CONTROL SYSTEM FOR A CHICKEN INCUBATOR

May 2023

Members: (From Left to Right)
Tommy El Hajjar
Emile Bou Khalil
Shafik Khalili
Antoine Hatab

Introduction

As part of our project, we were tasked with the exciting challenge of designing and building an incubator that would effectively simulate chicken incubation using an Arduino. Our design process involved careful consideration of the unique challenges posed by this project, including the precise calibration of temperature levels, as well as the construction of a reliable turning mechanism. Ultimately, our efforts culminated in the successful manufacture of an effective egg incubator that met our project's goals.

Requirements

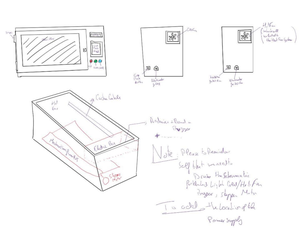
Temp Control Trough Ventilation	To regulate the incubator's air temperature, use two fans: one for hot air from a hairdryer and another for cool, room temperature air.
Manual Control of the Fans	Include two physical buttons, each dedicated to controlling the fan speed of one fan. These buttons allow the incubator owner to manually adjust the fan speeds as desired.
Buzzer alarms for High and Low Temp	Temperature above 40.5°C triggers red LED blinking and alarm, while temperature below 35°C triggers green LED blinking and alarm.
Data Sheet for the Thermistor	It is necessary to perform calibration on the sensor and create a professional data sheet for submission.

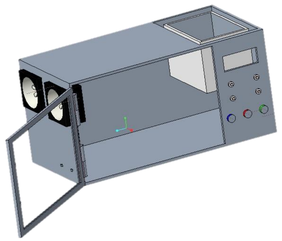
Temperature Range	Less than 35 °C	Between 35°C and 37.5°C	Between 37.5°C and 40.5°C	More than 40.5°C
Hot Fan Speed	65%	45%	Lowest possible speed	N/A
Cold Fan Speed	N/A	Lowest possible speed	50%	75%

Design Process

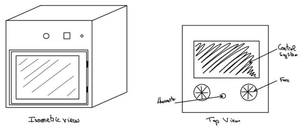
- During the design process, our goal was to create a user-friendly and visually appealing product without compromising functionality. We started with hand-drawn sketches and utilized software like Creo and Inventor to develop detailed 3D models. The initial prototype faced challenges, mainly with the electric box occupying too much space and complicating wiring. To overcome this, we redesigned the product, dedicating a separate section of the box to the electric components. This simplified construction, improved wiring efficiency, and ultimately resulted in a more effective and streamlined final product. The incubator creates an optimal hatching environment, with a servo motor gently rotating the eggs to mimic natural behavior. This promotes healthy development and prevents sticking for successful hatching.

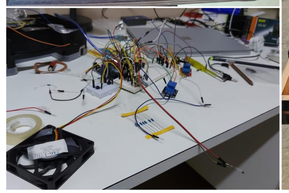
FIRST PROTOTYPE





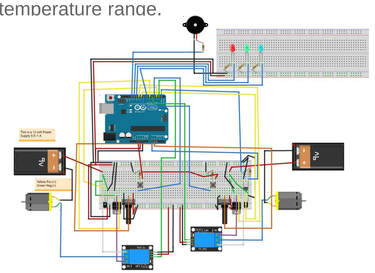
FINAL DESIGN





Circuit & Code

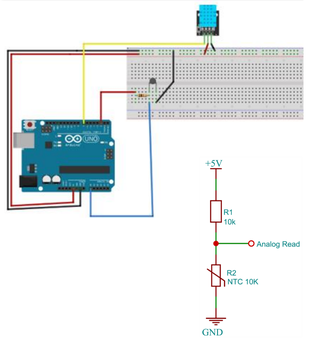
This Arduino code enables the control of fans based on temperature readings from a thermistor sensor. It converts the analog reading to temperature in Celsius. Based on the temperature reading, it adjusts the fan speed to maintain a desired temperature range.



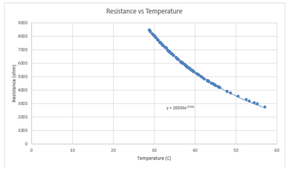
Data Sheet

NTC 10K THERMISTOR

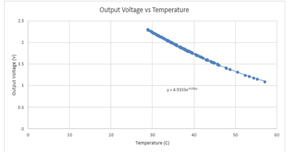
CIRCUIT SCHEMATIC



NTC 10K THERMISTOR - CALIBRATION CURVE



$$R = 26596 \times e^{-0.047}$$



$$V = 4.9333 \times e^{-0.0247}$$

GENERAL DESCRIPTION

The NTC 10K thermistor is a high-precision temperature sensing device with a nominal resistance of 10,000 ohms at 25°C. It is characterized by a negative temperature coefficient, meaning that its resistance decreases as the temperature increases. This allows for accurate and sensitive temperature measurements across a wide temperature range.

The NTC 10K thermistor is widely used in various temperature sensing and control applications, including HVAC systems, refrigeration, and automotive applications. Its high sensitivity and accuracy make it a popular choice for precise temperature measurement and control.

NTC 10K THERMISTOR - SPECIFICATIONS

Specification	Experimental	Theoretical	Formula used (if applicable)
Input Voltage Range (V)	0 to 5	0 to 5	
Output Voltage Range (V)	1.08 to 2.29	0 to 5	$V_{out} = V_{in} \times \frac{R_{thermistor}}{R_{thermistor} + 10000}$
Power Consumption (mW)	27 to 57.25	0 to 125	$P = E \times I$
Temperature Range (°C)	28.9 to 57.1	-55 to 150	
Thermal Dissipation Constant (mW/°C)	0.84 to 14.7		$\delta = \frac{P}{T - T_a}$
β (K)	3751.75	3750	$\beta = \frac{\ln(R/R_0)}{\frac{1}{T} - \frac{1}{T_0}}$
Resolution (%)	±0.005	±0.005	
Accuracy (%)	±1%	±1%	

Conclusion

In conclusion, our chicken incubator project effectively used two fans, a temperature sensor, a servo motor, and an Arduino for controlled egg incubation. The system maintained optimal temperature conditions, rotated the eggs, and demonstrated the significance of precise control for successful hatching.

AMERICAN UNIVERSITY OF BEIRUT
MAROUN SEMAAN FACULTY OF ENGINEERING & ARCHITECTURE

Department of Mechanical Engineering
American University of Beirut, Lebanon
www.aub.edu.lb/MSFEA