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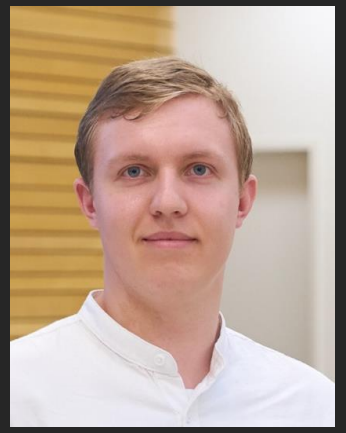
Team

Joe

Andi

Michi



Dani

Alex

Nika

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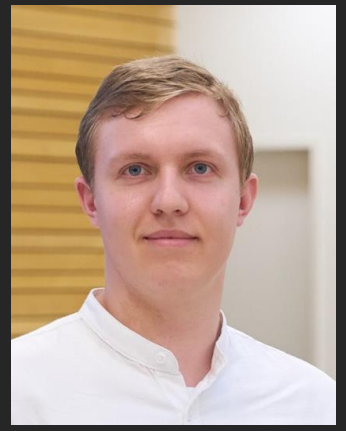
Project Structure

Lead,
Pitch

Pitch,
Concept

Front End



Full Stack

Modeling

Modeling

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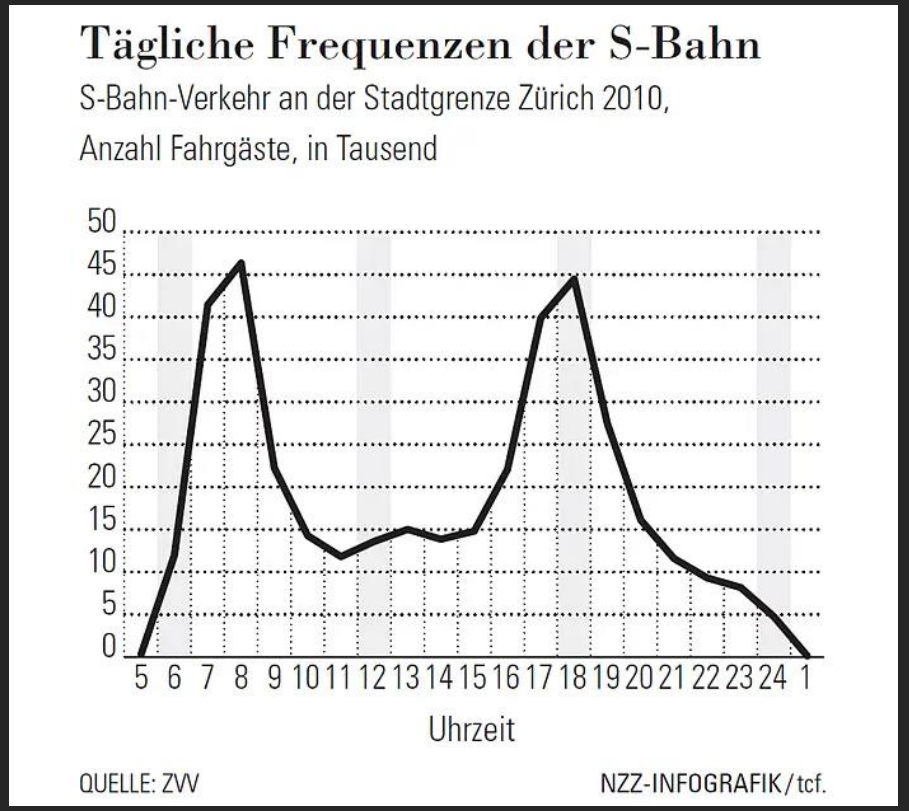
Problem Statement

Too Few Capacities During Rush Hour

Unused Public Transport Capacities During The Day



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Solution

Reward program based on occupancy data

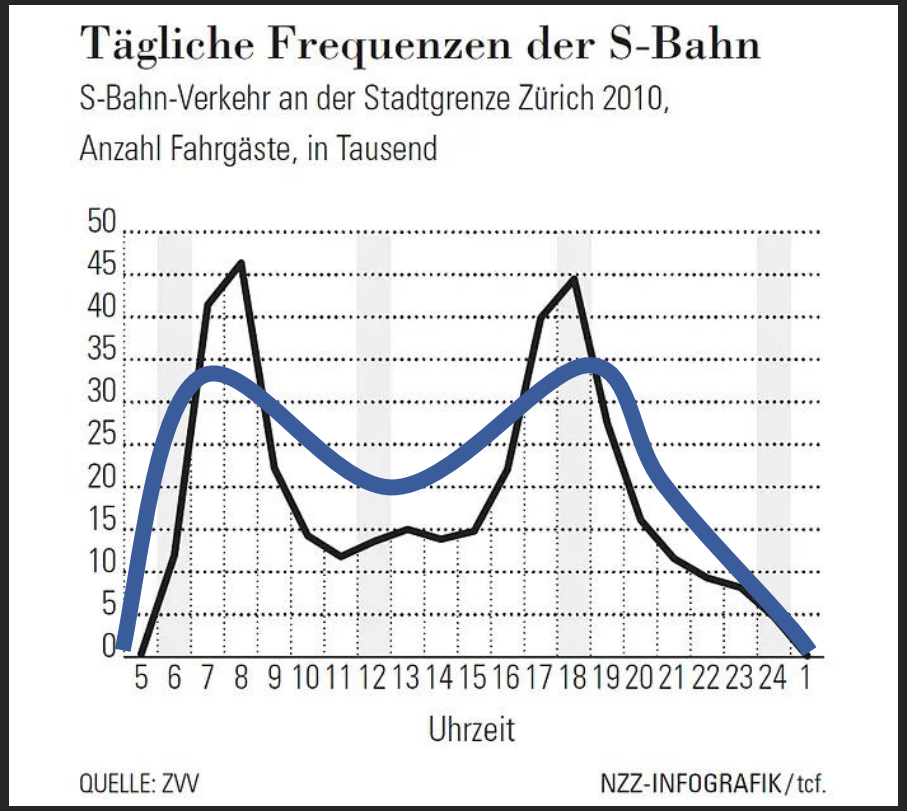
- Customers pays per ride
- Reward program: collect low occupancy kilometers to pay future rides
- Let the market solve the rush hour crisis

Provider

- Control of passenger flow
- More customers can be served

Passengers

- Free rides through reward program



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Passenger Counting

Data: l, l_{rssi}, l_s
$M \leftarrow \emptyset$ // List of on-bus devices
$C \leftarrow \emptyset$ // List of counters
$M_x \leftarrow \emptyset$ // List of MAC common in interval
$M_xj \leftarrow \emptyset$ // Set of MAC for sensor j in interval
$P(e) \leftarrow \emptyset$ // Probes with earliest timestamps
$P(l) \leftarrow \emptyset$ // Probes with latest timestamps
$x \leftarrow 0$
Result: M // MAC of devices defined as on bus
begin
  while *between bus stops* **do**
    $x++$ // counts intervals of s seconds
    $M_x \leftarrow \emptyset$
    /* Find probes common to q sensors */
    for $j \leftarrow 1$ **to** q **do**
      foreach $p_{xji} \in P_xj$ **do**
        if $p_{xji}^{rssi} > l_{rssi}$ **then**
          $M_{xj} \leftarrow M_{xj} \oplus \{p_{xji}^{MAC}\}$
          $y(e) \leftarrow findProbeWithMatchingMac(P(e))$
          $y(l) \leftarrow findProbeWithMatchingMac(P(l))$
          if $p_{xji}^{t} < y^t(e)$ **then**
            $y(e) \leftarrow p_{xji}$
          if $p_{xji}^{t} > y^t(l)$ **then**
            $y(l) \leftarrow p_{xji}$
      $M_x \leftarrow M_x \cap M_{xj}$
    /* All probes of interval list */
    foreach $m_{xi} \in M_x$ **do**
      /* Go through result list M */
      for $k \leftarrow 1$ **to** n **do**
        /* Check if MAC in result */
        if $m_{xi} = m_k$ **then**
          c_k++ // increment counter
        else
          $M \leftarrow M + \{m_{xi}\}$
          $C \leftarrow C + \{1\}$ // add new counter
  /* Go through result list M */
  for $k \leftarrow 1$ **to** n **do**
    if $c_k < l$ // check occurrences **then**
      $M \leftarrow M \setminus \{m_k\}$ $C \leftarrow C \setminus \{c_k\}$
    $y(e) \leftarrow findProbeWithMatchingMac(P(e))$
    $y(l) \leftarrow findProbeWithMatchingMac(P(l))$
    if $(y^t(l) - y^t(e)) < l_s$ // check time difference **then**
      $M \leftarrow M \setminus \{m_k\}$

Prediction Algorithm

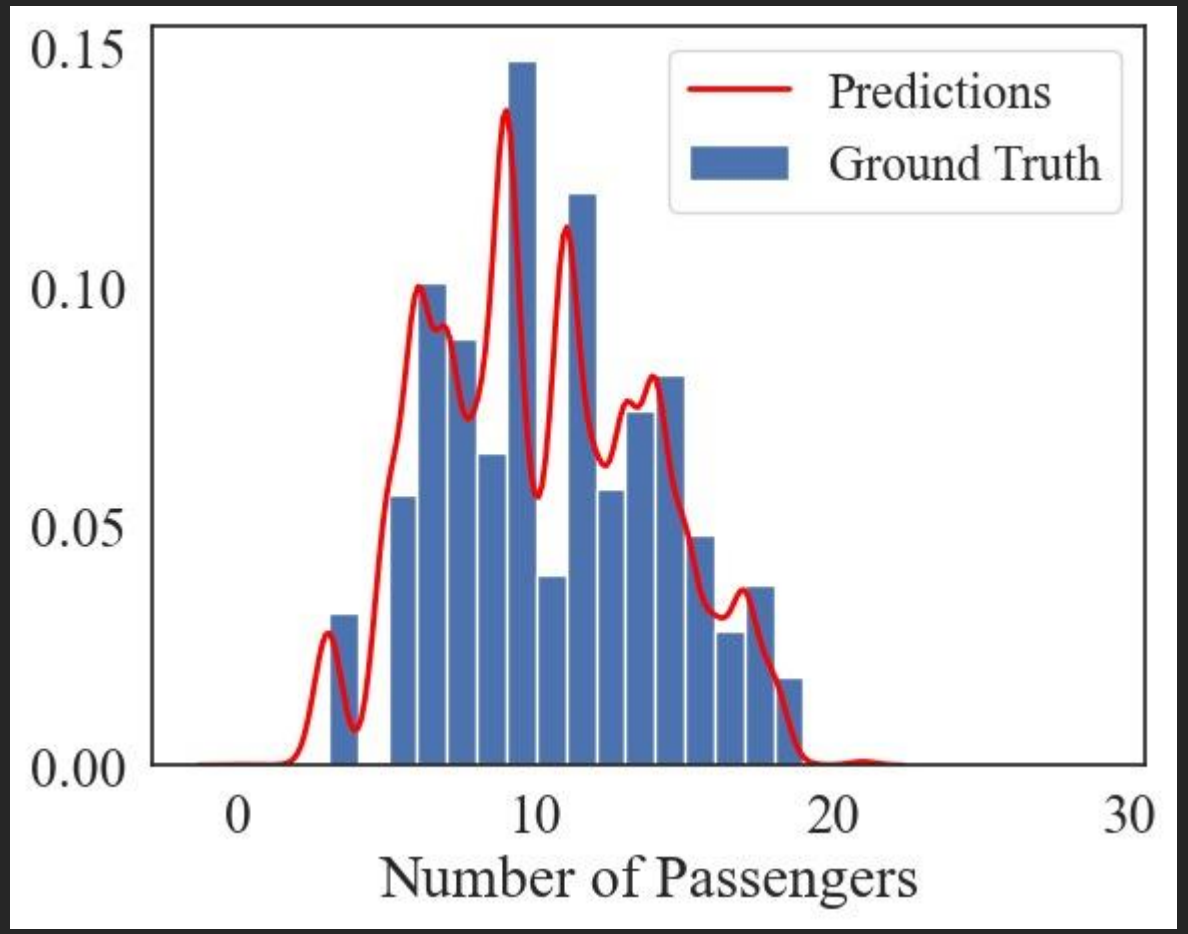
$$\min_{\mathbf{w},b,\xi,\xi^*} \quad \frac{1}{2}\|\mathbf{w}\|_2^2 + C\sum_{i=1}^{m}(\xi_i + \xi_i^*)$$

$$\text{subject to} \quad \mathbf{w}^T\phi(\mathbf{x}_i) + b - y_i \le \epsilon + \xi_i$$
$$y_i - \mathbf{w}^T\phi(\mathbf{x}_i) - b \le \epsilon + \xi_i^*$$
$$\xi_i, \xi_i^* \ge 0, i = 1, \cdots, m$$

$$L(D) = \frac{1}{|D|}\sum_{(x,y)\in D}(y - \bar{y}_D)^2$$

$$\text{where } \bar{y}_D = \frac{1}{|D|}\sum_{(x,y)\in D} y$$

Mehmood, Ubaid, et al. "Occupancy estimation using WiFi: A case study for counting passengers on busses." *2019 IEEE 5th World Forum on Internet of Things (WF-IoT)*. IEEE, 2019.



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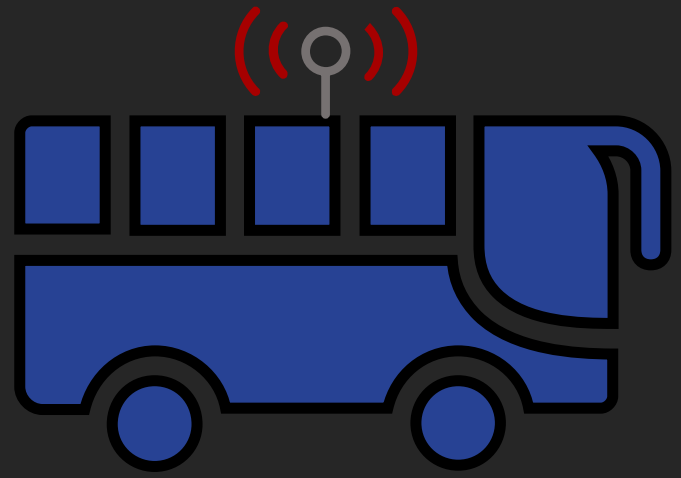
Passenger Counting



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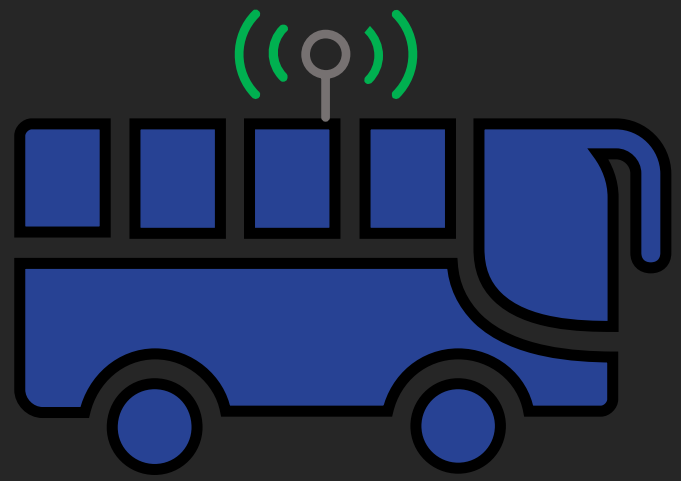
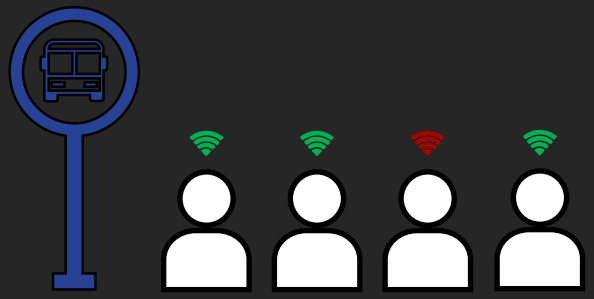
Passenger Counting

+3





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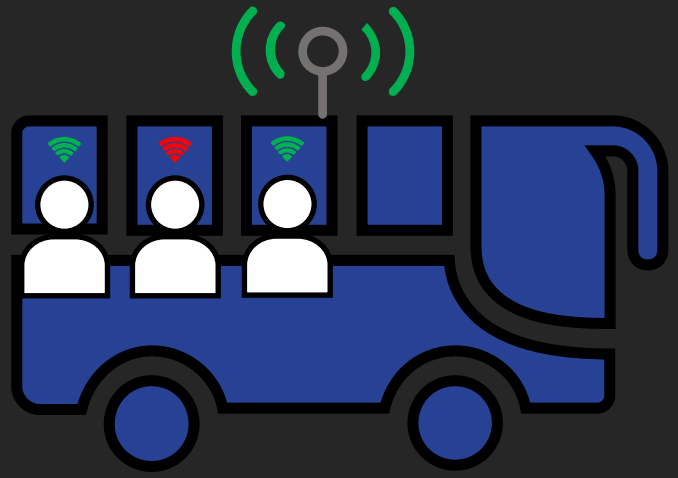
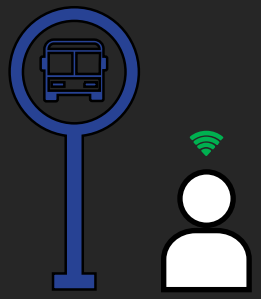
Passenger Counting





Passenger Counting

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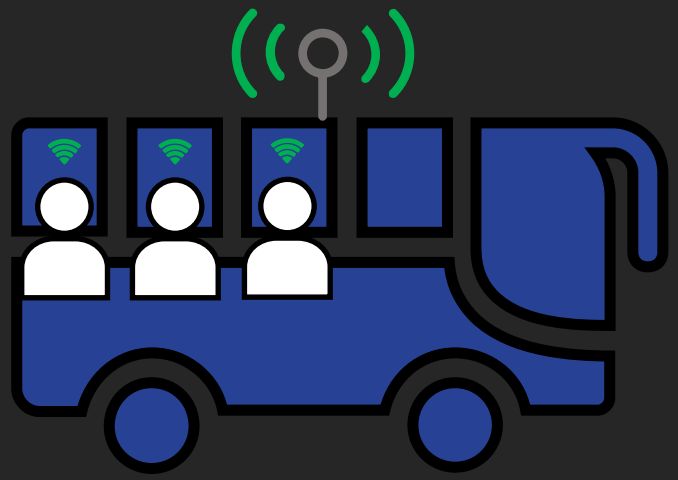
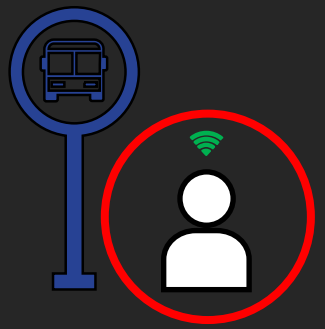
-1





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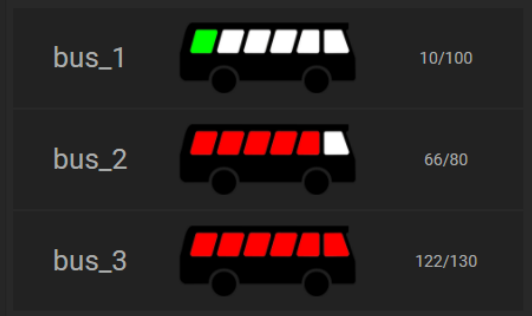
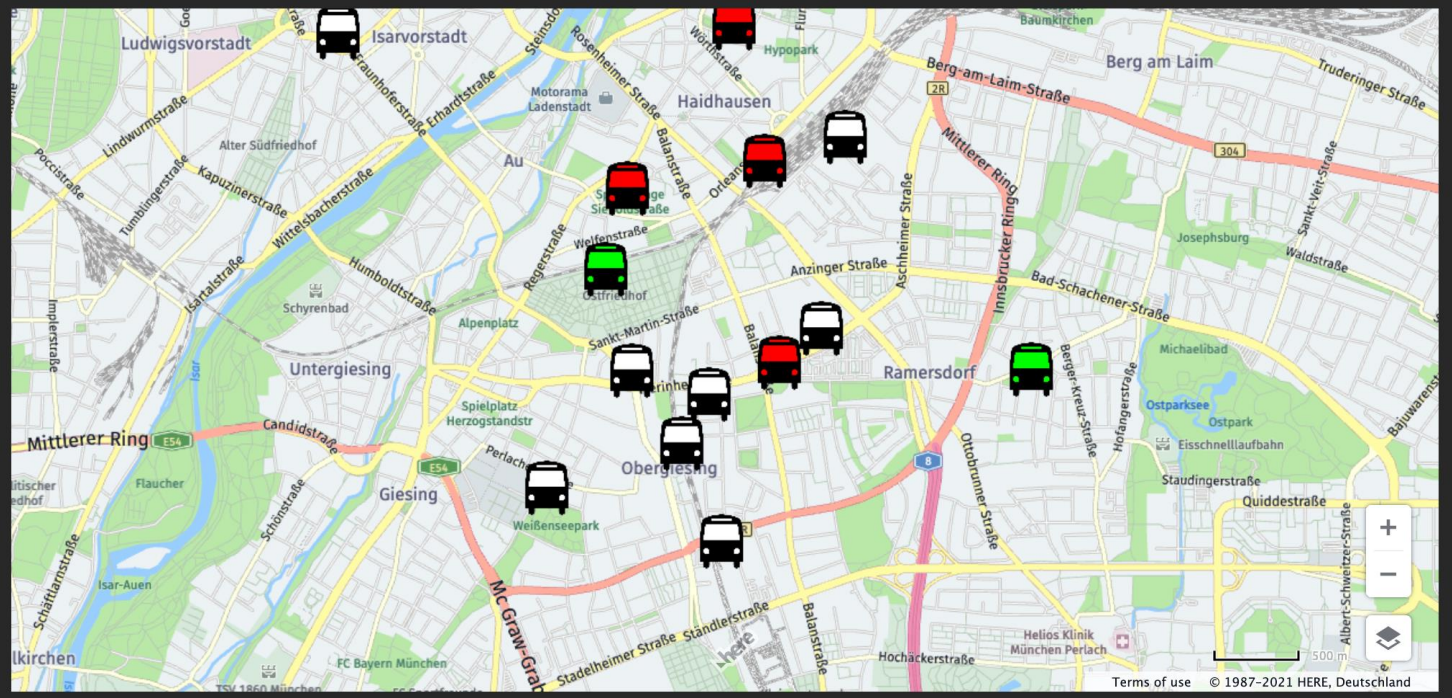
Provider perspective





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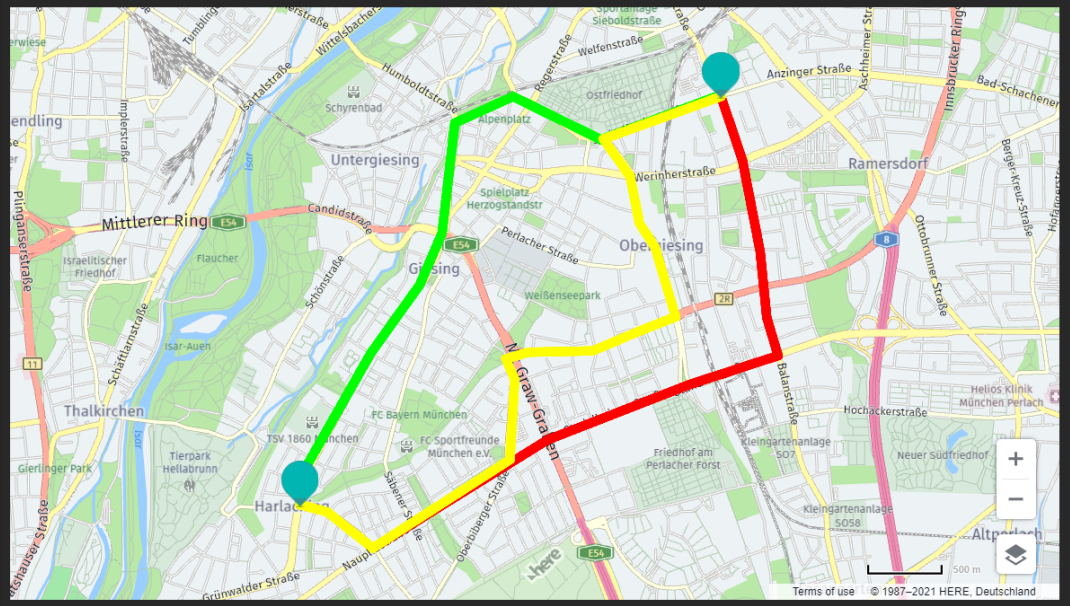
Reward Model

- Pay per Distance
  - Fixed Fair: 1.00€
  - 0.30€ per driven km
  - Payment option: Use bonus km

Less occupancy → more bonus kilometers



Search Journey

Harlaching

St.-Martin-Straße

07:30

Fastest

Search

Results

7:30 7:55	53		Bonus: +0km
7:40 8:00	20		Bonus: +1.67km
8:00 8:30	56		Bonus: +4.67km

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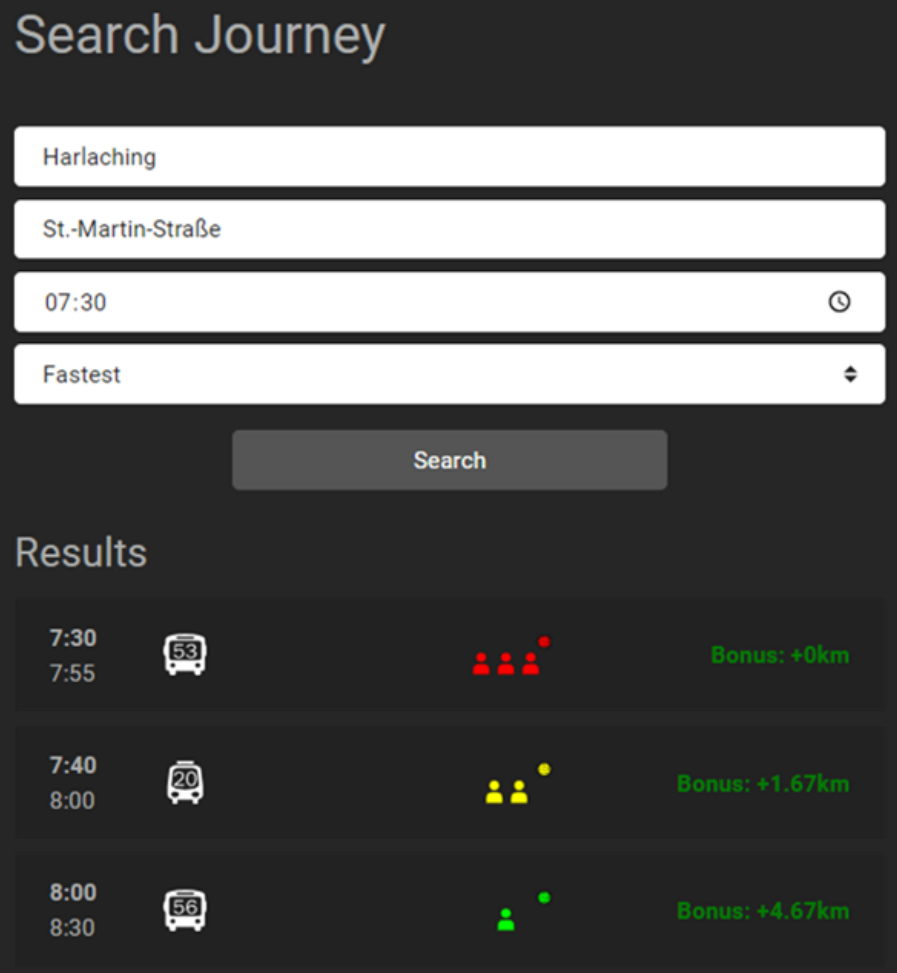
User perspective: Professor

- Focus:
  - Punctuality
  - Efficiency
  - Shortest commute



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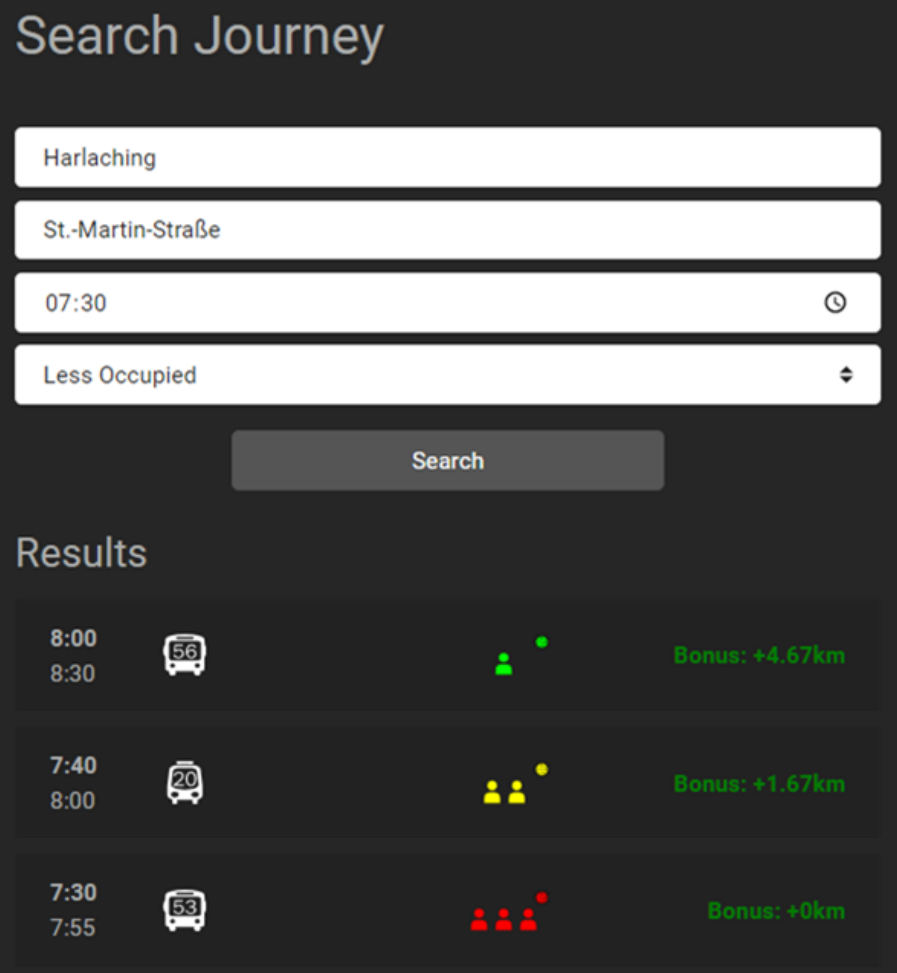
User perspective: Student

- Focus:
  - Maximizing reward

- Acceptable drawback:
  - Later arrival
  - Longer travel time



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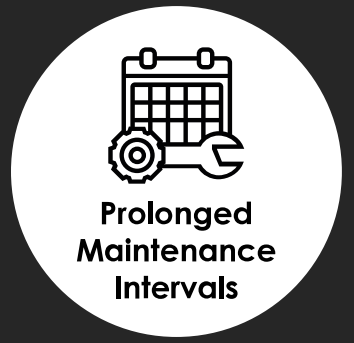

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One More Thing...

PIXIDA

SCIENCE HACK