A
Mini–Project Report on

"Image And Animation Board Using GLCD And LPC2138"

Submitted By

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Abstract

The project, "Image on Animation Board Using GLCD And LPC2138," represents a significant stride in the field of embedded systems, strategically harnessing the capabilities of the LPC2138 microcontroller and Graphical LCD (GLCD) technology. This ambitious venture converges hardware and software intricacies to create an innovative platform capable of displaying both static images and dynamic animations. The incorporation of the echo concept in serial communication adds a layer of interactivity, enabling users to engage with the system seamlessly.

This report serves as a comprehensive narrative, chronicling the project's inception, outlining the methodologies employed, and illuminating the outcomes achieved. Beyond the mere fusion of components, the project embarks on the exploration of novel frontiers, pushing the boundaries of conventional display systems. The synergy between the LPC2138 microcontroller and GLCD unfolds a tapestry of visual possibilities, culminating in an interactive and visually immersive experience. The abstract encapsulates the essence of this endeavor, offering a glimpse into the innovative integration of technology to redefine user interactions with graphical displays in embedded systems.

Contents

Chapter 1

1.1 Introduction

In the dynamic landscape of embedded systems, the convergence of microcontrollers and graphical displays has become a linchpin for transformative technological experiences. At the forefront of this synergy is the LPC2138 microcontroller, celebrated for its reliability and adaptability. Paired with Graphical LCD (GLCD) technology, the project titled "Image on Animation Board Using GLCD And LPC2138" embarks on a pioneering journey to redefine the boundaries of visual interaction in embedded systems.

As technology continues to advance, the demand for richer and more immersive user experiences intensifies. The LPC2138 microcontroller, boasting robust processing capabilities, serves as a potent orchestrator for graphics-intensive tasks, while GLCD provides the canvas for dynamic visual expression. This project not only seeks to display static images and dynamic animations but aspires to elevate these visual elements into an interactive and engaging experience. Integrated with the echo concept in serial communication, the project introduces a layer of sophistication to user interaction, fostering a responsive and dynamic interface. This introduction sets the stage for a multifaceted exploration, where the LPC2138 and GLCD converge to redefine the possibilities of graphical displays in embedded systems, marrying cutting-edge technology with aesthetic appeal.

1.2 Project idea

The core concept driving this project is the development of a versatile system capable of displaying both static images and dynamic animations on a graphical LCD. The LPC2138 microcontroller acts as the brain of the system, orchestrating the rendering of visuals on the GLCD. The project envisions a user-friendly platform that transcends the limitations of conventional displays, providing an immersive and dynamic visual experience.

1.3 Problem definition

Conventional methods of visual representation in embedded systems often fall short in terms of interactivity and visual richness. This project addresses this limitation by ingeniously combining the processing capabilities of the LPC2138 microcontroller with the graphical prowess of GLCD. The challenge is to create a seamless interface that not only displays images

and animations but also facilitates user interaction through the echo concept in serial communication.

1.4 Objectives

1) To successfully establish a connection between the LPC2138 microcontroller and the Graphical Liquid Crystal Display (GLCD).

2) To Enable LPC2138 to Display Images on GLCD via Serial Communication Input.

3) To demonstrate the capability of the LPC2138 microcontroller to display images on the GLCD.

1.5 Expected Outcomes

1)The image/animation of inputted type on virtual terminl should be displayed on GLCD.

2)The image type/name should be displayed on 16X2 LCD.

3) Upon successful completion, this project anticipates delivering a fully functional Image on Animation Board. The system should seamlessly integrate static and dynamic visual elements, showcasing the potential of embedded systems in graphical displays. Users can expect a responsive and visually captivating experience, facilitated by the optimized interaction between the LPC2138 microcontroller and GLCD. This project lays the groundwork for practical applications in diverse embedded systems, illustrating the convergence of hardware and software for enhanced visual representation.

Chapter 2

Literature Survey

1. Microcontroller and Embedded Systems:

- "Embedded Systems: Introduction to Arm Cortex-M Microcontrollers" by Jonathan Valvano.
- "Programming Embedded Systems in C and C++" by Michael Barr and Anthony Massa.

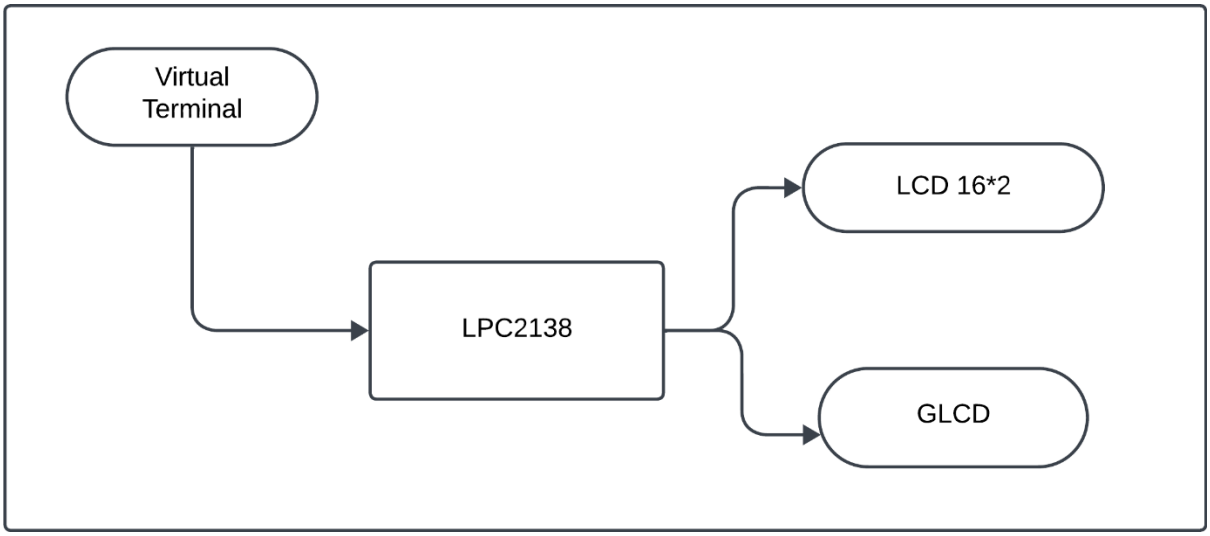
2. Graphical LCD (GLCD) Technology:

- "Programming Graphical User Interfaces in C" by David J. Benson
- Serial Port Complete: COM Ports, USB Virtual COM Ports, and Ports for Embedded Systems" by Jan Axelson.

Chapter 3

Design Methodology

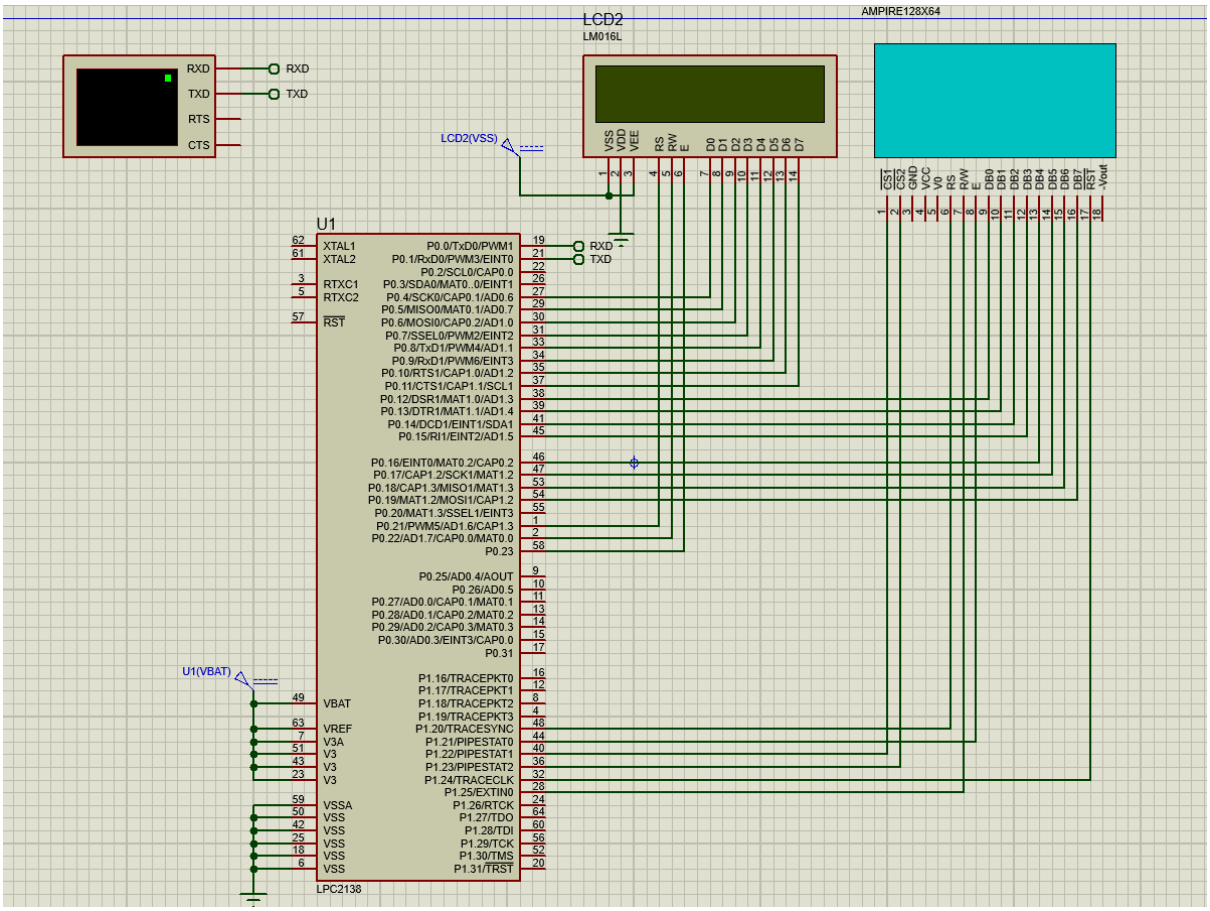
3.1 System Block Diagram



3.2 Block Description

The circuit for the "Image on Animation Board Using GLCD And LPC2138" project is carefully designed to facilitate seamless communication and control. The LPC2138 microcontroller receives input from a virtual terminal through pins P0.0 and P0.1, dedicated to serial communication. These input signals trigger actions such as displaying static images and dynamic animations on the connected Graphical LCD (GLCD). Data bits from the GLCD are intricately connected to specific ports on the LPC2138, ensuring accurate representation of visual elements. Additionally, a 16x2 LCD display is incorporated with eight data pins and three control pins (RS, RW, and Enable), providing supplementary information for a comprehensive and interactive user experience.

3.3 Circuit Diagram



3.4 List of components

- LPC2138
- Virtual Terminal
- Graphical LCD
- LCD 16*2

Chapter 4

Implementation

4.1 Mathematical modelling

4.1.1 Objective 1

1. To successfully establish a connection between the LPC2138 microcontroller and the Graphical Liquid Crystal Display (GLCD).

Explanation : The primary objective of this project is to successfully establish a seamless connection between the LPC2138 microcontroller and the Graphical Liquid Crystal Display (GLCD). This entails configuring the necessary data and control lines to ensure efficient communication between the microcontroller and the GLCD, enabling the accurate rendering of static images and dynamic animations on the display.

4.1.2 Objective 2

2. To Enable LPC2138 to Display Images on GLCD via Serial Communication Input.

Explanation : Connect pins P0.0 and P0.1 on the LPC2138 to receive serial communication input. Establish connections between the LPC2138 data and control lines and the GLCD for seamless image display. Use a virtual terminal to transmit image data, enabling the LPC2138 to showcase dynamic visuals on the GLCD.

4.1.3 Objective 3

3) To demonstrate the capability of the LPC2138 microcontroller to display images on the GLCD.

Explanation : This involves implementing algorithms and mechanisms within the microcontroller to interpret image data and transmit it to the GLCD for visual representation. Successfully achieving this objective showcases the microcontroller's graphic processing capabilities and ensures that the project fulfills its fundamental goal of rendering static images on the GLCD with precision and clarity

4.2 Final Program

```
#include <LPC213X.H>
#define TEMT (1<<6)
#define LINE_FEED 0xA
#define CARRIAGE_RET 0xD

void init_UR0()
{
	PINSEL0 = 0X05;
	U0FCR = 0X07;
	U0LCR = 0X83;
	U0DLL = 20;
	U0DLM = 0X00;
	U0LCR = 0X03;
}

unsigned char Maharaj[1024]= {
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0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x80, 0xc0, 0xf4, 0x3e, 0x76, 0xe3, 0x83, 0x02, 0x0e, 0x1c, 0x38, 0xf0, 0xc0, 0x80, 0xc0, 0xc8, 0x8c, 0x8e, 0x03, 0x81, 0xc0, 0xc0, 0x60, 0x60, 0x20, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x01, 0x00, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x01, 0x00, 0x00, 0x00, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x01, 0x01, 0x01, 0x01, 0x01, 0x00, 0x00, 0x01, 0x01, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x01, 0x01, 0x01, 0x00, 0x00, 0x00, 0x00, 0x01, 0x00, 0x00, 0x00, 0x01, 0x01, 0x00, 0x00, 0x00, 0x01, 0x01, 0x01, 0x01, 0x00, 0x01, 0x00, 0x00,

0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x80, 0x80, 0xc0, 0xc0, 0xc0, 0x60, 0x60, 0x30, 0x18, 0x0c, 0x0c, 0x07, 0x03, 0x01, 0x00, 0x00, 0x00, 0x00, 0x03, 0x07, 0x0e, 0x18, 0x70, 0xe0, 0xc1, 0x03, 0x0f, 0x1c, 0x38, 0x7f, 0xcf, 0x80, 0x00, 0x00, 0x18, 0x08, 0x18, 0x18, 0x18, 0x08, 0x00,

0x00, 0x00, 0x78, 0xfe, 0x86, 0x03, 0x03, 0x01, 0x01, 0x00, 0x00, 0x01, 0x07, 0x8e, 0x9c, 0xf0, 0xe0, 0xe0, 0x60, 0x20, 0x30, 0x30, 0x30, 0x10, 0x10, 0x18, 0x18, 0x18, 0x18, 0x18,

```
0x08, 0x1b, 0x1f, 0x1e, 0x1c, 0x10, 0x30, 0x31, 0x1f, 0x1e, 0x04, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x01, 0x03, 0x03, 0x02, 0x02, 0x02, 0x03, 0x03, 0x03, 0x07, 0x07,
0x0c, 0x18, 0x71, 0x63, 0x47, 0x6e, 0x78, 0x38, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
};

unsigned char Mobile[1024]={
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xe0, 0x50,
0x70, 0x70, 0xf8, 0x70, 0xf0, 0xf8, 0xf0, 0xe0, 0xf0, 0xe0, 0xe0, 0xf0, 0xe0, 0xe0, 0xe0, 0xe0,
0xe0, 0xc0, 0xc0, 0xe0, 0x60, 0x80, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x80,
0xc0, 0xc0, 0xe0, 0xf0, 0xf8, 0xf8, 0xfc, 0xfe, 0x7f, 0xff, 0x1f, 0x06, 0x02, 0x01, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x01, 0x01, 0x01, 0x01,
0xc1, 0x71, 0x1b, 0xe7, 0x89, 0xc2, 0xc0, 0xc0, 0x80, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x80, 0xc0, 0xe0, 0xf0, 0xf8, 0xfc, 0xfe, 0xfe, 0xff, 0xff, 0xff,
0xff, 0xff, 0xbf, 0xdf, 0x73, 0x1b, 0x0c, 0x03, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xe0, 0xf0, 0xf0, 0xec, 0xf7,
0xe5, 0xec, 0xe7, 0x07, 0x07, 0x07, 0x03, 0x03, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x80, 0x80,
0xc0, 0xe0, 0xe0, 0xf8, 0xfc, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0x7f, 0x1f, 0xff, 0xe5,
0x1d, 0x06, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
```

```
0x00, 0x00, 0x00, 0x00, 0x00, 0x80, 0x80, 0xfe, 0x9e, 0x7e, 0xff, 0xff, 0xff, 0x7d, 0x1f, 0x03,
0x03, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
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0x00, 0x00, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x80, 0x80, 0xc0, 0xc0, 0x60, 0x60,
0x30, 0x30, 0x18, 0x08, 0x0c, 0x0c, 0x06, 0x06, 0x06, 0x0e, 0x1f, 0x7f, 0xff, 0xff, 0xff, 0xff,
0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xfd, 0xfa, 0xf3, 0xff, 0xf7, 0xef,
0xff, 0xef, 0xef, 0xfe, 0xfa, 0xda, 0xd2, 0xf6, 0xd6, 0xbc, 0x7c, 0x3c, 0x7c, 0x7c, 0x7c, 0x78,
0x78, 0x38, 0x1a, 0x4f, 0x3f, 0x3f, 0x1f, 0x1f, 0x0e, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
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0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x03, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00,
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0x03, 0x03, 0x03, 0x01, 0x01, 0x01, 0x01, 0x01, 0x20, 0xe0, 0xe0, 0xe0, 0xf0, 0xa0, 0x00,
0x80, 0xc0, 0x60, 0xe0, 0x60, 0x20, 0x00, 0x80, 0xc0, 0xe0, 0x20, 0xe0, 0xf0, 0xe0, 0xe0,
0xc0, 0x00, 0x80, 0xc0, 0xe0, 0xe0, 0xe0, 0xa0, 0x20, 0x60, 0xe0, 0xe0, 0x20, 0x00, 0xe0,
0x60, 0x30, 0xa0, 0xf0, 0xe0, 0xe0, 0xe0, 0x20, 0x70, 0xe0, 0x60, 0x20, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x20, 0xf0, 0xe0, 0xf0, 0xe0, 0xe0, 0x80,
0xe0, 0xe0, 0x60, 0x20, 0x20, 0x20, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x80, 0x80,
0x80, 0xc0, 0x60, 0x23, 0x3f, 0x38, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x1f, 0x1f, 0x1f, 0x0f,
0x06, 0x03, 0x00, 0x00, 0x30, 0x10, 0x38, 0x1e, 0x07, 0x07, 0x36, 0x1e, 0x1f, 0x3f, 0x1f,
0x07, 0x10, 0x1c, 0x1c, 0x19, 0x13, 0x17, 0x37, 0x1f, 0x1f, 0x1f, 0x0e, 0x00, 0x00, 0x00,
0x00, 0x10, 0x1c, 0x3f, 0x3f, 0x1f, 0x07, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x30, 0x10, 0x38, 0x3c, 0x0c, 0x07, 0x07, 0x1f, 0x3f,
0x3f, 0x1c, 0x30, 0x00, 0x00, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x30, 0x18, 0x18, 0x08, 0x0c, 0x06, 0x06, 0x02, 0x03, 0x01, 0x01,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
};


unsigned char Hurry[1024]={
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
```

0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0xc0, 0xe0, 0xf0, 0xf0, 0xf8, 0xf8, 0xf8, 0xf8, 0xf8, 0xf8, 0xf0, 0xf0, 0xe0, 0xc0, 0x80, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xe0, 0xf0, 0x70,
0x20, 0xc0, 0xf0, 0x70, 0x10, 0xc0, 0xf8, 0xb0, 0x80, 0xc0, 0x30, 0x10, 0xc0, 0xf0, 0x70,
0xd8, 0xf0, 0xb0, 0x20, 0xc0, 0xf8, 0x70, 0x50, 0xf0, 0xf0, 0x10, 0x00, 0x10, 0xf0, 0xf0,
0x60, 0x20, 0x10, 0x10, 0x00, 0x40, 0xf0, 0xf0, 0x90, 0x80, 0x60, 0x30, 0x90, 0xe0, 0xf8,
0x70, 0x40, 0x70, 0x30, 0x00, 0x00, 0xe0, 0xf0, 0xb0, 0xd8, 0xc0, 0x70, 0x00, 0xc0, 0xf0,
0xf0, 0x00, 0xc0, 0x70, 0x10, 0x00, 0x10, 0xf0, 0xf0, 0x60, 0x30, 0x10, 0x90, 0xa0, 0x70,
0xe0, 0xe0, 0xb0, 0x10, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0xc0, 0xc0, 0xe0, 0xe0, 0xc0, 0xc0, 0xc0, 0x80, 0x80, 0x00, 0x00, 0x03,
0x0f, 0x1f, 0x3f, 0x3f, 0x7f, 0x7f, 0x7f, 0x7f, 0x7f, 0x7f, 0xbf, 0xbf, 0x9f, 0x8f, 0x87, 0x80,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x01, 0x00,
0x00, 0x01, 0x01, 0x00, 0x00, 0x00, 0x01, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x00,
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0xfe, 0x7e, 0xfe, 0x7f, 0x7f, 0x7f, 0x7f, 0x3f, 0x7f, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff,
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0xfe, 0xfe, 0xfe, 0xfe, 0xfe, 0xfe, 0xfe, 0xfe, 0xfe, 0xfe, 0xfc, 0xfc, 0xfe, 0xfc, 0xfe, 0xfc,
0x7e, 0x7c, 0x7c, 0x7c, 0x7c, 0x7c, 0x7e, 0x7c, 0x7c, 0x7c, 0x7c, 0x7c, 0x3c, 0x7c, 0x3c,
0x3c, 0x3c, 0x3c, 0x3c, 0x3c, 0x3c, 0x38, 0x3c, 0x38, 0x3c, 0x38, 0x1c, 0x38, 0x1c, 0x1c,
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0xff, 0xff, 0xff, 0xf8, 0xc3, 0x9f, 0x7c, 0xf9, 0xe7, 0xef, 0xdf, 0xdf, 0xdf, 0xdf, 0xdf, 0xef,
0xe6, 0xf0, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0x7f, 0x7f, 0x7f, 0x7f, 0x7f, 0x7f, 0x7f, 0x7f,
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0x00, 0x00, 0x00, 0x00, 0x80, 0xc0, 0xe0, 0xf0, 0xf8, 0xfc, 0xfe, 0xff, 0xff, 0xff, 0x7f, 0x7f,
0x3f, 0x7f, 0xff, 0xff, 0xff, 0xff, 0xfe, 0xfc, 0xf9, 0xf7, 0xcf, 0x9f, 0xbf, 0xbf, 0xbf, 0xbf,
0xbf, 0xbf, 0xbf, 0xbf, 0xbf, 0xbf, 0x7f, 0x3f, 0x3f, 0x7f, 0x3f, 0x3f, 0x3f, 0x3f, 0x3f, 0x3e,
0x3f, 0x3e, 0x3f, 0x3e, 0x1e, 0x3e, 0x1e, 0x3e, 0x1e, 0x1e, 0x1e, 0x1e, 0x1c, 0x1e, 0x1c,
0x1c, 0x1c, 0x0c, 0x1c, 0x1c, 0x0c, 0x0c, 0x0c, 0x0c, 0x18, 0x08, 0x0c, 0x0c, 0x08, 0x08,
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0x00, 0x00, 0x00, 0x00, 0x00,

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0xf0, 0xf8, 0xfc, 0xff, 0xff, 0xff, 0xff, 0xff, 0x3f, 0x9f, 0xcf, 0xf7, 0xfb, 0xfc, 0xfe, 0xff, 0xff,
0xfe, 0xfc, 0xf9, 0xe3, 0xcf, 0xdf, 0x9f, 0xbf, 0x3f, 0xbf, 0xbf, 0x3f, 0x3f, 0x3f, 0x1f, 0x3f,
0x3f, 0x1f, 0x3f, 0x1f, 0x1f, 0x1f, 0x0e, 0x10, 0x3e, 0x1e, 0x1e, 0x1e, 0x1e, 0x1e, 0x1e, 0x1e,
0x1e, 0x1c, 0x1e, 0x1c, 0x0c, 0x1c, 0x0c, 0x1c, 0x1c, 0x0c, 0x0c, 0x0c, 0x08, 0x0c, 0x08,
0x0c, 0x08, 0x08, 0x08, 0x08, 0x08, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
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0x00, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x08, 0x0f, 0x1f, 0x3f,
0x3f, 0x3f, 0x1f, 0x1f, 0x0f, 0x13, 0x39, 0x1c, 0x3f, 0x3f, 0x3f, 0x1f, 0x3f, 0x3f, 0x3f, 0x3f,
0x3f, 0x3f, 0x3f, 0x3f, 0x1f, 0x3f, 0x1f, 0x1f, 0x1f, 0x1f, 0x1f, 0x1f, 0x1f, 0x1f, 0x1f, 0x1f,
0x1f, 0x1f, 0x1f, 0x1e, 0x0f, 0x1e, 0x0f, 0x0e, 0x1e, 0x0e, 0x0e, 0x0e, 0x0e, 0x1e, 0x0c, 0x0c,
0x0c, 0x0c, 0x0c, 0x0c, 0x0c, 0x04, 0x0c, 0x04, 0x08, 0x08, 0x00, 0x08, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00
};

unsigned char Book[1024]={
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
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0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
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0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
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0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
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0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x10,
```

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0xfe, 0xff, 0x01, 0x01, 0x01, 0x01, 0x79, 0x79, 0x59, 0x59, 0x79, 0x31, 0x21, 0x31, 0x79,
0x49, 0x49, 0x69, 0x79, 0x31, 0x11, 0x39, 0x79, 0x49, 0x49, 0x69, 0x79, 0x11, 0x19, 0x79,
0x31, 0x31, 0x79, 0x69, 0x01, 0x01, 0x01, 0x79, 0x79, 0x19, 0x31, 0x61, 0x79, 0x79, 0x11,
0x31, 0x79, 0x49, 0x4d, 0x49, 0x79, 0xb1, 0x09, 0x39, 0x79, 0x71, 0x39, 0x39, 0x61, 0x79,
0x39, 0x01, 0x01, 0x01, 0x01, 0x01, 0xff, 0xfe, 0x08, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
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0x00, 0x01, 0x01, 0x00, 0x01, 0x01, 0x01, 0x01, 0x81, 0xf3, 0x3e, 0x0c, 0x00, 0x00, 0x00,
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0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
};

unsigned char Horse[1024]= {
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x20, 0x00, 0x68, 0x64, 0xf0, 0xb2, 0x92, 0x82, 0x02, 0x00, 0x04, 0x84, 0x88, 0xc0,
```

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0x80, 0x00, 0x80, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x40, 0xc0, 0xe0, 0x90, 0x80, 0x90, 0xb0, 0x20, 0xa0, 0x80,
0xb8, 0x98, 0x60, 0x30, 0x38, 0x18, 0x00, 0x00, 0x10, 0x10, 0x18, 0x38, 0x28, 0x38, 0x38,
0x38, 0x58, 0x58, 0x58, 0xfc, 0xbc, 0xbc, 0xf7, 0x7a, 0x78, 0xf9, 0xff, 0xff, 0xfe, 0xfe, 0xfe,
0xfc, 0xf8, 0xa0, 0x80, 0x80, 0xe0, 0xc0, 0x00, 0x26, 0xca, 0x01, 0x00, 0x00, 0x00, 0x00,
0xe0, 0x00, 0x00, 0x81, 0xe2, 0xfe, 0xf8, 0xf0, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xf0, 0xfe, 0x3f, 0xff, 0xff,
0xc7, 0x83, 0x81, 0x80, 0x80, 0x80, 0x40, 0x40, 0x20, 0x10, 0x04, 0x18, 0xf0, 0xc0, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x81, 0x81, 0x83, 0x02, 0x02, 0x45, 0x05,
0x0b, 0x83, 0xa7, 0x73, 0x63, 0x33, 0x31, 0x30, 0x38, 0x18, 0x58, 0x18, 0x48, 0x4c, 0x04,
0x43, 0x80, 0x40, 0x41, 0x41, 0x41, 0x61, 0x73, 0x73, 0x87, 0x8c, 0x8c, 0xc8, 0xf0, 0xf0,
0x80, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x0e, 0x0f, 0x0d, 0x1c, 0x0c, 0x0c,
0x06, 0x03, 0x01, 0x01, 0x00, 0x00, 0x00, 0x02, 0x02, 0x02, 0x02, 0x02, 0x03, 0x0f, 0x3e,
0x31, 0x41, 0x81, 0x01, 0x01, 0x01, 0x00, 0x00, 0x00, 0x00, 0x38, 0x3c, 0x62, 0xce, 0xd9,
0xb9, 0xf8, 0xf8, 0xf8, 0xf0, 0x00, 0x00, 0x00, 0x02, 0x00, 0x42, 0x02, 0x21, 0x11, 0x0d,
0x05, 0x04, 0x04, 0x04, 0x04, 0x00, 0x00, 0x01, 0x03, 0x0f, 0x06, 0x00, 0x01, 0x01, 0x01,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x00, 0x01, 0x01, 0x01, 0x01, 0x01, 0x01, 0x01,
0x02, 0x02, 0x02, 0x02, 0x02, 0x04, 0x04, 0x00, 0x08, 0x00, 0x00, 0x20, 0x60, 0x60, 0x60,
0x70, 0x60, 0x70, 0xf0, 0x70, 0x70, 0xf0, 0xf0, 0xf0, 0xf0, 0xf0, 0xf0, 0xf0, 0xf0, 0xf0, 0xe0,
0xf0, 0xe0, 0xe0, 0xe0, 0x40, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x0e, 0x18, 0xb1, 0x60, 0x40, 0x80, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x60,
0x60, 0x60, 0x60, 0x61, 0x57, 0x80, 0xe0, 0xc0, 0xa1, 0x81, 0x81, 0x81, 0x81, 0x80, 0x01,
0x80, 0x00, 0x81, 0x00, 0x80, 0x00, 0x80, 0x00, 0x00, 0x00, 0x00, 0xe0, 0xf0, 0x9c, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x80, 0x80, 0x80, 0xc0, 0xc0, 0x40, 0x60, 0x20, 0x10, 0x18, 0x00, 0x00, 0x80,
0x40, 0x00, 0x00, 0x00, 0x00, 0x80, 0xe0, 0xf0, 0x70, 0xf8, 0xfd, 0x7f, 0x3f, 0x1f, 0x0f,
0x07, 0x1f, 0x3f, 0x43, 0x01, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xc0, 0xe0, 0xf0, 0xf0,
0xf8, 0x7c, 0x3e, 0x17, 0x13, 0x18, 0x0c, 0x0c, 0x0c, 0xfe, 0xe0, 0x00, 0x00, 0x00, 0x80,
0x60, 0x3c, 0x06, 0x02, 0x01, 0x00, 0x01, 0x01, 0x00, 0x01, 0x01, 0x01, 0x01, 0x00, 0x01,
0x01, 0x00, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x01, 0x03,
0x06, 0x0c, 0x38, 0x70, 0xe0, 0xc0, 0x80, 0x00, 0x08, 0xfc, 0xe4, 0x86, 0x02, 0x03, 0x03,
0x01, 0x19, 0x31, 0x61, 0xc0, 0xc0, 0x80, 0x00, 0x00, 0x70, 0xfc, 0x8c, 0x82, 0x01, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x00, 0x00, 0x03, 0x05, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
```

```
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x01, 0x03,
0x03, 0x07, 0x07, 0x06, 0x0e, 0x0e, 0x1c, 0x18, 0x1b, 0x1f, 0x1f, 0x1e, 0x1c, 0x3f, 0x1d,
0x38, 0x30, 0x70, 0xe0, 0xe0, 0xe0, 0xe0, 0xc0, 0xc0, 0x80, 0x80, 0x80, 0x80, 0x80, 0x80,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x80, 0xc0, 0xc0, 0xe0, 0xe0, 0xf0, 0xf0,
0x70, 0x38, 0x38, 0x3c, 0x1f, 0x1f, 0x0f, 0x0f, 0x0f, 0x0f, 0x07, 0x07, 0x07, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x81, 0xc7, 0xfe, 0xfe, 0xfc, 0x78, 0x19, 0x0f, 0x06,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
  0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x01, 0x01, 0x01, 0x01, 0x01, 0x03, 0x03, 0x03, 0x03,
0x03, 0x06, 0x00, 0x00, 0x00, 0x00, 0x0e, 0x0f, 0x0f, 0x07, 0x07, 0x07, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x60, 0x20, 0x70,
0x70, 0x38, 0x78, 0x3c, 0x3e, 0x2e, 0x07, 0x07, 0x07, 0x03, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
};

void delay(unsigned int time)
{
        unsigned int i,j;
        for(i=0;i<time;i++)
        {
                for(j=0;j<50;j++);
        }
}

void delay2()
{
        unsigned int i;
        for(i=0;i<180000;i++);
}

void GLCD_data(unsigned char data)
{
        IOCLR0 = (0xFF<<12);
        IOSET0 = (data<<12);
        IOSET1 = (1<<20);
        IOSET1 = (1<<21);
        delay(1);
        IOCLR1 = (1<<21);
        delay(1);
}

void lcd_data(unsigned char disp_data)
{
        IOPIN0 &=00;
        IOPIN0 |= (disp_data<<4);
```

```
	IOSET0 = (1<<21);   //RS=1
	IOCLR0 = (1<<22);   //RW=0
	IOSET0 = (1<<23);   //E=1
	delay(1);
	IOCLR0 = (1<<23);   //E=0
}

void GLCD_cmd(unsigned char command)
{
	IOCLR0 = (0xFF<<12);
	IOSET0 = (command<<12);
	IOCLR1 = (1<<20);
	IOSET1 = (1<<21);
	delay(1);
	IOCLR1 = (1<<21);
	delay(1);
}

void lcd_cmd(unsigned char command)
{
	IOPIN0 &=00;
	IOPIN0 |= (command<<4);
	IOCLR0 = (1<<21);   //RS=0
	IOCLR0 = (1<<22);   //RW=0
	IOSET0 = (1<<23);   //E=1
	delay(1);
	IOCLR0 = (1<<23);   //E=0
}

void GLCD_init()
{
	PINSEL0 = 0; //set pins as GPIO
	PINSEL1 = 0;
	PINSEL2 = 0;

	 //set pins as output
	IODIR0 = (0XFF<<12);
	IODIR1 = (0X3F<<20);

	IOSET1 = (1<<24) | (1<<22) | (1<<23) ;
	IOCLR1 = (1<<25) | (1<<20) | (1<<21) ;

	GLCD_cmd(0x3F); //Display ON
	GLCD_cmd(0x40); //Select Column 0
	GLCD_cmd(0xB8);    //Select Page 0
}

void lcd_init()
{
	lcd_cmd(0x38);
```

```
	delay(1);
	lcd_cmd(0x0C);
	delay(1);
	lcd_cmd(0x80);
	delay(1);
	lcd_cmd(0x06);
	delay(1);
}

void GLCD_disp(unsigned char *Intro,unsigned char *Mobile,unsigned char *Hurry,unsigned
char *Book) //display routine
{
	int i,j;

	//Intro
	for(i=0;i<8;i++)
	{
		IO1CLR = (1<<22); //select controller 2
		IO1SET = (1<<23);
		GLCD_cmd(0xB8 | i);
		GLCD_cmd(0x40);
		for(j=0;j<64;j++) //display controller 2 data
		{
		  GLCD_data(Intro[(i*128)+j]);
		}
		IO1SET = (1<<22); //select controller 1
		IO1CLR = (1<<23);
		GLCD_cmd(0xB8 | i);
		GLCD_cmd(0x40);
		for(j=64;j<128;j++) //display controller 1 data
		{
			GLCD_data(Intro[(i*128)+j]);
		}
	}
	delay2();

	//Mobile
	for(i=0;i<8;i++)
	{
		IO1CLR = (1<<22); //select controller 2
		IO1SET = (1<<23);
		GLCD_cmd(0xB8 | i);
		GLCD_cmd(0x40);
		for(j=0;j<64;j++) //display controller 2 data
		{
		  GLCD_data(Mobile[(i*128)+j]);
		}
		IO1SET = (1<<22); //select controller 1
		IO1CLR = (1<<23);
		GLCD_cmd(0xB8 | i);
```

```
		GLCD_cmd(0x40);
		for(j=64;j<128;j++) //display controller 1 data
		{
			GLCD_data(Mobile[(i*128)+j]);
		}
}
delay2();

//Hurry
for(i=0;i<8;i++)
{
		IO1CLR = (1<<22); //select controller 2
		IO1SET = (1<<23);
		GLCD_cmd(0xB8 | i);
		GLCD_cmd(0x40);
		for(j=0;j<64;j++) //display controller 2 data
		{
		  GLCD_data(Hurry[(i*128)+j]);
		}
		IO1SET = (1<<22); //select controller 1
		IO1CLR = (1<<23);
		GLCD_cmd(0xB8 | i);
		GLCD_cmd(0x40);
		for(j=64;j<128;j++) //display controller 1 data
		{
			GLCD_data(Hurry[(i*128)+j]);
		}
}
delay2();

//Book
for(i=0;i<8;i++)
{
		//Intro
		IO1CLR = (1<<22); //select controller 2
		IO1SET = (1<<23);
		GLCD_cmd(0xB8 | i);
		GLCD_cmd(0x40);
		for(j=0;j<64;j++) //display controller 2 data
		{
		  GLCD_data(Book[(i*128)+j]);
		}
		IO1SET = (1<<22); //select controller 1
		IO1CLR = (1<<23);
		GLCD_cmd(0xB8 | i);
		GLCD_cmd(0x40);
		for(j=64;j<128;j++) //display controller 1 data
		{
			GLCD_data(Book[(i*128)+j]);
		}
```

```
	}
	delay2();
}

void GLCD_disp1(unsigned char *Horse) //display routine
{
	int i,j;
	for(i=0;i<8;i++)
	{
		//second half
		IO1CLR = (1<<22); //select controller 2
		IO1SET = (1<<23);
		GLCD_cmd(0xB8 | i);
		GLCD_cmd(0x40);
		for(j=0;j<64;j++) //display controller 2 data
		{
		  GLCD_data(Horse[(i*128)+j]);
		}

		//first half
		IO1SET = (1<<22); //select controller 1
		IO1CLR = (1<<23);
		GLCD_cmd(0xB8 | i);
		GLCD_cmd(0x40);
		for(j=64;j<128;j++) //display controller 1 data
		{
			GLCD_data(Horse[(i*128)+j]);
		}
	}

	for(i=0;i<8;i++)
	{
		//first half
		IO1SET = (1<<22); //select controller 1
		IO1CLR = (1<<23);
		GLCD_cmd(0xB8 | i);
		GLCD_cmd(0x40);
		for(j=0;j<64;j++) //display controller 1 data
		{
			GLCD_data(Horse[(i*128)+j]);
		}

		//second half
		IO1CLR = (1<<22); //select controller 2
		IO1SET = (1<<23);
		GLCD_cmd(0xB8 | i);
		GLCD_cmd(0x40);
		for(j=64;j<128;j++) //display controller 2 data
		{
		  GLCD_data(Horse[(i*128)+j]);
```

```
                }

        }
}

void GLCD_disp3(unsigned char *temp1) //display routine
{
        int i,j;
        for(i=0;i<8;i++)
        {
                //second half
                IO1CLR = (1<<22); //select controller 2
                IO1SET = (1<<23);
                GLCD_cmd(0xB8 | i);
                GLCD_cmd(0x40);
                for(j=0;j<64;j++) //display controller 2 data
                {
                  GLCD_data(Maharaj[(i*128)+j]);
                }

                //first half
                IO1SET = (1<<22); //select controller 1
                IO1CLR = (1<<23);
                GLCD_cmd(0xB8 | i);
                GLCD_cmd(0x40);
                for(j=64;j<128;j++) //display controller 1 data
                {
                        GLCD_data(Maharaj[(i*128)+j]);
                }
        }
}

void lcd_disp1()
{
        unsigned char a[]="Horse Race";
        unsigned char b[]="Current Activity :";
        int i =0,j=0;
        IODIR0 =(0xFF<<4) | (0x7<<21);

        lcd_init();
        while(b[j] != '\0')
        {
                lcd_data(b[j]);
                j++;
                delay(1);
        }

        lcd_cmd(0xC0);
        while(a[i] != '\0')
        {
```

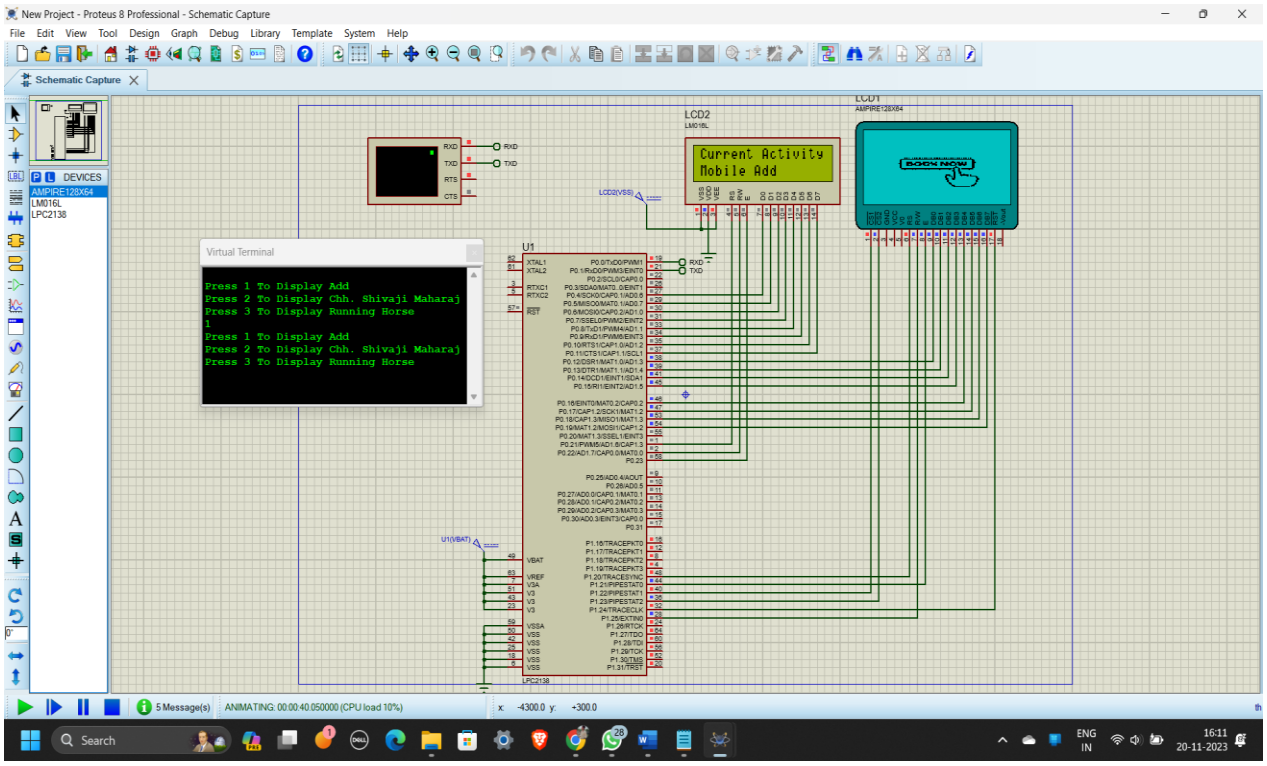
```
                lcd_data(a[i]);
                i++;
                delay(1);
        }
}

void lcd_disp2()
{
        unsigned char a[]="Mobile Add";
        unsigned char b[]="Current Activity :";
        int i =0,j=0;
        IODIR0 =(0xFF<<4) | (0x7<<21);

        lcd_init();
        while(b[j] != '\0')
        {
                lcd_data(b[j]);
                j++;
                delay(1);
        }

        lcd_cmd(0xC0);
        while(a[i] != '\0')
        {
                lcd_data(a[i]);
                i++;
                delay(1);
        }
}

void lcd_disp3()
{
        unsigned char a[]="Shivaji Maharaj";
        unsigned char b[]="Current Activity :";
        int i =0,j=0;
        IODIR0 =(0xFF<<4) | (0x7<<21);

        lcd_init();
        while(b[j] != '\0')
        {
                lcd_data(b[j]);
                j++;
                delay(1);
        }

        lcd_cmd(0xC0);
        while(a[i] != '\0')
        {
                lcd_data(a[i]);
                i++;
```

```
                delay(1);
        }
}

void Trans1()
{
        lcd_disp2();
        GLCD_init();
        GLCD_disp(Intro,Mobile,Hurry,Book);
        delay(1);
}

void Trans2()
{
        while(1)
        {
                lcd_disp1();
                GLCD_init();
                GLCD_disp1(Horse);
                delay(1);
        }
}

void Trans3()
{
        lcd_disp3();
        GLCD_init();
        GLCD_disp3(Maharaj);
        delay(1);
}

void invalid()
{
        unsigned char a[]=" Invalid Choice";
        int i=0;
        IODIR0 =(0xFF<<4) | (0x7<<21);
        lcd_cmd(0x01);
        lcd_init();

        while(a[i] != '\0')
        {
                lcd_data(a[i]);
                delay(1);
                i++;
        }
}

int main()
{
        while(1)
```

```
{
        unsigned char byte;
        int j=0,k=0,l=0;
        char c[]="Press 1 To Display Add";
        char d[]="Press 2 To Display Chh. Shivaji Maharaj";
        char e[]="Press 3 To Display Running Horse";
        init_UR0();

        U0THR = LINE_FEED;
        U0THR = CARRIAGE_RET;

        while(c[j])
        {
                U0THR = c[j];
                while(!(U0LSR & TEMT));
                j++;
        }
        U0THR = LINE_FEED;
        U0THR = CARRIAGE_RET;

        while(d[k])
        {
                U0THR = d[k];
                while(!(U0LSR & TEMT));
                k++;
        }
        U0THR = LINE_FEED;
        U0THR = CARRIAGE_RET;

        while(e[l])
        {
                U0THR = e[l];
                while(!(U0LSR & TEMT));
                l++;
        }
        U0THR = LINE_FEED;
        U0THR = CARRIAGE_RET;

        while(!(U0LSR & 0x01));
        byte = U0RBR;
        U0THR = byte;

        while(!(U0LSR & TEMT));
        delay(1);

        if(byte == '1')
        {
                Trans1();
        }
```

```
                else if(byte == '2')
                {
                        Trans3();
                }
                else if(byte == '3')
                {
                        Trans2();
                }
                else
                {
                        invalid();
                }
        }
}
```

4.3 Final Proteus simulation

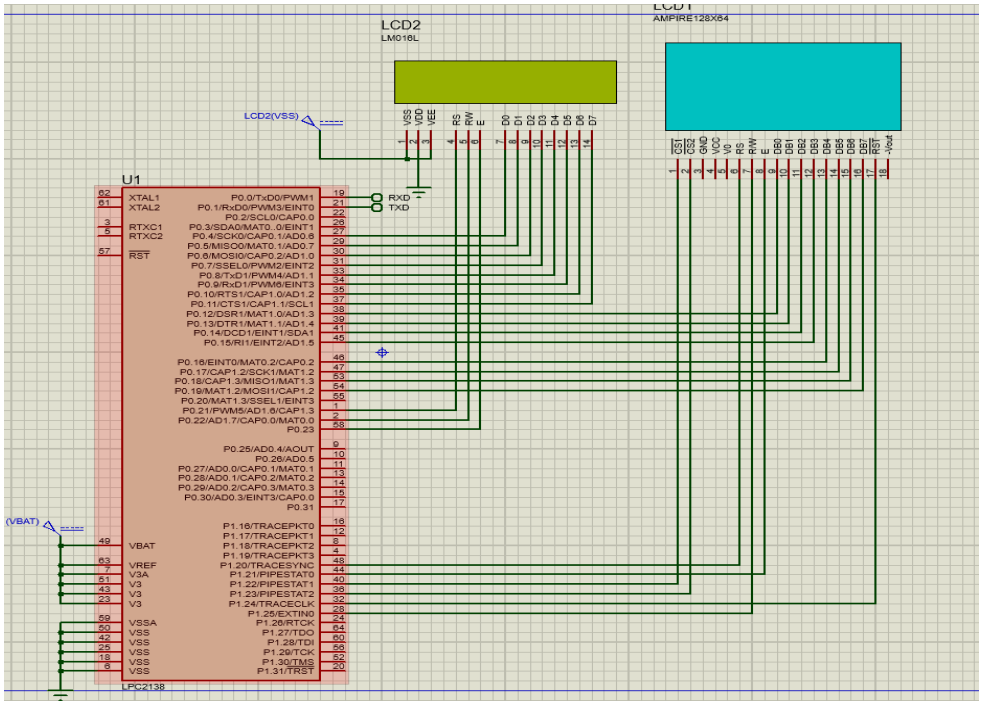


Chapter 5

Result and Testing

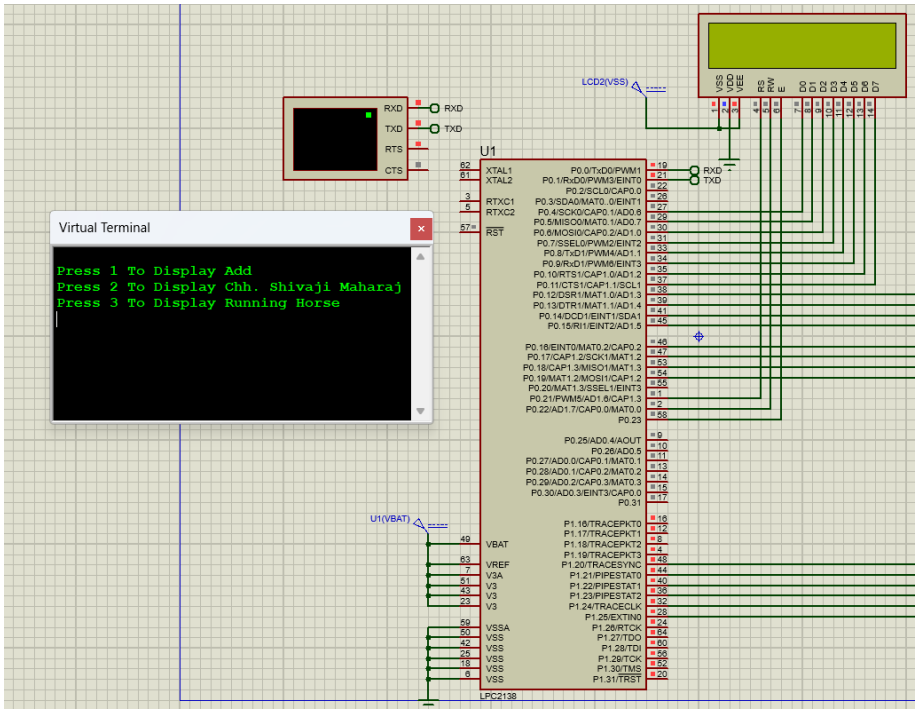
5.1 Objective 1

Objective wise results and ss from proteus/keil if any.



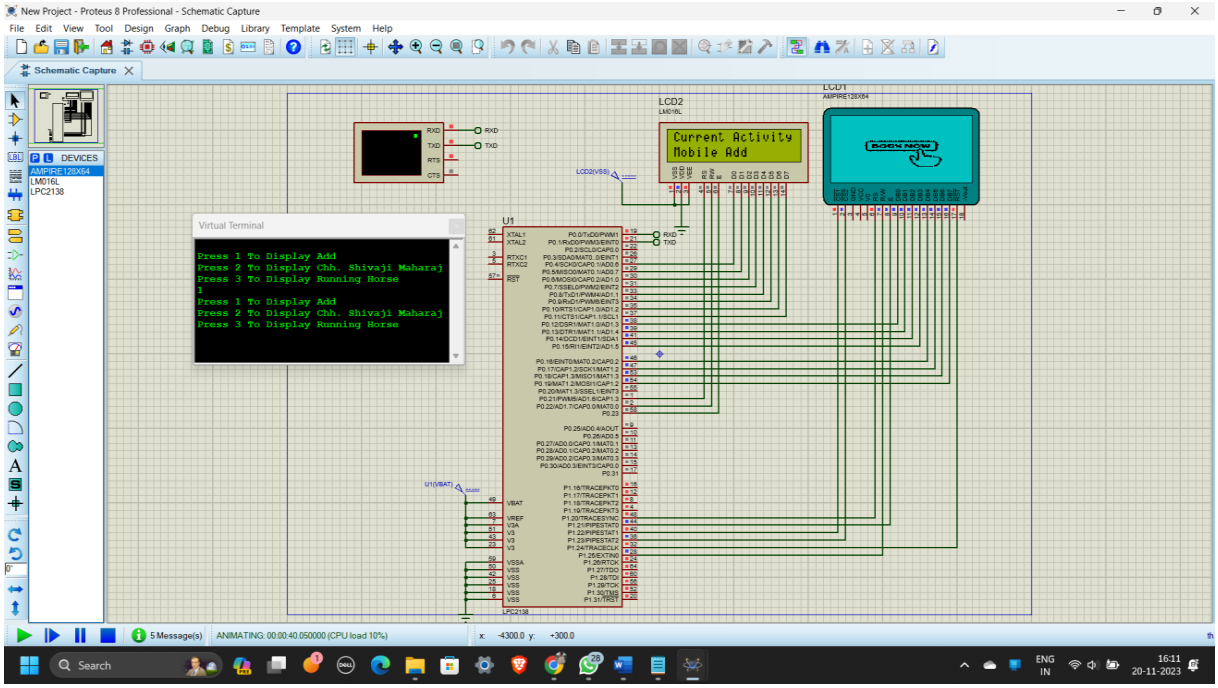
5.2 Objective 2

Objective wise results and ss from proteus/keil Explanation of modifications if any.



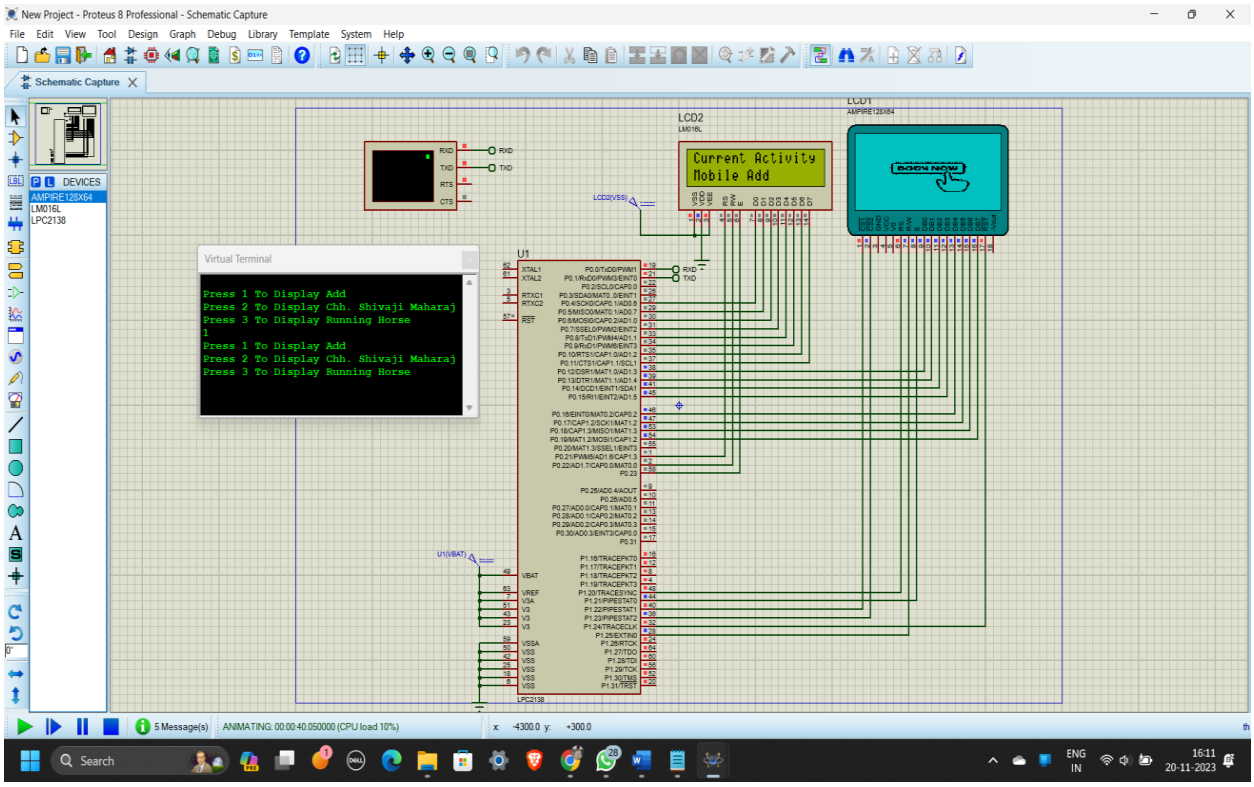
5.3 Objective 3

Objective-wise results and ss from proteus/keil if any.



5.4 System output

System output keil/proteus ss



Chapter 6

Conclusion & Future Scope

The mini-project successfully integrates the LPC2138 microcontroller with the Graphical Liquid Crystal Display (GLCD), achieving dynamic image rendering through a reliable serial communication link. This accomplishment showcases the system's versatility and responsiveness, signaling a convergence of hardware and software expertise. The project's success paves the way for innovative applications in embedded systems, emphasizing the potential for enhanced graphical interactions.

Future Scope:

1. Enhanced Graphics and Animation Capabilities: Explore advanced graphics libraries and algorithms to enhance the rendering capabilities of your GLCD. Implement support for higher resolutions and color displays.
2. Touchscreen Integration: Integrate a touchscreen interface to allow users to interact directly with the display.Implement gestures and touch-based controls for a more intuitive user experience.
3. Wireless Connectivity: Add wireless communication capabilities, such as Bluetooth or Wi-Fi, to enable remote control or data transfer. Develop a mobile app to control and interact with the Image and Animation Board.
4. External Storage and File Formats:Extend the project to support a wider range of image and animation formats. Incorporate external storage options like SD cards or USB drives for increased data storage capacity.
5. Real-time Data Display: Integrate sensors to display real-time data, such as temperature, humidity, or sensor readings, on the GLCD. Implement dynamic data visualization for practical applications.
6. Multi-Display Systems: Explore the possibility of connecting multiple GLCDs to create a larger display or multi-panel setup.Develop synchronization mechanisms for coordinated animations across multiple displays.