Design of Automatic Body Mass Index Measurement and Centralization Data Collection

Primaadi Airlangga[1)], Dandi Kurniawan[2)]

[1-2)] Departement of Information system, Universitas KH. A. Wahab Hasbullah

Correspondence Author: primaadi.airlangga@unwaha.ac.id

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ABSTRACT

Body mass index is one of the indicators used in assessing and measuring a person's nutritional and health status which is important to know and understand for human life. Technological developments in today's modern era have touched almost all sectors of life to improve performance, in terms of effectiveness and efficiency as well as convenience for users, including health facilities. The design of a centralized body index measuring device was created to alleviate and overcome various problems that occur in health facilities regarding patient body mass index data which are often inaccurate because the data is missing or does not match between one table and another. This body index measuring device includes microcontroller, RFID, HX711 Load Cell digital scales, height measuring instrument, website and smartphone. All of data from sensor readings will be displayed via a 16x2 LCD, stored on a server, and displayed via a website and user's smartphone.

1. INTRODUCTION

Health facilities are health care centers for people who need to store patient data. With a system that has been digitized or digitally written, it allows patient data collection to be arranged in a more structured manner and information about patients is easily displayed as patient consultation material per period of examination. So that with this system it is hoped that it can help handle patient data in a structured manner and be able to help analyze and monitor patients if problems occur during the examination process.

This research is focused on designing an exchange center (in the form of devices, websites, and applications) data collection automation that is carried out through sensors, RFID, ultrasonic and digital scales that automatically collect data centralized on the website and record patient data from the results of body index mass examination on patient to determine developmental status and medical history.

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2. RESEARCH METHODS

The method used by researchers in this research is research and development, which is a method of developing a particular product that is used as a reference material to produce a new product with the development of certain components.

3. RESULTS AND DISCUSSION.

3.1. Body Mass Index (BMI)

The way to measure ideal body weight with the body mass index (kilogram) is by dividing body weight by height in meters squared before. The BMI threshold is determined by referring to FAO or WHO provisions. The BMI calculation formula uses the Equation below (Trefethen, 2013).

$$BMI = \frac{W}{(H)^2} \quad (1)$$

Where BMI is body mass index, W is weight (kg), and H is height (m). The search for the ideal body weight limit (BBI) is to use the following Equations 2 and 3.

$$LT = 18\,xH^2 \quad (2)$$

$$LT = 25\,xH^2 \quad (3)$$

Where LT is low threshold and UT is upper threshold. Then the ideal (normal), thin, or fat grouping follows

Table 1. BMI classification according to WHO (Trefethen, 2013).

Classification	IMT Value
Thin (Underweight)	<18
Normal (Ideal)	18-25
Fat (Overweight)	>25

3.2. Microcontroller

The micro controller used is NodeMCU ESP8266 which has Wi-Fi access capability so there is no need to add modules. The ESP8266 MCU node functions as a regulator of the performance of the components used, as well as establishing communication with Android via the internet network.

3.3. RFID

3.3.1. HX711 Load Cell digital scales

In designing an integrated digital scale with Android-based Body Mass Index (BMI) information, a load cell sensor is used to determine body weight. The results of sensor readings will be displayed on a 16x2 LCD, stored on a server, and can be monitored via an Android smartphone and website. The Android application used is a special application made to be able to connect to this scale via the same network as the scale. The calculated BMI results will then be stored which can be used to find out changes from each measurement.

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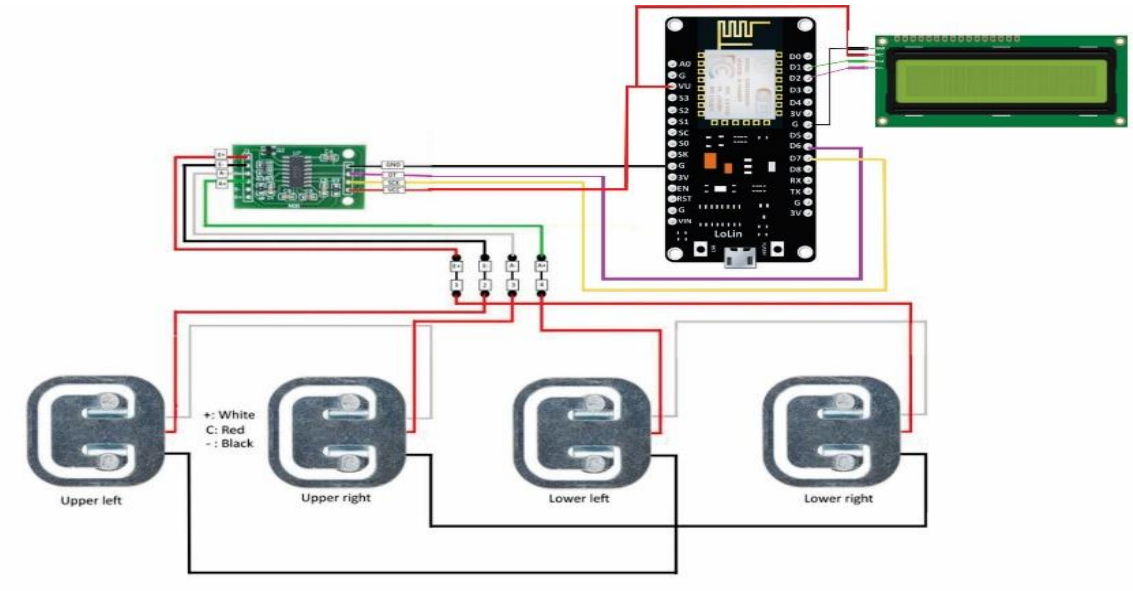

Figure 1. Schematic of a load cell scale

Table 2. Pint sensor load cell used in the schematic.

LOSAD CELL		LCD 12C	
PIN LOAD CELL	PIN ESP 8266	PIN LCD I2C	PIN ESP 8266
GND	GND	GND	GND
VCC	VV	5V	VV
SDA	D1	DT	D6
SCL	D2	SCK	D7

3.4 Height Measuring Tool

Measuring height using:

1. Ultrasonic sensor HC_SR 04 which has the function of changing physical quantities, aka sound, into electrical quantities, and vice versa. The working principle of this ultrasonic sensor is quite simple, which is based on the reflection of a sound wave so that it can be used to define the existence or distance of an object with a certain frequency.
2. ping sensor, is an ultrasonic sensor that can detect the distance of an object by emitting ultrasonic waves with a frequency of 40 KHz and then detecting the reflection.

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3. LCD (Liquid Crystal Display) is a type of display media that uses liquid crystals as the main viewer. The features presented in this LCD are: - Consists of 16 characters and 2 lines. - Has 192 saved characters. - There is a programmable character generator. - Addressable in 4-bit and 8-bit modes. -Equipped with a backlight. The process of initializing the Arduino pins connected to the LCD pins RS, Enable, D4, D5, D6, and D7, is carried out in the Liquid Crystal line (2, 3, 4, 5, 6, 12 7), where the lcd is a variable that is called every time the instruction associated LCD will be used. The definition of a 16x2 lcd pin can be seen in table 2.2 and figure 2.8 is an LCD device.
4. The NodeMCU ESP8266 module is an electronic board based on the ESP8266 chip with the ability to perform microcontroller functions and an internet connection (Wi-Fi). There are several I/O pins so that it can be developed into a monitoring and controlling application for IOT projects. NodeMCU ESP8266 can be programmed with the Arduino compiler, using the Arduino IDE.

3.5 Website

A Server Based System to Support Data Collection and Analysis of Body Mass Index for the Elderly Automatically uses a PHP-based website as the programming language used, Visual Studio Code programming language editor software, and MySQL as a database processor. This system centralizes data collection and various data exchanges to be made from all patient data and BMI measurements in patients.

How to use the IMT system program, namely:

1. For patient data collection from name, address, age, and institution.
2. Before registering, patients will be asked to register and given an RFID card as identification, then when they arrive at the place, they only need to offer an RFID card.
3. When the patient's condition has not been registered, the officer will register it. When the data on the patient already exists, then all that remains is to proceed with measuring the BMI.
4. When the data is entered, the patient will go to the next procedure, namely measuring body mass index, such as measuring height and measuring body weight.
5. The input of all measurements is carried out automatically on the system that has been created, with a connected database.
6. When it is successful and enters the available website, then the officers can add, edit, delete existing data.

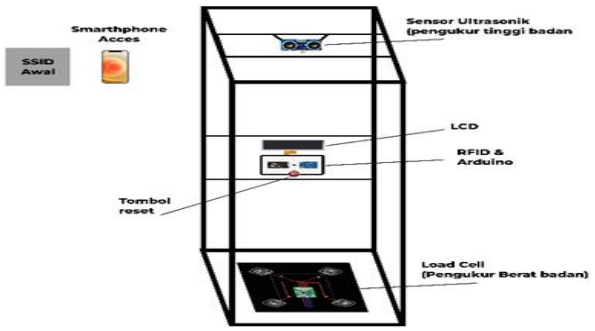

Figure 2. Design of Automatic Body Mass Index Measurement and Centralization Data Collection

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Figure 2 shows how the device can be operated. First the person who wants to use this device must place the id card that contains chips on the RFID scanner while standing on the scale. After the RFID scanner detects the ID card, the measurement of height and weight is done automatically. The result of this measurement is shown by LCD display (Figure 4) and at the same time is sent to server so that the person data and the measurement result can be recorded. The result of the measurement can be seen using the website (Figure 3) and mobile application provider (Figure 5).

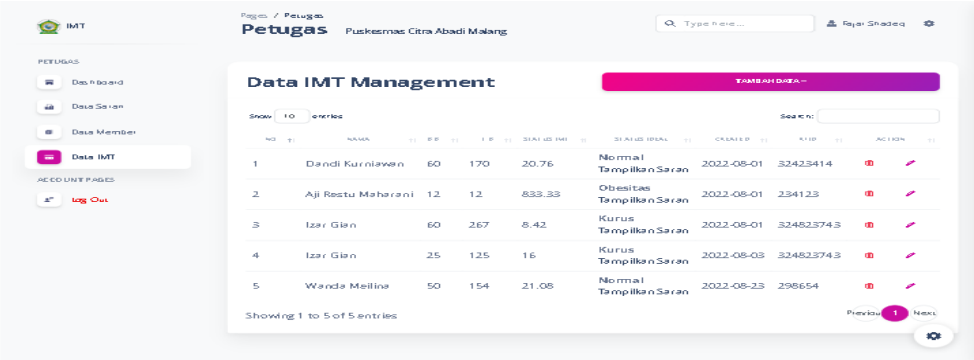

Figure 3. Website Display Dashboard

This web function is not only for managing but also for receiving data on the measurement results of the BMI measuring instrument, Arduino will send serial data in the form of weight, height, BMI value, user id during the measurement process. The following are parts of the web view that displays the data recorder for this BMI measurement tool.

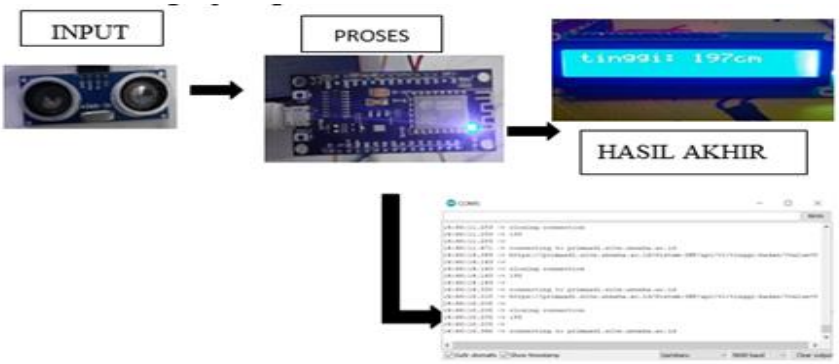

Figure 4. Displays the data recorder for BMI measurement tool.

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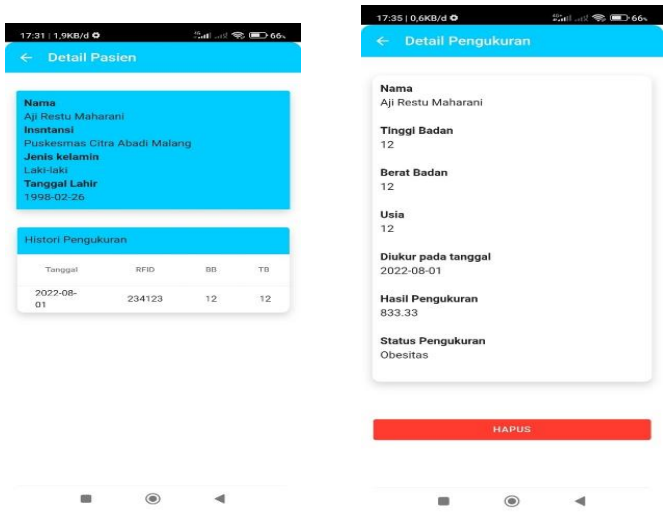

Figure 5. Display of Measurement Results on an Android Smartphone

The website and mobile application can be used by the government to track areas that have malnutrition problems. They can also be used by patient that was measured to track their growth and get opinion whether their mass body index is normal or not.

4. CONCLUSION

Provide a statement that what is expected, as stated in the "Introduction" chapter may eventually lead to the "Results and Discussion" chapter, so that there is compatibility. In addition, the prospect of developing research results and the prospect of applying further studies to the next (based on the results and discussion) can also be added.

The research manages to create a device, a website, and a mobile application. The device can help measurement of weight and height in an instant just by placing an RFID card to the card reader. Not only it measures data it also sends the result to the server which host a website that seamlessly record the data in structured manner and display those data in easy to read format for patients, health workers, and also government officials. The mobile application can be used as an alternative of the website to access the data and to manage patients data so their data can be verified, added, edited, and deleted.

With this research, the health workers can use the device, the website, and the mobile app to make height and weight measurement faster, manage the patients data and their results easier with its automatic recording.

5. DECLARATION OF COMPETING INTEREST

We declare that we have no conflict of interest.

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