Scientific Calculator

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Objective

The goal is to design a scientific calculator using an Arduino and an LCD display. The calculator should support basic arithmetic and scientific functions such as sine, cosine, and their inverses and logarithm.

Hardware Required

- Arduino Uno
- 16X2 LCD display
- Bread Board
- Push Buttons
- Connecting wires
- A Resistor of 220Ω

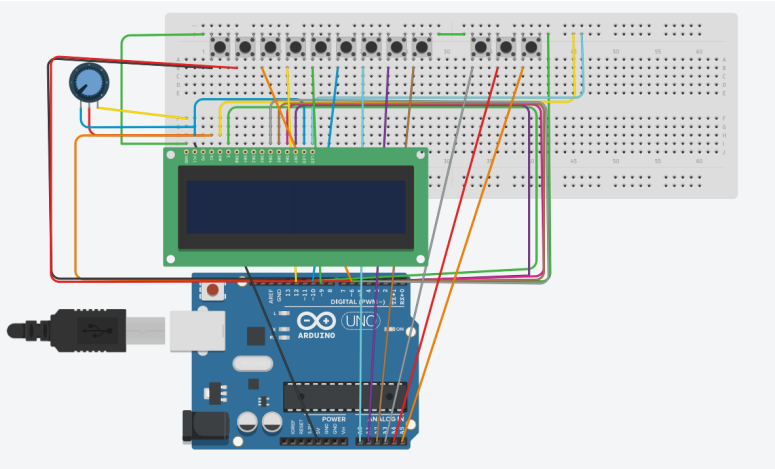
Circuit Design

- Connect the following

LCD	Connection
1	GND
2	5V
3	potentiometer (middle)
4	12
5	GND
6	11
11	5
12	4
13	3
14	2
15	5V
16	GND

Buttons	Connection
1	13
2	6
3	7
4	8
5	9
6	10
7	A0
8	A1
9	A2
10	A3
11	A4
12	A5

- The button 1 represents the right toggle button and the button 12 represents left toggle button.
- The rest represents different functions when toggled and normally it represents from 0-9 in order.



Button representing Functions:

Button	Right Toggle	Left Toggle
2	+	$sin^{-1}x$
3	-	$cos^{-1}x$
4	*	$tan^{-1}x$
5	/	$log_{10}x$
6	=	lnx
7	backspace	
8	sinx	
9	cosx	
10	e^x	
11	$\sqrt{x}$	

After Upload the following code to the Arduino Uno.Refer to the file `codes/main.c`.

Implementation

- **Toggle input Mechanism:** Instead of a matrix keypad, two toggle buttons (right toggle and left toggle) are used for selecting input values and operations.
- **Display handling :**The LCD display is controlled using the Arduino to show current input, operations, and results.
- **Arithmetic and Scientific Functions:**
  - Addition, subtraction, multiplication, and division are implemented in AVR assembly.
  - The trigonometric functions and logarithm functions are computed using differential equations.
- **Input Selection:**

  - Right toggle moves the selection forward through available numbers and operations.
  - Left toggle moves the selection backward through available numbers and operations.
- **Result Calculation:**Once the input is confirmed, the Arduino processes the selected operation and displays the result on the LCD.

Challenges and Solutions

- **Limited input Mechanism:** Overcame the lack of a keypad by using toggle buttons for sequential selection.
- **Handling Complex Calculations:** Used differential equations to compute trigonometric functions and logarithms.
- **Efficient Result Display :** Managed LCD updates to ensure smooth transitions between inputs and results.

Conclusion

The AVR-based scientific calculator successfully demonstrates:

- Integration of multiple hardware components
- Implementation of complex mathematical functions on limited hardware
- User interface design for embedded systems
- Numerical methods for function approximation