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CSE 3342 Embedded Systems I

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This Project Report is submitted towards and in support of the partial completion of the requirements for the Embedded Systems I Course

In this project I attempted to build and create a device that is capable of handling chemical samples in a turret mounted test tube and being able to perform chemical analysis using colorimetry. this was achieved by using the combination of different devices shown in the parts list in Figure 1 below. the hardware was supported by code created Code Composer Studio and ran on an evaluation were created by TI, the TM4C123GH6PMI. the functions that the device was expected to execute were that the device should be capable of homing manually and automatically at startup. device is able to spin the turret to any location with the use of the UART. the device is capable of calibrating the RGB LED intensity for the analog in from the light sensor. the device is capable of showing the test results of a selected tube as a pH of the solution using either the phenol red solution or the OTO solution, and lastly the device should be able to be controlled using the IR remote to support the home calibrate tube and measure functions.

Part	Quantity
3D-printed turret	1
17PM-K374BN01CN stepper motor with cable	1
3D-printed motor base and optical mount	1
WP154A4SEJ3VBDZGC-CA RGB LED	1
TEPT5600 ambient light sensor	1
SN754410 motor driver	1
2N3904 transistor	3
4.7kohm resistor	6
10kohm resistor (light sensor current-to-voltage)	1
0.01uF capacitor (light sensor filter)	1
TM4C123GXL board	1
2x10 pin header, 2.54mm pitch	2
2-position terminal strip (motor)	2
3-position terminal strip (LED/sensor)	2
Test tube	6

Figure 1: Parts list of the devices used to create a turret mounted chemical samples analyzer.

In order for the code to support the hardware many functions were created to handle different aspects of the device such as a function to handle the remote inputs, UART inputs and outputs, PWM control for the LEDs, control for the stepper motor and most importantly the calibration and calculation to measure the pH values. The calculations for the pH values were handled by first measuring the RGB values for a given PH sample, in dividing them by their corresponding calibrated RGB values which were then further process by using the equation

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Calculated = pow(REL_Green, 2) + pow(REL_Green * REL_Blue, 2) +(REL_Green * REL_Blue)
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to get a more linear slope for each of the pH values. this was further processed by taking the norm of the values and multiplying that by the log base 10 to process out into a straight linear slope. This allowed me to measure any new pH liquids and be able to process that out to print the correct pH values.