ELP305: DESIGN AND SYSTEM LABORATORY

EXPERIMENT 3: A Quick-and-Dirty Function Generator

GROUP NUMBER: 22
EXPERIMENT COMPLETED ON: 05/03/2018
SUBMITTED ON: 10/03/2018

SUBMITTED BY:
DRASHTI KHATSURIYA(2015MT10598)
CHARVI NAHAR(2015MT10595)
AVINASH KUMAR(2015MT10319)

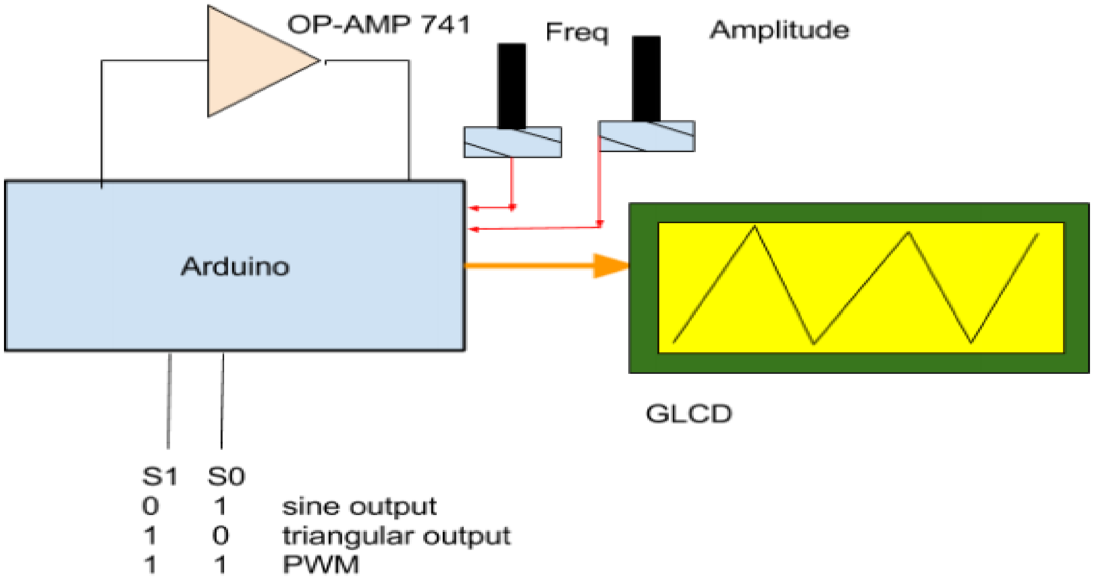
Objective: Producing square, triangular and sine waveforms using a microcontroller and vary the amplitude and frequency of the waves.

Apparatus Required: Arduino, GLCD, Push button, Breadboard, connecting wires, Potentiometer, Op-amp 741

Challenges Faced:

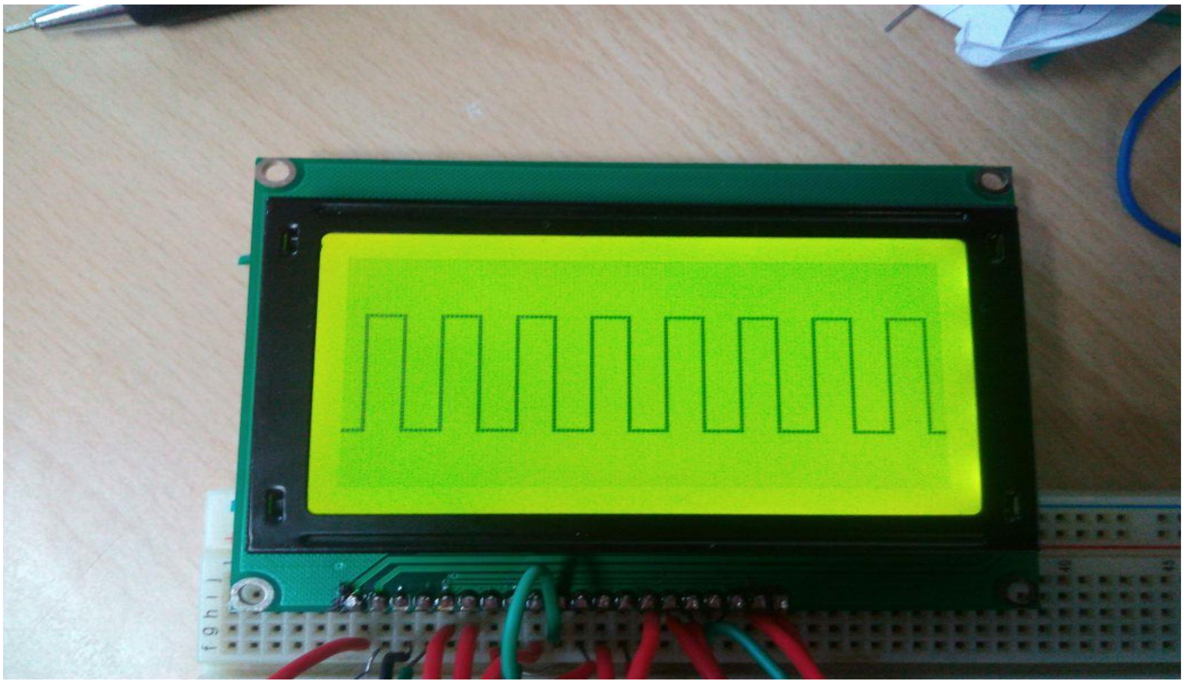
- We had difficulty due to the error stk500_getsync() and it took us time to realize that the GLCD should not be connected with Arduino while uploading the program.
- Connections between the glcd and arduino were difficult and it took us more than one lab turn to complete the experiment.

Block Diagram:

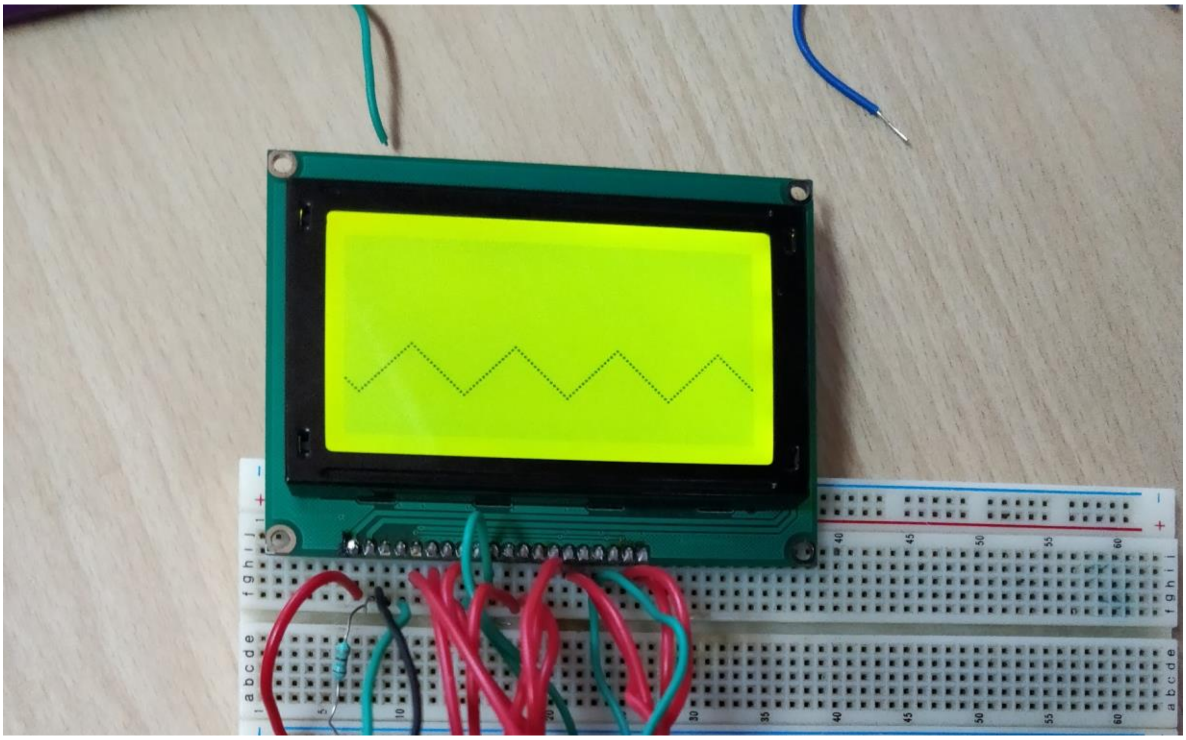


Observations:

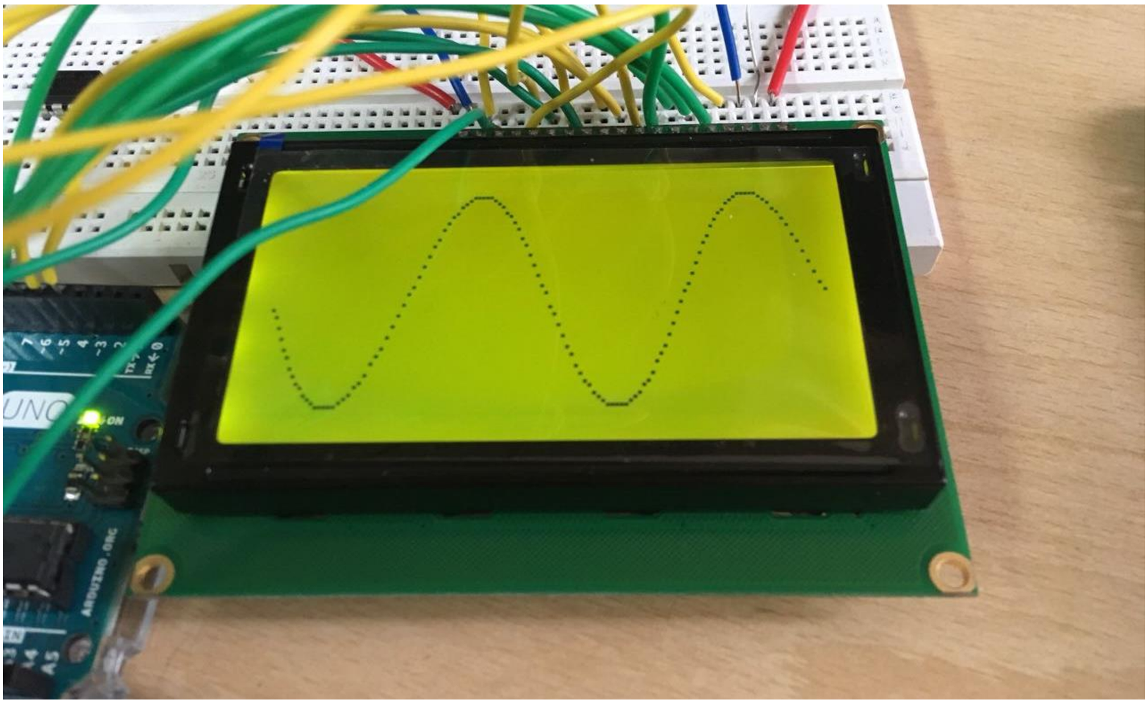
1) Square wave



2) Triangular wave

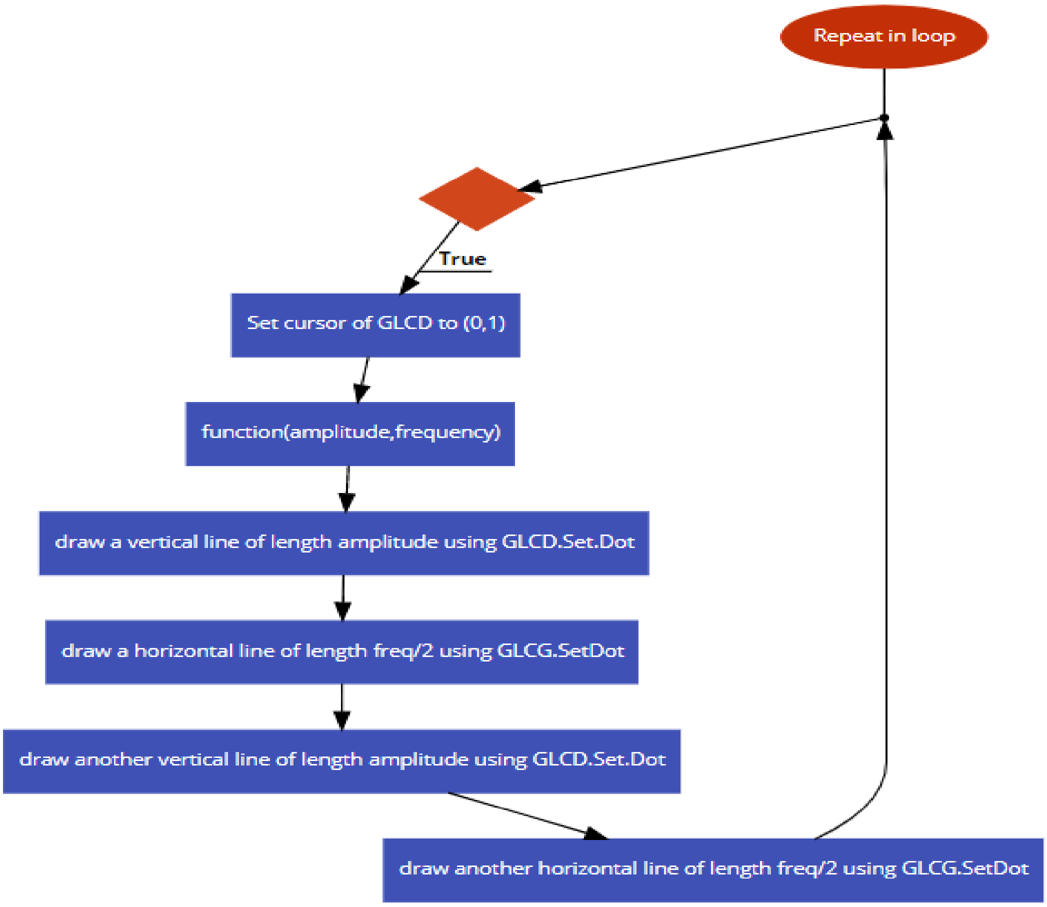


3) Sine wave

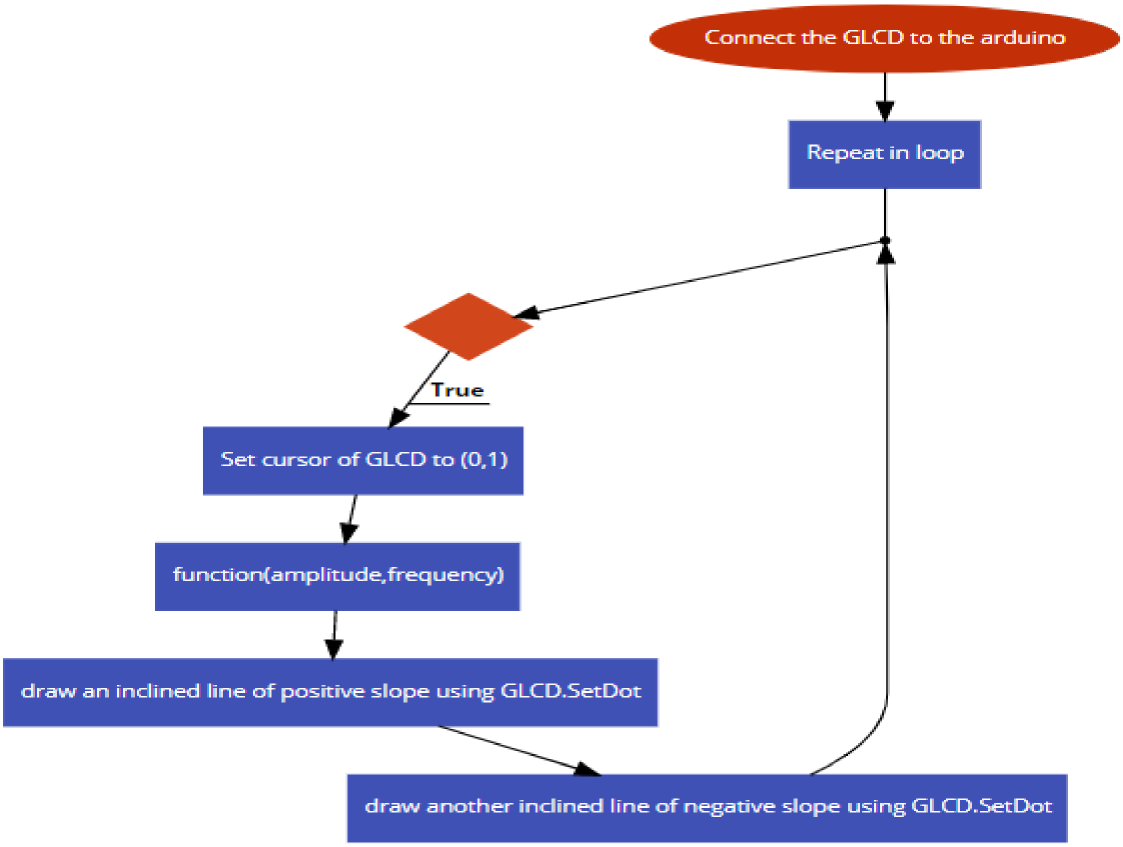


Flowchart

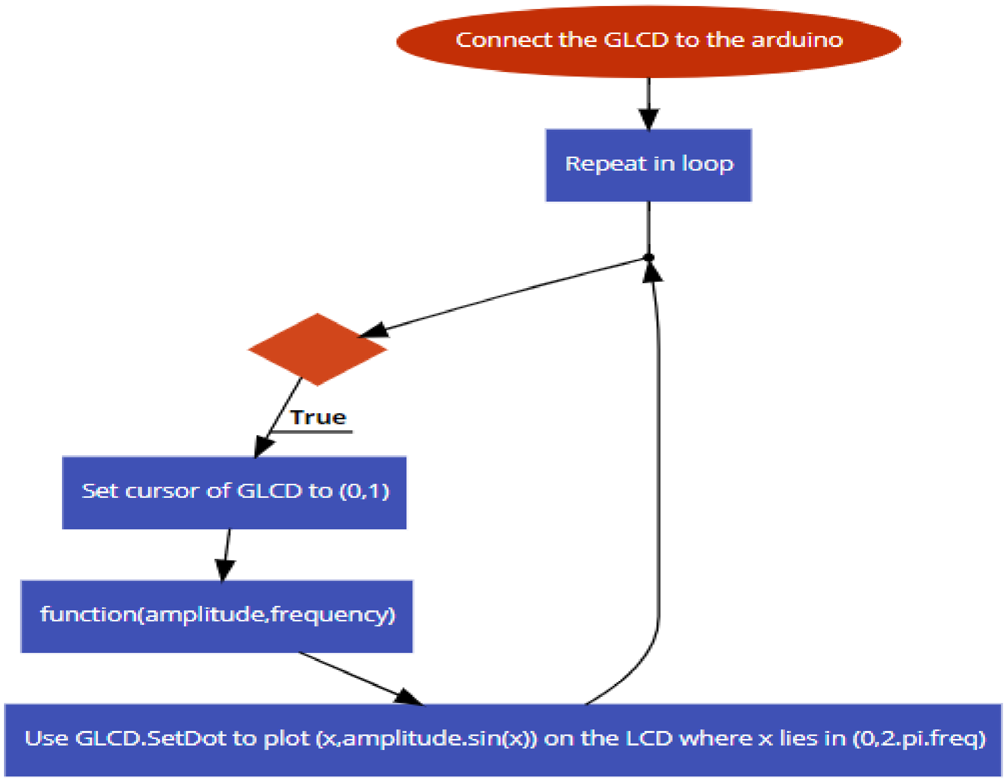
1)Square wave


Repeat in loop
True
Set cursor of GLCD to (0,1)
function(amplitude,frequency)
draw a vertical line of length amplitude using GLCD.Set.Dot
draw a horizontal line of length freq/2 using GLCG.SetDot
draw another vertical line of length amplitude using GLCD.Set.Dot
draw another horizontal line of length freq/2 using GLCG.SetDot

2)Triangular wave


Connect the GLCD to the arduino
Repeat in loop
True
Set cursor of GLCD to (0,1)
function(amplitude,frequency)
draw an inclined line of positive slope using GLCD.SetDot
draw another inclined line of negative slope using GLCD.SetDot

3) Sine wave


Connect the GLCD to the arduino
Repeat in loop
True
Set cursor of GLCD to (0,1)
function(amplitude,frequency)
Use GLCD.SetDot to plot (x,amplitude.sin(x)) on the LCD where x lies in (0,2.pi.freq)

Observations and Conclusions:

In this experiment, we made a function generator using Arduino and GLCD. Function generator has wide practical applications.The function generator in this experiment produces square wave, triangular wave and sine wave.In the experiment we used setdot function of glcd to plot the waves.We also learnt that square wave shows the values corresponding to PWM signal and triangular wave , is generated by the sum of the values of PWM signal to get a ramp function(as integration of a square wave is a triangular wave). But this cannot be used practically in labs because the sine wave generated is not continuous due to the presence of pixels(quantised). Hence it is a dirty function generator.

References:

- https://www.arduino.cc/en/Tutorial/PWM
- http://www.electronics-tutorials.ws/filter/filter_2.html
- http://www.ti.com/lit/ds/symlink/lm741.pdf

Appendix:

Square wave:

```
#include <openGLCD.h>
#include "fonts/SystemFont5x7.h"

void setup()
{
  // Initialize the GLCD
  GLCD.Init(NON_INVERTED);
  GLCD.ClearScreen();
 // Select the font for the default text area
  GLCD.SelectFont(System5x7);
  //GLCD.print("hello, world!");
}
int p = 4;
void loop()
{
  // set the cursor to column 0, line 1
  // (note: line 1 is the second row, since counting begins with 0):
  //int p=4;
  GLCD.CursorTo(0,1);
  function(16,16,p);
  p = p+16;
}

void function(int amp,int freq,int p){
  int j = 32;
  for(int i=j-amp;i<=j+amp;i++){
          GLCD.SetDot(p,i,BLACK);
  }
  for(int i=p;i<=p+(freq/2);i++){
          GLCD.SetDot(i,j-amp,BLACK);
  }
  for(int i=j-amp;i<=j+amp;i++){
          GLCD.SetDot(p+freq/2,i,BLACK);
  }
  for(int i=p+freq/2;i<=p+freq;i++){
          GLCD.SetDot(i,j+amp,BLACK);
  }
}
```

Triangular wave:

```
#include <openGLCD.h>
#include "fonts/SystemFont5x7.h"
void setup()
{
  GLCD.Init(NON_INVERTED);
  GLCD.ClearScreen();
  GLCD.SelectFont(System5x7);
}
int p = 4;
void loop()
{;
  GLCD.CursorTo(0,1);
  function(32,p);
  p = p+32;
}

void function(int freq,int p){
  for(int i=50;i>=50-freq/2;i--){
        GLCD.SetDot(p+50-i,i,BLACK);
  }
  for(int i=50-freq/2;i<=50;i++){
        GLCD.SetDot(i-50+freq+p,i,BLACK);
  }
}
```

Sine wave:

```
#include <openGLCD.h>
#include "fonts/SystemFont5x7.h"
void setup()
{
  GLCD.Init(NON_INVERTED);
  GLCD.ClearScreen();
  GLCD.SelectFont(System5x7);
}

void function(int amp, int w, int p){
 for(int i=p;i<p+w;i++){
  GLCD.SetDot(i,amp*sin((2*3.14/w)*(i-p))+32,BLACK);
 }
}
```

****