

Study the Effect of Temperature Variable on the Patient with Jaundice Stay Period inside the Incubator

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Abstract

This study is used for measuring the temperature of incubator during its used in the treatment of newborns who suffering from jaundice. The present system is characterized as low cost, easy to use and does not require a highly skilled operator, in which that used of DHT22 sensor based on the Arduino hardware platform. This system facilitates the continuous monitoring and the true knowledge of the temperature of the incubator for determination the period of stay of the child with jaundice in the hospital. In addition, the current system represents not only the possibility of knowing the temperature of the incubator but also a tool to assess the incubator's performance, and find out the percentage of error in the temperature and the difference between the required temperature and the real temperature.

Keywords: Jaundice ; Patient ; physical parameters;

Introduction

Newborns are at raised risk of jaundice, a condition during which excess bilirubin accumulates in the blood. Left untreated, jaundice will result in neurological impairment and death. Jaundice ensuing from unconjugated hyperbilirubinemia is well treated with exposure to blue light¹.

Immediately once giving birth, the child is transferred to a new and completely different surroundings for the mother's womb environment. This setting is certainly not protected and isn't appropriate initially for the child's life because of the changing factors surrounding the newborn particularly the temperature. The premature newborn is homoeothermic, however over a long amount, he cannot maintain the thermal processes. The energy he provides is employed within the following order of priority: for the functioning of important organs, for thermoregulation and growth². Thus it should give a healthful hydrothermal environment to decrease the risk of body hypothermia or hyperthermia for newborn infant³.

The process of measurement the temperature of the therapeutic environment and so understand the perfect conditions for the treatment process is one among the

most necessary things that should be of high interest, because it's an excellent link between the conditions and factors related to the treatment method, and therefore facilitate the study of the impact of temperature alone or combined with different factors in effecting on diagnosing and treatment method.

The Arduino system is considered one among the simplest and most versatile electronic solutions in terms of easy use and speed of learning still as low price of producing components as well as simple to connect and programming by computers, additionally the availability of those electronic components in the local markets, permitting the research worker to work in a very wide space of ideas to dynamical developing and therefore let to get output a lot of comprehensive solutions and optimality.

The main goal of this study is to manufacture an easy system which will provides a precise perception of measurement the temperature within the incubator and therefore facilitate to calibrate and determine the appropriate degree of treatment.

Theory

Neonatal jaundice is one among the foremost

common conditions needing medical attention in newborn babies. About 60% of term and 80% of preterm babies develop jaundice within the 1st week of life, and concerning 10% of breastfed babies are still jaundiced at age one month. Neonatal jaundice is usually harmless, however high concentrations of unconjugated bilirubin could occasionally cause kernicterus (permanent brain damage)⁴.

Neonatal jaundice is common, as a result of physiological jaundice or breastfeeding. In some neonates, unconjugated bilirubin concentration, in addition to different risk factors, is sufficient to permit free bilirubin to cross the blood-brain barrier and cause kernicterus. Another subgroup of infants is jaundiced as a result of elevated conjugated bilirubin; a marker for several pathological conditions. Bilirubin measuring should determine those infants in danger⁵.

Bilirubin is produced from the catabolism of heme within the reticuloendothelial system as shown in Fig. (1). This unconjugated bilirubin is released into the circulation wherever it's reversible however tightly bound to albumin. When the bilirubin-albumin complicated reaches the liver cell, it's transported into the hepatocyte wherever it combines enzymatically with glucuronic acid, manufacturing bilirubin mono- and diglucuronides. The unconjugated bilirubin is reabsorbed into the bloodstream by way of the enterohepatic circulation, adding bilirubin load to the already overstressed liver. This enterohepatic circulation of bilirubin is a crucial contributor to neonatal jaundice⁶.

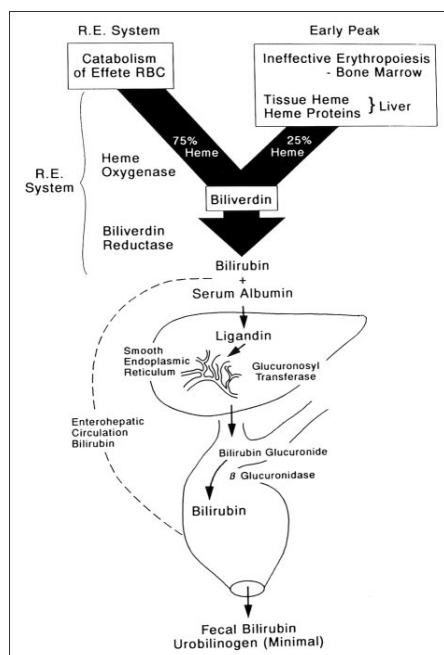


Fig. (1) Bilirubin Cycle.

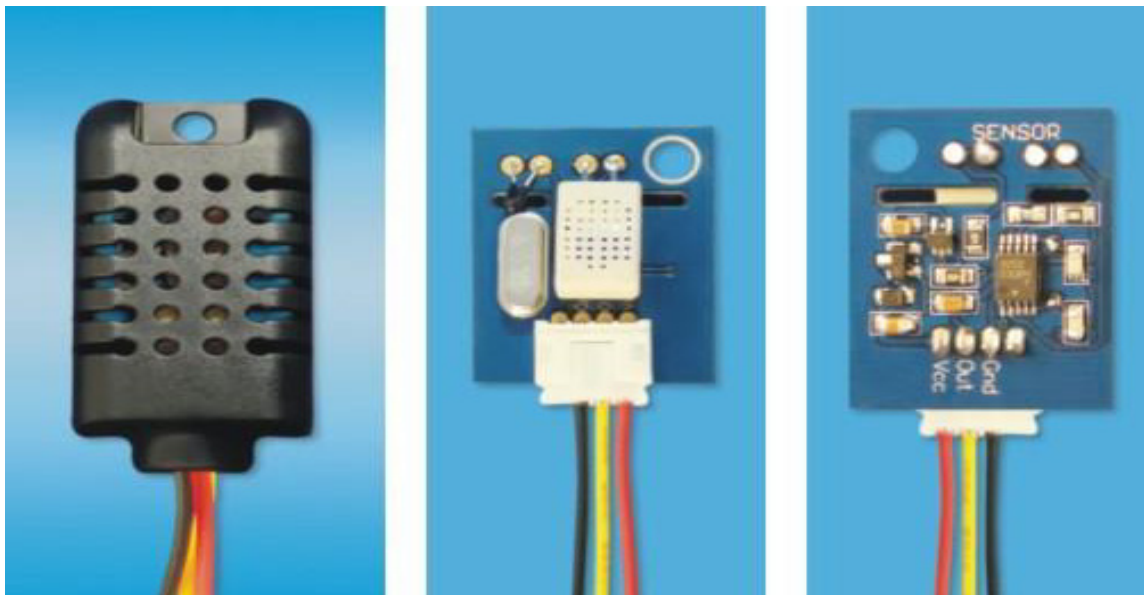
Materials and Method

The hardware and software are the main components of this technique, the hardware consists of two elements that are the AM2301 thermal sensing element and also the Arduino Uno platform.

The incubator was in the hospital which has its heat supply, through this sensing circuit the temperature of incubator is measured during treated the newborn with jaundice.

DHT21

The AM2301 thermal sensing element, that sensing digital temperature which contains the compound that has been calibrated the digital signal output of the temperature sensor. Application of a dedicated digital modules collection technology and also the temperature sensing technology, to make sure that the merchandise has high reliability and wonderful long-term stability. The sensing element includes a capacitive sensing element wet components and a high-precision temperature measuring devices and connected with a high-performance 8-bit microcontroller. The merchandise has wonderful quality, quick response, sturdy anti-jamming capability, and low price. The shape of procedures, the standardization coefficients hold on within the microcontroller, the sensor among the process of the heartbeat to call these calibration coefficients. Standard single-bus interface, system integration fast and simple. Small size, low power consumption, signal transmission distance up to twenty meters, creating it the most effective selection of all types of applications and even the most demanding applications. Product for the 3-lead (single-bus interface) connection convenience. Special packages in keeping with user wants⁷. Fig. (2) Illustrates the DHT21



sensor.

Fig. (2) The configuration of DHT21 sensor.

ARDUINO UNO

The Arduino Uno has shown in fig. (3) utilized in this study, that is a microcontroller board grounded on the ATmega328 (datasheet) was chosen as the microcontroller for this study. This was a perfect choice, as the processor is extraordinarily strong and cost-effective. It contains of 14 digital input/output pins (out of that 6 is utilized as PWM outputs), six analog inputs, a 16 MHz ceramic resonator, facilitation for USB connectivity, a power jack, an ICSP header, and a button. Its styles comprise of help that supports the microcontroller in each possible way. To induce to figure with it one has to merely connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery⁸.

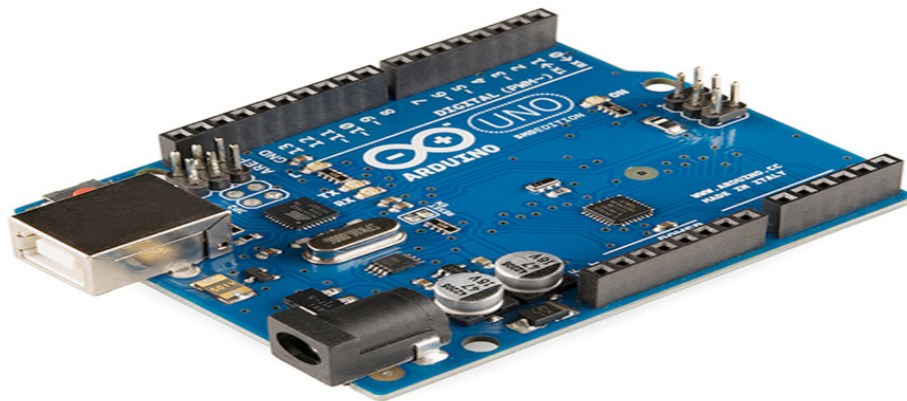


Fig. (3) The Arduino (Uno) type.

A systematic strategy was used for the design of this study, during which the obtained temperature of the incubator was to be detected for 135 patients with jaundice.

So, the information collected from the external sources that are the incubator were obtained employing a sensor. The strategy of management used is a microcontroller, that reads the results obtained from the sensing element to be then mentioned and show the impact on the speed of the healing process for a patient with jaundice.

Results

The measurement system that used in this study enables a real perception of temperature in the incubator environment during the presence of the newborn with jaundice, thus the results obtained represent exactly the conditions experienced by the newborn with jaundice during the treatment, which directly affect the speed of treatment.

To check the real readings of the proposed approach, the temperature of 135 patients with jaundice was compared to the time spent in the hospital is shown in table (1), and also see fig. (4) Which represent the relationship between the time which the child spent at the hospital and the incubator temperature range (° C) for all patients.

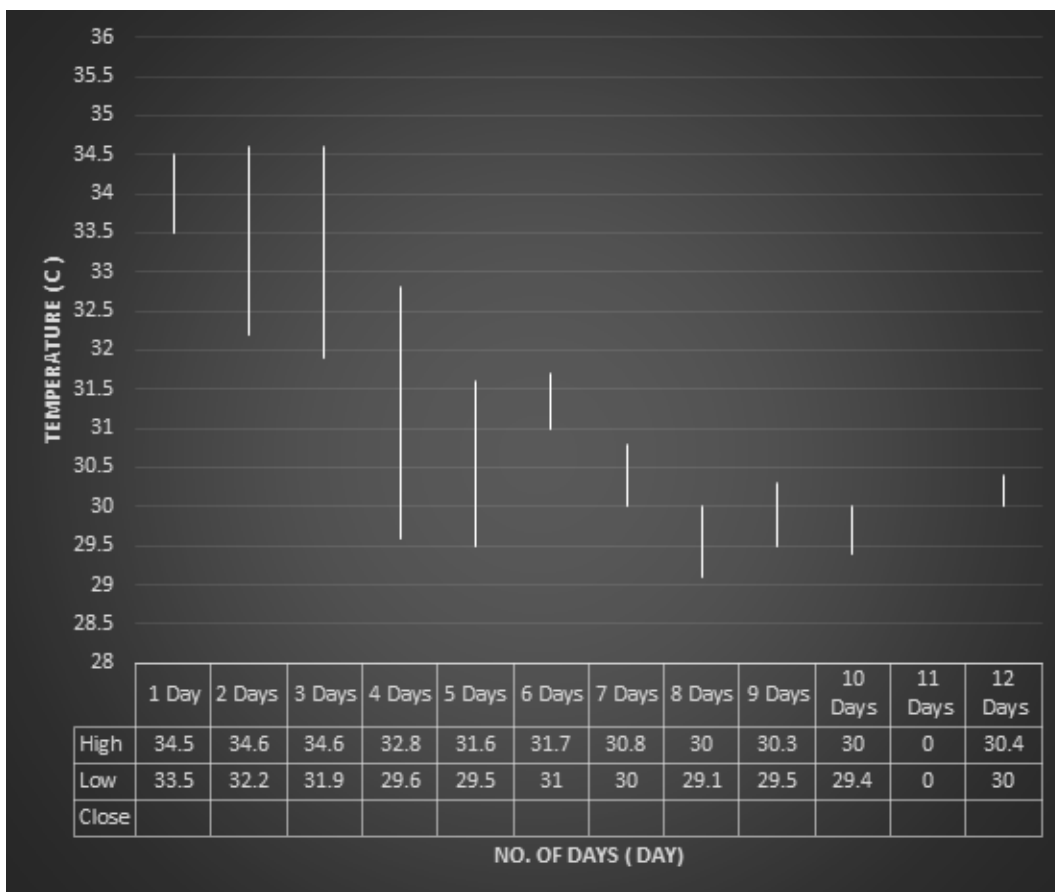


Table (1) Illustrates the relationship between incubator temperature ranges with staying period in the hospital.

NO.	Period of staying in hospital	Incubator temperature range (
1	1	33.5-34.5
2	2	32.2-34.6
3	3	31.9-34.6
4	4	29.6-32.8
5	5	29.5-31.6

6	6	31-31.7
7	7	30-30.8
8	8	29.1-30
9	9	29.5-30.3
10	10	29.4-30
11	11	-
12	12	30-30.4

Fig. (4) The relationship between the period of staying in hospital and corresponding temperature ranges.

Discussion

The incubator is considered an artificial womb and

will have the most vital effect of protecting newborn. One of the most important duties of the incubator is to control the temperature of the newborn to achieve thermal neutrality, which is achieved by control temperature stability in the incubator. However, this study shows that there is a large swing in the temperature from one to another, although the fixed value is the same, and that is due to the difference in efficiency of each incubator parts because of its operational life and its ability to work such as heat source and heat radiator and efficiency of thermal insulation of the incubator walls, In addition to the external effect of room temperature at the temperature of the incubator.

This work opens the way for comprehensive study on the conditions affecting the temperature in the incubator to design an ideal incubator that provides ideal conditions that will help to actually reduce the treatment period for patients with jaundice.

Conclusions

The concluding observations of this study explain the effect of the temperature which is the most popular variable affected on the patient stay period in hospital.

It was clearly found that the performances of the fixed environment factors including temperature, humidity and other factors in the mother's womb will disappear immediately after birth. This situation places the newborn in a state of sudden environmental change which requires a necessary and quick adaptation. The child who cannot cope with the new environment and if the mother is different in the blood group and RH factor in addition to children who born before 37 weeks (pre-term) the baby will suffer from jaundice disease.

It is obvious that the changes in baby temperature from the mother's womb temperature is considered as one of the conditions causing or helping diseases and therefore difficult to cure.

It is clear that the patient stay period of the children with jaundice inside the incubator was closely related to the incubator's high temperature, for example the incubator temperature of the children who had been cured in a short period varied between 1 and 3 days were at its lowest rates of 31.9 ° C and at its highest rates of 34.6 ° C.

It was found that the speed of recovery for children with jaundice which the temperature in its incubator

environment is higher than those no closer to the temperature of the mother's womb. This is due to the thermal regulation of the newborn inside the incubator is closer to the degree of the mother womb.

Ethical Clearance: The Research Ethical Committee at scientific research by ethical approval of both environmental and health and higher education and scientific research ministries in Iraq

Conflict of Interest: The authors declare that they have no conflict of interest.

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