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CSC 202
Final Project User Manual

The Dragonboard Microwave User Manual

Table Of Contents

Section 1. Introduction

Section 1.1 Welcome/Summary

Hello and thank you for your interest in using this dragonboard microwave simulation tool. This user manual will go over the initial software and hardware setup, a step by step run through the program, each of the outputs and inputs as well as a close look at the software.

Section 1.2 Intended Use

This program is meant to simulate a real world microwave without the heating element. It is in no way able to heat food or perform the core heating function of a microwave. This is merely a demonstration of the dragonboard capabilities and function.

Section 1.3 Warnings

- Do not disconnect components during execution
- Do not use the onboard power for the DC/Servo motor
- Make sure there is a fair amount of distance between an object and the ultrasonic sensor when starting
- Make sure you have adequate light when starting
- Make sure to reset the dragonboard before beginning each time
- Do not touch components not marked for input

Section 2. Preparation/Set-up

Follow the instructions below to prepare your dragonboard microwave for use. It is crucial to follow each instruction as described. Follow diagrams/illustrations provided to help with the set up.

2.1 Software Setup

1. Make sure you have Freescale CodeWarrior properly installed on your machine.
    a. Installation files can be found here: Freescale CodeWarrior
2. Make sure you have MiniIDE properly installed on your machine.
    a. Installation files can be found here: MiniIDE
3. Make sure you have the LBE Dragonboard 12 plus module installed on your machine and slotted into the root folder of HCS12X.

a. Installation files can be found here: LBE_dragonboard12_plus

4. If your Dragonboard has trouble connecting, download and install the following USB Driver.

2.2 Hardware Setup

The following section will describe in words the needed connections to ensure your dragonboard microwave works properly. It may be necessary to refer to the diagrams in section 2.3. Feel free to do so at any time.

The LED's

1. Starting with the red LED, grab one 1k Ohm resistor, and 2 jumper cables. Using a jumper cable connects ground to one end of the resistor while connecting the other end to the negative side of the LED on the breadboard (shorter end). Grab the second jumper cable and connect it to the positive side (longer end) and then connect it to PM2 under J90.
2. Repeat the same process as described above with the blue LED, however connect it to PE7 under J95 instead.

Ultrasonic Sensor

1. Using one jumper cable connect the Gnd of the ultrasonic sensor to ground.
2. Using one jumper cable connect the Vcc of the ultrasonic sensor to 5V on the dragonboard.
3. Using one jumper cable connect the Echo of the ultrasonic sensor to PT1 under J93.
4. Using one jumper cable connect the Trig of the ultrasonic sensor to PT0 under J93.

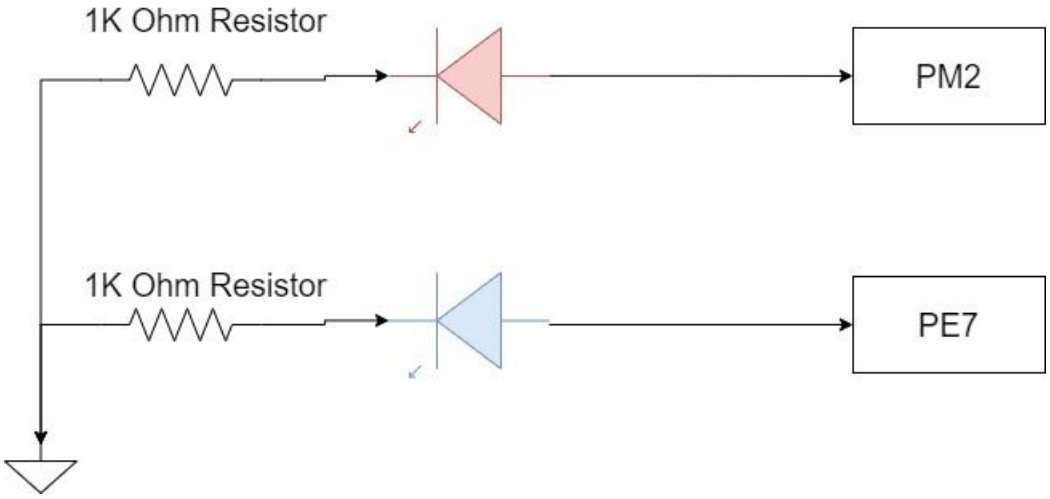
The Motors

The following description is needed for both motors using the HW-131 circuit power supply. Connect the power supply to a breadboard and make sure the right side jumper is placed on 5 volts. Next connect a 9 volt battery using the onboard plug in and turn on the circuit using the button. Make sure there is a jumper on external power under J25. Lastly connect the positive and ground to the respective + and - markings on the dragonboard under T3.

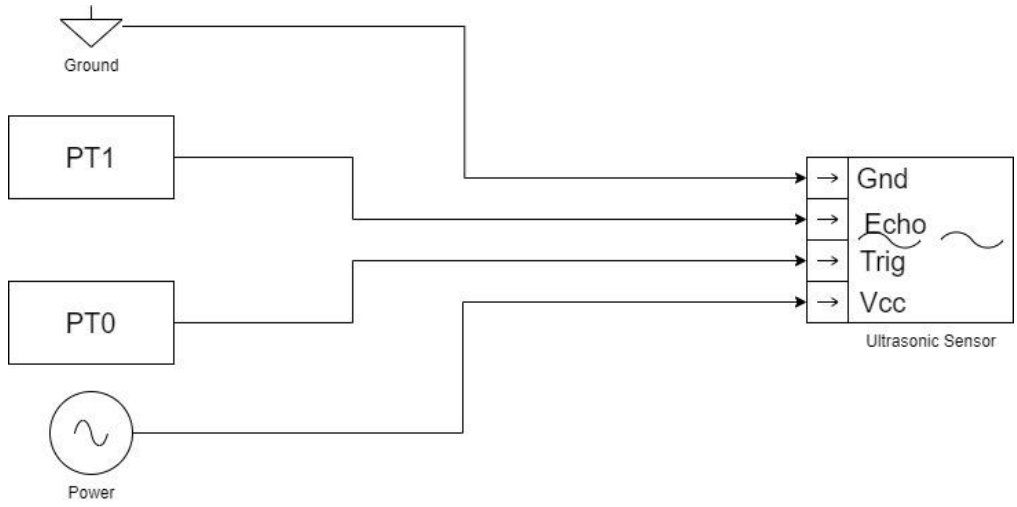
1. For the DC motor, connect its pins to M1 + M2.
2. For the servo motor, using three jumper cables connect the brown to ground, red to power and orange to J9 on the upper right hand corner of the board.

2.3 Hardware Diagrams

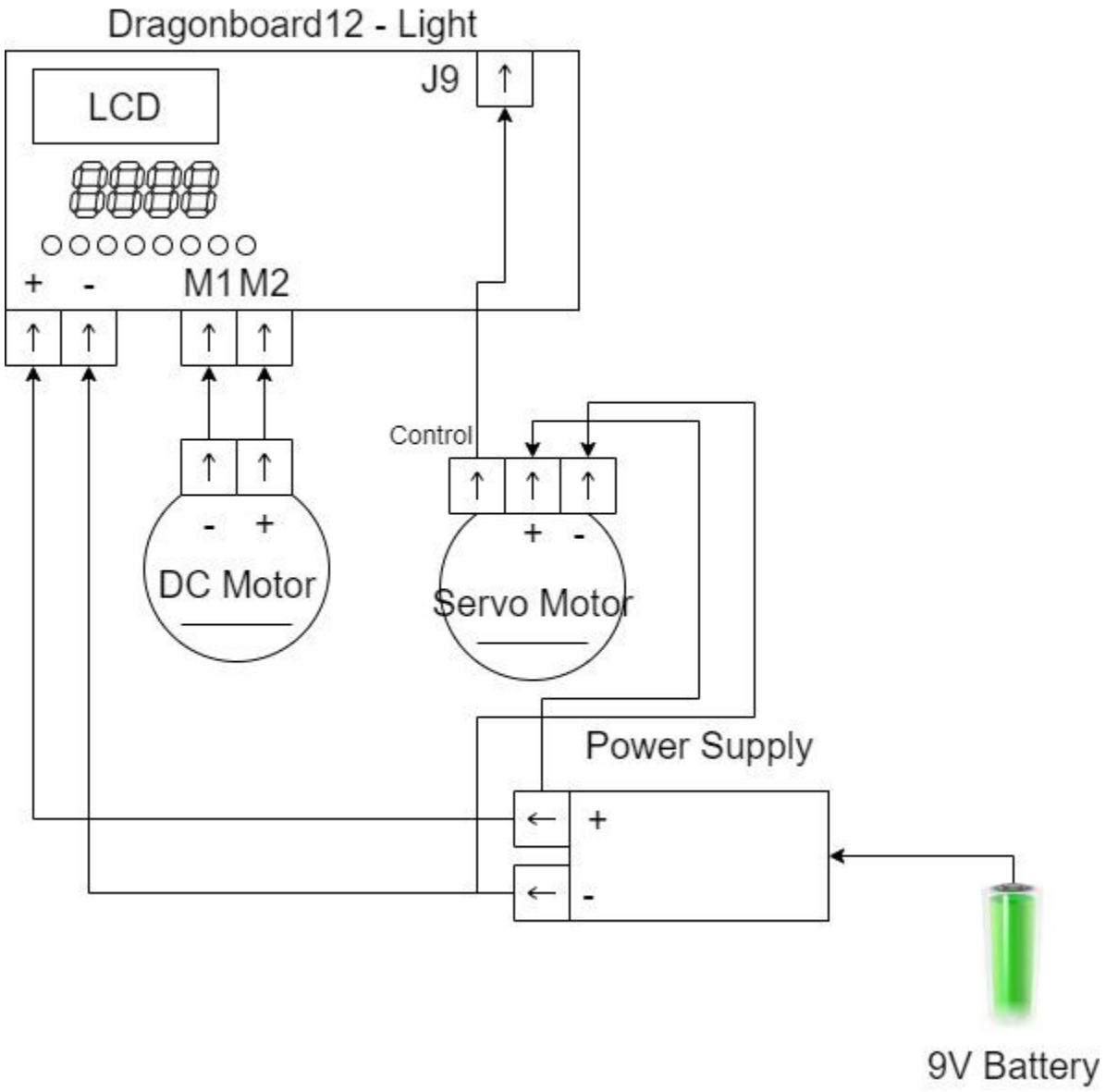
LED's



Ultrasonic Sensor



DC & Servo Motors



Section 3. Running the Program Step by Step

3.1 Starting the Program

When starting up the program it's important to follow the presented instructions closely. Failure to do so may cause the program to misbehave or not function correctly

Make sure you are connected via USB to the dragonboard and the 9V battery is supplying power. Next ensure the board is in “LOAD” under SW7 and press the reset button once. Next in Freescale CodeWarrior make sure the drop down option says “HCS12 Serial Monitor” and press run. Wait for the code to load and close the windows that pop open. Next, open MGTEK MiniIDE, navigate to the terminal and check connected. Lastly switch the board into “RUN” and press the reset button again. You have successfully started the program. The next sections will describe the step by step execution of the program, your options and more.

3.2 Waiting Stage

When loaded you will be displayed with a prompt on the LCD to enter time in seconds. You are able to use the keypad to enter a time from 0-99 seconds. Once you enter the second number the cooking will start and the program will move on to stage two.

3.3 Cooking Stage

The cooking stage has a lot of features and capabilities. First, the LCD display will show you how many seconds it has left to cook and countdown the number every second until zero. In addition it will display the current power level of the microwave. The DC motor will begin to spin emulating the food rotating and the servo motor will move 90 degrees simulating the microwave door locking. In addition the potentiometer can be turned to change the power level of the microwave.

3.4 Done Stage

Once the timer hits zero in the cooking stage the LCD will display an enjoy message that signifies cooking has completed. The onboard LED’s will flash in harmony with the speaker that

will beep repeatedly. The DC motor will also stop spinning and the servo motor will return to its original position signifying the microwave door unlocking.

3.5 Abort Stage

Anytime during execution you may press the SW5 button to abort/stop the current process whether it is mid cooking or finished cooking. Regardless the LCD will display an "Aborted" message for two seconds followed by the end of any flashing/beeping/motor spinning. The servo motor will also return to its original position (if it's not already there). At the end of those two seconds you will be put back into the waiting stage that prompts the user for input.

3.6 During execution features

It is important to notice that during any action the dragonboard microwave will take, a message will appear in the MiniIDE terminal that corresponds with this action. For a complete list refer to section 4.7 in the outputs. Next, the following features work during the cooking stage and onwards but not in the *waiting* stage. When the food is cooking, or done cooking the ultrasonic sensor will measure how close you are to the microwave and based on that it will either turn on/turn off a red LED. The red LED signifies you are too close to the heat. In addition if it is too dark the photo sensor will turn on a blue LED to provide the user light and turn it off if there is enough light. Both of these features work concurrently to provide the user the best experience.

Section 4. Outputs

This section highlights the meaning of each possible output in the dragonboard microwave. Notice an "X" represents a user's input that can vary or change. If you have further questions regarding how each piece interacts with the entire program please refer to section 3. It

is important to note that if any of the following occur when they are not designed to (although unlikely) this can be fixed by pressing the reset button.

4.1 External LED's

There are two external LED's, blue and red. When the blue one lights it signifies it is too dark during cooking and the dragonboard microwave thinks you need more light. The red one signifies you are too close to the cooking (within ~200mm) and you should be cautious.

4.2 Internal LED's

The internal 8 LED's light together on/off each second during the done stage (section 3.4). These signify that the food is done cooking. These are synchronized with the speaker.

4.3 Speaker

The internal speaker that beep's each second during the done stage (section 3.4). This signifies that the food is done cooking. These are synchronized with the internal LED's.

4.4 DC motor

The DC motor spins only during the cooking stage (section 3.3). It is meant to illustrate that the food is rotating during cooking.

4.5 Servo motor

The servo motor can turn 90 degrees back and forth when it enters the cooking stage (section 3.3) and exits it respectively. The 90 degree turns signify the microwave locking mechanism any time it begins or stops cooking. There is only one way it can lock, when the user gives a 0-99 second input. There are two ways it can unlock. When the food finishes cooking or the user presses the abort button during cooking.

4.6 LCD display

The LCD display is very important to how the user interacts with the program. It can display one of four possible outputs.

1. “**Enter Time**” and “Time: XX sec”. This is during the program section that is waiting for the user input (section 3.2).
2. “Cooking: XX sec” and “Power: X “. This is during the program section that cooks the food (section 3.3).
3. “**ENJOY**” and “Cooking Complete”. This is during the program section that signifies the food is done cooking (section 3.4).
4. “**ABORTED**” and “Returning…”. This is during the abort event that occurs when the user presses SW5 (section 3.5).

Each of the displays allows the user to see what’s currently happening during the execution and aids with user experience and interaction.

4.7 MiniIDE terminal

The MiniIDE terminal logs each and every action that occurs during execution (section 3.6). You are able to go back and look at what has previously occurred or keep track of what’s currently occurring by looking at the last entry. Muchlike with the LCD it is meant to aid with user experience and interaction. The following list is a detailed summary of the possible outputs to the terminal.. Refer to the attached sections to read about the stage of execution where the message may occur.

1. “**Waiting For Input**” - Section 3.2
2. “Cooking…” - Section 3.3
3. “**Finished Cooking**” - Section 3.4
4. “**Cooking Aborted**” - Section 3.5

5. “**Door Latched**” - Section 3.2
6. “**Door Unlatched**” - Section 3.4/Section 3.5
7. “**Adjusting Light**”- Section 3.3/Section 3.4/Section 3.5
8. “**Too Close Warning**” - Section 3.3/Section 3.4/Section 3.5
9. “**Power Changed**” - Section 3.3/Section 3.4/Section 3.5

Section 5. Inputs

5.1 Ultrasonic sensor

The ultrasonic sensor gathers data each second anytime past the waiting stage (section 3.2)(section 3.6). Through mathematics it translates the gathered data into a measurement in millimeters. This measurement is used to determine whether or not to turn on the red LED (within ~200mm).

5.2 Photo sensor

The photo sensor gathers data each second anytime past the waiting stage (section 3.2)(section 3.6). The data it measures is a value between 0-1023 signifying how bright/dark it is in the room. Generally below 100 is dim and below 30 is dark whereas above 250-500 it is extremely bright. This measurement is used to determine whether or not to turn on the blue LED (below ~30).

5.3 Hex keypad

This is one of the main tools the user can use to interact with the dragonboard microwave. During the waiting stage (section 3.2) the user can enter a value between 0-99 by pressing two values on the keypad. The moment the user enters the second value the cooking will begin entering the cooking stage (section 3.3).

5.4 Internal pushbutton

The pushbutton on SW5 is the abort or stop button that stops the cooking and resets the program. It can be pressed during *any* stage in the program to completely stop what's currently happening and reset the entire program. At the end the user ends up in the abort stage for ~2 seconds (section 3.5) and after in the waiting stage (section 3.2).

5.5 Potentiometer

The potentiometer updates the power setting of the microwave every second. It's current setting can be seen during the cooking stage (section 3.3) of the program. It is a value between (1-10) where 1 means the potentiometer is twisted all the way to the left whereas a 10 means the potentiometer is twisted all the way to the right.

Section 6. The Software

This is the last section of the user manual that describes the software aspect of this dragonboard microwave. Follow diagrams/illustrations provided to help with understanding of how this program functions.

6.1 Flow of execution

The main loop of the program is based on a one second delay from which everything else occurs. While around half of the program occurs within predetermined cooking stages, some code executes no matter what stage the cooking is on. Some of this code includes the ultrasonic sensor that controls the red LED and the photo sensor controlling the blue LED. This is because those parts of the program need to run nearly every second. The rest of the program such as different displays to the LCD, speakers, motors are all dependent on whether or not the food is done cooking. In addition, anytime an interrupt can occur through pressing SW5 that ends current execution and resets all stage variables back to their originals effectively restarting the

program. It's also important to mention that nearly after every action there is an output to the MiniIDE terminal that occurs.

6.2 Different stages

The main stage controlling variable controls most of the program based on what the microwave needs to do. It limits certain components of the dragonboard to only activate within a certain stage. For example there is only code in the cooking stage that activates the DC and servo motors and nowhere else. This ensures that the motors only work when they need to work. The following stages disable previous stages' components. The abort stage disables *all* components acting as a complete reset.

6.3 Software diagrams