Design Of Monitoring System of Height, Weight and Body Mass Index Using Android-Based Nodemcu ESP8266

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***Abstract*—Generally, height and weight measurements are carried out separately as well as to determine the Body Mass Index must be calculated manually using specific formulas that not everyone understands, so it is difficult to know whether the body has reached a normal number or not. This study will provide suggested solutions to support the body to be healthy in measuring devices and android applications, for height measurement using ultrasonic sensors, weight using loadcell sensors and NodeMCU ESP8266 as data processors. The results of measuring height and weight appear on an LCD, the results of Body Mass Index (BMI) and the recommended solutions to meet standard body numbers in calculating BMI appear on the android application. Based on the results of the tests carried out, it is known that designing a measuring instrument with NodeMCU ESP8266 based on Android has been successfully carried out. The measuring instrument by implementing the Ultrasonic Sensor HC-SR04 as a height measurement can perform a success percentage of 96.95% and Loadcell Sensor as a weight measurement can perform the percentage of success is 98.97%, while in measuring Body Mass Index (BMI) can do a success percentage of 90.84%, the measuring instrument can also emit sound in the form of body condition in accordance with the measurement results obtained by the microcontroller with a success percentage of the sound output of 100% but has an average percentage of voice output delay variations of 2.1 seconds.**

***Keywords*— Ultrasonic Sensor Height, Weight and Body Mass Index (BMI) Monitoring System, Nodemcu ESP8266.**

I. INTRODUCTION

Generally, as is often found in various places such as hospitals, campus UKS, and fitness care centers, height and weight measurements are still operated separately and determine Body Mass Index. Of course, it must be calculated manually using specific formulas that not everyone understands. Especially for people with disabilities, it is difficult to know whether the body is ideal or not [1]. Although an application on a smartphone can calculate Body Mass Index, the Application is not automatic. The total weight and height must be entered, and of course, you are required to take measurements first if you want to use the Application to find out the results of the Body Mass Index.

A previous study entitled Automatic Height and Weight Measurement Device Based on Microcontroller-Based Voice output realized an automatic height and weight measurement device based on sound output [2]. The tool uses an ultrasound proximity sensor to measure height, a loadcell to measure weight, and a circuit box coupled with a speaker to output the sound of the measurement results [3]. However, this study has drawbacks, namely the results of the percentage of error values are many so that the measurement results are less accurate when recording sound is also not done in a quiet place, so the sound is still noisy [4].

A previous study entitled Application of digital measuring instruments uses the Fuzzy Logic method to determine the ideal body condition with an LCD and Voice Output for the Blind. The study designed tools and software that we can display weight and height on an LCD screen using an Arduino microcontroller as a controller and the addition of a sound sensor that was useful for blind people. This study uses fuzzy logic in determining the nutritional status of the Body Mass Index. The test tool can detect a distance of 2cm to 180cm and can detect weight from 1kg to 50kg but has an average of 1.9% error for measuring height and 1.75% error for measuring weight [5].

Based on the above background, this thesis proposal proposes a title regarding designing a Monitoring System for Height, Weight, and Body Mass Index using Android-based Nodemcu ESP8266 [6][7]. The object to be studied will be focused on electronic devices measuring height and weight along with the Body Mass Index, which is calculated automatically [8]. The sound output showing information about body conditions such as underweight, overweight, obese, or standard will be issued through the speaker [9]. This sound output aims to have more benefits and can be used by more people, including people with disabilities, especially the illiterate and blind [10]. The device is also automatically connected to the Application on the Smartphone equipped with advice on health which aims to monitor electronic devices wirelessly through the Android mobile application and make it easier for users to keep physically healthy.

II. LITERATURE REVIEW

A. Related Works

The author in [1] realized an automatic height and weight measurement device based on voice output. The tool uses an ultrasound proximity sensor to measure height, a loadcell to measure weight, and a circuit box coupled with a speaker to output the sound of the measurement results. However, this study has drawbacks, namely the results of the percentage of error values are many so that the measurement results are less accurate when recording sound is also not done in a quiet place, so the sound is still noisy [1].

The author in [2] has succeeded in developing a new solution to assist daily human activities or work, such as measuring human height and weight. The tool uses a weight sensor and ultrasonic combined with a microcontroller and a thermal printer that prints information on height, weight, tags, and e-KTP ID. The tool is also equipped with a WAV format CD Card that already stores the results of speaker measurements in the form of sound. This study also has a drawback: ultrasonic sensors can only detect accurately when a board or flat object is applied above the head [2].

B. Sensor HC-SR04

The HC-SR04 sensor is an ultrasonic wave based proximity sensor. Ultrasonic sensor is a sensor that works based on the principle of sound wave reflection and is used to detect the presence of a certain object in front of it, its working frequency is in the area above the sound wave from 40 KHz to 400 KHz. The ultrasonic sensor consists of two units, namely a transmitting unit and a receiving unit. This sensor is suitable for electronic applications that require distance detection, including for sensors on robots. pins used by the HC-SR04 using 4 pins [7].

C. Strain Gauge

A weight sensor (load cell or strain gauge) is a type of sensor that has a function to measure the mass of objects. A strain gauge is a thin coiled metal wire attached to the surface of an object. By attaching a strain gauge to the test object using an insulating adhesive with an electric current, the strain gauge produces a change in resistance whose magnitude is directly proportional to the deformation of the wire. The resistance changes according to the applied force [11].

D. HX711

In reality, the strain gauge sensor cannot stand alone. A suitable amplifier for the strain gauge sensor is the HX711 module. HX711 is a weighing module which has the working principle of converting the measured change value in the change in resistance value and converting it into electrical quantities through an existing circuit[12]

E. NodeMCU ESP8266

The Wifi Node MCU ESP8266 module is an open-source IoT platform and development kit that uses the Lua programming language to help builders create IoT products or can be sketched with the Arduino IDE—equipped with wifi features and open-source firmware. NodeMCU ESP8266 is a microcontroller module designed with ESP8266 in it. ESP8266 functions for Wifi network connectivity between the microcontroller itself and the Wifi network [13].

F. Serial Mp3 YX5300

This module is a simple MP3 player device based on high-quality MP3 audio. This YX5300 chip can support 8k Hz ~ 48k Hz sampling frequency of MP3 and WAV file formats. There is a TF card socket on the board, so you can plug in a MicroSD card that stores audio files [14].

G. Application software arduino IDE

IDE stands for Integrated Development Environment. IDE is a program used to create programs on Esp 8266 NodeMcu. Programs written using the arduino Software (IDE) are called sketches [15].

III. SYSTEM MODEL

This section will discuss the tool design process, including block diagrams that explain the relationships between components.

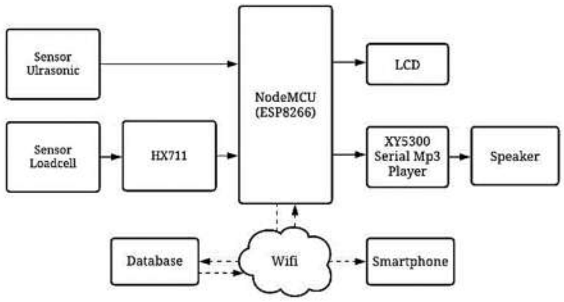

Fig. 1 Diagram block system

Fig. 1 contains two parts, namely the sender and the recipient. The sending part consists of an ultrasonic sensor HC-SR04, a digital height sensor where the sensor provides input in the form of detection results between distance and object. The load cell sensor is a pressure transducer used for weight measurement. HX711 as an amplifier of the readings and changes in the measured voltage on the loadcell sensor

The receiving part consists of NodeMCU ESP8266, LCD, XY5300 Serial Mp3 Player, Speaker, Database, Smartphone. The data received from the sender will be processed by the NodeMCU to be issued in the form of a display on the LCD and smartphone, in the form of sound to be issued through the speaker. To design the sender device, to calculate height and weight there is a 5V charger or power bank that is a voltage source. For receiver, there is a wifi network to receive data that has been sent from nodemcu esp8266 to display data on a smartphone.

The determination of the work procedures used in the research for the title Design of a Monitoring System for Height, Weight and Body Mass Index (BMI) Using NodeMCU ESP8266 Based on Android is as show in Fig. 2.

From the flowchart in Fig. 2, it can be explained that the working procedure of the tool is as follows. Starting with the reading process from ultrasonic sensors, loadcell sensors, wifi, firebase, LCD and NodeMCU. in the process of recognizing wifi, you must use wifi according to what is entered in the Arduino IDE. Then the results of the calculation of height and weight will be automatically detected, and if successful, it will proceed to the process of calculating Body Mass Index (BMI). Then the results of measuring height and weight will automatically appear on the LCD screen and the android application, along with suggestions regarding health in it. which is in the YX5300 Serial Mp3 microSD Card will be issued through the speaker.

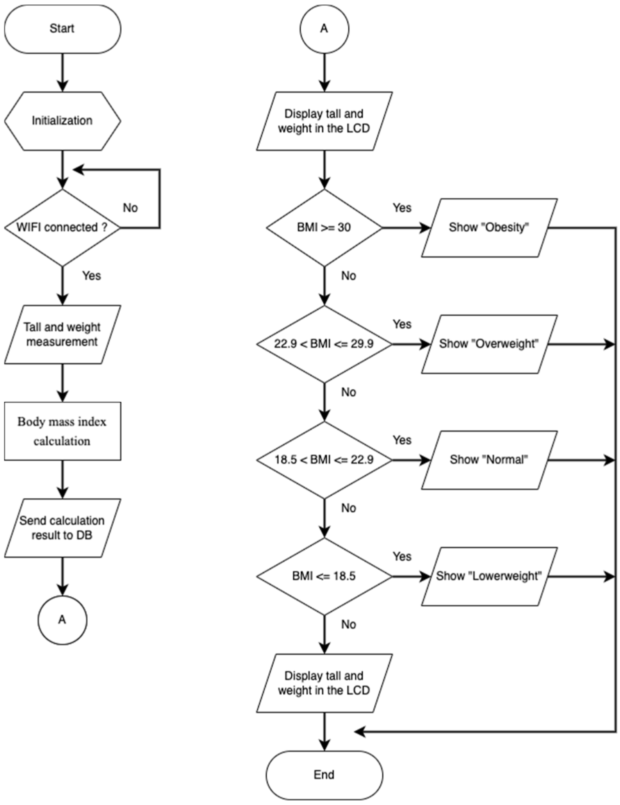

Fig. 2 Flowchart system model

The explanation of the working procedure of the android application used in the research for the title of Design for a Monitoring System for Height, Weight and Body Mass Index (BMI) Using NodeMCU ESP8266 Based on Android is as shown in Fig. 3.

From the flowchart of the Android application in Fig. 3, it can be explained that the way it works begins with reading the database. Height, weight and BMI will appear on the android application. If the BMI is more than 30, then the solution regarding obesity will appear. If the BMI is 22.9 to BMI 29.9, the solution regarding health will appear. If the BMI is 18.5 to 22.9, the solution regarding the ideal body will appear. If the BMI is less than 18.5, then the solution regarding the body is less will appear.

The parameters used in this study are as follows:

- Sensors can measure height, weight and body mass index (BMI).
- The measuring instrument can make a sound according to the BMI value obtained by the microcontroller.
- The measuring instrument can be connected wirelessly with the android application.

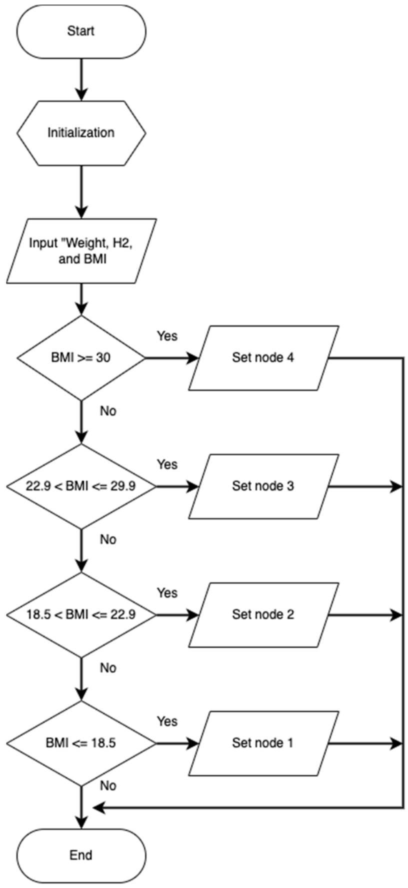

Fig. 3. Flowchart applications

IV. EXPERIMENT RESULTS

A. Experiment results

The results of implementing the Monitoring System for Height, Weight and Body Mass Index (BMI) are shown in Fig. 4.

B. Height measurement

Testing the height measurement system is carried out by comparing the results of the measurement of the design measuring instrument (module) with the results of the manual measurement of the height measuring instrument, namely a meter.

Based on the test results, the results are shown in Table I below:

TABLE I
MEASSUREMENT HEIGHT

No	Height ruler (cm)	Height devices (cm)	Rate successfully (%)	Error percentage
1	155	149	96.97	3.03
2	150	148	98.75	1.24
3	159	152	95.60	4.40
4	164	160	97.40	2.60
5	160	156	97.50	2.50
6	166	160	96.15	3.85
Delta successfull and error			96.95	3.04

C. Weight meassurement

Testing the weight measurement system is carried out by comparing the results of measurements using a design tool (module) to measuring weight using an analog scale.

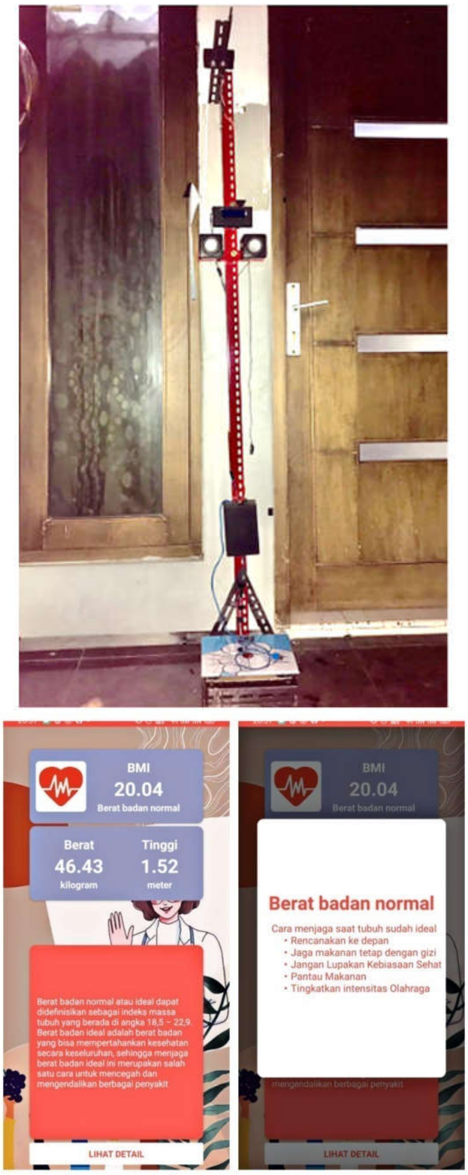

Fig. 4. Implementation of design

Fig. 5. Height meassurement

Fig. 6. Weight meassurement

Based on the test results, the results are shown in Table II.

TABLE II
WEIGHT MEASSUREMENT

No.	Digital weight standard (kg)	Weight devices (kg)	Successfully precentation (%)	Error precentation (%)
1	51.4	44.4	98.93	1.07
2	50	50.7	98.28	1.72
3	49.6	50	99.20	0.80
4	50.7	51.4	98.86	1.14
5	62.5	63.2	98.68	1.32
6	61.8	62.6	98.90	1.10
7	44.1	44.7	99.13	0.87
8	85.7	90.7	99.10	0.90
9	50.9	51.3	99.35	0.65
10	47.7	46.1	99.31	0.69
Delta successfully and error			98.97	1.02

D. Delay sound meassurement

The test of the sound display system is intended to test the system's performance in displaying the sound correctly according to the BMI value obtained on the microcontroller. This test was also observed ten times to obtain the variation of the delay in seconds(s) for each sound output. The results of the tests are those contained in this Table III

TABLE III
DELAY BMI

No.	BMI (Device)	Delay (second)
1	19.99	3.73
2	23.19	1.23
3	21.64	0.81
4	20.07	0.08
5	26.00	4.43
6	24.45	4.68
7	19.86	0.69
8	29.35	1.50
9	20.85	4.22
10	16.31	0.10
Average delay		2.1

E. Delay WIFI meassurement

It aims to determine whether or not the network quality is feasible. This test is completed using Wireshark software connected to the access point. The delayed test is done by comparing the results of the delay value using different WiFi, namely WiFi A and Wifi B

TABLE IV
DELAY WIFI MEASSUREMENT

No	Delay	
	WIFI A	WIFI B
1	0.049049	0.051851
2	0.000736	0.000101
3	0.043903	0.000299
4	0.000132	0.049277
5	0	0.053169
6	0.000137	0.101539
Average	0.049049	0.024044

Table IV has calculated the total delay and the overall average delay using 14 periods of the data communication process and the average delay on WiFi A is 0.04 seconds, and on Wifi B is 0.02 seconds. The delay value can be affected by distance, physical media, congestion, or extended processing time. The smaller the delay, the better the quality of data transmission.

V. CONCLUSION

Measuring instruments for height, weight, body mass index, and sound output have been successfully designed and realized. The tool can work well where the average percentage of success in measuring height is 96.95%, the average percentage of success in measuring weight is 98.97. The measuring instrument can produce sound in the form of body conditions by the measurement results obtained by the microcontroller and perform a percentage of sound output success of 100% but has an average percentage of the variation of the sound output delay of 2.1 seconds. Data transmission from the device to the android application on a smartphone can be done wirelessly using WiFi. The measuring instrument user can see the results of the Body Mass Index (BMI) measurement by the measurement results obtained on the microcontroller and perform the measurement success percentage of 90.84%. Information about normal, deficient, excess or obese body conditions, along with suggested solutions in the form of things to do and types of exercise, can also be viewed in the android application. Testing the Quality of Service (QOS) obtained an excellent category delay value with an overall average delay value using 14 periods of the data communication process, and the average delay on WiFi A was 0.04 seconds and on Wifi B was 0.02 seconds. The delay value can be affected by distance, physical media, congestion, or extended processing time. The smaller the delay, the better the quality of data transmission. The advantage of the measuring instrument that has been designed is that it can calculate height, weight and Body Mass Index (BMI) along with displaying health advice about body condition through an android application according to the body condition results that the speaker has issued from the measuring instrument. This sound output can also make it easier for people with disabilities if they want to know their body condition. The disadvantage of this tool is that the reading on height measurements using an ultrasonic sensor requires a flat surface to be more stable. It can be assisted by using thin plywood or thick paper above the head to get stable results.

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