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A Modular Infant Isolette with anti-intrusion Buzzer System

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ABSTRACT

Preterm infants birth rate are especially high in the developing countries. Nearly 20 million premature and low birth rate infants are born each year in developing countries. A combination of poor after-birth, poor facilities care have lead to infant mortality. In India due to rodents attacks and temperature increment infant death in incubator seems to be abundant. In this project we proposed a new feature for an incubator (isolette) that is an anti-intrusion system to prevent immature baby from rodents attack and also we include portable (modular) approach with multi parameters measurement include temperature, weight, head circumference by using temperature sensors (DHT 11), load cell and two ultrasound sensor respectively based on IOT using Node MCU 8266 processor. It is low cost, transportable, energy saving useful in ambulance services and rural areas.
Keywords : Portable (modular), incubator (isolette), anti- intrusion system, multi parameters, IOT.

I. INTRODUCTION

In developed and developing countries, many infants die in the first week of birth. Problems that are often encountered include hyperthermia, asphyxia and also infants born prematurely. WHO records the classification for hyperthermia which cold stress or mild hypothermia: 36.0 to 36.41C (96.8 to97.51 F);

1. moderate hypothermia: 32.0 to 35.91C (89.6 to 96.61 F);
2. severe hypothermia: below 321C (<89.61 F).

So here the incubator plays a big role where the incubator temperature must be set to maintain the infant's temperature between 95F and 98F or 99F. The infant can live well with temperatures that are slightly below normal.

Infants born prematurely have a high risk of controlling the exchange of heat between the surface of the skin with the conditions of the surrounding environment, even the heat dissipation that occurs can exceed the heat production of the infant's own metabolism. So, infants born prematurely are more likely to suffer from illness or death than infants born normal. One of the procedures to make premature infants still alive is put them into the incubator, the period premature infants in the incubator according to soundness, durability, and system of organs of them. The incubator is one of the tools to help premature infants to adjust with the outside world because the condition in the womb is very different with the outside world, especially condition of temperature. The temperature in the womb is approximately 36- 37°C but in the outside world is approximately 27°C–28°C.

The incubator discovered in 1880 triggered dramatic, popular and professional excitement about the prospect of reducing premature infant mortality. But, technology in the incubator develops slowly, which illustrates that the history of technology involves more than discovery.

The invention of the incubator itself is less significant than the development of a system to support the devices that . are in it. In this way, a new type of infant incubator must be studied that can independently adapt the environment based on a series of sensors and monitor in real time vital signs for the infant.

Advances in technology today following increases in the use of electromagnetic waves in everyday life. One example is the infant incubator. Monitoring the infant incubator is essential to keep the infant has a temperature corresponding to the environment at the newly born.

Not many parents realize that the size of the head circumference that also reflects the brain volume is also an important thing that should always be monitored growth to see whether the infant's brain grow and develop normally or not. Generally, doctors or midwives use a separate measuring instrument. The use of separate measuring instruments requires considerable time and a partially manual and part digital measuring instrument. This research aims to make a tool in one system that there are three measurement parameters including weight, temperature and head circumference that can record automatically. Facilitate the performance of paramedics to automatically measure the infant's weight, temperature, and head circumference to determine the condition of the infant. The tool is operated through IOT (internet of things) which can facilitate paramedic to monitor the infant's situation wherever and whenever using internet network that can be accessed via web or Android. The three parameters are controlled directly with the NodeMCU ESP8266 module using two ultrasonic sensors to determine the circumference of the infant's head, the weight sensor using load cell, while the temperature sensor uses an DHT11 temperature sensor.

Head circumference measurements use two ultrasonic sensors. The data will be processed directly with NodeMCU module ESP8266 displayed through web and Android with internet network. So that the instrument will get three measurements automatically in one system. Making this instrumentation through three stages including, making hardware, software manufacture, and testing instrumentation system. Test results infant incubator is a tool used to monitor the circumference of the infant's head circumference, the infant's weight and the temperature in the infant.

II. EXISTING METHODS

A neonatal incubator is a rigid box-like enclosure in which an infant can be kept in a controlled environment for observation and care. The device may include a heater, a fan, a container for water to add humidity, a control valve through which oxygen may be added, and access ports for nursing care. These neonatal incubator are provided with ventilator, oxygen hood and blood pressure monitor. In older techniques they used hot water to provide warmer condition for babies in incubator . Due to some technology developments several adaptable sensors were used to measure the temperature and humidity range of a baby. Recent study showed that there is possible for portable incubator which can be compacted and used and there is also various parameter measured incubator too.

III. LITERATURE SURVEY

Automation is not a new idea in our modern life due to advanced technological development. Large businesses and wealthy homeowners were implementing this technology for years now. In recent years this concept getting more accessible to many user due to cheaper cost, easier to setup and used modular concept and also higher internet penetration rate. However this automation are used in elderly monitoring too now a days so that doctors or physicians can easily access them.

Web based temperature monitoring also used that allows the user to continuously monitor the temperature condition of a room. Microcontrolled based parameters monitoring also plays vital role in incubator setup. an enhanced noise cancelling system that monitors the baby and reduces sound pollution has been suggested. The main function of the system is to reduce the noise that might disturb the baby by playing relaxing songs. This system can also adjust the room's light intensity with the aid of a light sensor. Even though there is lot of technology features mentioned above used in infant incubators still problem of infant in incubator seems to be major issues. Many articles and papers related to infant production in incubator are there but it is still in obligation to bring in real world due to cost and production availability.

Thus we setup a system of incubators that will be featured with advanced technology affordable cost and portable too.

IV. PROPOSED METHODOLOGY AND IMPLEMENTATION

In proposed system, we have designed one box as an Incubator section, hardware section and PC or Mobile as the monitoring section. Both will be communicate using HTTP using Node MCU. In an Incubator Section, we fixed temperature and humidity (DHT11) sensor, Ultrasonic sensor and the load cell. These devices are used to monitor internal temperature, humidity level of an Incubator. Ultrasonic sensors are used to find the baby's head circumstance. Load cell is used for measuring the baby's weight. Once the baby has placed in an Incubator, the weight of the baby is monitored by load cell. If the weight of the baby is increases or decreases from the baby's normal weight, an alert is sent to doctor immediately so that the doctor can take the necessary precautions.

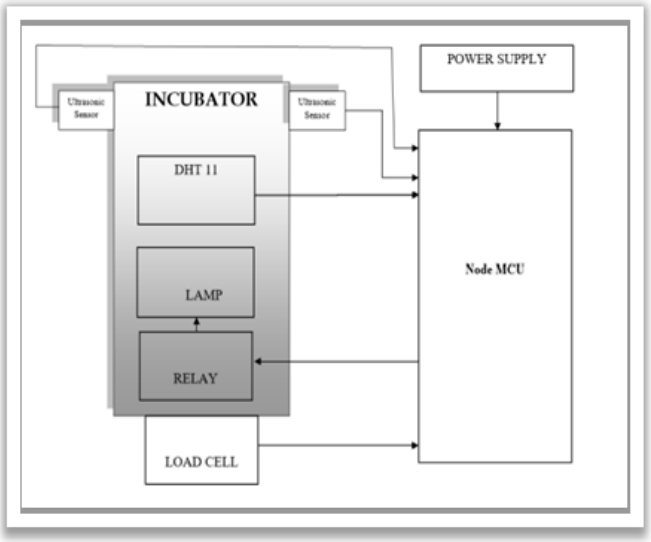

Fig.1. Block diagram of Incubator prototype

The incubator has a certain temperature range to keep the babies warm. In some cases, if the temperature becomes more than normal then the lamp will be turn on to maintain the same temperature. The doctors can monitor the

incubator's parameters remotely by using Ubidots cloud platform. The fig

1. explains the block diagram of incubator prototype.

A. Incubator Section

The prototype setup is designed by acrylic component that keeps infant incubator in warm. The setup will have six holes for necessary care and feeding. There is a mattress to have infant and a tray that hold mattress. The incubator is kept in folded table so it can be portable and also taken in ambulance also.

B. Hardware Section

The electronic component we used here are DHT 11, Load cell, ultrasound sensor, relay system, step down transformer (if portable mode not needed) and anti-intrusion buzzer system.

The Step down Transformer is used to step down the main supply voltage from 230V AC to lower value. This 230 AC voltage cannot be used directly, thus it is stepped down. The step down voltage is consists of 12V.The Transformer consists of primary and secondary coils. To reduce or step down the voltage, the transformer is designed to contain less number of turns in its secondary core. The output from the secondary coil is also AC waveform. Thus the conversion from AC to DC is essential. This conversion is achieved by using the Rectifier Circuit/Unit.

The Rectifier circuit is used to convert the AC voltage into its corresponding DC voltage. Rectifier having three types,

- Half wave rectifier
- Full wave rectifier
- Bridge rectifier

The most important and simple device used in Rectifier circuit is the diode. We used bridge rectifier. A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification.

If portable mode is not required the battery can be used for power sources. The fig 2 shows step down transformer and fig 3 shows bridge rectifier.

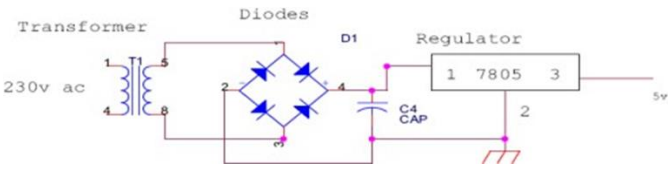

Fig 2. Bridge rectifier

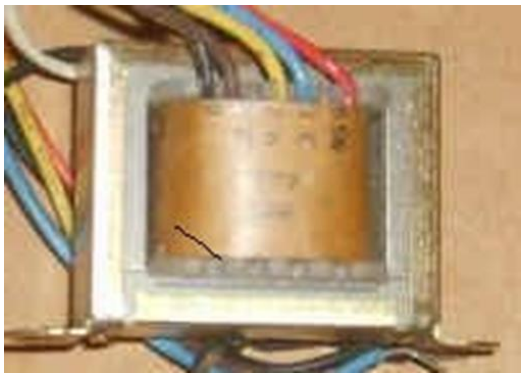

Fig 3. Step down transformer

The simple function of the diode is to conduct when forward biased and not to conduct in reverse bias. The Forward Bias is achieved by connecting the diode's positive with positive of the battery and negative with battery's negative. The efficient circuit used is the Full wave Bridge rectifier circuit. The output voltage of the rectifier is in rippled form, the ripples from the obtained DC voltage are removed using other circuits available. The circuit used for removing the ripples is called Filter circuit.

The simple capacitor filter is the most basic type of power supply filter. The application of the simple capacitor filter is very limited. It is sometimes used

on extremely high-voltage, low-current power supplies for cathode-ray and similar electron tubes, which require very little load current from the supply. The capacitor filter is also used where the power-supply ripple frequency is not critical; this frequency can be relatively high.

Capacitors are used as filter. The ripples from the DC voltage are removed and pure DC voltage is obtained. And also these capacitors are used to reduce the harmonics of the input voltage. The primary action performed by capacitor is charging and discharging. It charges in positive half cycle of the AC voltage and it will discharge in negative half cycle. Here we used 1000μF capacitor. So it allows only AC voltage and does not allow the DC voltage. This filter is fixed before the regulator. Thus the output is free from ripples.

Regulator regulates the output voltage to be always constant. Regulator having two types.

- Positive regulator (78XX)
- Negative regulator (79XX)

The output voltage is maintained irrespective of the fluctuations in the input AC voltage. As and then the AC voltage changes, the DC voltage also changes. Thus to avoid this Regulators are used. Also when the internal resistance of the power supply is greater than 30 ohms, the output gets affected. Thus this can be successfully reduced here. The regulators are mainly classified for low voltage and for high voltage. Here we used 7805 positive regulator. It reduces the 12V dc voltage to 5V dc.

The Filter circuit is often fixed after the Regulator circuit. Capacitor is most often used as filter. The principle of the capacitor is to charge and discharge. It charges during the positive half cycle of the AC voltage and discharges during the negative half cycle. So it allows only AC voltage and does not allow the DC voltage. This filter is fixed after the Regulator circuit to filter any of the possibly found ripples in the output received finally. Here we used 0.1μF capacitor. The output at this stage is 5V and is given to the Microcontroller In the power supply circuit two regulators are used. 7805 regulator is used to produce positive 5V dc. Microcontroller and sensors are operated at 5V dc voltage. The output of the 7805 regulator is connected to NODE MCU.

A Relay shown fig. 4 is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. It was invented by Joseph Henry in 1835. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier.

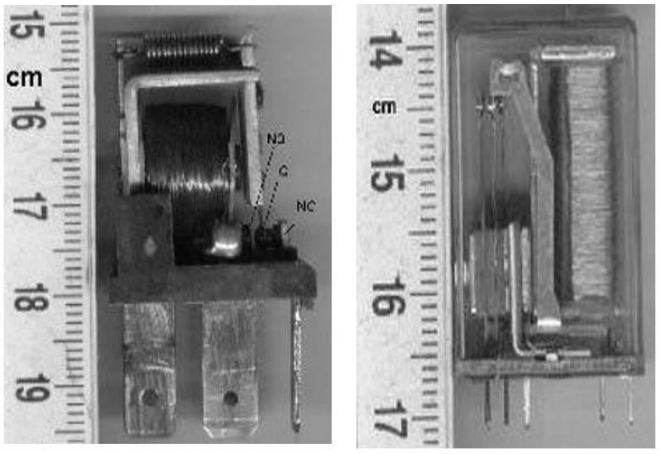

Fig 4. Relay circuit

The ultrasonic sensor used find distance from the object. The ultrasonic receiver is used to receive the reflected wave. Depends upon the distance of the object the received wave strength is varied. The received signal is given to amplifier unit. The amplifier unit is constructed with the operational amplifier which acts as power amplifier. The

received signal wave is in the form of AC wave form so the amplified signal is given to signal conditioning unit. Thus head circumference of a baby is found. The fig.5 shows ultrasound sensor.

Fig 5(a) Ultrasound sensor

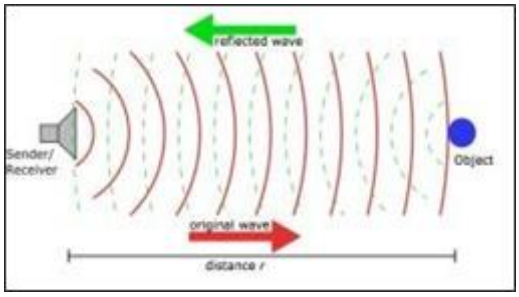

Fig 5(b) Ultrasound transmission

A load cell is a transducer which converts force into a measurable electrical output. Although there are many varieties of force sensors, strain gauge load cells are the most commonly used incubator and baby which is connected with anti-intrusion system.The load cell will be setup with threshold values if there is changes in weight of the incubator there comes the role of anti-intrusion buzzer alarm to notify that there is rodents interference or some issues. The fig 6 shows load cell that is used in this prototype

Fig 6. Load cell

This DHT11 Temperature and Humidity Sensor features a calibrated digital signal output with the temperature and humidity sensor complex. Its technology ensures the high reliability and excellent long-term stability. A high- performance 8-bit microcontroller is connected. This sensor includes a resistive element and a sense of wet NTC temperature measuring devices. It has excellent quality, fast response, anti-interference ability and high cost performance advantages. The table I shown below explain about DHT 11 specifications and fig 7

Table I. DHT 11 specifications

Sensor	DHT 11 (Temperature and humidity sensor)
Operating voltage	3.3 V-5.5 V
Humidity measuring range	20 %-95% (0^0-5^0 C)
Humidity measuring error	+_ 5
Temperature measuring range	0^0-5^0 C
Temperature measuring error	+_2^0 C
Dimensions	29.00 mm *18.00 mm
Fixing hole size	2.00 mm

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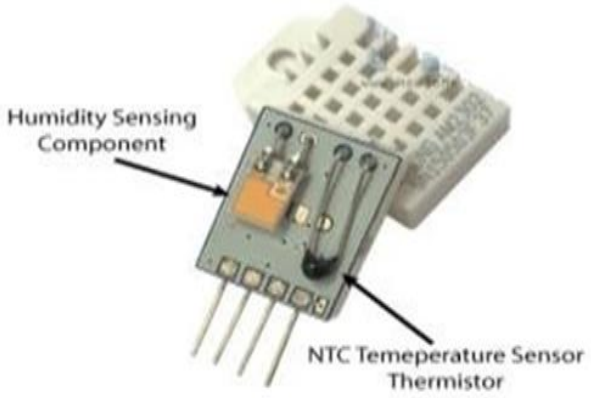

Fig 7. DHT 11 temperature sensor

Fig 8. Node MCU

Fig 9. Proposed model

The output of all parameters will be shown in monitoring sections like PC or mobile phones and these complete setup is controlled by Node MCU 8266 processor shown in fig 8which is a IOT plat form shown in fig. NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi- Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the dev kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson, and spiffs.

This proposed model shown in fig 9 .will avoid much man power and gives accurate care to neonatals.

V. RESULTS AND DISCUSSION

The prototype will provide successful results with good outcomes and avoid death rates in all places. This type of incubator model will also avoid need of more incubator populations and can also be used in primary health cares in rural areas. This setup can also used in homes under the surveillance of physicians and doctors with advanced IOT technology.

VI. CONCLUSION

The result obtained from research data is concluded that in this system each sensor are working properly in accordance with the calibration tool namely ruler, thermometer and multi tester. Based on sensor data obtained at the time of testing, monitoring the Internet-based system is to run well. Based on the experimental results of monitoring, the results of sensor data displayed is the Internet of things cloud platform thinger.io website and look at the monitor serial Arduino software. The device (infant incubator or infant isolette) is to put the ultrasonic sensor on all sides of the box incubator, to measure the head circumference infant and then DHT11 sensors and Load cell sensor to monitoring the weight , temperature of infant and also these prototype can be used as portable (modular) mode that may helpful in urban especially in primary care center of rural areas.

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