APPLICATION OF ADVANCED MICROPROCESSOR IN MODERN AGRICULTURE

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A project submitted in partial fulfilment of the
requirements for the award of the degree of
Masters of Engineering (Electrical – Computer and Microelectronic System)

Faculty of Electrical Engineering
Universiti Teknologi Malaysia

JUNE 2015

Dedicated to my beloved family;
Especially my mother, my Wife and Children, who have encouraged,
guided and inspired me throughout my journey of education

ACKNOWLEDGEMENT

First and foremost, I would like to thank Allah who made this accomplishment possible. Also, I would like to thank our parents, who provided support and everything I need in my study. For that, I ask Allah to bless all of them.

Then, I would like to express my appreciation to my supervisor Assoc.Prof.Dr. MUHAMMAD NASIR BIN IBRAHIM for his continuous help, support and encouragement.

In addition to, I am extremely grateful to my friends and colleagues who helped me to accomplish this study.

Besides, I would like to thank the authority of Universiti Teknologi Malaysia (UTM) and Faculty of Electrical Engineering (FKE) for providing me with a good environment and facilities such as an advanced microprocessor laboratory to complete this project with all the necessary software during the search process.

ABSTRACT

Appropriate environmental conditions are necessary for optimum plant growth inside the greenhouse. Improved crop yields are related to controllable environments, including efficient use of water and other resources. Hence there is a need for automating the data acquisition process of the soil moisture, temperature conditions and various climatic parameters that govern plant growth. A new environmental monitoring and control system is developed which employs Microcontroller Arduino ATmega2560. The system uses a PID controller with Pulse width modulation (PWM) used together with LM35 temperature sensor and an LM393 comparator chip of the soil moisture module. An LCD unit is used to display the various soil moisture levels for the monitoring operation. The outcome is a stabilized system with minimum error in both temperature and soil moisture modules and has been proven all curves in one chart that's displaying the rate of variation between soil moisture contents level and temperature degree against the time in real time data. According to this results, the system is done correctly.

ABSTRAK

Keadaan persekitaran sesuai adalah perlu untuk pertumbuhan pokok optimum di dalam rumah hijau. Hasil tanaman lebih baik ialah berkaitan dengan persekitaran dapat dikawal, mengandungi kecekapan penggunaan wang dan sumber-sumber lain. Maka terdapat satu keperluan untuk mengautomatikkan proses pemerolehan data lembapan tanah, keadaan suhu dan pelbagai parameter iklim yang mengawal pertumbuhan pokok. Satu pengawasan persekitaran baru dan sistem kawalan dibangunkan yang mana mengaplikasikan Microcontroller Arduino ATmega2560. Penggunaan sistem pengawal PID dengan modulasi (PWM) kelebaran Pulse digunakan bersama dengan pengesan suhu LM35 dan cip pembanding LM393 modul lembapan tanah. Unit LCD digunakan untuk mempamerkan pelbagai tahap-tahap kelembapan tanah untuk operasi pengawasan. Terhasilnya satu sistem dimantapkan dengan ralat minimum dalam kedua-dua modul suhu dan lembapan tanah dan telah terbukti semua graf di satu carta yang mempamerkan kadar variasi antara kandungan lembapan tanah datar dan darjah suhu terhadap masa di data masa nyata. Menurut keputusan ini, sistem tersebut dibuat dengan betul.

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LIST OF ABBREVIATION

PID	-	Proportional integral derivation
PWM	-	Pulse width modulation
LCD	-	Liquid crystal display
GPS	-	Geographical position in system
GIS	-	Geographical information system
DBMS	-	Database management system
RTOS	-	Real time operating systems
CADCS	-	Control and data acquisition system
ANN	-	Artificial neural network
CAN	-	Control area network
MCU	-	Microcontroller
MIPS	-	Million instruction per second
USB	-	Universal serial bus
IAE	-	Integrate absolute error
ISE	-	Integrate square error
GPIO	-	General purpose input/output
ALU	-	Arithmetic logic unit
RAM	-	Random access memory
CMOS	-	Comelementary metal oxide semiconductor
RISC	-	Reduced instruction set computing
CISC	-	Complex instruction set computing
CPU	-	Central processing unit
USART	-	Universal synchronous /asynchronous receiver transmitter
UART	-	Universal asynchronous receiver transmitter

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CHAPTER 1

INTRODUCTION

1.1 Overview

The term ‘Green Revolution’ was adopted by the agricultural industry to describe developments in agricultural technologies occurring in countries around the world. To achieve a Green Revolution, all farmers should adapt using modern technologies, such as intensive soil irrigation, high-yield seeds, chemicals, and mechanization (Shaker and Imran 2013) In other words, modern agriculture is a process of urban development to a certain degree.

It is a sustainable development of modern natural-human complex agro-ecosystems that is based on the large modern city resources, and it is a multi-functional integrated containing production, life and ecology. Agriculture facility is defined by changing internal environmental elements such as planting, breeding, and other agriculture areas of production. The main goal of this facility is to create suitable conditions and raise the quality of productions (Guangyong et al. 2011).

It is worth mentioning that greenhouse farming is one of the important aspects of agriculture, because it is easier to control, thus ensuring increased efficiency of production are efficient (Bansal and Reddy 2013).The benefits of greenhouses are as follows: increased light input, increased temperature throughout the winter season and decreased temperature throughout the summer season

(better regulation of temperature) (Fabrizio 2012). Another advantage that greenhouses offer is their use for increasing crop yield, reducing main power, and minimizing high costs by using different technologies, which depends on embedded functions such as monitoring and controlling systems.

Despite the challenges faced by researchers in the field of monitoring and controlling the environment by external devices, advances have enabled the manufacturing of various sensors and electronics that implement different operations simultaneously. This allows for the monitoring of conditions inside the greenhouse, providing a good environment, and producing optimal product yield.Specifically, this project will apply some important sensors used to monitor the status of plants, including parameters such as temperature, moist soil, and light intensity. Therefore, some researchers stressed the need to introduce a methodology for the development and use of microcontroller based process monitoring and controlling system (Prickett, Frankowiak and Grosvenor 2012).

Moreover,(Hou et al. 2012) confirmed the use of a sensitive temperature and relative humidity sensors such as SHT11 in the monitoring and control of external devices in order to determine the relationship between them and other research. (Rangan and Vigneswaran 2010) described an embedded system approach to monitoring a greenhouse, based on measuring parameters such as temperature, humidity, soil dampness, water pH, light intensity, surveyed by sensors that are positioned in different locations, the data for which were measured, controlled, processed and updated to the owner through SMS using GPS modem.

1.2 Background

This project presents the design of microcontroller ATMEGA2560 based on the electronic circuit that monitors and controls parameters such as temperature, soil moisture, and light of the natural environment. These are based on the proportional

integral derivation (PID) controller, with pulse width modulation (PWM), in order optimize them to achieve maximum plant growth.

This chip communicates with the various sensor modules to ensure the efficiency of a ventilation and irrigation process inside a greenhouse that depends on criteria and commands are sent from the processor through the set of bus I/O to actuating a cooler, valve, and pump water respectively. An integrated Liquid Crystal Display (LCD) Keypad module is also used to display the status results of data acquired from the various sensors. The design is quite flexible as software and can be developed in any time.

1.3 Problem statement

1) Obviously Transpiration on the leaf surface is ineffectual, the root and stem. Thus the system may not be able to supply adequate water to the leaves. The cooling system is therefore required to reduce these stresses.

2) Greenhouse shading; the amount of solar radiation and light intensity reaching the plants is restricted creating a closed difference between air temperature inside and outside the greenhouse. Shading also reduces leaf surface temperature significantly.

Therefore, it should be noted that in a naturally ventilated greenhouse in a tropical environment, inside air temperature is always greater than the outside, which can become a major problem during the summer season, when the maximum cooling is required.

1.4 Objective

The main objective is to build a general system to obtain data from an external device and then manipulate it to achieve a certain output. The data obtained during the processing must be displayed on LCD. This is done in order to achieve better quality environments for agricultural work inside the greenhouse with the help of a microcontroller Chip Kit ATMEGA2560. This project will execute the following steps:

1) Monitor the status of the plants in terms of the availability of the appropriate environments.
2) Irrigation of the soil according to their need. This is achieved through the use of special sensors and components necessary to avoid a decomposition soil based on the PID algorithm with PWM technique.
3) Measure the amount of light in order to control moving actuator by using special photosensitive.
4) Improve ventilation and soil moisture control which is crucial for tropical greenhouses to improve plant growth, nutrient and water uptake, and for disease reduction.

1.5 Scopes

This study will design an integrated system consisting of different sensors to sense the environment. This is done through the use of a microcontroller that reads analogue signals and sends the processed signal to the output through a buss. We explain more about the study through the following steps:

1) Design a PID based controller temperature sensor module using the PWM technique to achieve the desired set point for fan speed automatically, and to produce good condition plants, a temperature sensor reading in Celsius and

Fahrenheit. These results can then be plotted on a chart to improve the stability of the system.

2) Design a simple ON/OFF control for the light sensor in order to actuate opening of the windows on top of the greenhouse, because solar radiation provides the main energy input to plants, with much of this energy begin convert to heat whereas will effect on plant inside greenhouse(Jones 2013).

3) Design module regard soil moisture sensor also based PID controller with PWM technique to get desired set point automatically for valve water to reduce the consuming the water with minimum error and more stability for system. because the plant physiological responses to drought is from important ways during irrigation scheduling according to (Jones 2004).

4) Finally, an LCD will display status of PID controller, data including temperature module and soil moisture level module.

1.6 Summary

This is an introductory chapter that addressed the main problems related to providing a suitable environment for agriculture, according the problems statement of this project that is; the difficulty in creating a good ventilation system using PID controller and PWM techniques to remove all stress on the leaf surface with a design system of low cost. An embedded system will have been built to reduce the error in output, in order to get proper results for both temperature and soil moisture modules in agricultural work.

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