Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

15th October 2024. Vol. 4. No. 1; e-ISSN: 2808-4519

Nutritional Status Collection Using Height and Weight Indicators at Posyandu Latalanyir Based on the Internet of Things

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Abstract

This research aims to develop a nutritional status data collection system at Posyandu Latalanyir using height and weight indicators based on the Internet of Things (IoT). This system is designed to simplify the process of measuring and collecting data on the nutritional status of toddlers, as well as increasing the accuracy and efficiency of data processing. The approach used involves using an ultrasonic sensor to measure body height, an HX711 load cell sensor to measure body weight, and an ESP8266 module to send data to the Blynk platform. The collected data will be processed to calculate Body Mass Index (BMI) and sent to the Blynk application for real-time monitoring. The results of this research show that the system developed can measure height and weight accurately, as well as provide nutritional status data that can be easily accessed by health workers at posyandu. The conclusion of this research is that the IoT system developed is effective in improving the quality of nutritional status data collection in posyandu, as well as providing significant benefits in monitoring the nutritional development of toddlers.

Keywords: *Posyandu, IOT, Nutritional Status, Height, Weight*

1. Introduction

Human life which was once simple has now developed into a very modern life. In the current era of advances in information and communication technology, many things can be solved in a practical way. Information and communication technology plays an important role in facilitating various aspects of human life. The world of information now seems inseparable from technology. The use of information and communication technology by society encourages increasingly rapid technological progress[1].

Kambuhapang Village is one of the villages in Lewa District, Kambuhapang Village has health services, one of which is posyandu. Posyandu is the front guard that provides direct health services and is closest to the community and reaches remote villages that are far from the center of health facilities provided by each region[1]. Posyandu has many programs, one of which is the height and weight measurement program. In carrying out height and weight measurements at posyandu currently, height and weight measurements are still used using meters and hanging scales are used to measure body weight. In terms of effectiveness and efficiency, the measurement results are quite time consuming. The work carried out is also done twice, starting from measuring height and also measuring body weight. For this reason, the author designed an internet of things-based height and weight measurement tool which then used the height and weight measurement results as indicators to determine nutritional status and other criteria for the posyandu. The tool designed can help cadres measure height and weight at the same time and make it easier for posyandu cadres to collect data on nutritional status of children with height and weight indicators that are more efficient and do not take a long time. The research method is based on the stages of a design research model for data collection on nutritional status using height and weight indicators supported by IoT technology. The protocol used is MQTT (Message Queuing Telemetry Transport) which is one of the protocols of choice for IoT devices that can run on low bandwidth (high latency) networks so it is ideal for M2M connections for embedded systems. The MQTT protocol has been around since 1999 by IBM, but has only recently developed very rapidly in the IoT era[2]. The main aim of this research is to integrate Internet of Things (IoT) technology in public health services in collecting data on nutritional status with height and weight indicators, especially at Posyandu, in order to save time and energy for cadres in monitoring children's growth. To help posyandu cadres in measuring height and weight based on IoT faster because the previous process still used hanging scales and meters which made the process of measuring height and weight take quite a long time. The benefit of this research is that collecting data on nutritional status in children using IoT-based height and weight indicators can save health workers time and energy which was previously used for measuring height and weight which still used meters and hanging scales, allowing greater focus on better health services. direct. Internet of Things, or known as IoT, is an advanced technology that aims to expand and optimize the benefits of continuous internet connections, connecting objects around us to facilitate daily activities and increase the efficiency of human work[3].

The MQTT (Message Queue Telemetry Transport) protocol is a lightweight messaging protocol that uses the publish-subscribe concept on top of the TCP/IP protocol. This protocol has a small data packet size (minimum 2 gigabytes) and low power consumption. MQTT is open, simple, and designed to be easy to implement, and is capable of handling thousands of remote clients with just one server[4]. An ultrasonic distance measuring device can tell the current distance to an object using a microcontroller. This distance measuring tool uses an ultrasonic sensor so it can replace analog measuring tools. Where this ultrasonic sensor utilizes the properties of sound waves. The nature of these sound waves is that they bounce when they hit an obstacle[5]. This load cell sensor functions as a pressure converter from a weight which will be used as an electrical signal. Planar resistors are a form of mechanical arrangement in load cell sensors, based on the deformation of the strain gauges or what is called the strain gauge matrix, the pressure force will be detected. There is an effective resistance that will be changed through the strain consisting of 4 bridge strain gauges. And the Wheatstone will be read as a different voltage[6]. IDE is an abbreviation for Integrated Development Environment, or integrated development environment. It is called an environment because through this software, Arduino can be programmed to perform certain functions using programming syntax. Arduino uses its own programming language which is similar to C. The Arduino programming language, known as Sketch, has been modified to make it easier for beginners to program. Before being sold, the Arduino microcontroller IC has a program called Bootloader installed, which functions as an intermediary between the Arduino compiler and the microcontroller[7]. HX711 is an integrated component of "AVIA SEMICONDUCTOR", HX711 precision 24-bit analog to digital converter (ADC) designed for digital weighing sensors in industrial control applications connected to bridge sensors. HX711 is a weighing module, which has the working principle of converting measured changes in resistance changes and converting them into voltage quantities through an existing circuit. The module communicates with the computer / microcontroller via TTL232. Simple structure, easy to use, stable and reliable results, has high sensitivity, and is able to measure changes quickly[8]. Wemos is one such board can work with arduino especially for project that carries the IoT concept. Wemos can run stand-alone in contrast to other wifi modules that still need microcontroller as controller or brain from this series, WeMos can run stand-alone because it's already there A CPU that can program via serial port or via OTA (Over The Air) and transfer program wirelessly[9].

2. Research Methodology

Posyandu Latalanyir is one of the posyandu in Kambuhapang Village, Kec. Lewa District. East Sumba, which was founded on August 12 2000, with posyandu activities carried out once a month on the same date, according to the results of an interview with the head of the posyandu cadre, Latalanyir, there are five cadres and the number of children registered in 2024 will be 84, the number of girls will be 36 and 48 men. Health services at the Latalanyir posyandu cover 2 hamlets, namely Laikokur hamlet and Djawamara hamlet, children who receive services at the Latalanyir posyandu range from 0 months to 5 years old. At the Latalanyir posyandu there are activities called five registration desk activities, height and weight measurements, record keeping, nutritional education, and health services.

The following method was adopted as the research stage in this study

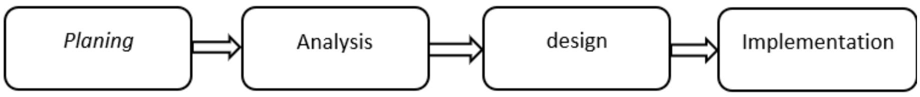

Fig. 1: Research Flow

The research methodology for this research is explained in Figure 1. Planning in the planning in question is the first step in conducting research, after knowing the problems that exist in the research object and finding possible solutions to overcome these problems, a Malnutrition Data Collection with High Indicators and Internet Of Things Based Weight Loss.

At the analysis stage the author carried out observations and interviews which included direct observation of the research object regarding height and weight measurement tools currently used at the Latalanyir posyandu, and conducted interviews with the head of the posyandu cadre with questions related to the research being carried out. From the results of observations and interviews, it was found that the process of measuring height and weight currently being carried out at the Latalanyir posyandu involves 2 stages, namely measuring body height using a height measuring meter, after that, measuring body weight using hanging scales. The data obtained was analyzed by identifying existing problems, then a statement was made that addressed the problem and a solution was sought by designing malnutrition mapping using height and weight indicators at the IOT-based Latalanyir posyandu.

The design of this tool uses an ultrasonic sensor to measure body height, a load cell to measure body weight, Wemos D1 as a microcontroller and MQTT to send data to the Blynk application to display the results of height and weight measurements as well as the child's nutritional status.

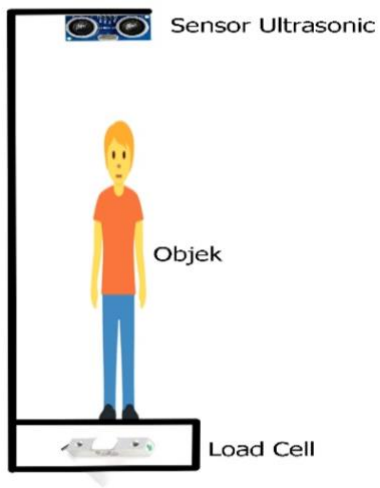

Fig. 2: Placement of Sensor Components on Objects

In Figure 2 above, the placement of the sensor components uses a 1 meter high pole on which an ultrasonic sensor of the HCR04 type is installed which is used as a height measuring tool by utilizing ultrasonic waves which are reflected on objects and then captured again by the sensor. Then the load cell sensor used to measure body weight is placed parallel to the end of the pole so that the height and weight measurement process occurs simultaneously.

In the implementation stage, it will be carried out at the Latalanyir posyandu by designing a height and weight measuring device using an ultrasonic sensor to measure body height and a load cell to measure children's weight at the Latalanyir posyandu, then the results of these measurements will become an indicator in determining malnutrition in children. After the system has been successfully created and can run well, the system will be tested on users using the System Usability Scale (SUS) method where the number of respondents used in SUS testing is 5 people who are cadres from posyandu and a questionnaire sheet will be given to users with 10 questionnaire questions with responses in the form of a score of 1 to 5 starting from strongly disagree (STS), disagree (TS), unsure (N), agree (S), strongly agree (SS). The ten questions in the SUS questionnaire.

2.1. System Workflow

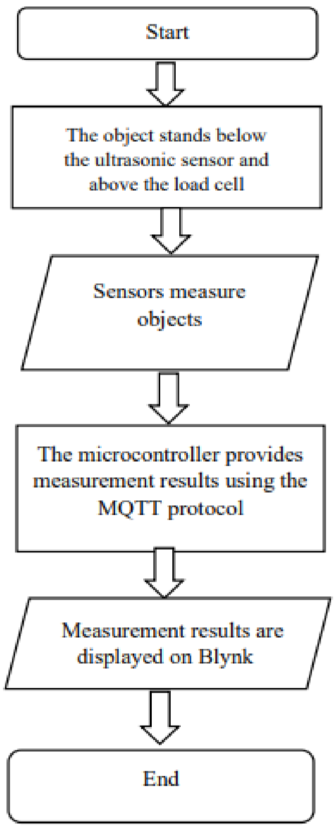

Fig. 3: System Workflow

In Figure 3 above, the system workflow starts from the object standing under the ultrasonic sensor and standing above the load cell sensor, then the ultrasonic sensor will measure the object using ultrasonic waves and the load cell detects the pressure or weight of the object. Then the microcontroller provides measurement results using the MQTT protocol. The measurement results will be displayed on the finished blynk.

2.2. BMI standards

Body Weight Index according to Body Length/Height (BB/PB or BB/TB) This BB/PB or BB/TB index describes whether the child's body weight is appropriate for his growth in length/height. This index can be used to identify children who are undernourished, severely wasted and children who are at risk of being overweight. Malnutrition conditions are usually caused by disease and nutritional deficiencies that have recently occurred (acute) or have occurred for a long time (chronic)[10]. Determination of children's nutritional status in this study uses BMI standards

Nutritional Status Categories Based on BMI (WHO Standard):

a) Malnutrition (Severely Underweight): BMI < 16.0
b) Malnutrition (Underweight): BMI 16.0 - 18.5
c) Normal Nutrition (Normal): BMI 18.5 - 25.0
d) Overweight (Overweight): BMI 25.0 - 30.0
e) Obesity (Obese): BMI > 30.0

2.3. Schematic Diagram

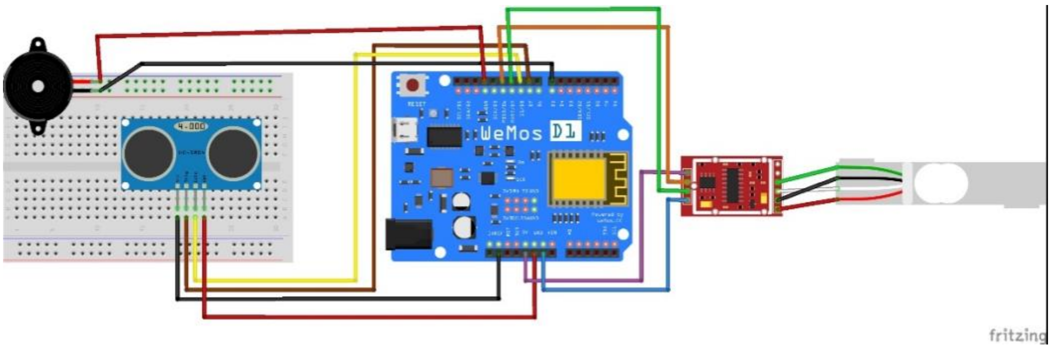

Fig. 4: Schematic Diagram

In Figure 4 above, researchers use a microcontroller to control and monitor height and weight measurements. The ESP8266 microcontroller sends data from Arduino and signals to the smartphone, then the blynk application will display height and weight results as well as nutritional status. and uses 2 sensors, namely an ultrasonic sensor and a loadcell.

Table 1: Input Output

No	I/O devices	Pin Wemos D1
1	Sensor Ultrasonic	
	Trig	Pin D5
	Echo	Pin D4
	VCC	5V
2	Load Cell	
	DOUT	Pin D12
	SCK	Pin D11
	VCC	5V
	GND	GND
3	HX711	Load Cell
	E+	Red Cable
	E-	Black Cable
	A-	White Cable
	A+	Green Cable
4	Buzzer	Wemos D1
	Long leg (+)	D13
	Short leg (-)	GND

3. Results and Discussion

```
#define BLYNK_TEMPLATE_ID "TMPL6gCEAeK8s"
#define BLYNK_TEMPLATE_NAME "Tinggi dan berat badan "
#define BLYNK_AUTH_TOKEN "Hb4uLmzXB9zaGKNC3XpG6L6oiZWLk7pe"

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include "HX711.h"

char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "Ireneee";
char pass[] = "irene00002";

#define DOUT  D12
#define CLK  D11

int trig_pin = D5;
int echo_pin = D4;
int buzzer_pin = D13; // Tambahkan pin untuk buzzer
long echotime;

HX711 scale;

BlynkTimer timer;
```

a)

```
HX711 scale;

BlynkTimer timer;

void sendSensorData() {
    // Pengukuran Tinggi Badan menggunakan sensor ultrasonik
    long duration, distance;
    digitalWrite(trig_pin, HIGH);
    delayMicroseconds(10);
    digitalWrite(trig_pin, LOW);
    echotime = pulseIn(echo_pin, HIGH);

    float tinggi_tiang = 150;
    float tinggi_Anak, jarak_pantul;

    jarak_pantul = (0.034 * (float) echotime) / 2;
    tinggi_Anak = tinggi_tiang - jarak_pantul;

    Serial.print("Tinggi_Anak   = ");
    Serial.print(tinggi_Anak);
    Serial.println(" cm");

    float weight_in_grams = scale.get_units();
    float weight_in_kg = weight_in_grams / 1000.0; // Konversi dari gram ke kilogram

    Serial.print("Berat: ");
    Serial.print(weight_in_kg, 3); // Membaca berat dalam kilogram dengan 3 angka di belakang koma
    Serial.println(" kg");
```

b)

```
// Menghitung BMI
float heightInMeters = tinggi_Anak / 100.0; // Konversi tinggi ke meter
float bmi = weight_in_kg / (heightInMeters * heightInMeters);

// Menentukan status gizi berdasarkan BMI
String nutritionStatus;
if (bmi < 16.0) {
    nutritionStatus = "Gizi Buruk";
} else if (bmi >= 16.0 && bmi < 18.5) {
    nutritionStatus = "Gizi Kurang";
} else if (bmi >= 18.5 && bmi < 25.0) {
    nutritionStatus = "Normal";
} else if (bmi >= 25.0 && bmi < 30.0) {
    nutritionStatus = "Gizi Lebih";
} else {
    nutritionStatus = "Obesitas";
}

// Menampilkan status gizi pada serial monitor
Serial.print("Status Gizi Anak: ");
Serial.println(nutritionStatus);

Serial.println("-----------------------------------");

// Mengirim data ke Blynk
Blynk.virtualWrite(V0, tinggi_Anak);
Blynk.virtualWrite(V1, weight_in_kg);
Blynk.virtualWrite(V2, nutritionStatus);
```

c)

```
    // Nyalakan buzzer selama 30 detik setelah pengukuran selesai
    digitalWrite(buzzer_pin, HIGH);
    delay(120);
    digitalWrite(buzzer_pin, LOW);
}

void setup() {
    Serial.begin(9600);
    Blynk.begin(auth, ssid, pass);
    scale.begin(DOUT, CLK);
    scale.set_scale(96.0943396226); // Mengatur nilai kalibrasi yang sudah Anda dapatkan dalam gram
    scale.tare(); // Mengatur titik nol (0)
    pinMode(trig_pin, OUTPUT);
    pinMode(echo_pin, INPUT);
    pinMode(buzzer_pin, OUTPUT); // Mengatur pin buzzer sebagai output
    digitalWrite(trig_pin, LOW);
    digitalWrite(buzzer_pin, LOW); // Pastikan buzzer mati pada awalnya

    timer.setInterval(2000L, sendSensorData); // Mengirim data setiap 2 detik
}

void loop() {
    Blynk.run();
    timer.run();
}
```

d)

Fig. 5: Height and Weight Program

In Figure 5 above, there is a program for measuring height, weight, determining nutritional status, and then the results will be displayed on the Blynk application on your cellphone. In measuring body height using an ultrasonic sensor with a pole height of 150 cm, in the process of calculating body height, pole height minus the reflection distance, you get the child's height in cm. To measure body weight using a load cell sensor, you need to calibrate it first on the HX711 by downloading the library on The Arduino IDE then calibrates. After that, the calibration results from the load cell are divided by the weight of the object that we know and the result is the calibration value that will be entered into the body weight measurement program. The results of measuring height and weight will be a reference in determining the nutritional status of children based on BMI standards, then the results will be displayed on the blynk application on cellphones.

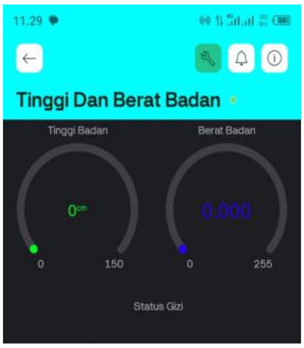

Fig. 6: Blynk Application Appearance

In figure 6 is the initial display of the Blynk application before carrying out the process of measuring height and weight and determining nutritional status, users can see height and weight as well as nutritional status on their cellphone using the Blynk application. For height measurement results, it will be displayed in cm units, while body weight will be displayed in kg units. Nutritional status is a standard assessment to determine whether weight and height are classified as malnourished, undernourished, normal and over nourished or obese.

4. Implementation

An IoT-based height and weight measuring device was successfully created with a pole height of 150 cm, using Wemos D1 as a microcontroller, an ultrasonic sensor to measure body height, and an HX711 load cell to measure body weight. This tool is designed to make it easier for posyandu parties to monitor children's nutritional status in real-time. In the picture below is the implementation of the tool using one child for the measurement experiment. The results of measurements of the child's height were 93 cm and weight 7,080 kg, which was calculated to produce a BMI of around 8.19. Based on these results, the child's nutritional status is categorized as malnourished. This tool sends measurement data to the Blynk platform.

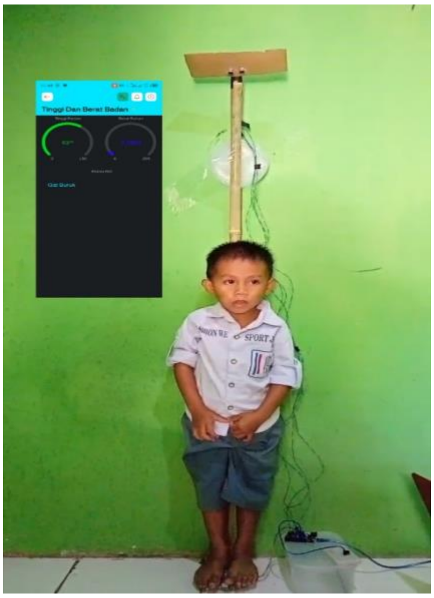

Fig. 7: Implementation

5. Conclusion

The conclusion of this research is that the IoT-based nutritional status data collection system developed for Posyandu Latalanyir is effective in improving the quality of data collection on the nutritional status of toddlers. This system, which uses an ultrasonic sensor to measure body height, an HX711 load cell sensor to measure body weight, and an ESP8266 module to send data to the Blynk platform, is proven to be able to measure height and weight accurately. In addition, this system provides nutritional status data that is easily accessible to health workers, thus providing significant benefits in monitoring the nutritional development of toddlers in real-time. The novelty of this research lies in the integration of IoT technology in the data collection process at Posyandu, which has not been widely applied before. The extraordinary results obtained show that this system not only increases the accuracy and efficiency of data processing, but also makes it easier for health workers to carry out timely nutritional monitoring and interventions.

Acknowledgement

For this reason, with all humility, the author expresses his thanks to: Almighty God who has created and given life to the world. Beloved father and mother who have supported the author both spiritually and materially. Mrs. Rambu Yetty Kalaway, ST., M.T., M.M as Dean of the Faculty of Science and Technology, Wira Wacana Christian University, Sumba. Mrs. Arini Aha Pekuwali, S.Kom, M.Kom as Head of the Informatics Engineering Study Program. Mr. Pingky Alfa Ray Leo Lede, S.Kom., M.Cs and Mr. Hawu Yogia Pradana Uly, S.Kom., M.Kom as supervisors who have provided direction and suggestions to the author in preparing the thesis. Absurd group friends who are always there.

May God Almighty reward you with kindness and always pour out His blessings.

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