Hardware Project - Scientific Calculator

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1 Introduction

This report presents the design and implementation of a scientific calculator using the ATmega328P microcontroller and an LCD display. The calculator performs basic arithmetic operations (addition, subtraction, multiplication, division), trigonometric functions (sine, cosine, tangent) and logarithmic functions (log , ln). The primary goal is to implement a versatile and efficient calculator that can display results on an LCD.

2 Hardware Components

The following hardware components were used in the project:

- Arduino UNO
- 16x2 LCD Display
- 23 Push Buttons
- Resistors (9 15kΩ ,1 2kΩ, 1 1kΩ,1 1.5 k Ω)
- Breadboard
- Jumper Wires and connecting wires
- Power Supply

3 Software and Tools

The following software and tools were utilized:

- AVR GCC Compiler
- ArduinoDroid for uploading the HEX file
- Termux for file management and HEX file handling

- Mathematical Functions (math.h) for trigonometric calculations
- LCD Control (util/delay.h) for time management

4 Circuit Design

1. Connect 5V and Ground from the Arduino onto the breadboard.
2. Connect the push buttons in 2 rows (each from grid to power lines not connected to Ground or 5V). The first row must have 10 buttons (for digits), and the second row must have 13 buttons (for functions). Connect one terminal of each button to Ground.

4.1 Connections

One end of Jumper Wire	**Another end of Jumper Wire**
Digital pin 0	Push button 16
Digital pin 1	Push button 17
Digital pin 2	LCD pin 4
Digital pin 3	LCD pin 6
Digital pin 4	LCD pin 11
Digital pin 5	LCD pin 12
Digital pin 6	LCD pin 13
Digital pin 7	LCD pin 14
Digital pin 8	Push button 18
Digital pin 9	Push button 19
Digital pin 10	Push button 20
Digital pin 11	Push button 21
Digital pin 12	Push button 22
Digital pin 13	Push button 23
Analog pin A1	Push button 15
Analog pin A2	Push button 14
Analog pin A3	Push button 13
Analog pin A4	Push button 12
Analog pin A5	Push button 11
Analog pin A0	Push buttons 1-10 (digit buttons)
LCD pin 1	Ground
LCD pin 2	5V
LCD pin 15	5V via 1k Ω resistor
LCD pin 16	Ground
LCD pin 3	Ground via 1.5 k Ω resistor
LCD pin 5	Ground
LCD pin 5	All push buttons

4.2 Push Button Designations

Button number	Function
1 - 10	Digits 0 - 9
11	Clear
12	$\ln(x)$ and $\log(x)$
13	Right Parenthesis
14	$\sin(x)$, $\cos(x)$, and $\tan(x)$
15	e and π
16	Backspace
17	Decimal Point
18	Equal To
19	Left Parenthesis
20	Division (/)
21	Multiplications (*)
22	Subtraction(-)
23	Addition (+)

4.3 Circuit Diagram

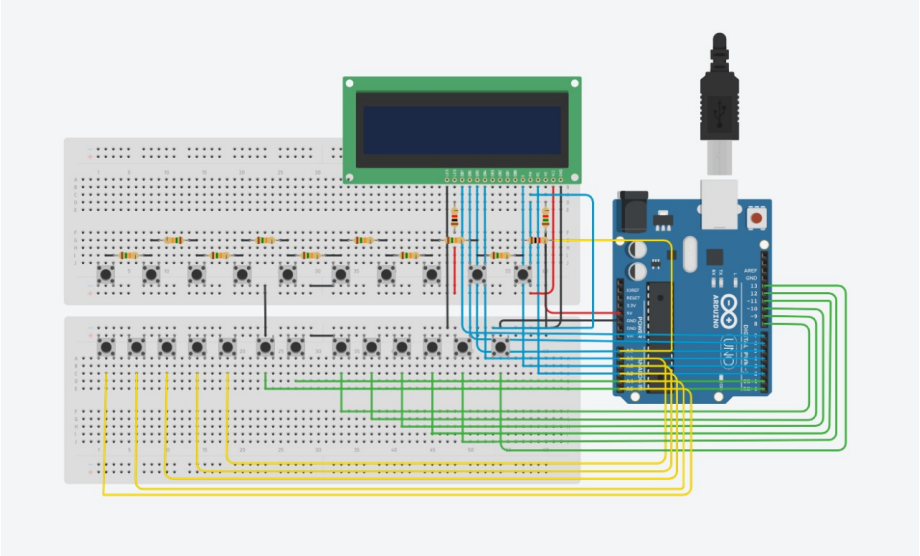

Figure 1: Circuit Diagram of the Scientific Calculator

5 AVR Code

The code follows a structured approach:

- Initialization of LCD and keypad
- Interrupt-based button handling
- Mathematical function execution
- Displaying results on the LCD

6 Results

The scientific calculator accurately calculates trigonometric functions, basic arithmetic operations and logarithmic functions and displays the results on the LCD display.

7 Conclusion

This project successfully implemented a basic scientific calculator using AVR-GCC and embedded C. The system demonstrates reliable performance in performing calculations while maintaining a simple user interface.

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