SMART IOT BASED INFANT INCUBATOR SYSTEM

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ABSTRACT:- The project proposes the development of a smart infant incubator monitoring and control system that uses IoT technology to customize the care and monitoring of premature and critically ill newborns. As the system is interfaced with advanced sensors, actuators, and connective solutions to create a smart and responsive incubator environment. The system adopts with some key components such as temperature and humidity sensor for precise check of environmental conditions, gas sensor, heartbeat sensor, to monitor the infant's conditions inside the incubator and actuators such as dc fan module is integrated to adjust the environmental conditions according to the threshold range on the processed sensor data. An LCD display provides the local feedback, while buzzer alerts the caretakers at time of critical periods. These sensors collectively provide data for the parameters as a Wi-Fi enabled microcontroller such as Arduino Wi-Fi R3 is utilized to process and transmit data which also communicates with cloud based IoT platforms. IoT application was developed using Thing speak to build an ideal communication through a Wi-Fi module, Healthcare providers can regularly monitor the infant's condition through a designed web or mobile interface. The developed IoT interface provides real-time data acquisition, and the system incorporates automated alert mechanism by integrating a wifi module. In the matter of change in normalities beyond the threshold ranges, an automated alert message will be forwarded to the attentive doctor or caretaker through web server

Keywords: Arduino Wi-Fi R3, GSM, IoT (Thing speak), sensor data acquisition, sensor datacommunication**.**

I. INTRODUCTION:-

According to a recent study, every year more than twenty million babies are born prematurely or with low birth weight - and an estimated 450 of them die each hour. Premature babies are infants who are born before 37 weeks of pregnancy and have low birth weight (less than 2.495 kg) or have any medical condition which needs special attention. They are more sensitive to the environmental conditions The rise in the deaths of premature babies and low weight at birth is non-uniform across India. Moreover, high investments are needed to develop incubators and intensive care units for getting proper infant care. Slight changes in the environment can create immediate effects in them. Even though the incubators play a vital role in the lives of premature babies, it requires instrument-health caregiver interactions due to its environmental and working conditions. Due to the ratio of the number of caregivers to the number of patients not matching i.e., more patients and fewer caregivers, the workload of the instrument-health

caregiver is high, which leads to improper monitoring of the incubators. Neonatal Intensive Care Unit (NICU) gives special medical attention to newborn babies in need. The babies who are admitted to the NICU are mostly premature. The current improvement in technology leads to strengthening of the medical industries and hence the death rate of premature infants is also regulated.

This can be easily prevented by using neonatal incubators for these premature babies. This life supporting machine provides adequate thermal regulation and environmental control for the baby while it uses all the available resources to complete development to attain normal size. The main objective of this paper is to keep their temperature and humidity stable throughout. In addition, in the developing countries there is a substantial proportion of primary and intermediate health facilities than there are in the developed world. All these facilities could be connected to benefit people. The incubator has a certain temperature range and humidity level to keep the babies warm. The required temperature should be surrounded around 36 to 37.5°C. Some of the premature babies in the comfort temperature shows the rectal temperature at around 36°c and the targeted humidity range should be 40%-60%. In some cases, if the temperature and the humidity levels become more than normal then an alert is sent to the doctor or the caretaker immediately, so that the doctor can take the necessary precautions. Information technology (IT) field is developing more in the instance of sensors, nanotechnology, and bio- industries. The designed device hardware module is composed of three main parts: 1. Microcontroller, 2. Information acquisition submodule, 3. Electronic communication submodule. This research is motivated by the fact that there exists an urgent need to give health professionals a simple toolkit for real-time assessment and management of an infant's environment in incubator. The combination of a sound sensor, heart rate monitor, MQ2 sensor, DHT 11 sensor, RFID reader module, LCD, humidifier, Wifi unit is at the center of our new system.

In this paper, we focus on the origins of neonatal care highlighting the importance of IoT in improving accuracy and responsiveness rate incubator systems. Each facing sensor and module is investigated based on the systematic integration showing essential details of design and development process. The research includes stringent tests, analysis and comparison with other conventional systems that will enable the understating of the practical features of our Smart Infant Incubator System.

II. LITERATURE SURVEY: -

[1] Rasha M. Abd El-Aziz et al proposed a" Real Time Monitoring And Control Of Neonatal Incubator Using IoT" , proposed system consists of an Arduino UNO microcontroller, which is to be connected directly to the incubator and the Temperature and Humidity sensor (DHT11) for sensing the temperature and the humidity in the surroundings of the neonate, the Pulse rate sensor is developed to notify the pulse rate of the infant and the Gas Sensor is deployed to sense the any gas leakage and the Light sensor is used to capture any extra light emitted, if there is any gas leakage inside the incubator and if the value of light and gas exceeds the optimum range then the system alerts the caretaker

regarding this through IoT.

[2] Enilson J. L. Costa et al developed a "Humidity Control System in Newborn Incubator," in this system they used a humidity controller works on the microcontroller and stepper motor, the device was inserted in the water reservoir of the infant incubator for the purpose to control the humidity. The step motor obtains a sign from microcontroller and start proceeding step of 30 degrees accelerating the windows of the humidity reservoir of arranged to his axle, whenever the parameter value of the humidity is exceeded then pre- engaged with maintaining it inside the bounds of comfort zone in the standard. The total data will be represented in the lcd display.

[3] Ashish. B et.al "Temperature Monitored IoT Based Smart Incubator," in this paper they proposed 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. Ifit 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. The. The HTML pages are coded to the microcontroller displays the continuous readings of the temperature and automated alerts were sent to the doctor if the temperature exceeds above the threshold ranges. Make the process easier an app was created to switch on / off the heater, or any other device connected to the raspberry pi. It was designed in a manner to receive alerts in case of emergency. And hence the doctor / nurse can take the necessary action.

III. METHODOLOGY: -

This section explains the integration of machine learning, neural networks, and IoT technologies used in our system. We discuss how these components work together to collect, process, and analyze data for smart monitoring and controlling of infant incubator using the enhanced IoT technology.

The Smart IoT-Based Infant Incubator System aims to develop an advanced incubator that integrates temperature sensors, gas sensors, and pulse oximeters to ensure optimal conditions for neonatal care. The system architecture includes these sensors, a microcontroller, a Wi-Fi module for IoT connectivity, cooling elements, an LCD display, and an alarm system. The development process involves identifying requirements, selecting and integrating sensors, designing hardware, and developing firmware and user interfaces. Implementation includes sensor calibration, system integration, and prototype development. Rigorous testing and validation ensure the system's functionality, robustness, and compliance with safety standards. Deployment involves refining the prototype, training users, and conducting a pilot deployment. Maintenance and support entail regular updates and technical assistance. The system concludes with a summary of achievements and potential future enhancements, supported by references to relevant datasheets and research.

IV: SYSTEM MODEL: -

This gives out an extensive solution for monitoring and controlling of infant incubators using the enhanced IoT technology. The proposed system is integrated with various sensors and actuators, sensors including sound, heartrate, gas, temperature, and humidity (DHT11) and accelerometer to monitor the necessary parameters and environmental conditions within the bounds of incubator. The system is incorporated with actuators such as RFID reader module for accurate temperature and a humidifier to maintain optimum humidity levels. If the temperature exceeds more than 36°C -37.2°Cand humidity of 60% then the microcontroller turns the RFID reader and humidifier accordingly. Aside alerts are generated through a buzzer and Wifimodule (800L) at the time of any deviations from thresholds or critical events, it allows healthcare providers to receive real-time updates on the infant status. Data collected from the sensors are transmitted to cloud based IoT platform Thing Speak where it allows remote analysis and the condition of the infant. It is also embedded with an LCD display where the sensed values are displayed. The idea developed to maintain the regularly of temperature, humidity and to monitor the baby.

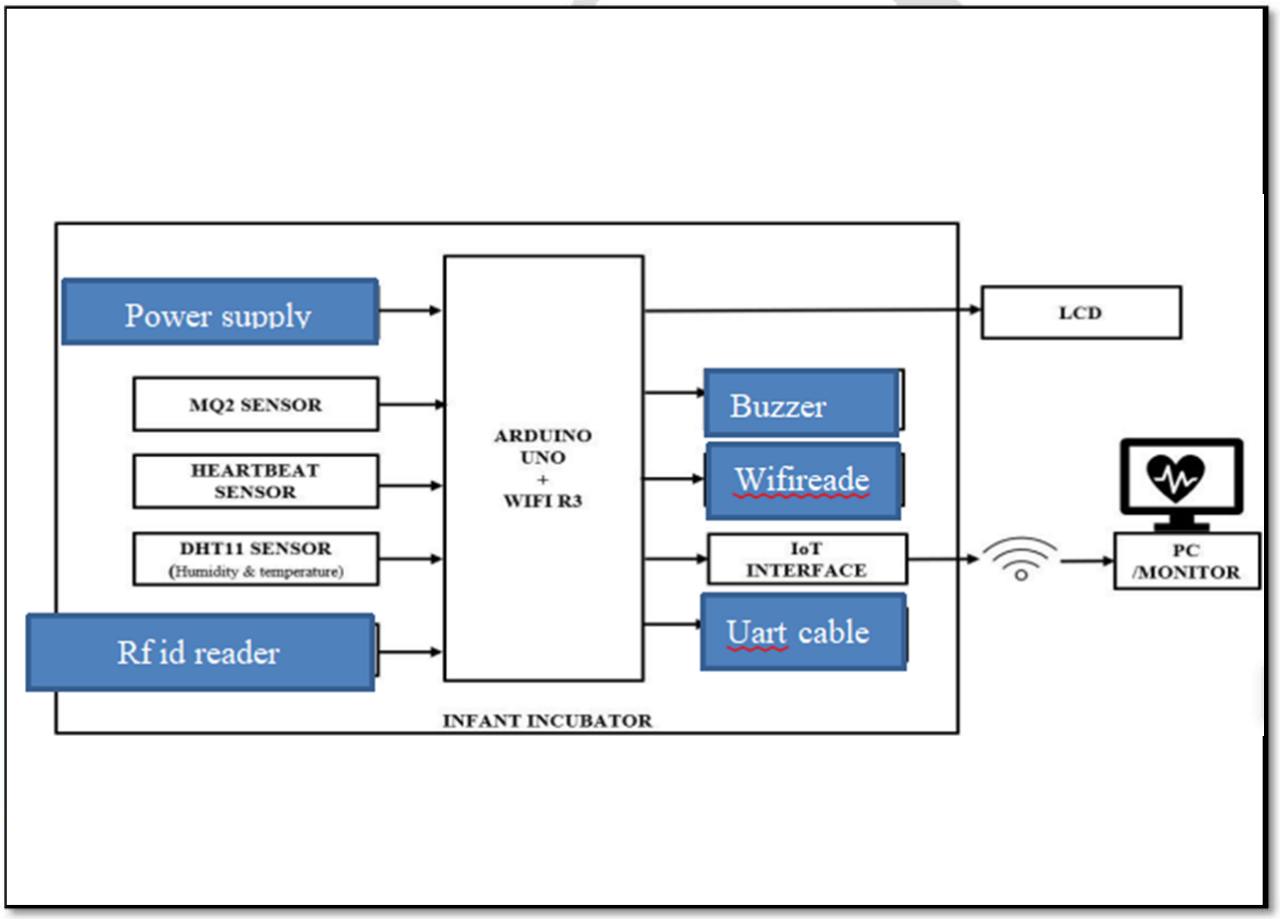


Figure: -1 Block Diagram

V: FLOW CHART:

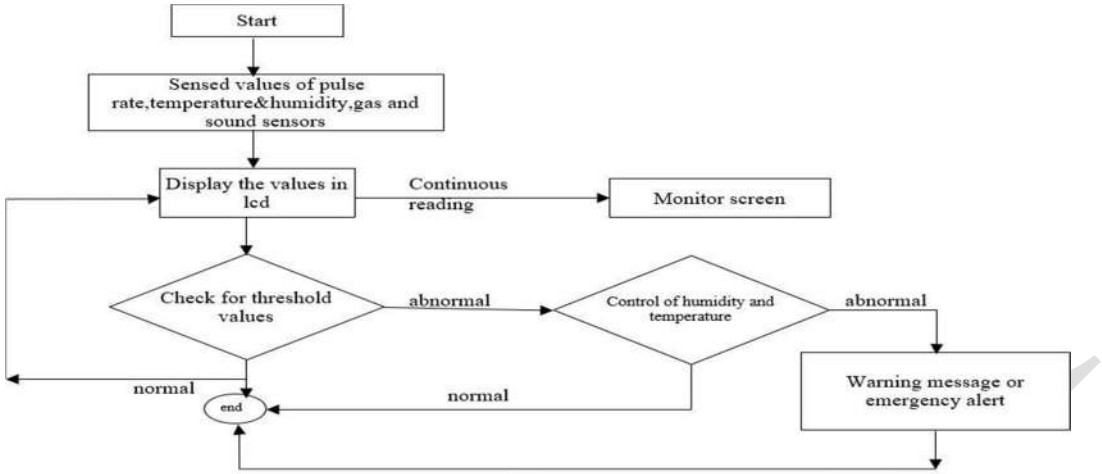


Figure: -2 Flow Chart

The proposed system is an integration of several sensors and microcontroller such as,

Fig 3: - NODE MCU

Node MCU is a versatile open-source development board based on the ESP8266 WiFi module, with a built-in USB-to-serial converter and Lua scripting language support. It offers an easy-to-use platform for IoT (Internet of Things) projects, enabling rapid prototyping and development of connected devices. With its onboard WiFi capability, GPIO pins, and a wide range of community-supported libraries, Node MCU empowers developers to create innovative solutions for home automation, sensor networks, and more. Its compact size, affordability, and rich feature set make it a popular choice among hobbyists and professionals alike for building smart, interconnected systems**.** In our project it is used for sending sensors data on a web based server i.e adafruit all sensors data like temperature humidity and growth i.e height of the plant is sent on server, nodemcu also used for collecting sensors data and displaying on lcd

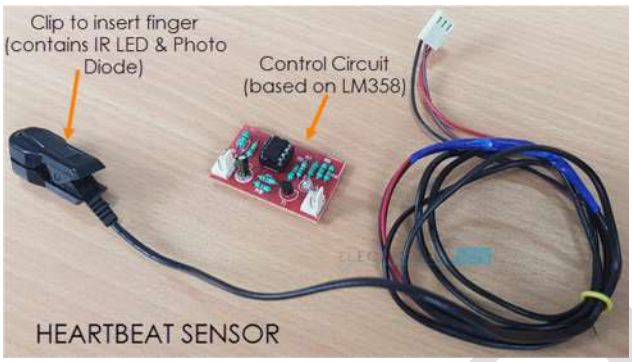


Fig 4:- HEART SENSOR

Heartbeat Sensor is an electronic device that is used to measure the heart rate i.e. speed of the heartbeat. Monitoring body temperature, heart rate and blood pressure are the basic things that we do in order to keep us healthy. In order to measure the body temperature, we use thermometers and a sphygmomanometer to monitor the Arterial Pressure or Blood Pressure. Heart Rate can be monitored in two ways: one way is to manually check the pulse either at wrists or neck and the other way is to use a Heartbeat Sensor.

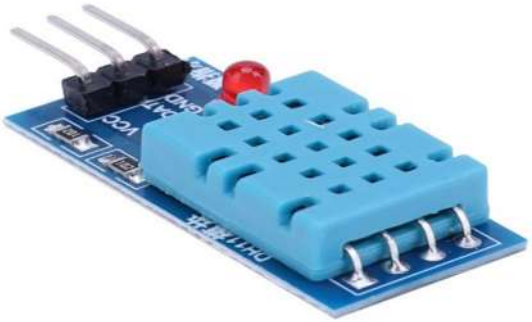


Fig 5 :- HUMIDITY SENSOR

A humidity sensor, also known as a hygrometer, measures the amount of water vapor in the air. These sensors are essential in various applications, including weather forecasting, HVAC systems, and manufacturing processes where moisture levels are critical. They come in different types, such as capacitive, resistive, and thermal, each utilizing distinct principles to detect and measure humidity. Capacitive sensors, for instance, measure changes in electrical capacitance due to humidity levels, offering high accuracy and stability.

Fig 6:- GAS SENSOR

A gas sensor, or gas detector, is a device that identifies the presence or concentration of gases in an environment, crucial for applications in industrial safety, environmental monitoring, medical diagnostics, and home safety. These sensors, which include types like electrochemical, infrared, semiconductor, photoionization, and catalytic bead, operate on principles such as chemical reactions, light absorption, conductivity changes, ionization, and oxidation. Key features include sensitivity, selectivity, response time, range, and durability, enabling them to detect gases like carbon monoxide, methane, and volatile organic compounds, thereby ensuring safety and health in various settings.

Fig 7:- RFID

RFID is a tracking technology used to identify and authenticate tags that are applied to any product, individual or animal. Radio frequency Identification and Detection is a general term used for technologies that make use of radio waves in order to identify objects and people Purpose of Radio frequency Identification and Detection system is to facilitate data transmission through the portable device known as tag that is read with the help of RFID reader; and process it as per the needs of an application. Information transmitted with the help of tag offers location or identification along with other specifics of product tagged – purchase date, color, and price. Typical RFID tag includes microchip with radio antenna, mounted on substrate. The RFID tags are configured to respond and receive signals from an RFID transceiver. This allows tags to be read from a distance, unlike other forms of authentication

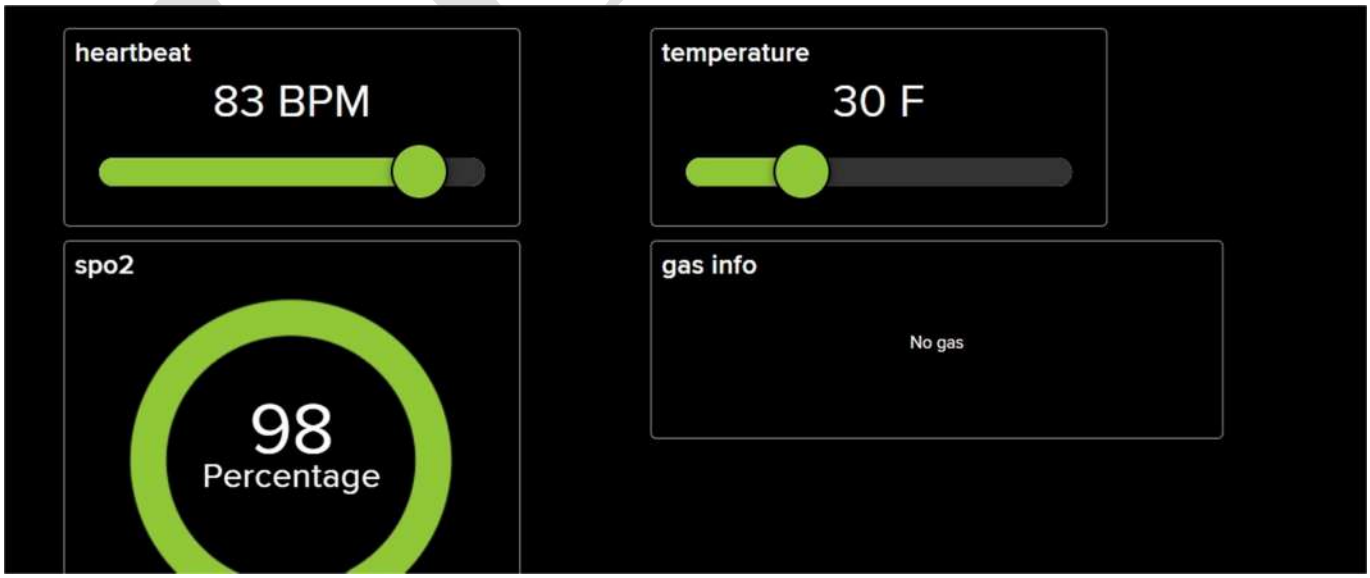
technology. The RFID system has gained wide acceptance in businesses, and is gradually replacing the barcode system

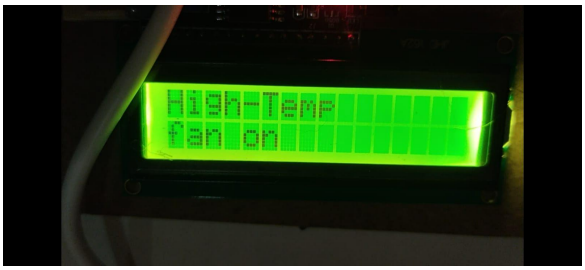
Fig8:- I2c LCD Display

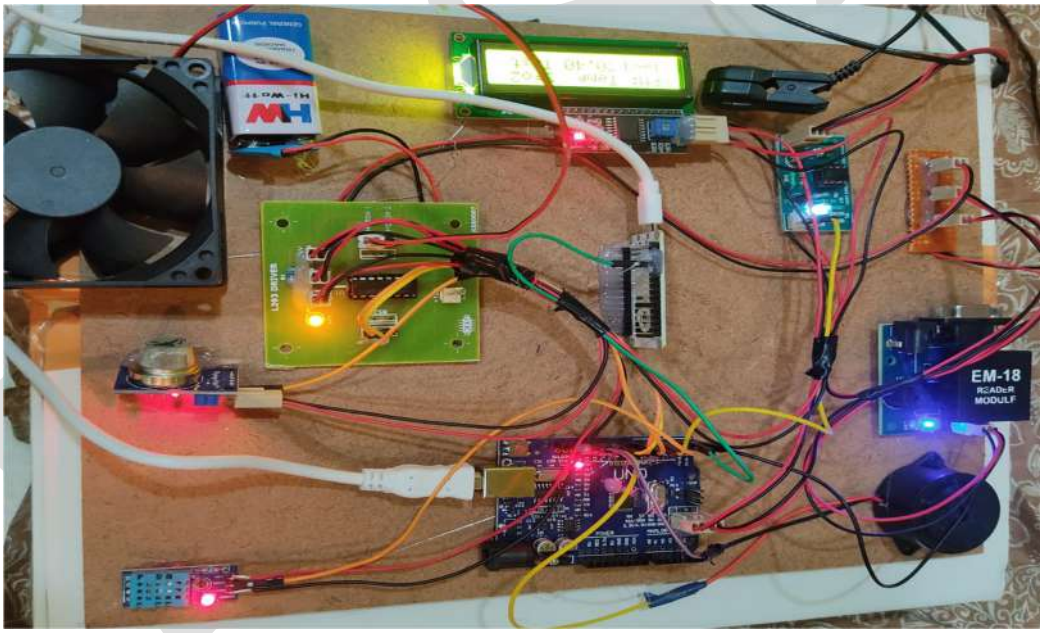
I2c lcd is used for monitoring sensors data, its connected with i2c module to make it less pins for easy interface with node MCU controller. this ld have two rows and sixteen columns.it displays different numbers and characters. From the sensors.

An LCD (Liquid Crystal Display) screen is a flat-panel display technology commonly used in TVs, computer monitors, and mobile devices. LCD screens work by manipulating liquid crystals with electric currents to block or allow light through specific areas, creating images. These screens Fig-6 eral advantages, including thin form factors, energy efficiency, and sharp image quality with accurate color reproduction. However, they can suffer from issues like limited viewing angles and slower response times compared to other technologies like OLED. LCDs come in various types, including TN, IPS, and VA, each with distinct characteristics suited for different applications.

RESULT: -







Overall hardware

CONCLUSION

There were many deaths caused due irregularity in monitoring and maintaining of the infant incubator as it became major issue in health care system. To overcome this situation the development and implementation of the Smart Infant Incubator Monitoring and Control System describes a significant advancement in neonatal care, using IoT technology. As it regularly monitors the vital parameters and maintains the optimal environmental conditions and timely provides alerts to health care providers to initiate immediate action. The system contributes to reduce the risk of

complications and enhances the overall health of the infant. The timely status of the infant is observed through IoT deployed web interface. It provides an improved quality of care for infants.

FUTURE SCOPE: -

The system developed for the well-being of the infant's life, it can create a foundation for further advancements such as integration of AI, live monitoring of baby through cam and expansion of sensor capabilities such as oxygen level monitoring, respiratory rates. This further integration improves the efficiency and accessibility of neonatal care through IoT enabled solutions.

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