would benefit tremendously as not only it is applicable, and easier to build or install compared to the other types of gardening systems that have existed. What makes this project unique is that it combines the rain harvesting system and the watering gardening system using tools and software to make it a special piece of project that can cut cost of the water bills by reusing the stored rainwater in the tank to water the garden without the help of the usual manual sprinklers. Not only this saves electricity but it also saves water and is environmental-friendly. In this project ultrasonic sensor is used to detect water level based on its advantages [1,2]. While the Arduino is chosen as main controller based on previous researches [3,4].

METHODOLOGY

This project is depicted in Figure 1 as a block diagram. Rainwater is harvested in a water tank based on the size of the garden. This project utilized one input which is to determine the water level in tank using ultrasonic sensor. The ultrasonic sensor in the water tank will pick use echolocation and figure out the depth of the water. The depth of water is defined by the LED, which there is the Red LED (lowest level), Yellow LED (half level) and Blue LED (highest level). The LED will light up according to which level the water is currently at. It will dim once it has decreased the supposed level. The input from ultrasonic sensor will send to Arduino Nano as microcontroller to be analyze. Then the microcontroller will produce corresponding outputs based on input received from the ultrasonic sensor. The water pump is used to control the flow of the water either by flushing out or filling up the tank. It is also used to pump water through drainage systems such as the hose to connect to the water sprinkler.

The water sprinkler uses the water stored by the rain supplied by the hose and it then waters the garden automatically or manually. Figure 2 shows the complete flow chart of the system operation.

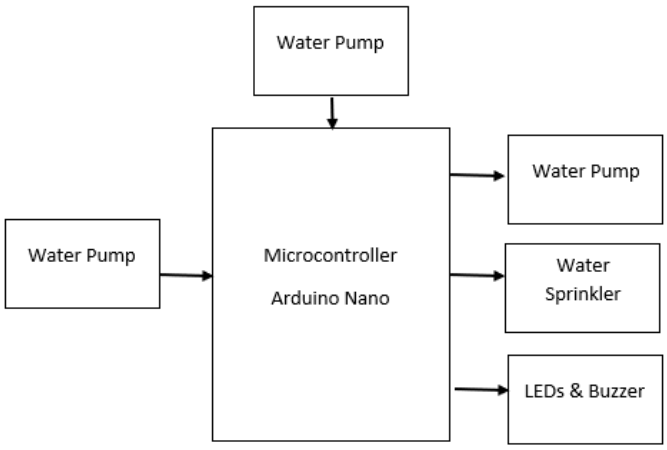

Figure 1. The rainwater system using ultrasonic sensor block diagram

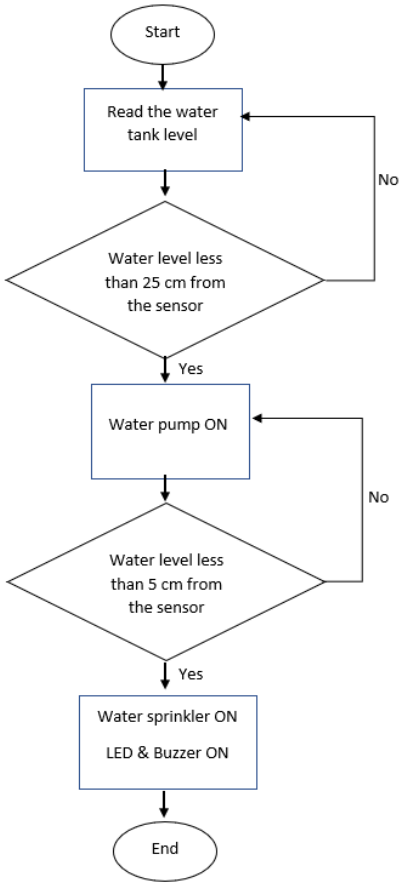

Figure 2. The system block diagram

RESULT AND DICUSSION

The simulation for this project is done using the Proteus Software which can simulate every part of the projects. The system schematic is shown in Figure 3. This flowchart shows the system operation for this project. Firstly, to wait for raindrops to be collected in the first water tank, wait until it is full. After that, when it is full, the ultrasonic sensor will scan and send a signal, a buzzing sound from the buzzer and an electric signal to light up the LED, from this it turns on the water pump, flowing out the rainwater from the first water tank into the second water tank. Immediately after this, the water flow through into the water pipes and through the sprinkler. Turn on the sprinkler and water will come out, thus the watering system for gardening is in succession. The testing results of the system are depicted in Table 1. The Figure 4 shows the complete system prototype.

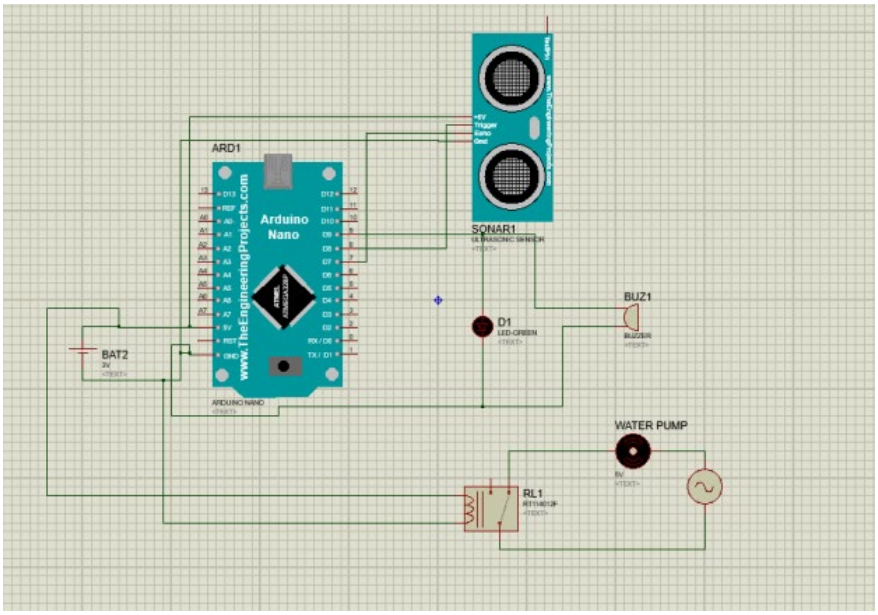

Figure 3. The system schematic

Table 1. Condition and Prototype Results

Condition	Water Pump	Water Sprinkler	LED/Buzzer
Water level in water tank empty (less than 25 cm from sensor)	ON	OFF	OFF
Water level in water tank full (less than 5 cm from sensor)	OFF	ON	ON

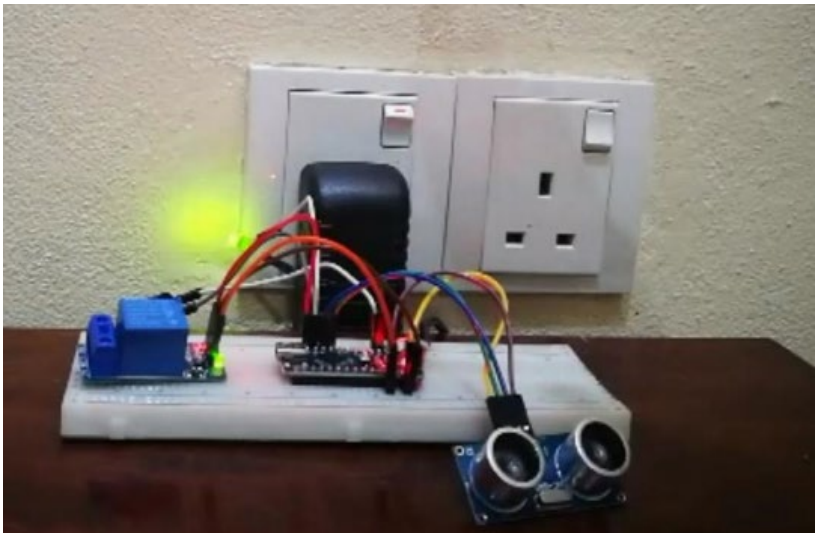

Figure 4. The rainwater system prototype setup

CONCLUSIONS

In summary, this project has been proven successful and can be deemed very useful in the agriculture sector or a miniature irrigation system to be built and in the backyard, lawns or farm for gardening purposes. A small and simple machine but it will help in reducing the costs of water bills as collecting rainwater is like harvesting it and using it for selves' benefit where it is free. Not only that but it helps in securing and maintaining the nature as the greenery is not something to be lightly taken care of. By using this, it reduces the cost of electricity and water bills it also helps in reusing the rainwater as fresh water for watering the gardens and the items needed for this project can be recycled items like old baskets or old tanks. For future references and purposes, it is highly supported and recommended that rainwater harvesting should be the norm as it may be very impactful to the economy and green sector in Malaysia.

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PORTABLE ECO HEATER

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***Abstract*:** This portable eco-heater is designed to heat or warm food in easier way. Since this project focuses on heating food likes microwave oven instead of using gases thus make it more eco-friendly because there is no emission of greenhouse gases to the surroundings. The Arduino Atmega328 is used as a controller to this project. The 12V battery is used to supply voltage to the heating element and thus make it portable to be used everywhere. This project is equipped with the timer to set the desired heating process. The LED light and buzzer are used to alert the user so that they are aware that the process of heating occurs. The LED will turn on during the heating process and the buzzer will turn on when the process heating end.

***Keywords*-** Arduino Atmega, eco-heater, relay, buzzer, LED.

INTRODUCTION

Microwave oven is known to save time by heating up foods quickly, but they consume more power. Most of these appliances that are available in the market are ac powered. There are few reported papers that have been studied using battery powered or DC powered induction cooking to be implemented to this appliance with the needs of DC/AC inverter. Ali et al [1] has successfully modified the conventional microwave oven with addition of new sensors that would be capable of measuring food temperature and accordingly setting the necessary heating time. The existing appliance has a limitation to control over the temperature of the food inside the cavity. Thus, this project is to make sure that the set point of the heating process does not exceeding the set point required for any particular recipe by replacing the microwave oven timer with a proportional integral derivative (PID) temperature control. As a result, this project has improved the microwave oven performance, reduce cost and time. R. Abdullah et al. [2] have reported to design a smart tudung saji which is able to keep the food warm using Atmega328P microcontroller and temperature sensor LM35. The temperature within the prototype is set to 60°C. The circuit is automatically turned off if the temperature sensor LM35 detects temperature higher than the set point which can save electricity. D. Weber et al. [3] has designed an induction stove powered from a low-voltage DC source which is cheaper and easier to bring anywhere. Since the induction stove is powered by a battery DC source, thus there is a limitation towards the usage of the source. Bikal et al. [4] has designed a DC powered induction cooker by simulation and experimentally. They found that the simulation efficiency of which has been measured to be 90.10%. However, the hardware realization of the design is malfunctioning in real time due to several problems, for example the need of capacity to pass very high current at low voltage. Further study needs to be done to overcome these problems. Based on these literatures, there is a possibility to design a DC powered appliance. Thus, this portable eco-heater is designed to ease the people on heating foods and at the same time is mobile friendly due to its small size.

METHODOLOGY

This eco-heater mainly comprises of software and hardware development. The circuit is designed using schematic captured in Fritzing Software. Once the simulation is succeeded, the components are constructed on the breadboard and PCB board. Figure 1 shows the circuit implementation on breadboard which consist of electrical stove as heater, keypad as the (input) timer for the heater.

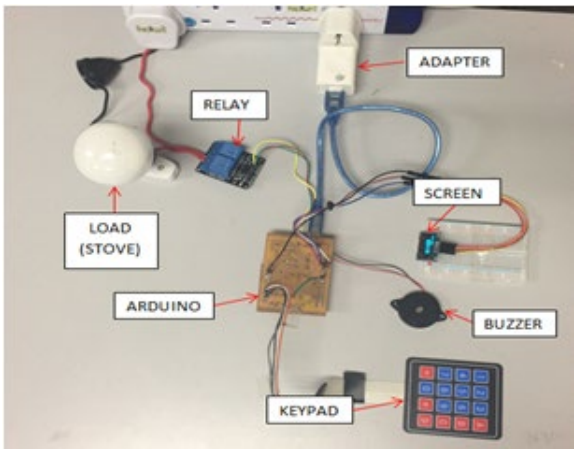

Figure 1. Circuit implementation on Breadboard

RESULT AND DICUSSION

Figure 2 shows the prototype of this project. The main controller used in this project is Atmega328. The battery 12 V is used as the power source to the circuit. Then, this DC source is converted to AC source using inverter DC/AC circuit diagram. The Arduino acts as a controller for the circuit where it received the input from the user (keypad). The output will be LCD screen, buzzer, relay and heater.

Figure 2. Prototype of the Project

Table 1 shows the description of the keypad buttons which are displayed through LCD display. The heating element will automatically start to do heating process after the user has chosen either keypad buttons (A) or (B). The buzzer will notify the user the heating process reaches the limitation setting. This project has a limitation to control the heating process especially in longer time due to insufficient of power supply from battery to supply the inverter and the stove, since the inverter consumes a lot of power usage. Thus, more study is needed to further improve this project.

Table 1 Description of the Keypad Buttons Displayed on LCD

Keypad Button	Display on LCD	Description
A	Automatic	User able to set timer for 1-, 3- and 5-minutes heating
B	Manual	User able to ON/OFF heating depend on the food condition

CONCLUSIONS

As a conclusion, this portable eco-heater is built in portable and eco-friendly environment. This project is easier to operate and convenient to use anywhere since the battery DC source is used as the main source. In the future this project can be improved by using solar as a supply power source.

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