

Loyola Marymount University

Department of Electrical Engineering and Computer Science
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Introduction to ARM Assembly Language programming using Raspberry Pi

Objectives:

To develop a program in ARM Assembly Language using a Raspberry Pi (RPi) that requests text from the keyboard, processes the text, and outputs the result on the monitor and LEDs connected to the General-Purpose Input/Output (GPIO) header of the RPi.

REQUIRED EQUIPMENT:

HARDWARE:

- Raspberry Pi 3B+
- Computer monitor
- USB Keyboard
- USB Mouse
- Video adapter HDMI-VGA
- Power adapter for the Raspberry Pi 3B+
- VGA Cable
- LED (3 units)
- Male-Female Jumper Wire (4 units)
- 220 Ω resistor (3 units)
- Jumper Wires

SOFTWARE:

- Geany
- GNU Assembler
- GNU Project Debugger

PRELAB:

Develop a program that reads a text string of fifteen ASCII characters. The program needs to output the following string to request the text: "Please type text of 15 characters: " The program then needs to count the number of instances of "LMU". For example, there are three instances in "LMU! LMU! LMU!". The number of instances needs to be output on the monitor in decimal: "There are 3 instances of LMU" This number also needs to be shown in binary on three LEDs connected to the GPIO header. The program needs to loop indefinitely asking for and processing a new fifteen-character text string in every loop.

The tutorial project BlinkLED uses PIN17 of the GPIO to connect to the LED. You need to use PIN17, PIN18, and PIN27 in this assignment.

Important: It is not allowed to write the code in C and follow steps of tutorial doing nothing to generate the code in assembly from the code in C. The code needs to be completed in assembly

directly. Only the procedures of the tutorial can be used in your solution. It is not allowed to borrow code from anywhere else.

Submit the following deliverables:

- Flow chart of your assembly language program that follow the flow-chart convention attached.
- Simulation of your program using the tools learned in the prerequisite course on microprocessors. The simulation needs to show that your program counts the number of instances of “LMU” correctly. Use the following two strings for your simulation: “LMU! LMU! LMU!!”, LMU! LMX! LXX!.
- Copy of the assembly code including comments that explain your algorithm

EXPERIMENT:

Connect the RPi, run your program, and debug if needed. Your program needs to do the following correctly:

- Print “Please type text of 15 characters: ”
- Read 15 characters from the keyboard and store them in memory
- Count the number of LMU instances in the 15-character string
- Output the number of LMU instances on the monitor in decimal as follows: “There are [number] instances of LMU”
- Output the number of LMU instances on the three LEDs in binary
- Repeat this process indefinitely

Obtain the signature of the instructor when finished.

REPORT:

Submit the report according to the lab-report guidelines.