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Midsemester Project Report

Aim: Design and implement a scientific calculator application utilizing the 8051 micro controller platform.

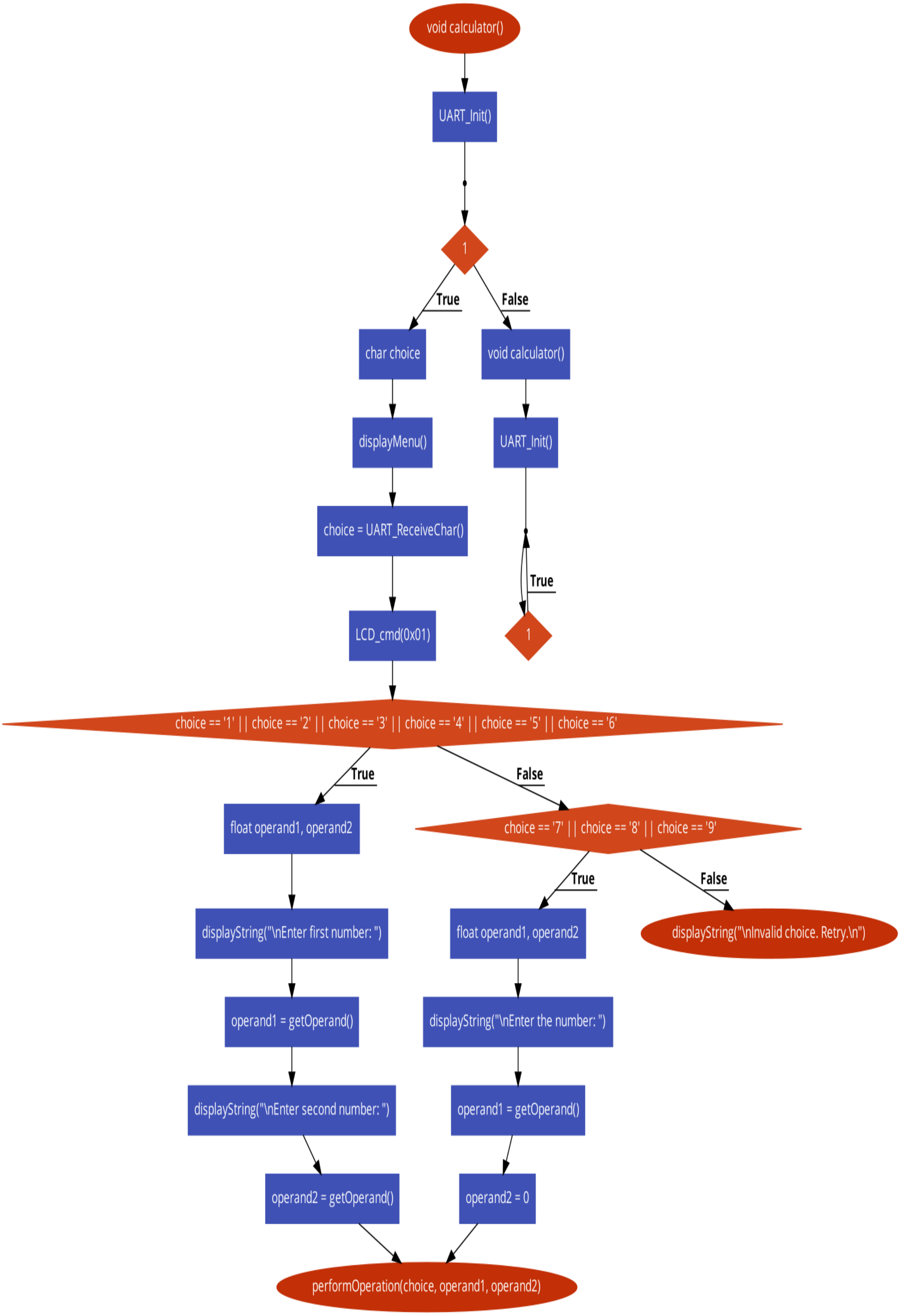
Pseudo-code:

```
Start
Define BAUDRATE as 4800
Define lcd_data as P1
Define rs as P0^0
Define en as P0^2
Define i as integer
Function UART_Init:
  Set TMOD as 0x20
  Set TH1 as 0xFA
  Set TR1 as 1
  Set SCON as 0x50

Function msdelay with parameter ms:
  Loop ms times:
    Set TH0 as 0xFC
    Set TL0 as 0x66
    Set TR0 as 1
    Wait until TF0 is 0
    Set TR0 as 0
    Set TF0 as 0

Function LCD_cmd with parameter a:
  Set lcd_data as a
  Set rs as 0
  Set en as 1
  Call msdelay with parameter 1
  Set en as 0
  Call msdelay with parameter 5
```

```
Function LCD_init:
    Call msdelay with parameter 20
    Call LCD_cmd with parameter 0x38
    Call LCD_cmd with parameter 0x0C
    Call LCD_cmd with parameter 0x06
    Call LCD_cmd with parameter 0x01
    Call LCD_cmd with parameter 0x80

Function LCD_char with parameter a:
    Set lcd_data as a
    Set rs as 1
    Set en as 1
    Call msdelay with parameter 1
    Set en as 0
    Call msdelay with parameter 2

Function LCD_string with parameter s:
    Loop until end of string s:
        Call LCD_char with current character of s
        Move to next character of s

Function UART_SendChar with parameter c:
    Set SBUF as c
    Wait until TI is 1
    Set TI as 0

Function UART_ReceiveChar:
    Wait until RI is 1
    Set RI as 0
    Return SBUF

Function displayString with parameter str:
    Loop until end of string str:
        Call UART_SendChar with current character of str
        Move to next character of str
Function displayMenu:
    Define menu as string containing menu options
    Call displayString with menu
```

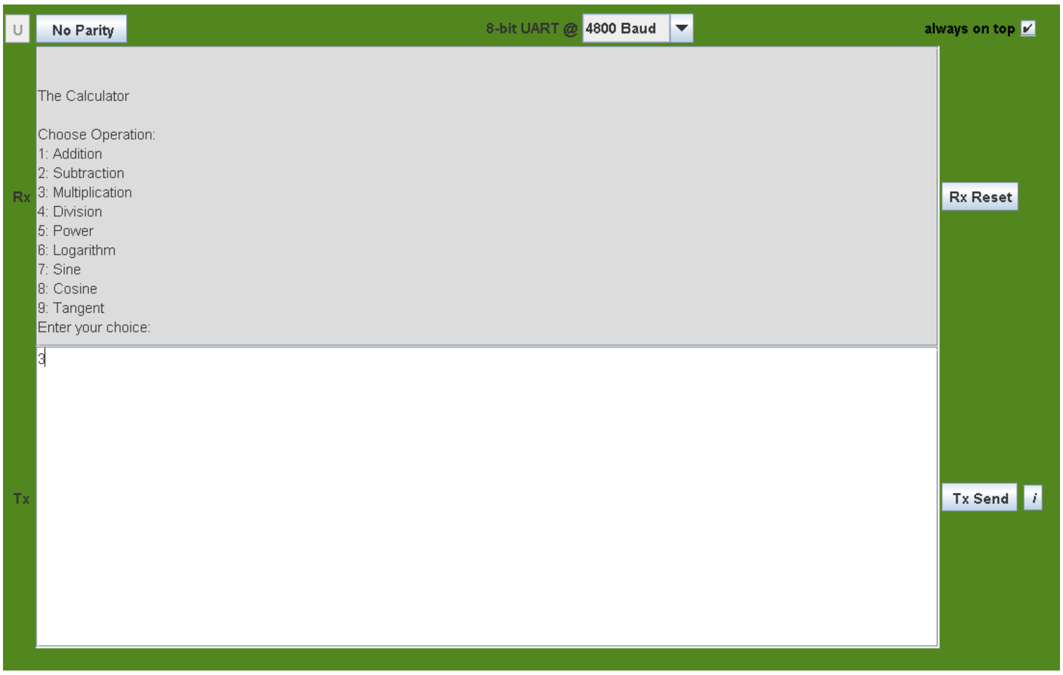
```
Function getOperand:
    Define buffer as character array of size 10
    Define c as character
    Define i as integer and set to 0
    Loop until newline or end of buffer:
        Read character c from UART
        Add c to buffer at index i
        Call UART_SendChar with c
        Increment i
    Add null terminator to buffer
    Convert buffer to float and return

Function performOperation with parameters choice, operand1, and operand2:
    Define result as float
    Define result_str as character array of size 20
    Switch on choice:
        Case '1':
            Set result as operand1 plus operand2
        Case '2':
            Set result as operand1 minus operand2
        Case '3':
            Set result as operand1 times operand2
        Case '4':
            If operand2 is not 0:
                Set result as operand1 divided by operand2
            Else:
                Call displayString with error message
                Return
        Case '5':
            Set result as operand1 raised to the power of operand2
        Case '6':
            If operand1 and operand2 are greater than 0:
                Set result as log of operand1 divided by log of operand2
            Else:
                Call displayString with error message
                Return
        Case '7':
            Convert operand1 from degrees to radians
            Set result as sine of operand1
        Case '8':
            Convert operand1 from degrees to radians
            Set result as cosine of operand1
        Case '9':
            Convert operand1 from degrees to radians
            Set result as tangent of operand1
        Default:
            Call displayString with invalid choice message
            Return
    Convert result to string with two decimal places
    Call displayString with result_str
    Call LCD_string with result_str

Function calculator:
    Call UART_Init
    Loop indefinitely:
        Define choice as character
        Call displayMenu
        Read choice from UART
        Call LCD_cmd with 0x01
        If choice is one of '1', '2', '3', '4', '5', or '6':
            Define operand1 and operand2 as floats
            Call displayString with message to enter first number
            Read operand1 from UART
            Call displayString with message to enter second number
            Read operand2 from UART
            Call performOperation with choice, operand1, and operand2
            Return
        ElseIf choice is one of '7', '8', or '9':
            Define operand1 as float
            Call displayString with message to enter the number
            Read operand1 from UART
            Set operand2 as 0
            Call performOperation with choice, operand1, and operand2
            Return
        Else:
            Call displayString with invalid choice message
            Return
Function main:
    Call LCD_init
    Loop indefinitely:
        Call calculator
End
```

Flowchart:


void calculator()
UART_Init()
1
True
False
char choice
void calculator()
displayMenu()
UART_Init()
choice = UART_ReceiveChar()
True
LCD_cmd(0x01)
1
choice == '1' || choice == '2' || choice == '3' || choice == '4' || choice == '5' || choice == '6'
True
False
float operand1, operand2
choice == '7' || choice == '8' || choice == '9'
True
False
displayString("\nEnter first number: ")
float operand1, operand2
displayString("\nInvalid choice. Retry.\n")
operand1 = getOperand()
displayString("\nEnter the number: ")
displayString("\nEnter second number: ")
operand1 = getOperand()
operand2 = getOperand()
operand2 = 0
performOperation(choice, operand1, operand2)

Output (Examples):

a. Multiplication



```
The Calculator

Choose Operation:
1: Addition
2: Subtraction
3: Multiplication
4: Division
5: Power
6: Logarithm
7: Sine
8: Cosine
9: Tangent
Enter your choice:
```

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3
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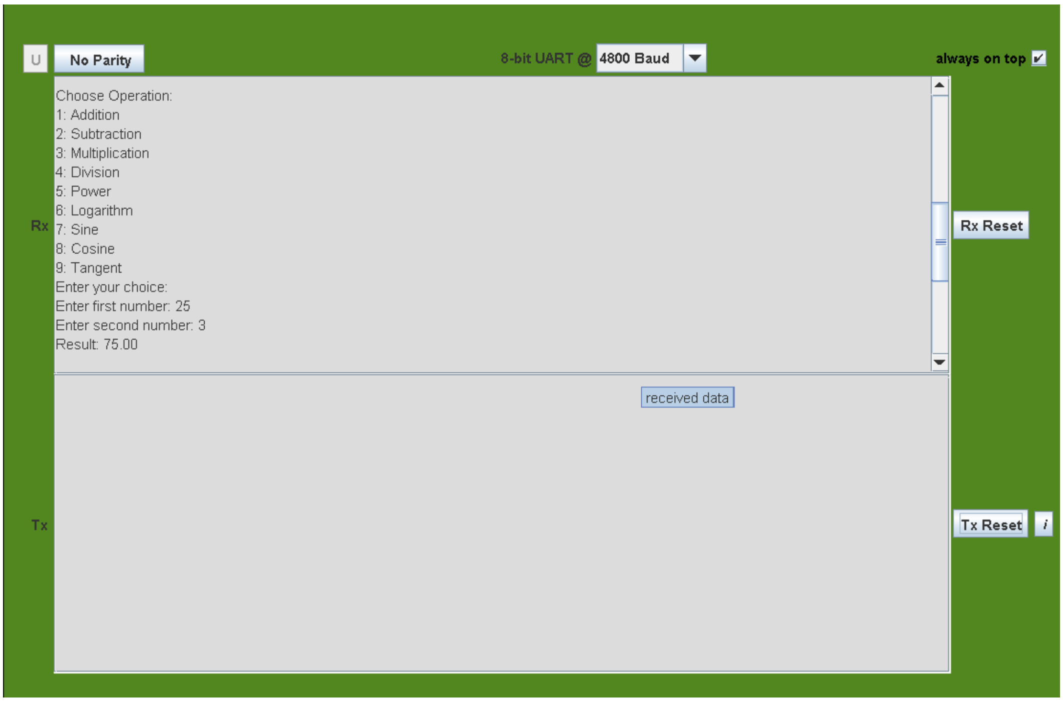
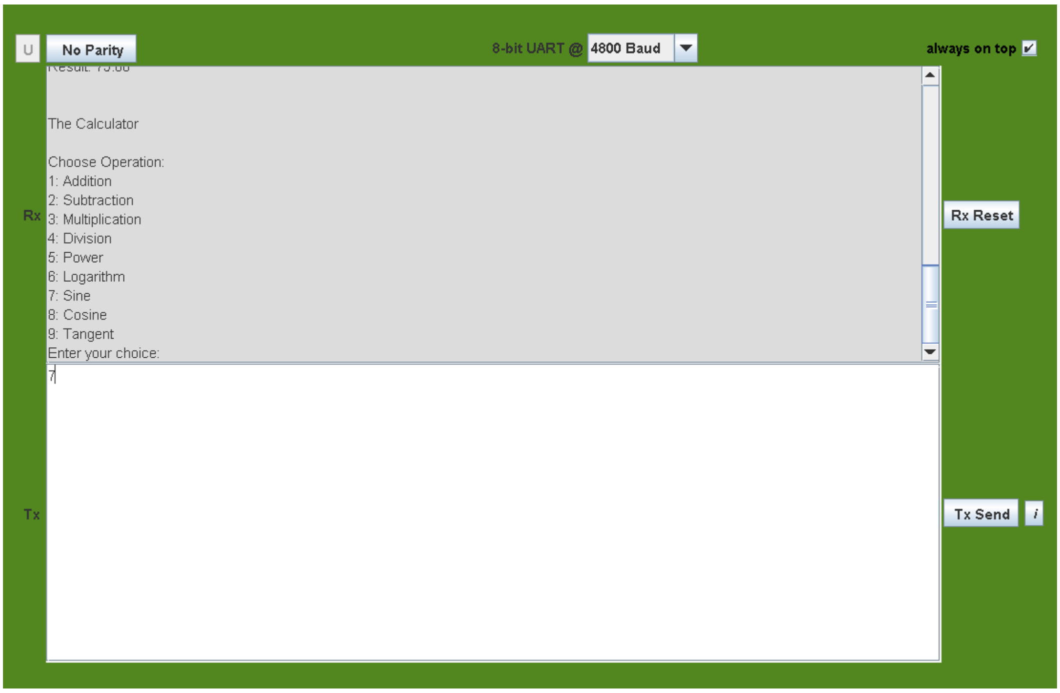


```
Choose Operation:
1: Addition
2: Subtraction
3: Multiplication
4: Division
5: Power
6: Logarithm
7: Sine
8: Cosine
9: Tangent
Enter your choice:
Enter first number: 25
Enter second number: 3
Result: 75.00
```

b. Sine function

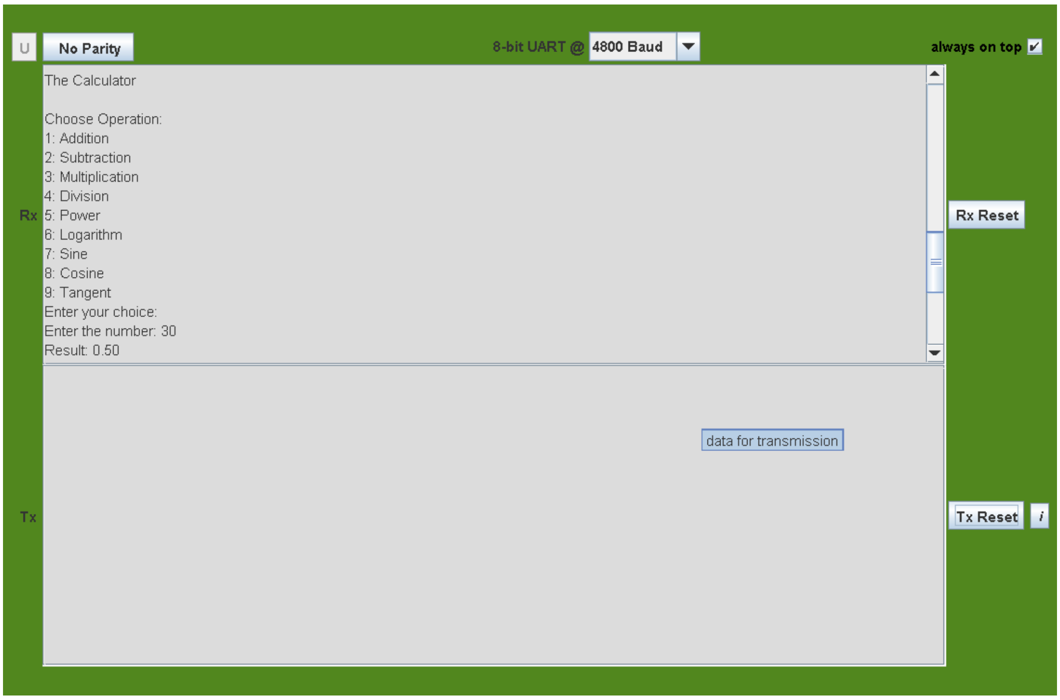


```
Result: 75.00


The Calculator

Choose Operation:
1: Addition
2: Subtraction
3: Multiplication
4: Division
5: Power
6: Logarithm
7: Sine
8: Cosine
9: Tangent
Enter your choice:
```

```
7
```



```
The Calculator

Choose Operation:
1: Addition
2: Subtraction
3: Multiplication
4: Division
5: Power
6: Logarithm
7: Sine
8: Cosine
9: Tangent
Enter your choice:
Enter the number: 30
Result: 0.50
```

Remarks:

- The code demonstrates efficient interfacing with peripherals such as UART for communication and an LCD for display.
- It provides a comprehensive set of mathematical functions including addition, subtraction, multiplication, division, exponentiation, logarithm, trigonometric and other arithmetic operations.
- The program ensures robust error handling, including division by zero and invalid input.
- Proper initialization and configuration of hardware peripherals are evident, enhancing reliability and performance.
- The use of clear and concise functions aids in readability and maintainability of the code.