Project Structure/Implementation:

Serial Calculator

Introduction

The **SerialCalculator** is a Windows based console app that communicates with a microcontroller through serial communication via USB to solve basic mathematical expressions. The microcontroller serves as a processing unit for the Serial communication dependent calculator.

This document's purpose is to give an overview of the implementation of the software structure, instructions to build the app, run the app, and test the app.

GitHub Link to Project: https://github.com/Mexperse/Serial-Calculator.git

Functional Overview

1. Arduino waits for a complete string expression from the serial port.
2. It parses the expression into two numbers and an operator.
3. It checks for errors (e.g., invalid format).
4. It performs arithmetic calculations.
5. It returns the result or error as a string.

Usage of A.I.

The A.I. intelliCode in Visual Studio was used for most of the comments on the code.

The use of Claude to help create the UML of the code.

The use of mermaid.live to generate the UML image from markdown.

The use of ChatGPT in debugging.

Software Architecture

This project is made up of two parts:

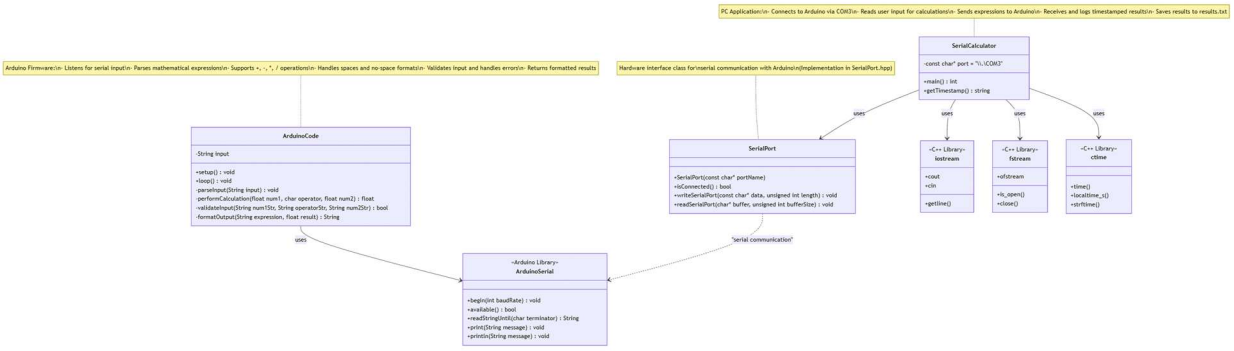
1. **Windows Console Application** (C++)
2. **Microcontroller Firmware** (C++ for Arduino)

The user enters the expression via the console; this is then sent over to the microcontroller over a serial connection. The microcontroller performs the calculation and returns the result, which is then displayed in the console.

Project Structure

UML Diagram

Figure 1 UML Diagram



Source: Generated using the prompt “Can you generate a UML diagram based on this code”

Key Components

Window Console Application

SerialCalculator.cpp

- It manages serial communication between the PC and microcontroller.
- Uses **SerialPort** library for serial communication.
- It opens and closes the serial port.
- Sends string expressions to the microcontroller.
- Receives the computed result.
- Displays the computed result or error.
- Saves the results to a **result.txt** file once the user types “**exit**”.

Microcontroller Firmware

ArduinoCode.ino

- Runs on the microcontroller (Arduino in this case).
- Evaluate the string expression sent from the **console**.
- Checks for error, otherwise computes the string.
- Sends the computed result back to the PC over **UART** (serial communication).

Communication Protocol

Data Flow

1. **PC** ➡ **Arduino**: Mathematical expression + newline (\n).
2. **Arduino** ➡ **PC**: Formatted result string.

Instructions On Compiling and Running the Software

Compiling and Running on the Windows CLI

Requirements:

- **Visual Studio**
- **SerialPort** library file (Installation in **UserManual.pdf**)
- **C++ desktop development components** installed:

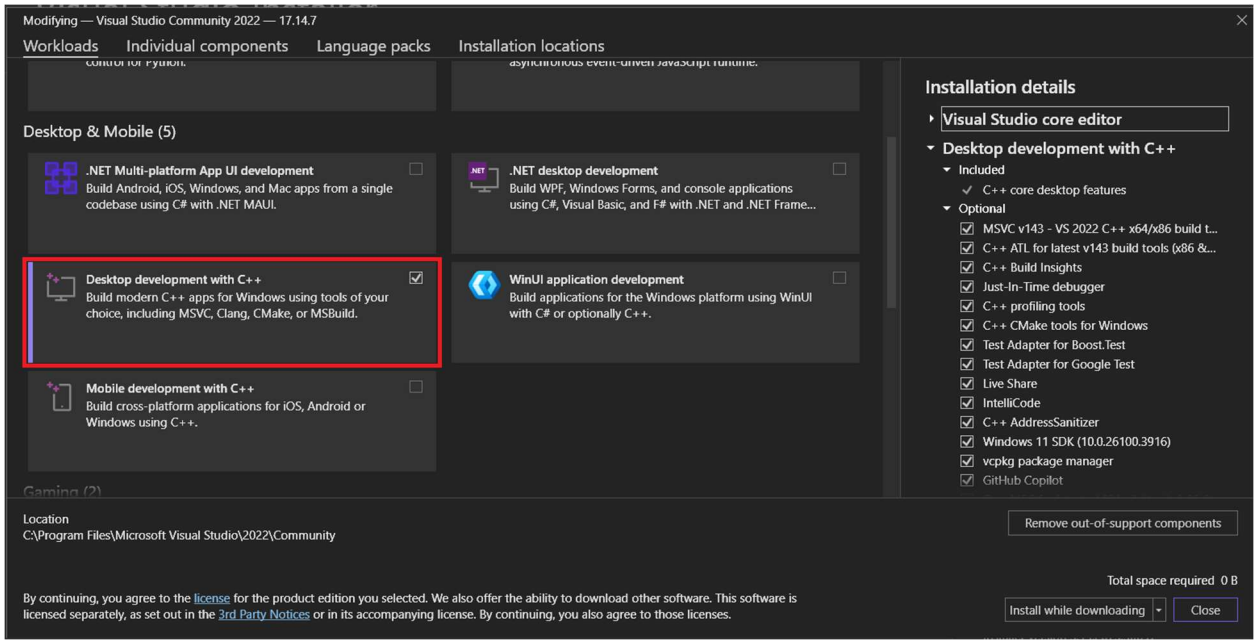


Figure 2 Install Desktop Development tool for C++

Steps:

1. Open *SerialCalculator.sln* in Visual Studio.
2. Click **Build** ➡ **Build Solution**.
3. Click **Start** (the play button looking icon) to run the application.

Uploading the Sketch to the Microcontroller

Requirements:

- Microcontroller (Arduino)
- **Arduino IDE**

Steps:

1. Open the *ArduinoCode.ino* in **Arduino IDE**.
2. Select the **board** being used and the **port**.
3. Click **Upload**.

Testing the connection

Steps:

1. Set the **COM port** in Visual Studio and **build**.
2. Open the *SerialCalculator.exe* application.
3. You can select the baud rate in *ArduinoCode.ino* to **9600** or as configured by the user.
4. Type a **mathematical expression** (basic) and press **Enter** to test.
5. If the setup is working correctly, the microcontroller will perform the calculation and display the result.

Note: Make sure the Serial Monitor in Arduino IDE is closed before using the **Conole App**, else, it won't connect because the **port** is busy.

Bibliography

Mandal, M (2020, Aprii 21). *SerialPort.* Github. https://github.com/manashmandal/SerialPort

OpenAI. (2025). ChatGPT (4-o) [Generative AI model]. https://chatgpt.com/

Microsoft. (2025). IntelliCode.

Anthropic. (2025). ClaudeAI (Sonnet 4) [Large language model]. https://claude.ai/

Mermaid. (2025). Mermaid Live Editor [Markdown to diagramming and charting tool]. https://mermaid.live/