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## Microcontroller Based Baby Incubator Using Sensors

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**ABSTRACT:** There are four million babies worldwide who die in the first month of life, one million die on their first day. Preterm birth is attributed, either directly or indirectly, to at least 25% of neonatal deaths, and low birth weight (LBW) new-borns are at the greatest risk. About half of the worldwide total, or 1.8 million babies each year, die for lack of a consistent heat until they have the body fat and metabolic rate to stay warm. This paper helps to prevent the death of such babies. The microcontroller based baby incubator helps to all peoples, the cost this project is very less than today's baby incubator which are used in big hospital. So, everyone which belongs to economical backward also use of it. This project not only used for monitoring and controlling the temperature but also provide number of advantages such as controlling humidity, monitoring pressure etc.

**KEYWORDS:** Microcontroller, Baby Incubator

### I. INTRODUCTION

There are four million babies worldwide who die in the first month of life, one million die on their first day. Preterm birth is attributed, either directly or indirectly, to at least 25% of neonatal deaths, and low birth weight (LBW) new-borns are at the greatest risk. About half of the worldwide total, or 1.8 million babies each year, die for lack of a consistent heat until they have the body fat and metabolic rate to stay warm. This paper helps to prevent the death of such babies. The microcontroller based baby incubator helps to all peoples, the cost this project is very less than today's baby incubator which are used in big hospital. So, everyone which belongs to economical backward also use of it. This project not only used for monitoring and controlling the temperature but also provide number of advantages such as controlling humidity, pressure etc. Incubators are attracting interest from the medical profession. They are glass and metal cases heated to certain Humidity, into which enough air is admitted to maintain life. Until such time as infant is strong enough for Humidity of room. In baby incubator Humidity control is very important. And therefore we are controlling the Humidity according to our requirements. Humidity controller can be done by using Electronic circuit, Microprocessor & microcontroller. Now microcontroller is advanced among all above circuits therefore we are using Microcontroller for Humidity controlling of baby incubator. This project presents an Adaptive decoupling temperature and humidity control for neonatal incubator process by exploiting an active humidification system. The neonatal incubator is a Two-Input Two-Output process (TITO). The coupling problem is treated by the weight adjustment of the output error. In addition, an Adaptive Decoupling strategy based on Generalized Predictive Control (ADGPC) with Multivariable Recursive Extended Least-Squares (MVRELS) parameters estimator is used.

#### 1.1 PREMATURE BABY

Preterm birth are also known as premature birth, is the birth of the baby at least 37 weeks gestational age. These babies are also known as preemies. Premature infants are at greater risk for delays in development, hearing problems and problems seeing. These risks are seeing only in the earlier a baby is born. Preterm birth is the most common cause of death among infants worldwide. About 15 million babies are preterm each year. I many countries rates of premature

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birth have increased between 1990s and 2015s. Complications from preterm births resulted in 0.74 million deaths in 2013 down from 1.57 million in 1990.

## 1.2 NEONATAL INTENSIVE CARE UNIT

Neonatal intensive care unit is known as intensive care nursery especially in the care of premature or ill newborn infants. Newborn babies who need intensive medical attention are often admitted into a special area of the hospital called the neonatal intensive care unit. The NICU combines advanced technology and trained health care professionals to provide specialized care for the tiniest patients.

## II. EXISTING SYSTEM

The incubator process is used to produce healthful micro-environment in order to reduce new born heat loss by controlling temperature inside incubator. Temperature is one of the most important factors that need to be maintained with a minimum variation. But only temperature control is not sufficient to provide comfortable environment. Also, the relative humidity control is very important to reduce the new born heat loss. In existing system temperature only been monitored.

## III. PROPOSED SYSTEM

Single chip microcontroller, incubator monitoring system that can be integrated with existing incubator monitoring system. The system consists of temperature sensor, humidity sensor, respiration sensor. Temperature sensor is sensing the data from the incubator. Humidity sensor is sensing the data from the incubator. Respiration sensor is sensing the data from the baby. The single chip microcontroller reads and frames the surrounding temperature, humidity, respiration along with the sensor. All the values are display on LCD. Single chip microcontroller can analysing all the three sensor data and the any variation will be occurred on that alert will be send to parents automatically.

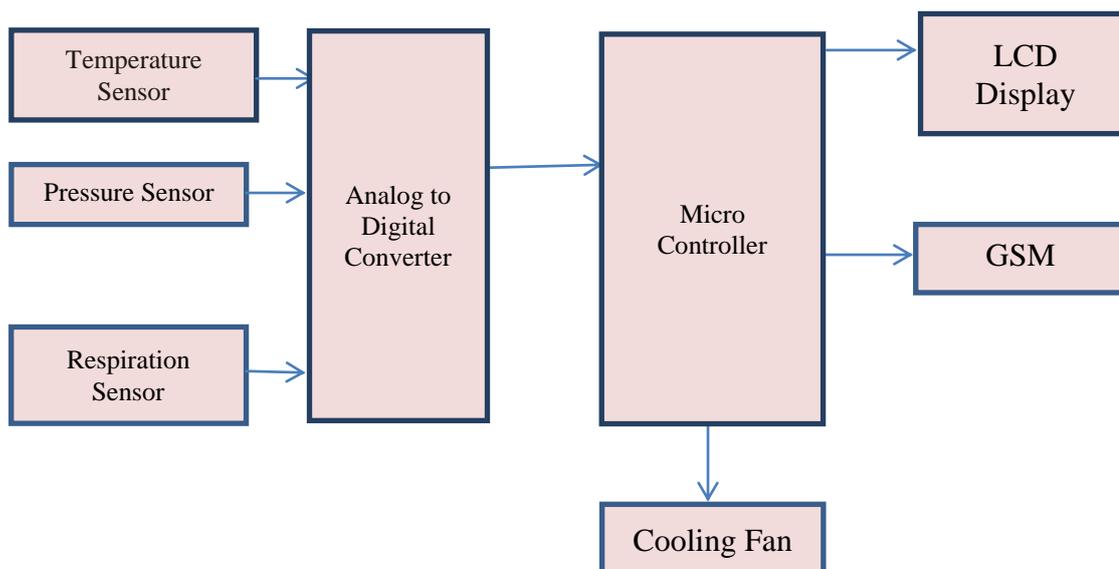


Fig.1. Architecture Diagram

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### IV. RELATED WORK

In this paper various sensors and then various components are used such as temperature sensor, pressure sensor, humidity sensor, LCD, cooling fan, 4 relay boards, SIM SMS MODEM to monitoring the baby incubators.

#### 4.1 TEMPERATURE SENSOR

The measurement of temperature is one of the fundamental requirements for environmental control, as well as certain chemical, electrical and mechanical controls. Many different types of temperature sensors are commercially available, and the type of temperature sensor that will be used in any particular application will depend on several factors. For example, cost, space constraints, durability, and accuracy of the temperature sensor are all considerations that typically need to be taken into account. Various types of temperature sensors are known including liquid-in-glass (LIG) thermometers, bimetallic thermometers, resistance thermometers, thermocouples, and radiometers. Depending upon the temperature to be measured, the required accuracy of the measurement, and other factors such as durability or cost, one type of temperature sensor may be preferable over another. Some temperature sensors provide a wide range of temperature measurement, whereas other temperature sensors may only provide temperature information for a small temperature range. In addition to the temperature range sensed, the sensitivity and the accuracy of temperature sensors may also vary widely. Additionally, some temperature sensors work at high voltages while others only work at low voltages.

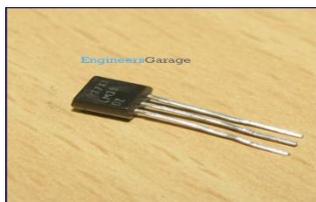


Fig.2. Temperature Sensor

There're many types of devices that can be employed as temperature sensors. They include integrated circuits (ICs), pyrometers, resistance temperature detectors (RTDs), thermistors, thermocouples, electromechanical & volume (EMV). LM35 is a precision IC temperature sensor with its output proportional to the temperature (in °C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possess low self-heating and does not cause more than 0.1 °C temperature rise in still air. The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every °C rise/fall in ambient temperature, *i.e.*, its scale factor is 0.01V/°C.

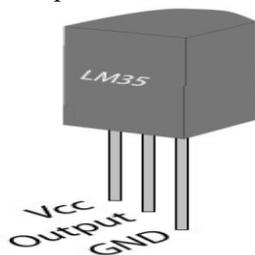


Fig.3. Temperature Sensor Circuit Diagram

Temperature sensors are frequently provided in integrated circuits to detect when the operating temperature limits have been exceeded. Typical integrated circuit (IC) solutions for sensing temperature change use a semiconductor temperature sensor manufactured, entirely on the IC. Such ICs include transistors, bolometers and pyroelectrics. The integrated circuit sensor typically employs an integrated diode whose output characteristics are dependent upon temperature. The semiconductor temperature sensor can be a forward-biased pn junction diode or variations thereof as is known in the art, such as a diode connected npn or pnp bipolar transistor. Bolometers incorporating temperature

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sensors are well known devices for measuring radiation, and in these devices the temperature sensors are arranged to have temperatures dependent on the flux of incident radiation. Different types of bolometer are used for measuring different types of radiation in various environments; in fusion experiments, for example, bolometers are used to measure quantitatively the radiation and neutral particle emission from the plasma. The resistance temperature detector (RTD) takes advantage of the principal that the resistivity of metals is, to a small degree, dependent upon temperature. Two temperature sensors are used for the premature infant and for the Incubator. The type of temperature sensor we are using here is LM35. The specifications of temperature sensor are coded such that if the sensor detects that the temperature is 34°Celsius or greater, the fan will get switched on automatically, in order to reduce the temperature to an optimum of 22-27°Celsius. Likewise, if the sensor detects that the temperature has reduced to 20°Celsius or less, the heater will automatically get switched on (which, in our case, is a bulb) to increase the temperature up to the desired value. As can be seen, the LM34 and LM35 are easy-to-use temperature sensors with excellent linearity. These sensors can be used with minimal external circuitry for a wide variety of applications and do not require any elaborate scaling schemes nor offset voltage subtraction to reproduce the Fahrenheit and Celsius temperature scales respectively.

## 4.2 PRESSURE SENSOR

A pressure sensor measures pressure, typically of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical. Pressure sensors are used for control and monitoring in thousands of everyday applications. Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude. Pressure sensors can alternatively be called pressure transducers, pressure transmitters, pressure senders, pressure indicators, piezometers and manometers, among other names. There is also a category of pressure sensors that are designed to measure in a dynamic mode for capturing very high speed changes in pressure. Example applications for these types of sensor would be in the measuring of combustion pressure in an engine cylinder or in a gas turbine. These sensors are commonly manufactured out of piezoelectric materials such as quartz. Some pressure sensor, such as those found in some traffic enforcement cameras, function in a binary (off/on) manner, i.e., when pressure is applied to a. The MPXx5050 series piezoresistive transducer is a state-of-the-art monolithic silicon pressure sensor designed for a wide range of application but particularly silicon pressure sensor designed for a wide range of applications but particularly those employing a microcontroller or microprocessor with A/D inputs. This patented, single element transducer combines advanced micromachining techniques, thin-film metallization, and bipolar processing to accurate, high level analog output signal that is proportional to the applied pressure.

### 4.2.1 FEATURES

There are various features involved in Pressure sensor. Such as

- 2.5% maximum error over 0 degree to 85 degree
- Ideally suited for microprocessor or microcontroller based system
- Temperature compensated over -40 degree to +125 degree
- Patented silicon shear stress strain gauge
- Durable epoxy unitary element
- Easy to use chip carrier option

## 4.3 HUMIDITY SENSOR

Humidity is the amount of water vapor in the air. Water vapor is the gaseous state of water and is invisible. Humidity indicates the likelihood dew or fog. Higher humidity reduces the effectiveness of sweating in cooling the body of

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reducing the rate of evaporation of moisture from the skin. This effect is calculated in a heat index table or humidex. There are three main measurement of humidity: absolute, relative and specific. Absolute humidity is the water content of air at a given temperature expressed in gram per cubic meter. Relative humidity, expressed as a percent, measure the current absolute humidity relative to the maximum (highest point) for the temperature. Specific humidity is a ratio of the water vapor content of the mixture to the total air content on a mass basis.

## 4.4 SIM GSM MODEM

The GSM modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Advantages of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. Applications like SMS control, data transfer, remote control and logging can be developed easily. The modem can either be connected to pc serial port directly or to any microcontroller through MAX232. It can be used to send and receive SMS or make/receive voice calls. It can also be used in GPRS mode to connect to internet and do many applications for data logging and control. In GPRS mode you can also connect to any remote FTP server and upload files for data logging.

### 4.4.1 APPLICATION

Various applications involved using SIM SMS MODERM

- SMS based remote control and alerts
- Security application
- Sensor monitoring
- GPRS mode remote data logging

### 4.4.2 FEATURES

SIM SMS MODEM features are

- Status of modem indicated by LED
- Simple to use and low cost
- On board switching type power supply regulator
- RS232 output

## 4.5 4 RELAY BOARD

This is an easy to use 4 channel relay board that works on 12V. Use it to control four 240V power appliances directly from microcontroller or low voltage circuits. Perfect for switching 240V appliances-lights, fans and etc. and even high power motors at lower voltages. The board uses high quality relays, which can handle a maximum of 7A/240V AC or 7A/24V DC. Each relay has all three connections-common, normally closed brought out to 3 pin screw terminals which makes it easy to make and remove connections. The board has a power indication and a relay status LED to ease debugging. The board can accept inputs within a wide range of voltages from 4v 10 12v. Powers input and relay control signal are brought to header pins on the board. Hence, the board can be easily interfacing with our development boards using our female to female jumper wires. The power input for this board can also provide through the on-board DC barrel jack. Hence, our SMPS type power adapters can also be used to directly power this board.

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### 4.6 MICROCONTROLLER – PIC 16F877A

PIC 16F877 is one of the most advanced microcontroller from Microchip. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability. It is ideal for applications such as machine control applications, measurement devices, study purpose, and so on. The PIC16F877A is a microcontroller in the PIC family of controllers produced by Microchip Technology. The PIC16F877A CMOS FLASH-based 8-bit microcontroller is upward compatible with the PIC16C5x, PIC12Cxxx and PIC16C7x devices. It features 200 ns instruction execution, 256 bytes of EEPROM data memory, self-programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 2-wire I2C bus, a USART, and a Parallel Slave Port.

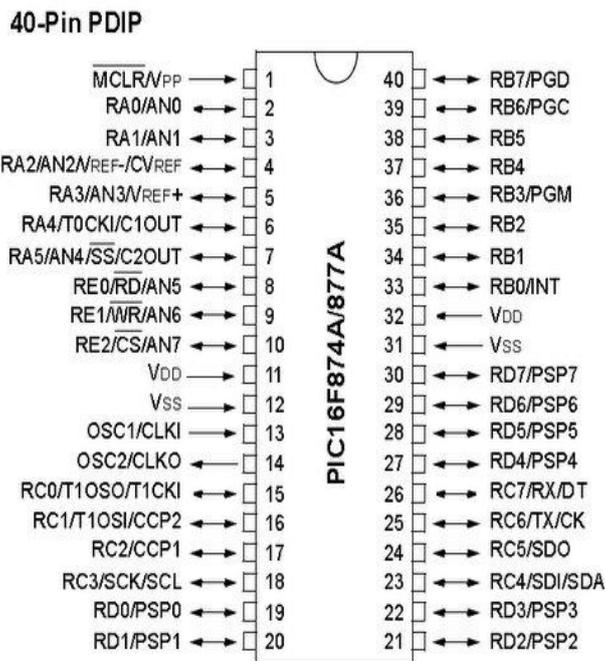


Fig.4. Microcontroller Chip

### 4.7 12V COOLING FANS

Cooling fans are essential to systems that produce a significant amount of heat like computers and other electronic components. Different systems are engineered to work with specific types of fans. Cooling fans come in all shapes and sizes as well as voltages, airflow and case size. Some are even weather resistant and can stand up against the elements. It's important to know the specific type of fan your CPU/ electronic component requires as fans and blowers are not universal. Be sure to reference the fan part number before you buy a replacement. Installing the wrong fan type can cause more harm to your computer/system. The fan is used to decrease the temperature if it has exceeded the specified value and brings it down to the normal value, hence protecting the baby. A relay circuit is used for the switching the voltage from 5V to 12V, which is the Voltage required to run the Fan.

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## V. IMPLEMENTATION

The given circuit diagram shows interfacing between all components of this project. Here microcontroller is used to control all operations of the baby incubator. There are many functions are involved such as cooling, heating, pulse rating, display all readings, etc.

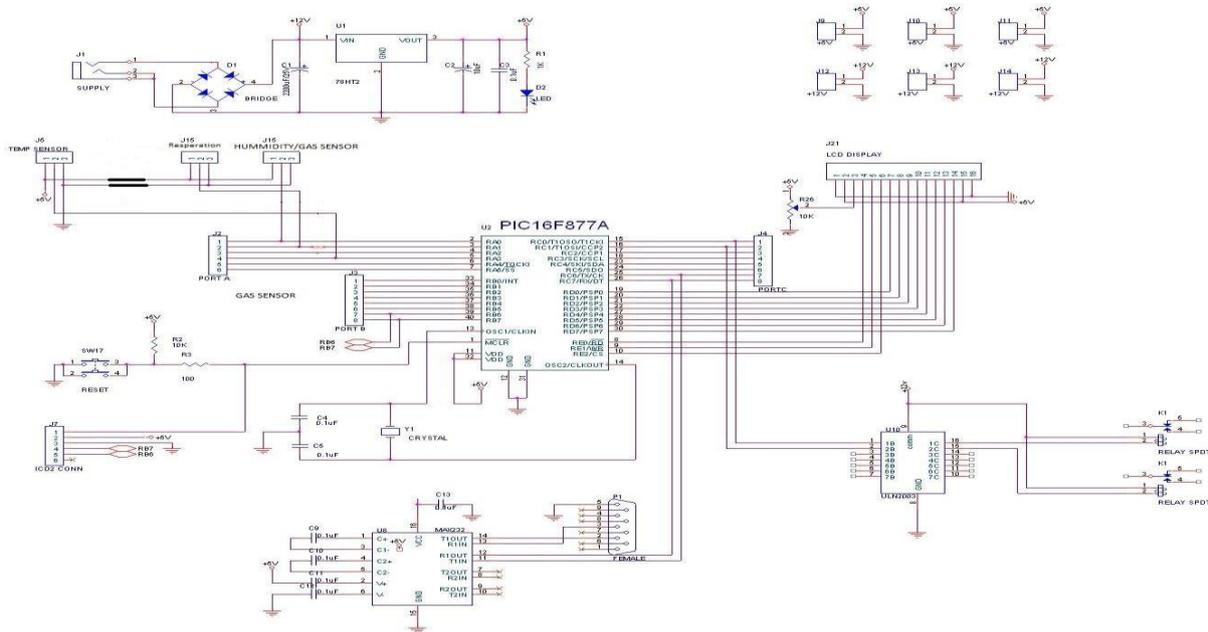


Fig.5. Circuit Diagram

## VI. RESULT

Figure show the result of microcontroller based premature baby incubator. Using the component like temperature sensor, pressure sensor, humidity sensor, gsm sim modem, cooling fan etc.,



Fig.6. Pic Kit 3

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## VII. CONCLUSION

The project is designed keeping in mind the medical conditions available in rural areas. This Equipment can be effectively used by technicians in a small health care centre. It can be a lifesaving machine for low birth weight infants. The components can be easily fixed. The chamber is sufficient enough to accommodate the baby comfortably. As the electronic part is separated from the Baby's compartment baby can be assured safe. The temperature of the system can be understood. This project is simple and efficient in maintaining the temperature of the chamber irrespective of the outside temperature and is designed at a low cost.

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