21COA202 Coursework

*F132708*

Semester 2

# FSMs

My finite state machine:



There are 4 main states. The first state SYNCHRONISATION prints Q every second until X is received then changes state to AFTER\_SYNC. In this state the names of extensions completed are printed followed by a new line character and the state is changed to AWAITING\_INPUT. In this state the program checks for any button inputs and handles scrolling up and down. It also handles scrolling descriptions when they are too long to show on the lcd. It also checks for if Select has been held for more than a seconds and displays the student ID and SRAM available. In this state if a Serial line has been received then it changes to PROCCESSING\_INPUT. In this state the program processes the Serial input. It checks what character the line began with and performs the suitable operations. E.g. “CAMain” will create a channel with id=’A’ and description=”Main”, VA10 will change the value of channel ‘A’ to 10 etc. After the incoming line has been processed the state is changed back to AWAITING\_INPUT.

Diagram

Description automatically generated

# 2 Data structures

Struct for channels:

Text

Description automatically generated

Code for initializing channel array:

A screenshot of a computer

Description automatically generated

Finite state machine:



Initialization:



Function for setting all channel values to starting values at the beginning, if there are values saved in EEPROM then load those instead:

Text

Description automatically generated

My functions for changing value, min, and max return false if there is an error (if the values entered are unsuitable or if the operation can not be done) and return true if the operation was successful.

Function for creating a channel (or changing description if it already exists):

Graphical user interface, text, application, email

Description automatically generatedFunction for changing the value of a channel:

Text

Description automatically generated

Functions for changing min and max values:

Graphical user interface, text, application, email

Description automatically generated

# 3 Debugging

I created a function that prints all my channels showing their id, description, value, min, max, average, previous values, and if they are active for debugging. I called this function whenever I made any changes to any channels so I could see if everything was working as intended. I will comment out any calls to this function before submitting.

Text

Description automatically generated

I created a function to clear EEPROM for debugging:

A picture containing graphical user interface

Description automatically generated

If I enter a string beginning with ‘\*’ it will clear EEPROM and reset all the channels:

Graphical user interface, text, application, email

Description automatically generated

# 4 Reflection

I implemented everything that the spec described, and everything works perfectly except RECENT. I had to make a compromise for RECENT because the Arduino does not have enough memory to store 64 values for 26 channels. Instead, I only store the most recent 12 values for every channel. The average for each channel is calculated using the most recent 12 values. Alternatively, I could have stored the last 64 values and limited the amount of channels instead.

At the beginning of the program, 26 empty channels are created. They are given starting default values and their ids are set to ‘?’. Whenever I create a channel by inputting a line beginning with ‘C’ the first blank channel is found (channel with id = ‘?’) and the id and description is changed to whatever has been inputted. E.g. “CAMain” will go through the list of channels and find the first channel with id = ‘?’, the id will be changed to ‘A’ and the description will be changed to “Main”. If there are no free channels available, then an error is presented.

I decided to create all the channels at the beginning in an array and set them to blank rather than creating a linked list and adding to it each time I create a channel, as this way I use a constant amount of memory. If I were to use a linked list my memory usage would increase with every channel which would present a lot more potential issues and could result in memory problems. This way I know that my program will always work.

# 5 UDCHARS

I used chareditor.com to create up and down arrow custom characters.

A picture containing text, indoor

Description automatically generated

Text

Description automatically generatedGraphical user interface, text

Description automatically generated with medium confidence

Text

Description automatically generated

# 6 FREERAM

I used the code from lab worksheet 3 to calculate the available SRAM. In my display\_channels function If the user is holding select and their student id is showing then I also display the amount of free SRAM:

*Text

Description automatically generated*

Graphical user interface, text, application, email

Description automatically generated

# 7 HCI

I created the Boolean variables left and right. If left is true then only show channels where the value is below the minimum, if right is true then only show channels where the value is above the maximum. I pass left and right into any function that calculates the amount of channels active or the next/previous channel active as these will change depending on whether left or right are true.

Graphical user interface, text, application

Description automatically generated

Function to find the number of active channels:

Graphical user interface, text, email

Description automatically generated

Function to find the index of the next active channel (SIZE(which is 26) indicates that there are no more active channels after the index given:

Graphical user interface, text, application

Description automatically generated

Function to find the index of the previous active channel. -1 indicates that there is no previous active channel:

Graphical user interface, text, application, email

Description automatically generated

# 8 EEPROM

To ensure that the values found in EEPROM have been written by my program I make the first byte of EEPROM a check byte that I set to a value defined by a macro EEPROM\_KEY every time I save to EEPROM (I set EEPROM\_KEY to 101). Every time my program starts it checks if the first byte of EEPROM matches EEPROM\_KEY and if it does it loads the values from EEPROM and if it does not match then I assume EEPROM has not been saved to previously and I create new blank channels instead.



Functions for loading data from EEPROM and saving data to EEPROM:

Text

Description automatically generated with low confidence

# 9 RECENT

The Arduino does not have enough memory to store the last 64 values for 26 channels so I made a compromise and only stored the last 12 values.

I created a macro PREVIOUS\_SIZE to hold the amount of previous values to be stored (set to 12). Byte average holds the average value for the channel. Byte previous[PREVIOIUS\_SIZE] is an array that holds the last 12 values. Byte n is a counter, it is incremented whenever a value is added. It is used to calculate the average. Once all spaces in previous have been filled n will no longer be incremented. I added code to update previous array and average and n to the change\_value function (called when V line received).

A picture containing text

Description automatically generated

Timeline

Description automatically generated

# 10 NAMES

*Text

Description automatically generated*Application

Description automatically generated with low confidence*I added code to my display\_channels function that prints the channel description on the lcd next to the average. Channel name is stored as a character array of length 16 called description in my channel struct.*

Text

Description automatically generated

# 11 SCROLL

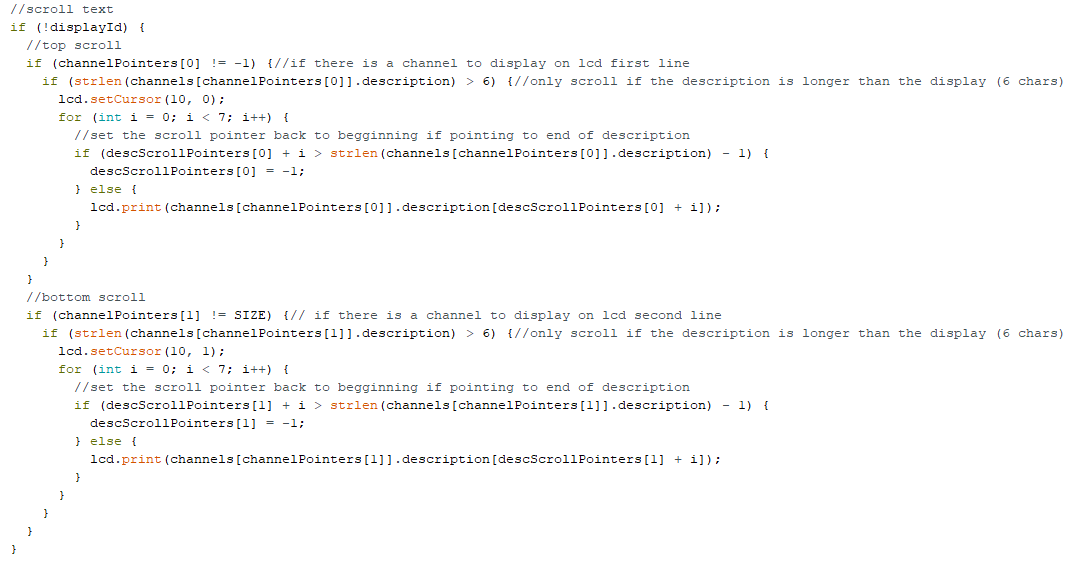
When the description of a channel being displayed on the lcd is too long to show it will scroll through at a rate of 1 character every 0.5 seconds.

Variables used for scrolling:

Text

Description automatically generated

This code is inside my loop for the AWAITING\_INPUT state:



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