Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF AUTOMATED HEIGHT RULER USING ULTRASONIC SENSOR

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Bachelor of Electronics Engineering Technology with Honours

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DEVELOPMENT OF AUTOMATED HEIGHT RULER USING ULTRASONIC SENSOR

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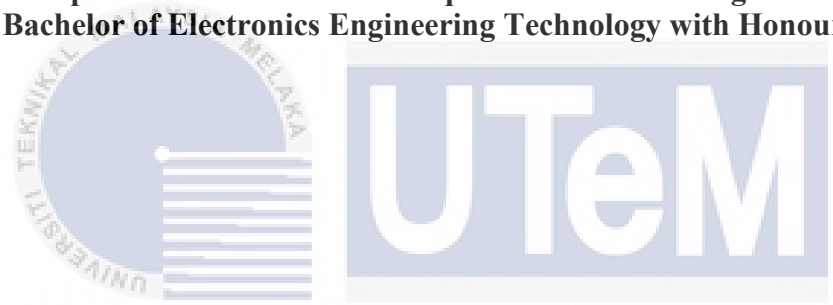
A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

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Tajuk Projek: DEVELOPMENT OF SMART HEIGHT RULER USING ULTRASONIC SENSOR

Sesi Pengajian: SEMESTER 1 2022/2023

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I declare that this project report entitled “Development Of Automated Height Ruler Using Ultrasonic Sensor ” 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 Electrical Engineering Technology with Honours.

Signature : 

Supervisor Name : TS SAIFULLAH BIN SALAM

Date : 25/2/2023

Signature :

Co-Supervisor :

Name (if any) AMAR FAIZ BIN ZAINAL ABIDIN

Date :

DEDICATION

To my beloved father, Mr.Noordin Bin Ahmad

In remembrance of my beloved mother, Mrs. Nurani Binti Hj Said

My supportive supervisor and co-supervisor Mr. Saifullah Bin Salam and Mr Amar Faiz Bin Zainal Abidin

My faithful panels, lecturers, and staff of FTK

My Beez Cohort 9 classmates

ABSTRACT

Height measuring device is a device that is used to measure the height of a person. The measurement can be little bit difficult if the targets that want to be measured are far from reaching or high. This will be causing error such as parallax error due to the eye level arenot perpendicular to the reading. The purpose of this project is to design and create a betterdistance measurement that can encounter the measuring problem with enhance of weight measurement that can display the BMI of a person. An ultrasonic measuring device is proposed to solve the problem as the ultrasonic using an ultrasonic sound. The smart height ruler is installing with Arduino Nano, and Ultrasonic Distance Sensor. The main component used in this projectis Ultrasonic Distance Sensor. The height is taken when a person is standing under the sensor and the weight is taken by standing on weighing scale. The sensor detects the distance from the bottom to the top of the person and the weighing scale detect the weight hence calculate the BMI. The height in centimeter and the weight in kilogram with the Body Mass Index will display onthe LCD display.

ABSTRAK

Alat pengukur ketinggian ialah alat yang digunakan untuk mengukur ketinggian seseorang. Pengukuran boleh menjadi sedikit sukar jika sasaran yang ingin diukur jauh daripada mencapai atau tinggi. Ini akan menyebabkan ralat seperti ralat paralaks kerana paras mata tidak berserenjang dengan bacaan. Tujuan projek ini adalah untuk mereka bentuk dan mencipta ukuran jarak yang lebih baik yang boleh menghadapi masalah pengukuran dengan dan penambahan ukuran berat yang boleh memaparkan BMI seseorang. Alat pengukur ultrasonik dicadangkan untuk menyelesaikan masalah kerana ultrasonik menggunakan bunyi ultrasonik. Pembaris ketinggian pintar dipasang dengan Arduino Nano, dan Penderia Jarak Ultrasonik. Komponen utama yang digunakan dalam projek ini ialah Pendeia Jarak Ultrasonik. Ketinggian diambil apabila seseorang berdiri di bawah penderia dan berat diambil dengan berdiri di atas penimbang. Penderia mengesan jarak dari bahagian bawah ke bahagian atas seseorang dan penimbang mengesan beratnya dan mengira BMI. Ketinggian dalam sentimeter dan berat dalam kilogram dengan Indeks Jisim Badan akan dipaparkan pada paparan LCD.

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LIST OF SYMBOLS

T1	-	The transmitter that sends out a signal at time
T1	-	Signal goes out of the transmitter, strikes the object and is received back at time
(T)	-	Time taken for signal to transmit and receive back
T/2	-	Time taken in one direction
S	-	Speed of ultrasonic sound waves in air as S
Hz	-	Hertz
cm	-	Centimeter
m	-	Meter
kg	-	kilogram
TX	-	Transmitter
RX	-	Receiver
%	-	Percent

LIST OF ABBREVIATIONS

V	-	Voltage
MPU	-	Microprocessor Unit
UART TTL	-	Universally Asynchronous receiver/transmitter transistor-transistor Logic
TWI	-	Two Wire Interface
SPI	-	Serial Peripheral Interface
A/D	-	Analog/Digital
LCD	-	Liguid-Crystal Display
BMI	-	Body Mass Index
IDE	-	Integrated Development Environmen
KB	-	Kilobyte

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CHAPTER 1

INTRODUCTION

1.1 Background

Height changes rapidly with weight during childhood and can indicate health issues if it deviates from development curves. Therefore, height and weight measurement is an important statistic for medical professionals and their patients to calculate the Body Mass Index. The aim for this project is to create a smarter and new version of the physical height-measurement instruments with weight-measurement that are now utilized in hospitals and clinics. While attempting to maintain the accuracy and speed of present devices, this instrument would have enhanced portability.

1.2 Problem Statement

Traditional stadiometers are the most common equipment used in hospitals and clinics, but they can be inaccurate at times. Measure height and weight of a person required another person to record the value of height. This will be causing error such as parallax error due to the eye level are not perpendicular to the reading for example when the person in charge to record the data is shorter than the person being measured. The project is used to measure the height and weight of a person automatically.

Besides that, the patient and the doctor have to spend more time in discussing about the patient's health. These devices make the process becomes slower. The patient only has a limited amount of time during their visit. Hence, speedier height and weight measurement

technique is necesary to allow the maximum time to be spent according to the individual needs.

1.3 Project Objective

The major goal of this study is to develop a systematic and practical approach for accurately measuring height. The following are the specific objectives:

a) To study the function of ultrasonic distance sensor for smart height ruler.
b) To develop a smart height ruler using ultrasonic sonic sensor.
c) To evaluate the performance between smart height ruler and traditionalstadiometer.

1.4 Scope of Project

Work scope focused in implementing the low-cost prototype that can be used in medical based. The project will be focusing on measuring height using ultrasonic distancesensor which has capability of measuring distance in range from 0-400 cm in order to fulfill the need for accurate and quick height measurement and study the comparison between smartheight ruler and traditional stadiometer.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter summarizes the past studies towards on development of smart height using ultrasonic sensor. The purpose of this review will describe about the use of ultrasonic distance sensor in different project which determine the performance of this sensor compared to another sensor. The following observation will be closely linked to this project. This chapter will cover the theory and the main exploratory of the study.

2.2 Ultrasonic Sensor

Ultrasonic sensor usually utilized in computerization assignments to measure distance, position changes, level estimation, such as nearness finders or in uncommon applications for example when measuring the virtue of straightforward materials [1]. They are based on the rule of measuring the engendering time of ultrasonic waves. This rule guarantees solid location is independent of the color rendering of the protest or to the design and the sort of its surface [2]. It is conceivable to reliably detect indeed such materials as fluids, bulk materials, transparent objects, glass etc.

Ultrasonic sensors are made in a variety of mechanical designs. For example, basic housing used for transmitter and receiver individually or in a single housing is commonly manufactured sturdy metal housing for laboratory use [3]. Some varieties include the option of adjusting the sensitivity with a potentiometer or digitally. The output can also be a unified version or a digital representation of an analogue signal [4]. It is possible to define

comprehensive parameters of all the sensor's working range and measured distance in the case of sensors that can be connected to the PC via the communication interface [5].

2.2.1 Ultrasonic Transducer

Ultrasonic sensors often known as transceivers when they send and receive data, interpreting radio or sound wave echoes to examine a target's attributes. Ultrasonic sensors generate high-frequency sound waves and evaluate the echo received by the sensor [6]. Sensors calculate the time period between giving the signal and receiving the echo to estimate the distance to an object.

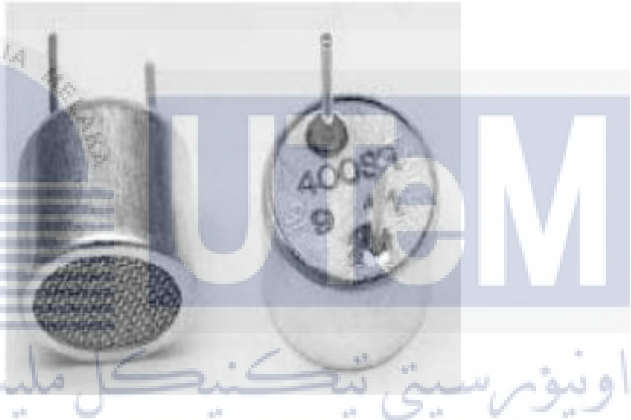

Figure 2.1 Ultrasonic Transmitter and Receiver Pair **[2]**

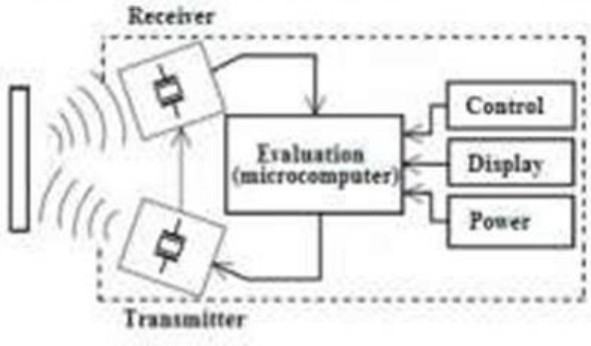

Figure 2.2 Block Diagram of the Ultrasonic sensor **[1]**

One method for measuring distance without any contact is to employ ultrasonic waves at 40 kHz. Ultrasonic receivers calculate the duration of a sound pulse to travel to a

certain surface and return as a reflected echo and can measure distances up to 2.5 metres using it [7].

2.2.2 Ultrasonic Distance Sensor HC-SR04

The HC-SR04 is an ultrasonic distance sensor that determines the distance between the target object and the sensor. It can determines the distance between the sensors and the subject by using a non-contact technology to measure the distance. It means that the sensor and the object are not in physical contact. It measures the distance between itself and an object with a 3mm accuracy using ultrasonic sound waves in the range of 2cm to 400cm [8]. Ultrasonic distance sensor contains 4 pins as shown in figure 2.3. The sensor receives a +5V power source from Pin 1 (Vcc). Pin2 (Trigger) is an input pin that is used to initiate measurement by emitting ultrasonic pulses for 10 seconds. Pin3 (Echo) is an output pin that goes high for a set amount of time, which corresponds to the time it takes for the wave to return to the sensor. Pin4 (Ground) is a GND pin that connects to the system's GND [9].

Figure 2.3 Ultrasonic Sensor HC-SR04 **[7]**

Table 2.1 Distance Sensor PINs **[10]**

No	Name	Description
1	Vcc	The power supply pin of the sensor. It is connected to 5V DC
2	TRIG	It is used to send out a signal
3	ECHO	It is used to receive a signal
4	GND	This pin is connected to ground

The sensor only gives an impulse of certain duration. All calculations must be made by the microcontroller. A transmitter in the sensor vibrates short in high-frequency sound pulses that bounce back to the receiver after reaching a surface. The Pulse Method is a method of electronically measuring distance [11].

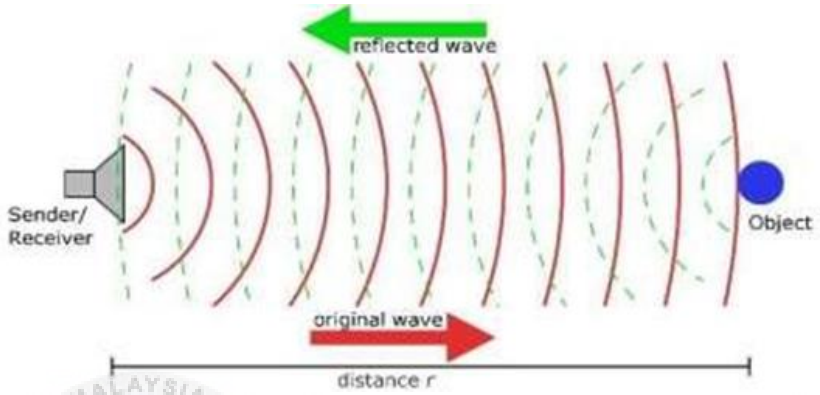

Figure 2.4 Principle of Ultrasonic Distance Meter **[12]**

2.2.2.1 Example calculation distance of an object using HC-SR04

T1= The transmitter that sends out a signal at time

T2= Signal goes out of the transmitter, strikes the object and is received back at time

Time taken for signal to transmit and receive back [10]

(T) = T2-T1

Time taken in one direction=T/2

If we assume that speed of ultrasonic sound waves in air as S/sec

After known the time taken by the signal to go and strike the object and speed of sound, Then can calculate the distance

Distance = T/2 X S

2.3 Microcontroller

A microcontroller is an IC component that controls other parts of an electronic system using a microprocessor unit (MPU), memory, and peripherals. These devices are made for embedded applications that require processing capabilities as well as rapid and efficient interaction with digital, analogue, or electromechanical components [13]. The term "controller" denotes a greater power to carry out control functions, whereas the word "micro" denotes smallness. This functionality is achieved, as previously indicated, by combining a digital processor and digital memory with extra circuitry designed to help the microcontroller interface with other components.

2.3.1 Arduino

Arduino is a microcontroller, which at controls small devices such as sensors, motors, and lights. For example, Arduino best suited in the projects like making a wake-up light, motion detecting alarm, or even a small robot. If the prototype is successful and the device functions, printed circuit boards can be used to produce it on a bigger scale [13]. In term of power, the Arduino's power requirements are relatively simple as it can plug it into the computer or into a battery pack, and it will immediately begin running code. It will deactivate when the power is withdrawn which is no shut-down procedure is required. It has a very low power demand and may run for an extended period of time without consuming much power.

The Arduino does not come with any built-in connectivity features. It needs another piece of hardware with an ethernet connector if must connect it to the internet and a different piece of hardware for Wi-Fi connectivity. As Arduino is designed for hardware projects rather that software, it takes a little fiddling to get it working. Therefore, as this project did not require any access to the internet and Wi-Fi, Arduino is a suitable to use in this project.