

ML PARKING TRAFFIC ANALYSIS

Jake Haines

THE PROBLEM.







THE SOLUTION.





how to measure traffic



Google Search

I'm Feeling Lucky

Options to Measure Traffic



Image courtesy of 102.5 KISS FM

Making a Road Tube Traffic Counter



Image courtesy of Kris Temmerman on YouTube

Diamond Traffic Products - TT-2HL - Traffic Tally 2 Vehicle Counter

Item #: 13315596 MFR SKU: TT-2HL

\$491.21

1 + ADD TO CART

Stock Status: CALL FOR STOCK (shipping delay possible)
Average lead time for this brand: 3-4 weeks. Specific products may vary.

The TT-2 is a no frills "grand total" counter. Just attach the base unit to any perm across the area you'd like to monitor. A single vehicle count is recorded for every front and rear tires. Readings are shown on a seven-digit LCD, which has a conv

A photograph of a green Diamond Traffic Products TT-2HL Traffic Tally 2 Vehicle Counter device. It is a rectangular unit with a small LCD screen and a keypad. The screen displays "TRAFFIC TALLY 2" and "DISPLAY COUNT". The keypad has buttons for "1", "+", "ADD TO CART", and "Stock Status: CALL FOR STOCK". The unit is mounted on a stand.

System	Type	Cost
SenSource	pneumatic	\$695
RoadPod	pneumatic	\$1,150
JAMAR TRAX I Plus	pneumatic	\$2,600
Wavetronix SmartSensor HD	radar	\$6,700
Miovision Technologies VCU	video	\$3,700

Table 1: Selection of traffic counting systems

Courtesy of Nathan Rooy

Nathan Rooy



A Low Cost Approach to Improving Pedestrian Safety with Deep Learning

Posted: April 17, 2018

My choice of system



CODEX

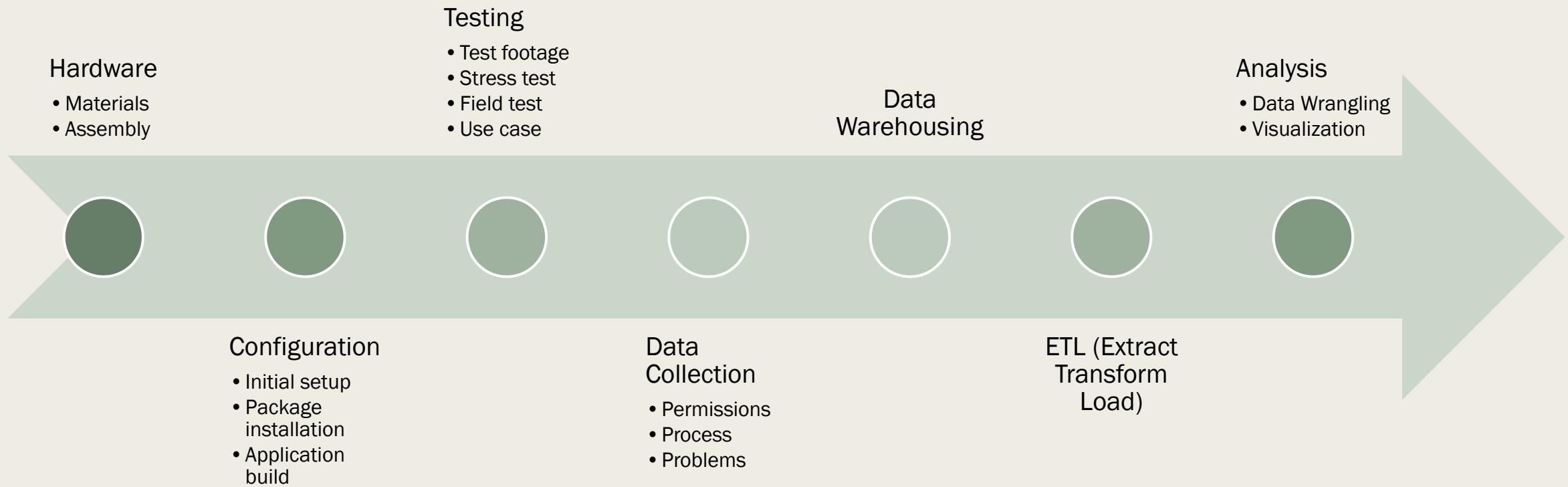
How I Created a System to
Measure Parking Traffic

 Jake Haines
Mar 19 · 15 min read

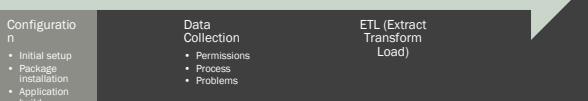
[Twitter](#) [LinkedIn](#) [Facebook](#) [Book](#) ...



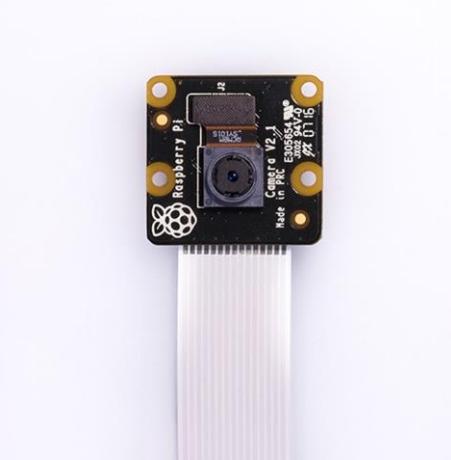
Project Timeline



HARDWARE & CONFIGURATION



Hardware



Hardware
• Materials
• Assembly

Testing
• Test footage
• Stress test
• Field test
• Use case

Data
Warehousing

Analysis
• Data
Wrangling
• Visualization

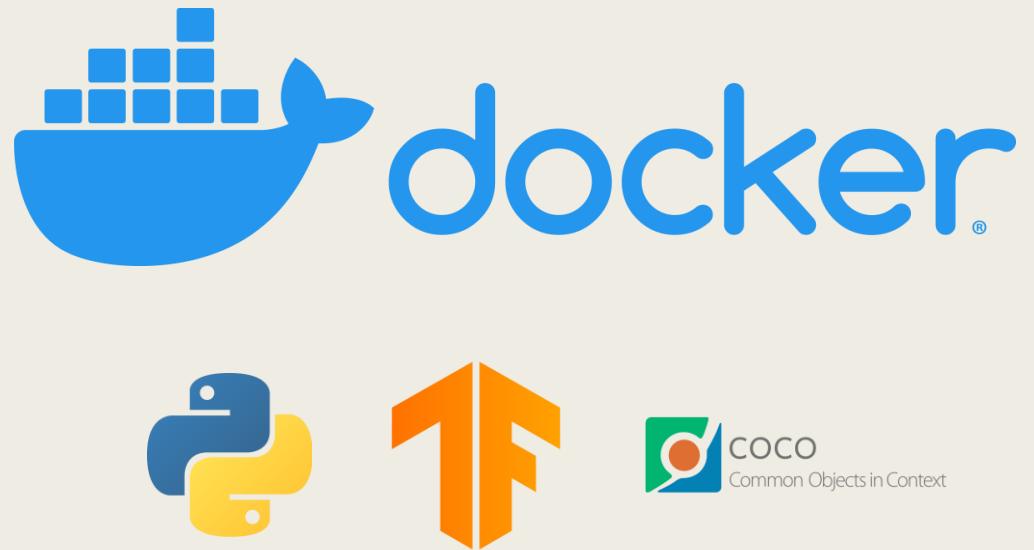
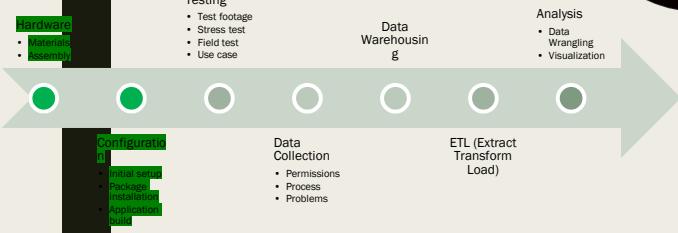
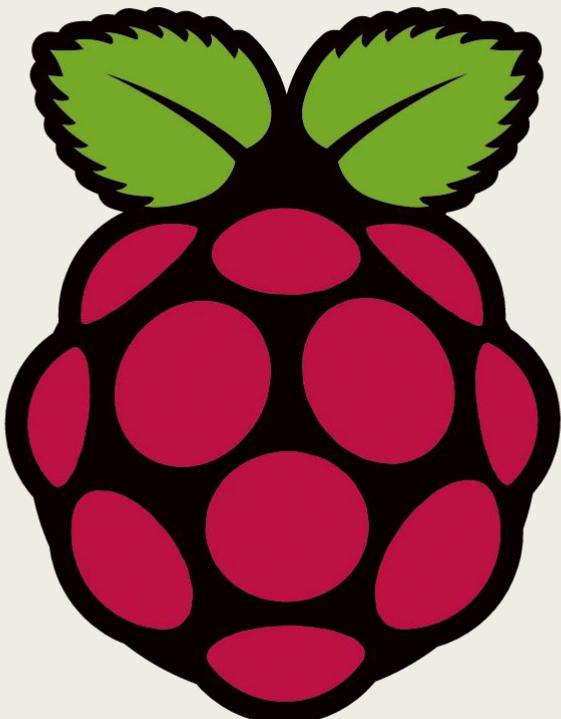


Configuration
• Initial setup
• Package installation
• Application build

Data
Collection
• Permissions
• Process
• Problems

ETL (Extract
Transform
Load)

Configuration



TESTING

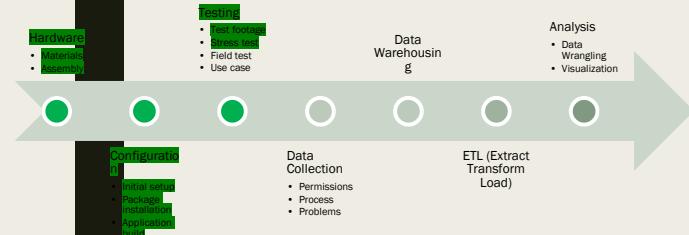
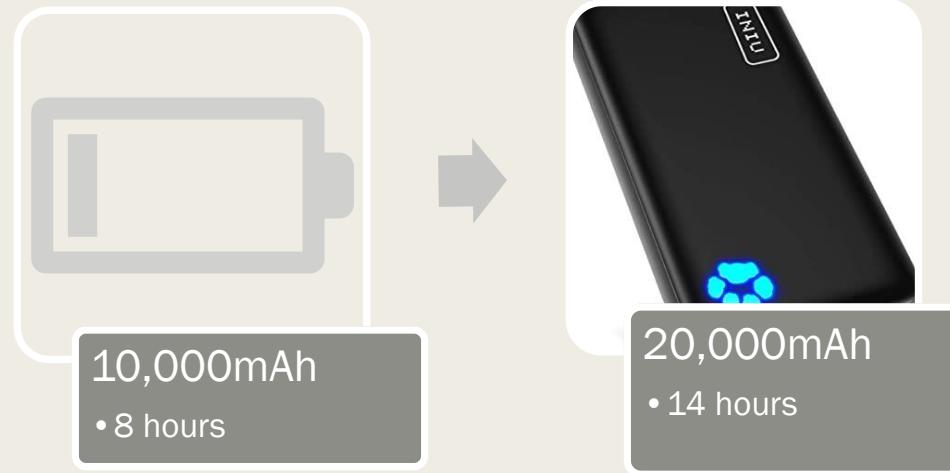




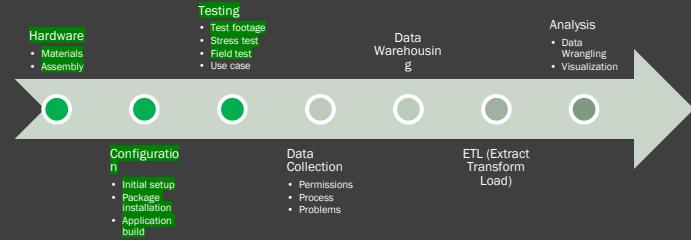
Test model with pre-recorded footage



Stress tests



FIELD TESTING





Hardware

- Materials
- Assembly

Testing

- Test footage
- Stress test
- Field test
- User case

Data Warehousing

- Permissions
- Processes
- Problems

Analysis

- Data Wrangling
- Visualization

Configuration

▪ Initial setup

- Package installation
- Application build

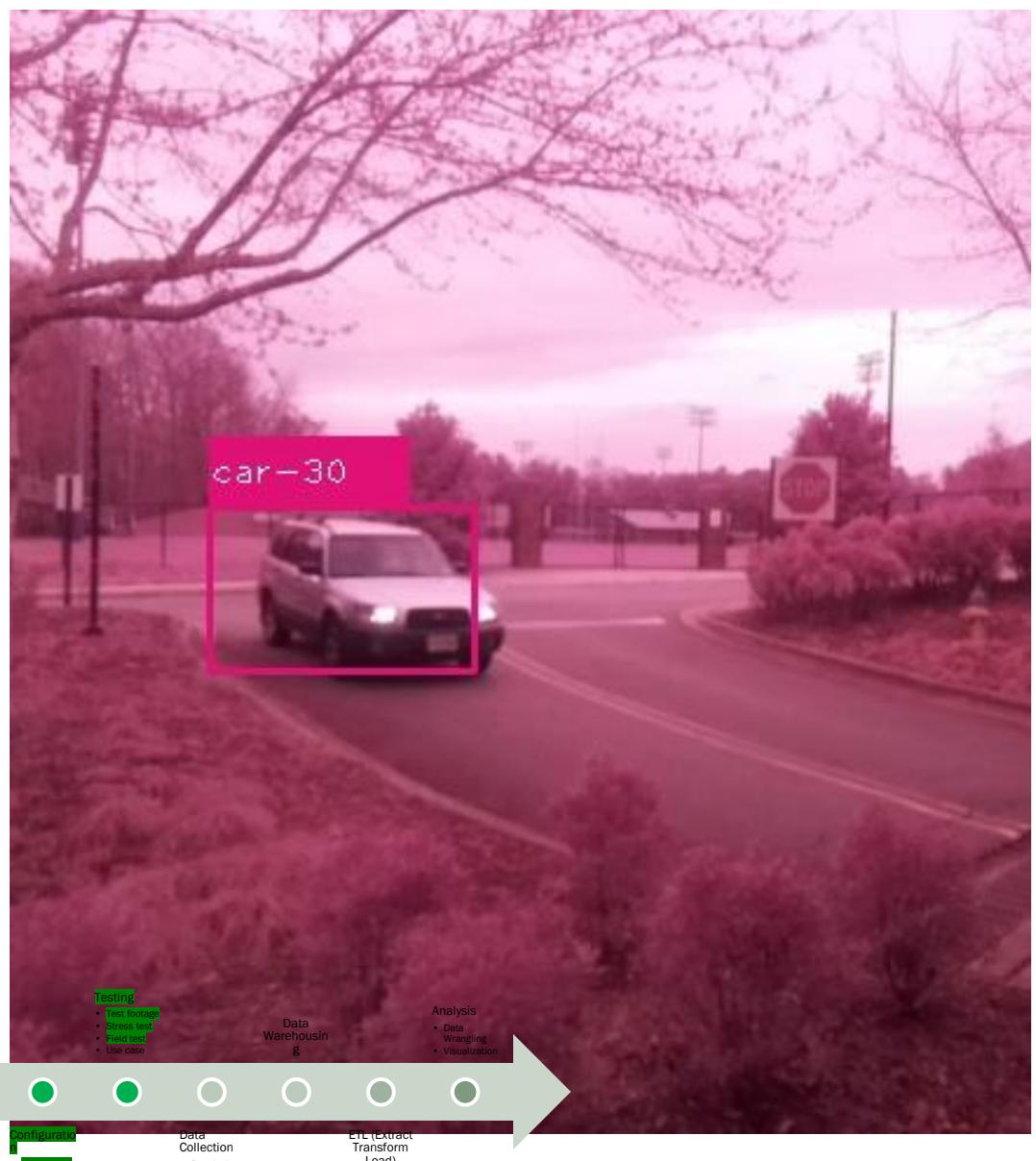
Data Collection

▪ Permissions

▪ Processes

▪ Problems

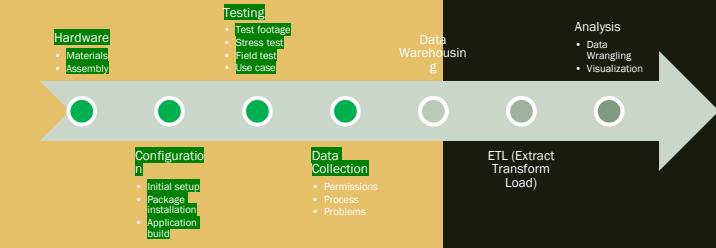
ETL (Extract, Transform, Load)



Use cases

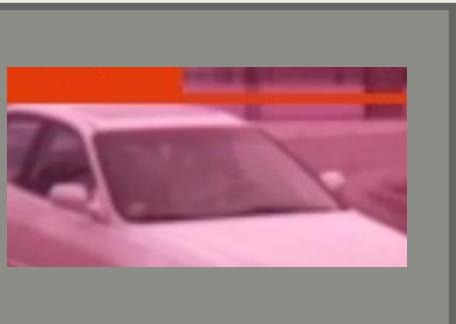
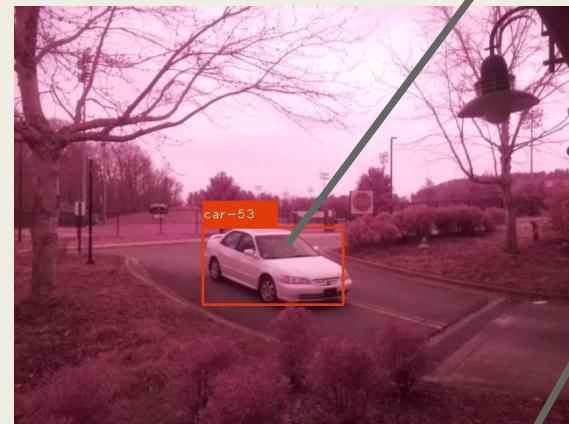


DATA COLLECTION



Test Data

frame_num	rpi_time	obj_class	obj_id	obj_age	obj_t_since	obj_hits	xmin	ymin	xmax	ymax
1	1615982671	person	2	1	0	1	178	161	509	481
2	1615982671	person	2	2	0	2	156	171	480	481
2	1615982671	person	3	1	0	1	262	168	572	487
3	1615982671	person	2	2	0	2	122	170	451	470



Configuration
• Initial setup
• Package Installation
• Application Setup

Data Collection
• Permissions
• Process
• Problems

ETL (Extract, Transform, Load)

FROM: UNC Asheville Institutional Review Board

PROJECT TITLE: [1722575-1] Analysis for campus parking traffic

REFERENCE #:

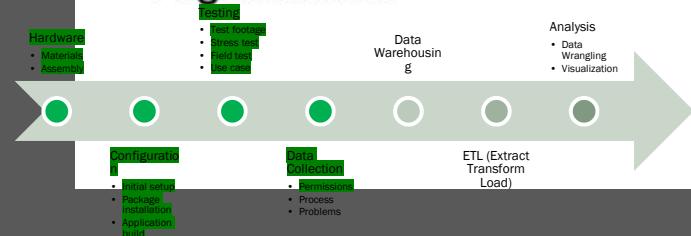
SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF EXEMPT STATUS

DECISION DATE:

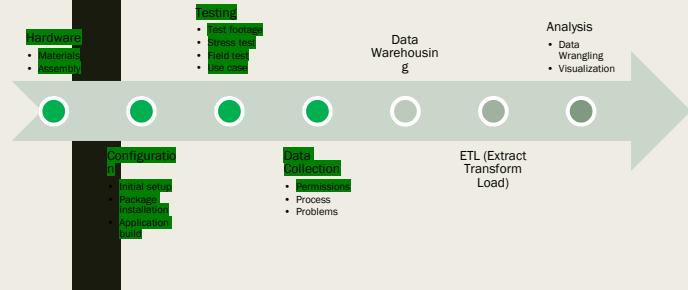
REVIEW CATEGORY: Exemption category #3

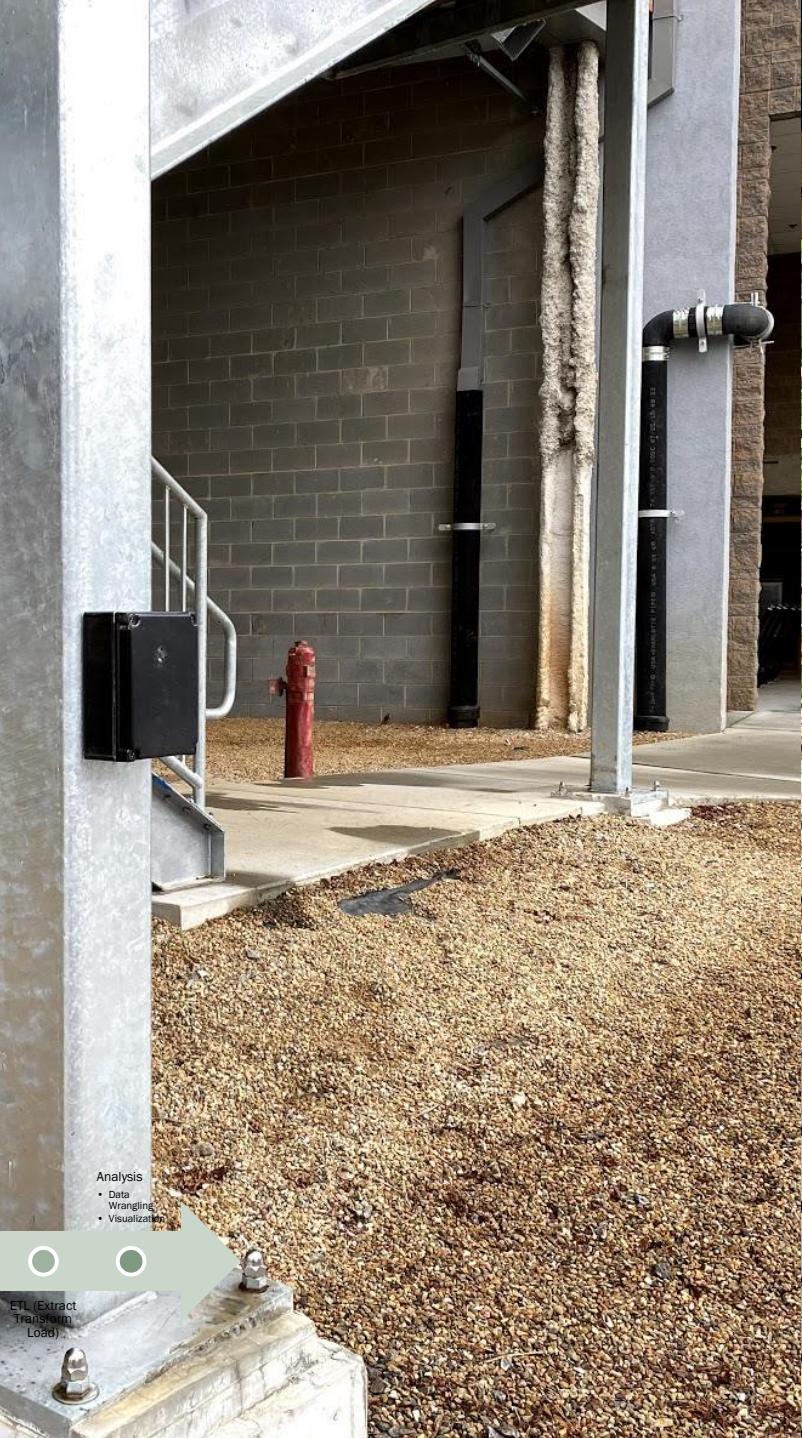
Thank you for your submission of New Project materials for this project. The UNC Asheville Institutional Review Board has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.



Official data

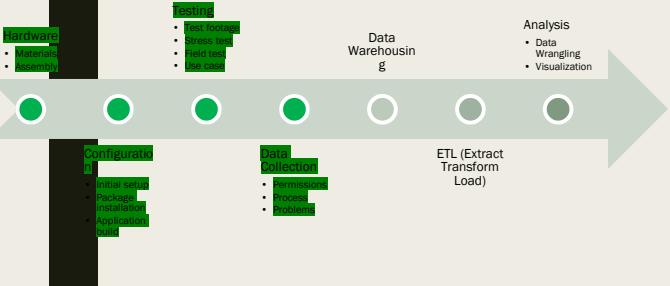
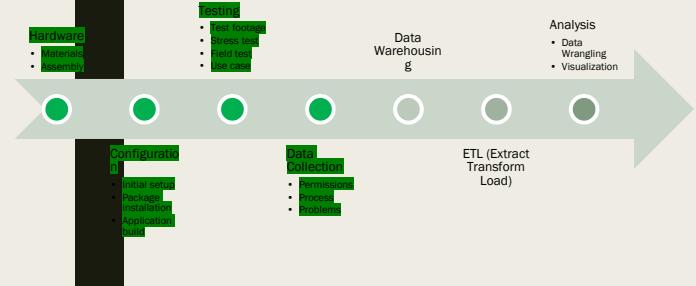
frame_num	rpi_time	obj_class	obj_id	obj_age	obj_t_since	obj_hits	xmin	ymin	xmax	ymax	
1	1615982671	person		2	1	0	1	178	161	509	481
2	1615982671	person		2	2	0	2	156	171	480	481
2	1615982671	person		3	1	0	1	262	168	572	487
2	1615982671	person		2	2	0	2	122	170	451	479



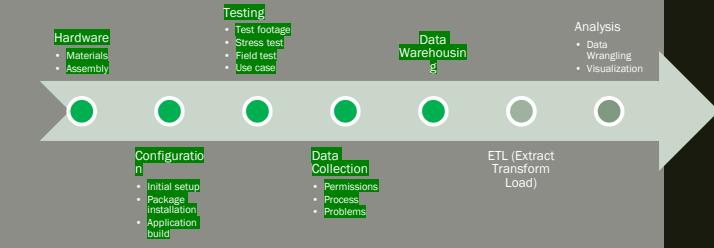


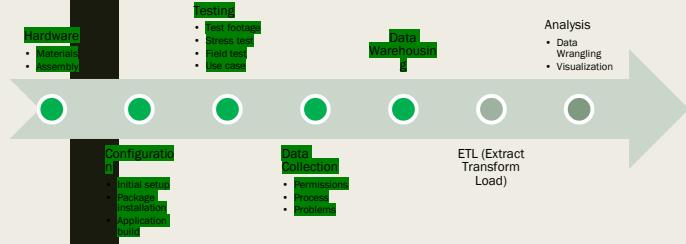
Problems

- Battery charging
- Class and exams
- Theft



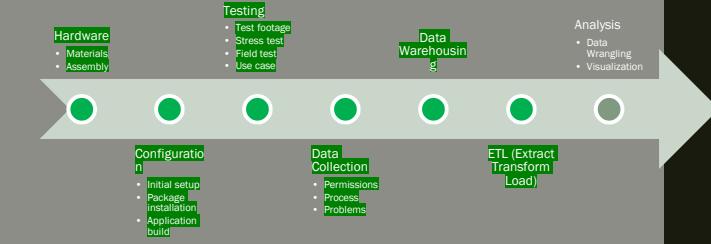
DATA WAREHOUSING



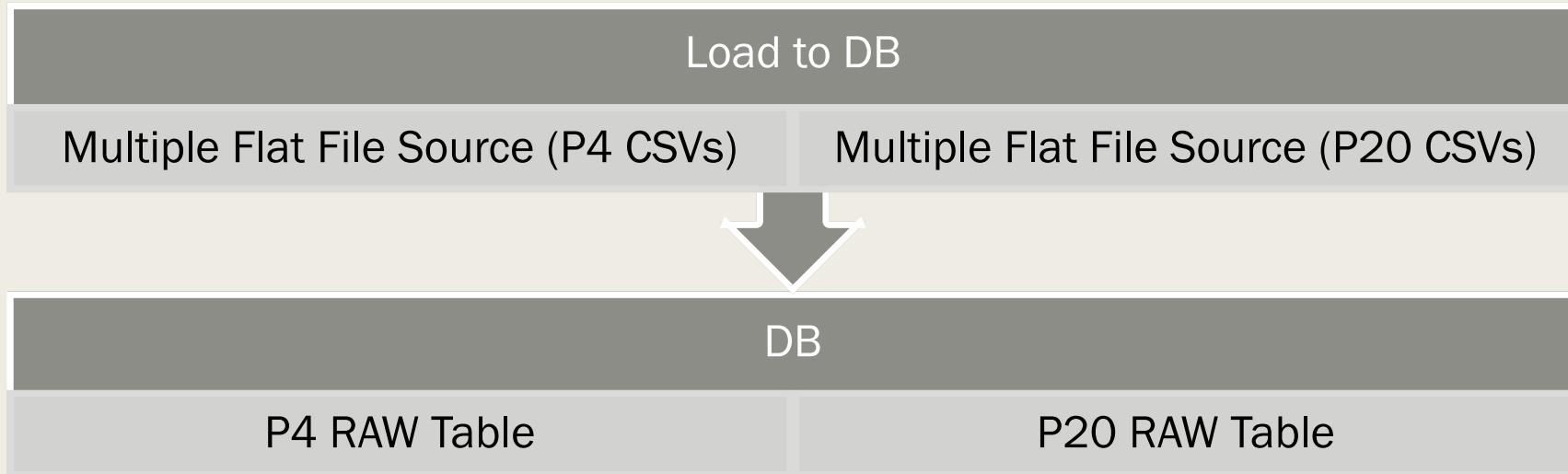


Name
20210317_founders.csv
20210317_Notes.txt
20210317_p4.csv
20210318_founders.csv
20210318_Notes.txt
20210318_p4.csv
20210319_founders.csv
20210319_Notes.txt
20210319_p4.csv

ETL



Extract



	frame_num	rpi_time	obj_class	obj_id	obj_age	obj_t_since_last_update	obj_hits	xmin	ymin	xmax	ymax
1	227313	1616030061	cat	2420	1653	0	1651	24	4	643	255
2	227313	1616030061	cat	2468	52	0	52	15	27	629	393
3	227314	1616030061	cat	2420	1654	0	1652	26	4	638	251
4	227314	1616030061	cat	2468	53	0	53	9	25	635	397
5	227315	1616030062	cat	2420	1655	0	1653	20	5	640	256
6	227315	1616030062	cat	2468	54	0	54	10	31	634	402
7	227316	1616030062	cat	2420	1656	0	1654	17	5	641	258
8	227316	1616030062	cat	2468	55	0	55	13	35	631	402

Hardware
Materials
Assembly

Testing
• Unit testing
• Stress test
• Field test
• Use case

Analysis
• Data Wrangling
• Visualization

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Configuration
• Initial setup
• Package
• Installation
• Application
Build

Data Collection
• Sensors
• Process
• Protocols

ETL, Extract
Transform
Load

Transform

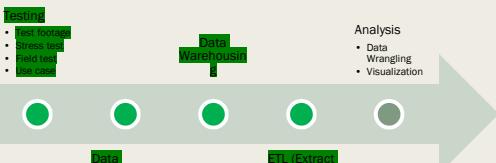
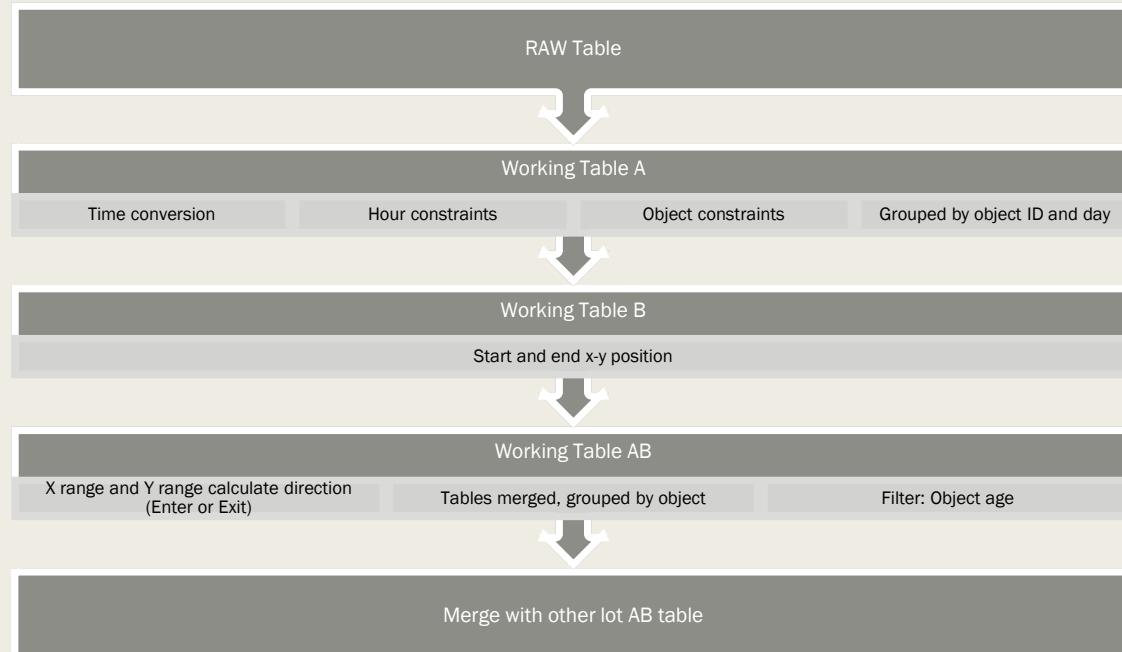
	frame_num	rpi_time	obj_class	obj_id	obj_age	obj_t_since_last_update	obj_hits	xmin	ymin	xmax	ymax
1	227313	1616030061	cat	2420	1653	0	1651	24	4	643	255
2	227313	1616030061	cat	2468	52	0	52	15	27	629	393
3	227314	1616030061	cat	2420	1654	0	1652	26	4	638	251

P20: 584,432 rows

	frame_num	rpi_time	obj_class	obj_id	obj_age	obj_t_since_last_update	obj_hits	xmin	ymin	xmax	ymax
1	227313	1616030061	cat	2420	1653	0	1651	24	4	643	255
2	227313	1616030061	cat	2468	52	0	52	15	27	629	393
3	227314	1616030061	cat	2420	1654	0	1652	26	4	638	251

P20: 841,024 rows

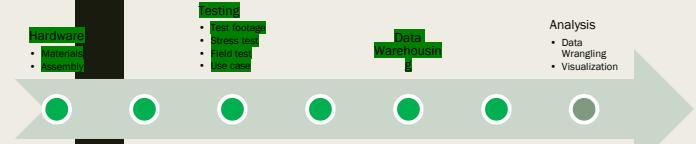
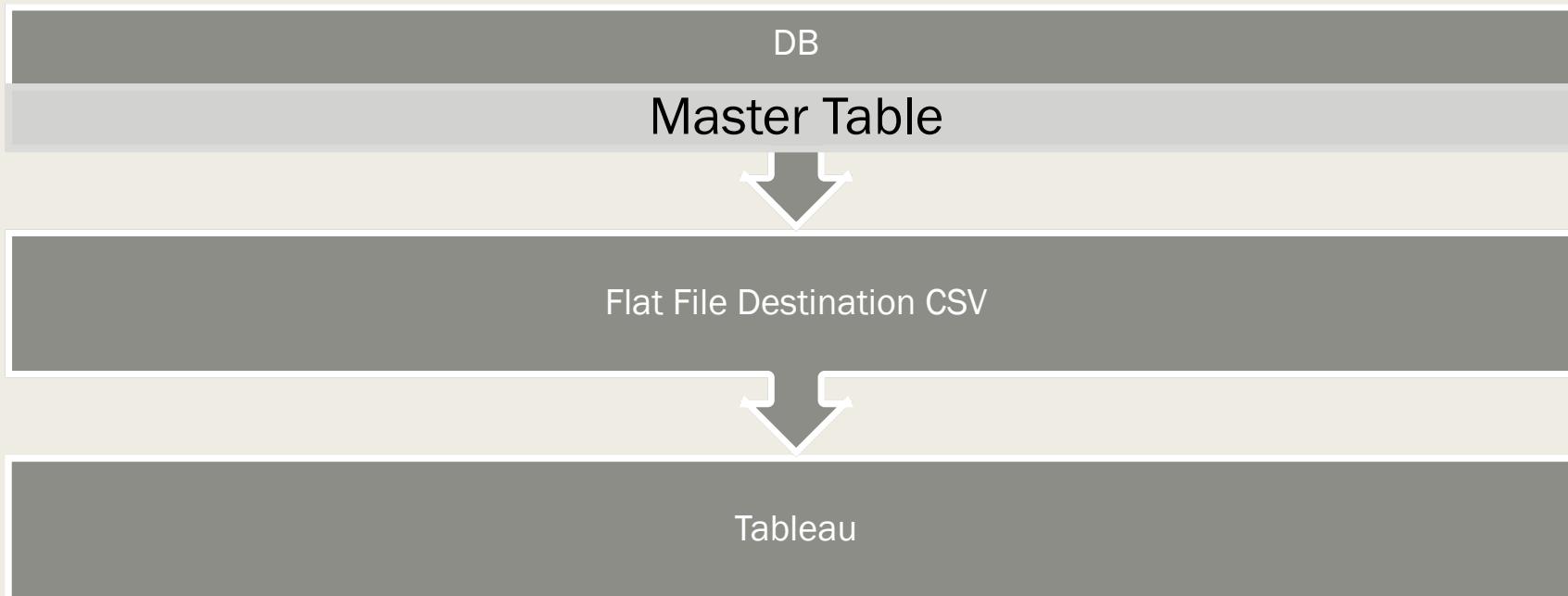
= 1,425,426 rows



	Date	StartTime	Weekday	ID	Lot	Direction	DateTime
1	2021-03-23	17:35:34.000000	Tuesday	1095	P20	ENTER	2021-03-23 17:35:34.000
2	2021-03-26	17:00:01.000000	Friday	1668	P20	EXIT	2021-03-26 17:00:01.000
3	2021-03-23	19:25:12.000000	Tuesday	1562	P20	EXIT	2021-03-23 19:25:12.000
4	2021-03-26	14:42:37.000000	Friday	1141	P20	ENTER	2021-03-26 14:42:37.000
5	2021-03-19	10:52:59.000000	Friday	2068	P20	ENTER	2021-03-19 10:52:59.000
6	2021-03-26	15:41:39.000000	Friday	1355	P20	ENTER	2021-03-26 15:41:39.000
7	2021-03-18	18:52:58.000000	Thursday	1528	P20	ENTER	2021-03-18 18:52:58.000
8	2021-03-17	19:28:42.000000	Wednesday	2527	P20	EXIT	2021-03-17 19:28:42.000

8,564 rows

Load

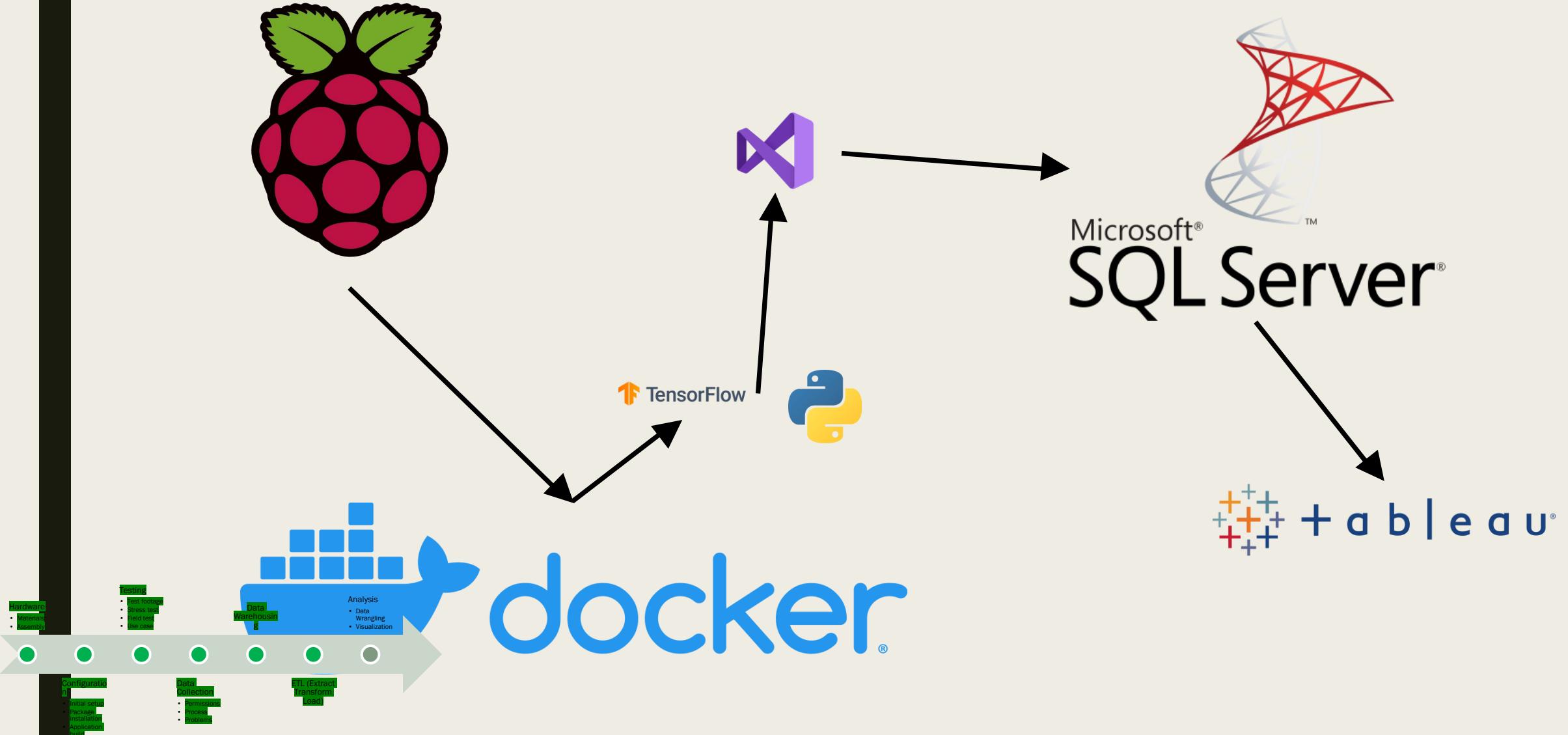


Configuration
Initial setup
Package installation
Application build

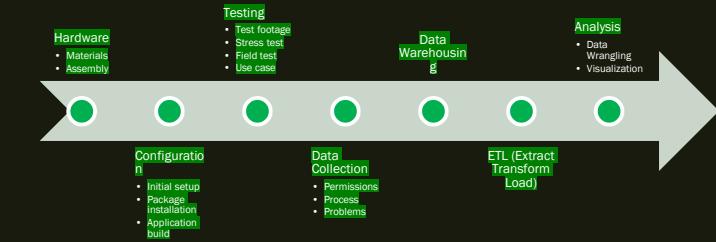
Data Collection
Acquisition
Procesing

ETL (Extract, Transform, Load)

Project Software



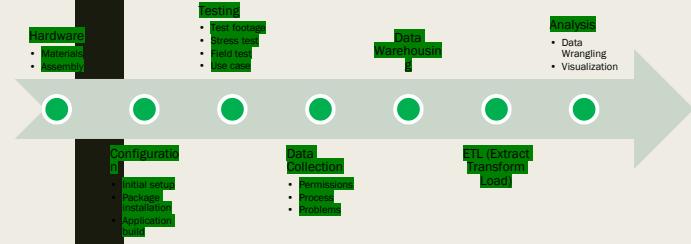
ANALYSIS & VISUALIZATION

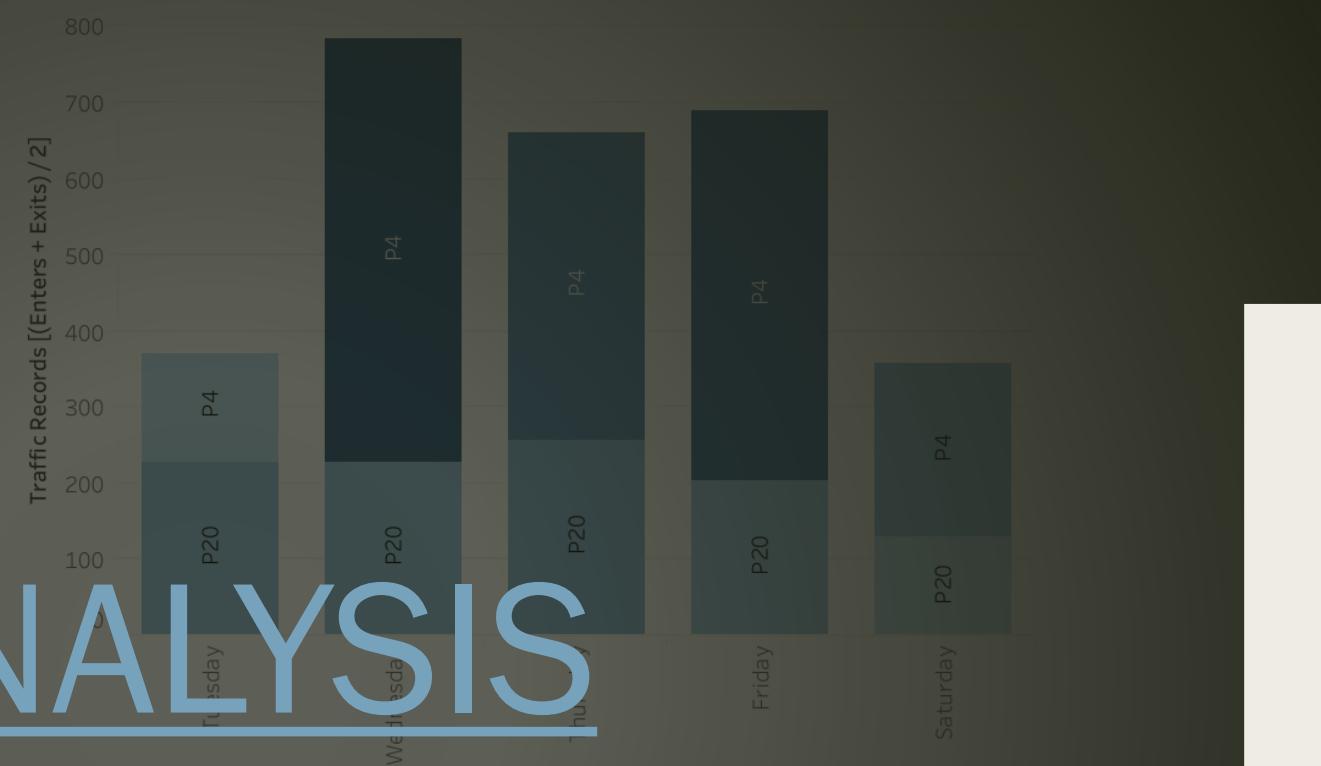
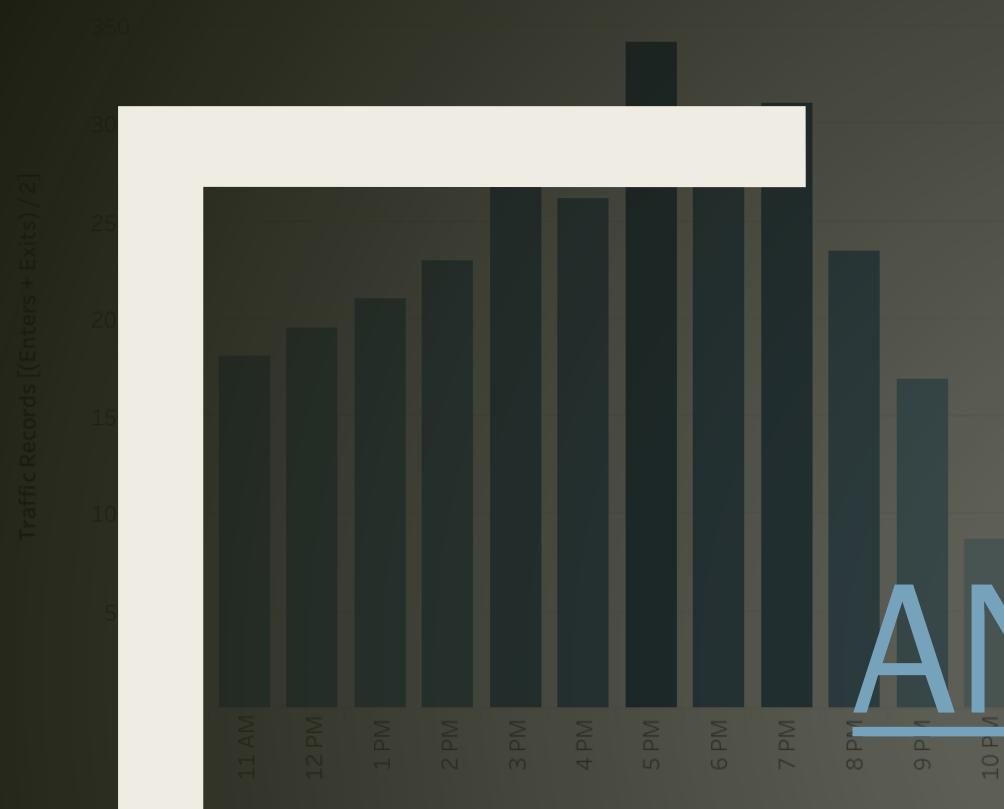


Calculations

$$\text{Traffic Records: } R(t) = \frac{n(t) + x(t)}{2}$$

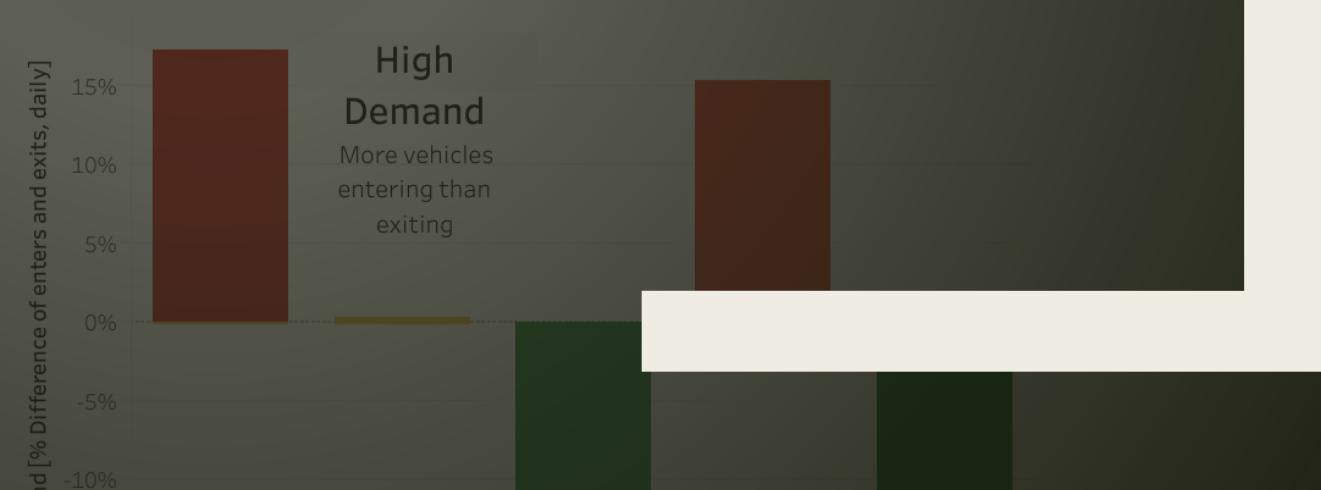
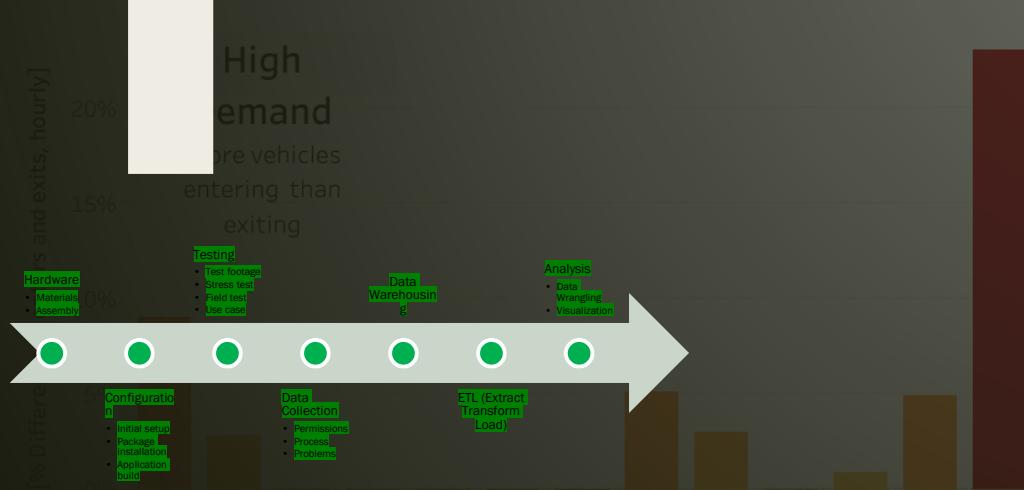
$$\text{Parking Demand: } D(t) = \frac{n(t) - x(t)}{x(t)}$$





ANALYSIS

Overall Residential Parking Demand, Hourly (P4 and P20)





Q&A

A black vertical bar with white rectangular highlights at the top and bottom is positioned on the right side of the image. The text "Q&A" is centered within the dark area of the bar.