DEVELOPMENT OF SOLAR WATERING PUMP USING MICROCONTROLLER

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Special dedicated to my beloved family, lecturer, friend and those people who have guided and inspired me throughout my journey of education.

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ABSTRACT

The purposes of this project are to develop smart solar watering pump in field of agriculture where can reduce human work force and as a green or saving energy. Besides, this project purposes to develop a program by using microcontroller to maintain the proper balance of moisture in the soil. In the field of agriculture, use of proper method of irrigation is important because the main reason is the lack of rains & scarcity of land reservoir water. This project will focus on the moisture in the soil and will provide the balance in the soil so that it can bring nutrients to the plant. It is important to ensure adequate water supply to maintain the proper balance of moisture in the soil. The result is that plants will get enough water without human energy work force. This project also can save from wasting water because of the using soil moisture sensor where the soil moisture sensor can identify a suitable time of water pump to work. The implications of this project are perfect in the world right now where it facilitates the work, saving time and energy.

ABSTRAK

Tujuan projek ini dilaksanakan adalah untuk membangunkan pam air solar pintar dalam bidang pertanian di mana boleh mengurangkan tenaga kerja manusia. Selain itu, projek ini juga menghasilkan satu program menggunakan pengawal mikro untuk mengekalkan kelembapan yang seimbang di dalam tanah. Dalam bidang pertanian, penggunaan kaedah pengairan yang sesuai adalah penting disebabkan oleh kekurangan hujan dan kekurangan takungan air. Projek ini membri tumpuan kepada kelembapan tanah dan menghasilkan keseimbangan tanah seterusnya memberi nutrien kepada tumbuhan. Ia adalah penting untuk memastikan bekalan air yang mencukupi bagi mengekalkan kelembapan yang seimbang di dalam tanah. Hasilnya, tumbuhan mendapat bekalan air yang mencukupi tanpa melibatkan tenaga kerja manusia. Projek ini juga boleh menjimatkan air disebabkan penggunaan pengesan kelembapan tanah di mana ia boleh mengenalpasti masa yang sesuai untuk pam air solar berfungsi. Implikasi projek ini sangat sesuai pada dunia sekarang di mana ia memudahkan kerja, menjimatkan masa dan tenaga.

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INTRODUCTION

1.1 Project Overview

Water recourses are essential for satisfying the human needs, protection and ensuring food production, energy and the restoration of ecosystems, as well as for social and economic development and for sustainable development. In the field of agriculture, use of proper method of irrigation is important because the main reason is the lack of rains and scarcity of land reservoir water. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming slowly in the zones of un-irrigated land. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes waste.

In this project solar energy is used to operate the irrigation pump. The circuit comprises of moisture sensor and water level sensor. The stiff copper wires are inserted in the soil to sense whether the soil is wet or dry. This project also used a water level sensor where a Light Emitting Diode (LED) will give a warning when the water supply is running low.

The Microcontroller is used to control the whole system by monitoring the sensors and when sensors sense the dry condition then the microcontroller will send command to relay driver IC the contacts of which are used to switch on the motor

and it will switch off the motor when all the sensors are in wet condition. The microcontroller does the above job as it receives the signal from the sensors and these signals operate under the control of software which is stored in the Microcontroller.

1.2 Problem Statement of Project

Water is commonly used for agriculture, industry, and domestic consumption. Therefore, efficient water monitoring are potential constraint for plantation water management system.

In a big farm or in a nursery, usually need many worker involve. Hence, if farmers are still using traditional irrigation system, there will obtain human work force. Therefore, need to spend money to pay the worker's salary which can be high and expensive.

Otherwise, it is difficult to verify the effect moisturizing in the soil. Some of models in solar watering pump which available today still can't be proved in order to maintain the proper balance of moisture in the soil. The water in the soil is important to carry the nutrients to the plant. It is significant to ensure sufficient amount of water are supplied to keep a proper balance of the moisture in the soil.

An affordable, convenient and flexible system is much needed because different soil has different needs and level of moisture. Microcontroller is used to assist the understanding on how that system can control the balance of moisture properly.

1.3 Objective of Project

The objective of doing this project is:

i. To develop smart solar watering pump in field of agriculture where can reduce human work force and as a green or saving energy.

ii. To develop a program by using microcontroller to maintain the proper balance of moisture in the soil.

1.4 Scope of Project

In order to design solar watering pump using Microcontroller, it is capable to interfacing with many kinds of new devices, but a basic operational of plant watering system must be investigate. The project has four main scopes:

i. Consumer electronics in solar watering pump where it uses microcontroller.
ii. Microcontroller is use to develop a program for solar watering pump process.
iii. Green energy involve due solar energy convert to electrical energy and then to mechanical energy which is run the water pump.
iv. A good impact in field of agriculture which is for watering plantation.

1.5 Report Structure

This report is documentary delivering the ideas generated, the concepts applied, and activities done. It consists of five chapters. The followings are the chapter-by-chapter description of information in this report.

Chapter 1 conveys readers a basic introduction on why and how the idea of this project is developed. This chapter consists of introduction, , problem statement of project, objectives of the project, scopes of project, and report structure.

Chapter 2 is a literature review of theoretical concepts applied in this project. This chapter includes background study of several existed solar panel watering pump using microcontroller and any other related project.

Chapter 3 introduces the methodology of the project which include a flow chart that explains the overall method taken along the development of the project and also a flowchart that explains on how the system operate in a desired sequence. Apart

from that, explanation of the hardware that will be used which PIC, sensors and others are explained too in this chapter.

Chapter 4 discusses the result of this project. At last, chapter 5 will discuss the conclusions and recommendations for the further research when the others students want to upgrading the system in this research in future study

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review is a process to find, search, collect, analyze and concluded all debates and issues raised for developing the final product of the project. Besides, it also provide examples of what other experts have or researcher has found in the last time and that idea could be a benefit for the next development process. That information will use to overcome the current problems and try to investigate the solution to give the best result for the project. The literature reviews focuses on the various theory and basic computer engineering knowledge used in the project. The sources of the information were grab from the books, magazine, articles, web pages, or testing result.

2.2 Existing/Current Project of Solar Watering Pump Using Microcontroller

Example of Solar Watering Pump has been design and implemented in in Zile District of Tokat Province of Turkey. One of motor was used for driving deep well pump which has been utilized for the purpose of water storing to a pool. The other one was used for driving centrifugal pump which has been utilized for the

purpose of transferring of water waited in pool to drip irrigation. Optimum solar panels were selected according to calculated maximum power consumption of motors. The need of energy of DC Motors has been provided from solar panels and batteries. Sun tracking system was used for increasing efficiency of system. A DC-DC converter has been developed to feed motor and charge the batteries safely. Automation of system was provided with, soil moisture sensors and solenoid valves.[1]

Studies mostly concentrated on DC motors cause of energy obtained from solar panel is DC. Photo irrigation system has advantages than flooding irrigation. Some of these are, bringing utilization of water sources more efficient, preventing erosion and growing of weeds only by irrigating the requested areas, decreasing moisture stress, no operation cost, providing opportunity for local energy sources and exhibiting a parallel point of view with water requirement. In terms of automation, developed wireless technologies, researches focused on automatic irrigation with sensors in agricultural systems. [1]

Disadvantages of it are their high initial capital costs, the variability of the yield of the solar panels according to the prevailing weather conditions and in high temperature efficiency decreases. At the current prices of PV modules, the cost of the proposed photovoltaic powered water pumping system is found to be less expensive than the cost of the conventional fuel system. The expected reduction in the prices of photovoltaic modules in the near future will make photovoltaic powered water pumping systems more feasible.[1]

Designed system was provided site-specific management of irrigation systems with 7 V-1.8 W solar panel and low power Microchip PIC16F877A micro controller chip. Additionally the sensor unit has soil moisture sensor, the valve has 12 V, 10 W normally-closed solenoid valve and battery.[1]

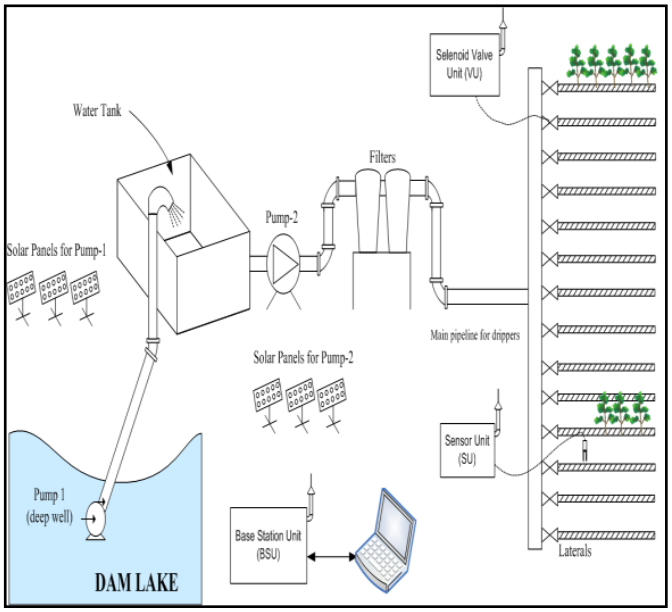

Figure 2.1: Application of the system[1]

2.2.1 Solar Panel (Photovoltaic, PV)

There is requirement to study about solar panel characteristic. This study present the detail significance of Photovoltaic (PV) panels. Photovoltaic (PV) panels are often used for agricultural operations, especially in remote areas or where the use of an alternative energy source is desired. In particular, they have been demonstrated time and time again to reliably produce sufficient electricity directly from solar radiation (sunlight) to power livestock and irrigation watering systems.[2]

A benefit of using solar energy to power agricultural water pump systems is that increased water requirements for livestock and irrigation tend to coincide with the seasonal increase of incoming solar energy. When properly designed, these PV systems can also result in significant long-term cost savings and a smaller environmental footprint compared to conventional power systems.[2]

PV panels are made up of a series of solar cells, as shown in Figure 2.2, below. Each solar cell has two or more specially prepared layers of semiconductor

material that produce DC electricity when exposed to sunlight. A single, typical solar cell can generate approximately 3 watts of energy in full sunlight. [2]

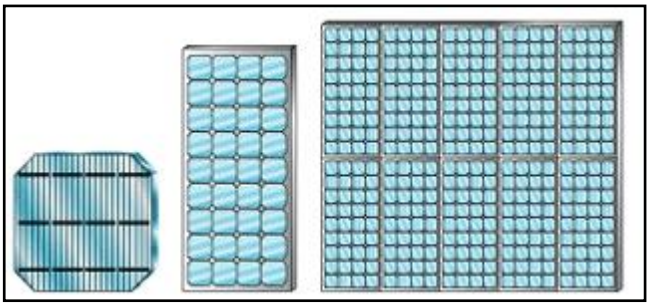

Figure 2.2: Solar cell, PV solar panel, and PV panel array.[2]

The semiconductor layers can be either crystalline or thin film. Crystalline solar cells are generally constructed out of silicon and have an efficiency of approximately 15%. Solar cells that are constructed out of thin films, which can consist of a variety of different metals, have efficiencies of approximately to 8% to 11%. They are not as durable as silicon solar cells, but they are lighter and considerably less expensive.[2]

Solar panels (also called Photovoltaic or PV panels) are used to generate electricity from sunlight. The electricity can be used to power a water pump, normally used for village water supply, livestock watering and small-scale crop irrigation, e.g. vegetable plants in a home garden. The water is pumped from underground into a tank, which must be large enough to store sufficient water to supply the village needs during cloudy weather. Installing a solar powered water pump is a fairly expensive option (several thousand Euros or US dollars), although the systems last for a long time and are reliable. Before installing this kind of system, a detailed assessment must be made of water demand (including needs of people, livestock and crops) and availability (e.g. well yield). The site must also be carefully surveyed to ensure the system is designed correctly. Although solar-powered water pumps are generally reliable and need little maintenance, if they do go wrong, skilled technicians are required to carry out repairs. Availability of this expertise is another factor in choosing whether to have such a system.[3]

Because of the costs and expertise needed, solar powered systems are usually associated with either donor-funded projects or government water- supply programmers. In The Gambia, the Japan International Cooperation Agency (JICA) has been working with the government to install solar-powered water pumps in around 150 large (over 1000 people) communities. Each community must raise US$1000 per year to cover the costs of servicing and maintenance. Night watchmen are employed to protect the panels. In Solar-powered water pumps, Acting head of Rural Water Supply, Alhagi Jabbi, says that the provision of pumped water has had a real benefit in reducing incidents of water-borne disease. The success of the project has led JICA to consider scaling up the approach to other African countries.[3]

2.2.1.1 Solar Panel Electrical Characteristic

PV panels are rated according to their output, which is based on an incoming solar irradiance of 1 kW/m2 at a specified temperature. Panel output data include peak power (Watts [Pw]), voltage (Volts [V]), and current (Amps[A]).Under conditions of reduced solar radiation, the current produced is decreased accordingly, but the voltage is reduced only slightly. Multiple panel arrays should be wired in a series and/or parallel so that the resulting voltage and current are compatible with the controller and pump motor requirements.[2]

When multiple panels are wired in a series, the total output voltage is the sum of the individual panel output voltages; the total current stays the same. Conversely, when panels are wired in parallel, the voltage stays the same while the resultant total current is the sum of the individual panel current inputs. The total power output from a PV panel array is determined by multiplying the total output voltage by the total output current. Power output will decline at about one percent per year due to environmental wear on the system. Oregon Construction Specification 68: Photovoltaic (PV) Power Supply for Pump specifies that the panel output shall be warranted against a degradation of power output in excess of 10 percent in a 10-year period following installation.[2]

2.3 Microcontroller versus other Technologies

Among the technologies available in the market, there are plenty of devices suit for the proposed automated size sorter such as microprocessor, microcontroller, and PLC. Each of these devices has its unique advantages among each other. Specification of the devices is compiled as in Table 2.1 below:

Table 2.1: Comparison between Microcontroller, Programmable Logic Circuit (PLC) and Microprocessor [5]

Specification	**Microcontroller**	**PLC**	**Microprocessor**
Architecture	Reduced Instruction Set Computer (RISC) & Harvard	Reduced Instruction SetComputer (RISC)	Complex Instruction Set Computer (CISC) & Von-Neumann
Operation	All in one, all CPU, memory, I/O port and others features integrated in a single chip	All in one, all CPU, memory, I/O port and others features integrated in a device	Need to interface with different type of IC to perform the desired task
Coding	Assembly Language/ C Programming	Simple and Clear Ladder diagram or Function block	Tedious Assembly Language
Input & Output Port	Input and output ports are available	multiple input and output ports	Input and output ports are not available; need extra devices
Price	Cheap	Expensive	Moderate
Memory & Timer	Internal (RAM, ROM) and timer	Internal (RAM, ROM) and timer	Do not have internal memory and timer