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Monitoring Ideal Body Mass Index Using a Blynk-Based Internet of Things Measurement System

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Abstract

This study presents the design and implementation of an Internet of Things (IoT)-based automated measurement system for monitoring height, weight, and Body Mass Index (BMI). The system utilizes an ultrasonic sensor for height measurement and a load cell sensor for weight measurement, integrated with a NodeMCU ESP8266 microcontroller and the Blynk application for real-time data visualization. The increasing prevalence of obesity and lifestyle-related health issues, particularly during the COVID-19 pandemic, highlights the need for efficient and accurate health monitoring tools. The study adopts an action research methodology, consisting of diagnosing, action planning, action taking, evaluating, and learning phases. Experimental results show that weight measurements obtained from the load cell sensor produced a high level of accuracy with an average error of 0.5–0.75 kg, while height measurements using the ultrasonic sensor showed an average error of 1 cm. The system successfully displays measurement results on both an LCD module and the Blynk mobile application. The findings indicate that IoT-based measurement systems offer significant potential to support personal health monitoring and provide a practical solution for continuous tracking of BMI.

Keywords

Action Research; Body Mass Index; Blynk; IoT; Health Monitoring

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Introduction

Advancements in digital technology have accelerated the development of Internet of Things (IoT)–based systems, enabling automated, accurate, and real-time monitoring across various sectors, particularly in the field of health. IoT integrates sensors, microcontrollers, and wireless communication to facilitate continuous data collection and analysis, thereby supporting individuals in managing their health more proactively and efficiently. Among the essential biometric indicators routinely measured, height and weight serve as fundamental parameters for evaluating overall health status, identifying risks of malnutrition, assessing growth patterns, and detecting early signs of metabolic disorders such as obesity and cardiovascular disease. The increasing prevalence of obesity—exacerbated by limited physical activity during the pandemic—highlights the urgent need for accessible and reliable self-monitoring tools.

Recent studies have introduced IoT-based health measurement devices utilizing microcontrollers such as the ESP8266, combined with sensors like ultrasonic modules for height measurement and load cell sensors for weight detection. These tools enable real-time monitoring via wireless connectivity to mobile applications, fostering continuous health awareness and allowing users to track changes in their biometric profile instantly. One widely used health indicator is the Body Mass Index (BMI), a simple yet effective calculation that illustrates the relationship between height and weight. According to Reza Ardaffa Putra et al. (2023), BMI is a practical method for assessing an individual's nutritional status and classifying them into categories such as underweight, normal weight, overweight, or obese. Its ease of calculation and global acceptance make BMI a standard reference for public health monitoring.

The integration of IoT technology into BMI measurement enhances not only convenience but also accuracy. Platforms such as Blynk provide user-friendly interfaces for IoT devices, allowing seamless real-time data transmission, device control, and visualization through mobile applications. With Blynk, users can instantly view their height, weight, and calculated BMI, reducing dependency on manual tools that are prone to human error. This connectivity supports autonomous health monitoring and encourages consistent check-ups, which are vital for early detection of potential health issues.

In educational environments such as Universitas Bina Darma (UBD), students often experience irregular lifestyle patterns that impact their physical health. Limited awareness regarding proper nutritional status and the absence of routine health monitoring tools contribute to undetected health risks. Therefore, an IoT-based system that provides accurate biometric measurements and BMI analysis can serve as an effective preventative tool, encouraging students to adopt healthier habits and make informed decisions about their well-being.

This study aims to design and develop an IoT-based BMI monitoring system that integrates ultrasonic and load cell sensors with the Blynk application. The system is designed to automatically measure height, weight, and BMI, store the data, and present it in a visually intuitive format through the Blynk dashboard. By offering higher accuracy compared to conventional manual measurements, the device supports UBD students in independently monitoring their nutritional status and maintaining a healthier lifestyle. Additionally, the system contributes to the broader advancement of IoT applications in health monitoring and provides a cost-effective and scalable solution for educational institutions and public health initiatives.

Methodology

This study employed an action research methodology, which emphasizes iterative analysis and improvement through practical implementation. The methodology consists of five key stages: diagnosing, action planning, action taking, evaluating, and learning (Zaluchu, 2021; Ariyadi et al., 2023). Figure 1 illustrates the action research process.

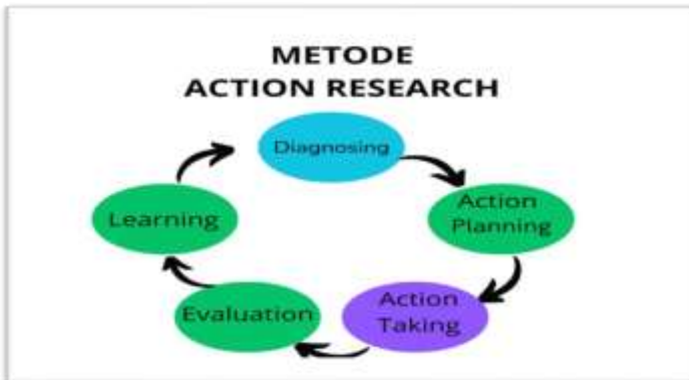

Figure 1. Action Research Method

Diagnosing

The initial phase identified issues with conventional height and weight measurement tools, which rely on manual stadiometers and analog weighing scales. These tools often lack accuracy and require considerable time. To address these limitations, an IoT-based measurement system was proposed, incorporating a load cell sensor for weight and an ultrasonic sensor for height. Data output is displayed via an LCD panel and transmitted to the Blynk application.

Action Planning

In this phase, the system design was formulated. The plan involved integrating sensors, microcontrollers, and cloud-based monitoring through Blynk to create an efficient and user-friendly system for height, weight, and BMI measurement.

Action Taking

The system was implemented according to the planned design. A prototype with a height capacity of 200 cm was constructed, and input-output components were connected. The load cell and ultrasonic sensors served as input devices, while the LCD and Blynk application provided output displays.

Evaluating

Evaluation focused on comparing sensor measurements with manual measurements to determine accuracy. Data processing was conducted using Arduino IDE, and measurement results were displayed simultaneously on the LCD and Blynk application.

Learning

The final stage involved analyzing system performance, identifying sensor limitations, and recommending improvements. Understanding the principles of height and weight measurement was essential to refining the prototype. Sensor selection, wiring, IoT integration, and data monitoring through Blynk were crucial components of the development process.

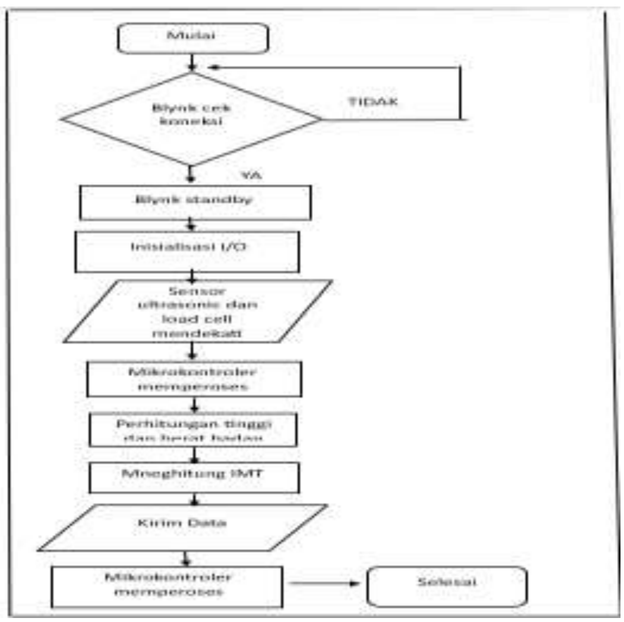

Figure 2 Flowchart for Using a Height and Weight Measuring Tool Using Blynk

Results

Sensor Weight Measurement Accuracy

Table 1. Load Cell Sensor Weight Accuracy

No	Name	IoT Weight (kg)	Manual Weight (kg)	Difference (kg)
1	Arief Rahman	69.11	68.90	0.50
2	Anugrah Dwi Putra	52.35	53.10	0.75
3	M. Ary Januarta	45.34	45.60	0.26
4	M. Syaiful Huda	55.68	56.00	0.32
5	Viren Pranata	39.68	40.20	0.52

No	Name	IoT Weight (kg)	Manual Weight (kg)	Difference (kg)
6	M. Reihan Pratama	42.84	43.00	0.16
7	Daud Rusdi	86.35	86.80	0.45
8	Dedi Kurniawan	70.11	69.43	0.68
9	Ardiansyah	59.82	59.30	0.52
10	M. Ricki Ghozali	61.10	60.90	0.20

The results demonstrate that the load cell sensor produced accurate weight readings, with an average error ranging from 0.2 to 0.75 kg.

Sensor Height Measurement Accuracy

Table 2. Ultrasonic Sensor Height Accuracy

No	Name	IoT Height (cm)	Manual Height (cm)	Difference (cm)
1	Arief Rahman	163	164	1.00
2	Anugrah Dwi Putra	164	165	1.00
3	M. Ary Januarta	166.36	167	0.64
4	M. Syaiful Huda	160.45	160	0.45
5	Viren Pranata	152.34	153	0.66
6	M. Reihan Pratama	162.50	163	0.50
7	Daud Rusdi	177.60	178	0.40
8	Dedi Kurniawan	178.23	178	0.24
9	Ardiansyah	162.86	163	0.14
10	M. Ricki Ghozali	162.64	163	0.36

The ultrasonic sensor produced an average error of approximately 1 cm.

BMI Measurement Results

Table 3. BMI Calculation Results

No	Name	Weight (kg)	Height (cm)	BMI	Category
1	Arief Rahman	68.1	163	26.1	Obesity
2	Anugrah Dwi Putra	52.35	164	22.3	Normal
3	M. Ary Januarta	45.34	167	15.5	Underweight
4	M. Syaiful Huda	55.68	160	21.8	Normal
5	Viren Pranata	40	153	17.1	Underweight
6	M. Reihan Pratama	43	163	16.2	Underweight
7	Daud Rusdi	86.80	178	27.4	Obesity

No	Name	Weight (kg)	Height (cm)	BMI	Category
8	Dedi Kurniawan	70.11	178	22.1	Normal
9	Ardiansyah	59	163	22.2	Normal
10	M. Ricki Ghozali	60.90	163	22.9	Normal

Discussion

The evaluation confirmed that the IoT-based measurement system performed reliably. The load cell sensor demonstrated high accuracy, with only minor deviations from manual measurements. The ultrasonic sensor, while generally accurate, was sensitive to object surface irregularities, necessitating the use of a thin and wide calibration object such as a sheet of paper to ensure reliable height detection.

The integration with the Blynk application enabled real-time visualization of height, weight, and BMI data, enhancing user experience and promoting ease of monitoring. The combination of hardware and IoT software provided a functional and efficient system for biometric measurement.

Conclusion

The IoT-based measurement system accurately recorded and displayed height, weight, and BMI through both the LCD and Blynk application. The ultrasonic sensor exhibited an average measurement error of 1 cm, while the load cell sensor demonstrated a high level of accuracy with an error range of 0.2–0.75 kg. The primary issue identified in system performance was the high sensitivity of the ultrasonic sensor, which required the use of a thin, wide object to ensure accurate height detection.

Disclosure Statement

The authors declare no conflicts of interest related to this study.

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Biographical Notes

Arief Rahman is a student at the Faculty of Vocational Studies, Universitas Bina Darma (UBD) in Palembang, Indonesia. They maintain strong interests in Embedded Systems, the Internet of Things (IoT), Health Informatics, and the development of Sensor-Based Monitoring Systems.