Abstract of Simple Calculator Using Microcontroller Project

The Project requires building a calculator that works by performing the calculations on one side which is a microcontroller board, and getting inputs and showing outputs to the User on another side on the PC. This is great example on how to make a connection between both devices and working on having serial communication between them via RS232, we will be able at the end to manage code writing with C++ on the Visual Studio Code, using Compilers as G++, learning more about Arduino boards, practicing the Arduino Ide, and focusing on the functions that work best for the communications, since the core of the project is more than a calculator.

As mentioned, we start by installing the Visual Studio Code which is code editor, it is one of a lot other choices, we have also chosen the G++ compiler to convert the C++ language in the code editor into an executable program. The other side we can use the Arduino ide to write the code on and upload it to the board connected.

Building codes is mainly including the libraries needed that contains the functions that perform the target of the task, referring to the simple tasks that the program need, we search for every side for the suitable functions, writing them in the correct way, defining the variables, and adding the comments for better understanding of the codes

The method is introducing the functions that is needed to make a proper connection between both devices, this is the core of the project, we also need to identify the settings of both devices, since any mismatching will simply lead to disconnection between the codes, and thus not performing any task required.

It is good to start discovering the functions suitable to build the PC code, we will be able to get the functions from common libraries like iostream, windows.h, and fstream. These will help supplying us with the functions to perform the several orders we expect the code to do, like opening a serial port, we used the CreateFile that will attempt to open a serial channel, here COM3 chosen.

An important step also is knowing which parameters to choose for our serial port, we needed the GetCommState and SetCommState, these functions are basics to retrieve the current control settings for a specified serial port, and to configure the communication parameters from baud rate, this is the speed of the data transmitted over the serial port, this is measured per second, we chosen the rate of 19200 , it is a moderate speed and in our task it is fairly enough. Other parameters like the byte size which is the number of data bits transmitted in each byte, as we provided 8 bits in the program means that each byte of data contains 8 bits, and this is a standard byte size usually used. We also specify the stop bits, it is used to signal the end of a byte, this can affect the synchronization and error detection, and sure the Parity parameter which we set as a simple error checking, that is a form of error checking that add extra bit to each byte to ensure the number of bits with the value ‘1’ is even or odd.

Understanding and choosing the best parameters can serve on getting the proper function of the program, since not every task fit with the same parameter. In the chosen parameters we ensured the efficient data transmission and reliable communication that our task needs, they are common for many serial communication applications, providing a good balance between simplicity, speed, and reliability.

The PC code will mostly have the communication functions, in addition to some other components and simple details, other functions are also the WriteFile and the ReadFile, the mentioned functions respectively, works on sending the inputs that the User type after transferring them into strings, these strings are transferred over the RS232 in the shape of bytes and the board receive them in the same form and then transfer them to values to be calculated. The second function is taking the role of receiving the result from the Microcontroller either as a normal result from algebraic calculation or as a message that the order is invalid.

Main role of the code from this side is achieved, and we must add the other parts like the printing out functions and error message function, and defining the variables in the code. This completes one side of the project, and we step now to build the other side on the Arduino board.

The Arduino code is best working on its Arduino ide, and searching for the functions is probably easier since you will find everything in the official website of Arduino platform, as discussed previously, the project is mainly connecting programs, so the functions mainly will serve this purpose, from these functions we start with initializing the settings and then choosing the correct port and board used, after that and since the board is working as receiver of data from the PC, it should be able to check for any data being sent all the time, the function that serve this purpose referring to the website is the Serial.available().

Now we received the input, we should sure make the program read the data and having the values to calculate, this would be done by adding the Serial.readStringUntil(), in this part of reading and to be able to separate the positions of the commas in the string to get 2 numbers and an operation, indexOf and substring and get the components and then transfer them into numbers by String.toDouble.

We reached to the easy part that is defining the code to perform the operations and then last part is convert the result into a string again by String() function and send the string via the serial port by Serial.println().

We simply searched the libraries of each device and managed using the functions that best accomplish the task in each part, test the functions, defined the variables, setting configurations and assured the matching of them on both sides, and got the overall program to work efficiently, and the reading the results and having the board blinking normally with the operations will conclude for us the success of our project, and gaining knowledge in programming and Arduino boards tasks.

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