Sidewalk Slope Monitoring System

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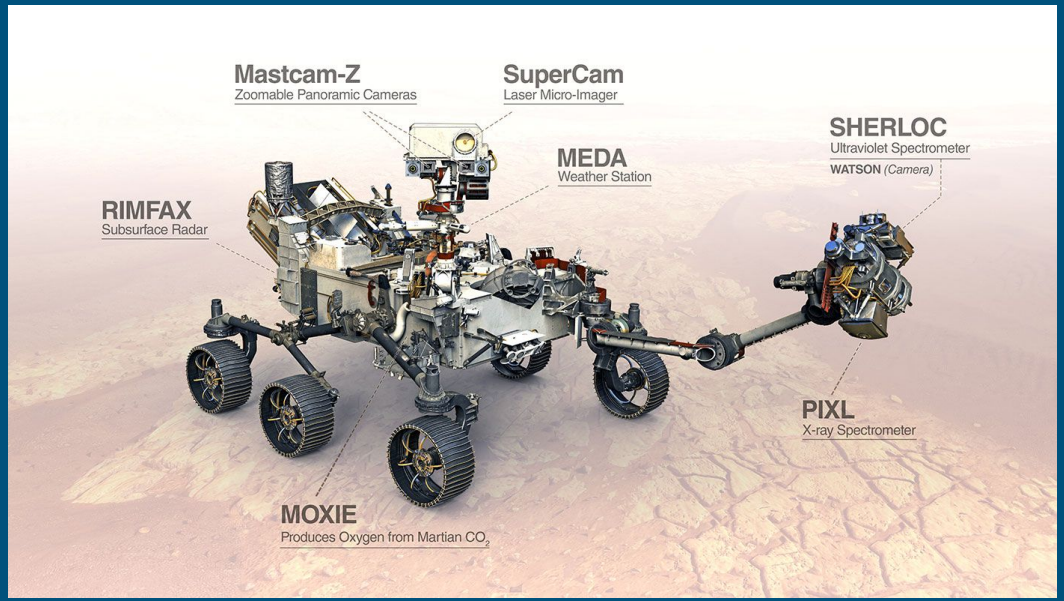
Alisa Blake

Advisor:
Jungsoo Lim

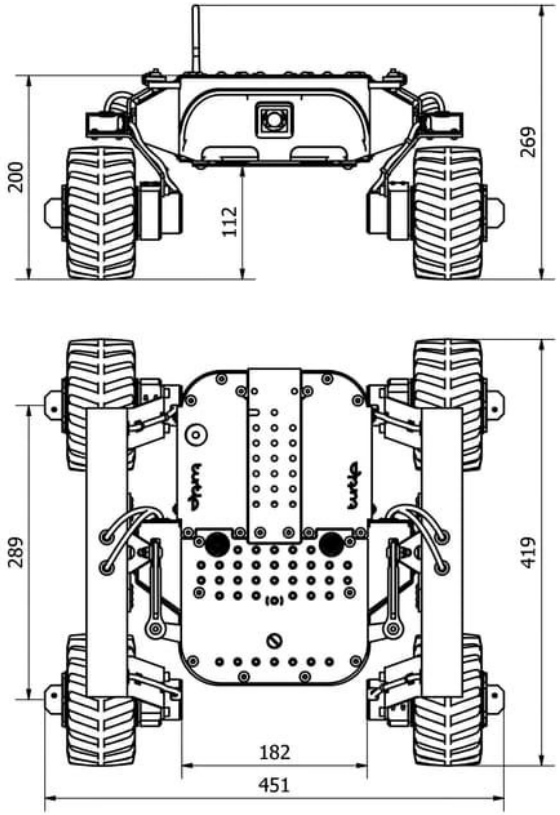
Introduction

- 1st Year
  - Rover
  - Slope Monitoring
  - Image Capture

- 2nd Year
  - Web Application
  - Rover User Interface
  - Image Processing - AI
  - Database Backend



LEO ROVER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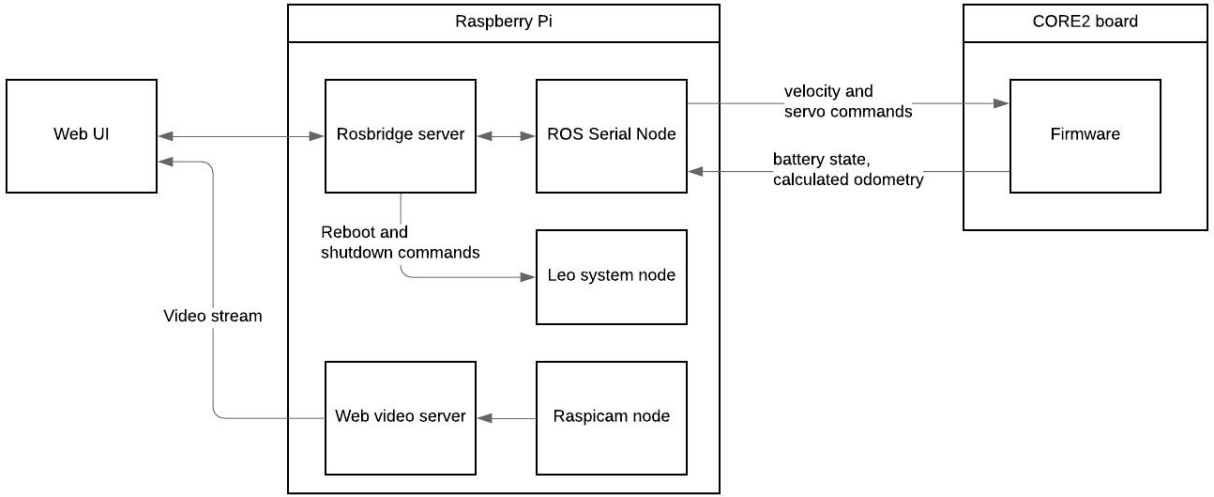
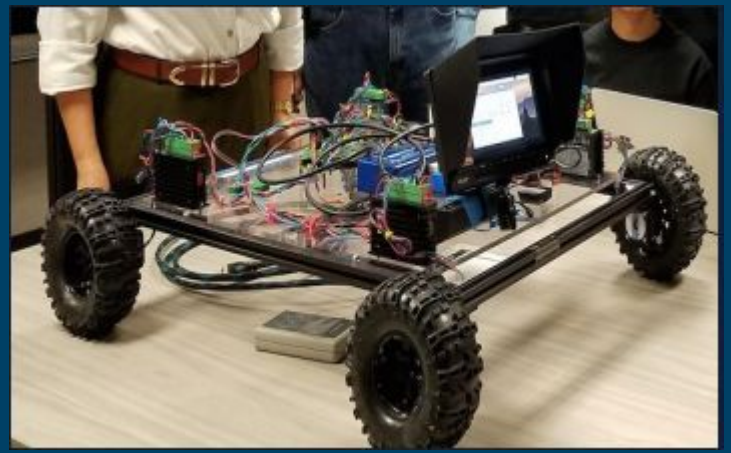
182
451


Raspberry Pi
CORE2 board
Web UI
Rosbridge server
ROS Serial Node
Firmware
velocity and
servo commands
battery state,
calculated odometry
Reboot and
shutdown commands
Leo system node
Video stream
Web video server
Raspicam node

Robecca



Leo Rover

Leo Rover Image found online

Web Application

- Display data & images
- Why we are working on this project
- Why it's important.

Search by Image Name or GPS coords

IMAGE NAME

Date

SLOPE X

******

SLOPE Y

******

Global Positioning System (GPS)

Latitude	North/South(N/S)
Longitude	East/West (E/W)
Validity?	

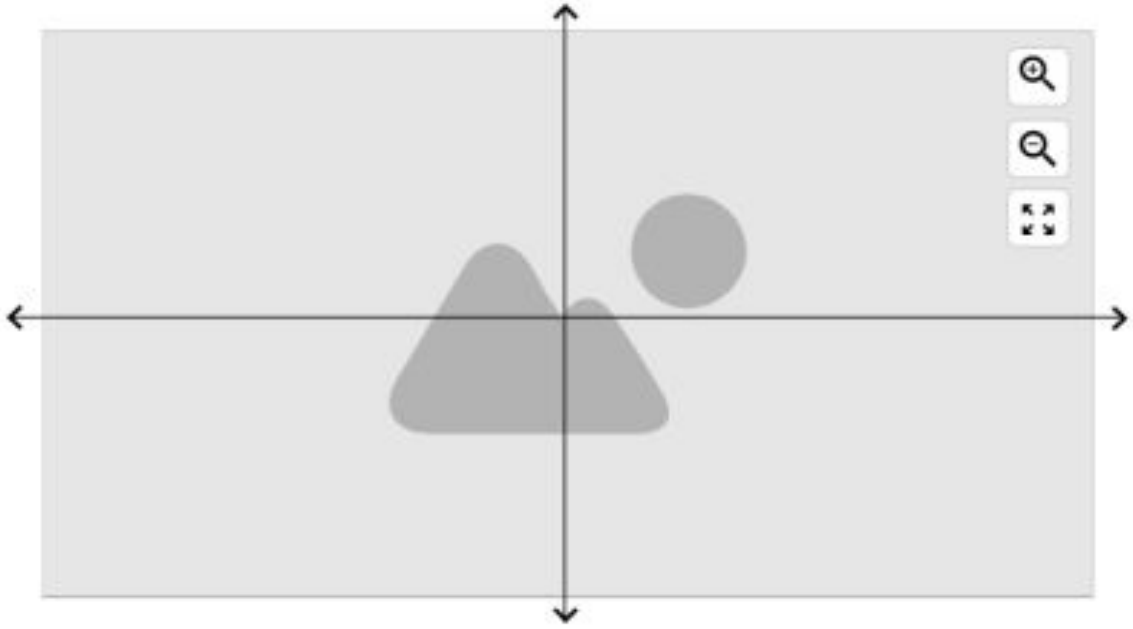
GoPro

Latitude	North/South(N/S)
Longitude	East/West (E/W)
Altitude	

Optional

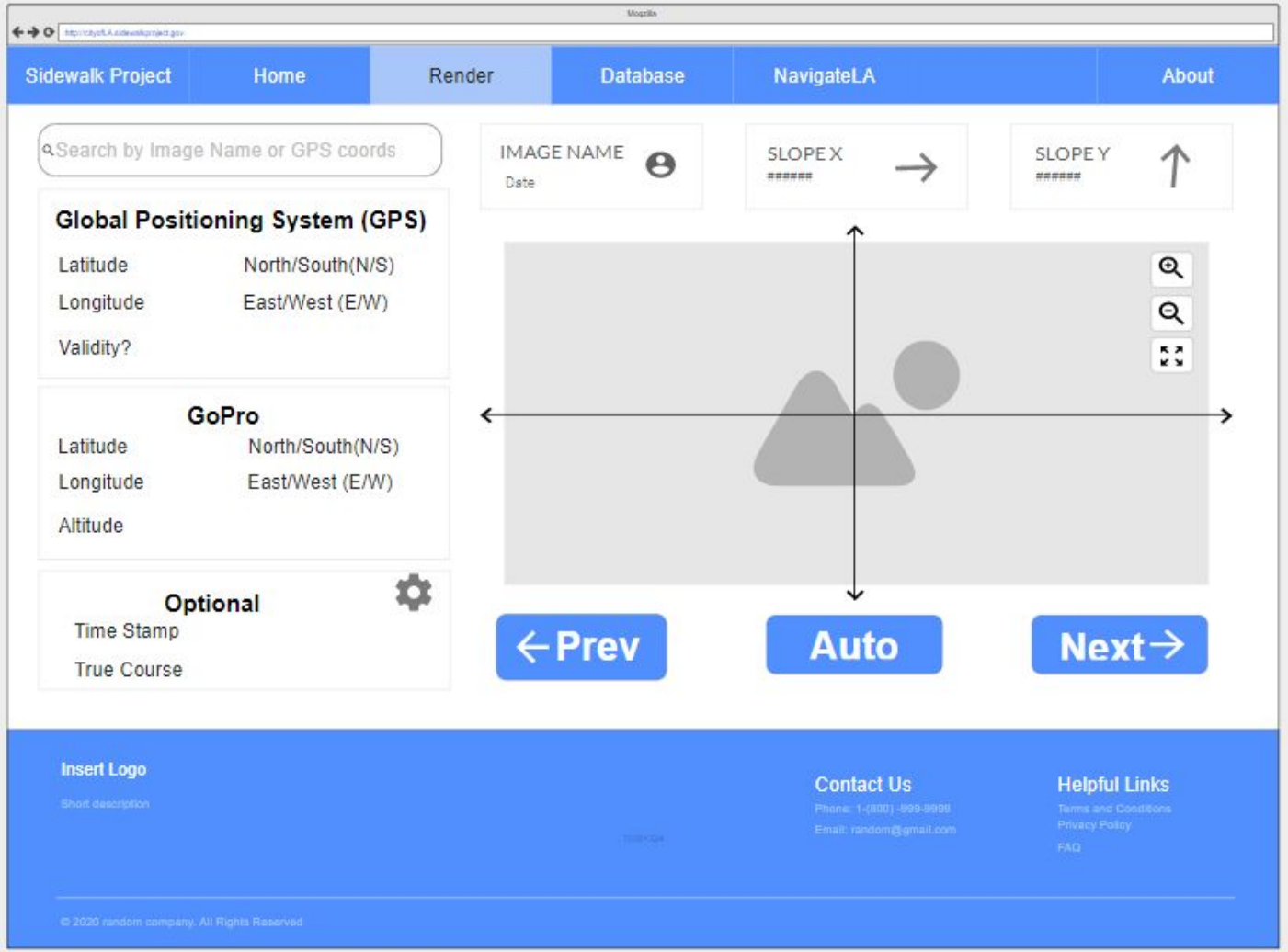
Time Stamp

True Course



← Prev | Auto | Next →

Framework


Sidewalk Project
Home
Render
Database
NavigateLA
About
Search by Image Name or GPS coords
IMAGE NAME
Date
SLOPE X
######
SLOPE Y
######
Global Positioning System (GPS)
Latitude
North/South(N/S)
Longitude
East/West (E/W)
Validity?
GoPro
Latitude
North/South(N/S)
Longitude
East/West (E/W)
Altitude
Optional
Time Stamp
True Course
Optional
Time Stamp
True Course
←Prev
Auto
Next→
Insert Logo
Short description
Contact Us
Helpful Links
Terms and Conditions
Privacy Policy
FAQ
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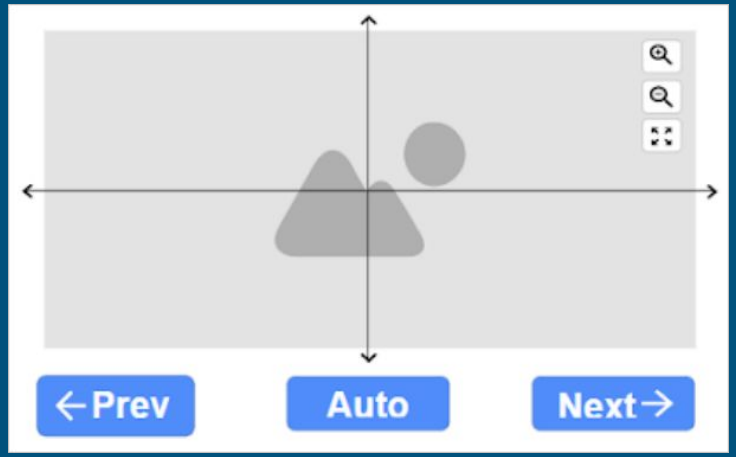
Date: (insert from database) (insert from database) (insert from database)

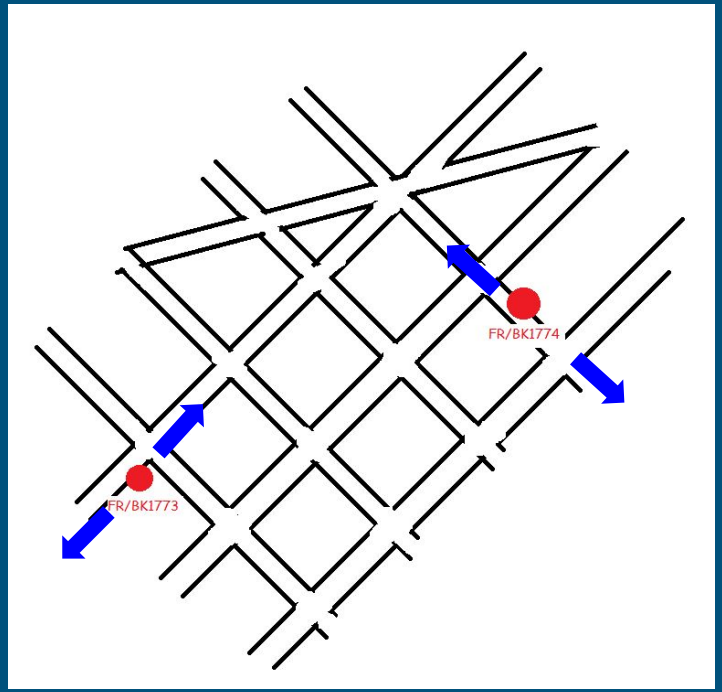
Pan/Zoom In Function

Auto

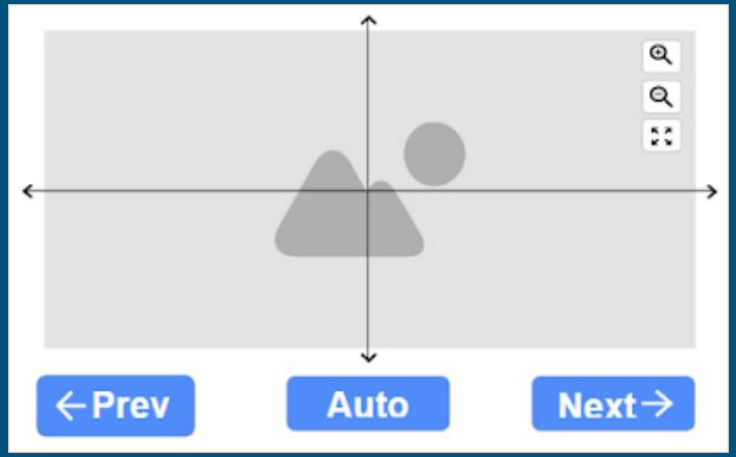
Next →

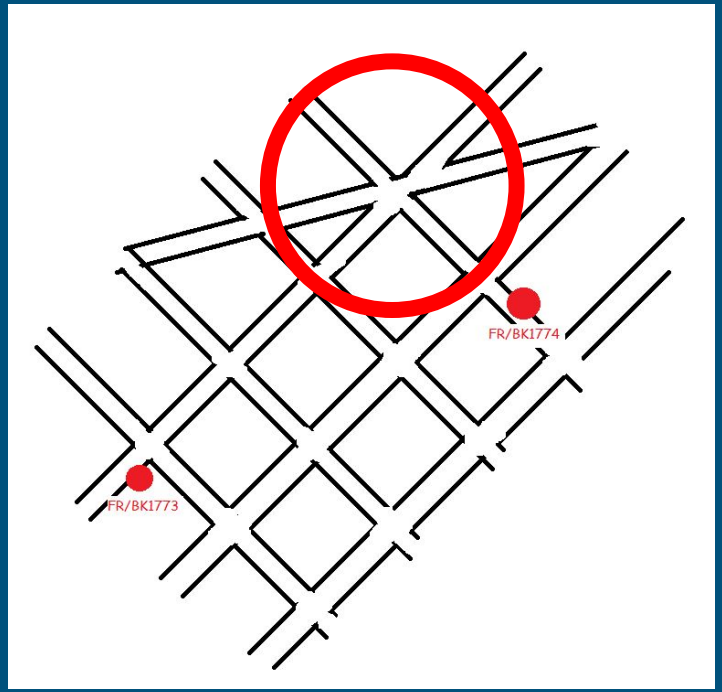
Web Application | Movement using current position



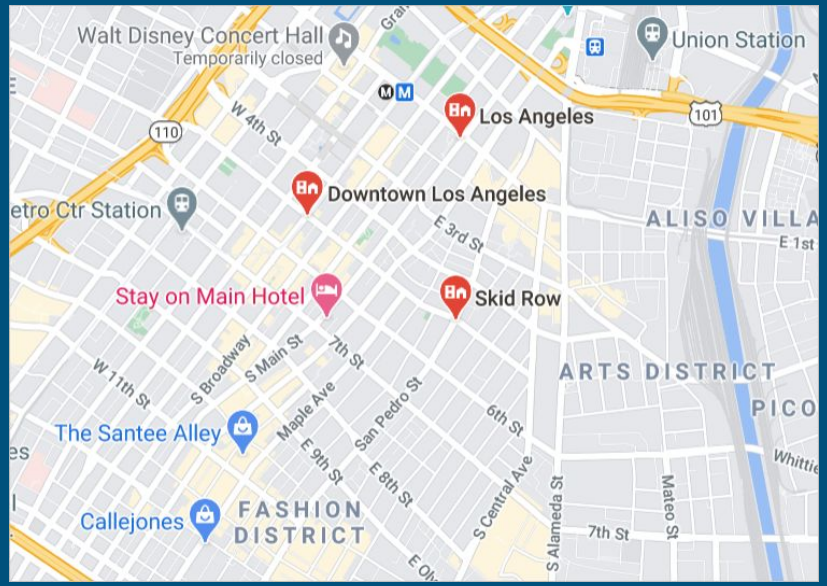


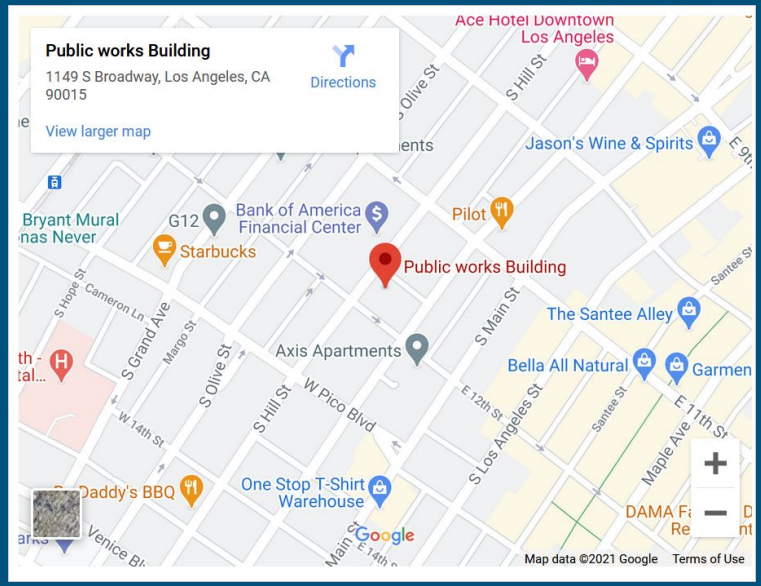
Web Application | Movement using current position



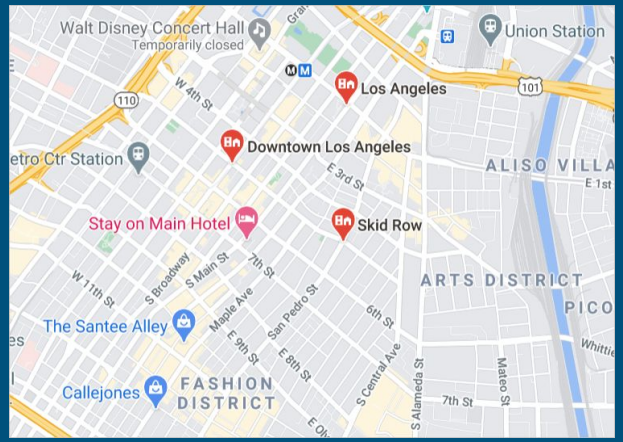


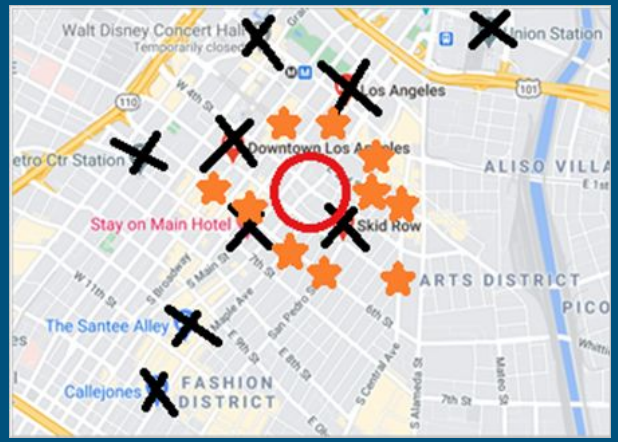
Web Application | Google Maps API





Web Application | Google Maps API

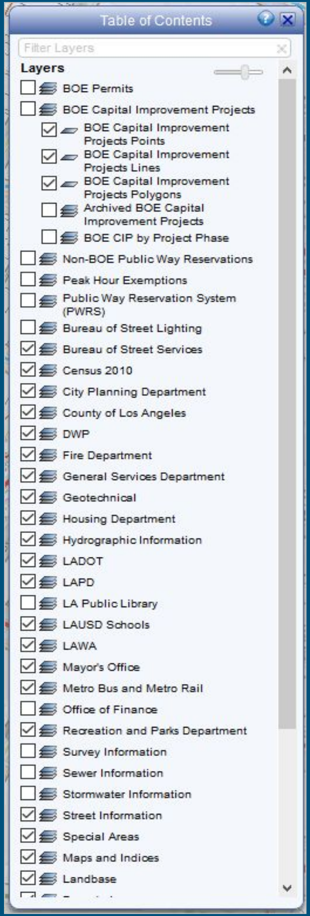




Out of scope image

Old markers

Old markers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Bureau of Street Lighting
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Fire Department
General Services Department
Geotechnical
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Recreation and Parks Department
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Stormwater Information
Street Information
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Maps and Indices
Landbase


W 7th St
Wilshire Grand Center
Central Library
Francisco St
LEBANON ST
WILSHIRE BLVD
Wilshire Blvd
Ernst & Young
777 Tower
8TH ST
W 8th St
S Figueroa St
FIGUEROA ST
S Flower St
FLOWER ST
S Hope St
HOPE ST
Macy's Plaza Shopping Center
The BLOC
GRAND AVE
S Grand Ave
7TH ST
6TH ST
Pacific Center
Millennium and Copthorne Biltmore
Pershing Square
City National Bank
OLIVE ST
S Olive St
MERCURY CT
HILL ST
S Hill St
LINDLEY PL
BROADWAY
S Broadway
ST VINCENT CT
ALLEY
W 8th Pl
9TH ST
W 9th St
FRANCISCO ST
W 7th St

Sidewalk Repair Program - Prioritization and Scoring System
Council File 14-0163-S3

Sidewalk Repair Program - Prioritization and Scoring System

Sidewalk Repair Program - Prioritization and Scoring System

CITY OF LOS ANGELES
INTERDEPARTMENTAL CORRESPONDENCE

Date: September 26, 2017

To: The Honorable Council Member Paul Krekorian, Chair
Budget and Finance Committee

The Honorable Council Member Bob Blumenfield, Chair
Public Works and Gang Reduction Committee

From: Gary Lee Moore, City Engineer
Bureau of Engineering

Subject: **SIDEWALK REPAIR PROGRAM**
PRIORITIZATION AND SCORING SYSTEM
COUNCIL FILE 14-0163-S3

RECOMMENDATIONS:

As part of the City's Sidewalk Repair Program:

1. APPROVE the establishment of the Access Request Program Prioritization and Scoring System as detailed in Table 1, Access Request Program Prioritization Matrix.
2. APPROVE the establishment of the City Facilities and Program Access Improvements Prioritization and Scoring System as detailed in Table 2, City Facilities and Program Access Improvements Prioritization Matrix and Table 3, Damage Severity Matrix.
3. AUTHORIZE the City Engineer to make technical modifications to the Sidewalk Repair Program Prioritization and Scoring Systems as necessary to meet the requirements of the program.

BACKGROUND:

This report is in response to Council's request for the Bureau of Engineering (BOE) to report back on Item No. 15 in Council File 14-0163-S3 as outlined below:

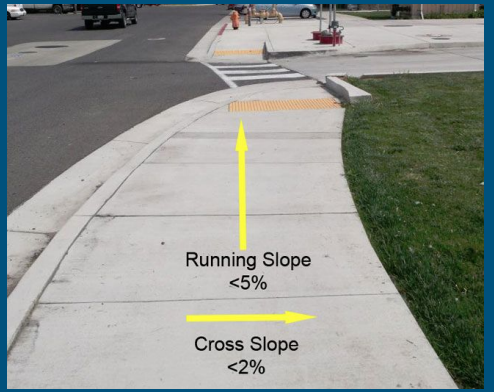
Instruct the Bureau of Engineering (BOE) to develop a prioritization and scoring system that assigns a numerical score to each sidewalk segment, based on the following:

- The Priority List criteria, as indicated in the Willits Term Sheet
- Severity of damage
- Cost effectiveness and contiguity of a damaged section
- Concerns and consistency with the priorities of the Vision Zero Plan, with special emphasis on the High Injury Network
- A mobility disability nexus by nearby residents or other users of the sidewalk

Table 3 –Damage Severity Matrix (See Attachment for examples)

Damage Severity Matrix

Severity Index	Vertical Displacement (Uplift)	Sidewalk Cross-slope	Horizontal Displacement (Cracking / Crumbling)	Possible Points
5 Very Severe	≥ 12"	≥ 20%	≥ 6" gap	40
4 Severe	< 12" to ≥ 6"	< 20% to ≥10%	< 6" to ≥ 3" gap ≥ 50% cracking, chipping, flaking, or crumbling	30
3 Moderate	< 6" to ≥ 1"	< 10% to ≥ 5%	< 3" to ≥ 1" gap < 50% to ≥ 25% cracking, chipping, flaking, or crumbling	20
2 Minor	< 1" to ≥ 1/4"	< 5% to > 2%	< 1" to ≥ 1/4" gap < 25% cracking, chipping, flaking, or crumbling	10
1 Very Minor	< 1/4"	≤ 2%	< 1/4" gap	0



Sidewalk Cross-slope	Sidewalk Cross-slope
≥ 20%	5
< 20% to ≥10%	4
< 10% to ≥ 5%	3
< 5% to > 2%	2
≤ 2%	1

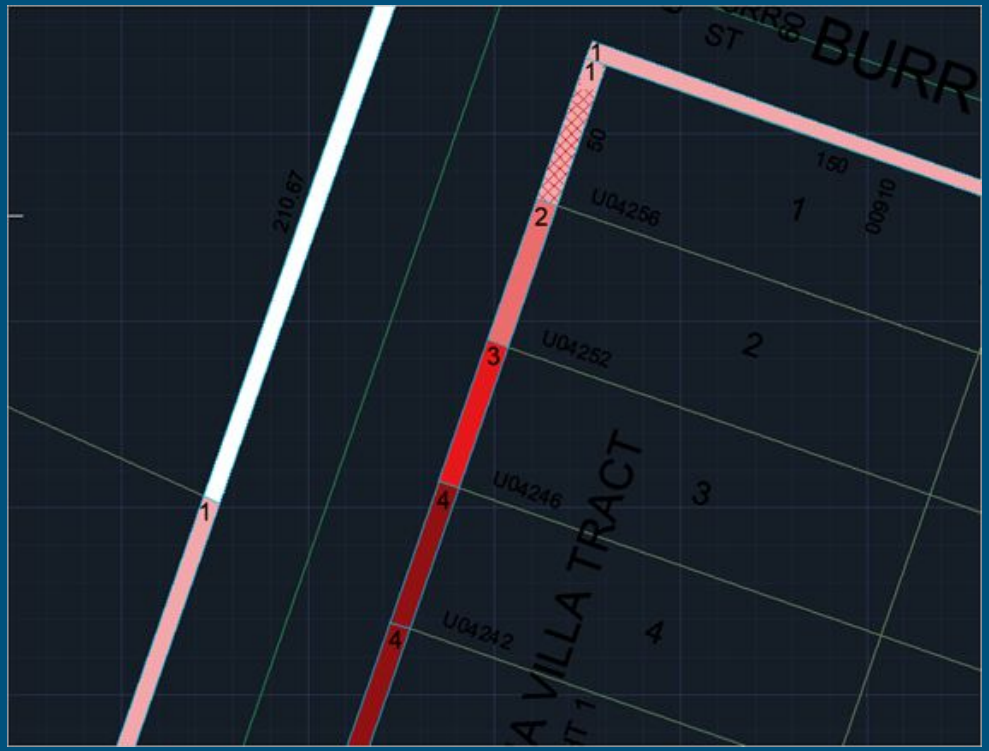


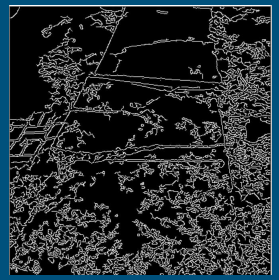
Image Processing

- Blur Image
- Canny edge detection
- Analyze image and figure out disjointed area
- Mark area in Image

Steps

source image

Input

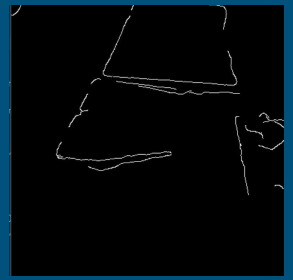


(a) Canny edge detection

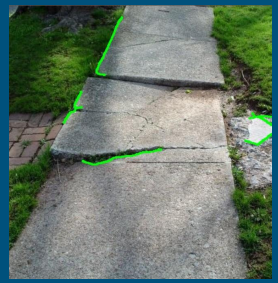
(b) Median Blur

result image

Output



(c) Canny edge after blur



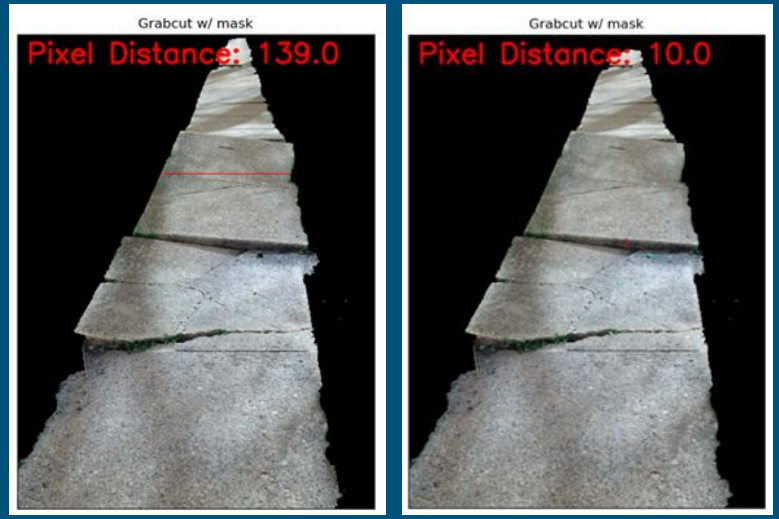
(d) Position edge

Goal

Vertical displacement

Horizontal displacement

Counting Pixels



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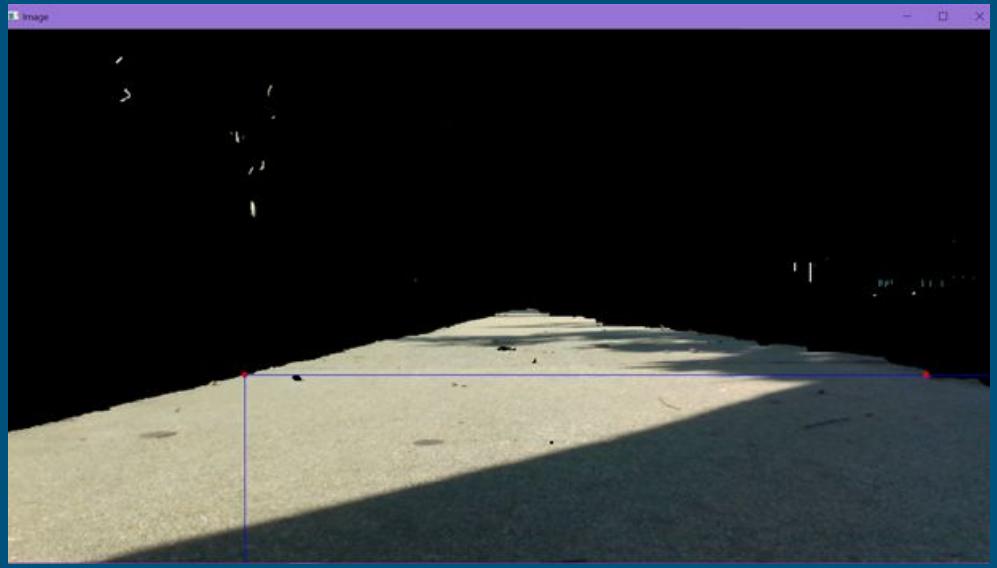
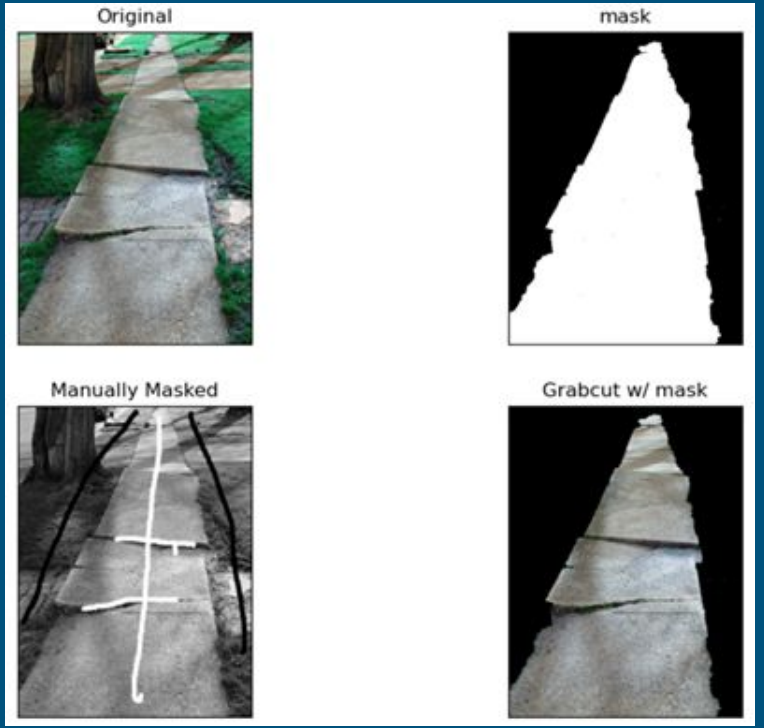
[172, 176, 171]



468 686
1783 686

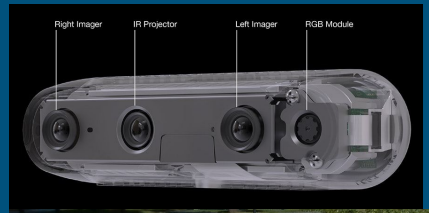
Image Segmentation - Grabcut Algorithm

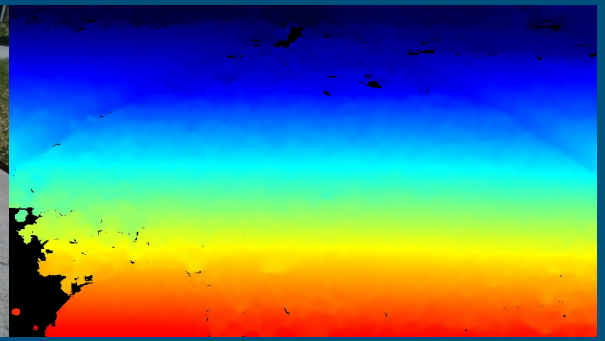
- Removes noise
- Requires user input



Measuring the Displacements

- Depth camera D435
- Save as .bag or .raw
- Alignment
- Obtain 3D coordinates
- Perform Euclidean distance





Future Planning

- Allow automatic masking
- Bring in machine learning/AI

Rover UI

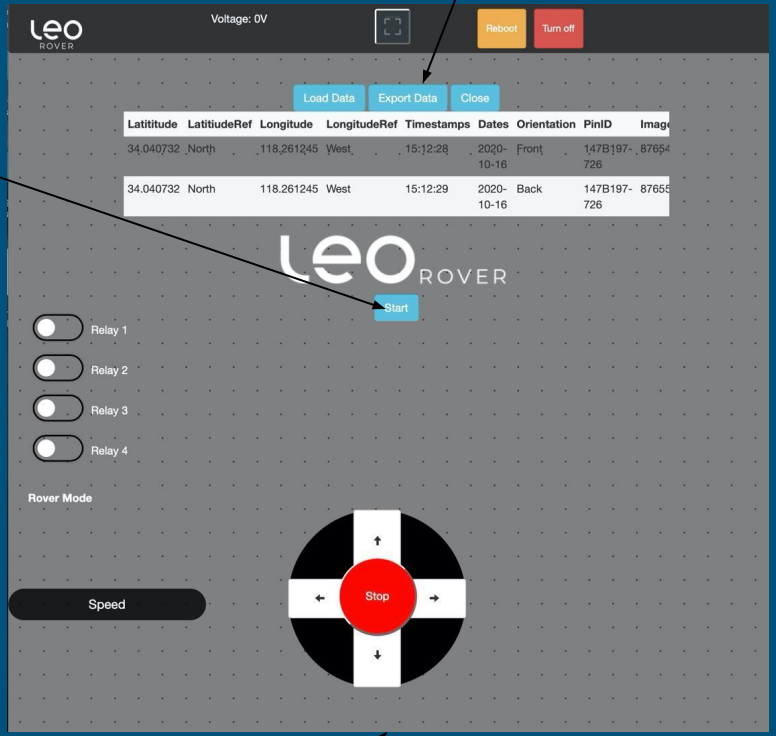
- The Robot UI Now and Before
- Data Display and Rover Mode Controls
- Complete Work

The Rover UI Now

Exporting the data

Start /Stop it starts /Stops the Rover

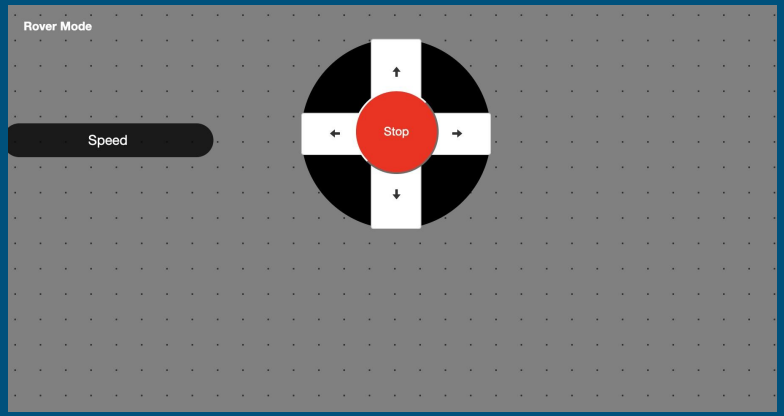
Displays Data Collected



Displays Rover movement controls

Latest Rover UI Design 2020

Data Display & Rover Mode Controls

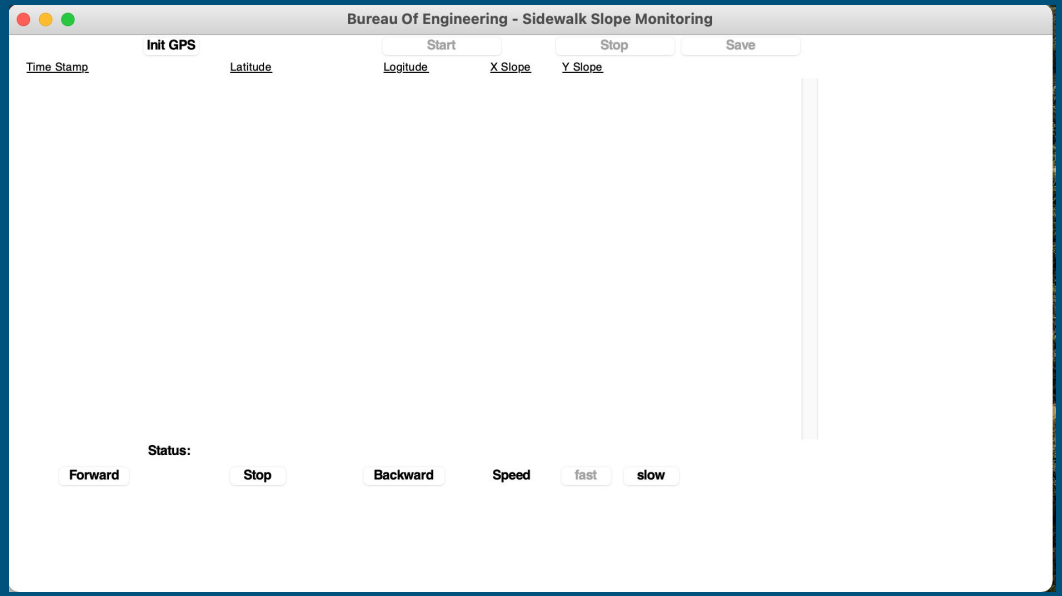


tk #2

Latititude	LatitiudeRef	Longitude	LongitudeRef	Timestamps	Dates	Orientation	PinID	ImageID	GPSCoordinate
34.040732	North	-118.261245	West	15:12:28	2020-10-16	Front	D15B197-1441	FR1776	.0732, W118.2
34.040732	North	-118.261245	West	15:12:29	2020-10-16	Back	D15B197-1441	BK1776	.0732, W118.2
34.039931	North	-118.263258	West	15:03:48	2020-10-15	Front	D15B197-1441	FR1772	9931, W-118.
34.039931	North	-118.263258	West	15:03:49	2020-10-15	Back	D15B197-1441	BK1772	9931, W-118.
34.039981	North	-118.2633	West	15:05:34	2020-10-15	Front	D15B197-1441	FR1773	39981, W-118
34.039981	North	-118.2633	West	15:05:35	2020-10-15	Back	D15B197-1441	BK1773	39981, W-118

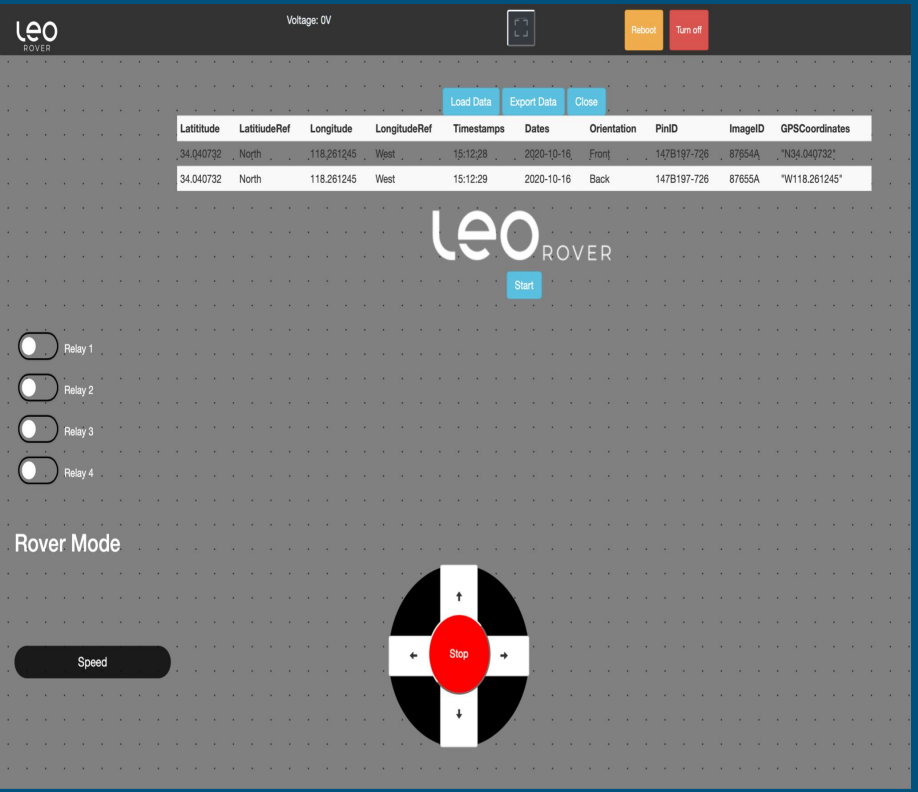
Latest Rover UI Design
2020-2021

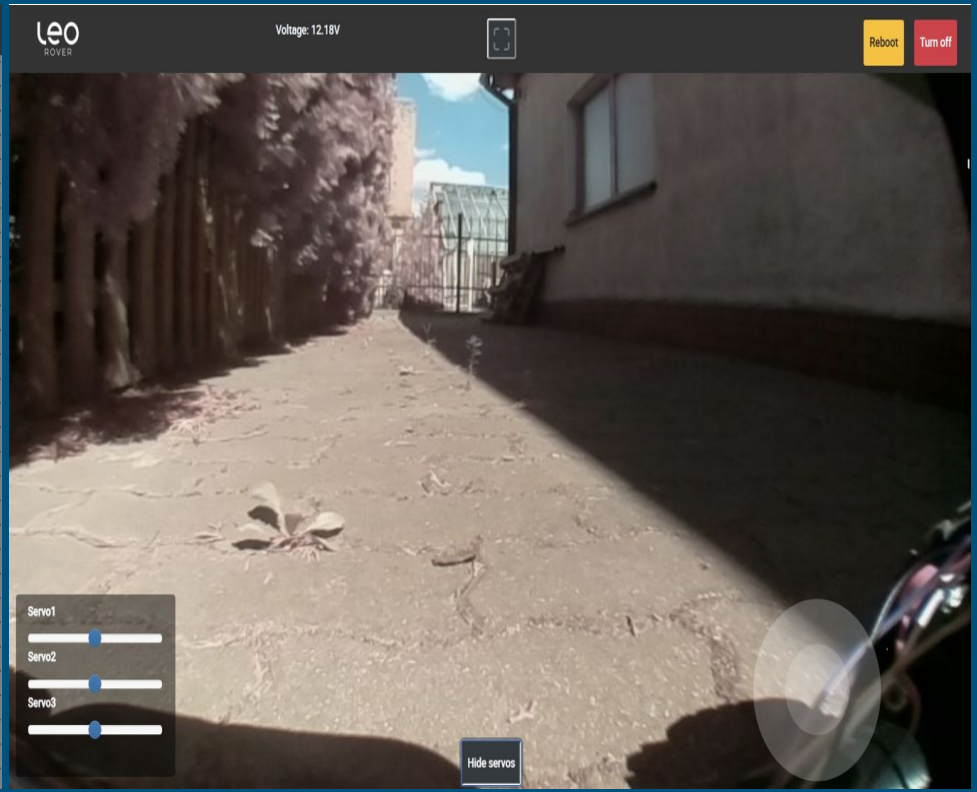
The Rover UI Before



Previous Rover UI design in 2019

Complete Ui


leo ROVER
Voltage: 0V
Reboot
Turn off
Load Data
Export Data
Close
Latititude LatitiudeRef Longitude LongitudeRef Timestamps Dates Orientation PinID ImageID GPSCoordinates
34.040732 North 118.261245 West 15:12:28 2020-10-16 Front 147B197-726 87654A "N34.040732"
34.040732 North 118.261245 West 15:12:29 2020-10-16 Back 147B197-726 87655A "W118.261245"
leo ROVER
Start
Relay 1
Relay 2
Relay 3
Relay 4
Rover Mode
Speed
Stop


leo ROVER
Voltage: 12.18V
Reboot
Turn off
Servo1
Servo2
Servo3
Hide servos

Backend Database

- Hardware & Data
- Database & Azure Blob Storage
- Relational Schema
- Automation
- Expansion

Hardware & Data

- Hardware
  - Level
  - Lidar & Depth Camera
  - GoPro 360
  - GPS Module
- Data
  - Slope %
  - GPS Coordinates
  - JPG’s
  - EXIF - Metadata
  - Timestamps
  - Dates

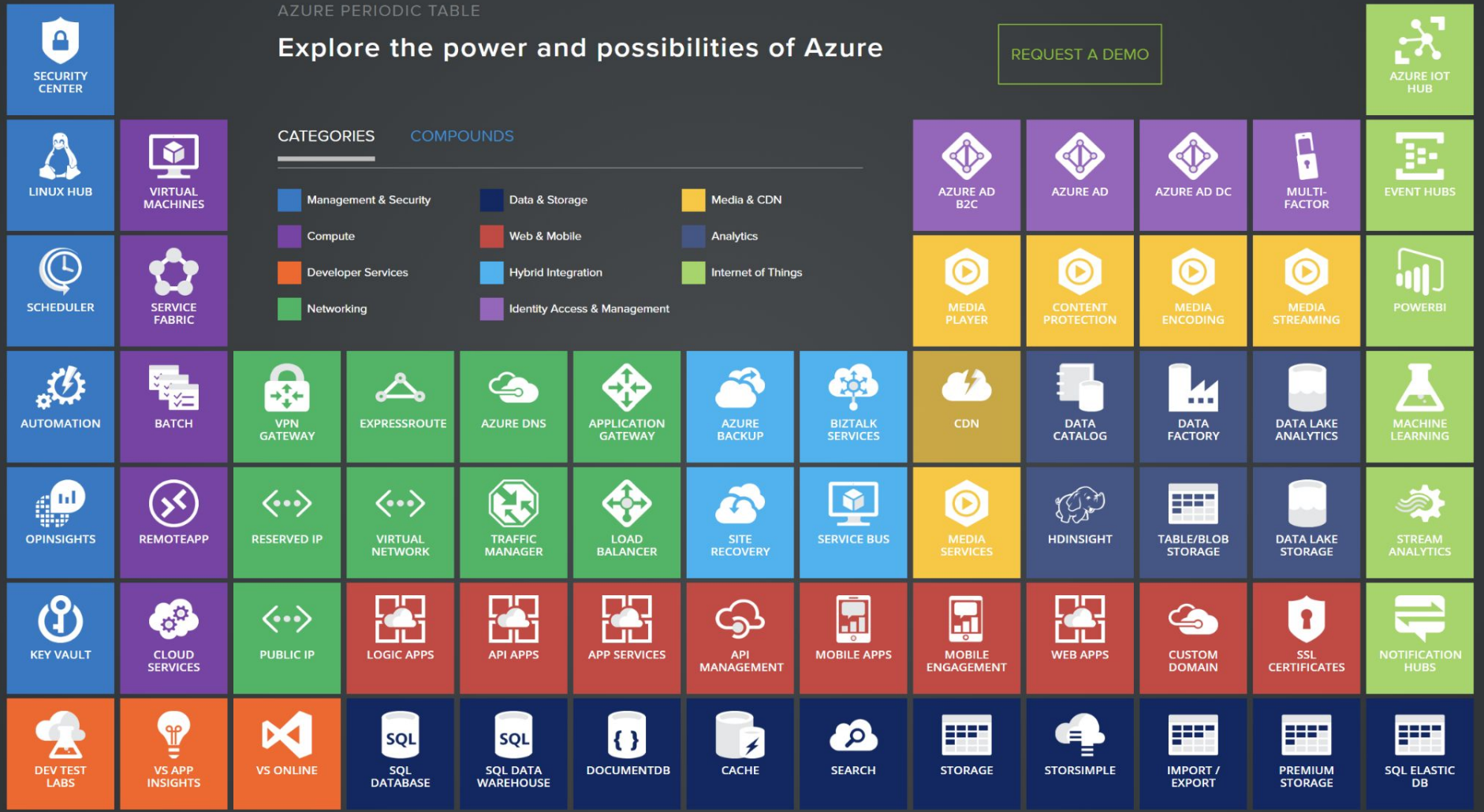
AZURE PERIODIC TABLE

Explore the power and possibilities of Azure

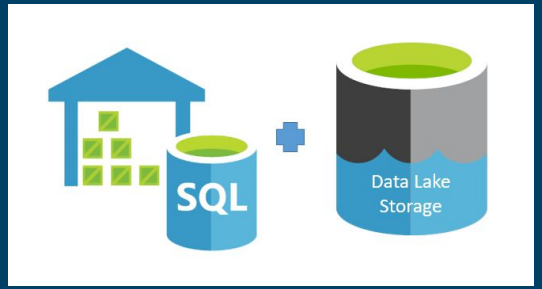
REQUEST A DEMO

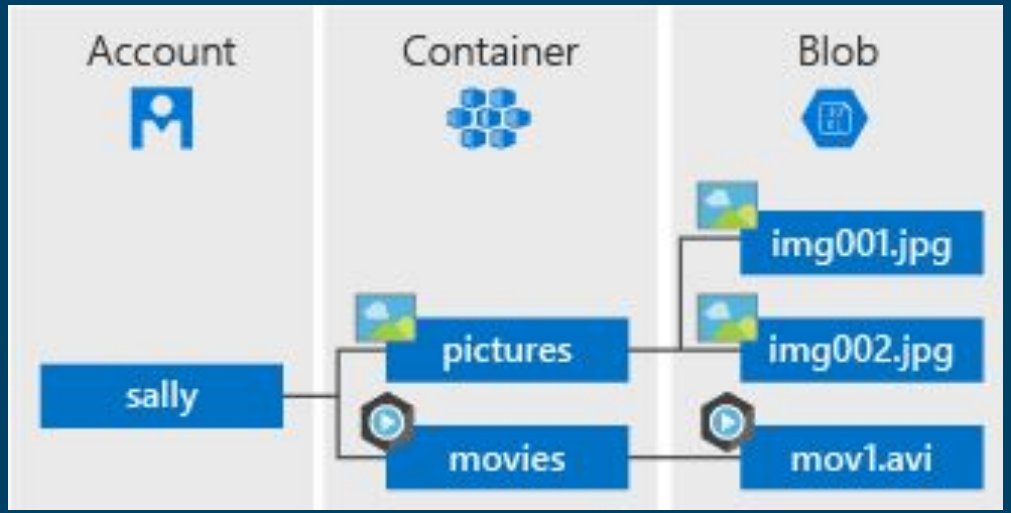
CATEGORIES COMPOUNDS

- Management & Security
- Data & Storage
- Media & CDN
- Compute
- Web & Mobile
- Analytics
- Developer Services
- Hybrid Integration
- Internet of Things
- Networking
- Identity Access & Management

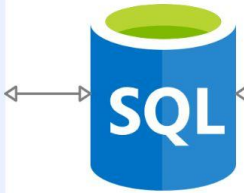


Azure Blob Storage





LEO ROVER

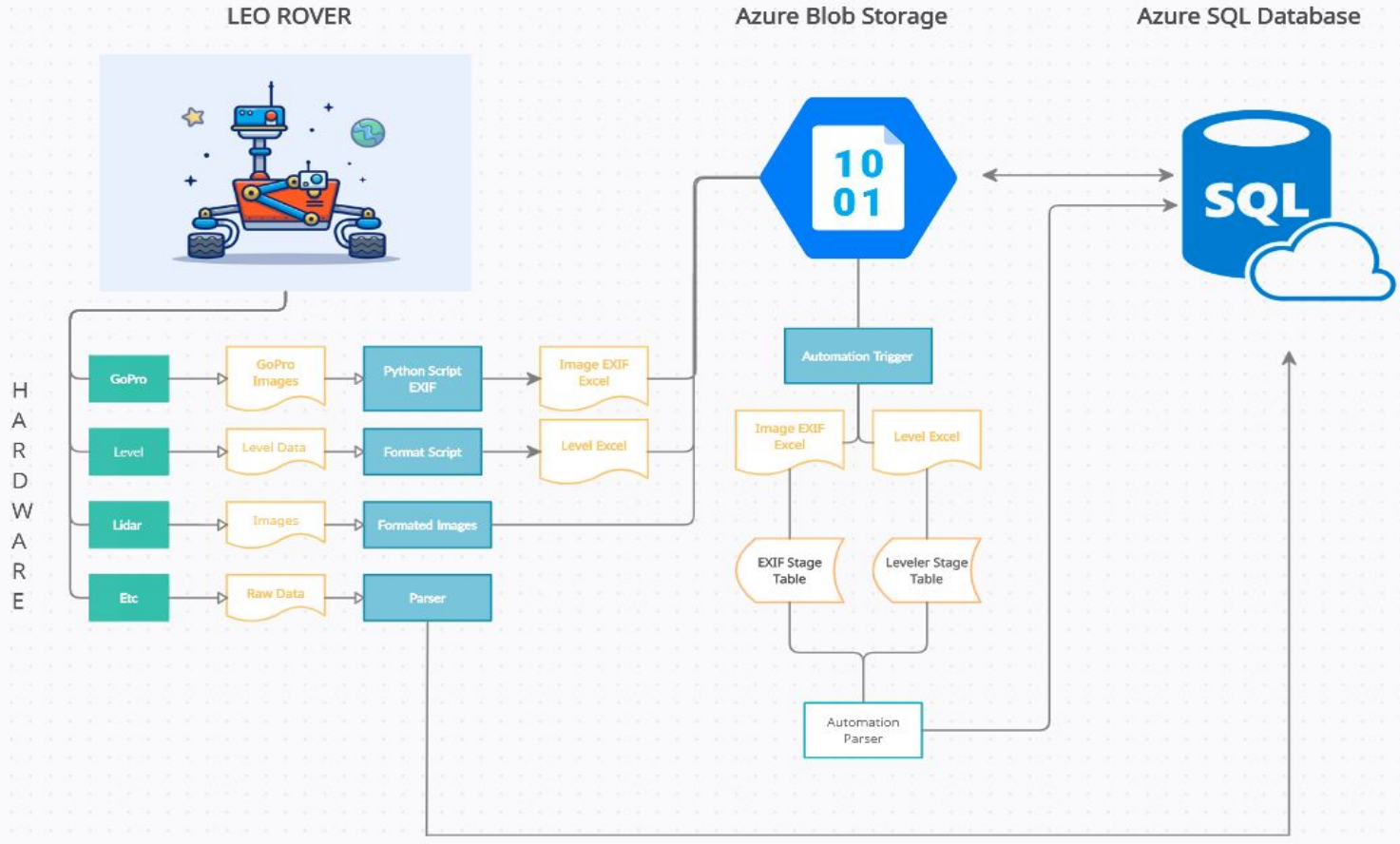


SQL Databases

Artificial Intelligence

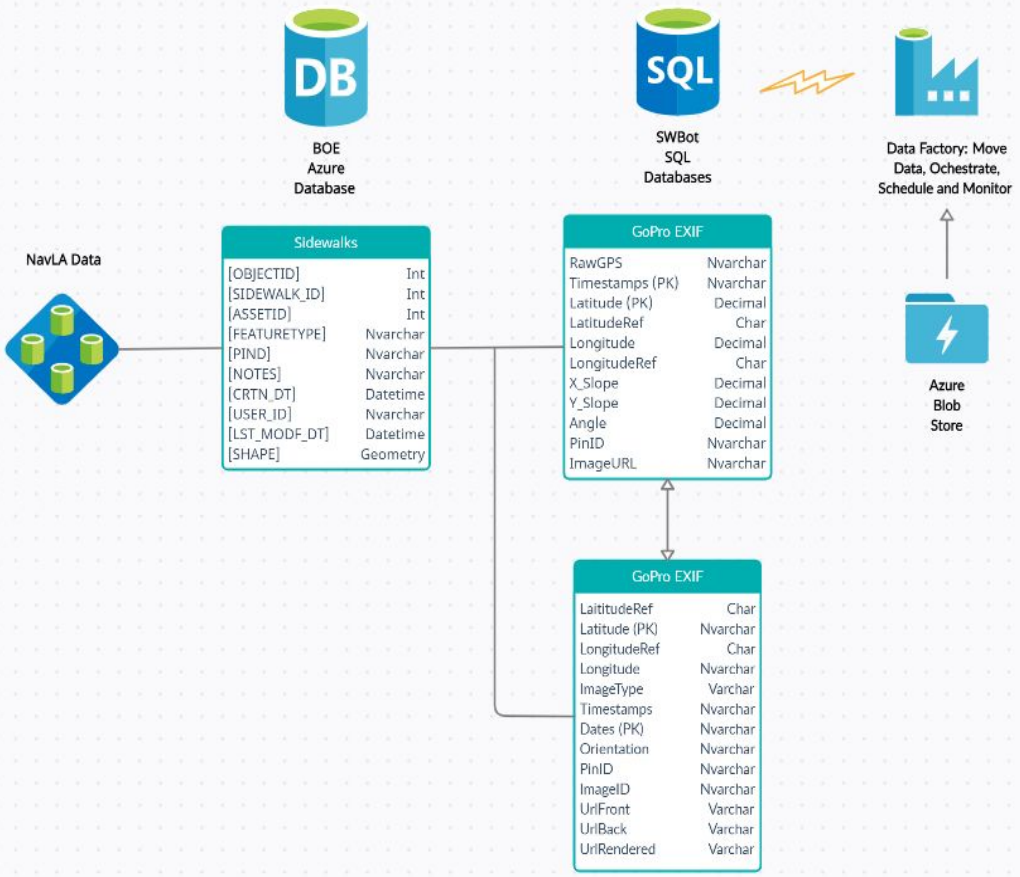
Web User Interface

Rover Interface


LEO ROVER
Azure Blob Storage
Azure SQL Database
HARDWARE
GoPro
Level
Lidar
Etc
GoPro Images
Level Data
Images
Raw Data
Python Script EXIF
Format Script
Formated Images
Parser
Image EXIF Excel
Level Excel
10
01
SQL
Automation Trigger
Image EXIF Excel
Level Excel
EXIF Stage Table
Leveler Stage Table
Automation Parser

Relational Schema

- Integrating all data sources (Rover Hardware + NavLA)



- Expansion -

- Data Manipulation
- Severity levels
- Implement Azure tools to refine and visualize data
- Azure AI

Thank you!