Home Security System

Embedded Systems I Final Project

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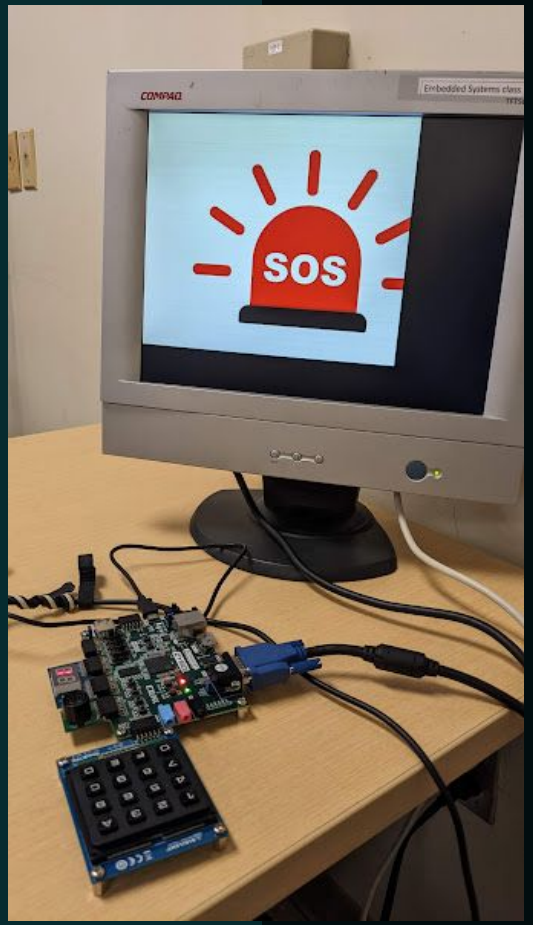


Introduction

- Goal => To develop an embedded system with two or more PMODs

- Developed a Home Security System using four PMODs
  - Ultrasonic Range Finder (MAXSONAR)
  - 16-Button Keypad (KYPD)
  - Seven Segment Display (SSD)
  - Video Graphics Array (VGA)

Concept Inspiration

- Need for security is not selective
  - Home owners, commercial industries, the government, etc. are all in favor of security measures to protect themselves or their belongings
- Modern day security systems implement cameras, motion sensors, and built-in features to contact emergency services
  - To mimic this functionality in my embedded design I implemented PMODs with similar features
    - MAXSONAR => similar to motion detector
    - KYPD => locking/unlocking system
    - SSD => displays who triggered the alarm
    - VGA => communicate emergencies

General System Description

A person appears within 10 inches* of the Ultrasonic Range Finder. → An LED is triggered based on how far the person is standing. → The SSD displays whether the person is an intruder, guest, or owner.

The keypad can be used to disable the alarm (given the user has the correct codes). If an incorrect code is entered the SSD will report an intruder. → The user can manually trigger a panic button in the event of an emergency. This will toggle the remaining LEDs and generate an SOS message.

Problem Solving

- Aimed at enforcing security in classified or protected spaces
- Statistically, homes without security systems are 300x more likely to get broken into
- Beyond personal use, it solves common critical issues in the aerospace or defense industry
    - Aerospace facilities and any military facilities may be susceptible to security breaches.
    - For instance, aircrafts that are parked in hangars are vulnerable to security threats such as vandalism or theft.

This project aims to provide a solution for industrial and commercial security concerns to protect personal belongings and spaces.

Application Space

The application space for a security system covers a variety of fields.

- **Commercial Applications**
  - As intended, a home security system
- **Defense Industry**
  - Enforce perimeter security to protect against unauthorized access
- **Aerospace Industry**
  - Integration with other sensors for environmental monitoring, such as the HYGRO PMOD, could be used to detect space debris

Market/End User

There are both industrial, commercial, and personal uses for a security system. To generalize, the end user is a company or individual that values operational or personal security.

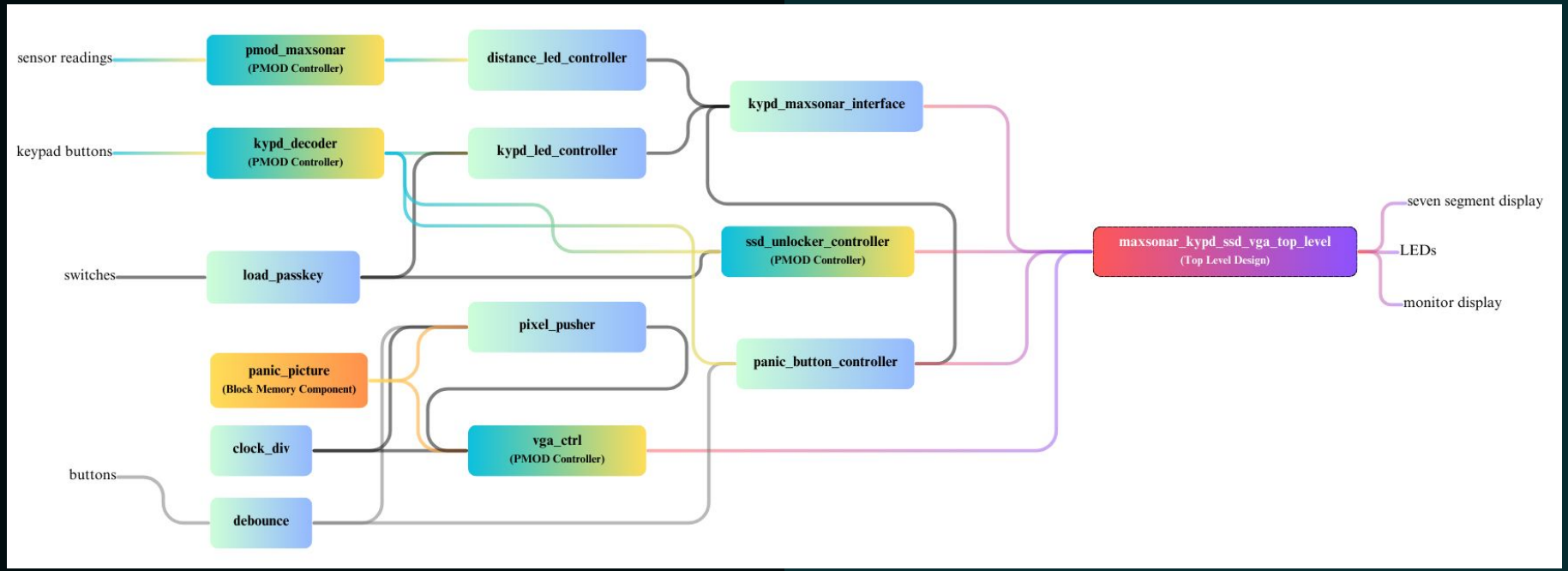
Industrial/Commercial

- Can be implemented in restricted areas, or areas deemed unsafe for humans
- Can be used to protect proprietary information or locations

Personal

- Can be implemented as a security system for homes and personal property to avoid trespassing, robbery, etc.

System Block Diagram



Implementation Challenges/Choices

Choices

- Chose to build in some default passcode for the security system to allow overriding the alarm
- Chose to integrate the VGA PMOD to develop a panic “button” for emergency situations

Challenges

- Integrating all four PMODs
  - Developed intermediate top-level designs every time a new PMOD was introduced to the system
  - Simulated/tested low-level designs to confirm functionality before integrating it into the larger system

Implementation Challenges/Choices

- Due to the replicable nature of this project, it can be quickly reproduced and distributed off-the-shelf
- This Home Security System is created by hardware implementation and software to connect the various components into a coherent system.
- The base system serve one purpose, to detect trespassers and signal an alarm

Further Ideas

- Limitations in the range of the Ultrasonic Range Finder prevented the design from measuring movement beyond 255 inches
- Additionally, the Ultrasonic Range Finder is only able to determine if objects are in direct line of “sight” of the PMOD
    - Objects placed slightly to the side would not be recognized, leading to a large blind spot in this system
- To further extend this design, I would implement a Wi-Fi PMOD to integrate the alarm system with a device like Google Home or Alexa

Summary

Through the use of the Ultrasonic Range Finder, Keypad, Seven Segment Display, and VGA, I was able to develop a home security system that could detect and report intruders or trespassers in real time.

However, the applications of this embedded system can extend beyond this space, to industrial and governmental areas.

To conclude, this project was aimed at solving the security needs in the commercial space by mimicking existing home alarm systems.

Thank you!