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EE102-02

Project Proposal

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Door Security System

Abstract

The purpose of this term project is to implement a Door Security System using the concepts and hardware communication techniques that we learned in EE102 course. I will design a VHDL based logic on the Basys3 FPGA board that takes 4-digit password, which is entered via hand gestures from an external Python/AI application. The password that has been entered by the user will also be displayed on the seven-segment display. The project will demonstrate the integration of both hardware and software required to process the incoming data and control the door system using servo motor.

Design Specification Plan

There will be several hardware components used in this project. Basys3 board will be serving as the central control unit and logic processor. I will use the PMOD pins of the Basys3 board to connect the external components. The main component for my door security system is the SG90 Servo Motor, which enables me to control the door position. I will use a breadboard to provide a stable 5 V supply voltage to the servo motor and other components. The breadboard is an important part for this design because I need to organize lots of components and make the proper connections. 7-Segment Display also will demonstrate the entered password digits sequentially.

Methodology

The primary function of the design is to verify the entered password against a predefined one stored in FPGA and to perform the corresponding actions. The input digits are detected by using hand recognition algorithm in Python and the UART module enables communication between the Python and VHDL design on Basys3. Each recognized digit takes value between 1 to 5, representing the number of fingers detected on one hand. The 7-Segment Display will provide visual feedback to user by displaying the entered password digits. The 7-segment display will be quite useful for providing a clear visual representation of the entered inputs.

Also, I will use a SG90 servo motor to open the door. If the entered password matches the predefined one, the servo motor will rotate to open the door. The SG90 is a small servo motor that works with 5 V and can rotate about 180 degrees depending on the signal it receives. Additionally, when the door is opens, a green LED on the breadboard will turn on to indicate the entered password is correct. Otherwise, if the entered password does not match with the predefined one, the red LED will turn on to show that the password is incorrect. A buzzer is also used in this project to provide sound feedback to the user that a wrong password has been entered. I will use appropriate resistor for the LEDs to on the breadboard to prevent damage and limit the current.

One of the push buttons on the Basys3 board will be assigned as a reset button. In case of any errors, unexpected conditions or unintentional inputs were given to the system, pressing this button will reset the system to its initial state. The reset button will clear all inputs and outputs to ensure that the system is working properly.

Phases of the Project

Phase 1: In the first phase, I will be working on the UART communication module, the servo motor control and the 7-segment display. My goal is to ensure that the Basys3 board can successfully receive the password digits through UART and display them on the 7-segment display. Also, I will try to rotate the servo motor when the correct password is entered in real environment. If any problems occur during this phase, I will work on solving them in Phase 2.

Phase 2: I will implement the remaining components including the LEDs, buzzer and the reset button. In this phase, I will make the proper hardware connections and implementations on the Basys3 board and the breadboard. I will make sure that the reset button works accordingly because if any error happens it will help a lot. Overall, I will test and debug the full system to ensure that my design works properly.