Final Project – Media Centre

COE718 – Embedded Systems Design

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1. Abstract

The media player implemented for the major project has various parts that utilize the instruments on the MCB1700 board and the methodologies and programming concepts learned in the course so far. The media centre's features include a photo gallery capable of displaying various BMP files, an MP3 player that streams audio tracks from the PC and a game center featuring a popular single player game called Flappy Bird. All these parts utilize the LCD panel and joystick of the MCB1700 board. This report will run down the specifications of the program and it will explain how everything was implemented using uVision.

2. Introduction

Embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. In this course, we covered the basics of embedded system organization, system on programmable-chip technologies and real-time systems. Embedded systems control many devices in common use today. We were introduced to software development concepts applicable to real-time and embedded systems in class. The study of ARM Cortex M3 was extremely useful when implanting this final project onto the MCB1700 board.

3. Methodology

The methodology used for the media project will be discussed here. I used functions to execute all the necessary parts of the program. Firstly, once the program is uploaded to the flash memory on the board, it will display the menu on the LCD panel. Users are able to choose between the 3 options (Photo Gallery, MP3 Player, Game) and select whichever option and the program will execute that command. At any time, users may press the LEFT on the joystick to return to the menu to choose another option.

If the Photo Gallery is selected, users are prompted to press a direction on the joystick to display a certain image. If users press the Up button on the joystick, the LCD panel will display a Red Flappy Bird. Down button will display a Blue Flappy Bird and Right will display a Black Flappy Bird. Once the user is finished with the photos of the Photo Gallery, they may press the Left joystick to return back to main menu. Another option a user may select is the MP3 Player.

Once the MP3 player is selected, users may play a MP3 file that will be played off the MCB1700 board. The potentiometer on the MCB1700 board can be used to control the volume of the song played. Again, users may press the Left joystick to return back to the main menu.

The last option that users may select is the Game option. When the Game option is selected using the Push Select Button on the joystick, they will be prompted with a screen on the LCD panel that describes how to play the game Flappy Bird. Users are asked to press Select to start the game. Once the Select button has been pressed, users will see a Flappy Bird on the left hand side of the LCD panel. Using the Select button, they are able to let the Bird flap into the sky. If nothing is pressed, the Flappy Bird will slowly fall. The goal of the game is to keep the Flappy Bird in side sky without it touching the top or bottom of the LCD panel. In addition, there are Tubes that appear from right side of the screen and move towards the Flappy Bird on the left. Another challenge appears as the user must avoid these tubes by either letting the bird rise or fall, avoiding the tubes approaching it. There is a score counter that keeps track of the distance that the Flappy Bird has traveled. If the Flappy Bird touches the bottom/top of the screen or touches the tubes, the game is over and a game ending screen will appear on the LCD panel. This screen will indicate the score that the user had achieved. At any time during the game or after the game, the user may press the Left joystick to return back to main menu and choose another option.

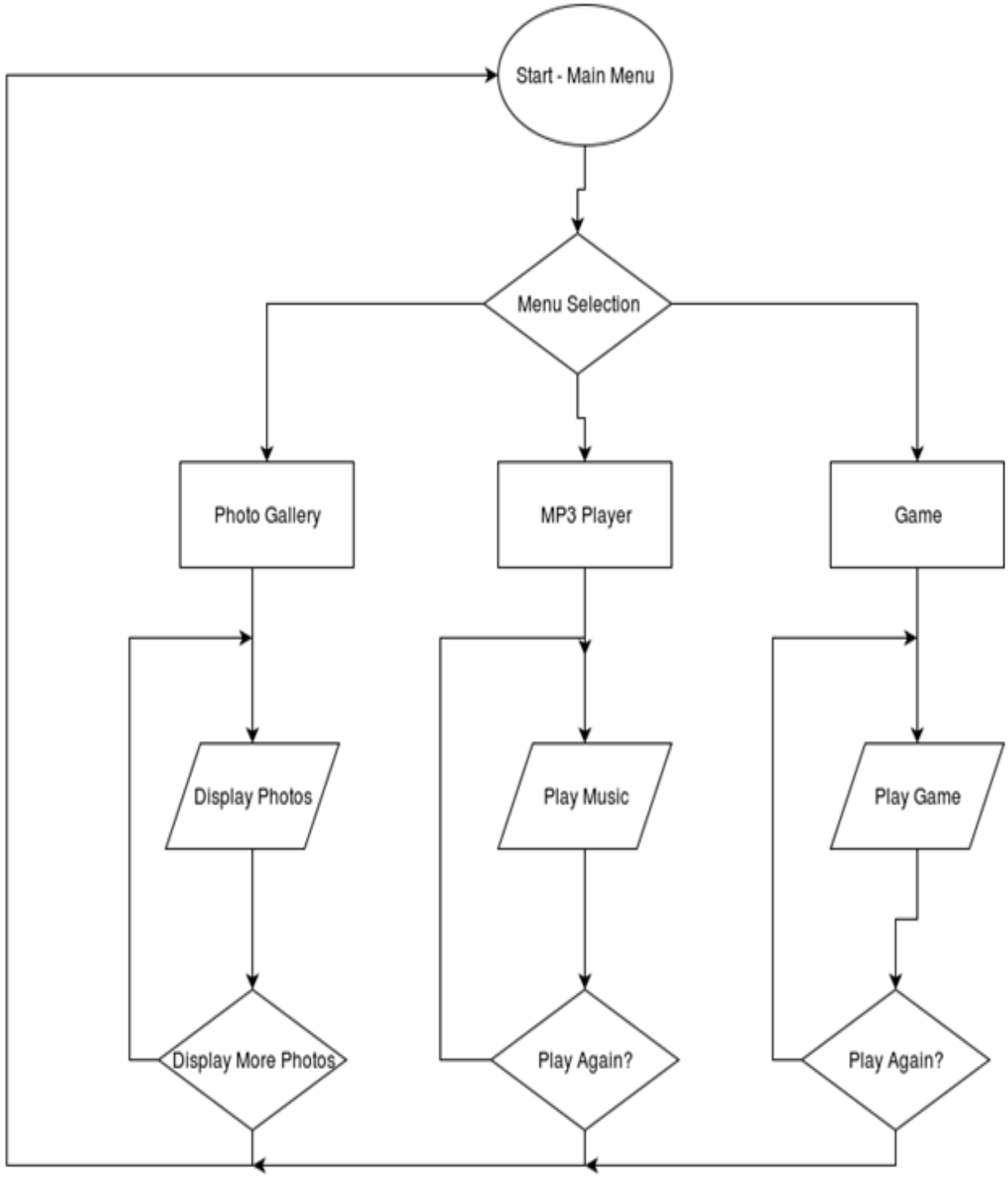

Figure 1 – Flowchart of Media Center

4. Design

The overall implementation of the media center will be discussed here. Most portions of the program are done with the concept of using functions to execute a certain function. With the use of functions, the implementation was not difficult. When the program gets uploaded to the flash memory of the MCB1700 board, the main will execute the menu function. The menu function starts off by clearing the LCD panel using GLCD commands and displaying the menu options. The selection variable is incremented or decremented depending on which option the joystick lands on. There is specific GLCD code depending on which menu is selected which highlights the one which is selected by the joystick. Whichever the joystick selects, the menu option will execute the function of that corresponding function.

For example, if the Photo Gallery is selected, the photogallery() function will be executed and the program will jump to that portion of the program. Inside the photogallery() function, the LCD panel is refreshed so that it can display the options for the user. The entire function after the LCD update is contained in a while loop so that the user may return to the menu if the Left joystick is pressed. Inside the while loop, the program checks which button is pressed and displays that corresponding image on the LCD panel. For example, if the Up joystick is pressed, the program will display the Blue Flappy Bird on the LCD panel. This is gone by clearing the LCD panel first, then having a LCD Bitmap on the LCD screen that takes up the entire 320x240 display.

When the MP3 player is selected, the music_player() function is executed. The music player files will play from the PC and sound will come off the MCB1700 board. The potentiometer of the MCB1700 board can control the volume of the MP3 player.

When the game() function is executed, the program jumps to that portion of the code. The game() function runs using structural programming. From the beginning of the program, the variables are initialized. These variables include the x and y coordinates of the Small Tube, Medium Tube and Large Tube. This also applies for the Tubes that appear upside down which is indicated as upSmall Tube, upMedium Tube, upLarge Tube. The program checks if the Select joystick is pressed and once it’s pressed the game begins. The Flappy Bird Bitmap coordinates of (5,120). This means the Flappy Bird image is placed on the x = 5 and y = 120 on the LCD panel. The Flappy Bird has a fixed x coordinate. When game starts, the Flappy Bird’s y coordinate will decrement by 1 for every clock cycle. This means that the bird will fall at a rate of 1 pixel per clock cycle. When the Select joystick is pressed, the Flappy Bird’s y coordinate will increment by 2 meaning it will rise. This is the fundamentals of the Flappy Bird’s implementation in the program. Whilst this is happening, tubes

appear from the right side of the screen. These tubes have a fixed y coordinate. For each clock cycle, the Tube's x values will decrement by 1, meaning they will move towards the left by 1 pixel every clock cycle. The entire game() function is inside a while loop.

This while loop checks if Left joystick is triggered. If the Left joystick is triggered, the program will exit the while loop and return back to the main menu. Alongside the game() function, I implemented reset() function that resets all the x and y coordinates of each tube and the Flappy Bird itself. There is also a gameover() function that is thrown whenever there is a case where the game is over and it will refresh the LCD screen. After the implementation of the Flappy Bird and Tubes moving as intended, the collision factors are checked for the program.

These collision factors are done in if else statements. The program checks the x coordinate of the Tubes to see if they are between 30 and 35 x value and it also checks the y position of the Flappy Bird. Since there are multiple sizes of Tubes, this is done a total of 6 times for 6 different scenarios. Whenever these if statements are true, the gameover() and reset() function is thrown which indicates that the Flappy Bird was not able to satisfy the fundamental goal of the game. There is also a scoring system that is implemented whenever the bird does not collide with a tube, the score counter is incremented. The entire game is programmed structurally. So the code runs from top to bottom and whenever something is done on the joystick, the game will respond

5. Experimental Results

Figure 2 – Main Menu

In figure 2, you can see the Main Menu on the LCD panel. You can see the background is yellow and the text at the top that indicate my name and course code is in red text. The menu options are in blue. Depending on which menu is selected, that corresponding menu option is highlighted with a blue background and have white text. This is done so it is easy for the user to know which menu option is selected.

Figure 3 – Gallery Options

In figure 3, the Gallery Options are displayed. The LCD updates to this when the Gallery Photo option is selected in the main menu. Here the options are displayed so users are able to pick which image they would like to display on the LCD panel. Once the corresponding joystick is pressed, the LCD panel will clear and display the 320x240 image. When the Up joystick is pressed, the Red Bird image (Figure 4) will display on the board. When the Right joystick is pressed, the Blue Bird image (Figure 5) will display on the LCD panel.

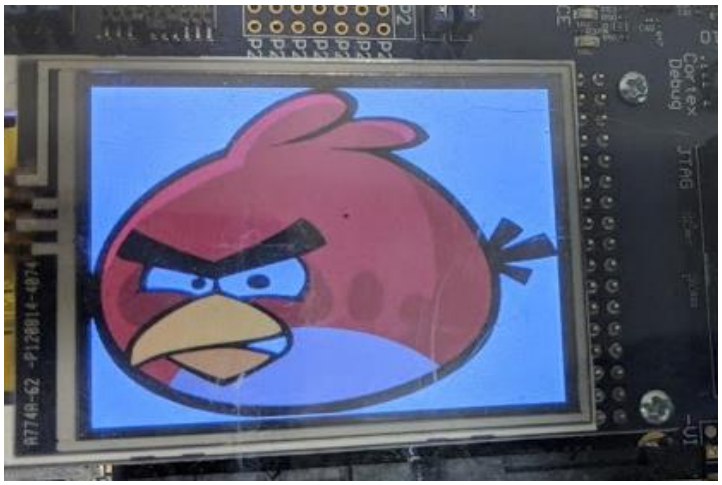

Figure 4 – Red Bird Image

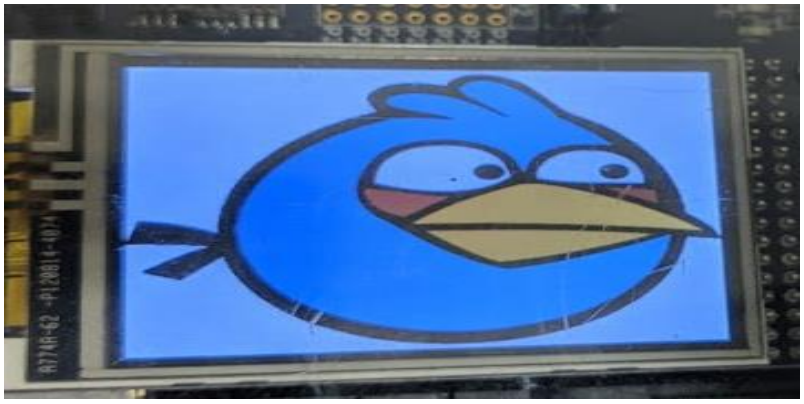

Figure 5 – Blue Bird Image

Figure 6 – MP3 Player Menu Option

Figure 7 – MP3 Player Indication

In figure 6, the LCD panel displays the Main Menu while the MP3 Player is selected. When the MP3 player is selected, the music player () function is thrown and that refreshes the LCD panel to indicate that the MP3 Player has been selected (Figure 7). When the PC plays a MP3 file, the music will play off the MCB1700 board and the potentiometer will control the volume of the board.

Figure 8 – Game Main Menu Selection

In figure 8, the Game menu in the Main Menu is selected and highlighted.

Figure 9 – Pre-Game Options

In figure 9, the Pre-Game options are displayed. This LCD screen is shown when the user pressed the Game option in the Main Menu. This screen displays how the game is to be played and the goal of the game. The game is fairly basic in terms of how to play. The user needs to keep the bird in the air whilst avoiding obstacles coming towards it.

Figure 10 – Beginning of Game

Figure 11 – First Tubes Appears

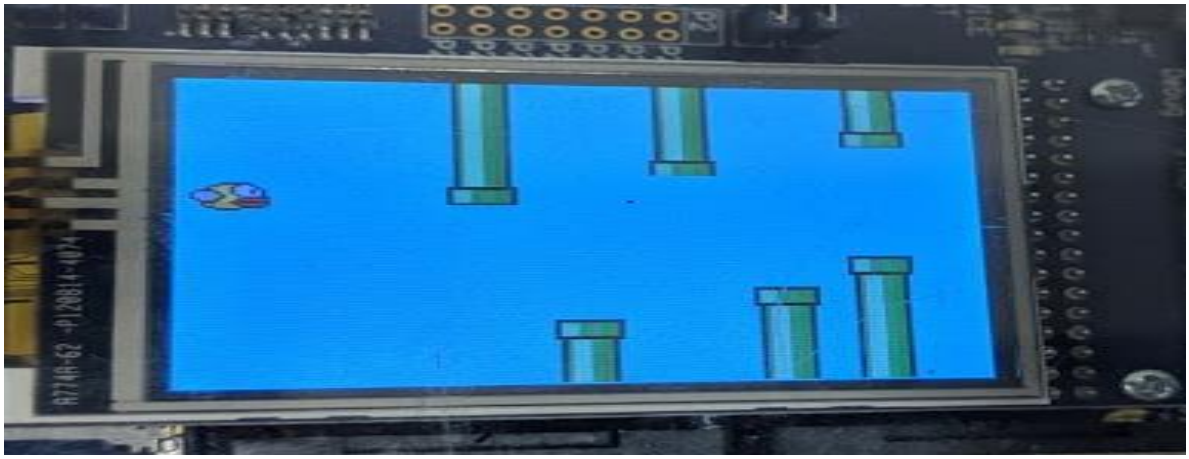

Figure 12 – First Wave Appears

Figure 13 – Game Over Screen

Once the Select button is pressed on the joystick, the bird will appear like in figure 10. At this point, the bird will slowly fall and the user needs to push the Select button on the joystick to keep the bird in the air. Tubes will appear from the right side as obstacles like in figure 11 and figure 12. If the Flappy Bird touches the bottom or top of the screen, the Game Over screen will appear as the user has failed to keep the Flappy Bird up in the air. If the Flappy Bird touches the Tubes, the Game Over screen will also appear.

6. Conclusion

Overall, the entire media player has been implemented successfully with very minor issues. Throughout this major project, there are various parts that utilize the instruments on the MCB1700 board and the methodologies and programming concepts learned in the course so far. The media centre that we have implemented features a photo gallery capable of displaying various BMP files, an MP3 player that streams audio tracks from the PC and a game center featuring a popular single player game called Flappy Bird. All these parts utilize the LCD panel and joystick of the MCB1700 board. In conclusion, the entire major project is a success and I have learned a lot from it.

7. Reference

1. Course Website

Khan, G. (n.d.). COE718 Major Project. Retrieved November 28, 2017, from https://www.ee.ryerson.ca/~courses//coe718

8. Appendix

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