**UNIVERSITY OF CALIFORNIA, DAVIS**
**Department of Electrical and Computer Engineering**
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**LAB 6 Verification**

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**Section Number/TA:** A08

| Date | TA Signature | Notes |
|---|---|---|
| 06/07 | | all requirement met !!<br>+ Good pattern locking system<br>+ message save option. |

Done!!

# Open-Ended IoT Project

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## 1. INTRODUCTION

This lab is about integrating what we learned throughout the quarter and our previous labs into creating a unique program. For our lab, we decided upon implementing a pattern lock passcode to unlock the screen of the OLED. To help make the system more interactive we decided upon adding a password reset option and a save option for the multi-tap texting from our lab 6 implementation. This will then be implemented on the CC3200 microcontroller with Amazon, which is a cloud based service that allows the CC3200 microcontroller to be connected to various services. More specifically, we will mainly focus on the email notification functionality by updating the user when the pattern has been reset and the amount of tries it took to unlock the pattern. The RESTful API allows the microcontroller to connect to the device shadow created in the AWS and update its information.

## 2. GOAL

The goal of this lab was to decode remote control signals received from the IR Receiver and interpret the buttons pressed. We will then implement the button pressed to work as arrow keys to help move the cursor so that a pattern could be implemented to unlock the OLED and gain access to the reset password and multi-taping functions. The RESTful API HTTP commands will be implemented to help connect to the thing created in the Amazon AWS. The AWS SNS trigger rule will also be used to help send email updates about the lock functions and sent messages.

## 3. LAB METHODS

### 3.1 Pattern Lock Implementation

The pattern lock we implemented is a 3 x 3 dot grid in which users need to unlock it by drawing line patterns connecting the correct dots in correct order. To store all the information of the 9 dots and display them on the OLED, we created an 2D-array with dimension 3 x 3 of struct CLetter named dots. For each dot we use the CLetter field x and y to store the coordinates of the dots and an integer c to store the color code of the dot. There are two possible colors for the dots: WHITE if the dot is unconnected, and GREEN if the dot is connected to the pattern. We then create two arrays of two-integer tuples to store the correct password and password entered by the user. Each tuple stores the 2D index of a dot from the dots 2D-array, and using the information from the tuple, we can draw the connected dots pattern and compare if the user entered pattern matches with the correct pattern.

To control the connection of dots with the IR receiver and remote control, we use the numerical buttons 2, 8, 4, 6, to control the movement of a cursor between the dots. When the cursor is on an unconnected dot, pressing button 5 will connect the dot with the last dot connected to the pattern. When realizing this feature, we would redraw the newly connected dot with the color green, add that dot's index tuple in the connected dots array, and draw lines connecting the newly connected dot with the last dot in the pattern. If there are unconnected dots on the path of the drawn line, that dot will also be redrawn in green and added to the connected dots array. When the LAST button is pressed, the program will compare if the tuples in the connected dots array matches with the key dots array. If the two array matches, the program will go into UNLOCKED mode and an AWS login message will be sent through email. If the two arrays don't match, the program will send an email saying authentication failed while showing the user how many times the wrong pattern is entered.

### 3.2 Reset Password Function

The reset password function is accessible in the UNLOCKED mode, and it has its dedicated mode called RESET_PWD. The reset password implementation uses the same code as the pattern entering code in the LOCKED mode. The only difference is upon hitting the LAST button, the dots pattern stored in the connected dots array will be copied to the key dots array, thus resetting the correct password. An AWS message will be sent to email when the new password is saved, and in the RESET_PWD mode, the users can also choose to press MUTE button to exit back to UNLOCKED mode without resetting the password.

### 3.3 Unlocked Interface and Texting

A menu mode was implemented and called UNLOCKED. This allowed for the changing of modes between the sending of emails, locking the pattern lock, and resetting the pattern lock. Upon unlocking the pattern lock, the mode is set to UNLOCKED and calls a function called showUnlockedInterface() which causes the OLED to display what buttons to press to access the three modes. To elaborate, if button 1 is pressed, then the mode is set to lock and then notifies the user that they have been logged out within the OLED. Additionally, it would then send them an

email of this through the use of the AWS by calling the http_post() function from lab 5. For the password reset, button 2 would need to be pressed and it would then display the information that the user might need to use the pattern reset and call the showLockedInterface(), which displays the setup needed to do the pattern on the OLED. Lastly, if button 3 is pressed, then the mode is set to TEXTING and calls the showTextingInterface(), which sets up the OLED so that the user can visualize the message created and any basic information that the user might need.

As previously mentioned, one of the functions implemented within our project includes multi tapping from Lab 3. To do this, we created a mode called TEXTING which allows for the multi-tap texting to be accessed. Within the actual multi-tapping texting code, if the button (LAST) is pressed then the http_post() function will be called to send the email containing the composed message. We also modified the http_post() function so that the content of the multi-tap buffer is used to compose the email message. We also then changed the function of the controls button 1, which originally changed the color of the message, so that the user could have the option to leave the texting mode and go back to the main menu.

Apart from changing the button 1 for multitap texting, we also added a save message option which checks if the buffer index is 0, then it sets the mode to UNLOCKED and calls the function showUnlockedInterface(), which displays the menu option. If the buffer index is greater than 0, then it displays the save option method in which the user is required to press button 0 to delete the message or 1 to save the message. Deleting the message would clear the buffer and would reset all variables needed to do the multi-tapping texting. If the user decides to save the message, then the variable called saved would be set to 1. In both cases, the UNLOCKED mode would then be set and would then call the showUnlockedInterface(). Therefore, next time the TEXTING mode is accessed, the saved variable would then print out the saved message onto the OLED and the saved variable would then be set to 0. This would then allow the user to continue the message on where they left off and allow for the saving of a new message.

## 4. DISCUSSION

We came up with the idea of this project based on the principle of combining the most reliable hardware to work with. Since we were unable to reliably determine the sound frequency from the provided microphone, we decided to use the more reliable IR receiver and OLED to construct our final project.

## 5. CONCLUSION

Within this lab we need to use the knowledge that we learned throughout our previous labs to make a pattern lock. This was done by using the CC3200 Launchpad to connect to the shadow device created on the AWS cloud. We then used the IR remote control for text input and to help implement a pattern lock. We also included the OLED to help display the pattern lock and to help display the composing message. This project was interactive by allowing the user to have access to unlock the OLED through a pattern lock, resetting the pattern password, and being able save or compose a message.

## 6. CONTRIBUTION

The contribution between our group is roughly equal. Jack is responsible for the programming the unlocking and password resetting interface. Anayeli is responsible for programming the multi-tab texting interface.