PERFORMANCE INVESTIGATION ON A CAPACITIVE SOIL MOISTURE SENSOR FOR SMART HOME IRRIGATION SYSTEM

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This report is submitted in partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering with Honours

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I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering with Honours.

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DEDICATION

I dedicate my dissertation work to my supervisor, family member and my friend Joseph who was backbone in helping me throughout the journey. A special feeling of gratitude to my GOD who has strengthened me throughout the process of finishing my thesis and project.

ABSTRACT

This paper provides a comparative analysis of soil moisture measurement using capacitive soil moisture sensors of various dimensions. Some methods use soil moisture sensing probes of various dimensions to study their response to different levels of moisture content. A gravimetric and volumetric technique is used to calibrate a capacitive soil moisture sensor in this study. A NodeMCU 8266 system is used to compare sensor characteristics such as response, sensitivity, and stability over different ranges of soil moisture content in order to select the best probe for soil moisture measurement applications involving a range of soil moisture level values that can be calibrated to the volumetric soil moisture content using gravimetric methods using dry and wet soil volume and weight. The project also have to build a smart irrigation system using the IoT concept which is also cost-effective. This smart irrigation system has an analogue multiplexer that adds on an analogue output pin for soil moisture sensors so that allowing the water pumps to function appropriately watering the plant in different places respectively. To promote the use of green energy, the system's power supply will be designed to utilise solar power. Finally, using an automatic irrigation system makes it easier for homeowners and farmers to irrigate their land more conveniently.

ABSTRAK

Kertas kerja ini menyediakan analisis perbandingan pengukuran kelembapan tanah menggunakan penderia lembapan tanah kapasitif pelbagai dimensi. Sesetengah kaedah menggunakan probe pengesan kelembapan tanah pelbagai dimensi untuk mengkaji tindak balasnya terhadap tahap kandungan lembapan yang berbeza. Teknik gravimetrik dan isipadu digunakan untuk menentukur penderia lembapan tanah kapasitif dalam kajian ini. Sistem NodeMCU 8266 digunakan untuk membandingkan ciri penderia seperti tindak balas, kepekaan dan kestabilan ke atas julat kandungan lembapan tanah yang berbeza untuk memilih probe terbaik untuk aplikasi pengukuran kelembapan tanah yang melibatkan julat nilai tahap kelembapan tanah yang boleh ditentukur kepada kandungan lembapan tanah isipadu menggunakan kaedah gravimetrik. Projek itu juga perlu membina sistem pengairan pintar menggunakan konsep IoT yang juga menjimatkan kos. Sistem pengairan pintar ini mempunyai pemultipleks analog yang menambah pin keluaran analog untuk penderia kelembapan tanah supaya membolehkan pam air berfungsi dengan sewajarnya menyiram tumbuhan di tempat yang berbeza masing-masing. Untuk menggalakkan penggunaan tenaga hijau, bekalan kuasa sistem akan direka bentuk untuk menggunakan tenaga solar. Akhirnya, menggunakan sistem pengairan

automatik memudahkan pemilik rumah dan petani untuk mengairi tanah mereka dengan lebih mudah.

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LIST OF SYMBOLS AND ABBREVIATIONS

A - Ampere

A - Area of plate

A0 - Analog Output

ADC - Analog-to-digital converter

A/D - Analog-to-digital

AC - Alternating current

C - Capacitor

COM - Common

CSM - Capacitive Soil Moisture Sensor

CMOS - Complementary metal-oxide-semiconductor

°C - Degree Celsius

d - Distance

D - Duty cycle

DC - Direct current

(DIP) - Dual in-line package

ESP - Electronic stability program

E - Electric field

F - Farad

f - Frequency

GWC - Gravimetric Water content

GPIO - General Purpose Input/Output

G - Geometric

GND - Ground

g - Gram

Hz - Hertz

IoT - Internet of things

IC - Integrated circuit

L - Inductor

LED - Light-emitting diode

M - Mega (x106)

ml - Milliliter

µ - Micro (x10-6)

mwet - The measured mass of the soil (wet or dry)

ms – The measured mass of the dry soil

MCU - Microcontroller unit

mA - Milliampere

Mm - Millimeter

Mw –- Mass of water

Ms- Mass of soil