MONITORING OF AN INCUBATOR USING IOT

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Abstract: Neonatal incubator is an apparatus that provides a closed and controlled environment for the sustenance of premature babies. But recently, many premature babies have lost their lives due to lack of proper monitoring of the incubator that leads to accidents (leakage of gas and overheating causing short circuits and eventually, the bursting of incubators). This project deals with the cost effective design of an embedded device that monitors certain parameters such as pulse rate of the baby, temperature, humidity, essential amount of gas and light inside the incubator. The details are sent as a message to the doctor or nurse through IOT, so that proper actions can be taken in advance, to maintain the apt environment inside the incubator and ensure safety to the infant's life. So, the objective of this project is to overcome the above-mentioned drawbacks and provide a safe and affordable mechanism for monitoring the incubator.

***Index Terms* – Node MCU, Arduini Uno, Wi-Fi Module, Incubators.**

I. INTRODUCTION

According to a recent study, premature birth or low birth-weight were two major reasons for about 370,000 neonatal deaths in India during 2015. The largest proportion of deaths among these two reasons belonged to neonates or premature babies. Also, a rise in neonatal deaths linked to premature birth and low birth-weight has been observed, from 12.3 per 1,000 live births in 2000 to 14.3 per 1,000 live births in 2015. The increase in neonatal deaths from premature birth and low birth-weight was found to be non-uniform across India such that the death rates were more in rural areas and poorer states but lesser in urban areas and in richer states. Moreover, premature births and low birth-weight babies may require more investments in incubators and intensive care units in order to provide appropriate neonatal care.

Every year more than 20 million babies are born prematurely or with low birth weight and an estimated 450 of them die each hour. There have also been incidents of death of premature babies due to accidents which have been categorized as a technical fault in the incubators. The increase in neonatal deaths from premature birth and low weight was found to be non-uniform across India such that the death rates were in rural areas and poorer states but lesser in urban areas and in richer states. Moreover, premature births and low weight babies may require more investments in incubators and intensive care units in order to provide appropriate neonatal care.

Incubator is a system where the premature and low birth weight babies are placed to provide a warm, secure, and comfortable environment for their better care. Premature babies also known as preemies are those that are born before the mother reached 37 weeks of gestation. Depending on how premature the baby is, he or she may have an underdeveloped digestive tract, lungs, immune system, and even skin. To help these babies survive outside of womb, they will placed in an apparatus known as Incubator which provides a warm, secure, and comfortable environment for their better care.

II. EXISTING TYPES INCUBATOR

2.1. Portable and non portable:

Portable incubation can be used to shift the patient to another area of hospital as needed.

Fig. 1 portable and non portable Incubator

2.2. Open box type:

It is also known as Armstrong. Here neonate is keep on the Plexiglas bassinet to keep unstable babies or newly born babies

Fig. 2 Open Box Incubator

2.3. Close Type:

Close type of incubator has special function to concentrate fresh air after filtration. It prevents water loss from radiation. As neonates remain inside the box the risk of infection is minimum.

Fig. 3 Close Type Incubator

2.4. Double Walled:

The incubator has two walls. As air is not good conductor of heat the incubator prevents heat and fluid loss.

Fig. 4 Double Walled Incubator

III. TEMPERATURE BASED INCUBATOR MONITORING

Incubation is the term used to describe the process of applying heat to an egg so that the embryo contained within develops into a chick [2]. Aviculturists of today have three options regarding the incubation of eggs and the procedure accordingly differs somewhat in each case. Each option has some advantages and some disadvantages as compared to the other two.

The first step in our design approach was the literature review. It involved searching the Internet for information for our project, asking people and reading articles. Based on the collected information, we defined the methods and tests that would be used to implement the project. We have explored different methods in which the project could be implemented.

The existing system proposes the use of a temperature sensor to sense the temperature of the incubator which is connected to the Node MCU (microcontroller unit). Any increase in the temperature beyond the specified range turns the alarm on and the heater in the incubator gets turned off through the usage of web app. The temperature readings can be continuously viewed by programming the Arduino and ESP8266 (electronic stability program). This enables the staff to receive notification during an emergency so that necessary preventive actions can be taken. This only ensures the maintenance of temperature inside the incubator. But there are other parameters which require being monitored and controlled to provide safety to the infant. So, the main objective of this project is to overcome the above-mentioned drawbacks and provide a safe and affordable mechanism for monitoring the incubator which will help in reducing the mortality rate of neonates. The Block diagram existing incubator is shown in Fig. 5.

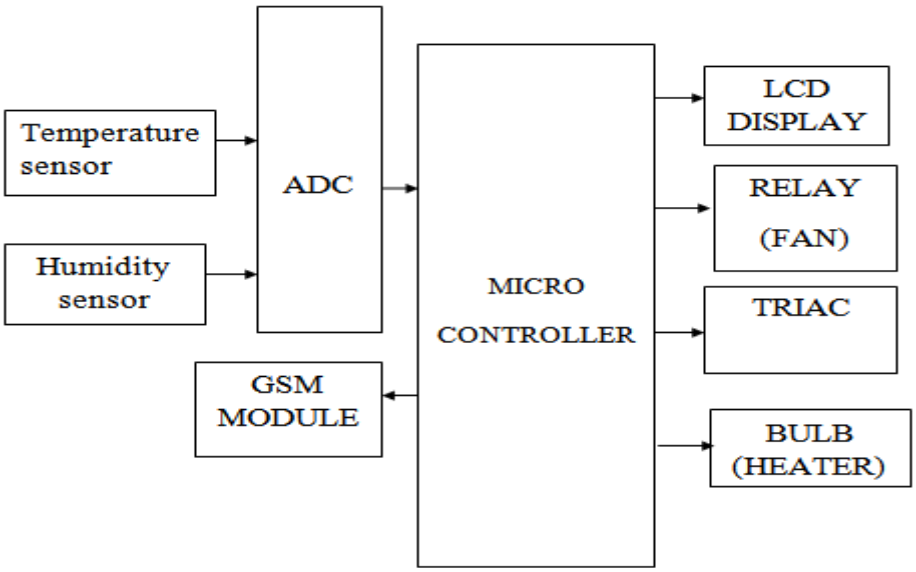

Fig. 5 Block diagram of existing Incubator

The external circuit consists of Node MCU which is connected to the incubator. The temperature sensor (LM35) which is integrated to the Node MCU senses the temperature of the incubator. If it exceeds more than the specified temperature range (36.5-37.2°C) monitored by a computer then relay goes OFF and the alarm goes ON and the heater goes off. Using GSM, the continuous reading of the temperature is sent to the doctor and also alerts the doctor if the temperature exceeds above the reference. It was also programmed to receive notifications in case of an emergency. And hence the doctor notified.

Following are the some of the disadvantages of Existing Incubator.

- Only temperature values can be sensed.
- There is no notification if there is any increase /decrease in light and gas.
- Will get Notifications only in emergency conditions.
- We won't get notifications for every time.

IV. PROPOSED SMART INCUBATOR

According to a recent study, premature birth and low weight was found to be non-uniform across India such that the death rates were in rural areas and poorer states but lesser in urban areas and in richer states. Moreover, premature births and low weight babies may require more investments in incubators and intensive care units in order to provide appropriate neonatal care. The main objective of this project is to overcome the drawbacks in existing system and provide a safe and affordable mechanism for reducing mortality rate of neonates. The block diagram of proposed smart incubator is shown in Fig. 6.

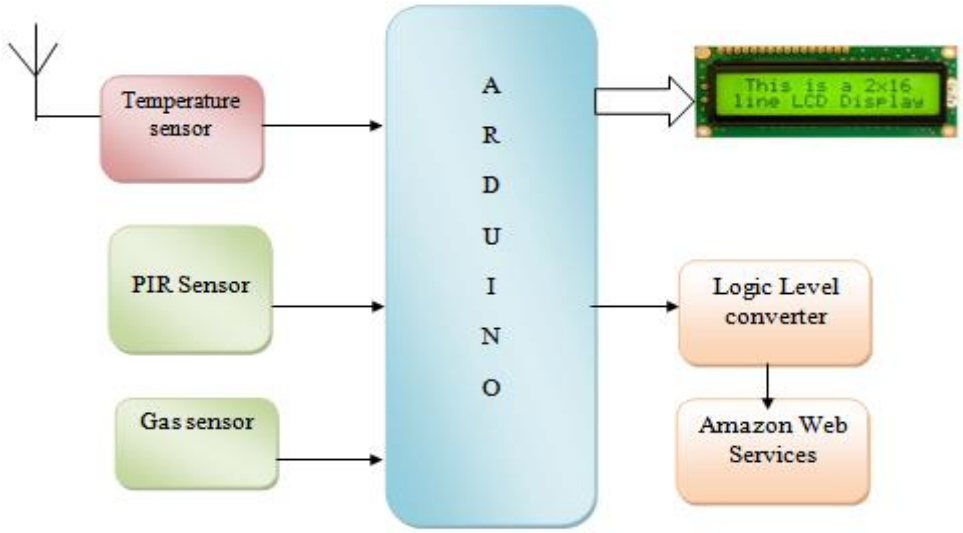

Fig. 6 Block Diagram of a Smart Incubator

The proposed system involves the use of Node MCU integrated to various sensor units such as gas, light, temperature, and humidity sensors. This system uses AWS cloud to collect the sensed data and send emergency notifications to the doctor or nurse when there exists any variation in specified condition. The readings of the sensor are continuously monitored with help of IOT and can be controlled, thereby providing efficient and safe working of an incubator. The proposed incubator consists three modules i.e. Node MCU, Arduino Uno and Wi-Fi module. The proposed incubator mainly used in Hospitals and developing an embryo in animals.

V. RESULTS AND DISCUSSION

Here the hardware is connected via USB cable through arduino and data will be sensed and collected through AWS services.

Pir:

- One terminal junction Vcc
- One to junction ground
- Middle pin to arduino pin3

Buzzer:

- Positive is connected to 2 pin of aurdino
- Negative to arduino ground.

Temperature sensor:

- One pin to junction ground another to junction Vcc
- Middle pin to A0 in arduino.

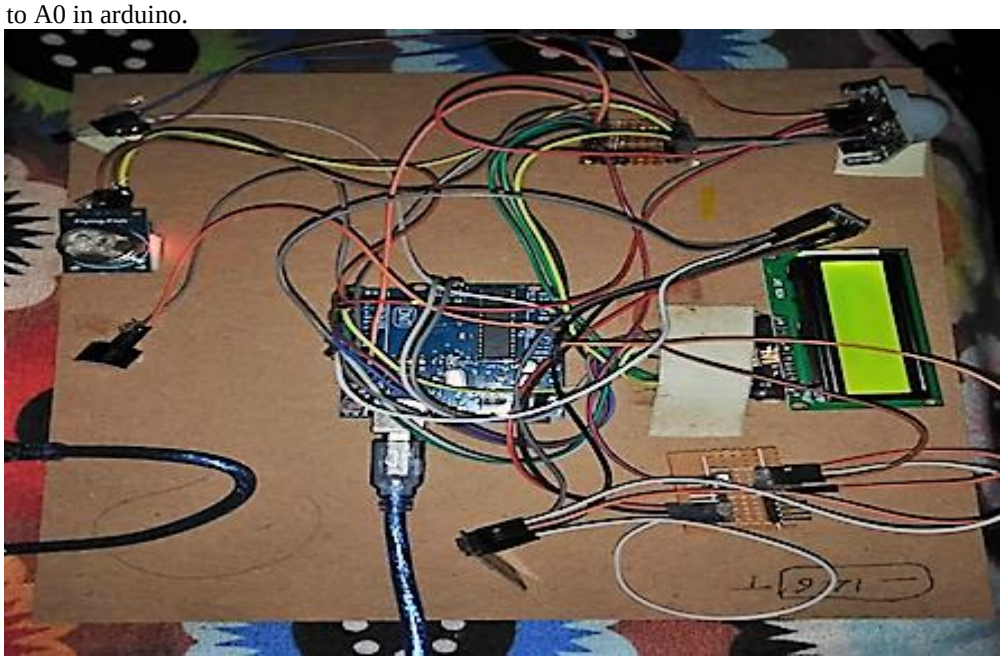

Fig. 7 Hardware Connection

After Hardware implementation write the source code in arduino. After the code implementation, check the output in Amazon Web Services i.e., AWS by using below link: http://3.16.44.193/gates/incubator/IOT_res.php.

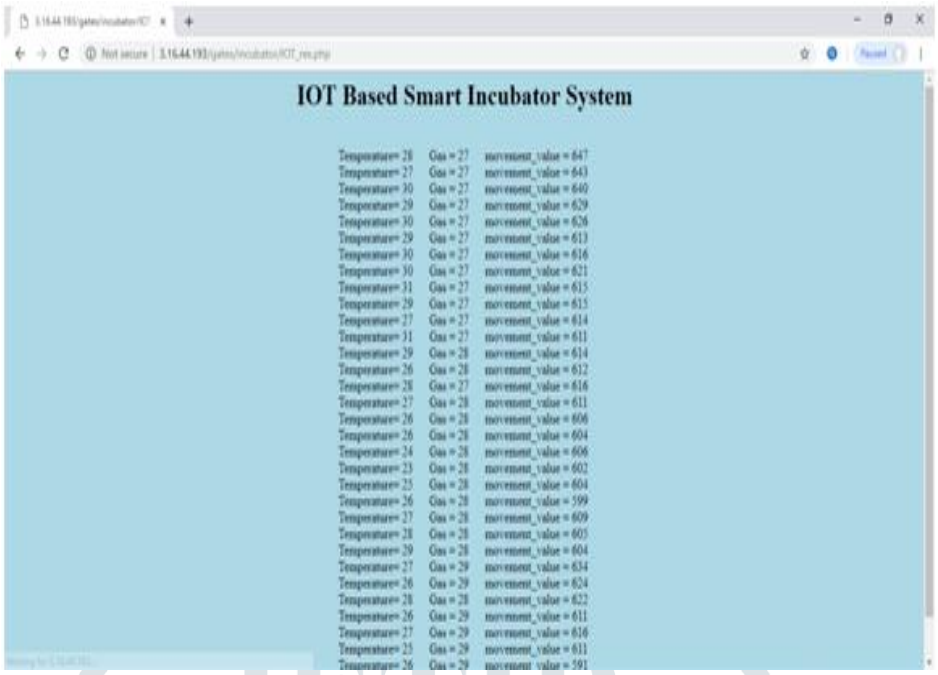

Fig. 8 Monitoring Through AWS

By various sensor units such as gas, light, temperature, and humidity sensors. If there is any increase in the levels of those sensors the buzzer will automatically alert the care taker. These values are seen in that IP address given above. This system uses AWS cloud to collect the sensed data and send emergency notifications to the doctor or nurse when there exists any variation in specified condition. The readings of the sensor are continuously monitored with help of IOT and can be controlled, thereby providing efficient and safe working of an incubator.

VI. CONCLUSION

Monitoring of Incubator using IOT is developed mainly for the medical conditions available in rural areas. This Equipment can be effectively used by caretaker in a small health care Centre. It can be life saving machine for low birth weight infants. The component can be easily fixed. The chamber is sufficient enough to accommodate the baby comfortably. As the electronic part is separated from the compartment the baby is kept the baby can be assured safe. The Arduino Uno microcontroller used here is efficient in controlling the temperature, pulse of the system and also the wet condition of the baby's bed.

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