

Premature Baby Weight Monitoring System and Incubator Temperature Using Telegram Messenger With Smart Notification

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ABSTRACTS

This research is designed as solution to maximize the automation service to premature baby in smart health concept. The aim of this research built the monitoring system to show the condition of premature baby weight and the incubator temperature using telegram messenger. The incubator in this research using grashof method and some hardware consist of DHT and load cell sensor, Ethernet shield and microcontroller arduino uno. The application in this research applied the Bot fitur from telegram messenger to response message and question. There are two service in the application, first baby weight service and incubator temperature services. Besides these services, the application also have notification service that inform the baby weight under 2,2 kg and the temperature. The experiment result of load cell circuit show error of baby weight measurement is 2,325 % and the bot testing using three commands and notification show the satisfied result.

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1. INTRODUCTION

The premature birth is the main cause of children death throughout the world. Almost every day, more than three thousand children under five years old pass away because of premature birth complication. In 2013, children death at number 1,1 million, around 965.000 death caused by premature birth with maximum age only 28 days and 125.000 death between one month and five year age. Nowadays, the premature baby is took care using incubator, because the premature baby should place in room with controlled temperature such as the womb temperature. Premature baby in incubator need intensive care. First, sensor oxygen saturation monitoring, place on arm or foot to monitor the blood oxygen level. Second, monitor vital sign on the chest to control breath, heart rate, body temperature [2][3] and weight [4].

The most development of information technology today is Internet of Things (IoT). IoT is internet service which integrated with usable of specific sensor [5-9]. Many application of IoT can be found in manufacture [10-11], agricultural management [12-14] and smart city management [15-20]. In health sector, IoT is used to monitoring system of patient health condition [21-23], using of android application on smartphone [24-27] and mobile web [28-30]. In this research, we designed and develop monitoring system to measure the weight of premature baby from our previous research [31]. The aim of this research is develop the monitoring system of weight premature baby and incubator temperature condition using telegram messenger. The differences between this research and another research have done before [24-30] is the using of telegram messenger application to monitoring the incubator temperature and baby weight. This application is chosen because free of charge, compatible and multiplatform. Telegram also has API Bot which quite complete and still growing, make it possible to create smart BOT which can response the message. The application using BOT Telegram is designed to inform the baby's weight and incubator condition to group of family, doctor, hospital and clinic which service the baby. The facility of the application not only sent the information but also chat among the participant inside the group and automatic notification on special condition of baby weight to the group. Using this monitoring system perhaps the doctor and family can watch the premature baby easily.

2. RESEARCH METHODOLOGY

The monitoring system in this research can separate into incubator system and telegram monitoring application on smart phone as seen in figure 1. Incubator in this research using grashof method base on research of Raldi A Koestoer [32] and some hardware such as DHT and load cell sensor, Ethernet shield and microcontroller arduino uno.

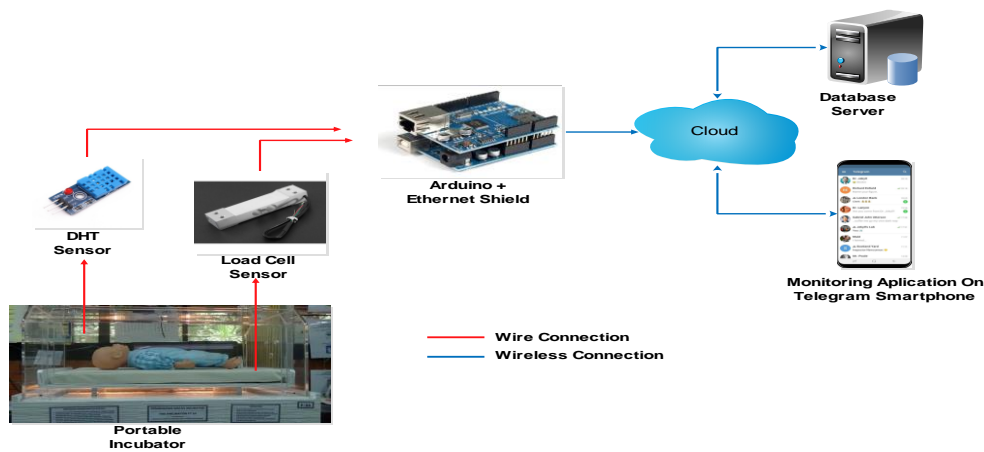


FIG 1. Block diagram system

Load cell sensor to measure the baby weight. This sensor has four pin with difference function. This load cell is completed by amplifier module HX711 ADC 24 bit. The circuit of load cell and module HX711 has the output while the baby put on this sensor and presses it. This condition will change the resistance caused by the changing of moment to voltage and change the value of load also. The changing of load in this sensor will inform the system has got the maximal value. Circuit of load cell and HX711 module schematic can be seen in figure 2. Temperature sensor in this circuit is DHT22 to detect the incubator temperature with digital output. Base on the testing already done, DHT22 have accuracy with error relative temperature measurement 4% and humidity 18% [33]. The incubator data output process by microcontroller arduino uno and sent to data base using PHP Myadmin application with protocol http using Ethernet shield. Hardware inside the incubator can be seen in the figure 3.

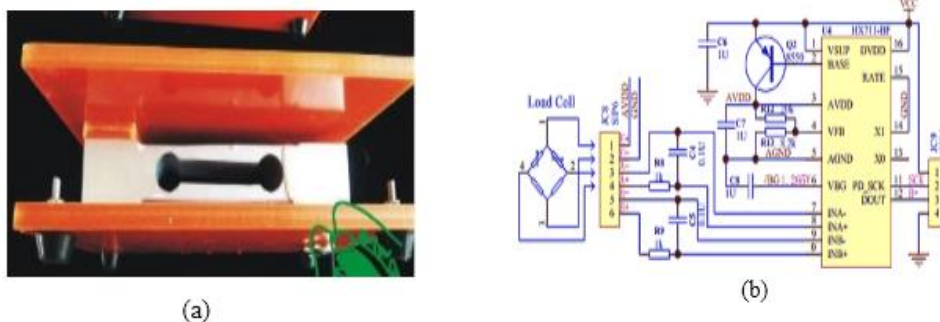


FIG 2. (a) Load cell sensor, and (b) schematic hx711 module circuit

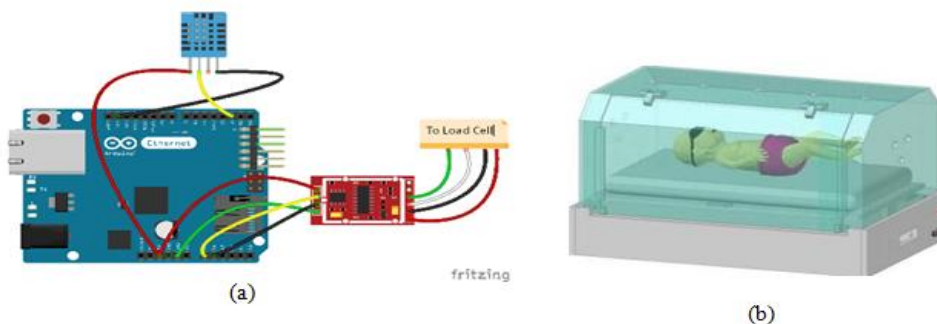


FIG 3. (a) Hardware desain , and (b) Incubator design

This research used the Telegram BOT fitur to response message or question from doctor or patient family. Telegram BOT architecture is show on figure 4. Doctor and patient family sent message to account BOT trough

telegram client which installed to hardware. Telegram server received the message and sends it to BOT Server. BOT Server processed the message and answered the message to application on patient family and doctor trough Telegram Server. Every message has function as command which influence the response to client. Patient family and doctor can reply the message from the server. The flowchart of sending message can be seen on figure 5.

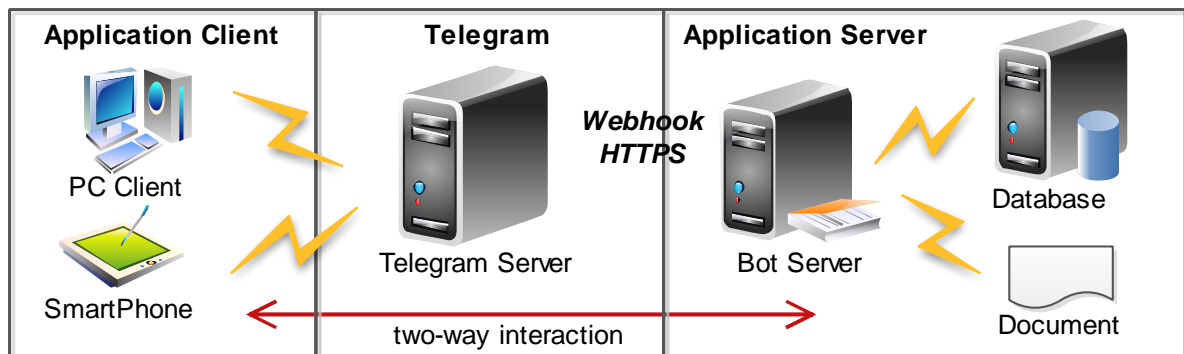


FIG 4. Telegram BOT Architecture

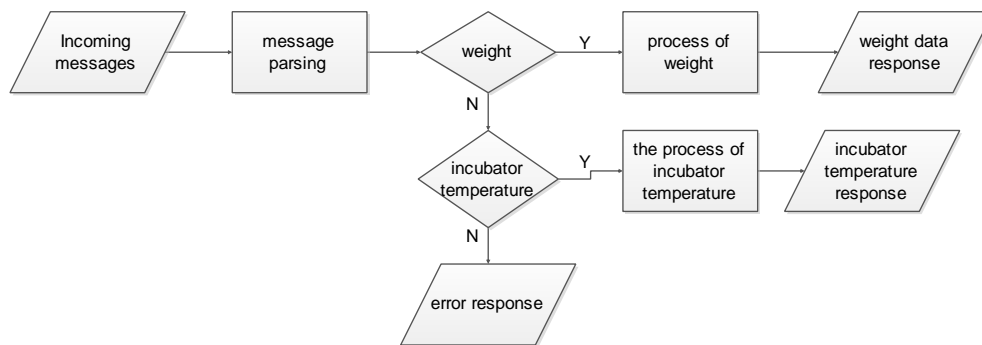


FIG 5. BOT Server process in general

Every message entry the BOT Server will be parsed to know the services category. There are two services category, first baby weight service and the other incubator temperature. Message classification services use authentication process base on patient's Id telegram. The notification services for weight of baby $\geq 2,2$ kg and temperature. Type of service can be seen in Table 1.

TABLE 1. Type of service provided

Service	Initial Command	Interaction	Output
Register	/daftar/ namaorangtua/namabayi	Multi message	
baby's weight	/beratbadan/idbayi	Multi message	Text
incubator temperature	/suhu/idbayi	Multi message	Text
notice if the baby weighs 2.2 kg		single message	Text

There are two natures of interactions, multi message and single message. Multi message service need next message from patient after the server response the previous message. This communications will continue interactively until the result in the server has enough information to give final response or cancel the interaction with ask the another service. The single message service just needs one message to get the server response.

3. RESULTS AND DISCUSSION

This part shows the result of system calibration. First, the whole hardware system testing, this data will compare with the result of measurement manually. The second testing of system monitoring uses telegram messenger. The whole system can be seen in the figure 6.

A. The Testing Of Load Cell Circuit

Load cell circuit to measure the baby weight consists of load cell sensor, HX711 amplifier, microcontroller and LCD. Load cell sensor including HX711 measure the baby weight, microcontroller to process the data and LCD display the data information about the baby. Load cell calibration in the circuit using 500 gram, 1000 gram, 1500 gram and 2300 gram. Output voltage of load cell needs amplifier to gain the output voltage because the result too small. The HX711 module is used to gain the voltage output and convert the result from analog to digital output. Program of load cell use HX711 library module in arduino convert digital output into weight scale. The result of calibration and measurement of baby weight circuit use load cell sensor can be seen in Table 2.



FIG 6. Monitoring baby weight and incubator temperature

TABLE 2. Result of calibration and measuring of baby weight circuit

Load (gram)	Number of testing	Measurement result (gram)	Weight mean (gram)	Error (%)	LCD Display
500	1	515	512,8	2,5	-
	2	513			
	3	512			
	4	513			
	5	511			
1000	1	1028	1027	2,7	-
	2	1028			
	3	1027			
	4	1025			
	5	1027			
1500	1	1532	1530	2	-
	2	1530			
	3	1527			
	4	1528			
	5	1535			
2300	1	2345	2341	2,1	take out the baby from incubator
	2	2338			
	3	2342			
	4	2341			
	5	2339			
Average error in measurement				2,325	

The result of system measurement of load cell circuit is compared with the real weight of the load. Table 2 shows the testing and measurement of load cell can be done and the circuit operates as designed. Load cell sensor can detect the weight through the pressure of the baby and display on LCD. Measurement use load 500 gram, the result has result error 2,5 % compare with the real weight of the load. In the 1000 gram has the measurement error 2,7 %, 1500 gram has error 2 % and the last load 2300 gram has error 2,1%. The measurement result mean error is 2,325 %. Table 2 can be seen on the load 500 gram, 1000 gram and 2000 gram no display of LCD. In the weight of load 2300. gram, the LCD display “take out the baby from incubator”. This display indicates the condition of the baby reach the normal condition so the baby can be taken from the incubator.

B. The Testing Of Monitoring System Use Telegram Messenger

Making of BOT Telegram need BOT registration do by BOT Father Account to BOT name and got API key. API key is used in every request API to telegram server. BOT server application is built use PHP programming language and database MYSQL. Communication between server telegram and BOT server use WEBHOOK with https protocol. Interaction patient as user and BOT can be seen in figure 7. The services on menu registration, the user have to register to system and got the baby user id code. This code is used the monitor the baby weight and incubator temperature. the baby can be take out from the incubator if the weight has reach normal condition, the system sent the information three times as showed in figure 7 (e). The BOT Telegram testing is done by use all the command bot. Every command has multi user interaction and has been more than once. The BOT testing result can be seen in the Table 3.

TABLE 2. Bot Test Results

Service	Initial Command	Number terting	success
Register	/daftar/ namaorangtua//namabayi	10	100%
baby's weight	/beratbadan/idbayi	10	100%
incubator temperature	/suhu/idbayi	10	100%
notice if the baby weighs 2.2 kg		13	100%

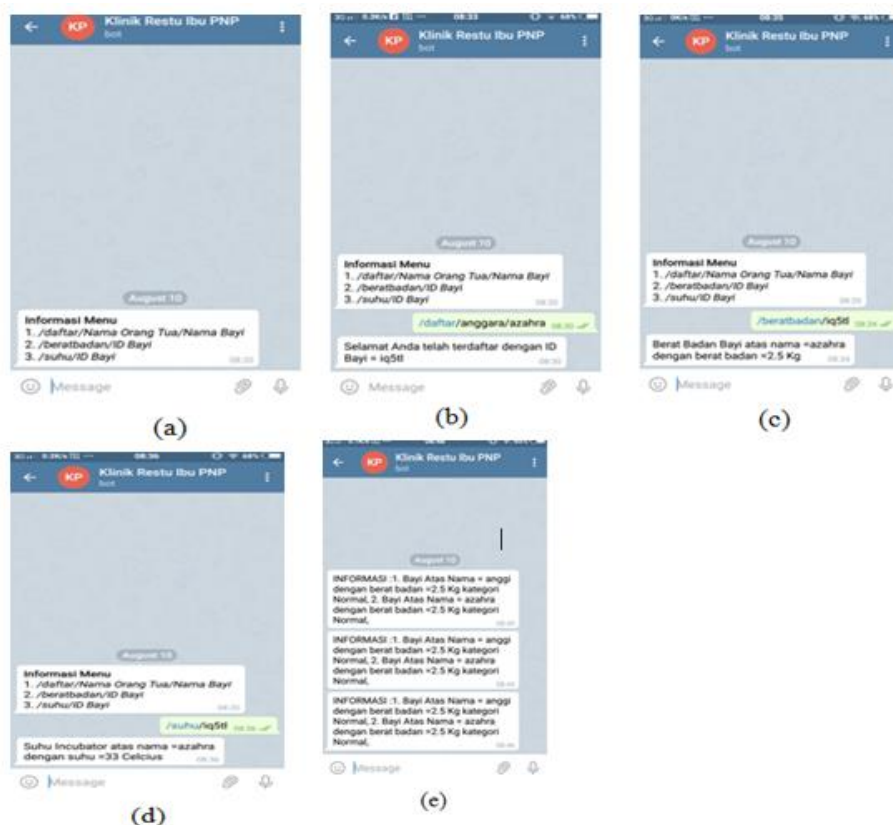


FIG 7. (a) menu information (b) registration to system (c) baby's weight information in incubator (d) incubator temperature information (e) notification of baby's weight in normal

4. CONCLUSIONS

The result of calibration system show the circuit can be operate well, perhaps this system can be implemented to baby who use incubator. Load cell sensor can detected baby weight in good way through the pressure of baby weight and display the result in LCD. The information show in LCD is the notification the baby can be out from incubator if the weight got 2300 gram. Bot telegram to services and patient information has been built in this research with three service commands and one notification as prototype. This early prototype system had the success 100%. Another command can be added in the future to completely entire service and patient information. The other, bot server can be connected to sensors which place in the hospital to know the inviroment information, doctor status, medical record, medicines and parking.

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