Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF ENERGY EFFICIENT FOR AUTOMATED HYDROPONIC SYSTEM BASED ON SOLAR ENERGY WITH ELECTRICITY SAVING BOX AND NODEMCU

ABDUL RAUF BIN YA'AKUB

Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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A project report submitted in partial fulfilment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Telecommunications) With Honours

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Alamat Tetap: LOT 443 KAMPUNG LEMBAH HIJAU, JALAN RIAM 98000 MIRI SARAWAK

Tarikh: 27/01/2023

DR. ADAM WONG YOON KHANG
Pensyarah Kanan
Jabatan Teknologi Kejuruteraan Elektronik dan Komputer
Fakulti Teknologi Kejuruteraan Elektrik & Elektronik
Universiti Teknikal Malaysia Melaka (UTeM)

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I declare that this project report entitled "Development Of Energy Efficient For Automated Hydroponic System Based on Solar Energy With Electricity Saving Box and Nodemcu" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

Signature : 

Supervisor Name : TS. DR ADAM WONG YOON KHANG

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DEDICATION

This research is dedicated to my parents, Ya'akub bin Peny and Dayang Norlia binti Awang Moksin, who have always encouraged me. They have given me the encouragement and motivation that I need to not give up in doing this project. To my supervisors, Ts Dr Adam Wong, I sincerely thank you for guiding me throughout the project. Without their love and support, this project would not have been possible.

ABSTRACT

A hydroponic system can be defined as a form of a soil-less farm. The majority of people nowadays want a plant in their homes. One of the main causes found is high usage energy using electrical energy that will increase bills every month and waste energy consumption. This growing use of electrical energy sources may cause high energy consumption in the hydroponic system. Due to high energy consumption, the solution is the use of renewable energy, called solar energy. Due to the high energy consumption using electricity, an improvement should be added to the hydroponic system. Therefore, the main purpose of this project is to develop algorithms employed in the hydroponic system. The objective of this project is to build an algorithm that controls the electricity production from solar panels depending on a program stored in the microcontroller. The NodeMCU and microcontroller will aid in collecting data and analysis. Based on observation, this project worked to monitor and optimize the energy based on a solar panel in the hydroponic system.

ABSTRAK

Sistem hidroponik boleh ditakrifkan sebagai satu bentuk ladang tanpa tanah. Majoriti orang pada masa kini mahukan tumbuhan di rumah mereka. Antara punca utama ialah penggunaan tenaga yang tinggi menggunakan tenaga elektrik yang akan meningkatkan bil setiap bulan dan membazirkan penggunaan tenaga. Penggunaan sumber tenaga elektrik yang semakin meningkat ini boleh menyebabkan penggunaan tenaga yang tinggi dalam sistem hidroponik. Oleh kerana penggunaan tenaga yang tinggi, penyelesaiannya ialah penggunaan tenaga boleh diperbaharui yang dipanggil tenaga suria. Oleh kerana penggunaan tenaga yang tinggi menggunakan elektrik, penambahbaikan perlu ditambah kepada sistem hidroponik. Oleh itu, tujuan utama projek ini adalah untuk membangunkan algoritma yang digunakan dalam sistem hidroponik. Objektif projek ini adalah untuk membina algoritma yang mengawal pengeluaran elektrik daripada panel solar bergantung pada program yang disimpan dalam mikropengawal. NodeMCU dan mikropengawal akan membantu dalam mengumpul data dan analisis. Berdasarkan pemerhatian, projek ini berfungsi untuk pemmantauan dan mengoptimumkan tenaga berdasarkan panel solar dalam sistem hidroponik

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My parents and other family members have my deepest gratitude for their support and prayers during this time of the study. My parents, Ya'akub bin Peny and Dayang Norlia Binti Awang Moksin deserve recognition as well for all of their inspiration and compassion. I was constantly getting more done because of your encouragement and prayer.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

V	-	Voltage
mm	-	Millimeter
k	-	Kilo
W	-	Watt
h	-	Hour
C	-	Temperature

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

Agriculture has expanded fast all across the world. Some new agricultural techniques have been created to replace traditional soil-based farming, with hydroponics being one of the most advanced and popular [1]. Hydroponics is a way of producing plants that do not require soil. That was previously thought to be a method with no growth material, such as the nutrient film technique (NFT) and Deep flow technique [2]. Most plant factories make hydroponic systems because of their extra advantage of automated monitoring and control of fertilization which can save labour [3].

Furthermore, when solar power is added to a hydroponic system, it becomes one of the most energy-efficient and environmentally responsible ways to raise food [4]. Solar energy is power from the radiation created by nuclear fusion in the sun [5]. Academics and industry executives are taking an interest in the developing Internet of Things (IoT). Hydroponics with IoT can increase plant output and lower maintenance costs [6]. Solar energy and the Internet of Things (IoT) are used in this project to create an automated hydroponic system. Solar energy is a power supply of this project to run all the hydroponic systems. Next, several parameters have been measured to control the hydroponics system and solar energy. The parameters that are measured for controlling and monitoring the hydroponic system are temperature water, light intensity, and nutrient water. For solar energy, the parameters are measured to control and monitor the voltage and current from the solar system.

1.2 Problem Statement

Nowadays, most emerging countries are dealing with the same issue of rising population and pollution. That has resulted in a rise in energy usage, forcing them to explore other energy sources other than diminishing fossil fuels, such as renewable energy, namely solar. Malaysia, located in South East Asia, is in a similar scenario. This growing use of electrical energy sources may cause high energy consumption in the hydroponic system. Due to high energy consumption, the solution uses renewable energy, called solar energy. It was difficult to control minimum and maximum output energy for the hydroponic system, especially for the water pump, which might be high energy. Energy may be saved by using environmental resources and setting up optimal operational parameters for hydroponic equipment. Not just that, unpredictable weather might hurt plants and make them tough to grow. It is tough to control the growth of the plant.

1.3 Project Objective

The main aim of this project is to develop an energy-efficient algorithm for an automated hydroponic system based on solar energy and Nodemcu. Specifically, the objectives are as follows:

a) To design an algorithm for the hydroponic system completely reduce the energy consumption devices.

b) To evaluate the functionality of the algorithm method.

c) To develop the hydroponic automatic control system using ESP-32

1.4 Scope of Project

This project focuses on the energy-efficient algorithm automated hydroponics system based on solar energy and Nodemcu. In achieving project objectives, several scopes of the project have been identified.

a) Create a hydroponic system that will use renewable power sources and enable automatic hydroponic with an energy-saving circuit.

b) The system control unit is embedded with an algorithm and sets the output high and low energy thru the sensor in hydroponics.

c) The system is analyzed all the sensor data and is shared with the microcontroller and NodeMCU for analysis. All the parameters of growth can be monitored by the microcontroller and Node MCU 32.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This section aims to investigate and research previous studies by other researchers who have related and development strategists to construct the energy-efficient algorithm automated hydroponics system based on a solar panel. This chapter will discuss the optimization of the energy thru the hydroponic system, a water pump that might use high energy consumption. With comprehensive and accurate techniques, corrective and precautionary solutions of the energy-efficient algorithm on the hydroponics system can be planned and executed correctly.

2.2 Hydroponic system

Hydroponic is a process of growing plants in sand, gravel, or liquid with extra nutrients but without soil. There are other approaches to building a hydroponic system, but this project will concentrate on the Nutrient Film Technique (NFT). It is made of a basic growth medium, such as Polyvinyl Chloride (PVC), and a constant supply of fertilizer solution from a reservoir. Based on the figure below, a feeder line from a submerged pump within the reservoir to the growth medium and eventually finishing with a return pipe to the reservoir ensures a consistent supply of nutrient solution. [7]

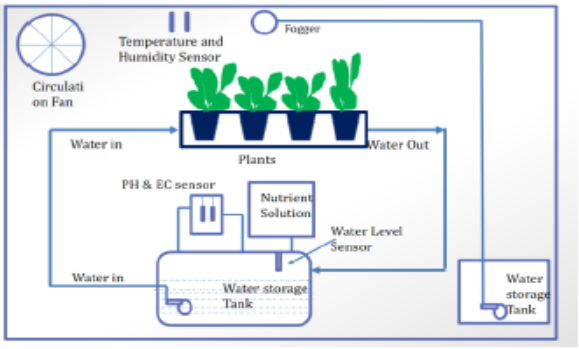

Figure 2.1 Hydroponic system [7]

2.3 Internet of Things in hydroponic

Nowadays Internet of things (IoT) is a new technology that uses the Internet to link things (hardware) and people. The data collected by the devices are saved in the cloud for the users to analyze or study. The rise of the Internet of things has created opportunities for an automated agricultural systems such as irrigation, water quality control, and environmental management. The hydroponic system can be automated by utilizing IoT. Remote monitoring and control of the hydroponic parameters such as light intensity, temperature, and the pH water level are possible. The data is acquired from items stored in the cloud. The data from the cloud may be retrieved by various mobile devices for monitoring, controlling, and feedback purposes. Arduino microcontrollers and other microcontrollers are made to carry out these operations.

2.4 Hydroponic System based on Solar Energy

This solar-powered hydroponic system is such a well technology. The solar panel is powered by the light of the sun. The energy supplied by the solar panel is transferred to the battery to charge and discharge power generation. A relay will activate the motor, and the humidity sensor and timer will be connected to the Arduino UNO. Figure 2.4 shows the block diagram presented [8]:

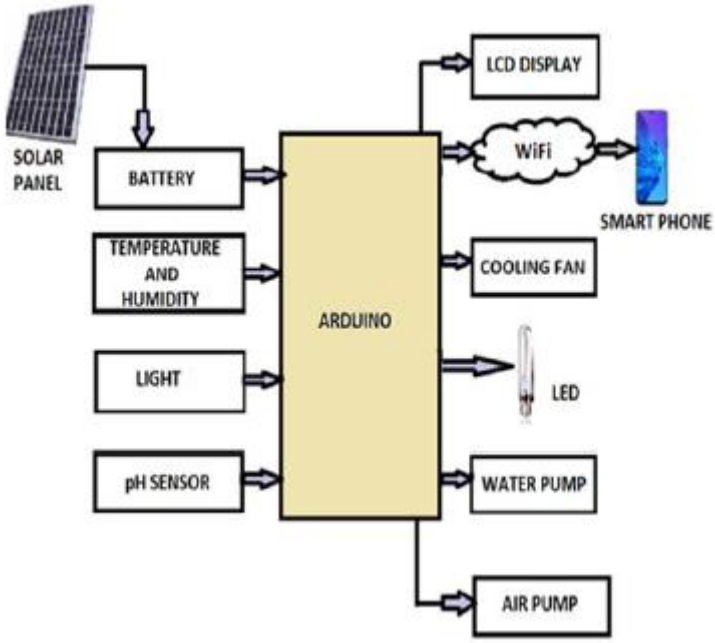

Figure 2.2 Block Diagram[8]

2.5 Energy Efficient Algorithm on Hydroponic System

Energy efficiency has been highlighted as a significant strategy in today's contemporary society to handle developing concerns such as rising fuel costs, market competitiveness, tightening regulation, climate change, and energy crises due to limited fossil fuel resources. There are three basic ways to use solar energy: direct conversion of solar energy to electric power, thermodynamic conversion of solar energy to electricity, and thermal conversion of solar energy. The highest need is for conversions to heat energy and direct electricity. The challenge of the hardware fulfilment of data processing algorithms on contemporary element bases is quite important nowadays. Using the capabilities of the current generations of programmable logic integrated circuits to solve this challenge allows it to be elevated to a new level. The article offers the findings of research conducted within the context of the specified objective. A comprehensive machine learning algorithm is a solution to reduce energy consumption that can be planned and executed correctly [9].

This section of the essay included a condensed introduction to the idea of architecture as well as the possible procedures. According to what was said before, two varieties of sensors (water level and humidity level) were provided and four varieties of actuators (water pump, overflow system, dehumidifier, and fogging system). The water level and humidity sensors were used to monitor the present water and humidity levels in the hydroponics environment. When the current water level was lower than the ideal level, the water pump was used to increase the water level. If the existing water level was higher than the level considered to be ideal, the overflow mechanism would be activated to bring the existing water level down. The same was true for the amount of humidity; the fogging system or humidifier was activated to raise or lower the existing humidity level. This picture shows a tiered perspective of the hydroponic environment designed for a specific purpose. IoT devices give the means to gather data, which is then analyzed, and an optimization algorithm and ideal parameters are produced [10].

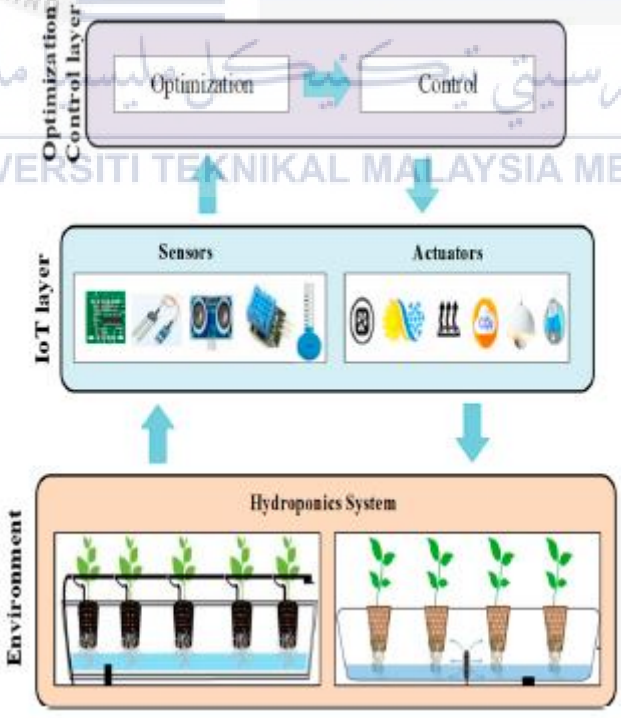

Figure 2.3 Layered model for proposed optimization and control scheme. [10]

2.6 Related Work

The sensors, light-emitting diode lights, water spray, and pump may reduce the concentration of dioxide and temperature while dramatically increasing the water level. [11] According to the paper, hydroponic farming may also be better managed in a greenhouse or indoor farming setting because of the surrounding circumstances. According to the paper, hydroponic farming may also be better managed in a greenhouse or indoor farming setting because of the surrounding circumstances. The unit of area parameters is automatically controlled by ensuring that all nutrients are delivered to the plant via the water solution. Furthermore, by deploying IOT software, the cultivator can comprehend plant development circumstances and remotely control the settings. For each plant one and plant 2, an Arduino microcontroller was utilized with three detector types: temperature sensor, pH detector, and LDR. In addition, the ESP8266 Wi-Fi module communicates with the IoT to control and monitor the hydroponic system.

This paper conducted research on monitoring the hydroponics environment using IoT devices. The authors adjusted the hydroponics system's conductivity, pH, and brightness, and a microcontroller was used to record all of the data [12]. The microcontroller shows the current state of the mentioned parameters and controls the lighting system through relay switches. Another study into the automated hydroponics system is an automated application that can be downloaded on Android/iOS-based devices and used to monitor the environment through the Internet from anywhere [13]. Touch controls are included in this application to modify the hydroponic system for a range of sensors, including humidity, temperature, and lighting level. Saving data regarding planning, rapid management, and collecting clarification information is one of the greatest features of this application. The data collected by sensors is saved in the cloud. They applied machine learning algorithms to the System with IoT devices for the automated application. The authors of one study used a Bayesian network to monitor the