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EMERGING DISRUPTIVE TECHNOLOGIES:
Balancing Innovation, Risks, and Societal Impact

Tackling the climate crisis by optimizing public transit with an app-based solution

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Climate crisis

In order to address the existential risk posed by the man-made climate crisis we are now facing, we need to drastically reduce our greenhouse gas emissions. Hereby **transportation** plays a significant role as it **accounts for 25% of all greenhouse gas emissions**.

While all other sectors are clearly showing a downwards trend in greenhouse gas emission, the transportation is the only sector whose emissions are still growing. Therefore, the **transportation sector needs special attention**.

Hereby the **choice of transportation mode plays a crucial role**. Private car use and air travel are the most emissions intensive modes and should be replaced by more collective and ground-based transportation modes.

Modal shift

One solution is the **modal shift** from private car to public bus.

However, such a shift might bear many challenges:

- Where is the **nearest** bus stop?
- When does the **next** bus run?
- Which **line** should I use?
- How close can I get to my **destination**?
- How **long** will it take me to get there?
- What kind of **ticket** do I need?
- How can I **purchase** a ticket?
- How do I get **back**? When is the **last bus** running?

Like the user also the bus provider faces many challenges:

- How should we **route** buses so that we reach the most users
- How should the **lines** be designed so that they provide optimal connectivity?
- How **often** should we run a bus on each line?
- What is the optimal between **frequency** and number of users?
- What **size** of bus should be employed?
- How much should we **charge** per trip?
- How much is the user **willing to pay** for the service?
- What **payment** options should we offer to the user?

What we often end up with is a bus system that…

- Fails to provide the service the user expects in terms of:
  - **Routing**: The bus does not necessarily go where the user needs to be
  - **Timetable**: The bus does not always run when the user needs it
  - **Price**: Single tickets are often deemed to be too expensive
  - **Payment**: Requires sometimes to download an app, payment by cash or the purchase of a fare card

- Fails the service provider in terms of:
  - **Profitability**: Overcapacity vs empty busses
  - **Risk**: Long term investments into vehicle fleet and new technologies

Our vision

- Creating a bus transit system that is more **on-demand** and **user oriented**
  - The bus operates **where** and **when** the user needs it

- Design an **app** that acts as the interface between the user and the service provider
  - The **need** for transportation is expressed through the app
  - The service will be **created** on demand
  - Route **planning** and **ticketing** happens through the app

- Use **gamification**
  - The user pays according to his/her **individual needs**: The closer the service comes to the individual needs the more the ride is going to cost

Dynamic timetables and routes

- We want to break off the **existing timetable structure** and instead make the timetable more **dynamic**, the bus runs **when the users need it** to run

- We want to break off the **existing route network** and instead make the routing more **dynamic**, the bus runs **where the users need** it to run

- Through the **app** the user indicates where he/she needs to go and when. Based on a bundle of users needs the dynamic timetable and route is generated
- The user gets a **bus service** that is more based on his/her needs and most likely gets the user faster to the destination than based on the current fixed system
- This bus system **differs** from individual mobility (private car or taxi) as it still carries many passengers in one vehicle (bus or mini-bus)

Ticketing and payment

- We want to break off the **existing fare structure** and instead make the fares more **dynamic**, the user **pays for the service level he/she needs**

- **Gamification**: The user pays by **quality of service**. The more the bus runs when and where the user needs it, the more the service is going to costs and vice versa.
- **Different demographics** have different needs:
  - A **businessman** needs a bus from his doorstep to the airport terminal at a certain time. He will pay the **highest fare** as the service is mainly built around his needs
  - A **retiree** who has a rather flexible schedule will join the same bus, however, neither the timetable nor the route might be optimal for him, but he **pays significantly less**

- Payment and ticketing happens through the **app**

Fleet optimization

- We want to help the service providers to better utilize their fleet in terms of:
  - utilizing the **right size** bus for the **right service**
  - increase **load factors**
  - traveling the **shortest route**
  - ensuring the **maximum profit**

- Understanding better the demand might also help to make **smarter investment decisions** for future fleet purchases

Opportunities

- After a successful **test phase** with one route or one transit system, the concept could be implemented on a **larger scale**, leading to a **reduced need** for individual car ownership
- More use of collective transportation helps **reduce greenhouse gas emissions**, local air pollution, traffic congestion and noise
- Optimized routing and vehicle utilization can help **increase profits** of service providers

Challenges

- Creating such an app can be **technologically challenging** especially as it requires to create timetables and routes in real time
- Finding a **partner** (bus company or city) to test this concept might be very challenging
- Shifting from a fixed route and fare-based system to a more dynamic one can lead to **resistance** among existing users

Our expertise

Dr. Stefan Baumeister

Climate and transportation scientist with special expertise on climate impact and carbon footprint calculations, modal shift and green consumer behaviour as well as policy making

Prof. Adrian Florea

Active researcher with expertise in prediction and optimisation applied to various engineering domains (microprocessor systems, suspension design and reliability, building energy efficiency), embedded systems, and IoT with applications in smart cities (environmental monitoring, smart parking, urban mobility, smart traffic, smart agriculture).

Claudia Banciu

Doctoral student in Computer Science with a focus on research and AIoT solutions development for the optimization of the decision-making process in real-world applications, such as air quality monitoring and efficient waste management. Claudia also works as a software developer, having projects in smart lighting!

Thank you for your attention

Questions? Comments?

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