# Joystick to Seven Segment Display

CE6302.301

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## Objective

Main aim of this project is to get the input value of one axis of the joystick, convert that value to the range 0 to 99 from the ADC value, and output that value on the LCD (seven segment) screen.

## Introduction

We use SimpleLink MSP432P4111 Launch Pad as the development kit with a 48MHz Arm Cortex-M4F as a core. It enables to develop high-precision sensor mode applications. We also use open source Energia as a prototyping platform to compile the program and upload it into the board. We use joystick as the sensor to control the display on the LCD and in turn represent the values on the seven-segment display.

## Components required

- MSP432P4111 LaunchPad
- Seven Segment LCD display
- Joystick

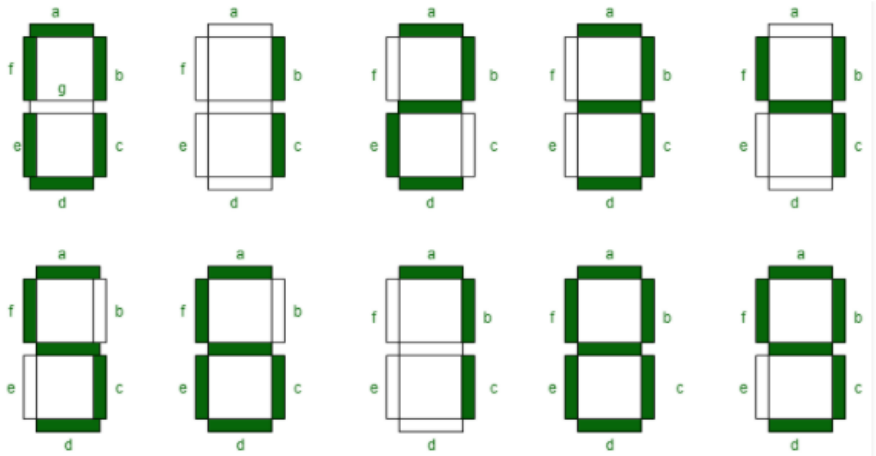
## Code overview

- In the program, we include several local libraries and header files of LCD screen
- We define constants for the Joystick pins
- We also set serial out put on the debug screen as Serial.begin(9600)
- Since we want to display the output continuously, we keep the part of the code in loop where we convert analog signal to values in the required range.
- We either select x or y axis of the joystick for this project
- We map analog signal in the range of 0 to 4096 to 0 to 99 ADC value
- x = map(analogRead(joystickXPin), 0, 4096, -3, 100); Please note that we had to shift bits to -3 and 100 to get the precise output.

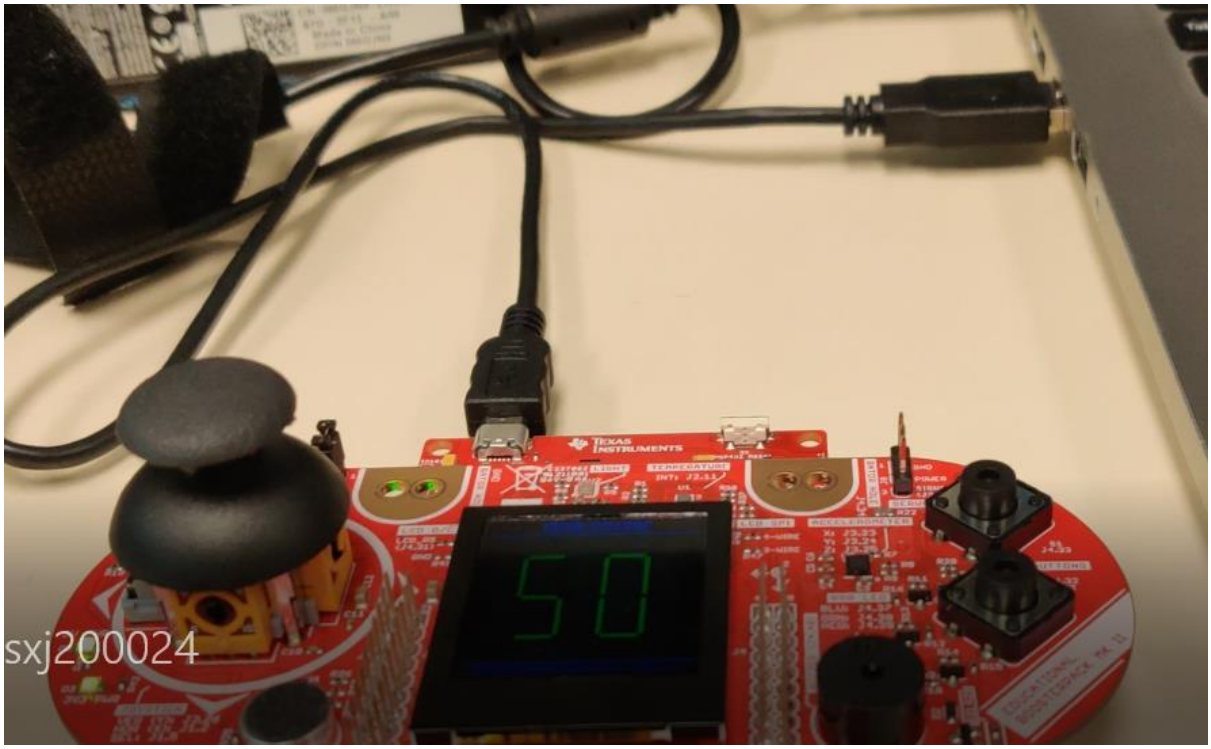
- Once we get a value, we have to manipulate it to get exact tens and ones bit in the LCD. Multiplication and mod function is used for this purpose
- This range is used to display the values on LCD.

# Figures

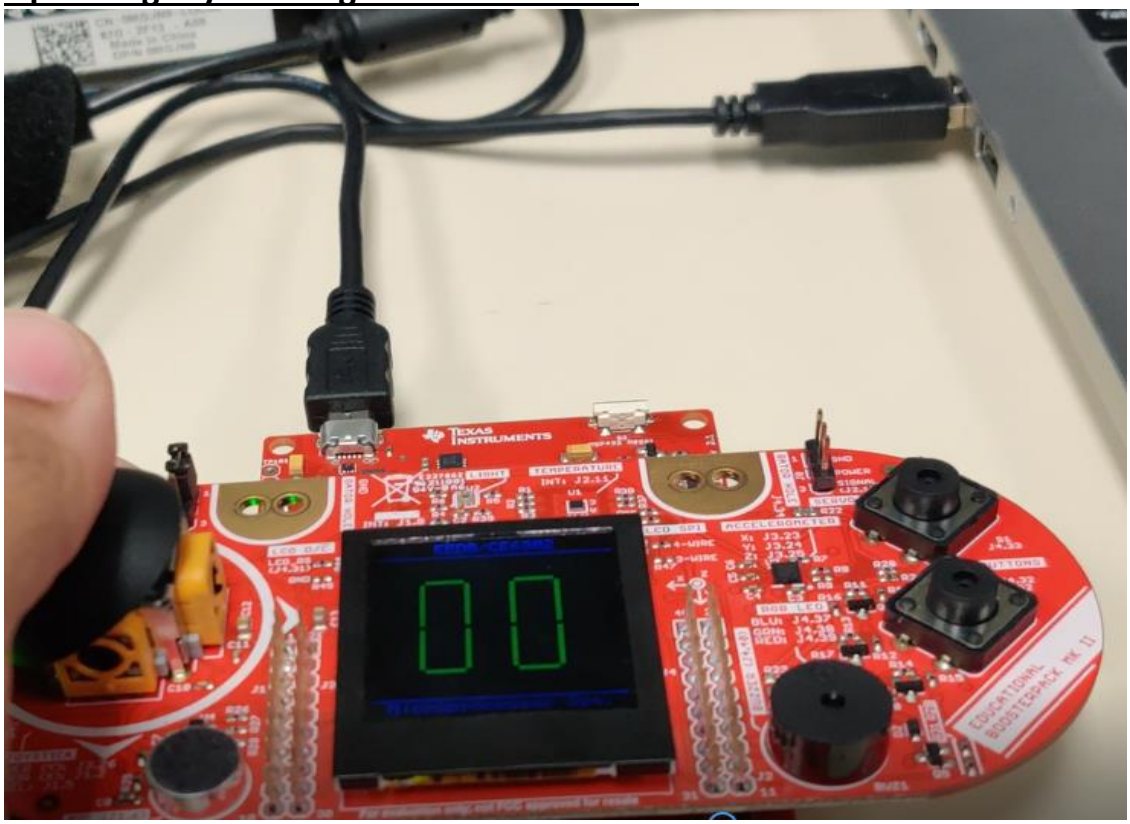
**Seven Segment display**



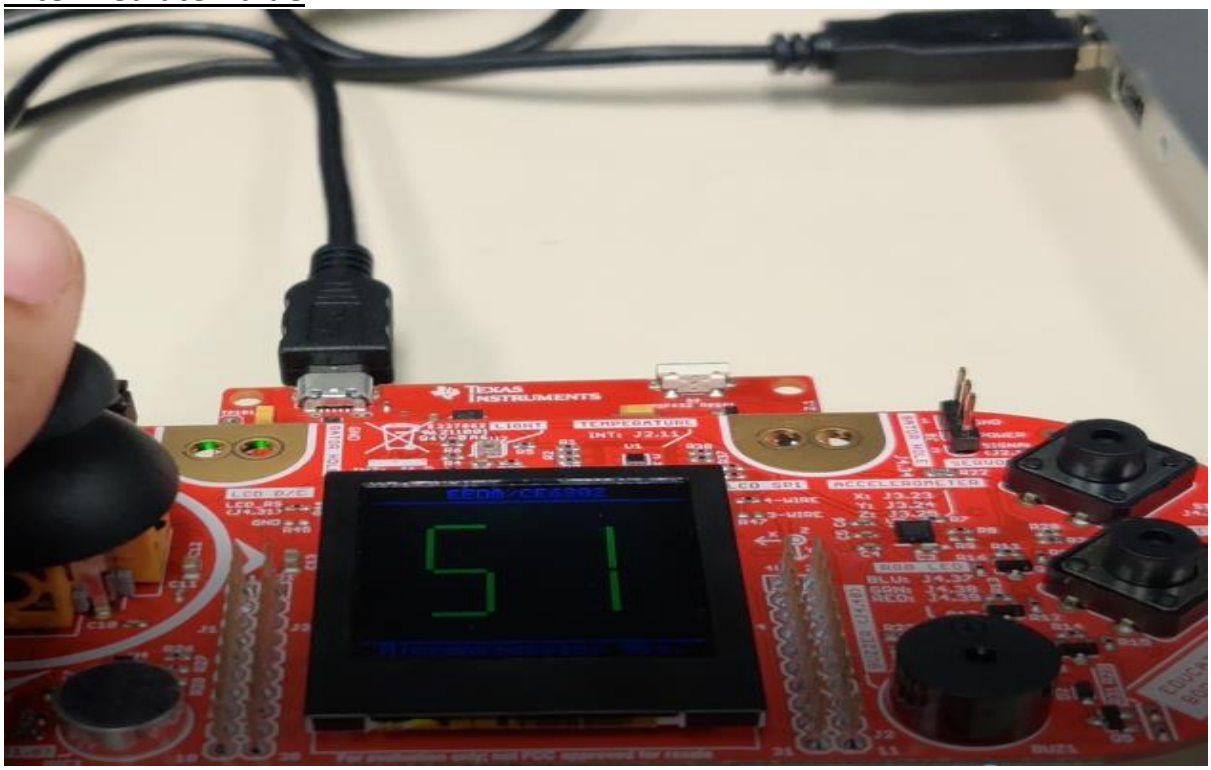

**Connection to the PC**



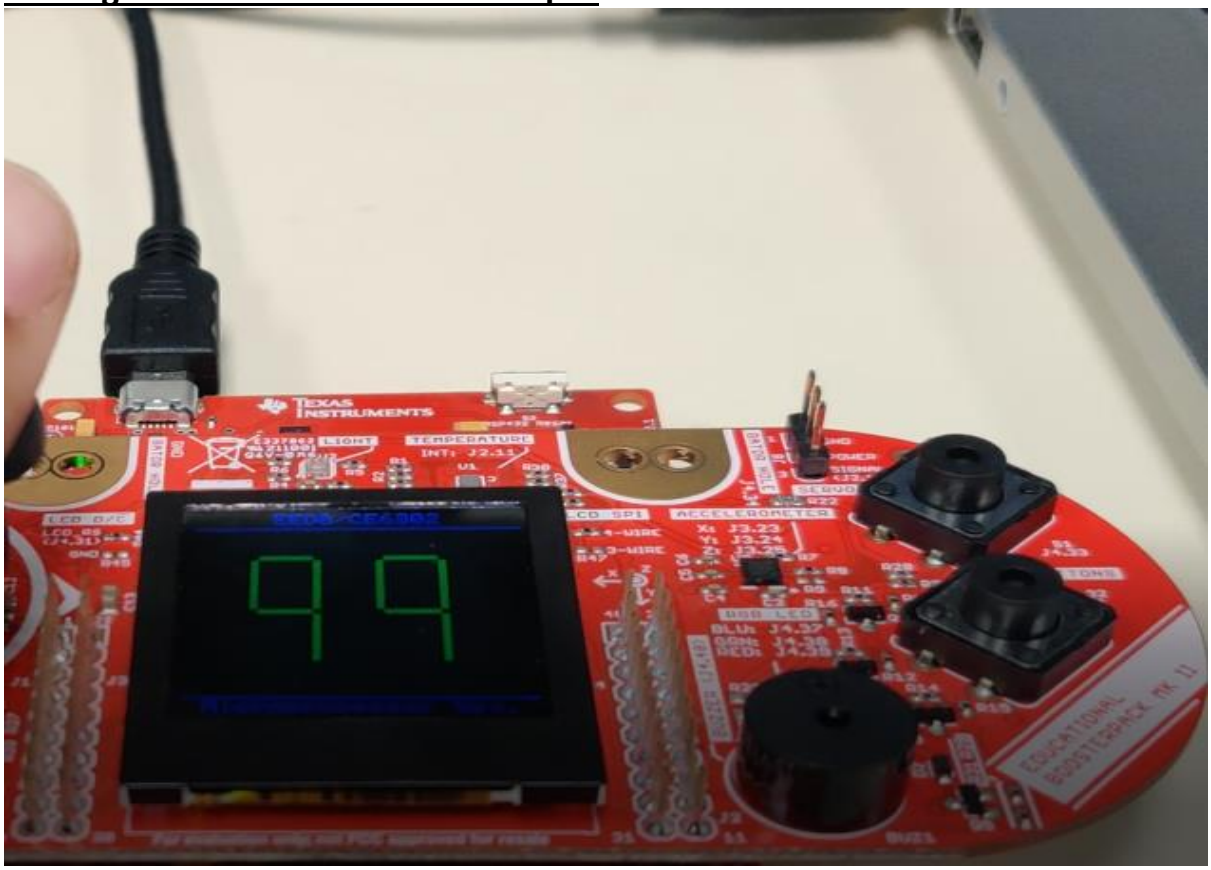
## Operating Joystick to get minimum value



## Intermediate Value




## Getting maximum value as the Output



## Code:

```
// Include application, user and local libraries
#include <SPI.h>
#include <LCD_screen.h>
#include <LCD_screen_font.h>
#include <LCD_utilities.h>
#include <Screen_HX8353E.h>
#include <Terminal12e.h>
#include <Terminal6e.h>
#include <Terminal8e.h>

// Declare header function with default values
void headerFooter(String header_text = "EEDG/CE6302",
                  String footer_text = "Microprocessor Sys.",
                  uint16_t color = blueColour);

// Define constants for the joystick pins
const int joystickXPin = 2;
const int joystickYPin = 26;
uint16_t x,x_n, y, x00, y00, High, Low;
uint16_t colour;
uint32_t z;

// Define screen
Screen_HX8353E myScreen;

/*
 * ---------------------------------------------------------------------------------------------
 * DO NOT EDIT CODE ABOVE THIS LINE
 * ---------------------------------------------------------------------------------------------
```

```
 */

// YOUR DECLARATIONS AND DEFINITIONS HERE

// Add setup code
void setup()
{
   /*
    * DO NOT EDIT BELOW THIS LINE
    */
   Serial.begin(9600); // for LCD debug output

   // By default MSP432 has analogRead() set to 10 bits.
   // This Sketch assumes 12 bits. Uncomment to line below to set analogRead()
   // to 12 bit resolution for MSP432.
   analogReadResolution(12);

   // Init screen
   myScreen.begin();
   myScreen.setPenSolid(true);

   // Print info screen
   infoScreen();
   delay(2000);

   // Clear screen and put header and footer on screen
   myScreen.clear();
   headerFooter();
   /*
    * DO NOT EDIT ABOVE THIS LINE
    */
```

```
    // YOUR SETUP CODE HERE (runs once)
    High = 120;
    Low = 10;
}

// Add loop code
void loop()
{
    // YOUR LOOP CODE HERE (runs continuously after setup function)
        x = map(analogRead(joystickXPin), 0, 4096, -3, 100);
    y = map(analogRead(joystickYPin), 0, 4096, 128, 0);
        setTens(x/10);
        setOnes(x%10);



}


/*
 * ------------------------------------------------------------------------------------------
 * DO NOT EDIT CODE BELOW THIS LINE
 * ------------------------------------------------------------------------------------------
 */
// Set specific colors
// Possible colors:
//  white, red, green, blue, yellow, cyan, orange, magenta, violet, gray, darkGray
const uint16_t digit_color = greenColour;
const uint16_t header_color = blueColour;
const uint16_t error_color = redColour;
```

```
// Define error variables
bool error_flag = true;
bool one_error = false;
bool ten_error = false;
uint16_t last_x = 0;

// Segment on/off definitions
//////// 1  //////
/////   _____
/////  |     |
//// 2 |     |  6
/////  |__3__|
/////  |     |
/////4 |     |  7
/////  |__5__|

// Segment mask
bool num_seg[11][7]={
  {1,1,0,1,1,1,1},
  {0,0,0,0,0,1,1},
  {1,0,1,1,1,1,0},
  {1,0,1,0,1,1,1},
  {0,1,1,0,0,1,1},
  {1,1,1,0,1,0,1},
  {0,1,1,1,1,0,1},
  {1,0,0,0,0,1,1},
  {1,1,1,1,1,1,1},
  {1,1,1,0,0,1,1},
  {1,1,1,1,1,0,0},
  };
```

```
// Digit pixel map
uint16_t sev_seg0[7][4] = {
                    { 3, 0,21,3},
                    { 0, 3,3,32},
                    { 3,35,21,3},
                    { 0,38,3,29},
                    { 3,67,21,3},
                    {24, 3,3,32},
                    {24,38,3,29}
                    };
// Draw a number at a given (x, y) position with (0,0) at top left
void drawNumber(int value, uint16_t x_offset, uint16_t y_offset, uint16_t color){
  // Handle header before drawing digit
  // This should probably be its own function or the whole thing should be a class
  if (one_error | ten_error)
  {
    // Use error flag to prevent redrawing the header in event of no error
    error_flag = true;
    headerFooter(">>>>>> ERROR <<<<<<", "Check serial monitor!", error_color);
  } else if (error_flag){
    error_flag = false;
    clearHeaderFooter();
    headerFooter();
  }
  // Draw rectangles for each segment
  for(int i=0;i<7;i++){
        if(num_seg[value][i])
          myScreen.dRectangle(sev_seg0[i][0] + x_offset,
                    sev_seg0[i][1] + y_offset,
                    sev_seg0[i][2],
                    sev_seg0[i][3],
```

```
                    color);
        else
          myScreen.dRectangle(sev_seg0[i][0] + x_offset,
                    sev_seg0[i][1] + y_offset,
                    sev_seg0[i][2],
                    sev_seg0[i][3],
                    blackColour);
      }

}

// Output the ones digit to the seven segment display
void setTens(int value) {
  // Offset definitions for tens digit
  uint16_t x_offset = 24;
  uint16_t y_offset = 29;

  // Error check and draw digit or 'E' for error
  if (value > 9) {
     ten_error = true;
     Serial.print("[ERROR]: Tens digit value of ");
     Serial.print(value);
     Serial.println(" is outside of expected range (0-9)!");
    drawNumber(10, x_offset, y_offset, error_color);
  } else {
     ten_error = false;
    drawNumber(value, x_offset, y_offset, digit_color);
  }
}

// Output the ones digit to the seven segment display
```

```
void setOnes(int value) {
  // Offset definitions for ones digit
  uint16_t x_offset = 72;
  uint16_t y_offset = 29;

  // Error check and draw digit or 'E' for error
  if (value > 9) {
     one_error = true;
     Serial.print("[ERROR]: Ones digit value of ");
     Serial.print(value);
     Serial.println(" is outside of expected range (0-9)!");
    drawNumber(10, x_offset, y_offset, error_color);
  } else {
     one_error = false;
    drawNumber(value, x_offset, y_offset, digit_color);
  }
}

void headerFooter(String header_text,
                  String footer_text,
                  uint16_t color) {
  // Determine header and footer x positions (in center)
  uint16_t header_x = (myScreen.screenSizeX() - myScreen.fontSizeX() *
header_text.length())/2;
  uint16_t footer_x = (myScreen.screenSizeX() - myScreen.fontSizeX() *
footer_text.length())/2;

  // Write out header and footer and lines to seperate
  myScreen.gText(header_x, 0, header_text, color);
  myScreen.gText(footer_x, myScreen.screenSizeY()-myScreen.fontSizeY()-1, footer_text,
color);
  myScreen.dLine(0, myScreen.fontSizeY() + 2, myScreen.screenSizeX(), 1, color);
```

```
  myScreen.dLine(0, myScreen.screenSizeY()-myScreen.fontSizeY()-3,
myScreen.screenSizeX(), 1, color);
}

// Clears the header and footer area
// Only needs to be done when going from error to regular
void clearHeaderFooter() {
  myScreen.dRectangle(0, 0, myScreen.screenSizeX(), myScreen.fontSizeY(), blackColour);
  myScreen.dRectangle(0, myScreen.screenSizeY()-myScreen.fontSizeY()-1,
myScreen.screenSizeX(), myScreen.fontSizeY(), blackColour);
}

void infoScreen() {
  // Print background
  myScreen.clear(cyanColour);

  // Top lines
  String line1 = " EEDG/CE 6302 ";
  String line2 = " MSP432: LCD Lab ";
  uint16_t t1_width = myScreen.fontSizeX() * line1.length();
  uint16_t t2_width = myScreen.fontSizeX() * line2.length();

  myScreen.dLine((myScreen.screenSizeX() - t1_width)/2, 4, t1_width, 1, blueColour);
  myScreen.gText((myScreen.screenSizeX() - t1_width)/2, 5, line1, whiteColour, blueColour);
  myScreen.gText((myScreen.screenSizeX() - t2_width)/2, 5 + myScreen.fontSizeY() * 1, line2,
whiteColour, blueColour);

  // Bottom lines
  String line4_bot = " Created by: ";
  String line3_bot = " Qilin Si ";
  String line2_bot = " & ";
  String line1_bot = " Max Steele ";
```

```
  uint16_t b1_width = myScreen.fontSizeX() * line1_bot.length();
  uint16_t b2_width = myScreen.fontSizeX() * line2_bot.length();
  uint16_t b3_width = myScreen.fontSizeX() * line3_bot.length();
  uint16_t b4_width = myScreen.fontSizeX() * line4_bot.length();


  myScreen.gText((myScreen.screenSizeX() - b1_width)/2, myScreen.screenSizeY() - (5 +
myScreen.fontSizeY() * 1), line1_bot, whiteColour, blueColour);
  myScreen.gText((myScreen.screenSizeX() - b2_width)/2, myScreen.screenSizeY() - (5 +
myScreen.fontSizeY() * 2), line2_bot, whiteColour, blueColour);
  myScreen.gText((myScreen.screenSizeX() - b3_width)/2, myScreen.screenSizeY() - (5 +
myScreen.fontSizeY() * 3), line3_bot, whiteColour, blueColour);
  myScreen.gText((myScreen.screenSizeX() - b4_width)/2, myScreen.screenSizeY() - (5 +
myScreen.fontSizeY() * 4), line4_bot, whiteColour, blueColour);
  myScreen.dLine((myScreen.screenSizeX() - b4_width)/2, myScreen.screenSizeY() - (5 +
myScreen.fontSizeY() * 4) - 1, b4_width, 1, blueColour);
}
```

# THANK YOU