**Project Proposal**

1. Project Title

* Autonomous Threat Detection and Alarm Security Robot

2. Project Applicants

* Samantha Buckle
* Dylan Dauz
* Sheldon Peters
* Sameeh Olipani

3. Reason for the Project:

* Homes, businesses, and facilities become vulnerable at night to any manner of break-in or intrusion. Full security systems are semi-permanent and can be costly to buy and install. This project aims to create a robot that can do the job of break-in and intrusion detection without the drawback of a full security system. It will aim to create a mobile, autonomous, and cost-effective security system with comparable capabilities to a standard security system.

4. Knowledge of Subject

* As this challenge involves designing and building all aspects of our robot, the skills we have learned in our classes should come in handy. In PHYS-201, EMEC-200, 310, and 316, we learned about circuitry and how different components interact with each other. We also learned about some common sensors and how to interface them with an Arduino. EMEC-325, Engineering Design, taught us the importance of planning out the design beforehand and thinking about possible problems that could arise during the course of our project. COMP-121, 122, and 362 have been helpful in learning how to program in C and C++, in which the knowledge could be transferred over in the programming of our robot. Other courses that we are in the process of taking, or will be taking with EMEC-499 will be useful as we develop the skills in class and directly apply them as we are working on Capstone.
* Within our group, we have experience working on related projects such as the *Robot Rodeo*, and working with Rethink Robotics’ Sawyer Arm, in projects called: *Sawyer and Virtual Reality: Robotic Control for Object Manipulation*, and *Robot Control for Object Manipulation using Artificial Intelligence*. In robot rodeo, a challenge previously hosted by the navy, students were tasked with creating a robot capable of traversing an obstacle course similar to the interior of a ship. In this challenge, students gained experience in designing, manufacturing, and presenting their projects at the SAGE student research conference.
* Designing the robots for EMEC 470. The purpose of the project was to design and create a robot that could be used in the teaching of EMEC 470. Students have experience with Fusion 360 which was used to design multiple parts which were then 3D printed or laser cut.

5. Preliminary Research/Literature Search

* Important areas to continue to do more research in are the threat detection methods, and sensor integration.
* Threat detection can use technologies like computer vision, motion detection, infrared sensors, audio detection, ultrasonic sensors, and/or a combination of these technologies.
* Example of an a [fully autonomous outdoor security robot](https://www.knightscope.com/products/k5)
* Integration of efficient energy measures would be important, so it can function throughout a shift. Self-charging abilities or longer battery life would be important in doing so.
* Methods for threat response can be real-time notifications with wireless communication (GSM communication), and audible alarm response. Differentiating different levels of threat; for example, a small movement detection could be a less significant response while an example of an intruder could be a more significant response.
* Need to find quiet motors that won’t activate the sound sensor and constantly set off false alarms
* The ability to control arm/disarm the system and silence alarms after they go off with a (Bluetooth?) remote control

6. Project Description

* This project aims to design and build a robot for use in the monitoring of indoor spaces. The robot will be capable of autonomous movement, being able to move about a building or room without the need for human control. It will also house a suite of sensors that will enable the robot to detect loud noises or the presence of a person. Once a disturbance is detected the robot will alarm by flashing lights and playing an alarm sound. The customer should be able to turn the system on and off with the use of a remote control.

7. What You Will Produce During this Project/Outcomes

* Consistent updates on the progress of our project to our capstone advisor and within our team
* A robot prototype capable of navigating a room or building, sensing loud sounds like breaking glass, and if a person enters its view.
* A technical report explaining the design process, sensing methods, control algorithms, and test results.
* A final presentation given to our capstone advisor.
* A capstone poster to be presented at the Capstone Showcase.

8. Timeline or Tasks

* Preliminary research on topic (Literature review)
* Designing robot
* Ordering parts and components
* Prototyping and testing
* Building robot
* Testing
* Troubleshooting
* Completion of technical report
* Completion of presentations

9. Oversight

* Vida Vakilian is our capstone advisor. She is a mechatronics professor at CSUCI and is knowledgeable in many subjects that will assist us in the completion of our goal. We will have meetings with Dr. Vakilian every few weeks in which we will present our progress and will receive feedback. She will also review and comment on every final paper and presentation.
* Upholding ABET standards
* Team Roles:
  + Dylan Dauz: 3D Designer, Builder, Programmer
  + Sameeh Olipani: Builder, Logistics Manager, Electrician
  + Samantha Buckle: Time Manager, Programmer, Builder
  + Sheldon Peters: Control Systems Designer, Data Analyst
* Task Delegation:
  + Tasks are agreed upon and assigned at the start of every month
* Project Head:
  + Sheldon Peters

10. Possible Problems

* The most pressing issue to address is funding, as our own expenses may need to cover parts of the capstone project. Currently, we are unsure whether funding will be provided or if our group will need to pool the necessary resources to purchase the components for this project.
* Another issue is finding a suitable location to facilitate the construction of the project. The coordination of facility usage during this phase may present logistical issues, given that access to the school's laboratories requires additional clearance.
* The 3D printers at the school will be used by a multitude of other capstone groups and classes and availability may be uncertain. Another issue that arises when it comes to the 3D printers is the size of their print beds. If the project requires any significantly large 3D designs they will need to be printed in pieces and assembled after printing.
* Time management is another critical concern, as mistakes during the development process could lead to costly delays. The delivery of replacement parts may extend lead times, and any damage to components would result in additional downtime. It is essential to adhere to a schedule that aligns with the project's construction milestones to mitigate these risks and ensure timely completion.
* More challenges may come up during the construction phase of the project, as it will test both the skills to physically build the robot and the ability to program it. The robot needs to be designed and built from the ground up, so mechanical and interfacing problems are to be expected.
* Debugging and resolving errors in the code may also require significant time and effort. Moreover, the steep learning curve associated with this process, particularly in researching successful methodologies, could further prolong the timeline.
* The selection of parts presents a challenge that may become evident during the research phase of the project. One idea for the robot involves the use of a sound sensor, which may require the use of moderately quiet motors to not interfere with the sensor. Some research into the sensors will be based on full home security systems, and it will need to be determined which of these sensors are viable for a mobile platform.