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Calculation Of Fetal Weight Estimation Using TFT Displayed

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***Abstract*— Fetal weight estimation during pregnancy is one of the beneficial ways to solve morbidity and death during labor problems. Manually, the fundal height is measured from the edge of the pubic symphysis to the top of the uterine fundus by following the arch of the uterus, using a measuring tape. The purpose of this study is to develop an easy way to count fetal weight estimation so midwives don't have to count manually. The calculation of the fetal weight estimation tool uses a variable resistor (potentiometer) as a sensor to measure the fundal height. Then it will be processed in the microcontroller. The measurement results are fundal height and estimation of fetal weight that will be displayed on the TFT LCD. Based on the results of measuring the fundus uterine height as much as 6 times against the measuring tool (ruler), there is no error in the device so it can be concluded that this tool can be used according to its function. This calculation of fetal weight estimation tool is portable and easy to use to help midwives count the fetal weight estimation quickly.**

Keywords—Estimation Fetal Weight; Fundal Height; Pubic Symphysis.

I. INTRODUCTION

Perinatal mortality in infants with low birth weight and pain due to large birth weight is a problem in perinatal health and labor management. According to the Indonesian Demographic and Health Survey in 2012, infant mortality in Indonesia decreased slightly to 32 per 1000 live births from 34 per 1,000 live births in 2007. A very slow decline, while the target that has to be achieved according to the Millennium Development Agreement Goals (MDGs) in 2015 is 24 per 1000 live births[1].

Fetal Weight Estimation during pregnancy is one of the beneficial ways to overcome the problem of morbidity and death during labor. Birth weight will affect the accuracy of labor and the results so that it is expected to reduce mortality and morbidity in mothers.

The fetal weight estimation technique that is most often performed by midwives is by measuring fundal uterine height. Measuring the height of the uterine fundus is precisely done on a centimeter scale. Fundal uterine height has a strong and significant relationship with the baby's weight and reflects fetal growth and more accurate fetal size[2].

There are several formulas to find out the estimated birth weight of the baby, including the Johnson Tohsach formula. Johnson Tohsach's formula uses a method to estimate fetal weight by measuring fundal uterine height, which measures the distance between the edges of the pubic symphysis to the top of the uterine fundus by following the uterine arch, using a measuring tape and checking the vaginal taucher to find out the lowest decrease[3].

Usually, the calculation of the fetal weight estimation formula is done manually. Based on these problems, then the author will make "Calculation of Fetal Weight Estimation displayed with TFT LCD" tool. This module can be used to calculate the fetal weight estimation quickly and practically.

II. MATERIALS AND METHODS

A. Experimental Setup

This study used five pregnant women with a pregnancy age above 5 months who are not obese with the condition of a non-twin fetus, not breech, not transverse, and not experiencing amniotic abnormalities. The subjects were randomly sampled and the data collection is repeated 3 times.

1) Materials and Tool

This study is used a measuring tape to measure fundal height from top of the uterus to the pubic symphysis. The Arduino Nano microcontroller was used to convert ADC data from potentiometer to length that displayed to TFT LCD. A digital multimeter was used to measure the resistance and voltage of the potentiometer.

2) Experiment

In this study, after the design was completed then the length value (cm) on display was matched with a ruler with 1 cm resolution. And the fetal weight estimation was counted manually. Then this module was tested on pregnant women.

B. The Diagram Block

The potentiometer will read the fundal height of the uterus of the pregnant woman. The Yes and No buttons on the TFT LCD are used to input the location of the fetal head (it have

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entered to the pelvic inlet or not). After selecting the location of the fetal head, the microcontroller will process all these commands and provide data information to the TFT LCD so it can display the fundal height and fetal weight estimation. To repeat from the beginning, a reset button is used.

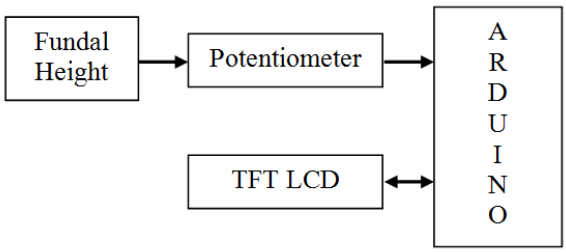

Fig. 1. The diagram block of the Modul

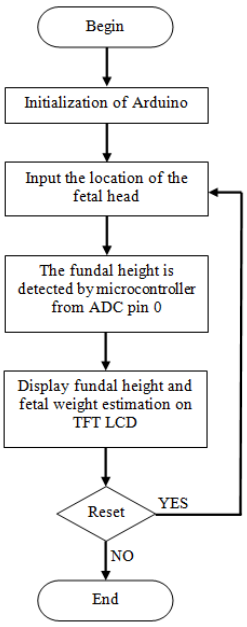

Fig. 2. The Flowchart of the Arduino Program

C. *The Flowchart*

The Arduino program was built based on the flowchart as shown in Fig. 2. After the initialization of the Arduino, then we select the location of the fetal head with YES or NO button on TFT LCD. After that, we can measure the fundal height using this module and the TFT LCD will display the fundal height and fetal weight estimation. To go back to the selection of fetal head, we can press the RESET button.

D. *The Fundal Height Detector Circuit*

The important part of this development is the fundal height detector circuit describes in Fig. 3

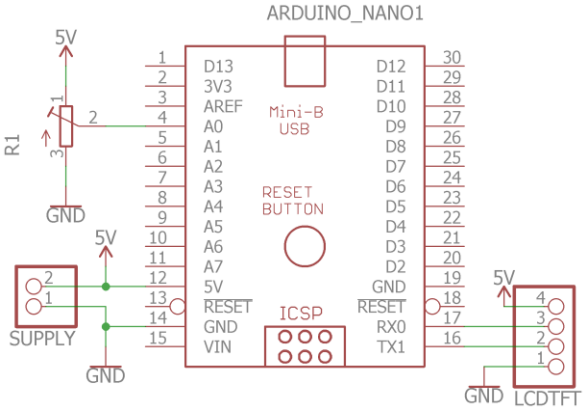

Fig. 3. Height detector circuit

This module uses a potentiometer as a sensor of fundal height that connected to measuring tape. This potentiometer's value is 10KΩ which can rotate 10 times. The resistance from the potentiometer will be connected to Arduino Nano in pin A0. The microcontroller will convert ADC data from the potentiometer to the length that displayed to TFT LCD.

III. RESULTS

In this study, this module is matched with a ruler with a resolution one cm. And the fetal weight estimation was counted manually using the Johnson Tohsach formula.

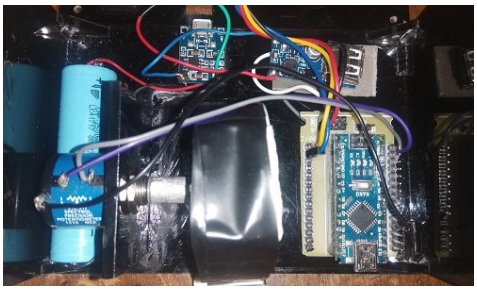

Fig. 4. The Calculation of Fetal Weight Estimation Design

1) *The Calculation of Fetal Weight Estimation Design*

The photograph of the calculation of fetal weight estimation design was shown in Fig. 4. The input of this module is from measuring tape that was connected to a potentiometer (10k Ω). There was 3 connectors from the potentiometer. That was connected to Vcc, ground, and A0 port in Arduino Nano microcontroller which is the main board of this module. The ADC data will be processed so the fundal height and fetal weight estimation can be displayed in TFT LCD.

2) *The Listing Program for Arduino*

This program is used to detect fundal height from potentiometer and display to TFT LCD. It will be explained below.

```
void loop()
{
    adc=analogRead(A0);
    jumlah=jumlah+adc;
    ke++;
    delay(10);
    if (ke>25)
    {
     ke=0;
     rata = jumlah/25;
    {
     ke=0;
     rata = jumlah/25;
     jumlah=0;
     panjang=rata*0.114503817;
     if (panjang<=3)
     {
      TFU=0;
     }
     else
     {
      TFU=panjang-3;
     }
     if (TFU<=11)
     {
      YPAP=0;
     }
     else
     {
     YPAP = (TFU-11)*155;
     }
     if (TFU<=12)
     {
      NPAP=0;
     }
     else
     {
     NPAP = (TFU-12)*155;
     }

 if (page == 3)
{
 Serial.print("n0.val=");
 Serial.print(TFU);
 Serial.write(0xff);
 Serial.write(0xff);
 Serial.write(0xff);
 Serial.print("n1.val=");
 Serial.print(YPAP);
 Serial.write(0xff);
 Serial.write(0xff);
 Serial.write(0xff);
 }
  if (page == 4)
 {
 Serial.print("n0.val=");
 Serial.print(TFU);
 Serial.write(0xff);
 Serial.write(0xff);
 Serial.write(0xff);
 Serial.print("n1.val=");
 Serial.write(0xff);
 Serial.write(0xff);
 Serial.write(0xff);
 }
 if (page == 4)
 {
 Serial.print("n0.val=");
 Serial.print(TFU);
 Serial.write(0xff);
 Serial.write(0xff);
 Serial.write(0xff);
 Serial.print("n1.val=");
 Serial.print(NPAP);
 Serial.write(0xff);
 Serial.write(0xff);
 Serial.write(0xff);
 }
}
nexLoop(nex_listen_list);
}
```

The height of Fundus Uteri is read by pin A0. It reads ADC data 25 times and then divided. After that the data will be proccessed by mocrocontroller and displayed on TFT LCD.

1. Adc = analogRead (A0), is a program that reads ADC0 data from input sensors, namely potentiometers.
2. Panjang = rata * 0.114503817; is the convertion program from ADC to length.
3. Because there is a mechanical addition of 3 cm, the length is reduced by 3 cm.
4. When the YES button is pressed, then the formula = (TFU-11) x 155. When the NO button is pressed, then the formula = (TFU-12) x 155
5. TFU and TBJ when the head of the fetus has entered the top of the pelvis will be displayed on page 3 nextion at n.0 and n.1. TFU and TBJ when the head of the fetus has not entered the upper pelvic door will be displayed on page 4 nextion at n.0 and n.1.

3) The Error of fundal height value

The validation of the fundal height value shown in the TFT LCD. The error was showed in Table I.

TABLE I. THE ERROR OF MEASUREMENT FOR FUNDAL HEIGHT PARAMETER BETWEEN THE DESIGN AND RULER.

Height (cm)	% Error	Height (cm)	% Error	Height (cm)	% Error
11	0%	21	0%	31	0%
12	0%	22	0%	32	0%
13	0%	23	0%	33	0%
14	0%	24	0%	34	0%
15	0%	25	0%	35	0%
16	0%	26	0%	36	0%
17	0%	27	0%	37	0%
18	0%	28	0%	38	0%
19	0%	29	0%	39	0%
20	0%	30	0%	40	0%

TABLE II. THE ERROR OF MEASUREMENT FOR THE FUNDAL HEIGTH PARAMETER BETWEEN THE DESIGN AND MEASURING TAPE ON SUBJECT

Subject	Fundal Height (cm)	% Error
P1	29	0%
P2	20	1,5%
P3	28	0%
P4	27	1,1%
P5	29	0%

The measurement of fundal height value using the module is compared with measuring tape on the subject. The result was shown in Table 2.

IV. DISCUSSION

The calculation of the fetal weight estimation module has been examined and test completely in this study. Based on the measurement of the module output with a ruler as a measuring instrument, it shows the right value of fundal height and fetal weight estimation with no error. This is indicated that this module is feasible to be used as a medical device.

By comparing the output of the module with measuring tape on the subject, it was shown that there is an error. The biggest error is 1,5% and the lowest error is 0%. This is reasonable because it depends on the user that determines the fundal height point.

V. CONCLUSION

This study has demonstrated the development of the module to measure the fundal height and calculate the fetal weight estimation a subject in real-time. This study was built based on an Arduino microcontroller. This study has proofed that accuracy is feasible to be used. In the future, this study can be used by midwives to calculate the fetal weight estimation quickly and practically.

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