

# Artificial Intelligence System Integrated with Smartphone Application for Early Detection of Stunting Based on Toddler Growth Index

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**Abstract**— Toddlers have certain characteristics and needs that require growth monitoring. Toddlers will experience a period called the "Golden age" which is a period of experiencing a golden period in early life. What needs to be considered during the Golden Age of Toddlers is the record of weight, height, and head circumference of the child at each visit, then the results are recorded using the Healthy Menu Card. Collaboration between Artificial Intelligence and IoT can provide innovative and effective solutions, these two fields of science can be collaborated with IoT Sensors for measuring weight and height, data collection and storage, AI systems for data analysis, providing recommendations, notification systems and monitoring. The method used to complete this research is a literature study and data collection to find reference materials, design technology concepts, development preparation, hardware assembly, Arduino IDE coding, uploading coding to hardware, PHP (Hypertext Preprocessor) coding, uploading PHP (Hypertext Preprocessor) Code to hosting, coding .Apk (Android Package), technology trials. This application is available on two platforms, namely web-based and Android. Everyone can weigh, but to record data to the system, users must register to get an account and QR code. QR code is used to transfer weight and height data into the system, and the account allows the user to view all weighing data and history. The system also displays a graph containing height, weight, and upper and lower limits of ideal weight.

**Keywords** : android, artificial intelligence, golden age, ideal weight

## I. INTRODUCTION

The development of information and communication technology has marked the era of the industrial revolution 4.0. In the health sector, crowdsensing no longer relies on mobile phones as information gathering devices due to the limitations of embedded sensors on phones. Various studies using crowdsensing have relied on the capabilities of Internet of Things (IoT) devices. [1].

Toddlers have certain characteristics and needs that require growth monitoring. [2]. Toddlers will experience a period called the "Golden Age", which is a period of experiencing the golden period in the early stages of life. [3]. Efforts to achieve critical period success require early identification to find out the existence of growth faltering problems. Growth monitoring can be seen through weighing media, namely the Healthy Menu Card. Ideally, toddlers should be weighed at least four times [4].

Based on the prevalence data of stunting toddlers collected by WHO, in 2020 as many as 22% or around 149.2 million toddlers in the world experienced stunting. Growth problems in toddlers are common problems found in almost all countries [2]. Indonesia is recorded as the third country with the highest prevalence in the Southeast Asia region. The main causes of toddler death are infection problems, as well as weight gain problems, namely malnutrition and undernutrition. Toddler growth can be known if weighed every month, the weighing results are recorded on the Healthy Menu Card, if there are indications of impaired weight growth or overnutrition, the toddler's parents can take corrective action after taking the child to a health facility[2].

Research conducted by Noliyanti and Magdalena in 2023 resulted in an Android-based stunting monitoring and evaluation information system application that can provide information to parents, health workers and related sectors in

the monitoring and intervention process to improve the fulfillment of toddler nutrition according to predetermined targets.[5].

Research conducted by Achmad Jaelani Rusdi in 2023, the examination form used for pregnant or postpartum women uses the Healthy Menu Card examination card form, the form for mothers giving birth uses the maternity form, while for newborns the Healthy Menu Card form is used. [6].

What needs to be considered during the Golden Age of Toddlers is the record of the child's weight, height, and head circumference at each visit, then the results are recorded using the Healthy Menu Card. Recording with the Healthy Menu Card has weaknesses.

1. The use of the Healthy Card which is still in paper form has the disadvantage that it is easily lost or damaged due to errors in storage.
2. The Healthy Menu Card is not yet effective if the doctor/officer wants to look for data on the child's development, this data could be the child's current age, the child's weight and the child's previous height.
3. If the Health Card is lost, the child's data cannot be known.
4. Recording or Measurement Errors, these errors can be caused by human factors such as inaccuracy.

The formulation of the problem to be solved is how to utilize the capabilities of Artificial Intelligence that can be integrated with smarthome applications that help with early detection of stunting based on the toddler growth index.

The problem solving approach is:

1. Migration to Digital Format, replacing the paper-based Healthy Card with a digital version can solve the

problem of damaged physical cards. Data can be stored electronically, allowing easier access

2. This system may include information on the child's age, weight, height, and other health information
3. Data Backup, performing regular data backup is an important step to overcome the risk of data loss if the Menuju Sehat Card is lost. Data can be stored on a secure server or in a cloud storage system so that it can be accessed again
4. A child information system developed based on AI that will be integrated with smartphones and combined with IoT technology.

Collaboration between AI and IoT can provide innovative and effective solutions, these two fields of science can be collaborated with

1. IoT sensor for weight and height measurement  
Installation of IoT sensors on children's scales or special devices for measuring weight and height. These sensors can be wirelessly connected to a data collection platform to transmit real-time weight information.
2. Data Collection and Storage  
Using a cloud platform to collect, store and analyze data from IoT sensors, Children's data security and personal privacy to stay safe
3. AI Systems for Data Analysis  
Using artificial intelligence to analyze weight, height and age data, Implement a child growth monitoring algorithm to assess whether they are within the ideal weight range
4. Providing Recommendations  
Based on AI analysis, it will provide recommendations to parents or guardians about healthy eating patterns, appropriate levels of physical activity, and other strategies to maintain or achieve ideal body weight
5. Notification and Monitoring System  
Implement a notification system that can notify parents if there is a significant change in the child's weight or activity patterns

## II. RESEARCH METHODS

The method/way used to complete this research is

1. Literature study and data collection Looking for reference materials
2. Designing the technology concept  
At this stage, it will be determined what capabilities will be displayed by the system / can be called the functional requirements of the system.
3. Development preparation  
Software preparation, including Arduino IDE Application and Arduino library (10). Development preparation includes computer hardware used and operating system used that is capable of supporting Arduino IDE coding activities, PHP (Hypertext Preprocessor) coding and .Apk (Android Package) coding
4. Hardware assembly  
Hardware assembly is done to assemble any device that can support IoT to monitor the ideal weight of toddlers based on the Body Mass Index. Some of the main

hardware that can support this research include Node MCU ESP8266, gm66, Ultrasonic, Load Cell, LCD I2C

5. Arduino IDE Coding  
The stage of writing the program code where this program code will be uploaded to the Arduino device. The programming language at this stage is C language.
6. Upload Coding to Hardware  
After the Arduino IDE coding is correct, the next step is to upload the coding to the Node MCU ESP8266 device
7. Coding PHP (Hypertext Preprocessor)  
The activity carried out is to create PHP coding that will display a more attractive screen display from the data that has been sent by the Node MCU ESP8266 device to the database, then the results of the data entered into the database will be displayed on the screen via PHP support
8. Upload PHP (Hypertext Preprocessor) Code to Hosting  
Cloud computing is a mainstay of modern technology, offering cost-effective and scalable solutions to a variety of different problems. [7]. After completing the PHP coding stage, the next step is to upload the PHP coding results along with the database to Hosting so that information can be accessed via the internet and data is always updated and received by both users and admins.
9. Coding .Apk (Android Package)  
Coding .Apk is done to produce Android-based applications that can be installed on smartphones based on the Android Operating System, so users can monitor the development of Toddler Weight through the installed Android application. The Android Operating System that supports it includes Android versions 7.0 - 7.1 (Nougat), Android 8.0 - 8.1 (Oreo), Android 9 (Pie), Android 10 (Android Q), where this application is also connected to IoT devices[8].
10. Technology Trial  
The trials conducted included trials
  - a. Can the assembled device send data to the Host properly? This data includes user account access, toddler weight and height data.
  - b. Features that come from the UI display generated by PHP coding
  - c. Can the .apk application be run according to the functional requirements that have been determined in the previous stage

## III. RESULT AND ANALYSIS

1. Literature study and data collection Looking for reference materials regarding :
  - a. The C programming language is used to code on the ESP8266 Node MCU device
  - b. PHP programming language and Database, where PHP will be used to display the display results of data that has been entered into the database. The data can be in the form of Table data or Graphics
  - c. Coding for .Apk (Android Package), this is used to create applications that can be installed on smartphones with the Android operating system

2. Designing the technology concept

At this stage, it will be determined what capabilities will be displayed by the system / can be called the functional needs of the system. The functional needs are:

a. Comprehensive User Registration

The system will provide an initial registration feature that makes it easy for potential users to register into the system. This registration process will include filling in relevant personal information and data validation to ensure that only verified users can access advanced features in the system.

b. Accurate BMI-Based Ideal Weight Calculation

One of the main features of this system is the ability to calculate the user's ideal weight using the Body Mass Index rule. This calculation will provide accurate and reliable results, which will later become the basis for providing health advice and information on risks that users may face.

c. Weighing Equipped with QR Code Technology

Users can weigh themselves in a modern and efficient way, namely by scanning a QR code. This feature is designed to speed up the weighing process while ensuring that the data recorded is the correct user data. With QR Code technology, this process becomes more practical and minimizes errors.

d. Expanded Weighing History with Health Information

Every time a user weighs themselves, the system will save the weighing history and complete it with information related to health conditions, potential risks, and suggestions based on the BMI calculation. This feature also allows users to delete weighing data if there is an error in the calculation or recording, so that users can manage their data more flexibly.

e. Data Visualization with Informative Ideal Weight Graphs

The system will display a graph of the user's ideal weight that not only shows the ideal weight, but also records changes in weight and height over the last ten weigh-ins. This visualization is designed to help users monitor the development of their physical condition clearly and easily, so that they can take appropriate action as needed.

f. Administrator Access Rights for Wider Data Management

Administrators in this system will have special access rights to view weighing data of all users, as well as the authority to add other users with administrator roles. This allows for more structured and controlled system management, and ensures that user data is managed properly.

3. Development preparation

Development preparation includes the computer hardware used and the operating system used which is capable of supporting Arduino IDE coding activities, PHP (Hypertext Preprocessor) coding and .Apk (Android Package) coding

4. Hardware assembly

Hardware assembly is done to assemble any device that can support IoT to monitor the ideal weight of toddlers based on the Body Mass Index. Some of the main hardware that can support this research include Node MCU ESP8266, gm66, Ultrasonic, Load Cell, LCD I2C. The series of hardware tools used are as shown in the following image

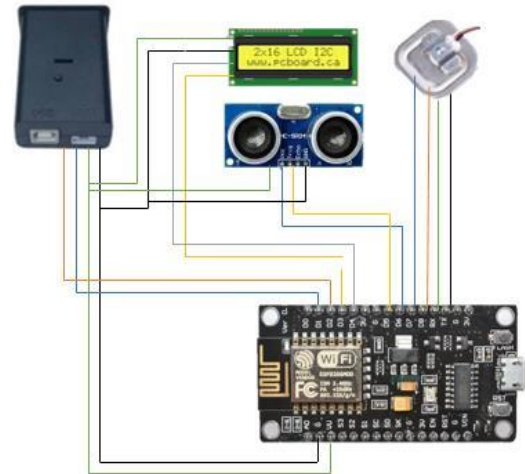


Figure 1. Hardware Tool Chain

5. Coding Arduino IDE

The stage of writing the program code where this program code will be uploaded to the Arduino device. The programming language at this stage is C. Below are some Arduino codings used

```
#include <ESP8266WiFi.h>
#include <WiFiClient.h>
#include <ESP8266WebServer.h>
#include <ESP8266HTTPClient.h>
#include <HX711.h> //memasukan library HX711
#include <SoftwareSerial.h>
#include <LiquidCrystal_I2C.h>
WiFiClient client;
int trig = 13; //D7
int echo = 15; //D8
#define DOUT 12 //D6 pin DT module HX711
#define CLK 14 //D5 pin SCK module HX711
HX711 scale(DOUT, CLK);
LiquidCrystal_I2C lcd(0x27, 16, 2);
SoftwareSerial GM66(2, 0); // RX, TX pin dari GM66
ke pin 10 dan 11 pada Arduino
String postData, tinggi, berat, link;
long durasi, jarak;
float calibration_factor = -27270;
```

6. Upload Coding to Hardware

After the Arduino IDE coding is correct, the next step is to upload the coding to the Node MCU ESP8266 device

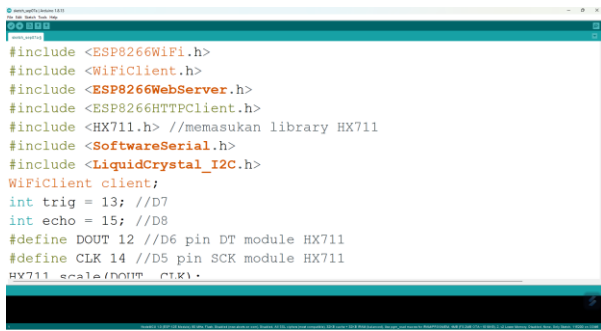


Figure 2. Arduino IDE

7. Coding PHP (Hypertext Preprocessor)

The activity carried out is to create PHP coding that will display a more attractive screen display from the data that has been sent by the Node MCU ESP8266 device to the database, then from the results of the data entered into the database will be displayed on the screen through PHP support. Below are some PHP coding used

Writing Program Code api.php

```
<?php
error_reporting(E_ALL);
ini_set('display_errors', 1);
include("koneksi.php");
date_default_timezone_set('Asia/Jakarta');

if(!empty($_POST['penimbang_id'])){
$penimbang_id = trim($_POST['penimbang_id']);
$timbangan_berat = $_POST['timbangan_berat'];
$timbangan_tinggi = $_POST['timbangan_tinggi'];
} else {

;
$data_penimbang = query("SELECT * FROM
penimbang WHERE penimbang_id =
'".$_penimbang_id.'");

if (count($data_penimbang) > 0){
echo "Nama:
".$_data_penimbang[0]['penimbang_nama'];
// echo $redirect_url;
} else {
echo 'gagal';
}
}
```

```
if (count($data_penimbang) > 0){
echo "Nama:
".$_data_penimbang[0]['penimbang_nama'];
// echo $redirect_url;
} else {
echo 'gagal';
}
}
```

Penulisan code index.php

```
<?php
session_start();
require 'koneksi.php';
if(isset($_SESSION['login_id'])){
header("location:pages/dashboard/index.php");
exit();
}
$notice = 'n';
?>
```

```
<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-
width, initial-scale=1.0">
<title>Sign in - Sistem Pengukur Berat Ideal</title>
<link rel="stylesheet"
href="pages/assets/css/bootstrap.css">
<link rel="shortcut icon"
href="pages/assets/images/favicon.png"
type="image/x-icon">
<link rel="stylesheet"
href="pages/assets/css/app.css">
<script
src="https://ajax.googleapis.com/ajax/libs/jquery/3.6.0/
jquery.min.js"></script>

<link rel="stylesheet"
href="pages/assets/vendors/sweetalert2/sweetalert2.min
.css">
<script
src="pages/assets/vendors/sweetalert2/sweetalert2.min.
js"></script>
</head>
<body>
```

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
1	login_id	varchar(225)	utf8mb4_general_ci		No	None			Change Drop More
2	login_nama	varchar(225)	utf8mb4_general_ci		No	None			Change Drop More
3	login_password	varchar(225)	utf8mb4_general_ci		No	None			Change Drop More
4	login_role	varchar(1)	utf8mb4_general_ci		No	None			Change Drop More
5	id_penimbang	varchar(225)	utf8mb4_general_ci		No	None			Change Drop More
6	nama_pengguna	varchar(225)	utf8mb4_general_ci		No	None			Change Drop More

Figure 3. Table user\_login

8. Upload PHP (Hypertext Preprocessor) Code to Hosting Cloud computing is the mainstay of modern technology, offering cost-effective and scalable solutions to a variety of different problems. After completing the PHP coding stage, the next step is to upload the PHP coding results along with the database to Hosting so that information can be accessed via the internet and data is always updated received from both the user and admin side

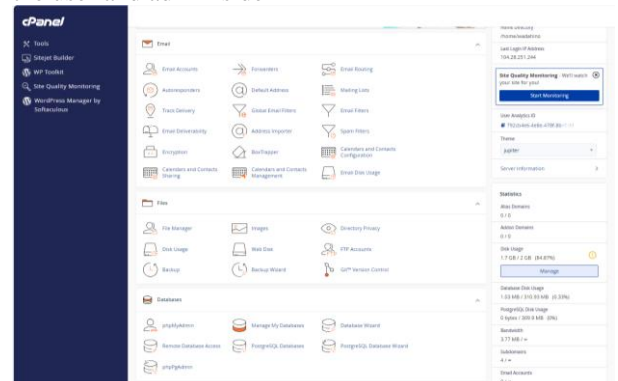


Figure 4. Cpanel View

9. Coding .Apk (Android Package)

Coding .Apk is done to produce Android-based applications that can be installed on smartphones based on the Android Operating System, so that users can monitor the development of toddler weight through the installed Android application

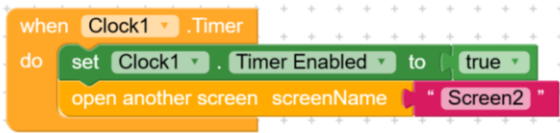


Figure 5. One of the Blocks used

10. Technology Trial

Table 1. Menu Trial

No	Variables	The One Under Test	Results
1.	Login Menu	Enter user and admin login	Success
2.	Registration Menu	Users have the ability to create accounts and use the system.	Success
3.	Dashboard Menu	The last ten weighing data can be displayed in tables and graphs in the User Dashboard menu. Administrators can also display the number of system users.	Success
4.	Account Menu	Admin has the ability to view, change and delete all user inputs. He also has the ability to add administrator accounts and view the weighing history of all users.	Success

IV. CONCLUSION

This application is available in 2 platforms, web-based and Android-based platforms. Everyone can weigh themselves, if they want the weighing data to be recorded into the system, the user must register with the system to get an account and QR code. Where the QR Code will later be used to transfer weighing and height data into the system and account to view all weighing data that has been done and see other history. The system will help display a weighing graph containing height, weight, ideal upper limit weight and ideal lower limit weight

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