Development of Cost-Worthy Smart Incubator system using IoT

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Abstract

An incubator is an apparatus used to monitor and maintain environmental conditions to provide a suitable environment for hatching eggs, raising chicks and various medical purposes. The device is equipped with sensors that monitor and control critical factors such as temperature and humidity. Its high-quality and durable materials make it easy to maintain, and its user-friendly controls make it simple to operate, even for novice users. This paper deals with the design of a cost-worthy Smart Incubator which is a user friendly device for farming, hatching and medical purposes for better monitoring.

Keywords: Smart Incubator, Microcontroller, Hatching eggs, IoT, Automatic control, Hospital.

1. Introduction

Infants who born before 37 weeks of the gestation period are known as preterm or premature babies. Preterm baby requires surrounding exactly similar as in the womb to cope with the external environment. In fact, mammals have the advantage of being homoeothermic, i.e., they have a nearly uniform body temperature, regulated independent of the environmental temperature. Vital organs or enzymes of premature babies grow to the very lesser extent and thus requires special attention to cope with external physical condition like temperature, humidity, light and oxygen level. The infant has several disadvantages in terms of thermal regulation. An infant has a relatively large surface area, poor thermal insulation, and a small amount of mass to act as a heat sink. The newborn has little ability to conserve heat by changing posture and no ability to adjust their own clothing in a response to thermal stress. To provide the similar environment as in the womb infants must be kept in a device known as incubator. An infant incubator is a device consisting of a rigid box-like enclosure in which an infant may be kept in a controlled environment for medical care. An infant incubator provides stable levels of temperature, relative humidity and oxygen concentration The relative humidity should follow set values according to the number of incubation days.

Humidity sensor senses the existence of moisture in our hands and indicates the moisture with the aid of LED's. The circuit can be used to examine the emotion, stress sit can also be used as lie indicator. Heartbeat does not reflect emotion and stress, blood pressure and body temperature but in that case skin moisture also elevates. The resistance decreases when the body is moist. When a person speaks lie its body resistance decreases. Therefore, stress level can be indicated by skin resistance Physiological changes occur when a person speaks a lie due to which body resistance decreases. We can relate it with the outcome for normal question. Restricting the amount of moisture in air is very important in many industrial & domestic uses. In various factories where semiconductors are made, moisture needed to be correctly controlled throughout the manufacturing process. In various medical usages, moisture balance is needed for breathing equipment's, incubating dispensation, etc. Dampness check is mandatory for gas cleansing and food dispensation. In the agricultural industry, the quantity of moisture is of wide importance aimed at plants, soil protection, etc. In households, dampness control is needed for existing situations in buildings. In all such things, humidity sensors are used to give a sign of the moisture level present in air. To make a mention of moisture level, many terms are required.

2. Methodology used for Smart Incubator

Circuit diagram of the proposed model for smart incubator is shown in Figure 1.

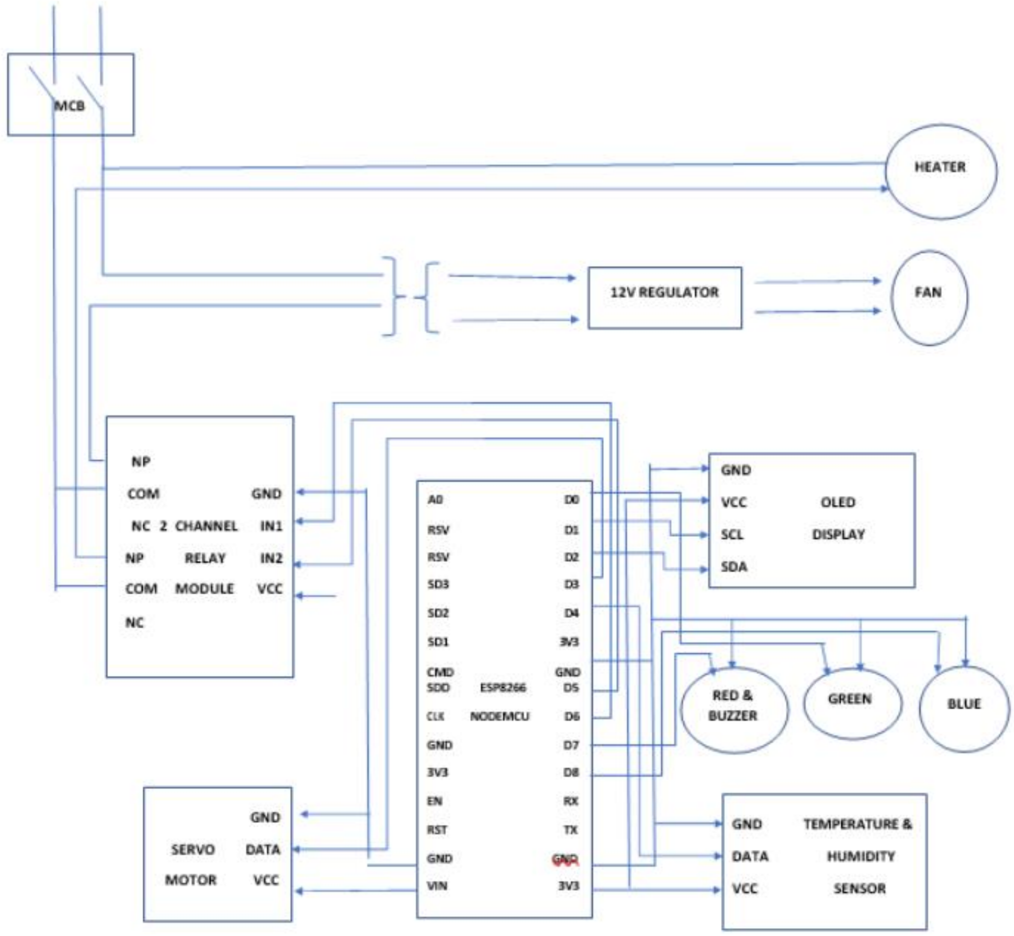

Figure 1. Circuit diagram of the IoT based smart incubator

The Temperature Controller in the smart incubator is used to control a heater or other equipment by comparing a sensor signal with a set point and performing calculations according to the deviation between those values. Devices that can handle sensor signals other than for temperature, such as humidity, pressure, and flow rate, are called Controllers. Electronic controllers are specifically called Digital Controllers. Temperature Controllers control temperature so that the process value will be the same as the set point, but the response will differ due to the characteristics of the controlled object and the control method of the Temperature Controller.

The major parts of the feedback control system are built into the Temperature Controller A feedback control system can be built and temperature can be controlled by combining a Temperature Controller with a controller and temperature sensor that are suitable for the controlled object.

Humidity controllers use several different control techniques. Limit control (off-on control, bang-bang control) establishes set points or limits that, when reached, send a signal to stop or start a process variable. Linear control matches a variable input signal with a correspondingly variable control signal. Signal conditioning, filtering, and amplification are then used to produce the proper output control signal. Proportional, integral, and derivative (PID) control requires real-time system feedback. Feedforward control provides direct-control compensation from the reference signal. This type of control technique can be open- Joop or used in conjunction with more advanced PID control. Fuzzy logic is a type of control in which variables can have imprecise values (as in partial truth) rather than a binary status (completely true or completely false). Advanced or nonlinear controls include algorithms such as adaptive gain and neural networking:

Specifications for humidity controllers include:

- Number of inputs
- Number of outputs
- Input types
- Output types
- Number of zones (if applicable)

The number of inputs is the total number of signals sent to the humidity controller. The number of outputs is the sum of all outputs used to control, compensate, or correct the process. Input types for humidity controllers include direct current (DC) voltage, current loops, analog signals from resistors or potentiometers, frequency inputs, and switch or relay inputs. Output types include analog voltage, current loops, switch or relay outputs, and pulses or frequencies. Some humidity controllers can also send inputs or receive outputs in serial, parallel, Ethernet, or other digital formats that indicate a process variable. Others can send inputs and receive outputs from information converted to an industrial fieldbus protocol such as CAN bus, PROFIBUS, or SERCOS. PROFIBUS is a registered trademark of PROFIBUS International. Humidity controllers differ in terms of user interface features and regulatory compliance. Many products feature a digital front panel or analog components such as knobs, switches, and meters. Computer-programmable, web-enabled, and Ethernet or network-ready humidity controllers are also available in terms of compliance.

3. Hardware model for Smart Incubator

3.1. Hardware components required

The various hardware components are required for implementing the proposed system. Table 1 shows the hardware components required for the development of the smart incubator.

Table 1. Hardware components required for smart incubator

Sl No	Components Name	Quantity
1	Miniature Circuit Breaker (MCB)	1
2	ESP 8266	1
3	DHT 11	1
4	Channel Relay	2
5	Servo motor	1
6	OLED Display	1
7	Water Vaporizer	1
8	Cooling Fan	1
9	Breadboard	1
10	SPDT Switch	1
11	Regulator	1
12	RGB LED Light	3
13	12V AC to DC power supply	1
14	Connecting Wires	20
15	Buzzer	1
16	USB	1

3.2. Hardware components required

Figure 2 shows the hardware prototype of smart incubator

Figure 2. Hardware prototype of smart incubator

4. Cost analysis for smart incubator

Table 2 represents the total cost analysis for developing the model of a smart incubator.

Table 2. Cost analysis for smart incubator

Sl No	Components Name	Quantity	Price (In Rupees)
1	Miniature Circuit Breaker (MCB)	1	157
2	ESP 8266	1	225
3	DHT 11	1	159
4	Channel Relay	2	199
5	Servo motor	1	157
6	OLED Display	1	520
7	Water Vaporizer	1	128
8	Cooling Fan	1	129
9	Breadboard	1	89
10	SPDT Switch	1	30
11	Regulator	1	249
12	RGB LED Light	3	30
13	12V AC to DC power supply	1	252
14	Connecting Wires	20	75
15	Buzzer	1	40
16	USB	1	99
Total component cost (In Rupees) = 2538			

5. Conclusion

In this paper, design and development of a working prototype of a smart incubator os discussed which is useful for hatchery system and baby care unit for temperature and humidity control. Agriculture field also requires measurement of humidity for plantation guard, soil dampness observing, etc. In domestic uses, it is essential for existing atmosphere in constructions, cookery switch for heat up ovens, etc. This paper can be helpful for the temperature optimization and monitoring for efficient growth and production in various fields such as agriculture, health and medical uses.

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