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# Title: Project Planning

# Outline of the Problem to be Solved

The project overall involves creating a software program that enables the writing robot to "draw out" text, based on a given file and text input. This program will read and interpret font data from SingleStrokeFont.txt, scale the text defined by the user input, and generate movement commands in G-code format to then be sent to the Arduino that controls the robotic arm’s movements.

All code must be developed using git for version control. This should include up to date commits as the project progresses for both documentations and codes. Also, an initial commit for the skeleton of the skeleton code.

As specified, the software must read the font data from the ‘SingleStrokeFont.txt’ file. After it is read, each character within the font file should be stored in a dynamic memory allocation, to free up the memory space once the robot has finished writing. This also ensures that the software has sufficient memory space and for the program to run at a faster time.

The program should ask the user to input the height of the text ranging from 4mm to 10mm. Create a function that adjusts the X and Y coordinates from the font file by a scale factor of to properly draw out the specified height in real life.

The code should read another text file that is obtained from the user keyboard’s input to draw out the text written within the file. The program should be able to process a file containing text of any length. This can be done by also storing it in a dynamic memory allocation to ensure there’s sufficient memory to run the software and automatically provides the right size array.

For each character within the text file, create a function that translates the font data into G-code commands. This function should include that each new letter that is instructed to be drawn, it must be offset in the X direction so that the letters won’t overlap each other. This is done by the starting position of the next character corresponds to the last position of the previous letter written. Another section to include within this function is to ensure that each text line are drawn with the space of 5mm apart from each other. This is prompted by the LF (ASCII 10) and CR (ASCII 13) codes respectively in the text file.

Finally a function that sends the G-code commands to the Arduino. These commands are then sent to the Arduino to communicate whether to raise or lower the pen and to control the arm’s movements to specific X-Y coordinates. The relevant commands of G-code that is related to the project is shown in Table 1. Once the pen finishes drawing, it should return to the point at origin (0,0) and rest once the pen is in a raised position.

|  |  |
| --- | --- |
| Command | Description |
| F1000 | feed rate, 1000 mm min−1 |
| G0 X Y | Move to the position X,Y |
| G1 X Y | Draw a straight line from the last position to X,Y |
| M3 | Turn on Spindle |
| S0 | Pen up |
| S1000 | Pen down |

**Table 1**: The relevant G-codes needed for the project.

# Key Data Items

|  |  |  |
| --- | --- | --- |
| Name | Data type | Rationale |
| **Character Data:** (ASCII Value(C), XYP Structure, Number of required to draw the character (N) | Structure | This data item is needed to define how the letter is drawn out by the robot. This needs to hold three numerical variables hence why it is a structure. This is extracting the data that describes each character from the font data file. |
| User Input (Text’s Height) | Float | This data item is needed as the user needs to input a height between 4mm to 10mm. This means it is a numerical value that can include decimal values. Hence why it is a float. |
| User Input (TextFile) | Strings (char) | Stored as a string as the text file name involves multiple characters that is considered a single item. This also contains ASCII characters hence why it is classified as ‘char.’ This data item is needed to specify which text file the user wants to draw out. |
| Scale factor (ScaleFactor) | Float | This data item is needed to properly draw out the specified height in real life. As it is originally 18 units in the font file. Since the scale factor is a fractional value, the data type needed is a float. |
| G-code commands | Structure | This data item is required to provide command to the Arduino and instruct the robotic arm’s movements and positions. |
| Text Data | Structure | This data item is needed to store the data from the text file. The reason why it needs to be a structure as there are multiple variables that describes how to draw each character. |

# Function Declarations

*Only include functions that you will develop.*

|  |
| --- |
| **void LoadFontData(char FontFile)**  Parameters: FontFile – Accessing the font data file to then store in the ‘CharacterData’ structure  Return Value: break if unsuccessful, 1 if it is successful |
| **Void LoadTextFile(char TextFile, struct Text \*original)**  Parameters: TextFile – Access the text file the user has specified to draw to the robot this then is  stored in a dynamic memory allocation  Text \* original – Where the ‘char’ characters are now converted to ‘int’ ASCII values.  Return Value – 1 if it is successful, 0 if failed |
| **void ScaledCoordinates(float ScaledFactor, struct Text \*original, struct Text \*scaled )**  Parameters: ScaledFactor – Input the scale factor to rescale the text properly  Text \*original – The original size of the text  Text \*scaled – The text being rescaled |
| **void GenerateGcode(struct Text \*scaled, struct \*Gcommand)**  Parameters: Text \*scaled – The scaled text  Gcommand – Converting the text to G-code  Return Value – 1 if it is successful, 0 if failed |
| **void SendtoArduino(char\* Gcommand)**  Parameters: Gcommand – Sending the G-code to the Arduino  Return Value – 1 if it is successful, 0 if failed |

# Testing Information

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| --- | --- | --- | --- |
| Function | Test Case | Test Data | Expected Output |
| LoadFontData | Load the font data file: ‘SingleStrokeFont.txt’ | The ‘SingleStrokeFont.txt’ is present and within the same folder | Font data correctly loaded into the structure. (Movement Data) |
| LoadFontData | Handle missing font file | No ‘SingleStrokeFont.txt’ is present within the folder | Display to the user ‘an error has occurred: file not found’ then exit the function |
| LoadTextFile | Load the text file specified by the user | The text file is found within the folder | Dynamically allocated memory stores ASCII values for each character. (Text Data) |
| LoadTextFile | Handle missing font file | No text file found within the folder | Display to the user ‘an error has occurred: file not found’ then exit the function |
| Main | Ensure that the letters’ size are adjusted correctly for the drawing bot | Change height input to be a constant variable: 4 | The variable for ScaledFactor should be 2/9 in decimal form |
| Main | The user has input outside the range of ‘4mm to 10mm’ height | User input: ‘2’ | Keep displaying to the user, ‘this is outside the allowable height of text range please try again and input between 4mm to 10mm’ |
| GenerateGcode | Attempt to generate the right G-code for a single character | Text file only containing: ‘H’ | G-code commands should be:  G1 0 0  S1000  G1 X0 Y18  S0  G0 X12 Y0  S1000  G1 X12 Y18  S0  G0 X0 Y9  S1000  G1 X12 Y9  S0  G0 X18 Y0 |
| SendtoArduino | Send G-code commands to the Arduino and verify acknowledgment | G-code: N/A | Program displays ‘Command not found, please check your Generate GCode function’ |

# Flowchart(s)

May be included as separate pdf