UM-SJTU Joint Institute
Microprocessor Based System Design
(VE373)

Project Proposal

Group 3

Smart Pressure-Sensitive Light

1 Objectives

In this project, our team uses the PIC32 Starter Kit to design a smart pressure-sensitive light. The design will have the following features.

- Every light on the LED board will adjust its brightness according to the pressure level exerted on the corresponding panel.
- Through the different pressure level sensed on the panel, the LED board will show the shape of the pressing object.
- One can turn off the light by pressing a button.
- If time allows, a infrared sensor will be applied so that when the lamp detects there's no people in front of it, it will go off automatically.

2 High Level Description

In this project, we will connect the PIC 32 development board with some sensors and LED light board to create a smart pressure-sensitive device that can adjust itself according to the pressure it received. In the design, infrared detector sensor and pressure sensor will transfer the signal to the PIC board. The board will then give out PWM signal and enable signal and power to the LED board so that the board can display the shape of the pressing object.

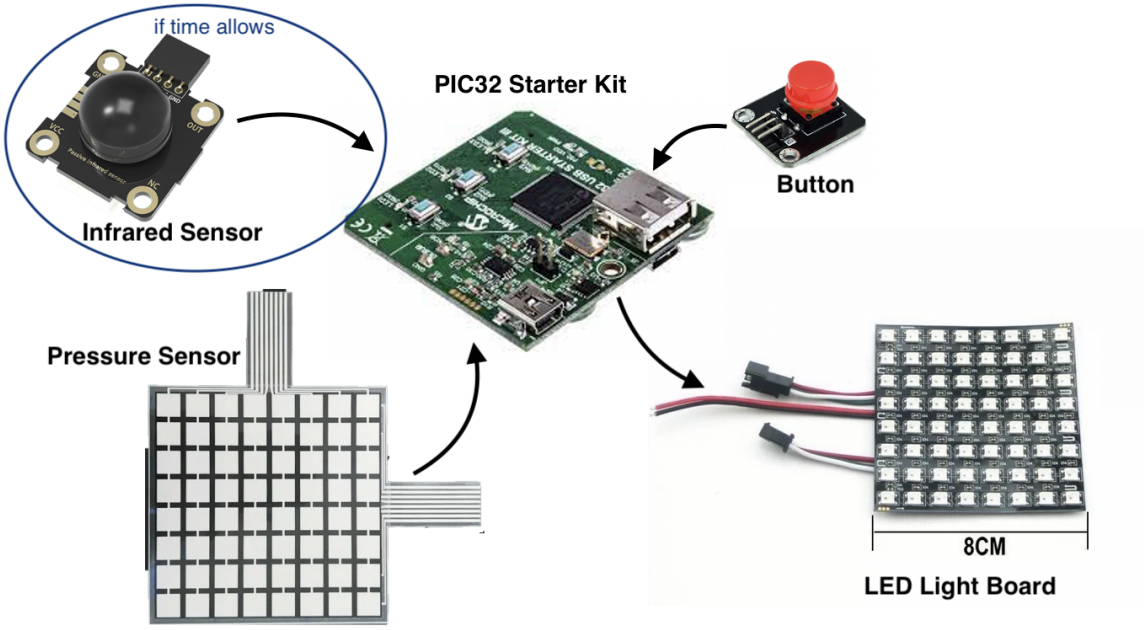

Figure 1: High level diagram

As the diagram shows, the PIC32 board serves as the commander of the whole design, with senors, button and LED light board being its peripherals.

- The board receives analog signals from the sensors. Here, we choose a distributed flexible thin film pressure sensor since it has many independent induction units that can serve our purpose of knowing where and how large the pressure is exerted on the sensor. Also, if time allows, we will use a infrared sensor to sense whether there are people nearby, so as to save energy when the device is not being used. The analog signals are converted into digital ones in PIC32 for further processes.
- The board also receives signals from a button. It is connected to the button for the manual control on output on LED board. Change notice interrupt is used here for detecting whether there's a push on the button.
- After data processed in PIC32 board, the message is sent to the LED light board in real time. The LED light board has many LEDs (in the picture there are 64 LEDs), each or a group of them represents a location corresponding to the pressure sensor. The light board supports I2C communication so that it is able to act as purposed.

3 Primary MCU Peripherals

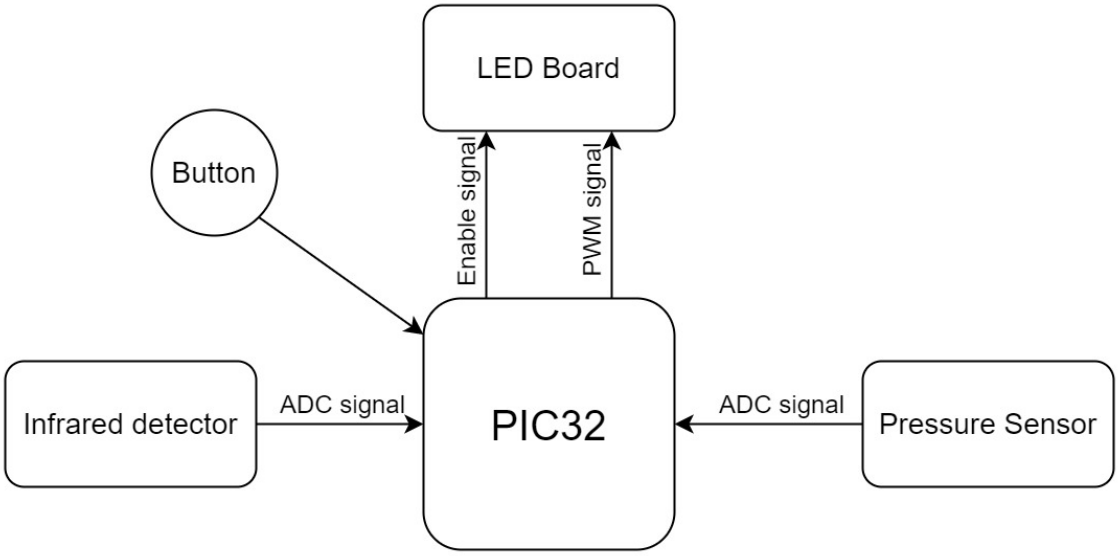

Figure 2: Component Level Diagram

3.1 PWM

In our design, PWM is used to control the brightness of the LED board. With the input signal from pressure sensor, we can decide the length of duty cycle for the out put PWM signal. Under high frequency flickering, the different length of duty cycle will result in different level of brightness for LED. We will analyze the response of pressure sensor and set proper duty cycle for corresponding PWM signal.

3.2 Serial Communication and DMA

For the connection between LED board and PIC32 board, we choose I2C based LED board. With clock signal, we can realize serial communication between LED module and PIC32 board. Also DMA can also be used in our design. When displaying certain patterns using LED, direct memory access can give a more effective data transfer.

3.3 ADC

There are two sensors that may related to ADC process in our design. First is the pressure sensor which converts the pressure into analog signal. After sampling by PIC32, it can be converted into digital signal. The pressure digital signal will be the base on which we decide the duty cycle for PWM signal. Another sensor is infrared detector. By setting a threshold, we can use the transferred digital signal from infrared detector to inform board about the user's distance and let board to turn itself off.

4 Preliminary Component List

The project will purchase the following components for development.

- Infrared sensor
- Pressure sensor
- Button for control on and off
- Wires for connecting the components
- LED light board
- Supporting frame

5 Preliminary Project Timeline

The tentative project timeline is listed in the Gantt chart below. For the time schedule, we intend to complete the development of the basic function by the middle presentation. After the middle presentation, we will keep making adjustments and add some bonus function to the device if time permits.

Figure 3: Gantt chart for the project timeline