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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 4

HYBRID SOLAR AND VOLTAIC-CELLS ENERGY HARVESTING SYSTEM

Wan Alma Kamelia Wan Azhar, Nur Fatin Najihah Mohd Ropi, Siti Sara Rais[1]

[1] School of Electrical Engineering, College of Engineering
University Teknologi MARA Terengganu
[1]E-mail sitisara851@uitm.edu.my

Abstract: Today, electricity is a priority in the use of our daily lives. Electricity supply is no longer a desire but has become a necessity in performing daily tasks. This demand directly causes an increase in electricity consumption. The project does not involve a large scale in generating electricity; it focuses on charging smartphones and tablets, installing lights, and other purposes via USB connections. The sources of power supply are from solar energy and voltaic cells. The electrolyte material used in voltaic cells are any sources that capable of generating energy, such as food waste, mud, soil, saltwater, seawater, and others. This combination of solar and voltaic cells will be used to charge batteries and subsequently used in applications. Charging from these two sources to the battery requires control from the Arduino UNO to maintain battery life.

Keywords: electricity, renewable energy, alternative energy, Arduino UNO, battery charging system.

INTRODUCTION

Consumption of electricity from non-renewable sources, including hydroelectric sources, can affect the environment. Numerous research has been conducted to lessen reliance on unsustainable energy sources such as solar, wind, tide and waves energy, so-called renewable energy. There is also alternative energy such as biogas, biothermal, geothermal, biomass, and more. Recognizing the necessity of employing renewable energy sources, this project is being undertaken on a small scale to lower electricity expenses. The block diagram of a complete system is depicted in Figure 1. The renewable energy sources are wired in series to provide 9V to the 9V battery. The solar panel is rated at 8 volts, whereas the voltaic cells are only rated at 1 or 2 volt. The voltage regulator is required to convert the 9V battery to 5V for use in USB devices. The charging process is controlled by an Arduino UNO. To regulate the charge and discharge process, Arduino reads the battery voltage.

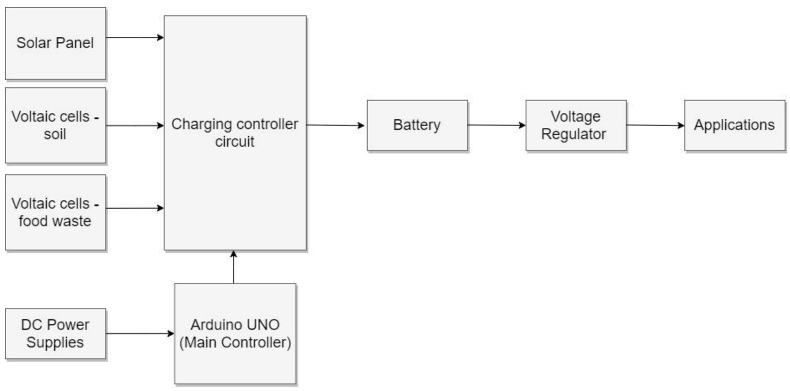

Figure 1. Block diagram of a project

The previous study demonstrated the use of Nigerian fruit juices as battery electrolytes, including Lemon, Lime, Orange, Grape, Watermelon, and Coconut. It was discovered that the battery system generates a small amount of voltage. The current generated is used to power an LED light. Lime juice electrolytes, on the other hand, created a larger voltage than other fruit juice electrolytes [1]. In a different study, pineapple, squeezed orange, and tomato were used experimentally as alternate energy sources for electricity. According to the author's analysis, all variations in the material's composition generate voltage and current and can power a modest 2 Volt LED bulb. As the author points out, as the volume of the orange solution increases, the solution becomes more acidic, resulting in a low pH and ideal current and voltage [2].

METHODOLOGY

The research is started with the voltaic cells experiment. Figure 2 illustrates the experimental setup for voltaic cells. Six cups were utilised in the experiment to hold various electrolytes and electrodes. A cup is 1L in volume. The experiment's outcome will identify the optimal resource possibilities for this system.

Figure 2. Experimental setup for different electrolytes and electrodes

The charging process is controlled by Arduino UNO is presented in a flowchart as depicted in Figure 3. The Arduino measures the battery voltage and, if it is less than 9V, the relay activates the charging connection. The LCD displays the battery voltage. The red LED illuminates to indicate charging. When the battery voltage exceeds 9V, the relay disconnects, the LCD displays the new voltage value, and the green LED illuminates as a discharging indicator. The flowchart is a guidance for programming part.

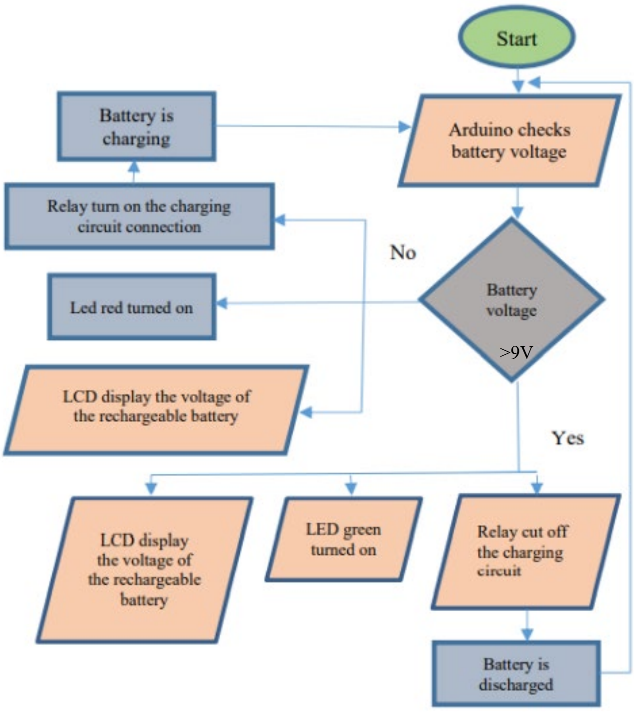

Figure 3. Flowchart of a charging process by Arduino UNO

Figure 4 exhibits a schematic diagram of a system. Alternative energy sources for this system include solar panels (8V), food waste (1-2V), and organic soil (1-2V) voltaic cells. The ATmega328P microprocessor controls the relay, which works as an automatic switch for the charging and discharging processes (in Arduino UNO board). R2 and R3 are utilised to measure the battery voltage using voltage divider rules [3] and provide signals to the relay. The LCD displays the battery voltage reading [4]. The green and red LEDs indicate whether the system is charging or discharging. Voltage regulators are required to convert 9V to 5V for USB applications.

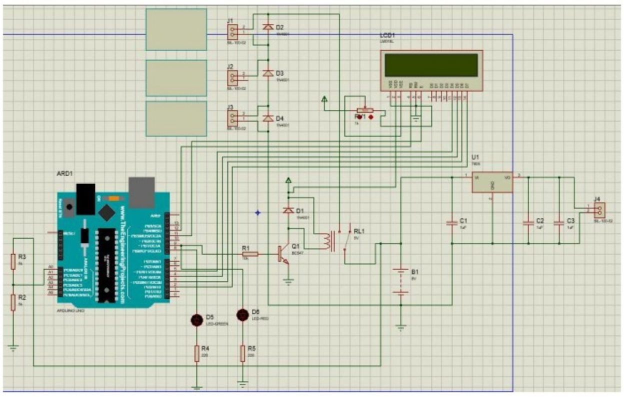

Figure 4. Schematic Diagram of a system

RESULT AND DISCUSSION

Table 1 presents the voltage and current measurement of the voltaic cells experiments. From this data, we can conclude that the food waste with a large volume can significantly achieve a higher voltage and current. It is apparent from this table, the usage of Fe+Cu as electrodes contributes to the higher current, while Al+Cu provides higher voltage. This data reveals that the usage of voltaic cells for energy harvesting required a large volume and number of cups.

Table 1. Result of the voltaic cells experiments

Electrolyte	Electrodes	No. of cups	Volume/cup	Voltage	Current
Food waste	Fe+Cu	6	1L	2.66V	0.49mA
	Al+Cu			2.87V	0.44mA
Organic soil	Fe+Cu			2.14V	0.16mA
	Al+Cu			2.20V	0.37mA
Mud	Al+Cu	5	100ml	15.4mV	0.5µA
Organic soil				155mV	3.6 µA
Food waste				55mV	1.8 µA

Figure 5 and Figure 6 show the results of a system when the system is discharging where the battery is beyond the setting voltage (condition voltage as shown in a flowchart). The green LED is turned on and the relay cuts the charging connection. Figure 5 is a simulation result, while Figure 6 is a result from a prototype model. The LCD displays the value of voltage measurement. When the battery is less than 9V, the charging process is activated by connecting the relay to its circuit connection and the red LED is turned on. However, this result is not shown in the figure here.

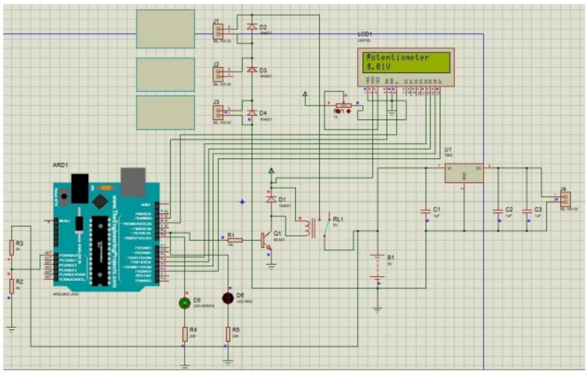

Figure 5. Simulation results of a system

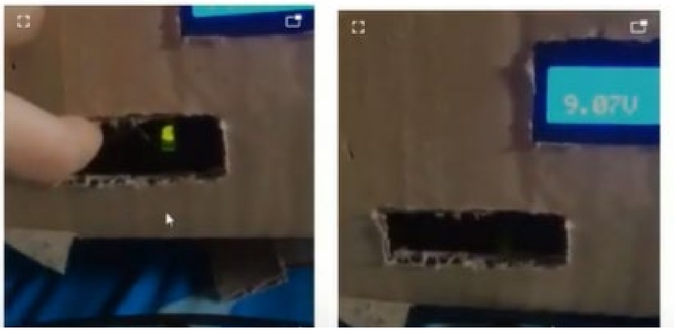

Figure 6. Results for a prototype system

CONCLUSIONS

This project was undertaken to design a hybrid renewable energy harvesting system with solar energy and voltaic cells in a small-scale application. The research began with voltaic cells experiments. These findings suggest that when using food waste or organic soil as an electrolyte to generate higher voltage and current requires a large volume and number of cells. However, the charging system is fully functional, and the operation is described in the flowchart given in the methodology section. It is recommended for future works; the system is required a Pulse Width Modulation (PWM) for the charging process to maintain battery life. Other than that, the features of IoT for monitoring and controlling the system.

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TREATMENT OF GREYWATER USING POTASSIUM ALUM AND ARDUINO UNO

Muhammad Faiz Amrie Ibrahim, Ahmad Jamalludin, Norhidayatul Hikmee Mahzan, Shaiful Bakhtiar Hashim[1]

School of Electrical Engineering, College of Engineering
University Teknologi MARA Terengganu
[1]shaifulbakhtiar@uitm.edu.my

Abstract: Water was used for everyday household purposes, such as bathing, dishes, flushing toilets, and washing machine. These activities are producing greywater. This project aims to develop the prototype of greywater treatment to conserve water and convert contaminated water from the washing machine (grey water) into clean water. Arduino Uno, pH sensor, ultrasonic sensor, solenoid valve, servo motor, and potassium alum are components and materials used in this project. This project was achieved by chemical filtration of the greywater using Arduino Uno. The greywater will be collected and identify the pH level by using a pH sensor. The quantity of potassium alum inserted in greywater was based on the accumulated pH value. The potassium alum was inserted into the greywater to eliminate the detergent in that greywater. The pH sensor was used once again to ensure the greywater are eliminated. The treated water was stored in a tank so that it can be used for the irrigation system, while the ultrasonic sensor was used to determine the level of treated water in the tank.

***Keywords*:** Greywater, Potassium Alum, Arduino Uno.

INTRODUCTION

Water is essential for human daily use, and it is necessary not only for drinking but also for our everyday life purposes. Water was used for everyday household purposes, such as bathing, dishes and flushing toilets. These activities are producing greywater. A widespread water shortage is encountered due to contamination of ground and surface water by industrial effluents and agricultural chemicals. In many developing countries, industrial pollution is less common than in larger urban areas [2]. Shortage of water is one of the main concerns that is faced throughout the world. Humans tend to wastewater every day [3]. Eighty-five percent of the world's water consumption is for farming activity, which is at a rate of 235 million litres per second, and 70% of this water spent is wasted [4][5].

Water consumed for washing machines becomes the second biggest water waster in an average household [6][7]. The wastewater from the washing machines should have been recycled. Whether a washing machine is built with old technology or recent water-efficient technology, each load uses between 15 and 40 gallons of water. The other problem is water scarcity. Water scarcity and conservation issues are rated differently depending on the geographical areas. The wise and efficient use of water is becoming a cultural norm. The consumption and the importance of water stewardship need to be emphasized among consumers.

This project aims to develop an inexpensive system to conserve water and convert contaminated water from the washing machine (greywater) into clean water. The demand for freshwater to deliver to our homes increases as more and more residential homes are being established. This is achieved by chemical filtration of the greywater using Arduino UNO. The greywater will be collected and identify the water's pH using a pH sensor to determine how much potassium alum is required to eliminate the detergent in the greywater. The treated water is stored in a tank so that it can be used for the irrigation system.

METHODOLOGY

Figure 1 shows the flowchart of the project. First, the pH sensor will sense the pH level of the water. After that, potassium alum will be added to coagulate the soap, and the sedimentation process will occur. After the two methods are completed, the ultrasonic sensor determines whether the clean water tank is full or not. If no, the switch will be turned on to open the gate valve. Water will flow through the cylindrical filter and store in a clean water tank. When the tank is full, the ultrasonic sensor will signal to change the servo motor's angle, and then the gate valve will be closed.

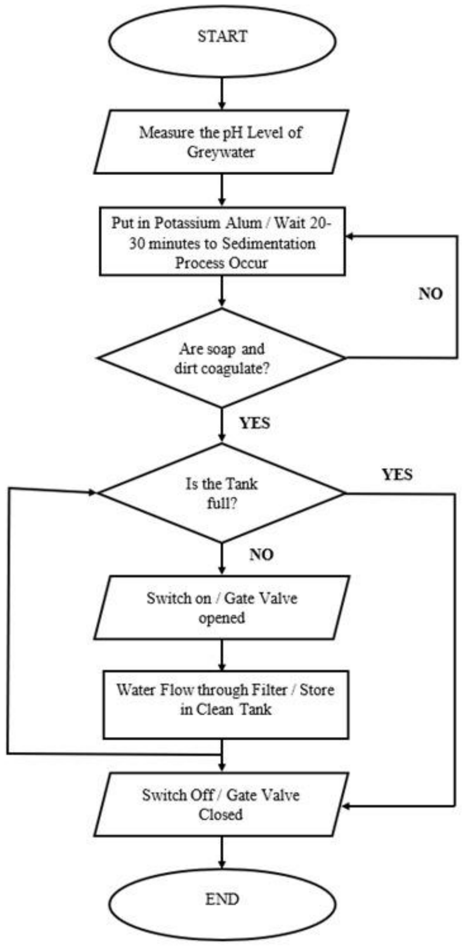

Figure 1. Flowchart of this project

RESULT AND DISCUSSION

Figure 2 shows the hardware connection for this project. Push-button was used to replace the actual pH sensor. The ultrasonic sensor measured the water level in a tank, while the servo motor for open and closed gate valves. Figure 3 shows the complete prototype for this project. Tank A was used to store the greywater from the washing machine. First, the pH sensor was used to identify the pH level from the washing machine, and then potassium alum was added for the coagulation and sedimentation processes in tank A. After tank A is full, and the pH level was neutral, the servo motor will open the gate valve to allow the water to flow. The treated water will flow through the cylindrical filter and to tank B. The treated water from tank B can be used for the irrigation system.

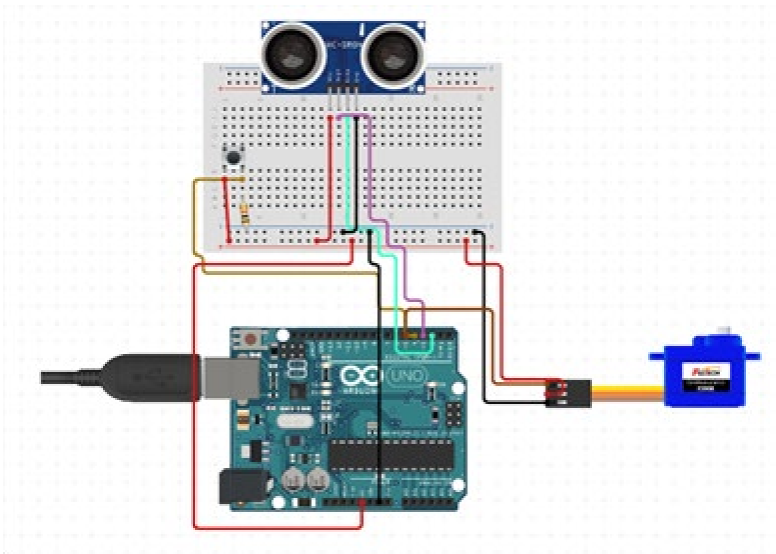

Figure 2. Hardware connection of this project

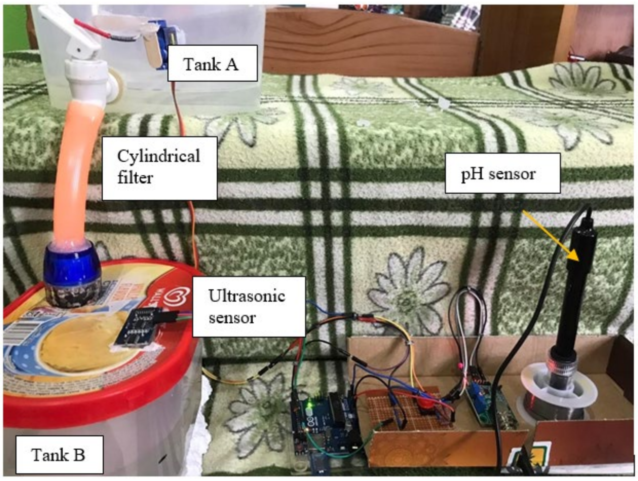

Figure 3. Prototype of this project

Table 1 shows the pH level result as potassium alum is added to greywater. The pH level was measured to identify how much potassium alum need to neutralize the soap. Alkalinity and pH are two essential factors in determining the suitability of water for irrigating plants. pH is a measure of the concentration of hydrogen ions (H+) in water or other liquids. The pH level of clean water is then measured to recognize if clean water is suitable for irrigation. In general, water for irrigation should have a pH between 5.0 and 7.0.

Table 1: pH level result as potassium alum added

No. of test	**Greywater pH level**	**Potassium Alum Added (tablespoon)**	**Clean water pH level**
1	11.66	11/2 tablespoon	6.27
2	9.83	1 tablespoon	5.92
3	11.34	11/4 tablespoon	6.44

CONCLUSIONS

In conclusion, the prototype for this project was successfully developed. The project was proposed to isolate household water that is being wasted. It found that chemical processes such as coagulation, followed by a filtration or disinfection stage, can reduce the suspended solids, organic substances, and surfactants in low-strength greywater to an acceptable level that can meet non-potable urban reuse needs [8]. However, for medium- and high-strength greywater, the water produced from chemical processes cannot always meet the required reuse standards in all situations unless these processes are combined with other techniques. The additional work that needs to be taken into account is the chemical that needs to be applied to minimize the microbial activity that is taking place in the recycled tank. Therefore, this prototype needs improvement to build a large-scale model.

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SWITCHING CONTROL SYSTEM FOR HYBRID POWER SOURCES

Ahmad Firdaus Ahmad Radhuan[1], Mohamad Aiman Ayob[2], Nur Idawati Md Enzai[3],

[1,2,3]*School of Electrical Engineering, College of Engineering*
University Teknologi MARA Terengganu
[1]*Ahmadfirdaus7422@gmail.com,* [2]*aimanayob25@gmail.com,* [3]*nurid333@uitm.edu.my*

Abstract: This project aims to provide people with continuous power supply to their homes without having to worry about sudden cuts of electricity or power outage during critical time. Our automatic switching control system will automatically change from one source to another, by selecting the supply from any of the three different power sources that can be chosen by the user to power the load. This project is motivated by the importance of electricity especially in term of continuous power supply. Our proposed system allows users to adopt their own power sources to be integrated. This system allows a user to decide the priority ranks of power sources; namely solar, wind turbine and main. Our system also smartly recognizes which power source has higher stored power than the other and that power source will be used as the main power source instead. The failure of the source that is being used will not affect the supply of electricity to the loads since the system will instantly change from one source to next available source. Consequently, energy can be saved and electricity bills can be reduced.

Keywords: Power supply, automatic, switch

INTRODUCTION

Electricity is a fundamental part of nature and it is one of our most commonly used sources of energy [1]. However, the frequent power cuts of electricity are causing numerous difficulties for areas that require continuous supply of electricity to operate well. That is why an alternative arrangement for power source is very crucial. Many works have been proposed to address this problem. For instance, four different sources which are 230V mains, thermal, solar panel and wind turbine are used. 8051 microcontroller is utilized as the brain of the system [2]. On the other hand, to achieve perfect switching and remove possible fluctuation resulting from voltage change, 4013-segment D-flip-flop logic device is incorporated by [3] . Our project aims to construct a precise relay circuit that consists of three power sources. An automatic switching control system without break power when the system changes from one source to another is designed by using Arduino. Consequently, constant and continuous power supply can be provided.

METHODOLOGY

The proposed prototype uses three Lithium-ion batteries with different voltages to represent three different power sources. Source 1 is 9V Lithium-ion Battery (Battery 1), Source 2 is another 9V Lithium-ion Battery (Battery 2) and Source 3 (Backup) is 5V Lithium-ion Battery (Battery 3). The dimensions are shown in Table 1. The operation details are as shown in Figure 1 and Figure 2:

Table 1. Dimensions of Prototype

Length	27.5cm
Height	5.2cm+0.4cm (screen)= 5.6cm
Width	17.3cm

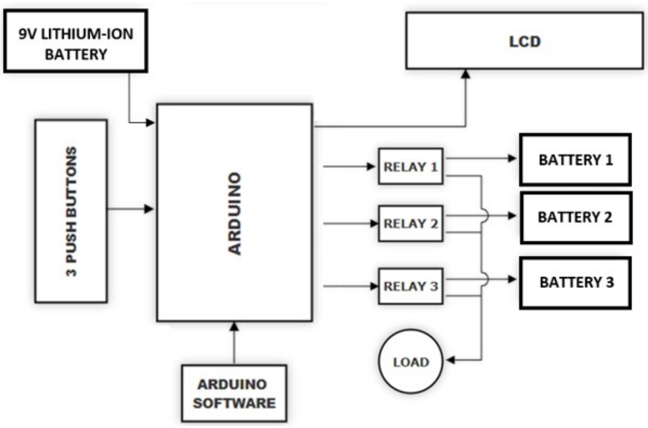


Figure 1. Block Diagram of the System

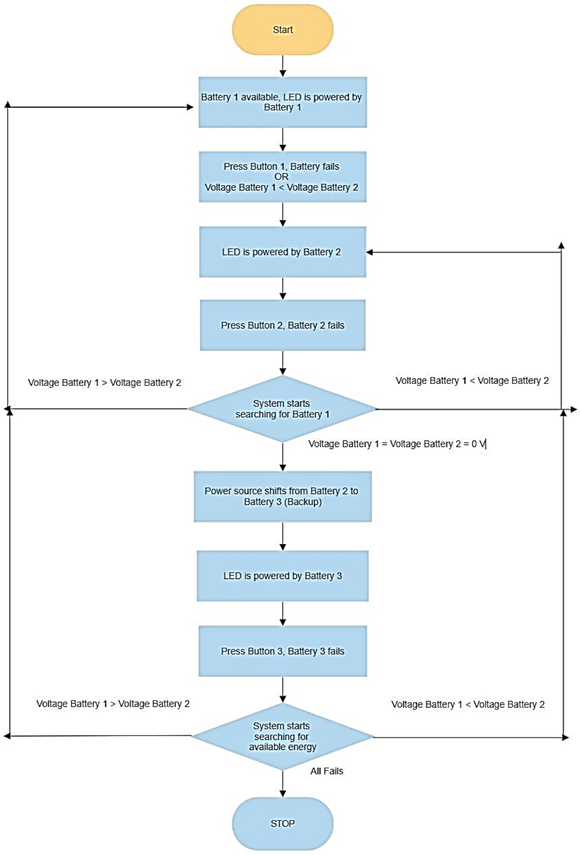
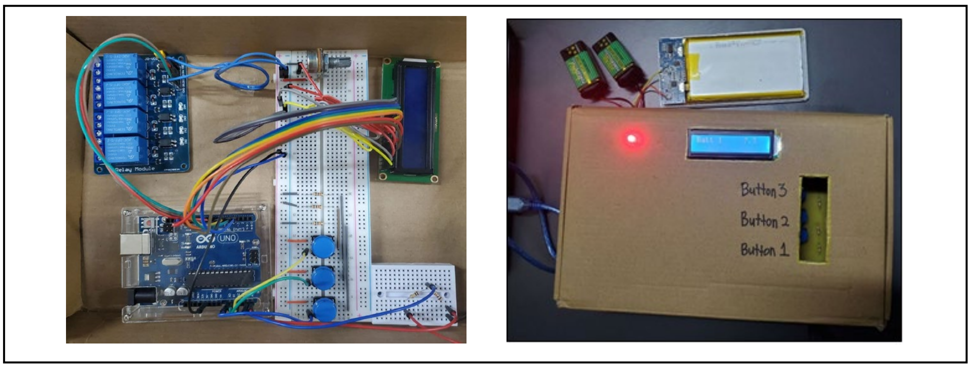


Figure 2. Flowchart of the System

RESULT AND DICUSSION

The developed prototypes are shown in Figure 3a) and Figure 3b): Meanwhile some of the testing results are depicted in Table 2:



(a) (b)

Figure 3: (a) Interior of the Prototype. (b) Exterior of the Prototype

Table 2. Button States Testing Results

	Power Source	Input Voltage (V)	Button Status	LCD Display	Load Status
Case 1	Battery 1	7.6	ON	Powered by: Battery 1	ON
	Battery 2	2.9	ON		
	Battery 3	5	ON		
Case 2	Battery 1	7.6	OFF	Powered by: Battery 2	ON
	Battery 2	2.9	ON	Battery 1 Fails	
	Battery 3	5	ON		
Case 3	Battery 1	7.6	ON	Powered by: Battery 1	ON
	Battery 2	2.9	OFF	Battery 2 Fails	
	Battery 3	5	ON		
Case 4	Battery 1	7.6	ON	Powered by: Battery 1	ON
	Battery 2	2.9	ON	Battery 3 Fails	
	Battery 3	5	OFF		
Case 5	Battery 1	7.6	OFF	Powered by: Battery 3	ON
	Battery 2	2.9	OFF	Battery 1 & Battery 2	
	Battery 3	5	ON	Fails	
Case 6	Battery 1	7.6	OFF	Powered by: -	OFF
	Battery 2	2.9	OFF	All Fails	
	Battery 3	5	OFF		

CONCLUSIONS

This project of Automatic Power Supply Switching Control System is designed and developed to give people uninterruptible power supply to the load from three types of different sources depending on users' preferences. Arduino ATmega328 is utilized as the microcontroller for this project. This project is part of the efforts towards more usage of renewable energy.

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STREETLIGHT COLOUR CHANGING BASED ON LIGHT INTENSITY AND HUMIDITY

Muhammad Wafiez Aimi Ab Rashid[1], Muhammad Taufiq Ab Fattah[2], Ahmad Izzat Mod Arifin[3],

[1,2,3]*School of Electrical Engineering, College of Engineering*
University Teknologi MARA Terengganu
[3]*ahmadizzat*@uitm.edu.my

Abstract: Malaysia's climate is categorised as equatorial since located near the equator. Usually being hot and humid throughout the year but Malaysia faced two monsoon seasons which brings more rainfall than usual [1]. Since Malaysia experienced in humid climate, fog easily will form. In a foggy condition, drivers have a limited visibility compared to a normal day. The primary function of streetlight is to illuminate objects or areas to the drivers. Mostly, streetlights in Malaysia is yellow in colour and it is suitable and makes road user more comfortable during rain and foggy condition. However, some road user complained that yellow street light distracted their views when its neither raining nor foggy. This project will recommend the solution in order to overcome this problem. This project provides the idea to change the colour of light in streetlight based on humidity which work in rain, foggy and normal night. The objective for this project is that it can reduce the rate of roadway incidents and can be useful and comfortable for road users to use at different climate condition. This project consists of two sensors which is humidity sensor and LDR sensor. Humidity sensor sense the changes in humidity while LDR can measure the light intensity. An Arduino process the input from the sensors and change the colour of the streetlight based on several condition. The streetlight will change colour from yellow to white according to the weather situation. It will give more illumination for the road users based on weather situation.

Keywords: streetlight, Arduino, LDR, humidity

INTRODUCTION

The earth is a special place for human to develop in various ways depending on the specific qualification for the human to achieve. For the common understanding in human civilisation, the earth surrounds the biggest star in our galaxy which is the sun in their own orbits and the earth also have its own circulation or in simple words, the earth have the night and days [2]. At night, the light was needed for illuminate the entire surroundings especially for the road user. Road is an important element in transportation sector and always been used either day or night. During night the streetlight will take its duty to give a better illumination for the road users. Last but not least street lights also are an important source of public security lighting intended to reduce crime.

In the most country, the common colour in streetlight are yellow. Sometimes, the colour are not suitable with the specific weather condition such as raining and foggy. Based on the research, the colour of light that suitable in raining and foggy is yellow and normal night is white. This project is to build the streetlight that can give the benefit to the road users by changing streetlight lighting colour based on weather condition.

METHODOLOGY

Figure 1 shows a block diagram of the proposed system. There are three main part which is Input, Microprocessor, and Output. As an input, the humidity and LDR were used to collect the input from the humidity and light intensity of the surrounding. The function of humidity sensor is to detect any changes in humidity while LDR to measure light intensity then the data were transfer into the microcontroller [3][4]. The main part of the system is microcontroller where ATmega328p were used. The data will process based on the algorithm and produce desired output. LED will act as output in this system, which it will change the colour of light based on humidity and light intensity of the surrounding.

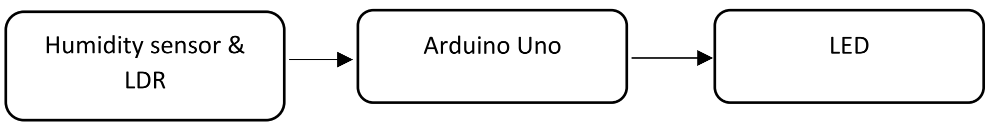

Figure 1. Block Diagram of the Project

Figure 2 shows the flow chart of the purposed system. The project was start to initialize the system then the LDR will sense the light intensity. After that humidity sensor detects any kind of changes in humidity. Next, it will send the signal to Arduino UNO to process the data based on humidity surrounding condition. If the humidity below 80% then the white light LED will turn on. If the humidity above 80% then the yellow LED will turn on.

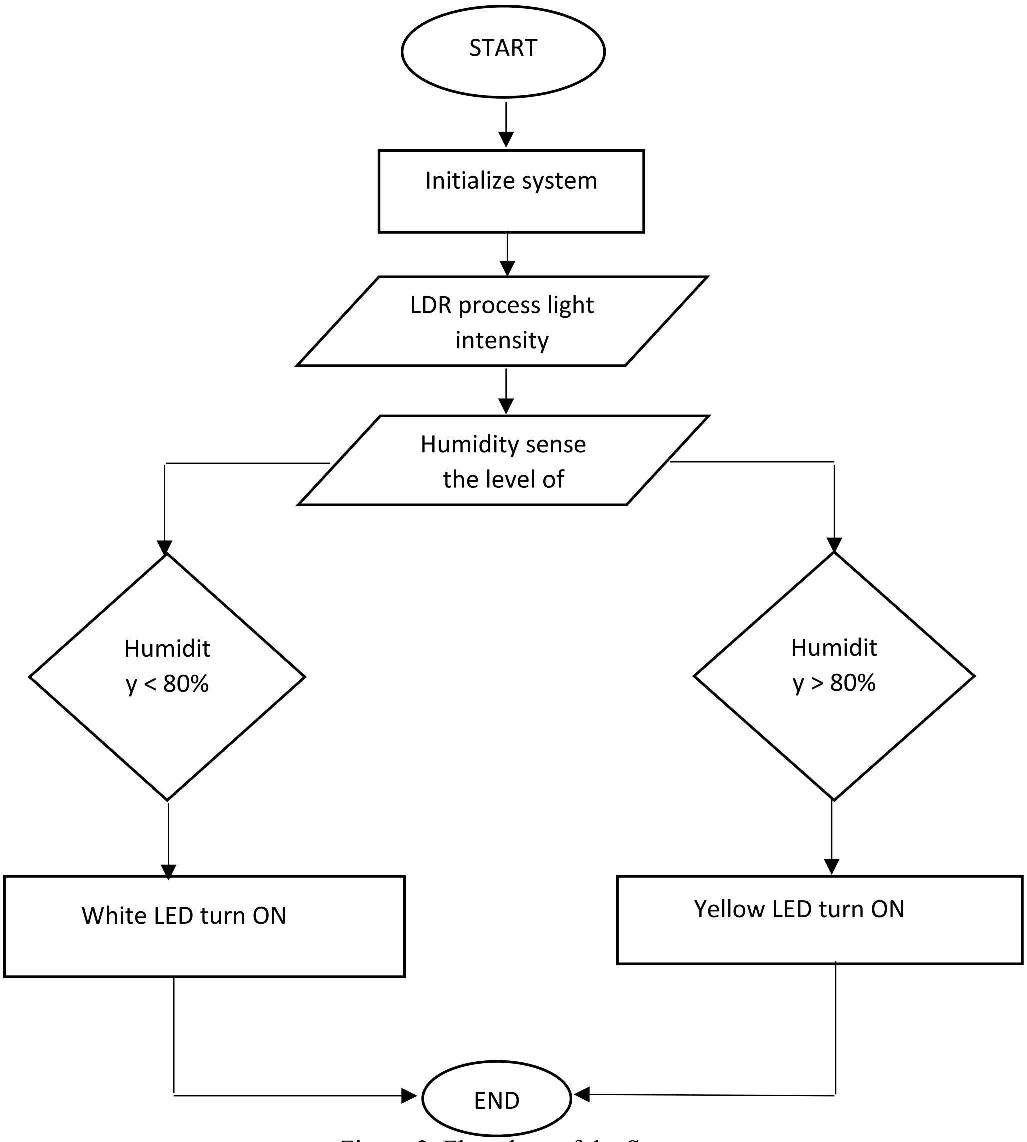

Figure 2. Flowchart of the System

RESULT AND DICUSSION

This prototype consists of a pole of and LED same goes with the standard streetlight. For make the humidity change, the wet tissue act as surrounding raining was put on humidity sensor and it will detect the surrounding was change and the colour of the light will change to yellow as it set when the raining or foggy. The colour will change back to normal when the surrounding become normal condition. The developed prototypes are shown in Figure 4. Meanwhile some of the testing results are depicted in Table 2:

Figure 4. Prototypes of this project (red lamp=white lamp)

Table 2. Condition and Prototype Results

Weather	**Lamp ON/OFF**	**Light colour**
Sunny	OFF	-
Night	ON	White (Red)
Sunny with heavy rain/foggy	ON	Yellow
Night with rain/foggy	ON	Yellow

CONCLUSIONS

In conclusion, the streetlight will give benefits to the road users especially at night, during raining or foggy and during sunny but heavy rain or foggy. With this transformation of streetlight, the road users can see the road clearly when driving in raining or fog. Perhaps that by implementing this project it may also give extra safety to the road users within the hazardous foggy or rainy weather.

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