# ECE 411 Practicum Project

## Suspicious Package Training Aid

## Contributing Members:

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Deven Lorenzen

Edward Sayers

Seth Ward

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## Team Formation

The members of this team were formed on the basis of having previously worked together, participation in the same classes, and recommendation from fellow classmates. Below is a list of the participating members:

* Jeremiah Franke
* Deven Lorenzen
* Edward Sayers
* Seth Ward

Of these members, Jeremiah and Edward are both in the Computer Engineering program at Portland State University with a focus in embedded systems. Deven and Seth are both Electrical Engineering students with the track of Analog RF. After the group was formed and contact information was exchanged, the group set about brainstorming project ideas that would be both challenging and accomplishable within the given constraints.

## Team Project Ideas

After a few meetings between all collaborators the following project ideas were proposed:

1. **Suspicious Package Training Aid**. The chief of security at the Oregon Zoo has requested a suspicious package training aid. This device is required to activate a buzzer when a UHF radio transmits a signal near it, if the device is moved, or set off by a tuned remote device.
2. **Voice/Whistle controlled lock-box**. This device records an audible sound from the user to use as a code to unlock. The users can than repeat this sound to activate solenoid to unlock the box.
3. **LED POV Ball**. For this project a gyroscope would be used to measure the velocity of a ball that is rolling. This information would be passed to a microprocessor that would then change the LEDs configured around the surface of the ball to maintain an image relative to its axis.
4. **LED turn signal lights that can be attached to a motorcycle helmet/jacket for added safety**. This device would connect either physically or relentlessly to a turn signal assembly on a motorcycle or scooter. LEDs arranged and the back shoulders, sleeves, and/or left and right side of a helmet would be activated in cadence with the turn signal. The LEDs would illuminate with the corresponding side to add visibility to a driver.

## Decision Matrix

After some discussion between project collaborators, it was decided that the Suspicious Package Training Aid would be the best choice for this quarter's practicum. The decision matrix used to make the decision is shown below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Criterion Weights** | | | | | | |
|  | Interest | Simplicity | Originality | Need | Mean | Weight |
| Interest | 1.00 | 3.00 | 3.00 | 1.00 | 1.73 | 0.39 |
| Simplicity | 0.33 | 1.00 | 3.00 | 3.00 | 1.32 | 0.29 |
| Originality | 0.33 | 0.33 | 1.00 | 0.33 | 0.44 | 0.1 |
| Need | 1.00 | 0.33 | 3.00 | 1.00 | 1 | 0.22 |

|  |
| --- |
| Interest: How much each project interests the group members. |
| Simplicity: How easy will the project be to complete. |
| Originality: How original is the project. |
| Need: How much does the project fill a real world need. |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |
| **Interest Weights** | | | | | | | | | |
|  | | Training Aid | | Lock Box | | POV Ball | | Bike Signal | |
| Edward | | 1 | | 3 | | 2 | | 4 | |
| Seth | | 2 | | 1 | | 3 | | 4 | |
| Devin | | 2 | | 3 | | 4 | | 1 | |
| Jeremiah | | 3 | | 1 | | 4 | | 2 | |
|  | Total | 8 | | 8 | | 3 | | 5 | |
| Weight | 0.33 | | 0.33 | | 0.13 | | 0.21 | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | |  |  | |  |  | |  | |  |  | |  |  | |  | |
| **Simplicity Weights** | | | | | | | | | | | | | | | |  | |  | |
|  | | | | Training Aid | | | Lock Box | | | POV Ball | | | Bike Signal | | | Mean | | Weight | |
| Training Aid | | | | 1.00 | | | 0.33 | | | 3.00 | | | 0.33 | | | 0.76 | | 0.15 | |
| Lock Box | | | | 3.00 | | | 1.00 | | | 5.00 | | | 1.00 | | | 1.97 | | 0.39 | |
| POV Ball | | | | 0.33 | | | 0.20 | | | 1.00 | | | 0.20 | | | 0.34 | | 0.07 | |
| Bike Signal | | | | 3.00 | | | 1.00 | | | 5.00 | | | 1.00 | | | 1.97 | | 0.39 | |
|  | |  | |  |  | |  |  | |  | |  |  | |  |  | |  | |
| **Originality Weights** | | | | | | | | | | | | | | | |  | |  | |
|  | | | | Training Aid | | | Lock Box | | | POV Ball | | | Bike Signal | | | Mean | | Weight | |
| Training Aid | | | | 1.00 | | | 5.00 | | | 3.00 | | | 5.00 | | | 2.94 | | 0.58 | |
| Lock Box | | | | 0.20 | | | 1.00 | | | 0.33 | | | 3.00 | | | 0.67 | | 0.13 | |
| POV Ball | | | | 0.33 | | | 3.00 | | | 1.00 | | | 5.00 | | | 1.5 | | 0.3 | |
| Bike Signal | | | | 0.20 | | | 0.33 | | | 0.20 | | | 1.00 | | | 0.34 | | 0.07 | |
|  | |  | |  |  | |  |  | |  | |  |  | |  |  | |  | |
| **Need Weights** | | | | | | | | | | | | | | | |  | |  | |
|  | | | | Training Aid | | | Lock Box | | | POV Ball | | | Bike Signal | | | Mean | | Weight | |
| Training Aid | | | | 1.00 | | | 5.00 | | | 9.00 | | | 7.00 | | | 4.21 | | 0.84 | |
| Lock Box | | | | 0.20 | | | 1.00 | | | 5.00 | | | 3.00 | | | 1.32 | | 0.26 | |
| POV Ball | | | | 0.11 | | | 0.20 | | | 1.00 | | | 3.00 | | | 0.51 | | 0.1 | |
| Bike Signal | | | | 0.14 | | | 0.33 | | | 0.33 | | | 1.00 | | | 0.35 | | 0.07 | |
|  | |  | |  |  | |  |  | |  | |  |  | |  |  | |  | |
|  | |  | | |  | | |  | |  | | |  | | |  | |  | |  |  |
| **Final Weights** | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | Training Aid | | | | | Lock Box | | | | | | POV Ball | | | | Bike Signal | |
|
| Interest | | 0.39 | | | 0.33 | | | | | 0.33 | | | | | | 0.13 | | | | 0.21 | |
| Simplicity | | 0.29 | | | 0.39 | | | | | 0.39 | | | | | | 0.07 | | | | 0.39 | |
| Originality | | 0.1 | | | 0.58 | | | | | 0.13 | | | | | | 0.3 | | | | 0.07 | |
| Need | | 0.22 | | | 0.84 | | | | | 0.26 | | | | | | 0.1 | | | | 0.07 | |
| Score | | | | | 0.48 | | | | | 0.31 | | | | | | 0.12 | | | | 0.22 | |

## Project Selection and Proposal

The final selection for this team’s practicum project was based primarily on interest, originality, and need. Out of the four projects proposed, the Suspicious Package Training aid weighted higher in interest, originality, and need. This project idea was initially proposed by Deven Lorenzen, whose father works for the Oregon Zoo and initially suggested the idea to him.

### Problem Statement

Security departments of various organizations need to be trained to react when encountering different types of events. In the event of a suspicious package that has been left unattended, certain protocols need to be followed to ensure safety. These protocols include:

* Not touching or moving the unknown package
* Making sure that the reporting official is more than 25 feet away from the package before using their radio to report the event.

### Proposed solution

Design and build a device that gives an alert/indication when it has been agitated or if a radio has been used within a defined radius. Future accessories of the device could include a remote activation using a key fob or some other remote control device and a visual display to indicate which protocols were not followed.

### Project requirements

In order to address the problem statement and the proposed solution, the project requires a number of specific elements:

1. A power switch to turn the device on.
2. A button or switch to put the device into simulation mode and put it into standby (optional).
3. An accelerometer to detect if the device has been agitated or if it is in motion.
4. A band-pass filter and amplifier to detect an RF signal (UHF radio band between 420MHz-470MHz).
5. A simple LED display to indicate if the device is on, in simulation mode, or if the training simulation has failed. Alternately an audio cue from a speaker has been suggested as an indication if an agitation or RF event has been detected.
6. A microcontroller to listen for events from the accelerometer and RF detection device, calculate the amount of agitation, and calculate if the RF signal received is within a 25 foot radius of the device. If either of these events happens while the device is in simulation mode the microcontroller will activate the LED indicator or send an alert through a speaker to indicate a failure in adhering to standard security protocols.