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Infant Warmer Equipped with Digital Weight Scales

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ABSTRACT Scales in the world of health are used to measure human body weight such as baby scales. Newborns are very important to be weighed because it is used as an indication of the health of the baby ranging from 2.4 kg to 4.2 kg. The purpose of this study is to make it easier for users to weigh with a 7 segment display on the Infant Warmer tool and external calibration. By using a loadcell sensor with a maximum capacity of 5 kg, the loadcell can detect the weight of the load where the voltage generated by the loadcell of 0.7 mV at a load of 1 kg is amplified to 0.62 V by the PSA circuit using the AD620 IC and then processed by Arudino UNO as a microcontroller. The weight results will be displayed on the 7Segment display located on the Infant Warmer tool. In the study, the measured load included a weight of 0 kg to a maximum weight of 5 kg. The measurement of the data results was carried out 5 times each by comparing the modules that had been made with the standard weight, namely (lead). The data from the measurement results of the research module shows that when the weight of the measurement at 1 kg has an error percentage of 0.08%. Measurements at a weight of 2 kg have an error percentage of 0.05%. Measurement of weight 3 kg has a presentation error of 0.01%. Measurements at a weight of 4 kg have a presentation error of 0.02%. And measurements at a weight of 5 kg have an error percentage of 0.04%. Then the data from the measurement results of the research module shows the largest error presentation of 0.08% at 1 kg of weight. And the data from the measurement results of the research module shows the smallest error presentation of 0.01% at a weight of 3 kg. Making a research module in the form of a scale placed on an infant warmer can make it easier for the wearer

INDEX TERMS Loadcell, IC AD620, Infant Warmer, Scales

I. INTRODUCTION

Infant is a baby, while a warmer is referred to as a warmer. So in terms of infant warmer is a tool used to warm newborns or babies born prematurely. where the baby needs a temperature that is in accordance with the temperature inside the mother's womb, which is between 34ºC - 37ºC, this is intended so that the baby's body temperature can be adjusted to its environment, then this tool is made so that newborns can feel the temperature outside the mother's womb will be the same as the existing temperature in the mother's womb.[1] The infant warmer is also a temporary shelter to stabilize the body temperature of the baby being born. In the temperature control, there is also a sensor placed on the baby bed which functions to sense the baby's body temperature.

Scales are tools used to measure the mass of an object. Scales or balances are categorized into mechanical systems and also electronic or digital. In the world of health, scales are often used to measure human body weight. In newborns, the scale is very important because it is used as an indication of the health of the baby ranging from 2.4 kg to 4.2 kg.[2] Currently the use of baby scales in hospitals or posyandu still uses analog scales so that the measurement results are less accurate due to human error when reading.

Infant research was developed by Sulistya Anggara Wira Bhuwana in 2012 with the title Digital Infant Warmer equipped with Phototherapy unit. This tool has the lack of the need for additions such as baby scales to directly see the newborn's weight, and to keep up with the times when Bluelight Phototherapy is replaced with LEDs. Because it has a longer lifetime, and high intensity.[3] Furthermore, the research was redeveloped by Brahminindya Resi Kanastriloka and Maimunah Novita Sari in 2018 with the title Infant Warmer equipped with Phototherapy. The tool uses Arduino Uno as a data processor and then uses an LCD as a temperature display. The weakness of this tool is the LCD that is used because the user is difficult to see the temperature indicator on the LCD, must approach first, cannot measure oxygen saturation and heart rate in patients, the mechanics of the phototherapy lamp are too rough so it is difficult to move, using sensors digital to reduce the temperature reading error value.[4] Subsequent research was carried out by I. W. Aris Wiyadnyana Putra, W. Widhiada, and I. N. Suarnadwipa with the title PID System for Control of Temperature and Humidity Stability in an Arduino Microcontroller-Based Infant Incubator. This tool uses a PID system with a trial and error tunning method using a DHT 22 sensor and an LM 35 sensor as a skin sensor. The drawback in this study is that the DHT 22 sensor is less sensitive than other sensors.[5] Digital Scales as Calibration Media for Baby Scales The research was carried out by Muhammad Zainal Arifin in 2014 where the tool entitled Digital Scales as Calibration Media for Baby Scales can only be used as a calibration for weighing scales with a character LCD display. The scales just stand alone without the combination between the infant warmer and the scales.[6] Digital scales equipped with external calibration with TFT display this research was carried out by Adventria Wijayanti in 2018 where the tool entitled Digital scales equipped with external calibration with TFT display can be used to calibrate and appear with a TFT screen. Digital scales made today are more developed in terms of appearance. However, the tool only stands alone without any combination of infant warmers and scales using TFT. The weakness of this tool is that in displaying the signal it still uses TFT.[7]

Based on the identification of the research above, it is based on the lack of tools that have been made that do not have scales on the infant warmer which is used as an observation tool and makes it easier for nurses to see the baby's weight. The author intends to make Infant Warmer Equipped with Digital Scales (Digital Scales). Where based on suggestions from the writing of Sulistya Anggara Wira Bhuwana's Scientific Writing to add baby scales to make it easier for nurses to directly see the baby's weight.

II. MATERIALS AND METHODS

A. EXPERIMENTAL SETUP

This research was conducted using a comparison, namely the weight of lead which weighs 1 kg-5kg with complete zero adjustment. When the reading has been done through the microcontroller it will be displayed on the 7 segment display.

1) MATERIAL AND TOOL

This study uses a loadcell for the weight sensor. For amplifier output from loadcell using IC Ad620. When the output gain from the AD620 is sufficient, it will be read by the Microcontroller in the form of an Arduino Uno and will be processed to display the baby's weight through the display display in the form of 7 Segments.

2) EXPERIMENT

In this study, after the design is complete, this tool will be tested using a comparison tool, namely digital scales on the market and through a lead weighing 1-5 kg.

B. THE DIAGRAM BLOCK

When the switch is ON, the voltage from the PLN grid is connected to the power supply. Then the power supply will provide voltage to all circuits and the load cell will detect and convert the load into electrical quantities. The load cell voltage output is still very small, on the order of milli volts, so the signal must be amplified then the data enters the microcontroller circuit to be processed and the results are displayed on the seven segment display as the baby's weight output. The diagram block is shown in **FIGURE 1.**

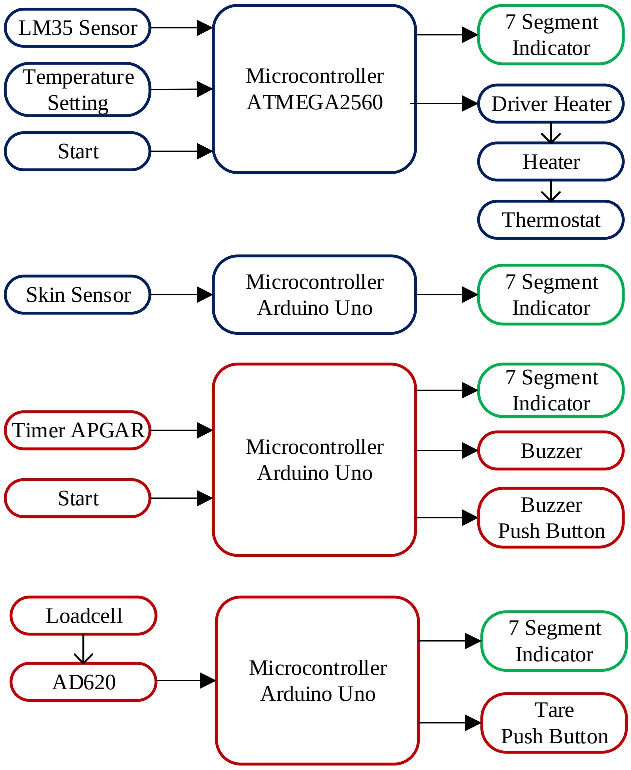

FIGURE 1. Diagram Block

C. THE FLOWCHART

As shown in **FIGURE 2.**, the first step is to connect the device to the PLN electricity grid, then turn the device ON by pressing the power button, then the seven segment display shows the number 00 and will initialize the ADC. As long as there is no load, the display still shows the number 00, once there is a load, the weight reading by the load cell will be started and the results will go to the ADC to be read and then will be displayed on the seven segment display which is displayed on the seven segment is the baby's weight . If there is a place or container before placing the baby on the scale, press Tare for Zero Adjustment on the scale.

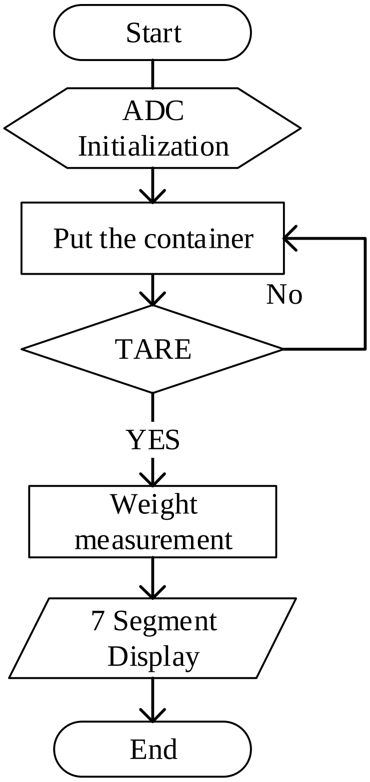

FIGURE 2. **The Flowchart of Scales**

D. ANALOG CIRCUIT

1) INSTRUMENTATION AMPLIFIER

AD 620 is a monolithic instrumentation amplifier, which is an instrumentation amplifier consisting of 3 op-amps so that it becomes an external resistor and capacitor used to control the instrumentation amplifier voltage gain up to 10000 times the gain. The output of this Load cell sensor then enters the IC AD 620 amplifier circuit through pins 2 and 3 to be amplified up to 10000 times the gain which can be adjusted with 1 external resistor (R1). This external resistor is used to control the gain of the gain voltage as desired.

7 segment is one of the electronic components in the shape of a block that functions as a display of certain numeric and letter characters. In general, 7-Segment applications are used in calculators, digital clocks, digital multimeters, digital counters, and other display pointers. The working principle of the component is to use the LED on and off in each part to form a certain character and number. In addition to that component there is a dot / point on the bottom right side.

III. RESULT

FIGURE 3 is the front-view image of the final task tool titled Infant warmer is equipped with a digital scale. In this study, the scales have been compared with 1kg, 2kg, 3kg, 4kg, and 5kg lead. and lead have been measured with other digital scales, and made sure that they are suitable for use the amplifier circuit uses an ICAD620 with a 115 ohm resistor on pins 1 and 8 and produces a voltage of 0.65 V. The output of the AD620 is then on voltage divider to be able to produce a buffer in order to amplify the output of v at a load of 0 grams. Before entering the microcontroller in the form of Arduino Uno to be converted into a 7 segment display.

.**FIGURE 3.** **Design Module**

Pseudocode: 1. ADC Reading and Calculation

```
VOID loop()
{
 tarer();
 adc_value = analogRead(A0);
FLOAT  a=map(adc_value,120,335,0,1023);
 konversi = 5*a/1023;
 sembarang=konversi-tare;
 muncul = sembarang * 10;
Serial.print("analog = ");
Serial.println(sembarang);
Serial.println("    ");
Serial.println(adc_value);
 delay(2000);
 }
```

Pseudocode: 2. Which consists of tare or zero adjustment programs

```
VOID tarer(){
 IF(digitalRead(2)==1){
 tare=1;
 tare=konversi;}
```

Pseudocode: 3. Listing program of Timer and Buzzer

```
VOIDloop() {
IF (digitalRead(5)==HIGH){
a:
t.update();
goto a;
}
VOIDpanggilTime() {
String(detik);
 showTime();
 detik++;
 IF(detik == 60)
 { detik = 0;
   menit++;
 }
 IF(menit == 60)
 { menit = 0;
   jam++;
 }
 IF(jam>24)
 {jam=0;}
}
VOIDshowTime() {
 angka = menit*100+detik;
 Serial.println(angka);
IF (angka==100)
{
 digitalWrite(2, HIGH);}
IF (angka==500)
{
 digitalWrite(2,HIGH);}
IF(angka==1000)
{
 digitalWrite(2,HIGH);}
IF(angka==1500)
{
 digitalWrite(2,HIGH);}
IF(angka==2000)
{
 digitalWrite(2,HIGH);
}
ELSE IF (digitalRead(4)==HIGH)
{
  digitalWrite(2,LOW);}
}
```

Validation of the results of the scales shown in the experiment and compared with the comparison weight in the form of lead. The error is shown in **TABLE 1.**

TABLE 1
THE ERROR OF MEASUREMENT FOR SCALED

Standart Load (kg)	Design (kg)	Error (%)
	X1	X2
0,0	0,0	0,00
1,0	1,2	0,08
2,0	2,2	0,05
3,0	3,1	0,01
4,0	3,9	0,02
5,0	5,2	0,04

The measurement of the results of the scales where the display is 7 segments when given a comparison load. The results are shown in **TABLE 2**

TABLE 2
THE ERROR OF MEASUREMENT FOR SCALED

Standard load (kg)	Display on 7 Segmen (kg)	Measured (kg)
0 kg	0,0	0,0
1 kg	1,2	1,0
2 kg	1,9	2,0
3 kg	3,1	3,0
4 kg	4,1	4,0
5 kg	5,2	5,0

IV. DISCUSSION

Measurements occur by the Loadcell sensor when it gets a voltage of 5 VDC, and the module will detect load 0 so that it produces a voltage of 0.3mV. The amplifier circuit will compare the output of the loadcell sensor using the AD620 ic where the loadcell voltage is amplified by 430.5 times by providing 115 ohm resistors on legs 1 and 8 in the op-amp. Then the output of the AD620 is entered into the Arduino Uno via the Analog Pin (A0) to read how many ADC values enter the microcontroller.

On the ADC reading, the output voltage can also be read there is a reading through the analog pin (A0), then the reading can be done with an empty load, the number 0.0 kg will appear which can appear on the 7 segment display If the initial condition does not contain the number 0.0 kg on the display then press the tare button for 0.0 kg conditioning.

By measuring on the scales using a lead load. In experiments that occur when the load is 1kg, the display shows 1.0 Kg, experiments that occur when the load is 2kg, the display shows 2.0 Kg, experiments that occur when the load is 3kg, the display shows 3.0 kg, experiments that occur when the load is 4kg, the display shows 4.0 kg, and experiments that occur when the load is 5 kg then the display shows 5.0 kg. Based on 5x experiments on each lead load, the biggest error lies in the 1 kg load with 0.08% and the smallest error 3 kg with 0.01%. The advantages of making scales on the infant warmer that I developed from the previous tool in this tool are: Scales can be placed on the infant warmer, Scales can make it easier for users to make observations because the previous tool did not exist, Scales according to lead as a comparison tool, and The display on the scales is in the form of 7 segments with a size of 1 inch so that it can be seen from a distance of more than 2 meters.

V. CONCLUSION

Based on the results of the discussion and the purpose of making the module, it can be concluded that: The module will detect load 0 resulting in a voltage of 0.3mV. The use of IC AD620 where the loadcell voltage is amplified by 430.5 times by providing resistors on legs 1 and 8 in the op-amp of 115 ohms, Reading an empty load, the output voltage is 0.0 kg if it is not in accordance with the initial conditions then you can press tare so that the display becomes 0.0 kg, Based on the experiments that have been carried out, the scales that have been made to measure the weight of the comparison in the form of lead have the largest error in the load of 1 kg with 0.08% and the smallest error of 3 kg with 0.01%. The following are suggestions that can be considered for the improvement of research from the manufacture of the tool that I developed and I hope to develop, namely: The scale can measure weight more than 5 kg, Displays are combined through a TFT display with a clear view that can be seen from 2 meters, and Using the HX711 module.

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Attachment:

a. Schematic:
https://drive.google.com/file/d/1Oi29XX1SfrJj8N9m1cZ1YVrW9QcrlW7W/view?usp=sharing

b. Listing Program :
https://drive.google.com/file/d/1hp7xri4dA8Kz4tNK3AAlyB796z8YOF9y/view?usp=sharing