

Using Deep Learning and Google Street View to Estimate the Demographic Makeup of the US

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**Each year,
the U.S. Census Bureau spends \$1 billion
surveying the population.**

Challenges of Population Survey

- Labor-intensive
- Time-consuming
- Ignore smaller areas

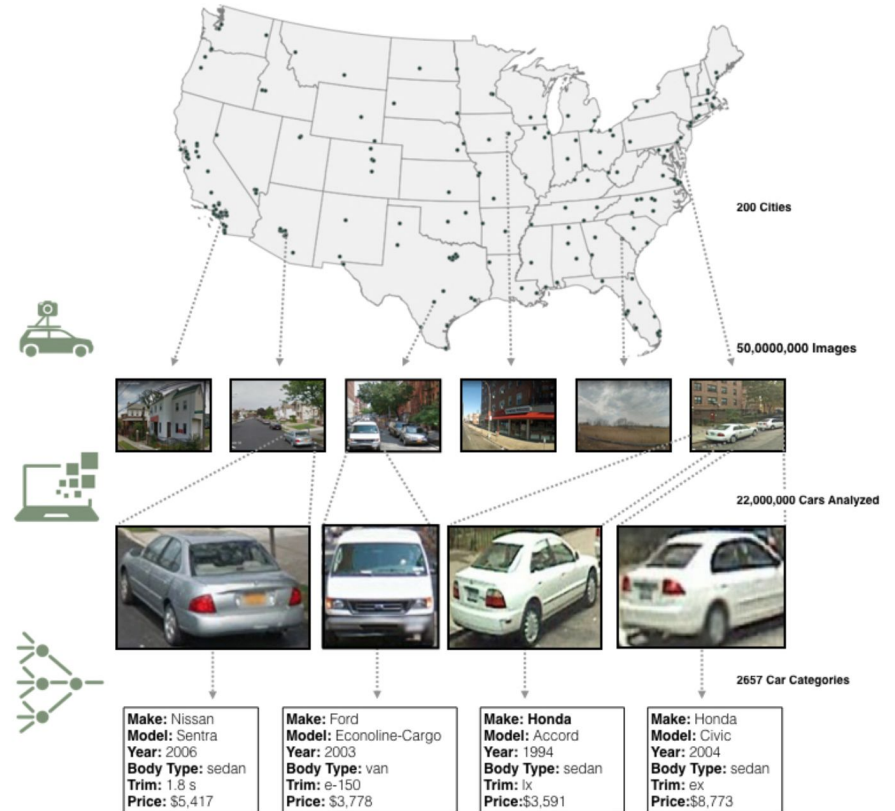


**A faster, more efficient, and higher-resolution
way of studying the population?**

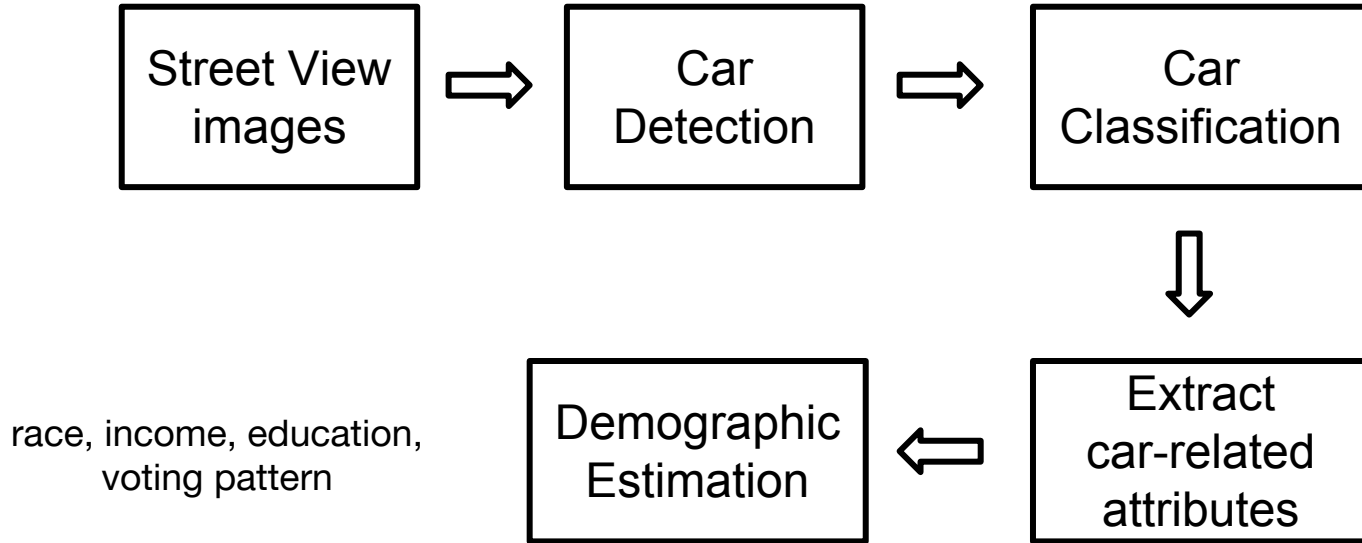
The type of **car people own is a strong indicator of their demographic information.**

Vehicular Census via Google Street View Images

- 200 American cities
- 50 million Street View Images
- 22 million vehicles
- 2,657 different categories of cars
- Vehicle characteristics
 - Make, model, year, body type...



Automated System for Monitoring Demographic Trends



Car Detection

- Deformable Part Models (DPMs)
- Tradeoff between performance and efficiency

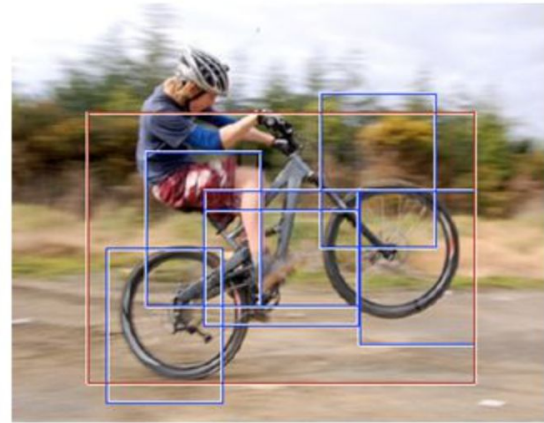
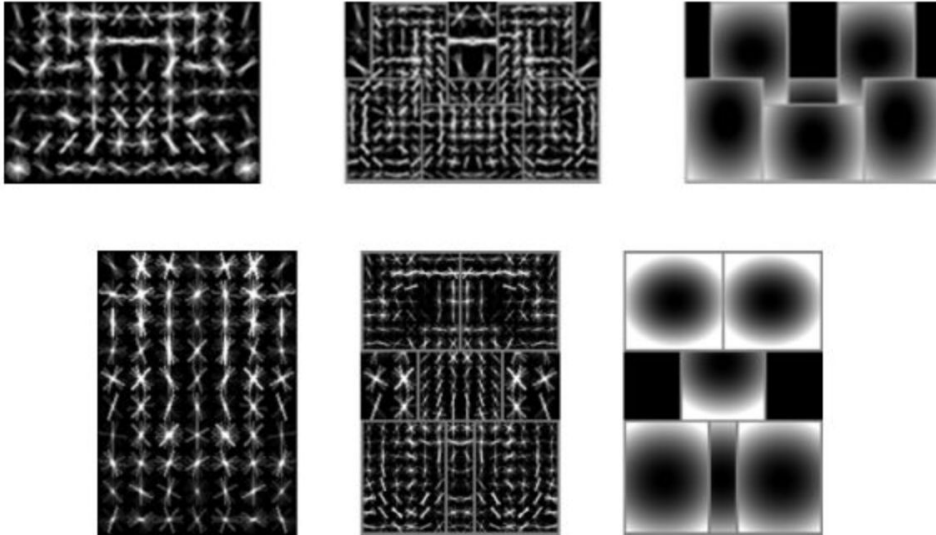


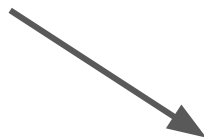
Image credit: P. Felzenszwalb et al.

Car Classification

Street View images



Product shot images



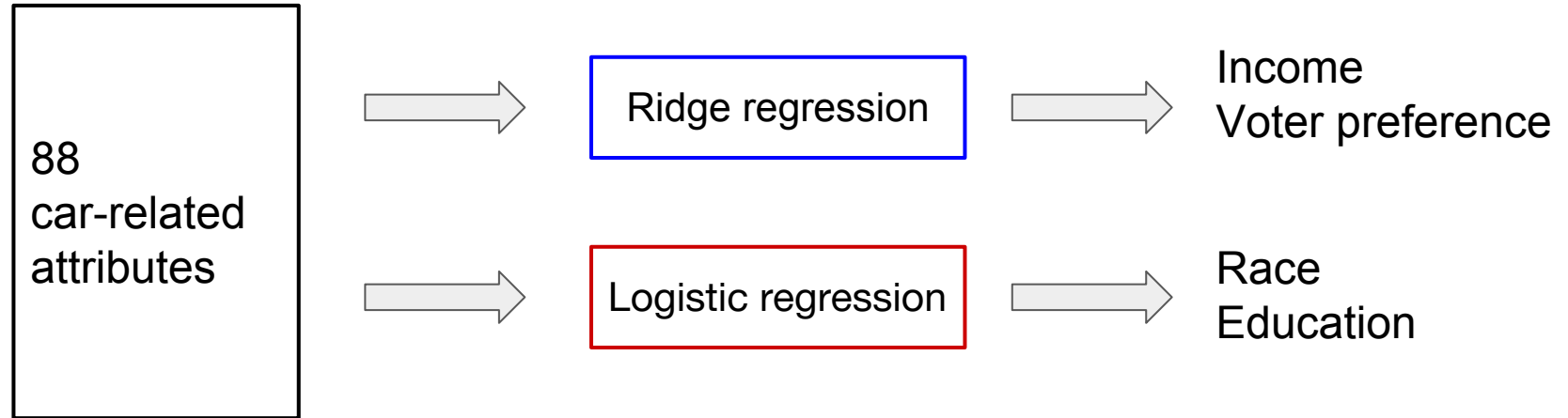
2657-way
classification

Car-Related Attributes

88 attributes:

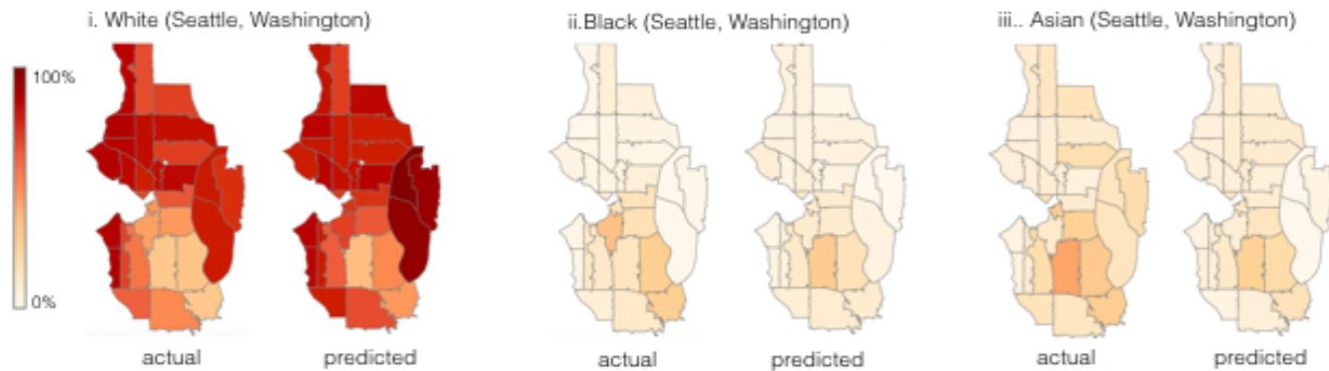
- The average number of detected cars per image
- Average car price
- Miles per gallon
- Percent of total cars that are hybrids
- Percent of total cars that are electric
- Percent of total cars that are from each of seven countries
- Percent of total cars that are foreign (not from the USA)
- Percent of total cars from each of 11 body types
- Percent of total cars whose year fall within each of five year ranges: 1990-1994, 1995-1999, 2000-2004, 2005-2009, and 2010-2014
- Percent of total cars whose make is each of 58 makes in our dataset

Demographic Estimation



Results

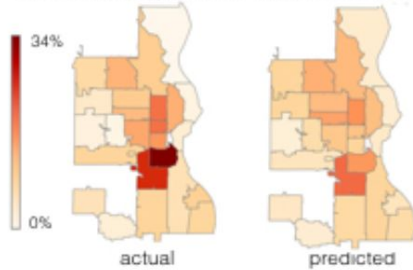
Race



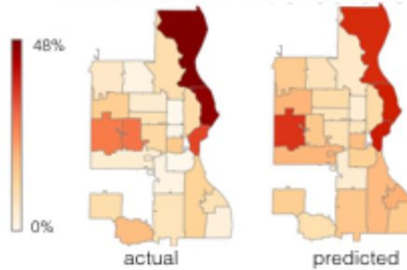
Results

Education

iv. Less than High school (Milwaukee, Wisconsin)

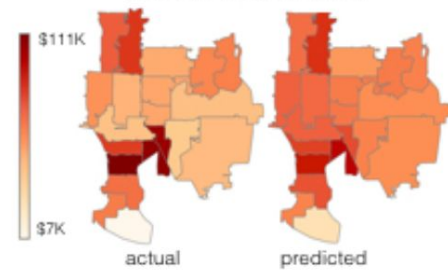


v. Graduate school (Milwaukee, Wisconsin)



Income

vi. Income (Tampa, Florida)



An interesting finding

“ If the number of **sedans** encountered during a 15-minute drive through a city is higher than the number of **pickup trucks**, the city is likely to vote for a **Democrat** during the next Presidential election; otherwise, it is likely to vote **Republican**. “



Strengths

Overall:

- Solve a practical problem
- Think outside of the box

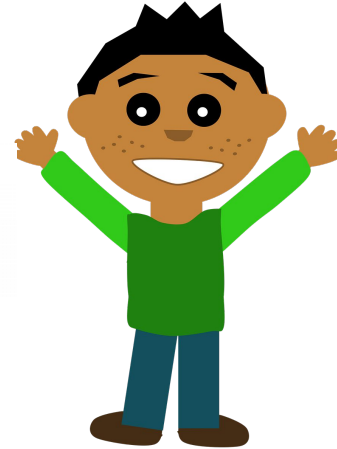
Technique:

- Almost real-time monitoring
- Fine spatial resolution



Weaknesses

- Hand-crafted car-related attributes
- Correlation between car ownership and demographics ?
- Generalizable to other demographic factors?
e.g. religion, birth rate, death rate, marriage age, marital status



Extension

- Other types of imagery
e.g. Drone View images, satellite images
- Predict traffic flow