

# ParkPULSE

CHECKPOINT 3



# PARKPULSE: FINDING PARKING PEACE OF MIND GLOBALLY

- AI-Driven Parking Prediction and Management Solution
- "Reduce congestion, save time, breathe easier."



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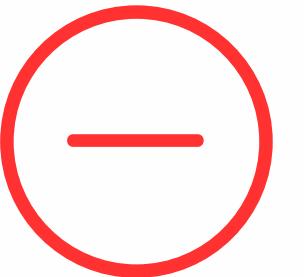


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Industrial Engineer &  
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Manager)

# THE PROBLEM

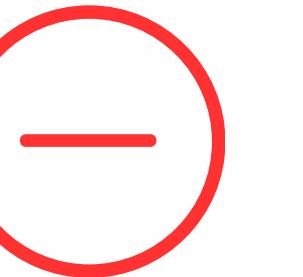
**Finding parking is a global challenge,  
wasting time, fuel, and causing frustration.**

**Time:**



- 17 hours/driver wasted annually searching for parking (global average).

**Economic Impact:**



- \$166 billion/year lost in wasted time and fuel (U.S. Alone).
- \$1.6 trillion/year in health and economic costs from air pollution (Europe).



# CASE STUDY: BARCELONA

- **Daily Vehicle Trips:**

Over 900,000 intensifying congestion and parking search times.

- **Health Impact:**

Pollution associated with 351 premature deaths yearly.

- **Mobility Insight:**

25% of trips via car or motorcycle, highlighting the urgent need for smarter transportation solutions.

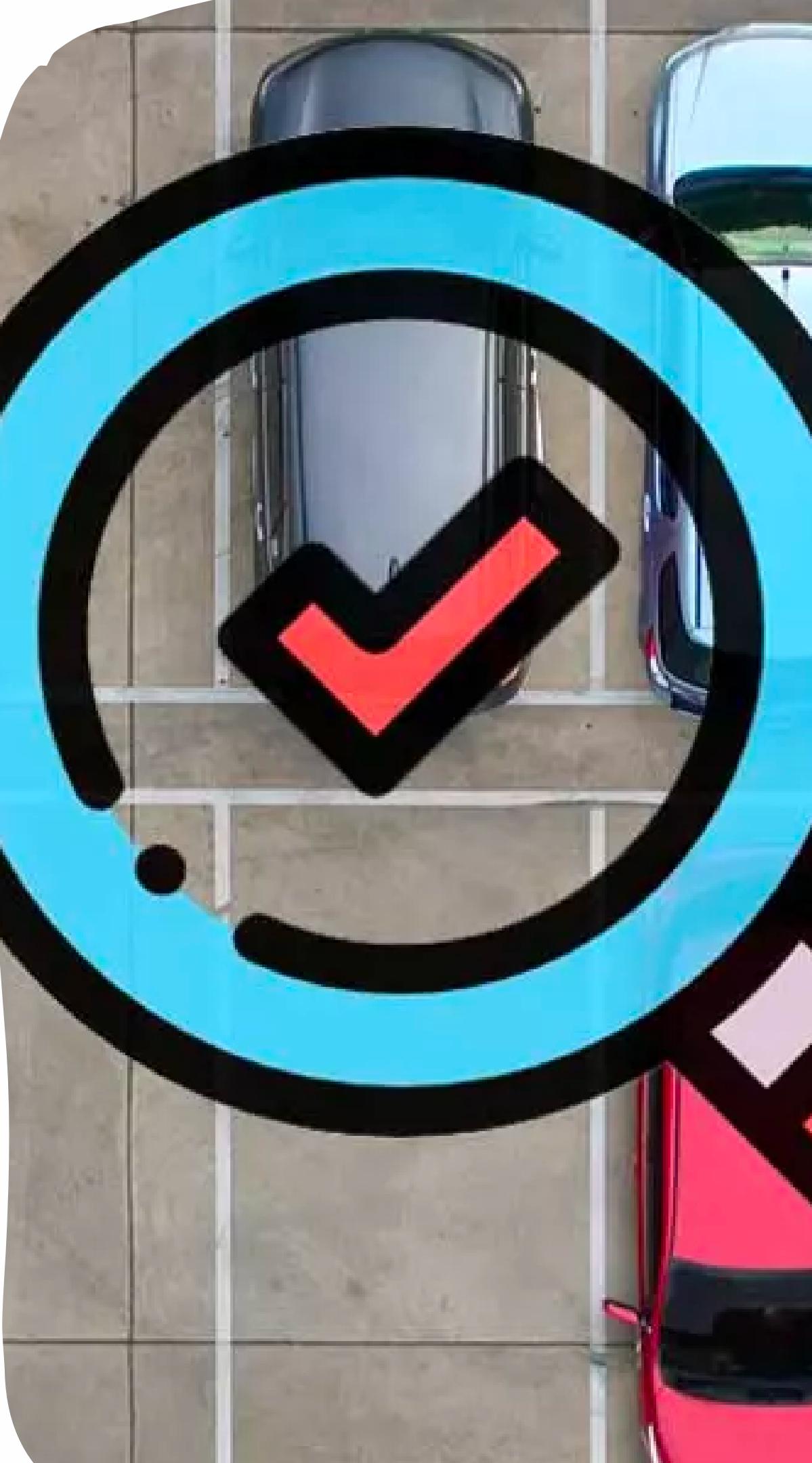
Highlighting the **urgent need** for  
**smarter transportation** solutions.



# THE SOLUTION

## PARKPULSE

ParkPulse uses **real-time data** and AI to predict parking availability **accurately**.



# PARKPULSE FEATURES



- **Tech Integration:**

Merges traffic data, image recognition, and environmental insights for comprehensive analysis.

- **AI Predictions:**

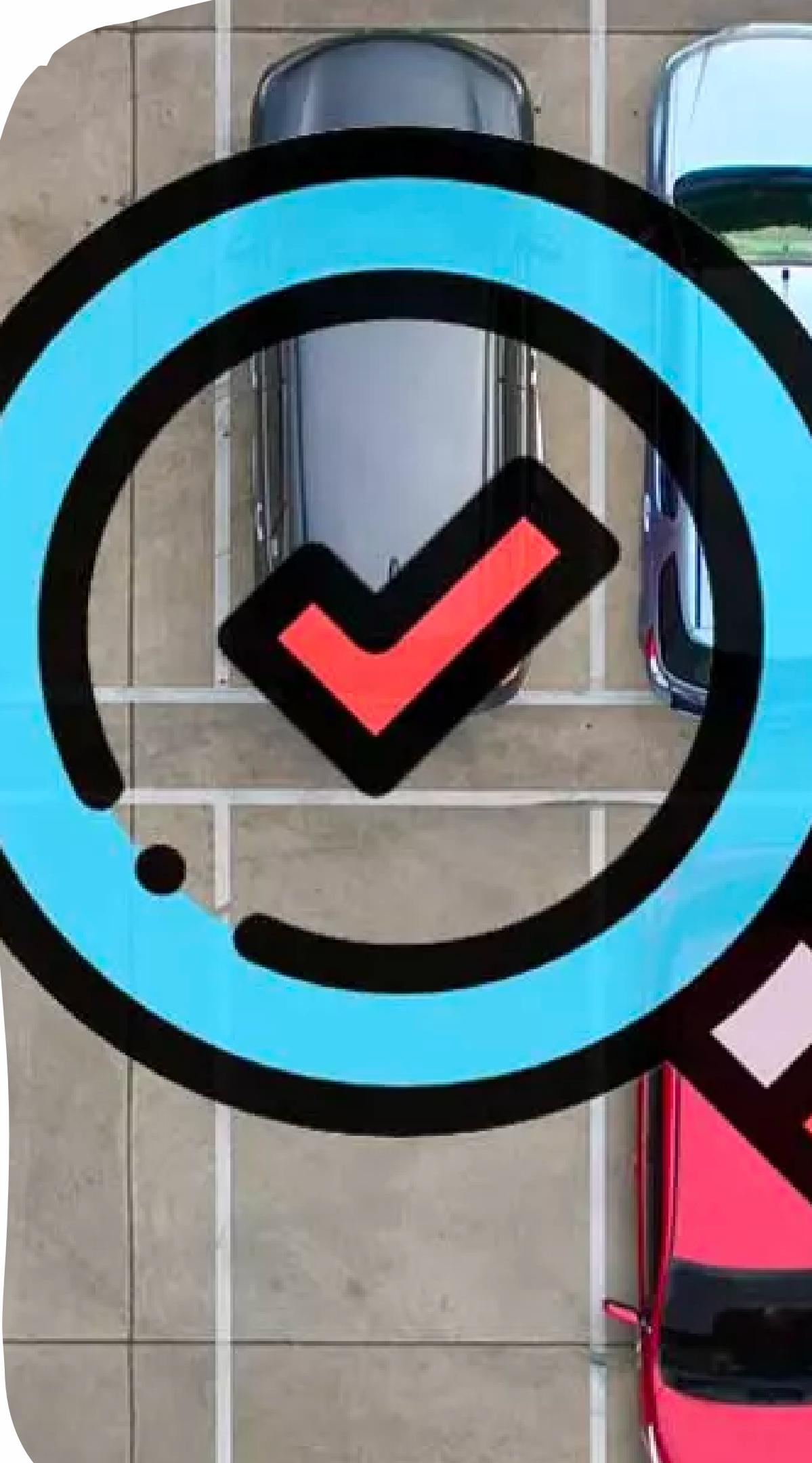
Employs cutting-edge AI for accurate parking and traffic predictions, enhancing decision-making.

- **Parking Guidance:**

Provides real-time, navigational assistance to available parking, improving driver experiences.

- **Forecasting Traffic:**

Develops a predictive model based on parking trends to preempt and ease congestion.



# PARKPULSE FEATURES



- **Urban Insights:**

Offers essential data for effective urban and traffic planning,  
supporting smarter city initiatives.

- **App Development:**

Aims to create intuitive applications that guide drivers swiftly,  
minimizing search times and congestion.

- **Stakeholder Empowerment:**

Enables city planners and businesses with valuable data for  
informed urban development and space optimization.



# BENEFITS OF PARKPULSE



## The Driver:

- Find parking faster, reduce stress, save time and fuel.
- Contribute to a cleaner environment.



## The Business:

- Optimize fleet routes and schedules, saving time and money.



## The Government:

- Reduce congestion and emissions, improve traffic flow.
- Gain valuable data for informed planning and management.



# MARKET OPPORTUNITY



- **300 million+ vehicles** in Europe alone.
- **30-40%** of city center traffic **searching for parking**.
- Mobile app **parking services market CAGR 26.2%**.
- **Global consumer spending** on premium apps and subscriptions expected to reach **\$233 billion** by 2026.

Large and growing market with **significant demand** for parking solutions.

# PROJECT OVERVIEW: BARCELONA CASE STUDY

Barcelona faces a significant **parking challenge**, leading to **congestion and frustration.**



**Proposed solution:**



Develop a predictive model using **traffic data** and **image recognition**.



# PROJECT OVERVIEW: BARCELONA CASE STUDY

Key components:

- Real-time traffic data processing.
- Advanced image recognition technology.
- Predictive analytics for parking availability.



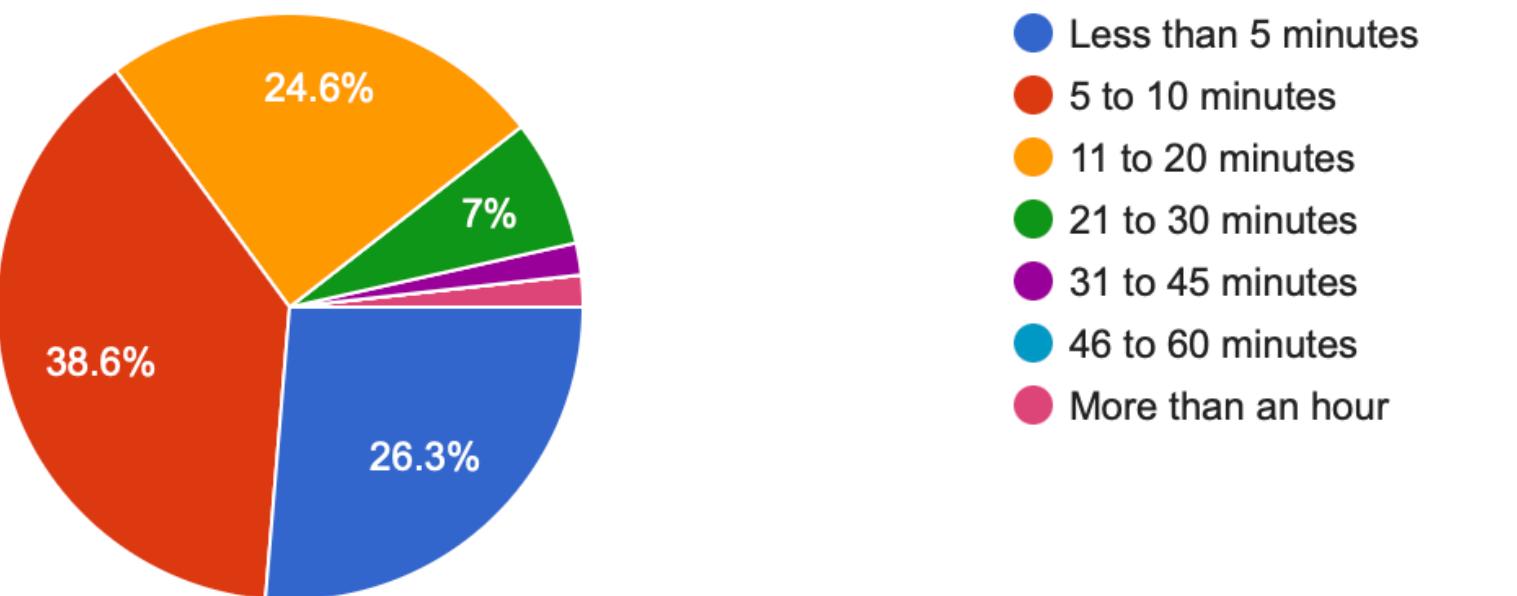
# DRIVERS CRAVE PARKING SOLUTIONS: PARKPULSE VALIDATED BY USER DEMAND

## Frequent Parking Needs:

- 83% of respondents navigate urban areas with parking needs at least **occasionally**.
- 25% spend **11-20 minutes searching** for parking per trip.

On average, how much time do you spend looking for parking each time you drive to such areas?

57 responses



# DRIVERS CRAVE PARKING SOLUTIONS: PARKPULSE VALIDATED BY USER DEMAND

## Limited Satisfaction with Existing Solutions:



- Only **18% use digital parking tools**, mainly Google Maps.
- Space availability (23%), search duration (26%), and cost (33%) are top concerns.

## High Interest in ParkPulse:



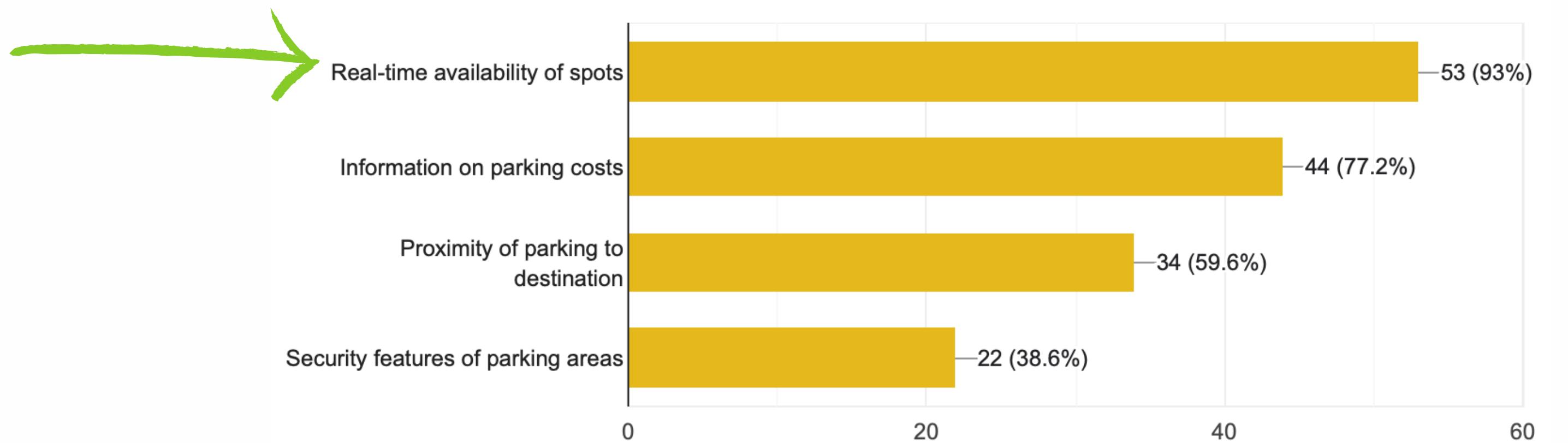
- 74% are enthusiastic about predictive parking data.
- **93% value real-time parking** availability information.
- **77%** seek cost information, **60%** prioritize location proximity.
- 25% are willing to pay for enhanced services (up to 10% more).

# DRIVERS CRAVE PARKING SOLUTIONS: PARKPULSE VALIDATED BY USER DEMAND

What features would you find most beneficial in a predictive parking platform?  
(Select all that apply)



57 responses



# PARKPULSE DATA

- Pacaba
- Barcelona Traffic Dataset
- surface parking spots in Barcelona
- VisualCrossing
- TomTom traffic index
- Electric Chargers stations



# PARKPULSE DATA

**Benefits** of the datasets:

- Train **image recognition** algorithms.
- **Understand** traffic patterns and parking availability.
- Evaluate **environmental impact**.



  Informatics

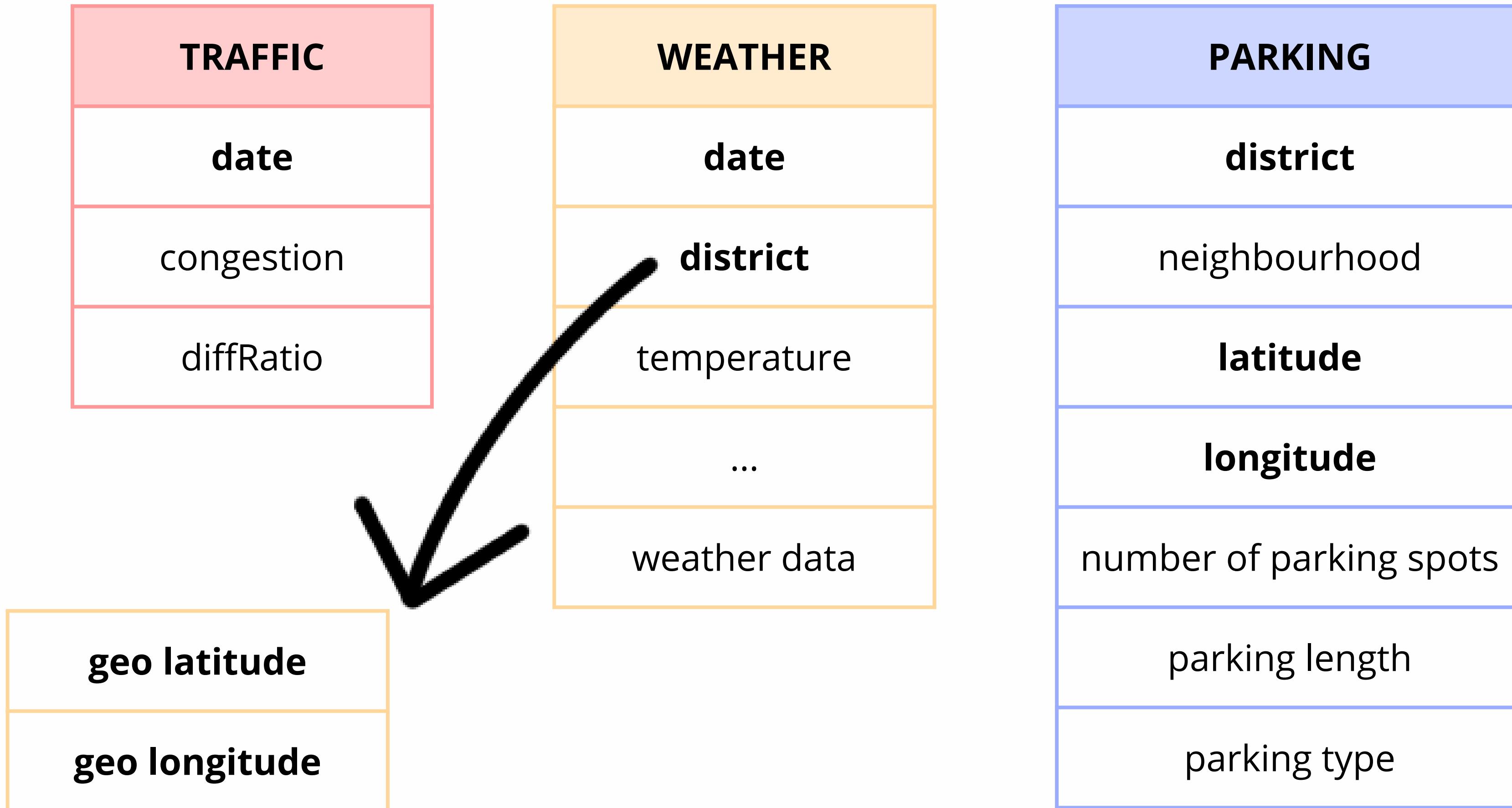
 Open Data **BCN**

 visualcrossing

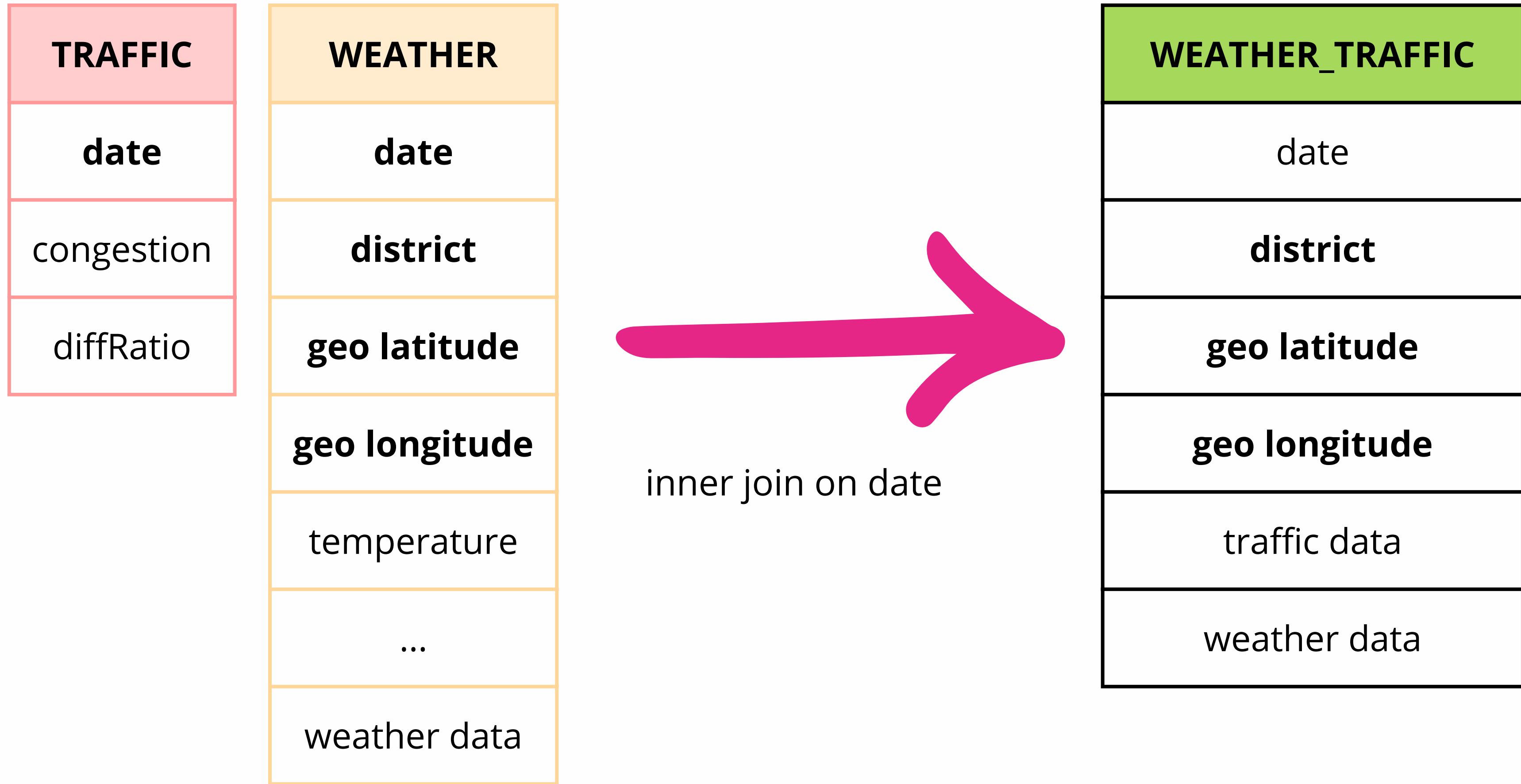
 Google APIs

 **TOMTOM**

# Datasets:



# Merging data:



# Merging data:

PARKING	WEATHER_TRAFFIC
district	date
neighbourhood	district
latitude	geo latitude
longitude	geo longitude
number of parking spots	traffic data
parking length	weather data
parking type	



inner join on  
longitude

WEATHER_TRAFFIC_PARKING
date
district
neighbourhood
latitude
longitude
traffic data
weather data
parking data

# First Model to predict the number of parking spots

Data from December 2019 to November 2020

	District Code	Neighborhood Code	Parking Facility Length	Parking Facility Type Description	Number of Parking Spaces	temp	humidity	precipprob	windgust	winddir	sealevelpressure	cloudcover	visibility
0	6.0	28.0	15.2	Línea	1.0	10.8	80.5	0.0	37.1	324.5	1032.0	46.3	11.3
2	6.0	28.0	5.0	Línea	1.0	10.8	80.5	0.0	37.1	324.5	1032.0	46.3	11.3
5	6.0	28.0	16.3	Línea	3.0	10.8	80.5	0.0	37.1	324.5	1032.0	46.3	11.3
12	6.0	28.0	12.2	Batería	12.0	10.8	80.5	0.0	37.1	324.5	1032.0	46.3	11.3
13	6.0	28.0	5.1	Línea	1.0	10.8	80.5	0.0	37.1	324.5	1032.0	46.3	11.3
...	...	...	...	...	...	...	...	...	...	...	...	...	...
3289984	5.0	26.0	4.0	Batería	10.0	11.5	78.7	0.0	23.6	316.7	1027.6	30.2	13.3
3289985	5.0	26.0	6.7	Batería	4.0	11.5	78.7	0.0	23.6	316.7	1027.6	30.2	13.3
3289989	5.0	26.0	5.6	Línea	1.0	11.5	78.7	0.0	23.6	316.7	1027.6	30.2	13.3
3289991	5.0	26.0	5.5	Batería	3.0	11.5	78.7	0.0	23.6	316.7	1027.6	30.2	13.3
3289996	5.0	26.0	8.2	Batería	18.0	11.5	78.7	0.0	23.6	316.7	1027.6	30.2	13.3

977508 rows × 13 columns

# Cross-validation with Random Forest

RF 30 times:

- Each time different training and test set.
- 30 times to statistically have a t-student distribution sufficiently similar to that of a Gaussian.
- Evaluation: R-squared & Mean Absolute Error.
- Confidence interval using mean and standard deviation.
- Central Limit Theorem: with a sufficiently large sample, the distribution of the sample mean is similar to a Normal distribution.

$$R^2 = 1 - \frac{\sum_{i=1}^n (EST_i - OBS_i)^2}{\sum_{i=1}^n (OBS_i - \bar{OBS})^2}$$

$$MAE = \frac{1}{n} \sum_{i=1}^n |EST_i - OBS_i|$$

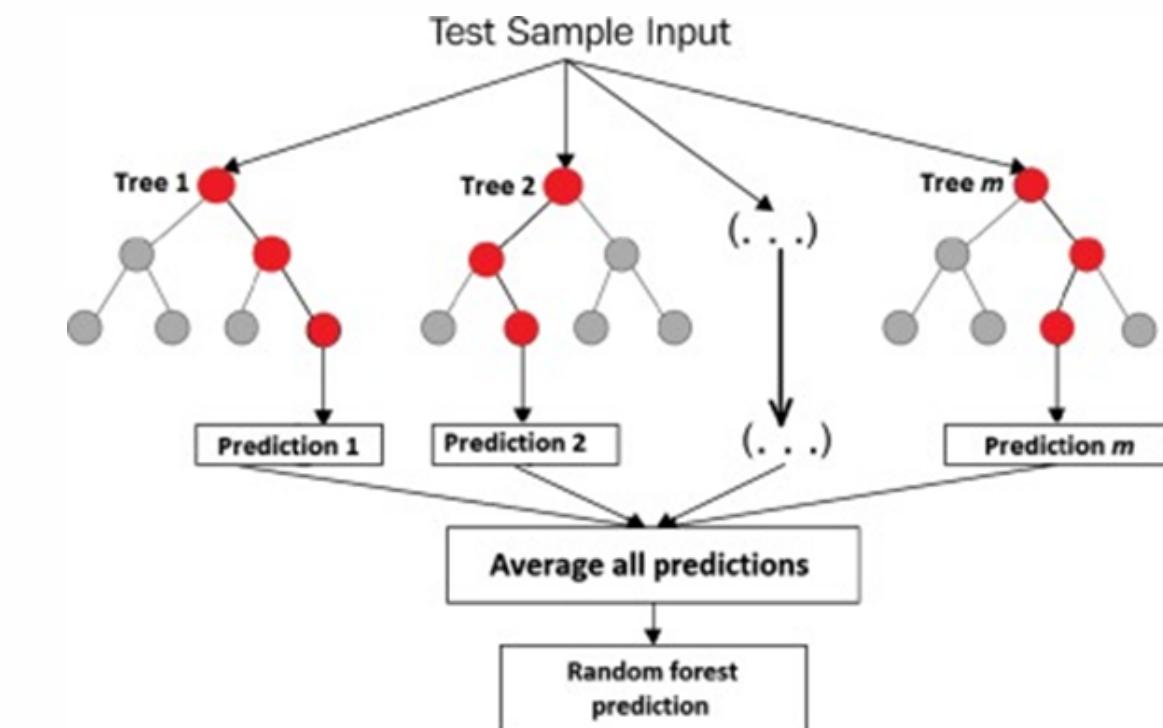
Results:



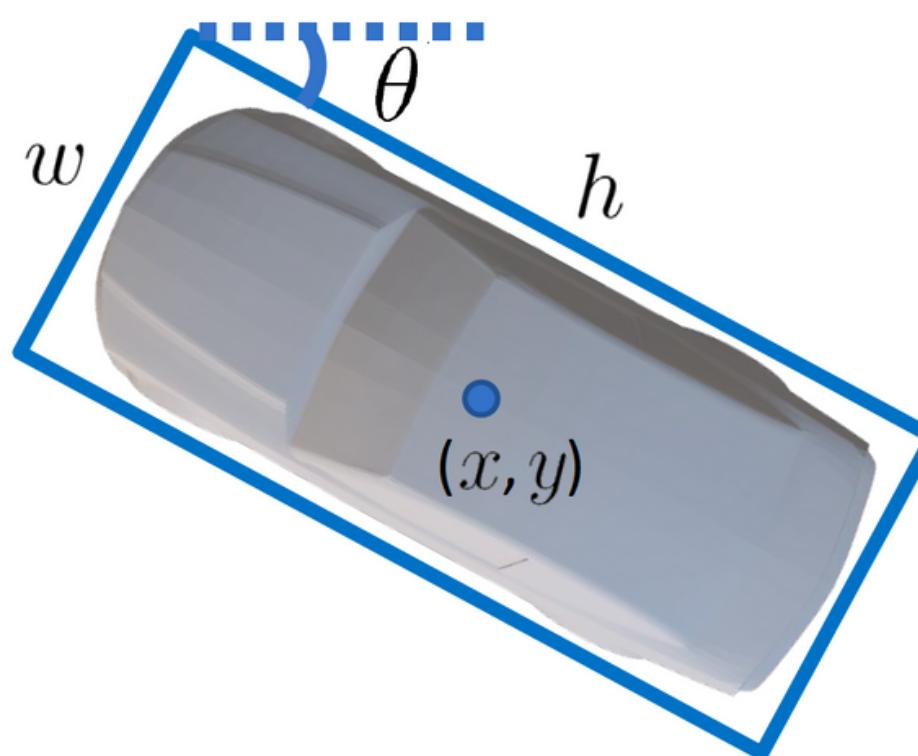
R-squared: ( 0.89 , 0.93 )

MAE: ( 2.84, 4.54 )

$$\left( \bar{X} - z_{\alpha/2} \cdot \frac{S}{\sqrt{n}}, \bar{X} + z_{\alpha/2} \cdot \frac{S}{\sqrt{n}} \right)$$



# PaCaBa Parking Dataset



- Location: Barcelona
- Date Acquired: 11:04:28.38 - 11:05:24.54
- Datasets: 7303 Parking Cars
- Annotation: Pascal Voc Format

# Maxar

- 10.4MP
- 60% of earth surface
- Daily Collection
- Fastest Revisit (intraday)

Introducing the first multi-payload, super-spectral, high-resolution commercial satellite ever to be launched.

# WorldView-3

DigitalGlobe

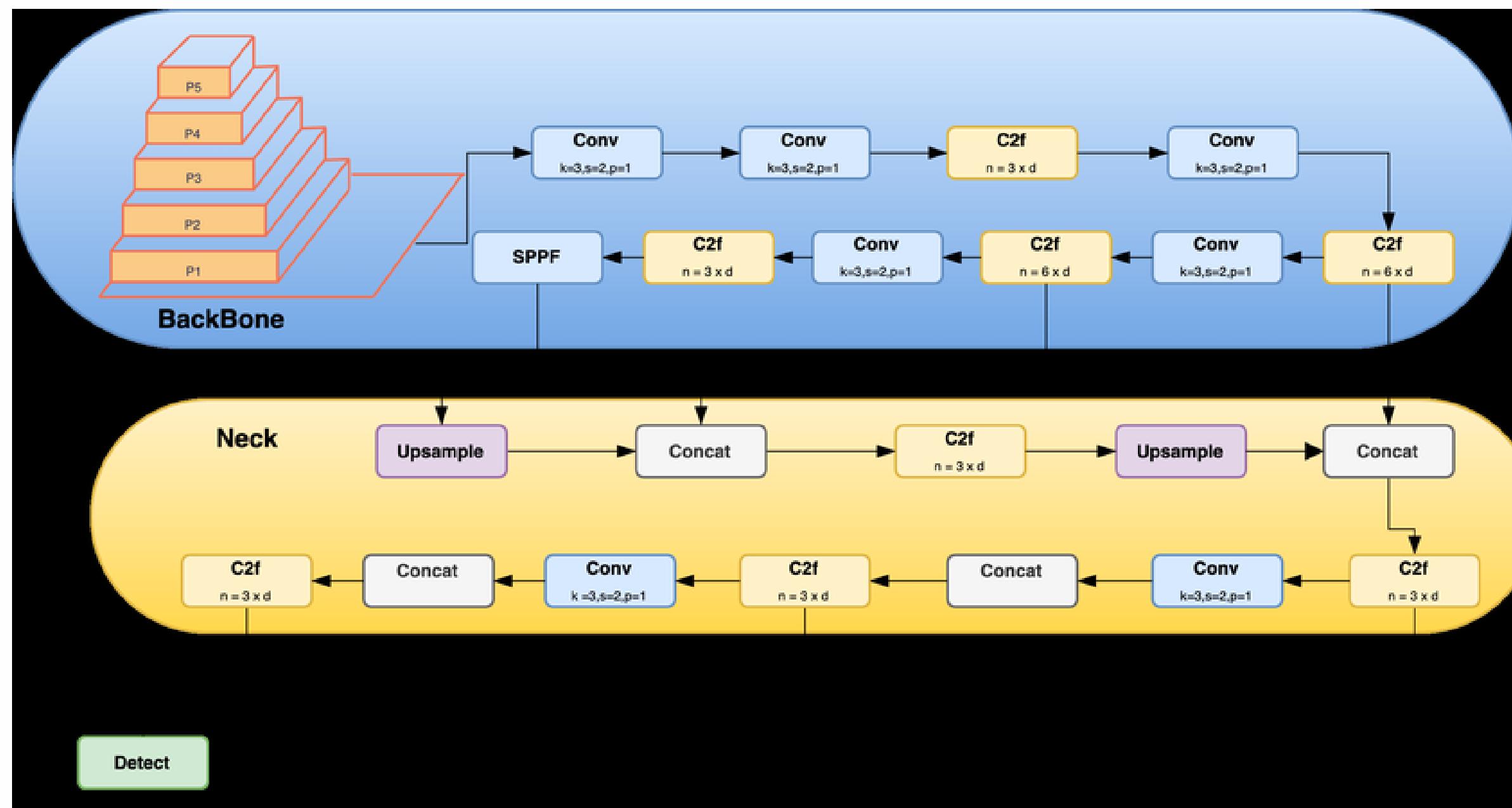
The diagram illustrates the WorldView-3 satellite's capabilities and spectral coverage. It features a central eye icon representing the visible spectrum (400–700 nm). To the left, a legend highlights the satellite's payload components: Panchromatic, Daily revisit, 8-Band multispectral, Rapid retarget CMGs, and 8-Band short wave infrared. To the right, a detailed wavelength chart shows the solar radiation spectrum from 250 to 2500 nm, with the visible range highlighted. The WorldView-3 multispectral bands are shown in the visible range (400–700 nm), and the SWIR bands are shown in the shortwave infrared range (1000–2500 nm). A table below provides a comparison of various satellite systems across various performance metrics.

Discover more at [digitalglobe.com/WorldView3](http://digitalglobe.com/WorldView3)

Satellite	Accuracy w/o GCP	Pan resolution	Multispectral resolution	SWIR resolution	Spectral characteristics	Swath width (nadir)	Operational altitude	Average revisit	Capacity km <sup>2</sup> /day	Onboard storage
IKONOS	15 m CE90	1.0 m	4.0 m	NA	Panchromatic 4-Band Multispectral	11.3 km	681 km	3 days	150,000	64 Gb
QuickBird	23 m CE90	65 cm	2.62 m	NA	Panchromatic 4-Band Multispectral	18 km	482 km	2.7 days	210,000	128 Gb
WorldView-1	< 3 m CE90	50 cm	NA	NA	Panchromatic	17.7 km	496 km	1.7 days	1.3 million	2199 Gb
GeoEye-1	5 m CE90	50 cm	2.0 m	NA	Panchromatic 4-Band Multispectral	15.2 km	681 km	< 3 days	1 million	1 Tb
WorldView-2	< 3 m CE90	46 cm	1.85 m	NA	Panchromatic 8-Band Multispectral	16.4 km	770 km	1.1 days	1.1 million	2199 Gb
WorldView-3 2014 expected launch	< 3 m CE90	31 cm	1.24 m	3.7 m	Panchromatic 8-Band Multispectral 8 SWIR Bands	13.2 km	617 km	< 1 day	680,000	2199 Gb

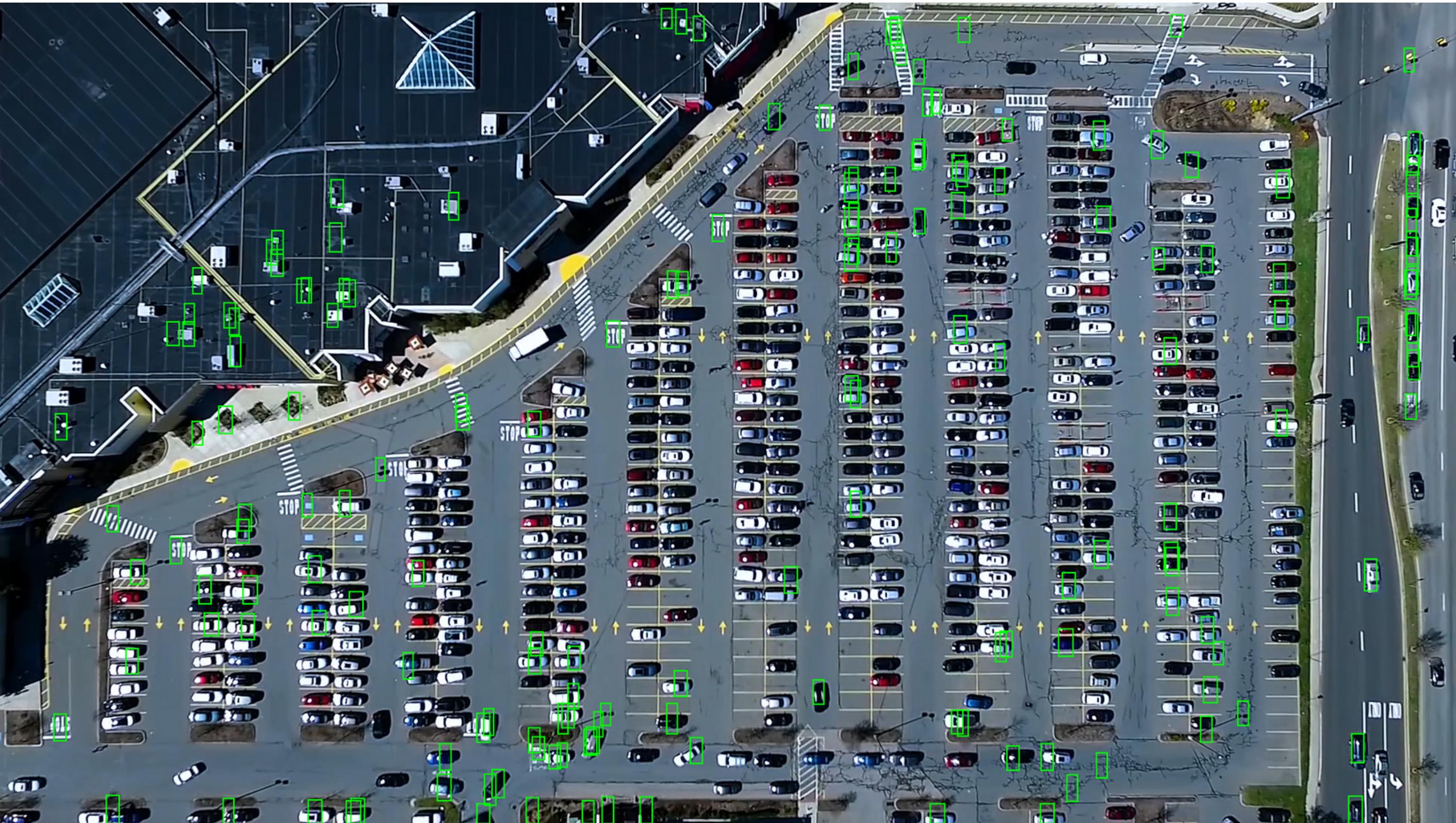
# Yolo V8

## Pretrained Model Architecture

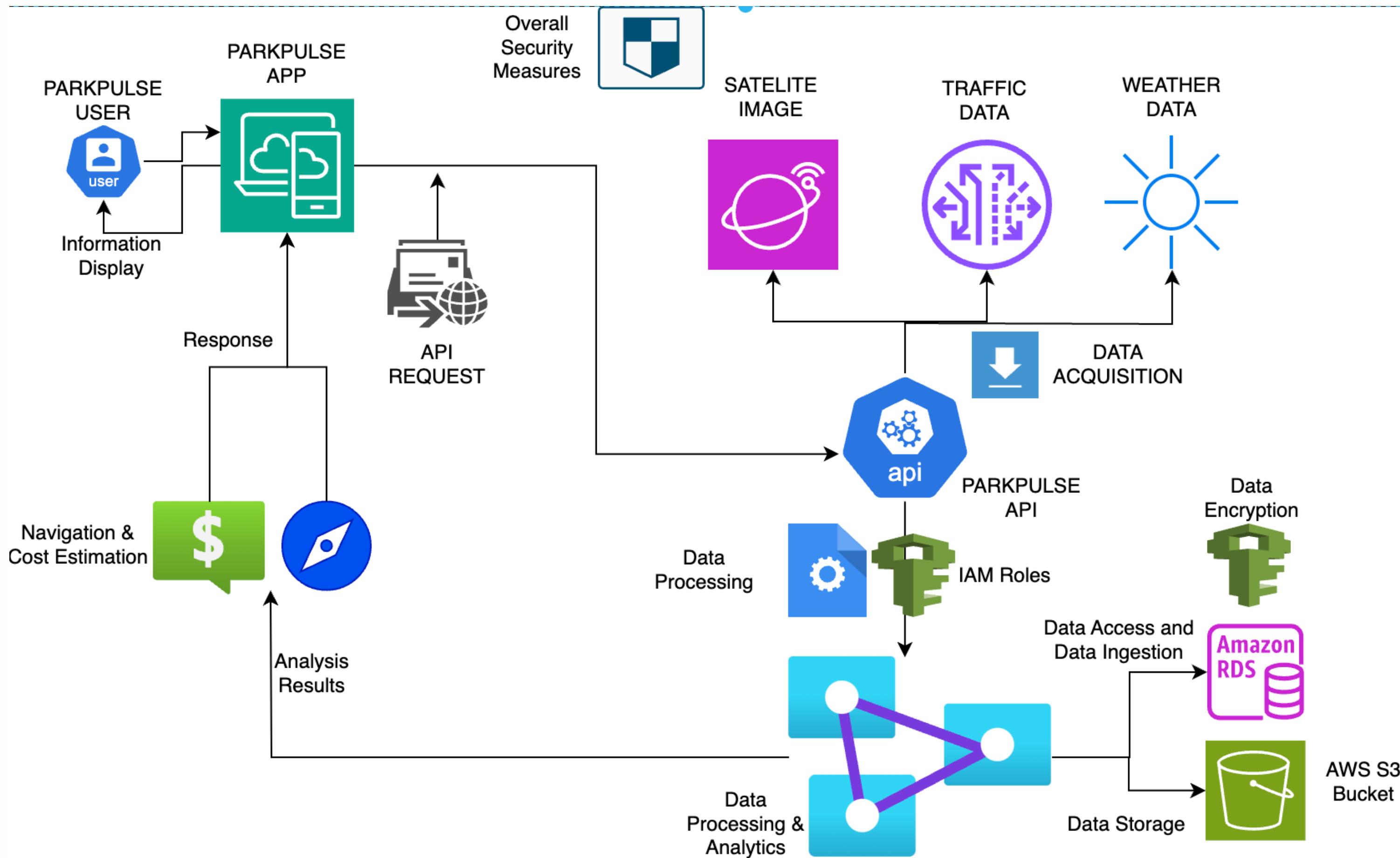


# Fine Tuning

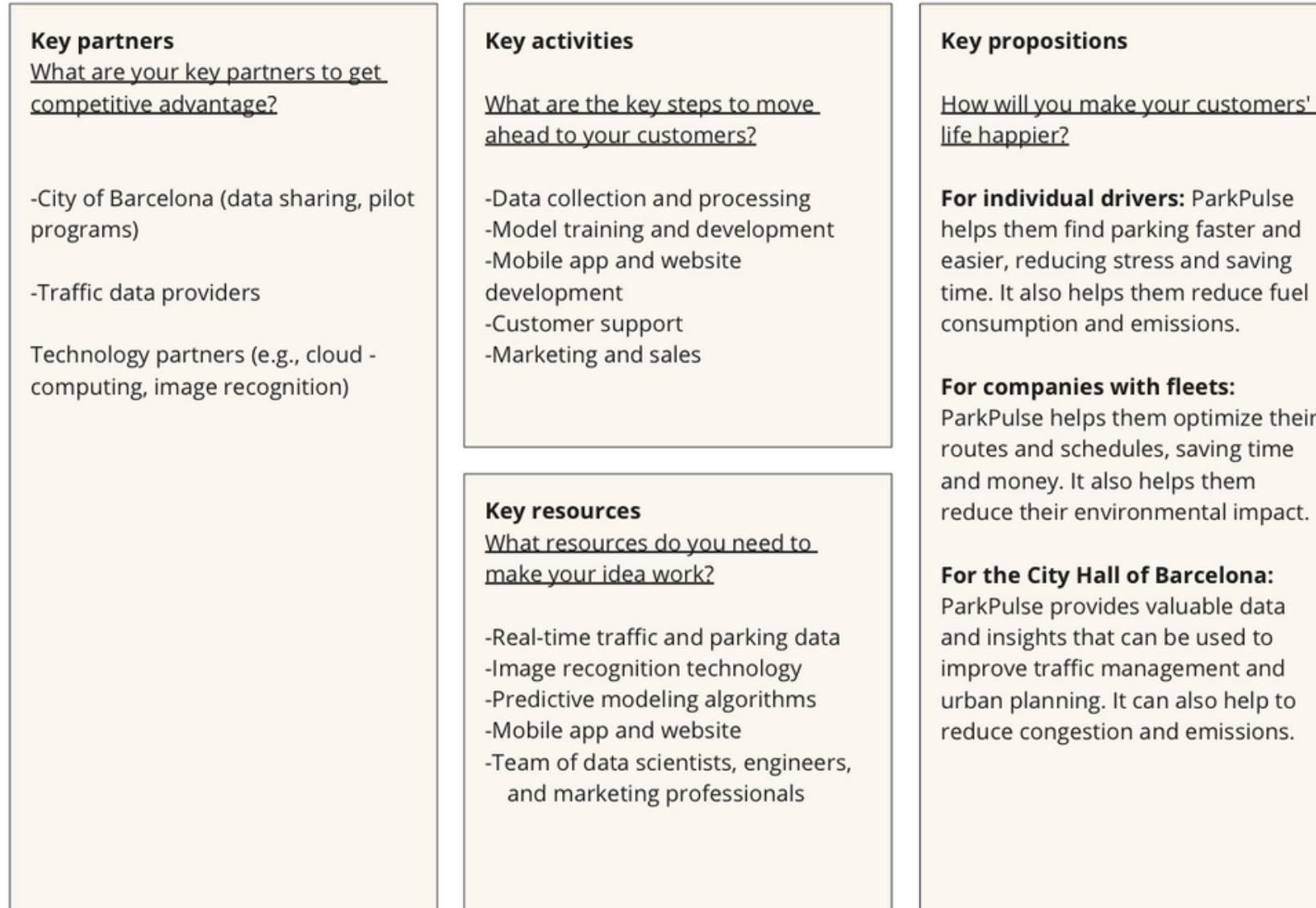
- Total Images: 310 images
- Train: 186 images
- Validation: 100 images
- Test: 24 images
- Model: Nano
- Epoch: 20



# ParkPulse APP Flow design



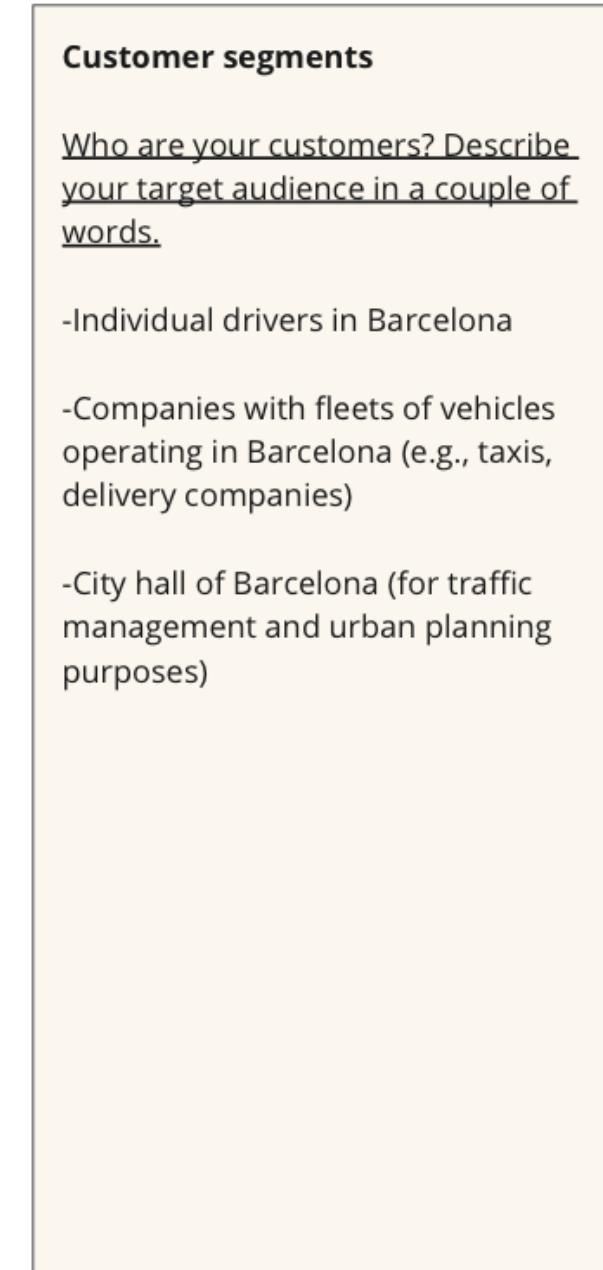
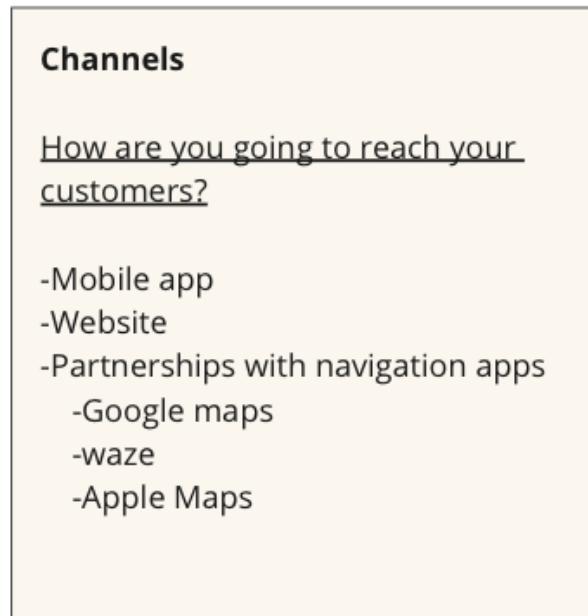
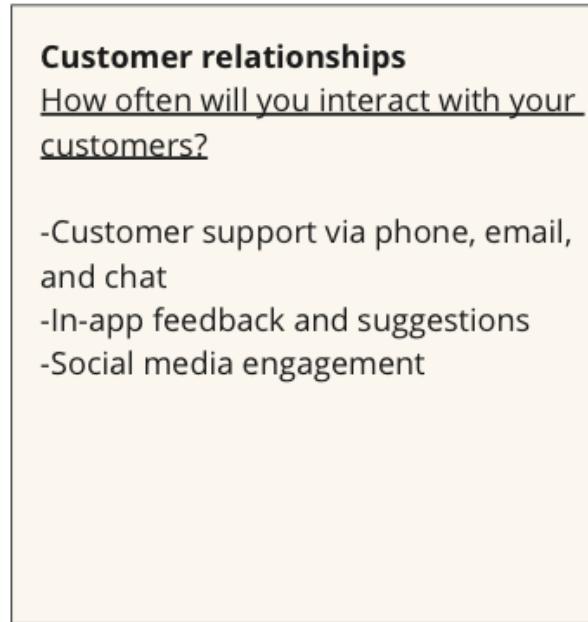
# The Business Model Canvas



- **Leveraging partnerships** with the City of Barcelona, traffic data providers, and tech innovators
- **Meticulous data handling**, continuous platform enhancement, and dedicated customer-centric marketing and support
- **Real-time data analytics**, advanced image recognition.
- **Finding Parking faster** reducing cost, time and stress while providing valuable data



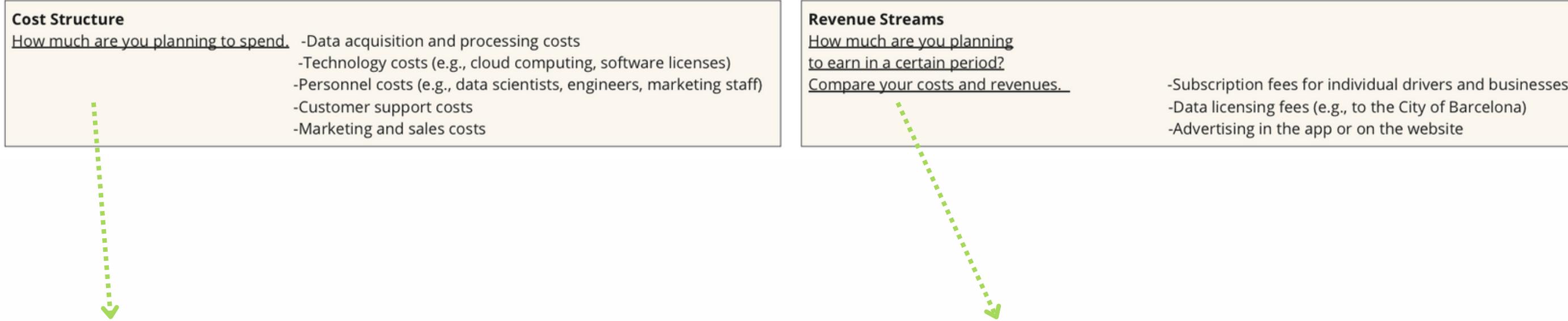
# The Business Model Canvas



- **Responsive support**, encourages in-app community engagement, and actively interacts with customers on social media platforms.
- **User-friendly** mobile app, an informative website, and integrations with Google Maps, Waze, and Apple Maps.
- **Tailored for individual drivers**, vehicle fleet companies, and the City Hall of Barcelona.



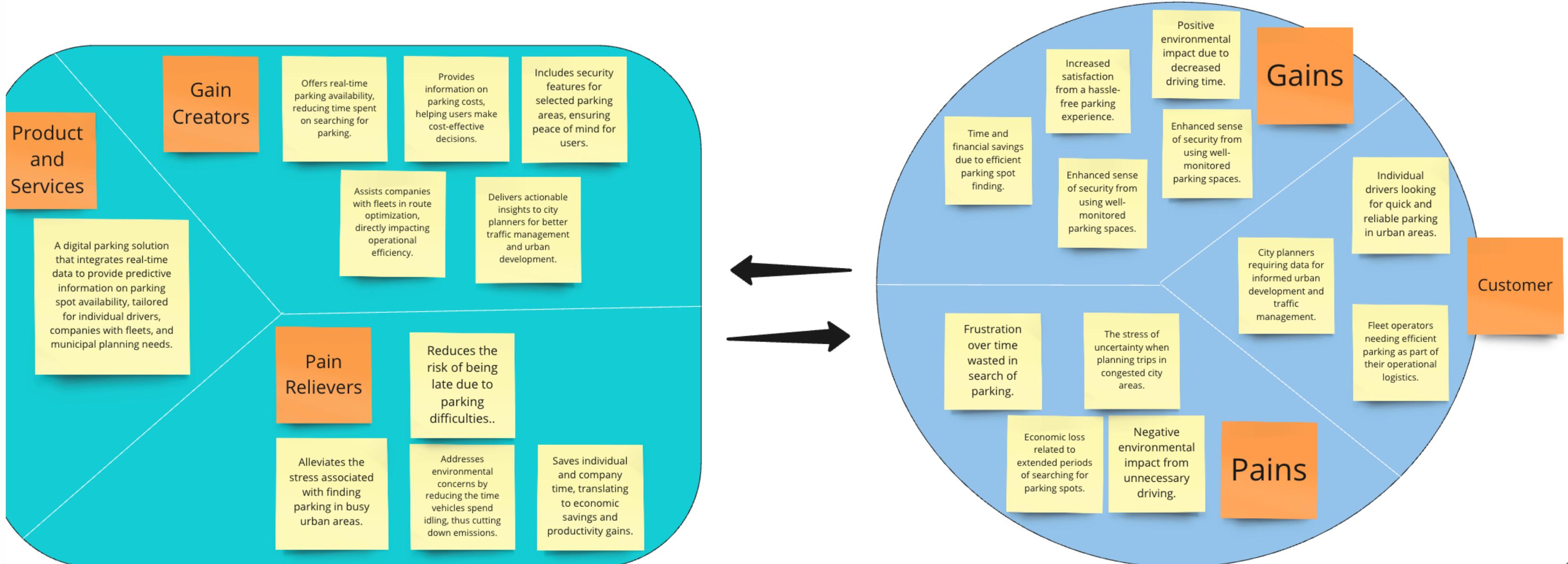
# The Business Model Canvas



- **Primarily allocated to** data handling, advanced technology deployment, skilled personnel, customer support, and targeted marketing efforts.
- **Subscription fees from users and businesses,** data licensing to the city authorities, and in-app and website advertising revenue.



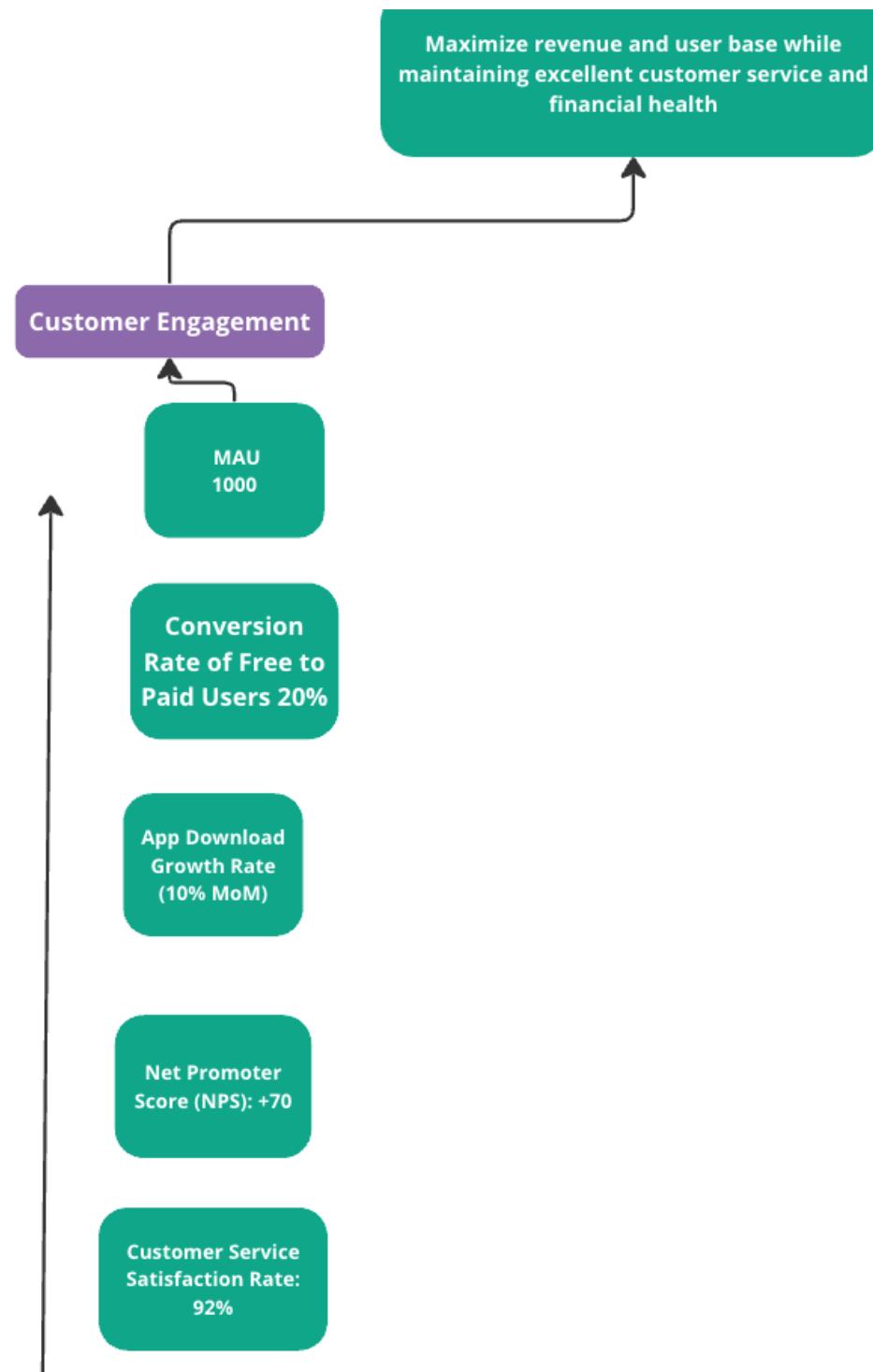
# Value Proposition Canvas



# Customer Journey

Journey phases	Awareness	Consideration	Acquisition	Service	Retention	Loyalty
Jobs to be done	Discovering solutions for quick parking spot finding	Comparing ParkPulse to other parking solutions and considering its efficiency for fleet operations.	Downloading the app and starting to use it for finding parking spots	Regular use of the app for daily parking needs and route optimization for fleets	Making ParkPulse a part of the daily routine and considering premium features	Advocating for ParkPulse, contributing data for traffic management
Context & Touchpoints	Word-of-mouth, online ads, social media presence	Website comparisons, online reviews, feature listings	Mobile app download platforms, first-time user onboarding within the app	Daily interaction with the app, customer service for inquiries	Notifications for app updates, promotions for premium features	Referral programs, community features within the app
Gains	Awareness of a potential solution to save time and cost	Recognizing ParkPulse's real-time parking data as superior	First experience of time savings and spot reliability	Consistent time and financial savings, improved security	Continued benefits from the app's features, possibly enhanced by premium options	Becoming a part of the solution for urban development, enjoying a community of like-minded users
Pains	Initial skepticism or lack of knowledge about digital parking solutions.	Concerns about app reliability and accuracy	Hesitation in trusting a new app for parking needs	Adjusting to a new routine and learning the app's features	Decision-making on whether to pay for premium features	Minimal, as the app is now integrated into the customer's lifestyle.
Emotion						
	Curiosity about ParkPulse's capabilities	Hope that ParkPulse might be the right solution	Tentative excitement upon initial use	Satisfaction with the efficient and secure parking experience	Trust in the app's reliability, leading to loyalty	Pride in contributing to a larger cause, loyalty to the brand

# ParkPulse KPI's

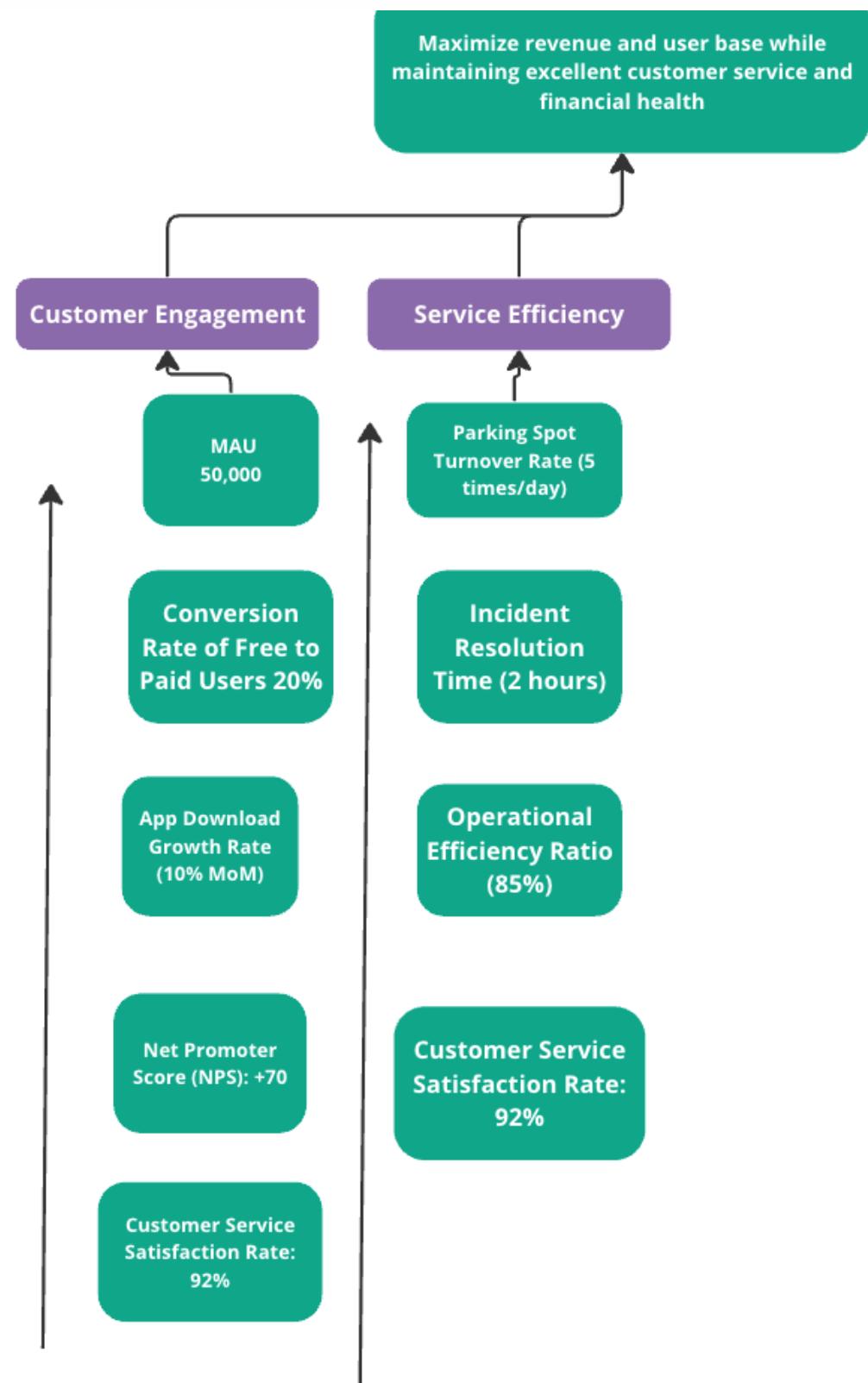


## Customer Engagement:

- **1000 Monthly Active Users** signal a large user base.
- **20% conversion rate** and 10% monthly app growth indicate strong engagement and adoption.
- **Net Promoter Score of +70** and 92% satisfaction rate reflect high customer loyalty.



# ParkPulse KPI's

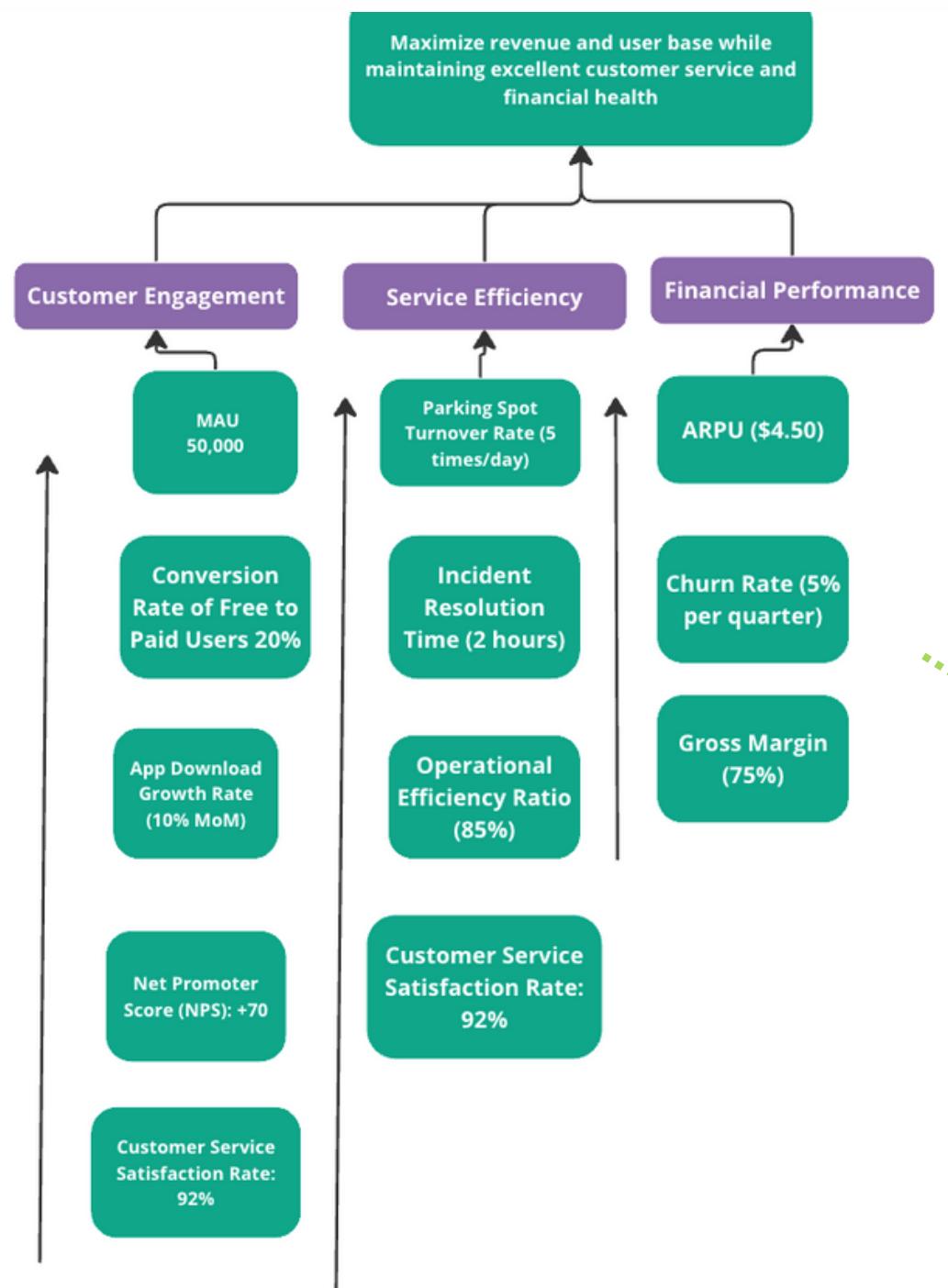


## Service Efficiency:

- 5 times daily parking turnover and 85% operational efficiency show resource effectiveness.
- **2-hour incident resolution** underscores quick customer service.



# ParkPulse KPI's

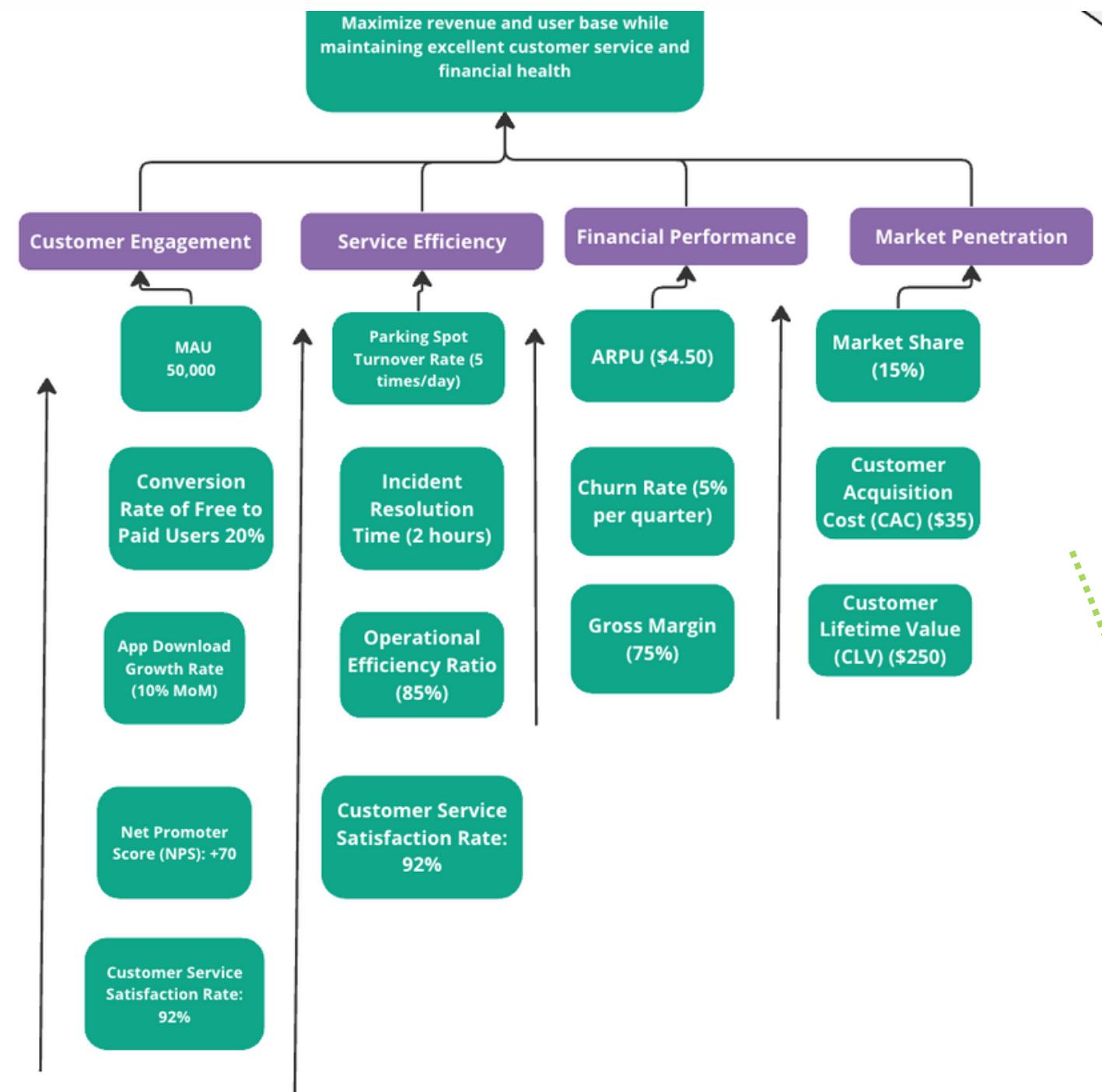


## Financial Performance:

- \$4.50 ARPU and 85% retention rate demonstrate revenue success and loyalty.
- 75% gross margin indicates healthy profitability.



# ParkPulse KPI's



## Market Penetration:

- 15% market share in urban areas highlights market impact.
- **\$250 CLV and \$35 CAC suggest effective revenue and acquisition strategies.**



# Ethic Model

## User Privacy:

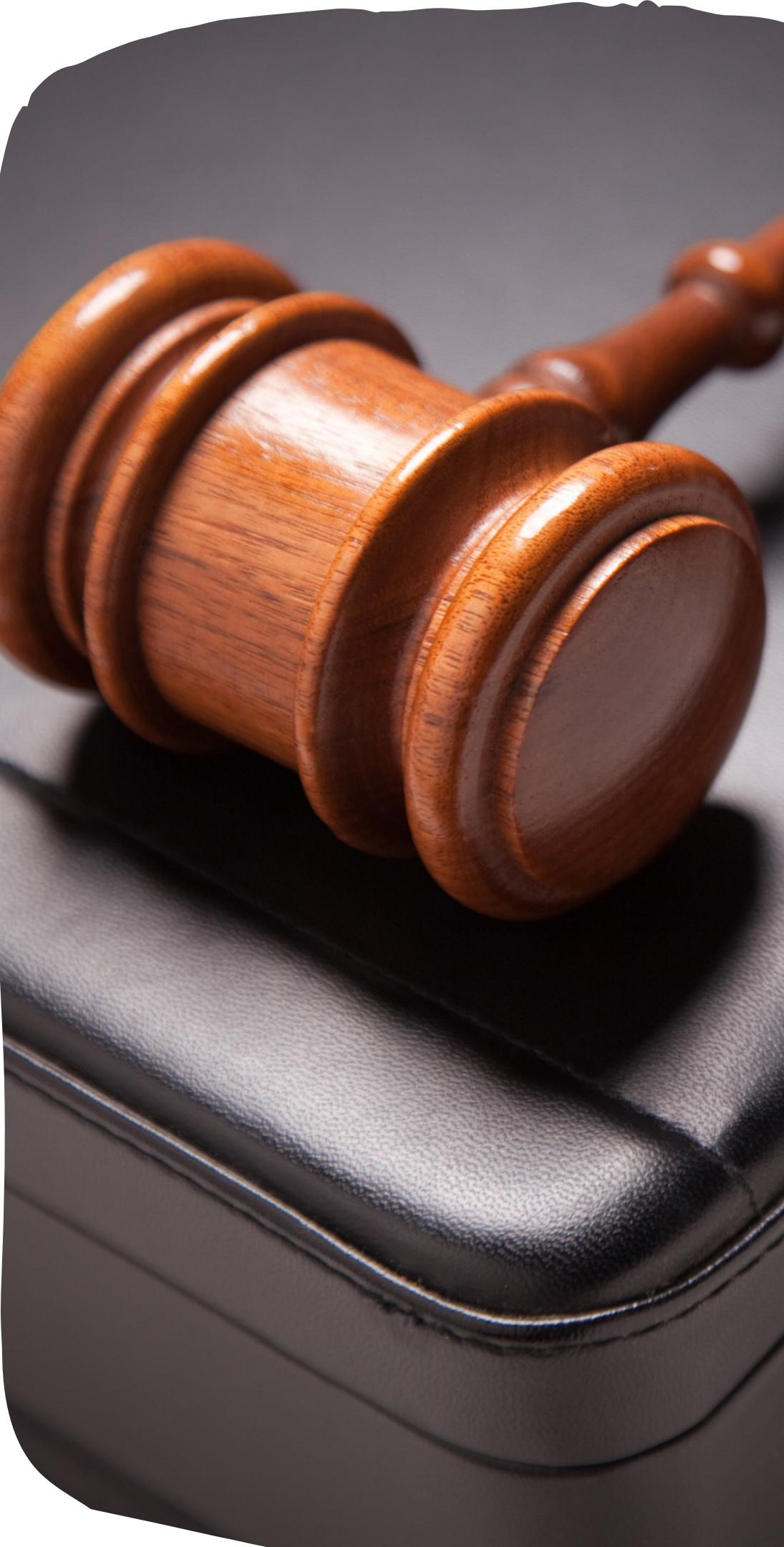
- **Ensure transparency** by clearly explaining data practices in a user-friendly policy.
- **Empower users with control over their data**, including editing and deleting their information.
- **Protect data** with strong security against unauthorized actions.



# Ethic Model

## Fairness and Non-discrimination:

- **Utilize fair**, unbiased algorithms and AI, preventing discrimination.
- **Guarantee equal service access** and non-discriminatory pricing.
- **Promote diversity** and inclusion within the workplace.



# Ethic Model

## Data Responsibility:

- Commit to ethical data use, respecting privacy and avoiding harmful practices.
- Maintain transparency about data handling and sharing.
- Safeguard data integrity and security with stringent cybersecurity.



# Reference List

## Slide 3 - Problem:

Statista. (n.d.). Share of respondents who say there is not enough parking. Retrieved from <https://www.statista.com/chart/31724/share-of-respondents-who-say-there-is-not-enough-parking/>

Statista. (n.d.). Environmental pollution - Statistics & Facts. Retrieved from <https://www.statista.com/topics/4739/environmental-pollution/#topicOverview>

## Slide 4 - Case Study:

RACC Corporativa. (n.d.). Let's turn Barcelona into a mobility benchmark. Retrieved from <https://corporativa.racc.es/lets-turn-barcelona-into-a-mobility-benchmark/>

## Slide 8 - Market Cap:

European Automobile Manufacturers Association (ACEA). (n.d.). Size distribution of the EU vehicle fleet. Retrieved from <https://www.acea.auto/figure/size-distribution-of-the-eu-vehicle-fleet/>

Yahoo Finance. (n.d.). Smart parking systems market worth. Retrieved from [https://finance.yahoo.com/news/smart-parking-systems-market-worth-143000491.html?guccounter=1&guce\\_referrer=aHR0cHM6Ly93d3cuZ29vZ2xIbmNvbS8&guce\\_referrer\\_sig=AQAAAEMEVH\\_d1P3jt0VYyyVabHKFoJeqTZh2TDclg9l0gDWtMzkTyKqPScKQlexNJKpbgKI0B-36H46uZyMun2DaH6nluCX6qNIJyQrcnrc97KacGBWi28S1GKwaQDAkDdbALrkPqrOM1POqxqwWyXRHt9xbqhpkKMtUYsN903tXY](https://finance.yahoo.com/news/smart-parking-systems-market-worth-143000491.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xIbmNvbS8&guce_referrer_sig=AQAAAEMEVH_d1P3jt0VYyyVabHKFoJeqTZh2TDclg9l0gDWtMzkTyKqPScKQlexNJKpbgKI0B-36H46uZyMun2DaH6nluCX6qNIJyQrcnrc97KacGBWi28S1GKwaQDAkDdbALrkPqrOM1POqxqwWyXRHt9xbqhpkKMtUYsN903tXY)

Sensor Tower. (n.d.). Sensor Tower app market forecast 2026. Retrieved from <https://sensortower.com/blog/sensor-tower-app-market-forecast-2026>



# Thank You.

