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DEPARTMENT OF ELECTONICS AND INSTRUMENTATION ENGINEERING

MINI PROJECT(UEI655P) REPORT ON

"DIGITAL TEMPERATURE INDICATOR AND AUTOMATIC CONTROLLER"

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Certificate

This is to certify that the Mini-Project Work (UEI655P) entitled "**DIGITAL TEMPERATURE INDICATOR AND AUTOMATIC CONTROLLER**" is a bona fide work carried out by

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The report has been approved as it satisfies the academic requirements of VI Semester B.E. (E&IE) in respect of mini-project work prescribe for the course.

Bagalkote

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ABSTRACT

This project proposes the implementation of a digital temperature indicator and automatic controller system to enhance the accuracy, reliability, and efficiency of temperature regulation in baby incubators. The system will utilize advanced sensors and microcontroller technology to monitor and control the temperature inside the incubator. The digital temperature indicator will provide real-time temperature readings, allowing medical professionals to easily monitor and adjust the incubator's temperature. It will feature a user-friendly interface with a clear display, enabling healthcare providers to quickly identify any deviations from the desired temperature range. The automatic controller will utilize feedback from the temperature sensors to maintain a consistent and stable environment within the incubator. It will employ a closed-loop control mechanism, continuously comparing the measured temperature with the desired setpoint and adjusting the heating or cooling mechanisms accordingly. This automatic control system will minimize manual interventions, reduce human error, and optimize temperature control, providing a safer and more comfortable environment for the infants.

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Chapter 1:

INTRODUCTION

1.1 Background

A baby incubator, also known as an infant incubator, is a medical device designed to provide a controlled environment for newborn infants, especially premature or ill babies, in order to promote their growth and development. The primary purpose of a baby incubator is to create a stable and regulated environment that mimics the conditions inside a mother's womb. Baby incubators maintain a constant temperature, usually between 32°C to 37°C, to keep the baby warm. Premature infants have difficulty regulating their body temperature, so maintaining a consistent and appropriate temperature is crucial for their well-being.

1.2 Introduction

The use of baby incubators has become a vital aspect of neonatal care, providing a controlled environment for premature or ill infants to thrive outside the womb. One critical element in the successful functioning of a baby incubator is precise temperature control. A digital temperature indicator and automatic controller play a crucial role in maintaining a stable and safe environment inside a baby incubator. These components ensure that the temperature inside the incubator remains within a specific range, providing the optimal conditions for the newborn's growth and development. The digital temperature indicator is a device that measures the temperature inside the incubator and displays it in a digital format. It typically consists of a temperature sensor, a microcontroller, and a display unit. The temperature sensor detects the ambient temperature within the incubator and sends the information to the microcontroller. The microcontroller processes the data and converts it into a digital format for display on the screen.

Fig 1. Baby Incubator

The automatic controller is another essential component in a baby incubator. Its purpose is to regulate the temperature inside the incubator and maintain it at a predetermined setpoint. The controller continuously compares the measured temperature from the temperature sensor with the desired temperature and adjusts the incubator's heating mechanisms accordingly. The automatic controller usually employs a feedback control system. It receives input from the temperature sensor and compares it to the setpoint temperature. Based on this comparison, the controller activates the appropriate heating elements to maintain the desired temperature. The controller also in corporate a proportional-integral-derivative (PID) algorithm to enhance its performance and response time.

1.2.1 Applications

Digital temperature indicator and automatic controller has wide range of applications in following sectors:

- ❖ Baby Incubators: Baby incubators can be employed with this model as it provides constant temperature which is a very important parameter for the growth of the baby inside the chamber.
- ❖ Microwave Oven: Temperature controllers are also used in ovens. When a temperature is set for an oven, a controller monitors the actual temperature inside of the oven.
- ❖ Green House Monitoring: Another important domain which can be implemented with this system is green-house monitoring system, as, temperature controls the rate of plant development and thus, crop timing.

1.3 Problem statement

"Design and implementation of digital temperature indicator and automatic controller using microcontroller."

Many industrial sectors like chemical, biological and food processing sectors need constant temperature for their use. So, maintaining a system at a constant range of temperature is needed there.

Motivation

Digital temperature indicators offer high accuracy and precision in temperature measurement compared to analog devices. They can provide temperature readings with greater resolution and reliability, allowing for better control of temperature-sensitive processes. They typically feature clear and easy-to-read displays, making it simple for users to monitor and interpret temperature readings. They provide real-time temperature monitoring, enabling users to continuously track temperature variations.

1.4 Objectives

- ✓ To design and implement an automated temperature control system using microcontroller
- ✓ To maintain a system at a constant temperature
- ✓ To study about sensors characteristics
- ✓ To study about Arduino programming
- ✓ To study about hardware interfacing with Arduino
- ✓ To build team work spirit
- ✓ To document the work in the form of report

1.5 Organizing of Report

- Chapter 2 deals with the literature survey of Smart wheel chair which describes hardware components and techniques used to develop the project
- Chapter 3 explains the block diagram and methodology of implementation where the various stages of the project are listed
- Chapter 4 provides the brief explanation of hardware components used to build the circuit and in software design the sequence of operation of Smart wheel chair is discussed
- Chapter 5 describes the results and pictorial representation of interconnection of various components and prototype of the wheelchair is shown
- Chapter 6 deals with the conclusion and future scope of the project

Chapter 2:

LITERATURE SURVEY

The invention of the incubator in 1880 ignited a dramatic outpouring of popular and professional excitement over the prospect of reducing premature infant mortality. Yet the technology itself progressed slowly and fitfully over the next 50 years. The story is worth examining not so much from the standpoint of technological progress, but from the perspective of how responsibility for the newborn shifted from mothers to obstetricians and eventually pediatricians. It also illustrates how the history of technology involves more than invention. The invention of the incubator itself was less significant than the development of a system to support the device. One of the most important elements in a newborn's survival is the infant's temperature regulation. Mammals have the advantage of being homeotherms, meaning that they are able to produce heat, allowing us to maintain a constant body temperature. However, homeothermy may be overwhelmed in extremes of cold or heat. The newborn baby has all the capabilities of a mature homeotherm, but the range of environmental temperature over which an infant can operate successfully is severely restricted. It took a war, famine, and poultry to develop the technological breakthrough responsible for saving thousands of premature infants. The Franco-Prussian war in 1870-1871, along with a concomitant famine, had contributed to a significant population decline in France. To increase the growth rate, the French needed to start having more babies, as quickly as possible. But one obstetrician realized that if he could find a way to reduce infant mortality, then the population growth rate problem could be solved far sooner.

[1]. P. Sihombing, T. P. Astuti, Herriyance, D. Sitompul, "Microcontroller Based Automatic Temperature Control for Oyster Mushroom Plants," Journal of Physics: Conference Series, Volume 978, 2nd International Conference on Computing and Applied Informatics, Medan, Indonesia, 2017, pp. 28-30, doi:10.1088/1742-6596/978/1/012031.

This proposed project mainly presents the automatically control the temperature of an oyster mushroom system using an Arduino Uno microcontroller and temperature controller. Mushroom cultivation is significantly grown in a controlled environment based on mushroom growth follows very complex and sensitive procedure. Automatic environment control on mushroom cultivation had been introduced by using the trend IQ3 controllers. The Arduino Uno microcontroller is the main part of automatic temperature controller for the oyster mushroom plant. Root of the oyster mushroom are surrounded by temperature sensor and will transmit the detection result every time to the Arduino microcontroller. The system flow begins with the detection of the temperature sensor. In the temperature sensor heat and humidity are detected the fan and pump will ignite and do the condensation. And, if normal temperature and normal humidity (22-28^{0}C) then the fan does not turn on. The Arduino Uno microcontroller serves to the real time system to set the alarm to the water pump. When alarm is activated, the relay will be activated and water pump will send the water solution into the oyster mushroom area. And if the relay is off, then the water pump will stop to supply water. The result of the temperature will show on the LCD display. Author has practically implemented this system for mushroom plant. And automatically and manually systems testing has been performed. Testing is automatically done with control via smartphone. They are developed an application on a smartphone to control the temperature automatically. In applications that have been designed on this smartphone can be done by clicking the option of the automatic button.

[2]. D. Wicaksono, D. Perdana, R. Mayasari, "Design and Analysis Automatic Temperature Control in the Broiler Poultry Farm Based on Wireless Sensor Network," 2nd International Conferences on Information Technology, Information Systems and Electrical Engineering (ICITISEE), Yogyakarta, Indonesia, 2017, pp. 450-455, doi: 10.1109/ICITISEE.2017.8285549.

In this paper author presents that automatic temperature control in the broiler poultry farm. One such factor is the heat and humidity in the broiler farm. Overall poultry meat consumption has increased continually. So they are give more attention to several factors that can support the production. One of these factors is the temperature and humidity in the chicken broiler farm. The concept of modern chicken nurseries using computer network technology is important. In this project they have developed a wireless sensor network technology that can monitor and control temperature and humidity conditions in the poultry cages. A combination of specialized sensors with a wireless communications infrastructure for monitoring and controlling conditions in the environment. Arduino nano microcontroller functions to collect data from the sensors, to control the relay and as the controller of sensor node to transmit data into coordinator node through Xbee S2 transmitter. And it makes use of DHT11 sensor which is capable of reading temperature and humidity of the sensor field. Xbee S2 is used to transmit data through wireless transmission. The process sequence of this temperature and humidity control system as follows. The initial stage is to connect several Xbee which has each functionality into a network. After the connection is complete, then the sensor reads the data. The data of the sensor use as a logic for relay. Then will sent to the coordinator for processing so that it can perform monitoring through the interface. Laptop is used as a server to processing, collecting, and interfacing the data which reached the coordinator node. The data are transformed into information form and then will be shown on a display.

[3]. M. Ali, M. Abdelwahab, S. Awadekreim, S. Abdalla, "Development of a Monitoring and Control System of Infant Incubator," 2018 International Conference on Computer, Control, Electrical, and Electronics Engineering (ICCCEEE), Khartoum, Sudan, 2018, pp. 1-4, doi: 10.1109/ICCCEEE.2018.8515785.

In this paper author presented an advance control system used to monitor some important parameter that affect the life of infant baby. This technique simultaneously monitors and controlled more than one parameter with advanced control system and provides smooth operation which helps to increase the accuracy of the system. This system contained four temperature sensors which are used to adjust the incubator temperature and extended to monitor the skin temperature. The system also used two sensors to measure humidity. An application page was designed to ensure easy monitoring service for user. The systems based on Arduino and offer the ability to control incubator using the serial port. Temperature and humidity are two very important parameters that needs constant monitoring in the infant incubator chamber so that, it provides the environment similar to mother's womb. Temperature can be displayed in terms of degree Celsius (0C) and humidity in terms of relative humidity which is expressed as % relative humidity (%RH). In this paper a design based on Arduino microcontroller to monitor an infant incubator was presented. LM35 sensor is used for measuring of temperature. DHT11 sensor is used to measure the humidity. The main parameters for infant incubator which aimed to be controlled in this system are temperature and humidity. To achieve this goal, a hardware design is developed with compatible Arduino software, thus the above mentioned parameters can be monitored for the normal growth of the infant. This system can provide optimum automatic control of temperature of the infant using Arduino, according to air temperature in the infant chamber. The control of relative humidity in chamber is required to reduce the thermal loss from them. In this system the infant temperature can be automatically controlled in great level of precision as well as to maintain high relative humidity, so, the thermal losses can be minimized. The developed system has been designed to be user friendly, cost effective and accurate.

Chapter 3:

METHODOLOGY

3.1 Block Diagram

3.1.1 Block diagram representation of automatic ON/OFF temperature controller is depicted in Fig. 2.

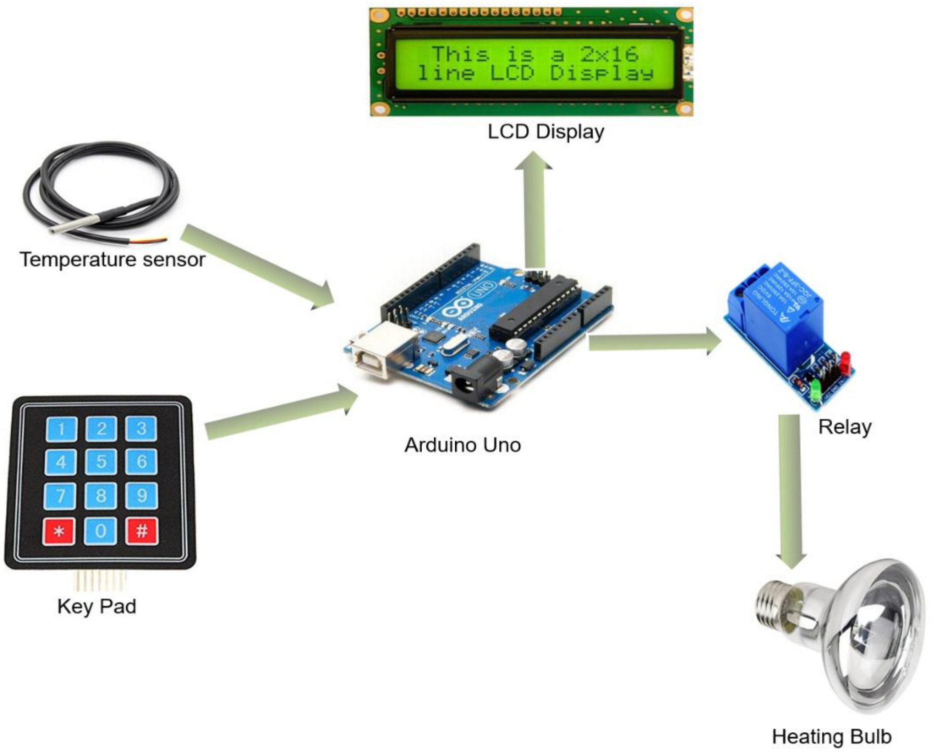

Fig. 2: Block Diagram of ON/OFF temperature controller

Figure 2 shows the methodology for ON/OFF controlling of temperature. A digital temperature controller circuit is precise temperature controller in medical, industrial and home applications. This proposed digital temperature controller system indicates the temperature on a display and when the temperature exceeds the set point then load switches off. In this project heater and cooler are provided as a load for demonstration purpose. The proposed digital temperature controller systems makes use of microcontroller. The digital temperature sensor interfaced to the microcontroller for sensing the temperature conditions. This system provided key pad switches for adjusting the temperature settings. The microcontroller continuously polls the temperature through a digital temperature sensor and displays over the display unit and automatically switches on the cooler, when the corresponding temperature exceeds the set point. Similarly, when the corresponding temperature falls below the set point, automatically switches on the heater. The system uses a digital temperature sensor in order to detect temperature and pass on data to the microcontroller. The microcontroller processes the data and sends the temperature to be displayed on the screen. After reading temperature from the sensor, microcontroller compares the temperature with user set temperature. If temperature is above the user set point, microcontroller sends high signals to relay, to turn on the cooling unit. A digital temperature sensor continuously reads the temperature and sends it to the microcontroller. If temperature is below the user set point microcontroller sends high signal to relay, to turn on the heating unit. Then the corresponding temperature show on the display.

3.1.2 Block diagram representation of automatic PID temperature controller is depicted in Fig. 3.

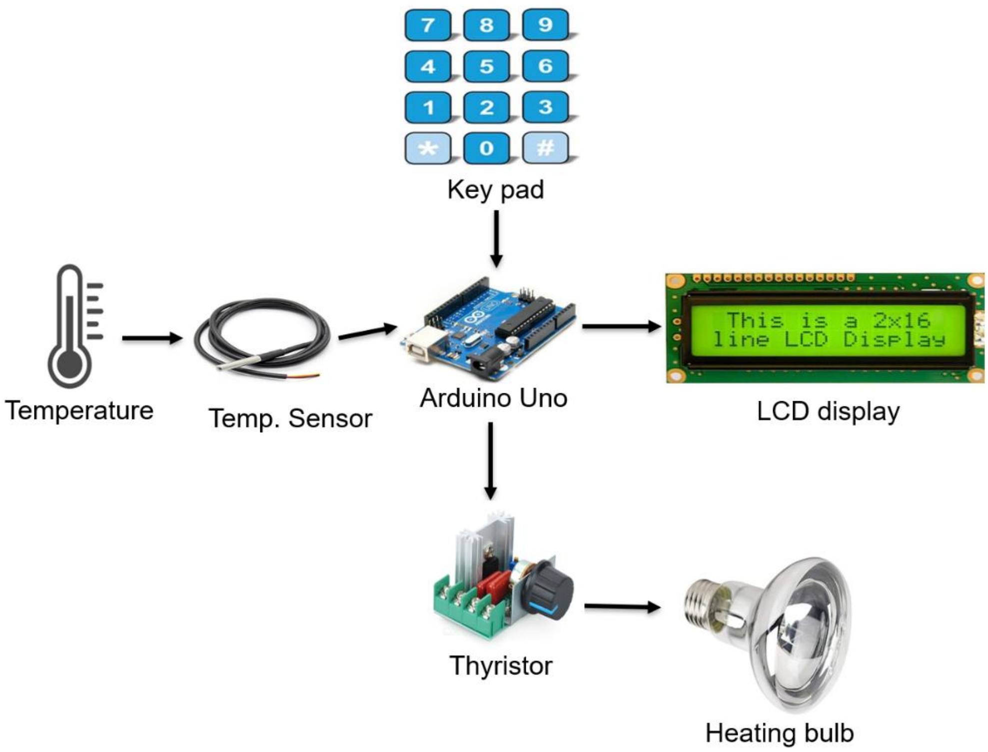

Fig. 3: Block Diagram of PID temperature controller

Figure 2 will show the methodology for PID controlling of temperature. A PID (**Proportional – Integral – Derivative**) controller is an instrument used by control engineers to regulate temperature, flow, pressure, speed, and other process variables in industrial control systems. We also using this controller for regulate the temperature. Arduino IDE has inbuilt PID controller library it takes setpoint, kp, ki, kd values and give a analog output on PWM pin. Analog output voltage is given to the Thyristor to control the ac voltage. Ac voltage will vary according to the PID output. In this methodology we use bulb as final control element. It will heat the incubator chamber according the error between set point and measured value. By this way monitoring the temperature in the incubator for well growth of infants.

3.2 Methodology

The proposed project is for designing and developing an automatic digital temperature controller is used to regulate the temperature in baby incubator to create a good environment for a newborn infant babies. The various stages of the project are listed below:

Stage 1: Selection of an appropriate sensor for measurement temperature of system.

Stage 2: Understanding the working and characterization of the selected sensor.

Stage 3: Selection of appropriate display, keypad, actuator and heating element.

Stage 4: Interfacing sensor, display, keypad, actuator and heating element to the Arduino.

Stage 5: Developing the program to read data from the sensor and take a appropriate action on heating element.

Stage 6: Developing prototype of incubator by integrating the all the hardware components with Arduino.

Chapter 4:

HARDWARE AND SOFTWARE

The list of the components used in the design and development of digital temperature indicator and automatic controller is as follows:

- Arduino UNO
- Temperature sensor: DS18B20
- Keypad(4x3)
- LCD display(16x3)
- Relay
- Bulb

4.1 Arduino UNO:

The Arduino Uno is an open-source microcontroller board that is based on the Microchip ATmega328P (for Arduino UNO R3) or Microchip ATmega4809(for Arduino UNO WIFI R2)micro-controller by Atmel and was the first USB powered board developed by Arduino.

The Arduino Uno R3 with cable is a microcontroller board based on the AT-mega(datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE)1.0. The Uno board and version 1.0 of Arduino Software (IDE) are the reference versions of Arduino. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform.

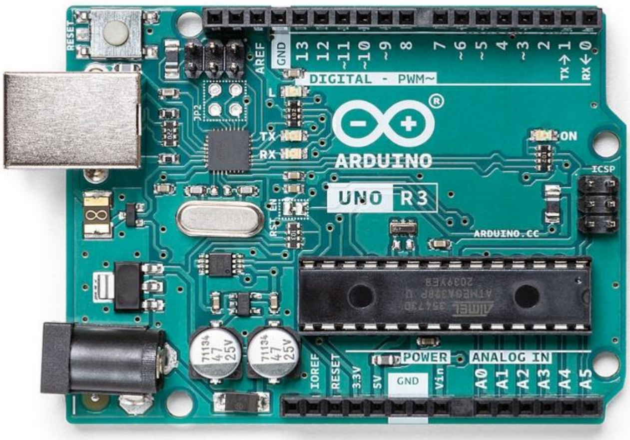

Fig. 4: Arduino UNO Board

4.1.1 Specifications of Arduino UNO:

- Microcontroller: Arduino Uno works on ATMEGA 328P microcontroller.
- Operating Voltage (VDC): It will operate with voltage of 5V.
- Input Voltage(recommended): Recommended input voltage for Arduino Uno is from 7 to 12V which will be converted to 5V using the internal voltage regulator. Input Voltage(limits) 6-20V
- Digital I/O Pins: There are 14 digital input/output pins in Arduino Uno, out of which 6 pins have caps-
- city to provide PWM output.
- Analog Input Pins: It has 6 analog input pins.
- DC Current per I/O Pin:40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: It has flash memory of 32 KB.
- EEPROM: It has SARM and EEPROM of 2KB and IKB respectively.
- Clock Speed: It has crystal to generate clock pulses of 16 MHz.

4.1.2 Power

The Arduino Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector. The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V however, the SV pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

- Vin: The input voltage to the Arduino board when it's using an external power source(as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin or if supplying voltage via the power jack access it through this pin
- 5V: This pin outputs a regulated 5 V from the regulator on the board. The board can be supplied with power either from the DC power jack(7-12V), the USB connector(5V), or the VIN pin of the board(7-12V). Supplying voltage via the SV or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it
- 3.3V: A 3.3volt supply generated by the on-board regulator. Maximum current draw is 50 mA
- GND: Ground pins
- IOREF: This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

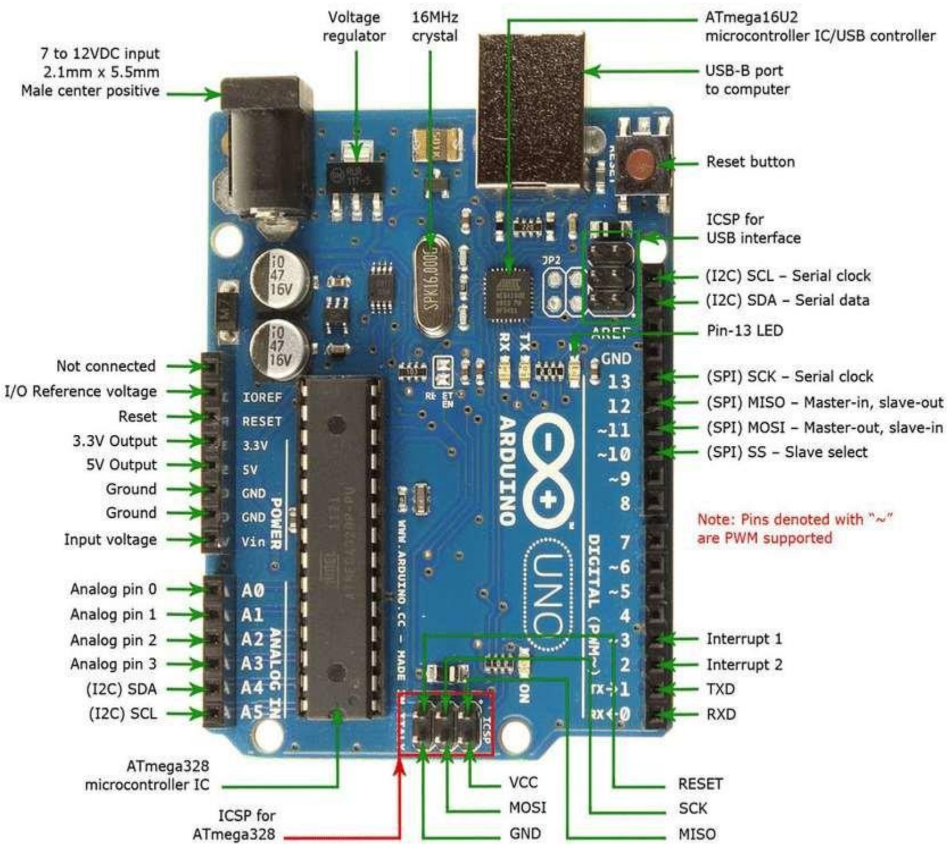

Fig. 5: Pin Diagram of Arduino UNO

4.1.3 Memory

The ATmega328 has 32 KB (with 0.5 KB) occupied by the boot loader. It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library.

4.1.4 Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output using Pin Mode. digital Write, and digital functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default of)20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any 10 pin to avoid permanent damage to the microcontroller. In addition, some pins have specialized functions

- **Serial:** 0(RX)and 1(TX) Used to receive (RX)and transmit (TX)TTL. serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- **External Interrupts:** 2 and 3. These pins can be configured to trigger an interrupt on a rising or falling edge or a change in value. See the attach interrupt function for details.
- **PWM:** 3,5,6,9,10, and 11. Provide 8-bit PWM output with the Analog write function.
- **PI:** 10(SS),11(MOSI), 12(MISO), 13(SCK) These pins support SPI communication using the SP library.
- **LED:** 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH, the LED is on when the pin is LOW it's off
- **TWI:** A4 or SDA pin and A5 or SCL pin, Support TWI communication using the Wire
- **Library.**
  The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution. By default, they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog reference function. There are a couple of other pins on the board:
- **AREF:** Reference voltage for the analog inputs. Used with analog reference.
- **Reset:** Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which

4.2 Temperature sensor: DS18B20

The DS18B20 is a silicon band gap temperature sensor**.** The sensor is based on the principle that the forward voltage drop of a silicon diode is temperature dependent. By measuring forward voltage drop across the diode, the temperature of the silicon is calculated. The DS18B20 temperature sensor is a one-wire digital temperature sensor. This means that it just requires one data line (and GND) to communicate with the Arduino. It can be powered by an external power supply or it can derive power from the data line, which eliminates the need for an external power supply.

Fig. 6: Temperature sensor (DS18B20)

4.2.1 Specifications of DS18B20 sensor:

The DS18B20 temperature sensor has a measuring range from -55 °C to + 125 °C, but the accuracy differs depending on the range in which the sensor operates:

- -55 °C to + 125 °C with ±2°C accuracy
- -30 °C to +100 °C with ±1 °C accuracy
- -10 °C to +85 °C with ±0.5°C accuracy

4.2.2: Working Principle of DS18B20 sensor:

It works on the principle of **direct conversion of temperature** into a digital value. Its main features are to change its bit numbers according to change in temperature Like, it changes a bit in 9, 10, 11, and 12 bits as temperature changes in values 0.5 ° C. 0.25°C,1.25 and 0.0625°C respectively. Each DS18B20 temperature sensor has a unique 64-bit serial code. This allows us to wire multiple sensors to the same data wire. So, we can get temperature from multiple sensors using just one Arduino digital pin.

4.3 Keypad(4x3)

In a temperature controlling system, a 4x3 keypad is a common input device used to interact with the system and input desired temperature values. It consists of a grid of buttons arranged in four rows and three columns, hence the name 4x3 keypad. Each button on the keypad represents a specific numerical or functional input. The system then reads the signals from the keypad and interprets the pressed button. This interpretation is usually done by mapping the rows and columns of the keypad to specific input values. The microcontroller monitors the state of each row and column in the keypad. When a button is pressed, the microcontroller detects the closed circuit caused by the button press and determines the specific row and column that make contact. By using a scanning algorithm, the microcontroller can identify the button pressed based on the row and column combination. It can then convert the pressed button into the corresponding numerical value or trigger the programmed action associated with that button. In a temperature controlling project, the 4x3 keypad could be used to set the desired temperature value, switch between different modes, adjust settings, or initiate other control actions. The microcontroller connected to the keypad reads the input and updates the temperature control system accordingly.

Fig. 7: Keypad(4x3)

4.4 LCD Display(16x2)

An LCD (Liquid Crystal Display) is a type of flat-panel display that uses the light-modulating properties of liquid crystals to display information. In the context of temperature controlling, an LCD display can be used to provide a visual interface for monitoring and adjusting temperature parameters. An LCD display can show the current temperature readings in a clear and easily readable format. The display typically consists of several segments or pixels that can be individually controlled to form numbers and characters. Temperature sensors or other monitoring devices provide the temperature data, which is then processed and shown on the LCD. This is particularly useful in temperature controlling applications such as thermostats or environmental chambers. The user can use buttons or a touchscreen interface integrated with the LCD to input the desired temperature setpoint. The LCD visually represents the setpoint and any changes made by the user.

Fig. 8: LCD Display

4.5 Bulb

In a temperature control system, a sensor is used to monitor the temperature of the controlled environment. When the temperature falls below the desired setpoint, the control system activates the heating bulb. The heating bulb, usually placed in proximity to the area or object that requires heating, begins to emit heat as it receives electrical power. The heat radiates from the bulb's filament and warms up the surrounding environment. As the heating bulb operates, the temperature sensor continuously monitors the environment's temperature. Once the temperature reaches the desired setpoint, the control system can either reduce or completely cut off the power supply to the heating bulb. To maintain precise temperature control, the control system uses a combination of monitoring and feedback mechanisms. It compares the actual temperature with the desired setpoint and adjusts the power supplied to the heating bulb accordingly. This allows the system to regulate the temperature and keep it within a specific range.

Fig. 9: Bulb

4.6 Relay

In temperature control systems, a relay is a device used to switch electrical circuits on or off based on temperature conditions. It acts as a control element that responds to temperature changes and triggers the operation of other electrical components, such as heaters, fans, or cooling systems. A temperature sensor, such as a thermocouple or a temperature probe, measures the ambient temperature and provides an electrical signal proportional to the temperature. The electrical signal from the temperature sensor is sent to a temperature controller. The controller compares the measured temperature to a desired setpoint temperature. The temperature controller determines whether the measured temperature is below or above the setpoint temperature. If the measured temperature is below the setpoint, indicating a need for heating, or above the setpoint, indicating a need for cooling, the controller activates the relay. The relay consists of an electromagnet that controls the switching action. When the relay receives the signal from the temperature controller, it energizes the electromagnet. This magnetic force causes the relay's internal switch contacts to change their position.

Fig. 10: Relay

4.7 Hardware Design

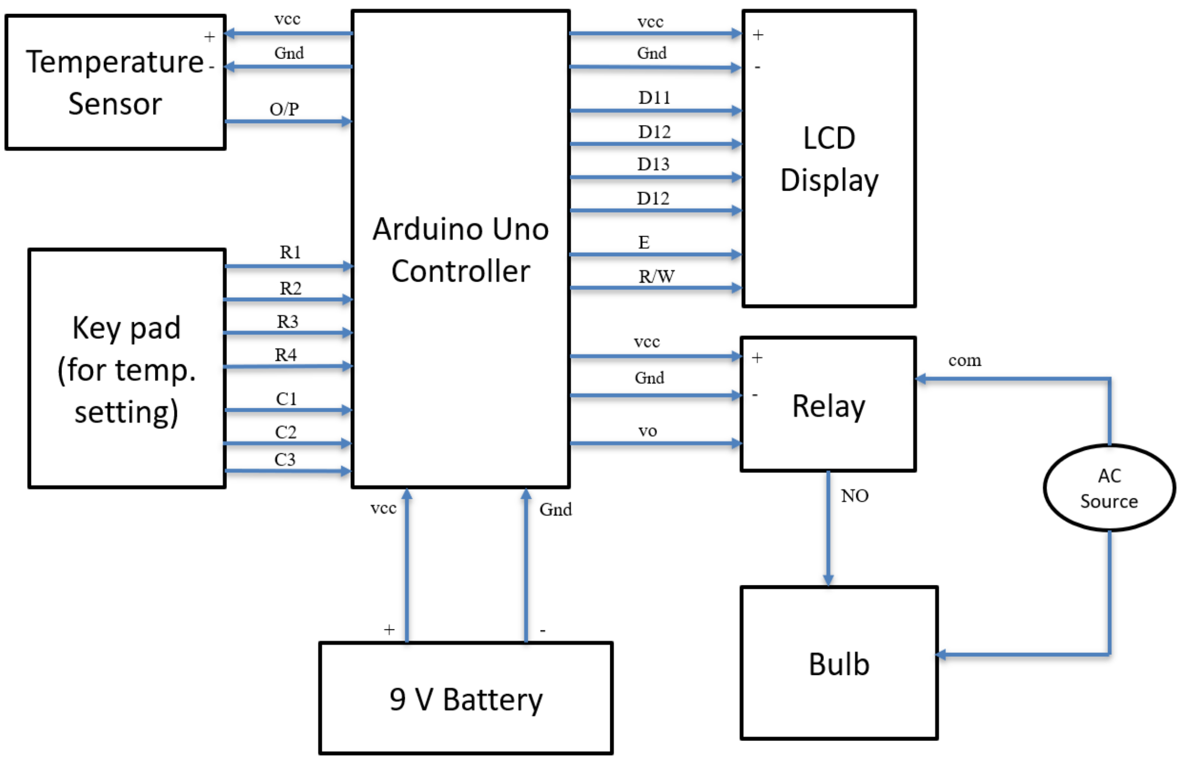

Fig. 11: Circuit connection

The Fig. 11 shows the circuit connection of automatic ON/OFF temperature controller. The circuit consist temperature sensor (DS18B20), keypad (4x3), LCD display (16x2), Relay, Bulb and Battery. Temperature sensor is used to measure the temperature from the system. LCD display is used display the temperature. Keypad is used to setting the temperature. Relay is used as actuator to control the bulb. Bulb is used to heating the incubator chamber. Batter is used to provide supply to the Arduino board.

4.8 Software Design

Software implementation includes the operation o identifying the instruction of human being. In software design Arduino uno initially takes the setpoint from the user. Read the data from the system and display it on LCD screen. If measured value is less then the setpoint controller will give high signal to the actuator to turn on the bulb. If measured value is greater then the setpoint controller will give low signal to turn of the bulb. This process is continues to regulate the temperature in the incubator at a constant level.

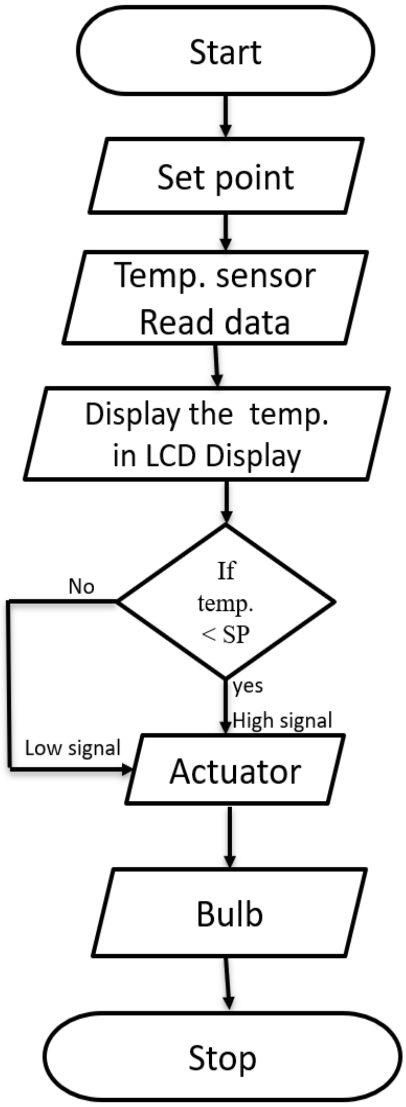

Fig. 12: Software Design

Chapter 5:

RESULTS AND DISCUSSION

Whenever the temperature of the chamber is less than the setpoint, the final control element(bulb) will turn on, to maintain the system at the desired temperature.

Fig. 13: Incubator Prototype Model

Chapter 6:

CONCLUSION AND FUTURE SCOPE

The temperature controlling project has been successfully implemented and achieved its objectives. Throughout the project, we focused on developing an efficient and reliable system to regulate temperature in a specific environment, especially in incubators. Firstly, we studied and understood the requirements and constraints of the temperature control system. This involved studying the desired temperature range, the size and layout of the space to be controlled, and any external factors that could affect temperature fluctuations. The system included sensors to monitor the current temperature, a controller unit to process the data, and actuators to regulate the temperature by adjusting heating mechanisms. These algorithms allowed the system to respond dynamically to changes in temperature and make adjustments accordingly. We also incorporated feedback loops to continuously monitor and fine-tune the temperature, ensuring it remained within the desired range.

FUTURE SCOPE

Digital temperature indicator and automatic controller has wide range of applications and scope in the following sectors:

- Baby Incubators: Baby incubators can be employed with this model as it provides constant temperature which is a very important parameter for the growth of the baby inside the chamber.
- Microwave Oven: Temperature controllers are also used in ovens. When a temperature is set for an oven, a controller monitors the actual temperature inside of the oven.
- Green House Monitoring: Another important domain which can be implemented with this system is green-house monitoring system, as, temperature controls the rate of plant development and thus, crop timing.

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