This document contains the project proposal for the course *Embedded System Design Lab* submitted by

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Voltian: A Microcontroller-Based Proximity-Activated Security Taser

Problem Statement

Security systems often rely on passive deterrents like alarms or surveillance cameras, which may not be sufficient to prevent unauthorized access. This project aims to develop an automated taser security system that detects an approaching object or hand using an HC-SR04 ultrasonic sensor and activates a taser circuit based on proximity. The system, controlled by a Tiva TM4C123 microcontroller, will provide an additional layer of security by deterring intruders through an automated response mechanism. The implementation will be tested both in simulation and through a real hardware prototype to evaluate its efficiency and responsiveness.

Methodology

The development of the proximity-based taser security system follows a structured methodology, starting with component selection and circuit design, where the necessary hardware, including the Tiva TM4C123 microcontroller, HC-SR04 sensor, relay module, step-up converter, and taser circuit elements, is identified. A schematic is then designed to enable taser activation based on proximity detection. Next, the sensor and microcontroller programming phase involves writing embedded C code to process distance measurements from the HC-SR04 sensor and implementing logic to trigger the taser circuit when predefined distance thresholds are met. The system is then subjected to simulation testing using software like Multisim and Keil uVision, allowing for debugging and refinement of the control logic before moving to physical implementation. In the hardware implementation and testing phase, the circuit is assembled on a breadboard, and response times and accuracy are tested under different conditions while ensuring safety measures are in place to prevent unintended activation. To ensure the functionality and safety of our taser circuit, we will conduct two primary testing methods. First, if we have access to an oscilloscope with a high-voltage probe to measure the pulse strength, frequency, and waveform characteristics of the circuit. This will allow us to analyze and fine-tune the system without direct exposure to high voltage. Second, we will perform a biological conductivity test using a raw piece of meat or chicken, held in place with a dry wooden stick to maintain electrical insulation and safety. This test will simulate how the taser interacts with organic tissue, allowing us to observe its effectiveness, arc formation, and potential energy transfer.

Task Distribution

In our project, Nour will primarily focus on coding, handling the embedded C programming for the Tiva TM4C123 microcontroller to process sensor data and control the taser circuit. Meanwhile, Mohamed will take the lead on the hardware, designing and assembling the circuit, integrating components like the HC-SR04 sensor, relay module, and step-up converter. However, to ensure full involvement in all aspects of the project, we will actively support each other whenever challenges arise. This collaborative approach allows both of us to gain hands-on experience with both software and hardware, ensuring a well-rounded understanding of the entire system.