PRELIMINARY RESULT FOR PORTABLE INFANT INCUBATOR TESTER

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ABSTRACT

Neonatal incubators were made for survival of new-borns. They regulate temperature, humidity and oxygen concentration, providing the perfect environmental conditions for the newborn improvement. The incubator analyzer used to test the performance of the incubator. The incubator analyzer simplifies testing and ensures proper performance and safety of newborn incubators and transport incubators. The biomedical staffs faces difficulties in lifting heavy safety analyzer from one place to another and the misplacement of external probes may disrupt the process flow of safety test. In this research, a portable infant incubator tester is developed. Temperature, humidity, noise level, and oxygen concentration are the main parameters that is measured in the infant incubator. The four parameters readings will be detected and measured from the infant incubator. The data will be transmitted and processed into Arduino Uno and the result willbedisplayed onthe LCDscreen. Thedataalso willbestoredin theSD card. In addition, the usability of the tester also has been compared with the incubator analyzer. The invention of the light-weight portable tester for neonatal incubator will help to reduce the burden of technician by bringing around the tester. It will also increase the efficiency of the staffs to perform betteratworkplacewith user-friendlytester.

Keywords: NeonatalIncubator,MultiparameterSensor,Portable,Tester

1. INTRODUCTION

Neonatal Intensive Care Unit (NICU) is a special unit for premature babies care in hospitals. The health of the baby is maintained and monitored through this unit. There are a lot of infant incubators analyzers out there in the market been designed for the PPM purpose. However, they are high in cost and not environmentally friendly. Basic infant incubator problem according to the report of WHO (World Health Organization), arecausedbyuncontrolledoxygen saturationanduncontrolledtemperature[2].

The infants have very low thermal regulation and temperature regulation is one of the most important factors which affect the preterm. One of the major problems that new-born's face is improper thermoregulation [3]. In premature baby studies, there is a delicate balance between too much and too little supplemental oxygen exposures [4]. Pretend infants usually have to spend long time incubator, excessive noise in which can adversephysiologicaleffectonneonates[5].

The sound pressure level (SPL) in the NICU is often much higher than the levels recommended by the American Academy of Pediatrics [6]. Alternatively, the portable tester is designed to overcome this problem. This invention is low cost and one of the high demand from biomedical team from hospital. The biomedical staffs face challenges in lifting heavy analyzer from one spot to another. Biomedical team from hospitalhadrequestedaprototypethatcanbeamodelfortheincubatoranalyzer.

This invention is developed to identify the infant incubator tester usability. Then the temperature, humidity, noise and also air quality parameter is assessed. Temperature sensor is used to detect the temperature and humidity. Gas sensor is used to measure air quality in environment of the incubator. Then, sound sensor is used to detect noise inside the infant incubator. Buzzer, LED indicator, LCD screen display and data logger willbeusedaspartofoutput.

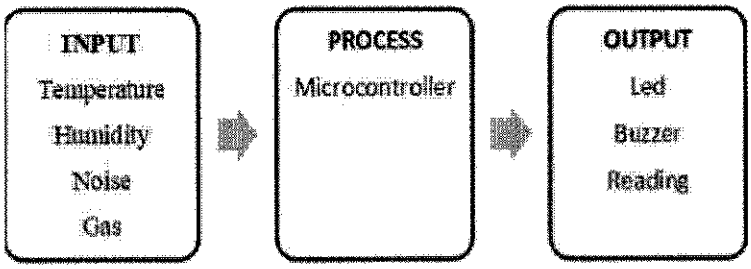
2. METHODOLOGY

The scope of this project is categorized into three parts such as software, hardware and mechanical design. Infant incubator tester is a biomedical equipment that used for perform preventative maintenance and routine verification of baby incubators in hospital. In this respect, the micro-controlled structure facilitates the programming of correction functions that can be modelled from the calibration points. The software whichusedforthisprojectisArduinoUNOsoftware.

2.1 Block Diagram of the System

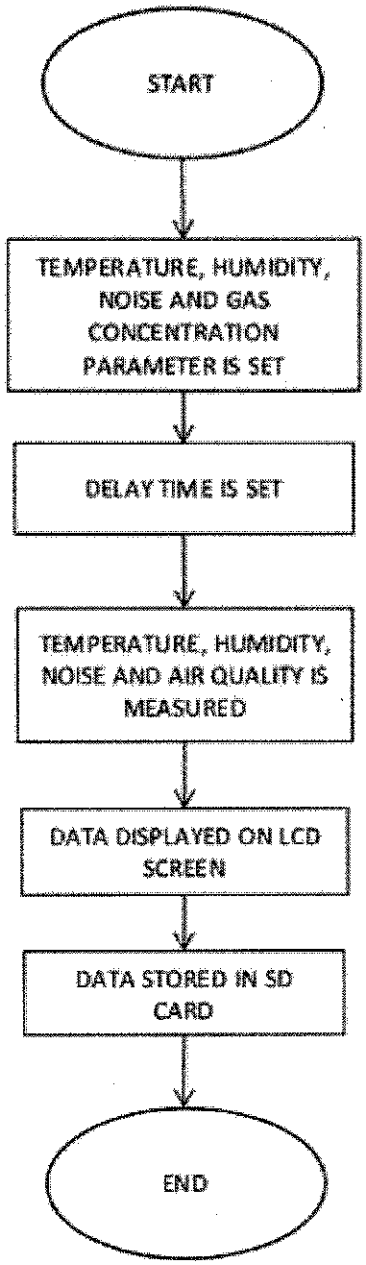
The system of the project starting from input, process and output. Input consists of 4 main parameter which is processed by microcontroller and gives output in form of displaying the reading, blinking of LED light, buzzer and store data.

Fig.1 : Block Diagram of the Incubator Tester



2.2 System Flow chart

Fig.2 : FlowchartoftheProject



2.3 3D Design of thet ester

The 3D design is based on the system size. The tester is designed by own creativity.

Fig.3. Isometric View of the Casing

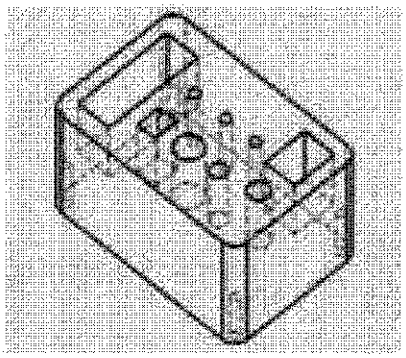


Fig. 4. 3D Sketching of the Hardware

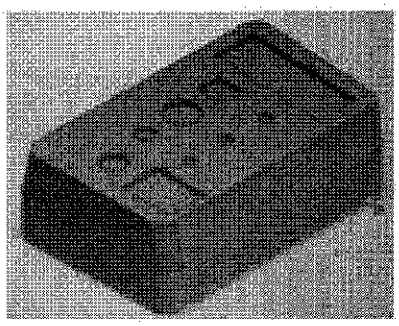
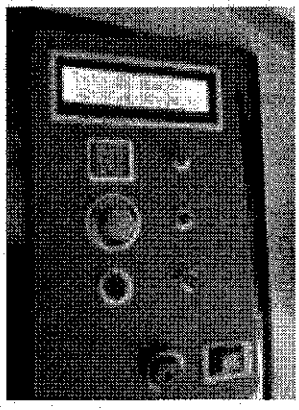


Fig. 5. 3D Design of Tester



3. RESULTS AND DISCUSSIONS

3.1 Experimental testing

The analysis of the results obtained by the tester is presented. The results are related to the testing performance of the parameter inside the incubator. The sensor response was monitored by changes in close.

3.1.1 Temperature testing

The incubator temperature is set to 35°C.The air temperature shows reading of 27.5°C. The humidity is set to 80%. The readings displayed is 59%. Table1 shows the data recorded.

Table1 : Air Temperature Inside the Incubator

Time (Mins)	Incubator Reading (°C)	Tester Reading °C
2	28.5	28
4	29.5	29
6	30.5	30
10	31.5	31
12	32.5	32
14	33.5	33
16	34.5	34
16m and 30s	35	35

The time interval taken for the temperature to increase is 2 minutes. The incubator temperature and the tester temperature show exact reading 16 minutes and 30 seconds. The results obtained were within the ranges specified in the standards.

3.1.2 Humidity testing

The humidity in incubator is set to 70%. Within 16 minutes, the humidity is measured. The data shows that the reading in incubator and tester is different by 2%. The gas concentration and noise level were read through the display for 16 minutes. Table 2 shows the data recorded.

Table2 : Humidity Reading of Incubator

Time (Mins)	Incubator Humidity (%)	Tester Humidity (%)
2	56	55
4	54	53
6	53	52
8	60	57
10	61	58
12	63	59
14	69	64
16	70	68

3.1.2 Humidity testing

The noise reading is taken along with gas concentration testing.

Table 3 : Noise Reading and Gas Concentration Inside the Incubator

Time (Mins)	Noise Level (dB)	Gas Concentration (%)
2	19.68	9.77
4	18.82	9.28
6	19.43	10.25
8	19.8	10.74
10	19.68	11.72
12	21.31	13.18
14	22.96	11.23
16	19.8	10.74

The measured values indicate acoustical environments just a little louder in the NICU's than within the incubators. This reveals that one of the best ways to decrease the sound levels close to the infants must consider the reduction of sound levels in the NICU's. Table 3 shows the reading taken in sound and gas sensor.

4. CONCLUSIONS

This project is focuses on design and develop portable tester based on temperature, humidity, noise, and air quality measurement for infant incubator. To achieve this, a 3D hardware is designed so that the above-mentioned parameters can be tested. The possibility of using the presented methodology, in the development of other prototypes analyzers of medical equipment, contributing to the production of national tester of good quality and low cost. Accuracy of the sensor was checked in the incubator and the acceptability of the obtained values was evaluated. The obtained test result shows that with more accurate sensors, this tester can be used as an incubator analyzer and user friendly.

ACKNOWLEDGEMENT

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REFERENCES

[1] K. Donato, "Incubators in Developing Countries," vol. 37, no. October 1883, pp. 1–9,2000.
[2] World Health Organization, "Core Medical Equipment Core medical equipment Information,"vol.2011,p.5,2011.
[3] Abdel Rahman Shabaan, Shereen M. Metwally, Moustafa M.A. Farghaly, AmrA. Sharawi, "PID and Fuzzy Logic Optimized Control for Temperature in Infant Incubators", Proceedings of International Conference on Modelling, Identification &Control(ICMIC)Cairo,Egypt,pp.53-59,September,2013.
[4] M. Chang, "Optimal oxygen saturation in premature infants," Korean journal of pediatrics, vol.54, no.9, pp.359–362, Sep2011.
[5] S. A. Falk and J. C. Farmer, "Incubator Noise and Possible Deafness," Arch.Otolaryngol., 1973.
[6] Shimizu, A., & Matsuo, H. (2016). Sound Environments Surrounding Preterm Infants Within an Occupied Closed Incubator. Journal of Pediatric Nursing, 31(2), e149–e154.doi:10.1016/j.pedn.2015.10.011