CS Capstone Requirements Document

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Slide Sentinel

Prepared for

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The Slide Sentinel

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Abstract

This document outlines the requirements for the Slide Sentinel 2018-19 senior capstone project. This document includes both the requirements for the Slide Sentinel and the integration of its components to LOOM. Outlined below is the requirements of the projects software for both hubs and the online client.

CONTENTS

Revisions: Revised April 2019

Section	Original	New
All	References to ONEhub	Integration of Freewave radio and Rockblock+ to LOOM
All	References to 4G LTE	Client has opted to go with just satellite communication
Specific Requirments	User Interface: Web client	Broken up into a spread sheet application and a map client

1 INTRODUCTION

Environmental sensing data is used extensively by both scientists and engineers for a variety of uses such as research, risk analysis, and many others. It is common for such data to come from remote locations where there isn't constant human presence, so a way of collecting this data remotely would be extremely convenient and practical. The ONE hub from the OSU Open Sensing lab seeks to provide such a way to not only remotely communicate with a sensing project, but also to interface with other sensors wirelessly for data collection.

Landslides are costly for land management to deal with due to their expensive clean up costs and the remote nature of most landslides. Monitoring the mass movement of geography can be used to accurately predict the likelihood of future landslides and track historical movements. Slide Sentinel is a project which will provide such a way to collect this data and remotely send it to the cloud for storage and future visualization. This project is a derivative project of the ONE hub and LOOM sensors in principle, but due to constraints, these projects are actually vastly different from one another.

1.1 Purpose

The Slide Sentinel system seeks to provide a method for land management owners to accurately monitor and track information about mass movement in remote mountainous locations. The system will track the positions of sensor nodes and communicate any changes in position to a larger database or spreadsheet. This information can then be accessed by the client for further analysis and shown in a Google maps visual of the positional changes.

The goal of the LOOM project at the OSU Open Sensing lab is to provide a framework for scientists and engineers to deploy sensing projects and collect information. The Project LOOM enables users to easily prototype and create new sensing projects through its plug-and-play software and modularity of the boards. One of the primary uses of sensing projects is to gather environmental data from a remote location. The Freewave radio and Rockblock used in the Slide Sentinel system will be integrated into LOOM towards the end of the project to add to LOOM's networking capabilities.

1.2 Scope

Starting from the bottom, the Slide Sentinel sensors are microcrontrollers with wireless radio capabilities along with an accelerometer module. The central hub consists of some microtroller which is outfitted to collect radio communication from the sensor array and send data over SatCom. Data will be collected in a Google sheet for detailed viewing. This data will then be used to construct a Google maps visualization to track the paths of sensors over time.

The radio and satellite communication device integration will expand the abilities of LOOM adding to the available devices users can use with LOOM. This integration will provide a high level abstraction similar to other communication devices on the platform which will be build off the final build of the hub for Slide Sentinel.

1.3 Product Overview

1.3.1 Overview

Slide Sentinel is a system of sensors, transmitters, and internet applications that collect, upload, and present data on land slide activity. Slide Sentinel is composed of multiple devices and applications that work together to detect land

slides, the main components are the sensor modules, a hub module, and an online application. The sensor module and hub module are physical devices placed in land slide prone areas which will collect positional data on local landslides. The sensors will be provided correctional positioning data from the hub to increase their accuracy. The sensor module will detect changes in its position or orientation and send this data to the central hub. Periodically this data will be sent over a satellite to an online spreadsheet application. The data can then be used by users for analysis and be shown in an online mapping application for easy viewing. The viewing application will provide information such as id, position, and status as well as a way to view the historical positions of the sensors.

LOOM is an Arduino library and device platform which provides a set of interfaces to directly use integrated hardware easily with other devices. The inter-node and satellite communication devices used in the Slide Sentinel system will be integrated in with LOOM providing their capabilities to the platform.

1.3.2 Perspective

The Slide Sentinel system consists of the three major elements. There are the sensors which collects information, the wireless hub, and a visualization web page. The sensors communicate with the wireless hub over a radio connection and the hub transmits data elsewhere over a satellite connection or cellular network.

The inter-node and satellite communication devices will integrate with the LOOM library in order to provide the networking capabilities of the Slide Sentinel hub to the larger ecosystem of LOOM sensor modules. The integrated device software will comply with all specifications and guidelines of the LOOM library including the Open Sound Control(OSC) specification used to communicate between LOOM devices.

1.3.3 Functions

The Slide Sentinel system will allow users to track and visualize the movement of sensors deployed in strategic locations to collect landslide information. Users will be able to access this information in a plain text format through an online spreadsheet application which will show information about individual sensors such as id, longitude, latitude, orientation, status, and a time stamp of the last data collection. A mapping application will be used to provide a way to visualize this information geometrically on a map for easy viewing.

The inter-node and satellite communication devices integrated into LOOM will provide an interface to use the radio used in Slide Sentinel as part of LOOM. Additionally the satellite communication device integration will provide an interface for interacting with a Rockblock. Both of these pieces of software will mostly provide a means of receiving and sending messages as well as some utility to check environment conditions such as signal quality.

1.3.4 User Characteristics

The primary user of Slide Sentinel is researchers working on monitoring or preventing landslides. This user will most likely have some technical background but not necessarily related to computers. Given the background of the users the online client can present scientific data in a plane manner, however the website should still be simple to use because the user might not have a background in computers. This user mostly cares about being able to see a visualization of how land has shifted and possibly access to the raw data itself. This means the primary focus of the user interface will be the

visualization functionality.

LOOM is designed to be used by people who have hardware experience but may lack some software experience. The integration of the communication devices will provide a high level abstraction with minimal complexity for users to make use of the device without knowing any of the specifics.

1.3.5 Limitations

- Hardware
  The hardware configurations for both hubs need to stay under and on budget. This includes choice of microcontroller, communication module, battery, antenna, and enclosure.
- Interface
  The Slide Sentinel hub needs enough open space to connect to a satellite for communication.
- Quality
  The battery chosen needs to be able to power the hardware configuration for at least three months. The hub needs to upload data on a consistent schedule.

2 REFERENCES

REFERENCES

Compliance

[A1] G. L. Marissa Kwon, "Project description for capstone," document hosted on OPEnSLab google drive.

[A2] G. Lund, "Landslide monitor development targets," document hosted on OPEnSLab google drive.

[A3] M. Wright, "The open sound control 1.0 specification," *OpenSoundControl*, 2002.

3 SPECIFIC REQUIREMENTS

3.1 External Interfaces

3.1.1 Hardware Interface

The hub will allow for users to manually retrieve data if the long range wireless connection is not functional. Data will be stored on a memory card and can be accessed through a universal serial connection.

3.1.2 User Interface

The online client will consist of a spreadsheet is view the raw data from the system as well as a map client to visualize the positions relative to each other on a map.

3.2 Logical Database

The system will frequently push data to an online spread sheet application. This data will come with specific formatting and will need to be parsed and processed before being entered into the spread sheet.

3.3 Performance Requirements

The hub and sensor components must be optimized to perform well in remote locations. In order to operate in remote locations for extended periods both the hub and the sensor components need to be very power efficient. The hub and sensor components are both used to transmit data and must balance power efficiency and performance in order to be able to upload all the necessary data. Both utilize a solar panel to mitigate

3.4 Enclosure Design Constraints

The Slide Sentinel hub will include an enclosure in the final product which can withstand outside weather conditions. The enclosure should provide protection against dust particles, water, and small impacts due to blown twigs and branches. The enclosure will be 3D-printed to reduce the overall cost of the project and allow for replacements to be readily constructed. This is equivalent to around an IP54/55 rating depending on the water resistance of the enclosure.

3.5 Supporting Information

Documentation on the usage of both hubs will be provided so that any user may understand the specifications of the product and the necessary technologies it supports. Information on the usage of the integrated components in the LOOM library will also be provided so users can easily use it in LOOM projects.

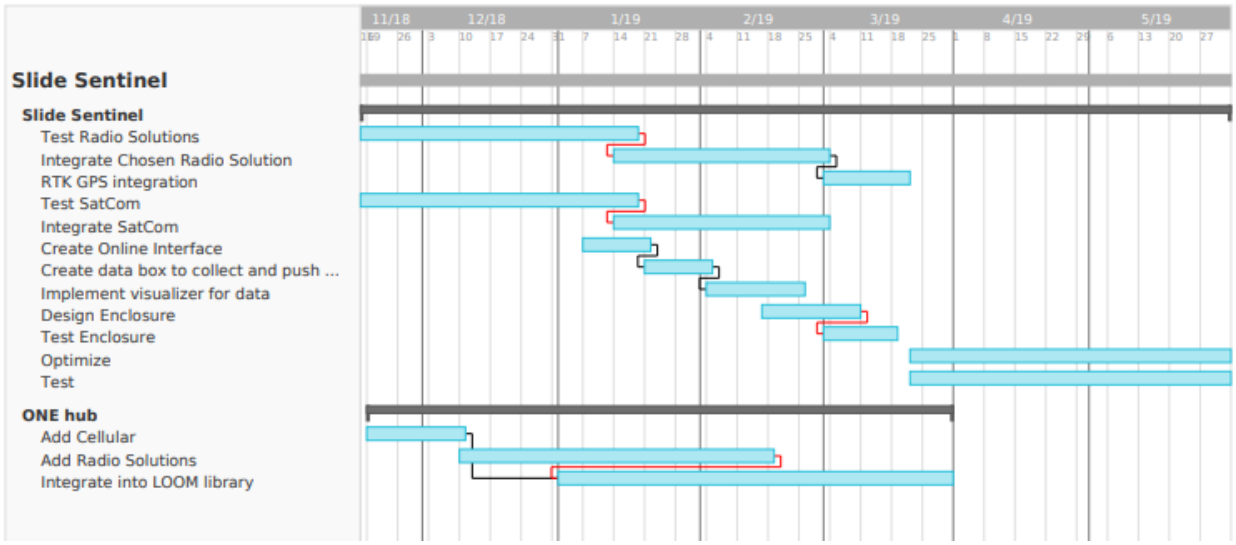

Fig. 1. Gantt Chart