TODDLER HEALTH MONITORING SYSTEM IN POSYANDU ANGGREK KACAPIRING VILLAGE BANDUNG CITY BASED ON IOT

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ABSTRACT

Posyandu (Integrated Service Post) is a unit engaged in public health services that is easily accessible and inexpensive. One of the available services is weighing and measuring weight, height and body temperature for toddlers every month. From this examination can be seen the physical development of infants through a growth chart. Problems arise when the inspection schedule takes place, namely equipment and services are still using conventional methods so that the inspection process becomes less optimal. The purpose of this research is to make a practical tool for weighing, measuring height and checking temperature at one time and creating a system to manage and monitor toddlers' data into information about toddler growth every month, then compare it with standard data on normal body conditions at Posyandu. This study uses a prototype method in its development. This method has several stages, namely communication, fast design, modeling and designing, building prototypes, implementation and accepting suggestions and input. The system test results show that the accuracy of the IoT-based measuring instrument is good enough with an average error percentage below 0.1%. The system can store and process data from tools that are made into information about the current growth conditions of infants through growth charts that can be accessed by parents of toddlers with information on conditions that are less, normal and excessive.

Keywords : Posyandu, Internet of Things, Monitoring, Toddler.

1. PRELIMINARY

1.1 Background

Posyandu is a public health service unit that is easily accessible and inexpensive. One of the available services is weighing, height measurement and body temperature measurement for toddlers. Toddler is a period of growth in children aged 1-5 years [1]. Problems occur in toddlers' data management which is often scattered and lost, inaccurate measurement tools and the recording of measurement results that must be done repeatedly making the service process at Posyandu less than optimal. The results of the growth check are entered into the KMS (Kartu Menuju Sehat) which can be taken home by parents of toddlers. But there is often a loss so that the data that has been written has to be rewritten by searching for it in the master book which takes a very long time. Not to mention if parents forget to bring KMS or cadres have difficulty recording it because of the large number of patients and documents that must be recorded, making the toddler monitoring process disrupted. Based on the problem, a solution is proposed by building a tool that acts as a monitoring medium and a system that acts as a container for storing and managing toddlers' data connected to the internet for easy access.

1.2 Purpose and Objective

The intention of the authors to carry out this research is to design and build a Health Monitoring System in the Posyandu Anggrek, Kacapiring Village, Bandung City, based on IoT.

The objectives in this thesis research are:

1. Reducing the error rate of human error and device error thereby increasing the accuracy of measuring the condition of toddlers.
2. Speed up the process of recording the condition check of infants and facilitate access.
3. Accelerate and complete the service for measuring the condition of children under five in Posyandu.

2. THEORETICAL BASIS

2.1 Monitoring System

Understanding the system is a collection of elements in achieving a goal of interaction and communication [2]. Monitoring is an activity of monitoring an ongoing process and then making a final conclusion on the conditions that have been achieved [3]. So, the monitoring system is a

combination of parts that have the aim to supervise a process and then conclusions are made on the conditions in it. Monitoring has the purpose of which is to review activities that are in accordance with the plan, identify existing problems, provide an assessment of the performance carried out, see the progress of a process and adjust the process to new rules or environments [4].

2.2 Toddler

Toddler is short for "Under Five Years", which is the growth period of children who have reached the age of 12-60 months or one to five years. During infancy there is a process of growth and development which is very important for humans, and becomes a determinant of the success of growth and development in the next period. In infancy also known as the golden period because the time period is fast, can not be repeated and is very influential on the growth of the next period [5].

2.3 Toddler Health Status

Assessment of nutritional status of children under five is done to see the growth that occurs in the body of toddlers for each month by collecting data, both subjective and objective then then compared with the standard values that have been available to obtain conclusions. [6]. One method that can be used is the anthropometric method which has two types of indexes, namely body weight according to age (BW / U) and height according to age (TB / U) [7].

2.4 *Internet of Things* (IoT)

Internet of Things is a concept with the aim of making the most of internet connectivity in human life. IoT can be implemented on objects in the real world with the ability to share data, control, and so on. The concept of IoT can be accessed at any time without limitations and is able to interact with other objects [8].

2.5 Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328 datasheet and entered into the AVR family. This microcontroller has 14 pins that can be used as input and output with several components such as USB Plug, External power supply, Reset pin, Analog I / O pin, Digital I / O pin, In-Circuit Serial Programmer, and Power pin. Uno is the latest device in a series of Arduino USB boards, and as a reference model for the Arduino platform, for comparison with previous versions. Arduino uno uses an ATmega328 32 KB processor (0.5 KB is used for bootloaders), 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library). Arduino can be activated via a USB connection or with an external (automatic) power supply. To provide commands for logical operations, Arduino uses programs that come from hardware with the Atmel AVR processor, while the software has its own programming language that resembles the C language [9].

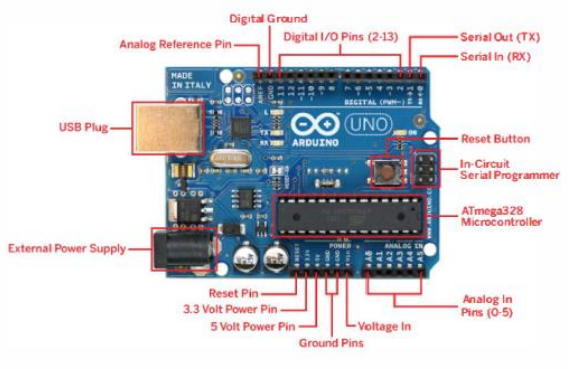

Figure 2.1 Arduino Uno

Arduino Uno is controlled through the website in the process of monitoring and automation.

2.6 Prototype Method

Prototype method is one method of software development that focuses on direct implementation in the field where the user becomes an important object because it acts as feedback from the testing system that was built in order to provide results that are as expected [10].

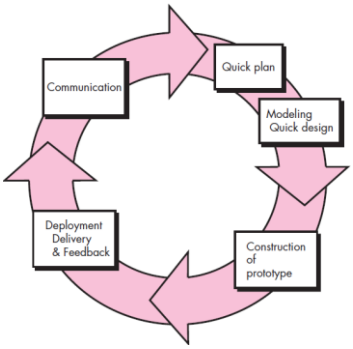

Figure 2.2 Prototype Method

The implementation stages of this research using the prototype method are as follows :

a. Communication : Doing direct interaction with resource persons who have problems in this case are Posyandu cadres and parents of toddlers, by gathering information on problems that occur in the current system.
b. Quick Plan : After getting the problems that occur in the field then the right solution is sought for these problems in order to help cadres and parents of toddlers. The solution is to build an IoT-based system and tool that has an accurate and practical advantage in the measurement process, provides toddler monitoring information in real time and is easily accessible and completes the process of recording checks at Posyandu.

c. Modeling Quick Design: The next stage is the process of modeling the system to be built such as the design of tools, databases and the flow of data. Then make a tool design and system interface design. At this stage Unified Modeling Language (UML) is used.

d. Construction of Prototype: After the design is done, the next step is to build the system. The tool is built using the CZL635 weight sensor, DS18B20 temperature sensor and the HC-SR04 ultrasonic sensor as a height gauge. All sensors are controlled via Arduino Uno connected to the Wifi Wemos D1 mini module, then the data obtained is forwarded to the toddlers monitoring website and can be accessed by cadres and toddlers' parents with an internet connection.

e. Deployment Delivery and Feedback: The final stage of this method is the implementation of the system directly in the field then conclusions are drawn whether the system is in accordance with price or there must be an improvement. If there is an improvement, the stages return to prototype development and so on until an optimal solution is found that meets expectations. The results of the test show that the tools built are proven to be accurate, speed up and make it easier for users in the process of measuring the condition of a toddler's body every month at Posyandu Anggrek.

3. RESEARCH CONTENTS

3.1 Analysis of ongoing procedures

From the results of data collection in the field, an evaluation of the current system is obtained in the form of a solution to the problems that occur then carried out the design and analysis, construction, implementation and testing of the system. In Posyandu, information gathering is done by observing the spaciousness and seeing the processes that are running.

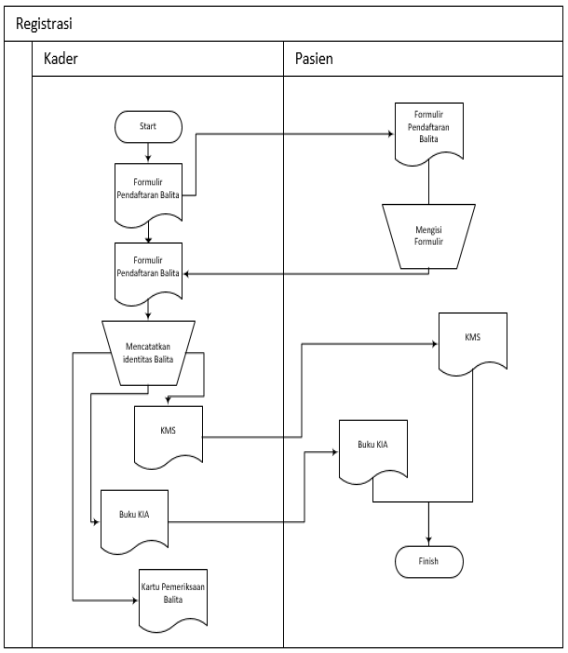

Figure 3.1 The Procedure of Registration

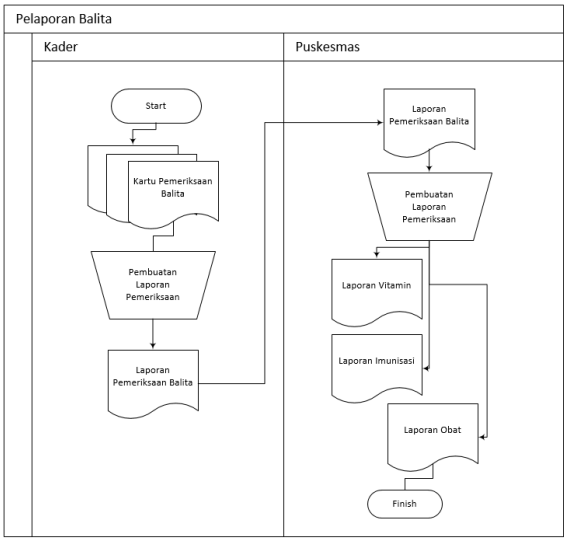

Figure 3.2 Toddler Reporting Procedure

3.2 Evaluation of ongoing procedures

Evaluation of running procedures is a process of analysis of existing systems in the field and conclusions drawn from the problems that arise. Evaluation of running procedures can be seen in table 3.1.

Table 3.1 Evaluation of Ongoing Prosedure

No	Problem	Solution
1	Examination of weight, height and temperature conditions for infants is still done manually using a scale, meter which has a fairly high error rate and	Build a system that can help check the condition of toddlers with high accuracy on the weight, height and body temperature checks of toddlers quickly and accurately.

	temperature using a digital thermometer.	
No	**Problem**	**Solution**
2	Learn to pronounce Patient registration and recording of examination results are still using conventional methods and must be copied several times so that the process takes a long time.	Build a system that can help patients in registering and cadres in recording automatically and just do it once.

3.3 Systems Architecture Analysis

System Architecture Analysis provides an overview of the interconnected components in the Internet of Things toddler health monitoring system, which is communicated with Arduino Uno and Wemos D1. A clearer explanation can be seen in Figure 3.3.

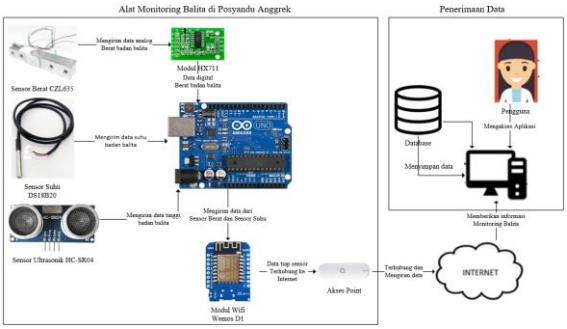

Figure 3.3 Architecture System

The workings of the architecture development toddler health monitoring system in the Internet-based Of Things (IoT) Posyandu Anggrek are as follows :

1. Website applications can be used by parents of toddlers, Posyandu cadres and admin. Parents of toddlers can only see the results of the development of toddler examinations at Posyandu, while Posyandu cadres can fill and change the inspection data entered by the IoT tool. The admin has access rights for user data management.
2. The application uses the API as a medium that wraps data from Arduino to the internet.
3. Wifi module Wemos D1 is used to connect Arduino to the internet network.
4. Arduino Uno R3 is used as the main control of the system, as a data processor received from the sensor.
5. The HX711 module is used as a digital analog converter for the output of the load cell sensor that enters Arduino Uno R3.
6. The weight sensor / load cell uses type CZL635, used as a scale to measure a toddler's weight.
7. Ultrasonic sensor HC-SR04 type is used to measure toddlers height. The way it works is by firing waves into toddlers and the value obtained will be a subtraction value from the length of the toddler's height measuring pole.
8. DS18B20 temperature sensor is used to measure the temperature of toddlers by flanking the toddler's armpits.
9. Access point is an internet media provider that is used like a router or teathering from a smartphone.
10. Website monitoring will process information needed by stakeholders in Posyandu.

3.4 Data Communications Analysis

Data communication is needed to describe the flow of data that occurs in the system and the interactions that occur therein. Data communication used in the toddler health monitoring system at the IoT-based Anggrek Posyandu is communication between Arduino Uno and Wemos D1 with the sensors used. The following is a block diagram can be seen in Figure 3.4.

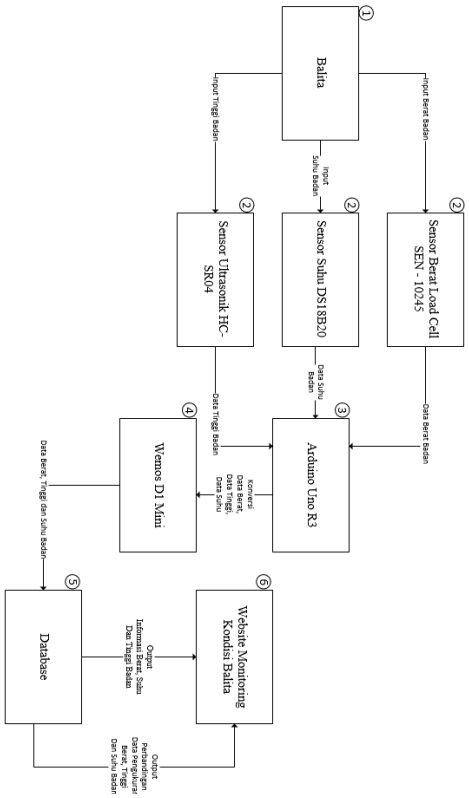

Figure 3.4 Block Diagram

An explanation of the data communication flow in the block diagram figure is :

1. The toddler is placed in a tool that has been designed, then the tool will work receiving data that is read from the toddler's body condition.
2. Weight data is accepted by load cell sensor, temperature data is received by DS18B20 sensor and height data is accepted by HC-SR04 sensor.

3. Data received will be forwarded to Arduino to be merged converted.
4. Data that has been processed is forwarded to Wemos and transferred to the database using the internet network.
5. In the database data is stored and processed in accordance with the information needed.
6. Data processing results will be displayed on the toddlers condition monitoring website and ready to use.

3.5 Use Case Diagram

Use Case Diagrams are used to describe the function of a system based on the user's perspective or it can also be summarized briefly in the form of a series of scenarios that are combined to describe the features of the system in order to achieve the general objectives of the user. use case diagram can be seen in Figure 3.5.

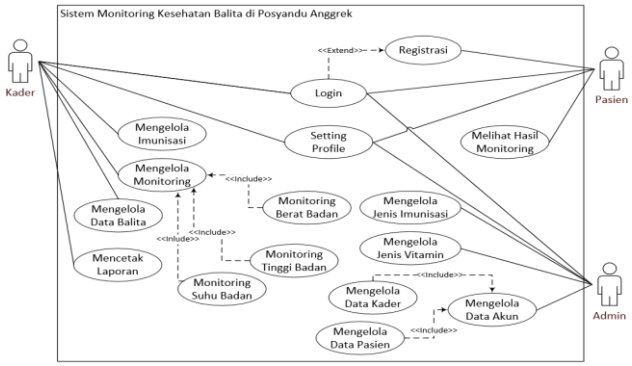

Figure 3.5 Use Case Diagram

3.6 Class Diagram

Class Diagram is an explanation to represent a static view of an application. Class diagrams are used to illustrate, document and build the code design of the software system that is built. Class Diagram can be seen in Figure 3.6.

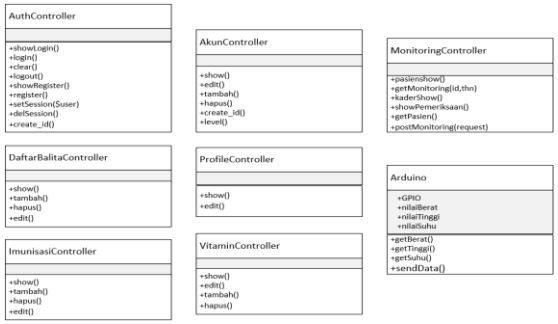

Figure 3.6 *Class Diagram*

3.7 Database Design

In the database design, all the variables found in the current system are analyzed, and then given the interrelationships between the variables so that the data flow is as needed. In this design using ERD to describe the attributes and tables used in the system. Database design can be seen in Figure 3.7.

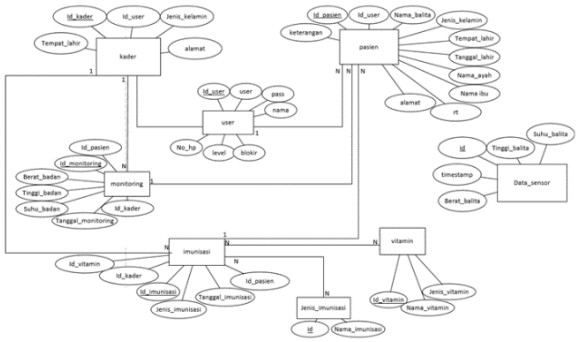

Figure 3.7 ERD Design

3.8 Black Box Testing Scenarios

Black box testing scenarios in software are used to assess the functional effectiveness of the system from the user's perspective including monitoring data, toddler data, examinations, immunization data, immunization type data, account data, profile settings, registration logins and print reports.

Table 3.2 Black Box Testing

Test Case	Testing Details	Type of Testing	Result
Registration	Register a new account	Black Box	Accepted
Login	Access to the system	Black Box	Accepted
Monitoring Balita	See data on examination results for toddlers	Black Box	Accepted
Setting Profile	Edit and save user profile data	Black Box	Accepted
Data Akun	View, delete and edit user data	Black Box	Accepted
Data Monitoring	View, delete and edit monitoring data	Black Box	Accepted
Data Imunisasi	View, delete and edit immunization data	Black Box	Accepted
Data Vitamin	View, delete and edit user data	Black Box	Accepted

Jenis Imunisasi	View, delete and edit immunization type data	Black Box	Accepted
Pemeriksaan	To see the results of examining the conditions of weight, temperature and height of a toddler	Black Box	Accepted
Cetak Laporan	View and print inspection reports	Black Box	Accepted

3.9 Implementation of Monitoring System Applications

Next is the display application that has been built in accordance with the previous design.

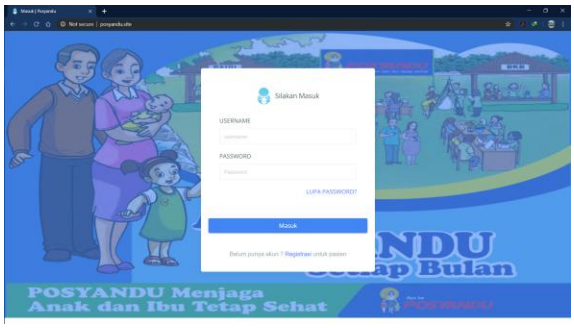

Figure 3.8 Login Page Interface

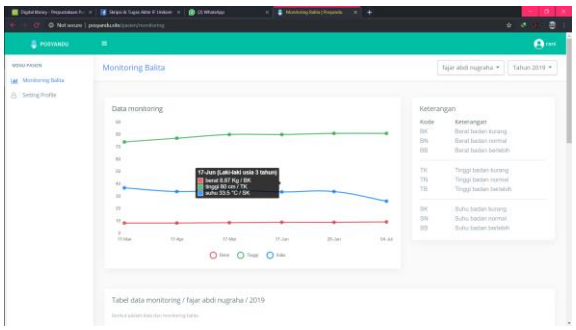

Figure 3.9 Monitoring Page Interface

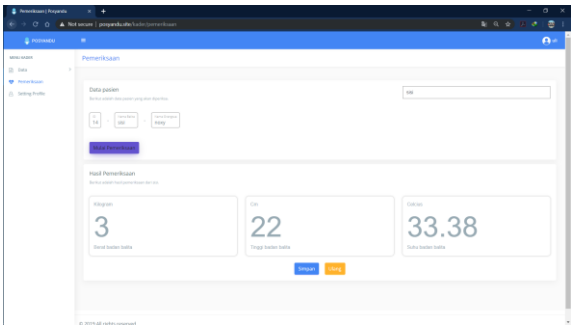

Figure 3.10 Examination Page Interface

3.10 Hardware Component Testing

Installation of tools has been carried out on the IoT hardware implementation. To find out if the equipment is running according to the original design, a test is needed. In this study the object of testing is toddlers. For more details, see Figure 3.11, 3.12 and 3.13 below.

Figure 3.11 Weighing Devices

Figure 3.12. Height Device

Figure 3.13 Temperature Device

3.11 Testing The CZL635 Load Cell Weight Sensor

Toddler weight detection testing is done by comparing the values read by the sensor with conventional weight gauges and then calculating the average error. The test results can be seen in table 3.3.

Table 3.3 Weight Sensor Testing

Test	Sensor Data Measurement (p1) (kg)	Measurement of Body Meter (p2) (cm)	Difference in Abs Measurement (p2-p1) / p2 x 100%
1	15,201	103	0,0198
2	9,634	81	0,06579
3	16,04	84	0,02439
4	15,521	98	0,057692
5	14,92	100	0,019608
6	12,589	94	0,030928
7	15,027	92	0,04545
8	14,721	77	0,02667
9	11,39	88	0,07317
10	14,878	106	0,01923
Average error percentage			0,034827

3.12Testing of Ultrasonic Sensors HC-SR04

Toddler height detection testing is done by comparing the value read by the sensor with a conventional height gauge and then calculating the average error. The test results can be seen in table 3.4.

Table 3.4 Ultrasonic Sensor Testing

Test	Sensor Data Measurement (p1) (cm)	Measurement of Body Meter (p2) (cm)	Difference in Abs Measurement (p2-p1) / p2 x 100%
1	101	103	0,0198
2	76	81	0,06579
3	82	84	0,02439
4	104	98	0,057692
5	102	100	0,019608
6	97	94	0,030928
7	88	92	0,04545
8	75	77	0,02667
9	82	88	0,07317
10	104	106	0,01923
Average error percentage			0,038273

3.13Testing of Temperature Sensor DS18B20 *Waterproof*

Detection of body temperature testing for toddlers is done by comparing the values read by the sensor with a digital thermometer body temperature gauge and then calculating the average error. The test results can be seen in table 3.5.

Table 3.5 Temperature Sensor Testing

Test	Sensor Data Measurement (p1)(^{0}C)	Measurement of Digital Body Thermometer (p2) (0C)	Difference in Abs Measurement (p2-p1) / p2 x 100%
1	35,01	36,5	0,068219
2	33,51	36,2	0,074309
3	33,04	36,3	0,089807
4	34,09	36,7	0,071117
5	34,73	36,9	0,113008
6	35,65	36,2	0,015193
7	32,33	35,6	0,091854
8	33,75	36,8	0,137228
9	34,29	36,4	0,057967
10	34,67	36, 6	0,107377
Average error percentage			0,082608

3.14Conclusion of sensor testing

Based on the test data in the table it can be assumed that the CZL635 load cell weight sensor has an average error percentage of up to 0.034827%, then the CZL635 weight sensor can be said to be accurate, the HC-SR04 height sensor has an average percentage error of up to 0.038273% then the sensor HC-SR04 high sensor can be said to be accurate and the DS18B20 Waterproof temperature sensor has an average error percentage up to 0.082608% then the DS18B20 body temperature sensor can be said to be not too accurate because the temperature sensitive variable with a difference of more than 0.5.

3.15Acceptence Testing

In this test, interviews were conducted directly with users, namely Posyandu cadres and parents of toddlers for evaluators and giving their opinions on the system that had been built. The test results can be seen in table 3.6.

Table 3.6 Results Of Further Interviews

No	Question	Answer
1	Does using the tools and systems that have been built based on IoT make it easier to check the condition of children under five in Posyandu Anggrek?	Yes, because the tool is measured and weighed at the same time and the recording is automatic, thus speeding up the service process.
2	Does the interface of the monitoring system that was built make it easier for parents to monitor the growth of toddlers?	Yes, because it's easier to access and not complicated, and also an easy graph reading event.
3	Are monitoring tools suitable for toddlers?	Yes, but the design is as good as being made more user-friendly.

No	Question	Answer
4	Is a monitoring system application that has been built useful?	Yes, it is useful because it already uses internet technology. However, serious training must be done for cadres and toddlers' parents.
5	Learn to pronounce What do you think if the tools and conventional inspection procedures at Posyandu Anggrek are replaced with tools and monitoring systems for toddlers built?	Possible yes for the long term because inevitably we have to use technology, it's just that the application must be serious and sustainable.

4. CLOSING

4.1 Conclusion

Based on the design of the system to the testing stage that has been done, it can be concluded that the Toddler Health Monitoring System in the Posyandu Anggrek, Kacapiring Urban Village, Bandung Based on IoT, namely :

1. The results of the system testing are able to assist the cadres and parents of toddlers in conducting routine toddler examinations at Posyandu Anggrek which includes examining the weight, height and toddler body temperature.
2. The results of reading the IoT tool can automatically enter the system as expected.
3. Based on the results of testing the use of HC-SR04 height sensor requires aids in the form of head cover with a flat plane to improve data accuracy.

4.2 Suggestion

Authors' suggestions that can be conveyed in this study are as follows :

1. Because ultrasonic sensors have a weakness that is the need for tools, it can be replaced using other high sensors such as laser sensors to get accurate and practical measurements.
2. Further research needs to be done to develop a better form of sensor device design so that it is appropriate for use by users.
3. The use of the DS18B20 Waterproof temperature sensor has a accuracy that is not too good when used for toddler objects, it is recommended to use another temperature sensor that can read toddlers body temperature conditions better.

BIBLIOGRAPHY

[1] Mitayani, S. W. 2010. Buku Saku Ilmu Gizi, Jakarta: Cv. Trans Info Media.

[2] Abdul Kadir. 2003. “Pengertian Sistem”. Graha Ilmu. Yogyakarta.

[3] Kumorotomo Wahyudi. 2007. “Konsep Dasar Pemantauan dan Evaluasi”. Universitas Gadjah Mada.

[4] Gentisya Tri Mardiani. 2013. “Sistem Monitoring Data Aset dan Inventaris PT. Telkom Cianjur Berbasis Web”. Universitas Komputer Indonesia.

[5] Uripi, V. 2004. “Menu Sehat Untuk Balita”. Jakarta : Puspa Swara.

[6] Arisman. 2009. “Gizi dalam Daur Kehidupan”. EGC. Jakarta.

[7] Kementerian Kesehatan RI. 2011. “Buku Pedoman Kesehatan 2011a”.

[8] Asthon, K. 2009, That “*Internet of Things’ Thing: In the real world, things matter more thanideas*”.http://www.rfidjournal.com/articles/view?4986. Diakses 28 Maret 2019.

[9] Yusuf Abdullahi Badamasi. 2015. “*The Working Principle of An Arduino*”. Nigerian Turkish Nile University.

[10] R. Pressman. 2010. “*Software Quality Engineering: A Practitioner’s Approach*”.