

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

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Abstract

In this study, a DHT22 sensor was used based on the Arduino platform for the purpose of measuring and monitoring the humidity in the incubator during the period of treatment of new-borns suffering from jaundice. This system was adopted because it has a range of advantages that make it accessible to researchers as it does not need a highly experienced or specialist operator because it is easy to use as well as low-cost. The use of this system provides continuous and real monitoring of the humidity in the incubator to help determine the effect of humidity on the treatment period of the child with jaundice in the hospital. In addition, checking the level in the humidity error and the difference between the required moisture and the actual moisture recorded.

Keyword (Jaundice, Humidity, and sensor)

Introduction

Jaundice which is a disease during which excess bilirubin accumulates in the blood, so the newborns are at raised risk of jaundice. When the newborn with jaundice let without treatment, which will result in neurological impairment and death. Jaundice ensuing from unconjugated bilirubin is well treated with exposure to blue light⁽¹⁾.

Immediately after birth, the newborn moves to a completely new environment that is radically different from the mother's womb environment, an environment that is not sufficiently protected compared to the womb and is initially unsuitable for a child's life due to the changing factors surrounding the newborn, especially the moisture factor.

If the relative humidity inside the incubator was increasing, so that will be reduced the loss of water for the skin of the premature new-borns and act as a contributed factor to the maintenance of his corporal temperature⁽²⁾.

The early days of new-born life are a watershed in his life, because the daily evaporation loss of preterm infants can reach 20% of the body mass, and by

increasing air humidity within the incubator, this loss can be reduced. The skin evaporative exchanges between the neonate and the environment are directly proportional to the water vapour partial pressure difference between the new-born's skin and the air⁽³⁾.

Thus it should give a healthful hydrothermal environment to decrease the risk of body hypothermia or hyperthermia for newborn infant⁽⁴⁾.

The process of measurement the humidity 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 humidity 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 humidity 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)⁽⁵⁾.

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 danger⁽⁶⁾.

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 humidity which contains the compound that has been calibrated the digital signal output of the humidity sensor. Application of a dedicated digital modules collection technology and also the humidity 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 humidity 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 wants⁽⁷⁾. Fig.(1)Illustrates the DHT21 sensor.

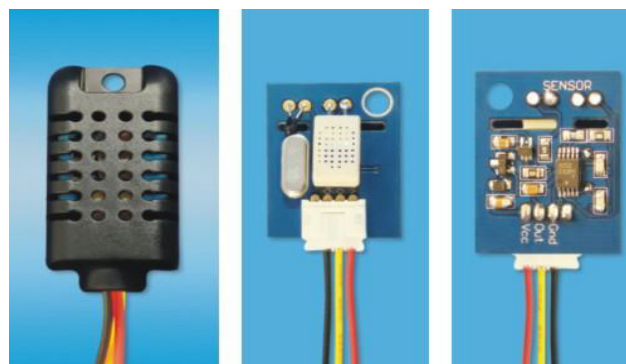


Fig. (1) The configuration of DHT21 sensor.

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 battery⁽⁸⁾.

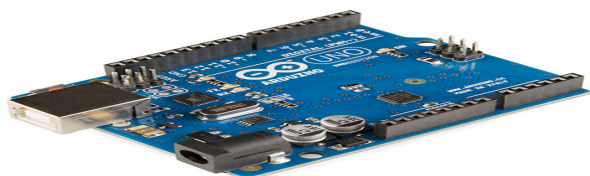


Fig. (2) The Arduino (Uno) type.

A systematic strategy was used for the design of this study, during which the obtained humidity 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 humidity 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 humidity of 135 patients with jaundice was compared to the time spent in the hospital is shown in table (1), and also see fig. (1) which represent the relationship between the time which the child spent at the hospital and the humidity of the incubator for all patients.

Table (1) The Effect of Humidity in the Incubator on the Staying of the Patients Period in the Hospital.

NO.	Period of Staying in Hospital (days)	Incubator Humidity Level (%)
1	1	45-49
2	2	47.2-50.6
3	3	43.16-49.6
4	4	31-35.75
5	5	31-33
6	6	30.7-35.7
7	7	30-33.5

8	8	30-33.03
9	9	30-31.8
10	10	30.5-31.7
11	11	0
12	12	30-33.5

Fig. (3) The Relation between Patients Stay Period and Incubator Humidity.

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 humidity of the newborn to achieve thermal neutrality, which is achieved by control humidity stability in the incubator. However, this study shows that there is a large swing in the humidity 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 humidity on the humidity of the incubator.

This work opens the way for comprehensive study on the conditions affecting the humidity 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 humidity 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 clear that the patient stay period of the children with jaundice inside the incubator was closely related to the incubator’s high humidity percentage, for example the humidity of the incubator of the children who had

been cured in a short period varied between 1 and 3 days were at its lowest rates of 43.16% and at its highest rates of 50.6%

It was found that the speed of recovery for children with jaundice which the humidity percentage in its incubator environment is higher than those no closer to the humidity 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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