

Application Prototyping

‘Bruges Toddler Transport’: The self-driving children
bus service

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1 Project Description

1.1 What is the service about?

The concept of a self-driving children bus is about using autonomous driving technology to transport toddlers and pre-schoolers from their homes or designated pick-up points to their schools, and vice versa.

1.2 How does the service work?

The self-driving children bus' concept works by using autonomous driving technology to transport toddlers and pre-schoolers from their homes or designated pick-up points to their schools, and vice versa.

The system starts with parents or guardians scheduling a pick-up time and location through a mobile app or a website. Once the pick-up time arrives, the self-driving bus arrives at the designated location, and the child is picked up by a designated supervisor. The supervisor is responsible for ensuring that the child is safely seated and secured before the bus departs.

The bus is equipped with a variety of sensors, cameras and lidars that allow it to navigate through the city streets safely. These sensors detect obstacles, pedestrians, and other vehicles on the road, and the bus adjusts its speed and direction accordingly. The bus also has a robust braking system that enables it to come to a stop quickly in case of an emergency.

To ensure the safety of the children, the bus is monitored remotely by a team of human operators who can take over control of the vehicle in case of any malfunction or emergency. The bus also has a GPS system that enables parents to track their child's journey in real-time and receive notifications when the child reaches their destination.

The self-driving bus is designed to be comfortable and child-friendly, with soft seats, colorful interiors, and an entertainment system to keep the children engaged during the ride.

In terms of scalability, the system is designed to be flexible and adaptable to accommodate the changing needs of the city. As the demand for the service grows, additional buses can be added to the fleet to cover more areas.

1.3 Why do we need this service?

The concept of a self-driving children bus provides lots of benefits that make it a great solution for busy cities like Bruges. Firstly, it reduces the stress on parents during the morning hours by providing a reliable and safe transportation method for their toddlers and preschoolers. This can significantly reduce traffic congestion as parents do no longer need to drive their children to school themselves, making the roads safer and less congested.

Secondly, the concept contributes to the city's efforts to reduce emissions and promote sustain-

ability by relying on electric batteries to power the buses. This aligns with the growing trend towards eco-friendliness, making the city more appealing to residents and tourists alike.

Additionally, the concept promotes technological progress and innovative designs which can enhance the cities reputation and attractiveness towards finding new talent and business opportunities. The city of Bruges can be the leading example of deploying cutting edge solutions to societal problems.

1.4 Who are the stakeholders depending on this service?

The stakeholders of this concept are: the city of Bruges, the parents and the children driving the bus. Parents want to be guaranteed that their children are safe and that they will arrive at their destination on time and in a safely manner. The city of Bruges wants to be known as a city that is innovative and that is willing to invest in new technologies. Ultimately, the children are the most important stakeholders as they are the ones that will be using the bus. They want to be entertained and have a fun time while driving to school.

2 User stories

Below are some user stories applicable to the bus driving service accompanied by solutions of possible concerns.

"As a teacher/school secretary I want a system that tells me who is going to be absent during the day."

Example: *Linda is a kindergarten teacher at an elementary school in Bruges. For administrative purposes, she needs to manually validate the presence of all her pupils in her class by ticking of a paper list each morning. She thinks this repetitive procedure wastes a lot of valuable learning and playtime for the toddlers.*

Solution: Each child riding the bus will be wearing a digital bracelet that contains a chip of their identity. When they enter the bus in the morning, the device will connect to a receiver in the bus (Bluetooth or WiFi) that will notify the school that the child will be present today.

"As a parent I want a safe and stress-free way of getting my children to school."

Example: *Hank is a busy man working full time as a police agent. He has seen many cases involving drunk drivers that seriously injured themselves or others. Because of this, he doesn't want his kids driving on human operated school buses and would rather drive them to school by himself. When he heard about the use of Artificial Intelligence in Bruges' new school buses, he got really excited as he is a strong believer in road safety.*

Solution: By using the latest technology of self-driving buses, parents can have peace of mind knowing that their children are in a safe and reliable mode of transportation. Allowing them to focus on their work and other responsibilities.

"As a divorced parent I want my child to be able to be dropped off with at my or my partner's house at customisable periods."

Example: *Being a divorced mother, Sarah juggles a lot of additional responsibilities and commitments every day. She recognizes the importance of sharing custody of her child with her ex-partner and acknowledges that having a dependable and flexible transportation option is essential in managing these responsibilities effectively and ensuring the best possible care for her child.*

Solution: Parents are able to register different pick-up and drop-off points for each day of the week ahead of time by using a mobile app.

Rules:

- Parents access a shared calendar where they can register the pick-up and drop-off points for each day of the week.

- Parents need to be flexible and willing to compromise with their ex-partner when registering the pick-up and drop-off points, ensuring that the child's transportation needs are met.

"As a parent, I have children that need special treatment or have a certain condition that needs to be monitored at all times."

Example: *Karen is a parent with two children, Emily and Jake. Emily has a severe peanut allergy that requires her to carry an 'EpiPen' at all times, while Jake has cerebral palsy and uses a wheelchair for mobility. Currently, I spend several hours each day driving them to and from school, physical therapy, and other appointments.*

Solution: Parents can register information about their child's medical condition, special needs and extra required accommodations while booking.

If necessary, a trained caretaker can be assigned to assist the child and provide the necessary care and support during the trip to and from school. Emily's allergy information will be stored in the "Bruges Toddler Transport" database, so the caretaker can give him the right care.

All buses are also fully wheelchair accessible, with electric lifts and provide medical equipment on board for health staff to use in case of an emergency like allergic reactions.

"As a child safety inspector, I want to be certain of the bus's safety while driving on the public road."

Example: *Emily is a child safety inspector at 'Kind en gezin'. She is motivated in her work by her deep concern for the safety of children, as they are the most vulnerable, innocent and fragile in our society. She wants to be ensured that the self-driving children's bus is held to the highest safety standards.*

Solution: The self-driving buses will have a low maximum speed of 50 km/h or lower in bad weather conditions. In order to avoid hitting obstacles and other vehicles on the road, the buses will be equipped with a variety of sensors, cameras and radars. Each seat will be equipped with modern safety belts and deployable airbags. Buses in service will be fully monitored in a SOC, operated by engineers and safety professionals.

As a last resort, all buses are equipped with emergency buttons and can be remotely taken over or stopped by a qualified bus operator.

"As the city council members of Bruges we want less traffic during rush hours."

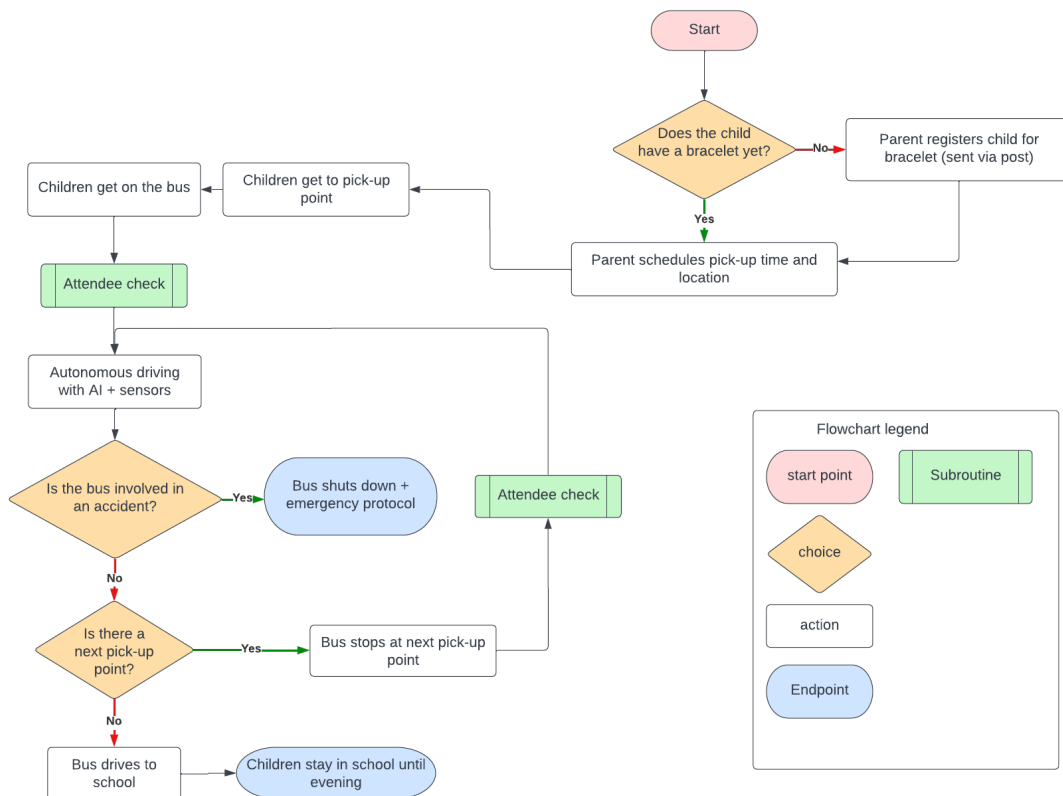
Example: *As any big city like Bruges, it is known for its daily traffic jams consisting of people commuting from and to work.*

Solution: By promoting this mode of public transport, less cars will be on the road which will make morning and evening commuting hours more bearable.

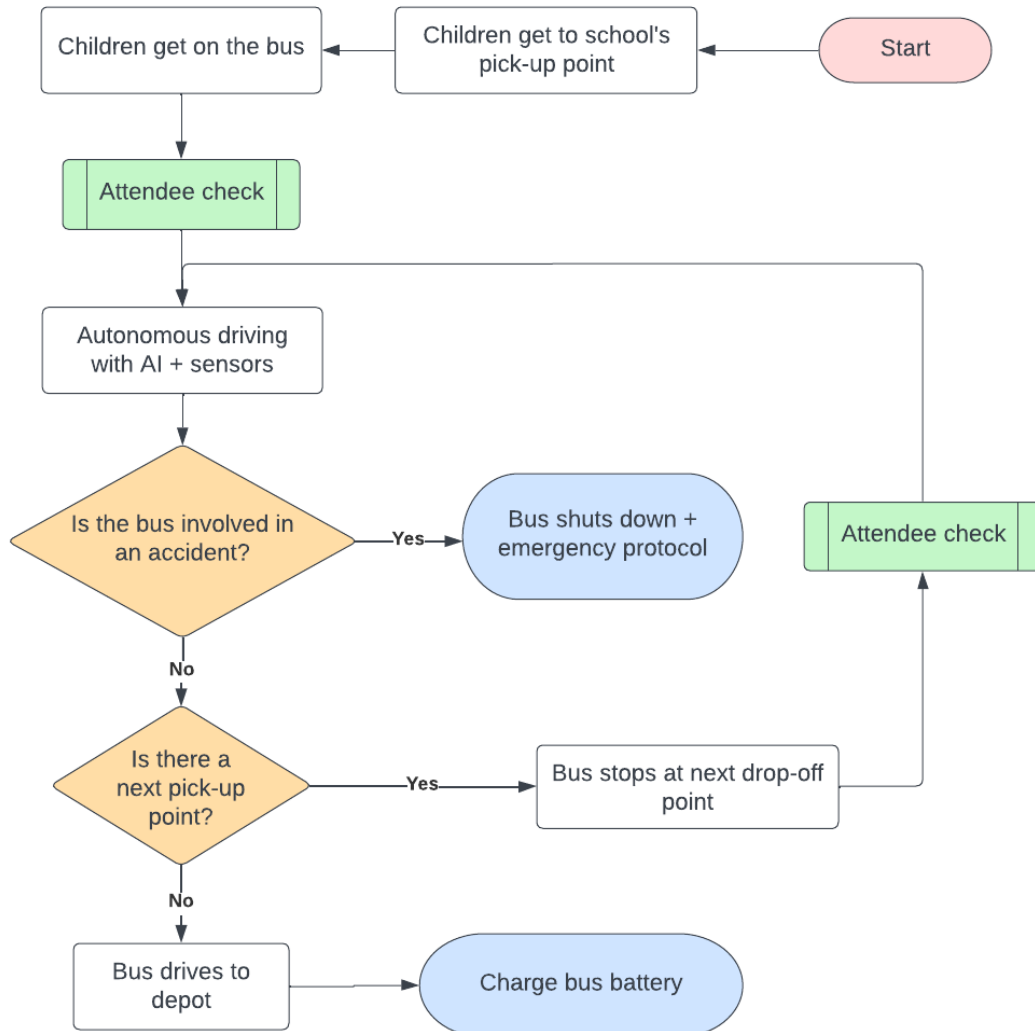
3 Flow charts

Below are flowcharts describing how the main bus driving system will work.

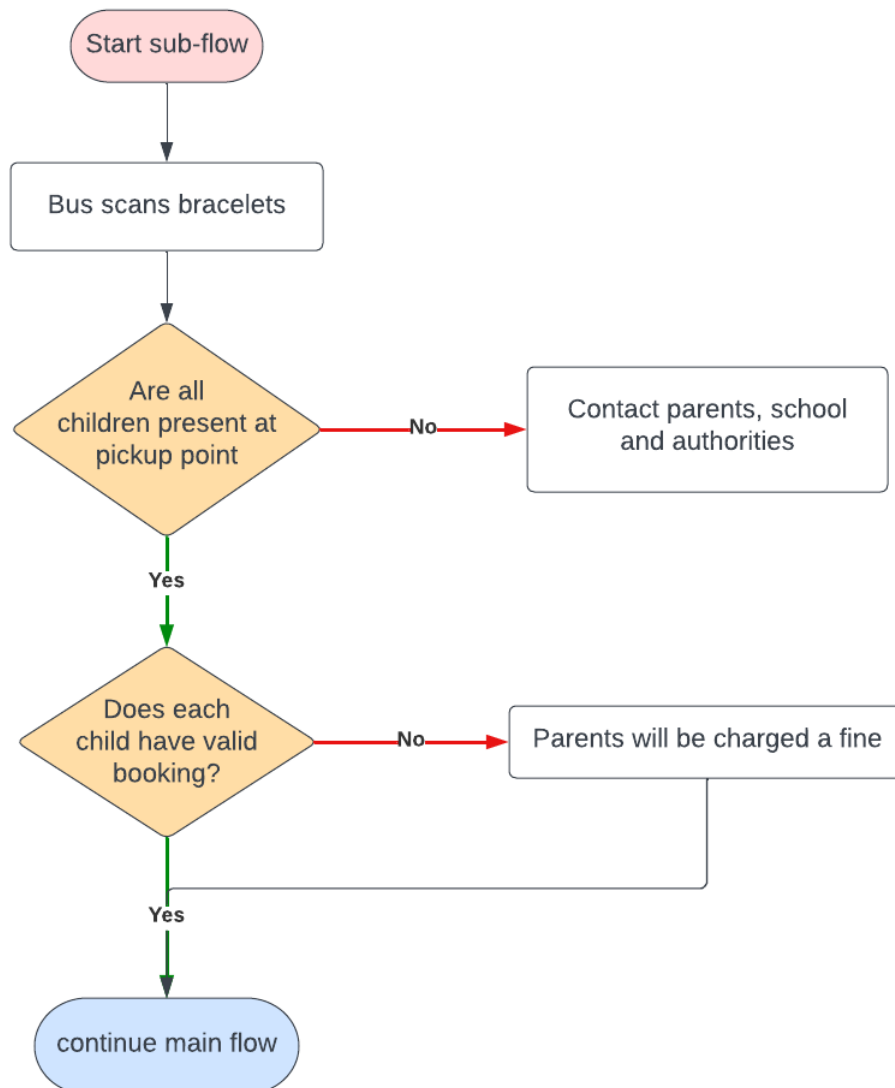
3.1 Bus drives to school (morning)



3.2 Bus drives from school (evening)

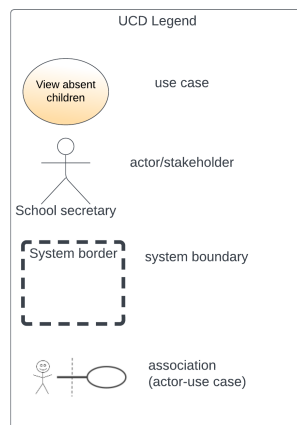
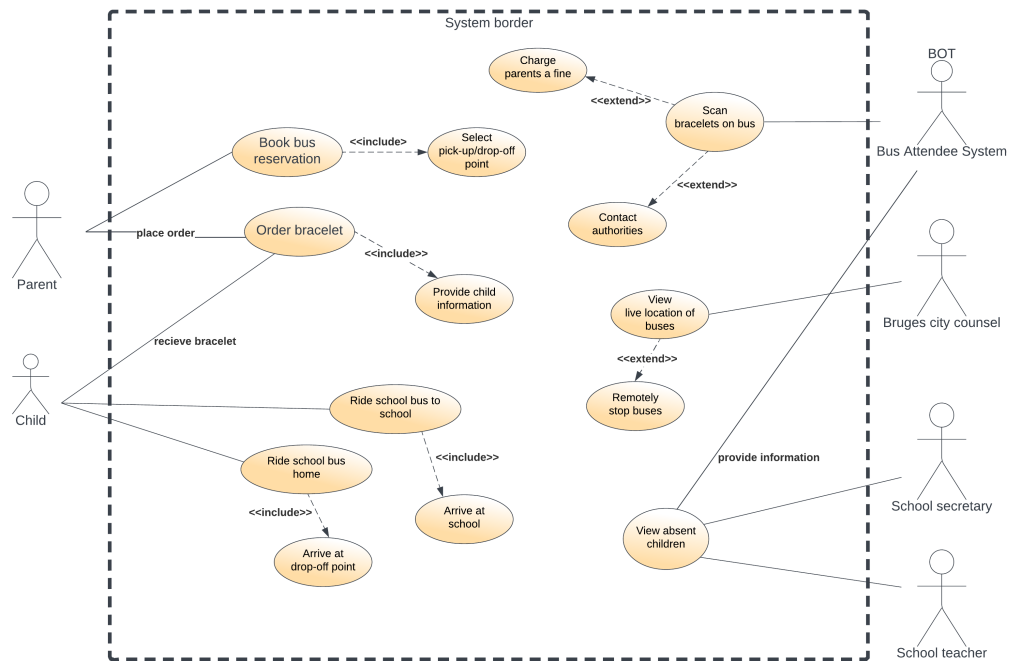


3.3 Attendee check (subroutine)



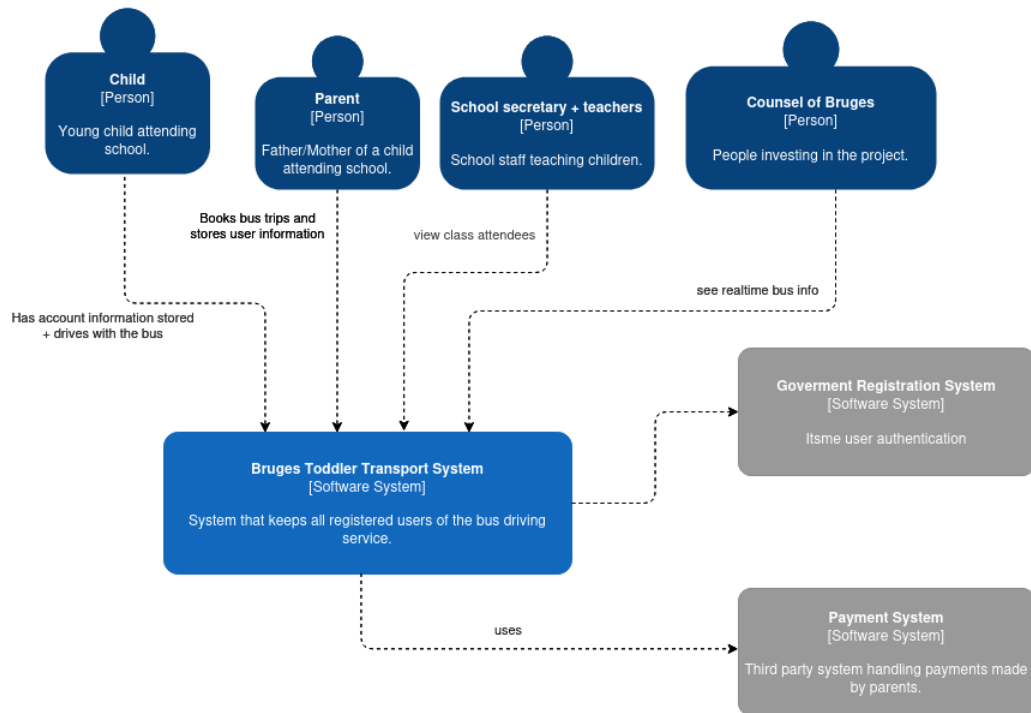
4 Use Case Diagram

In order to map out the requirements of “Bruges Toddler Transport”, the following case diagram below was created.

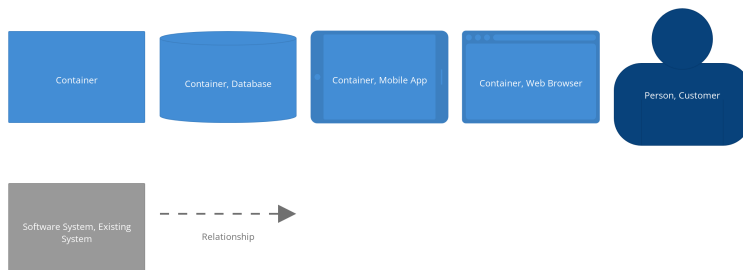


5 C4 Diagram

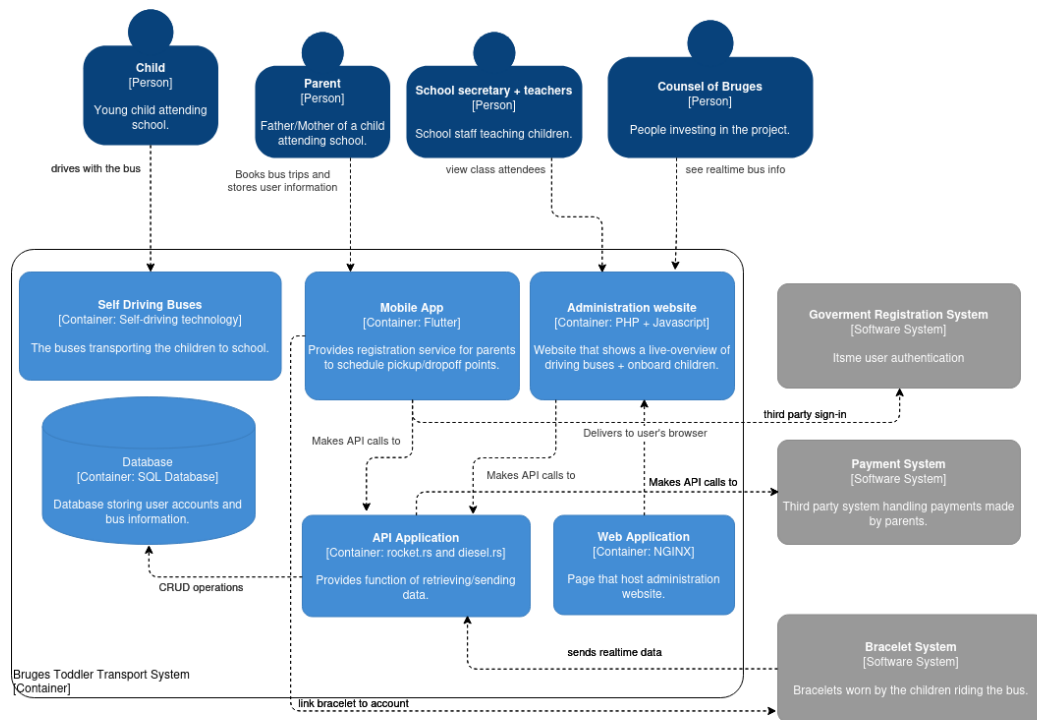
5.1 Layer 1: System Context



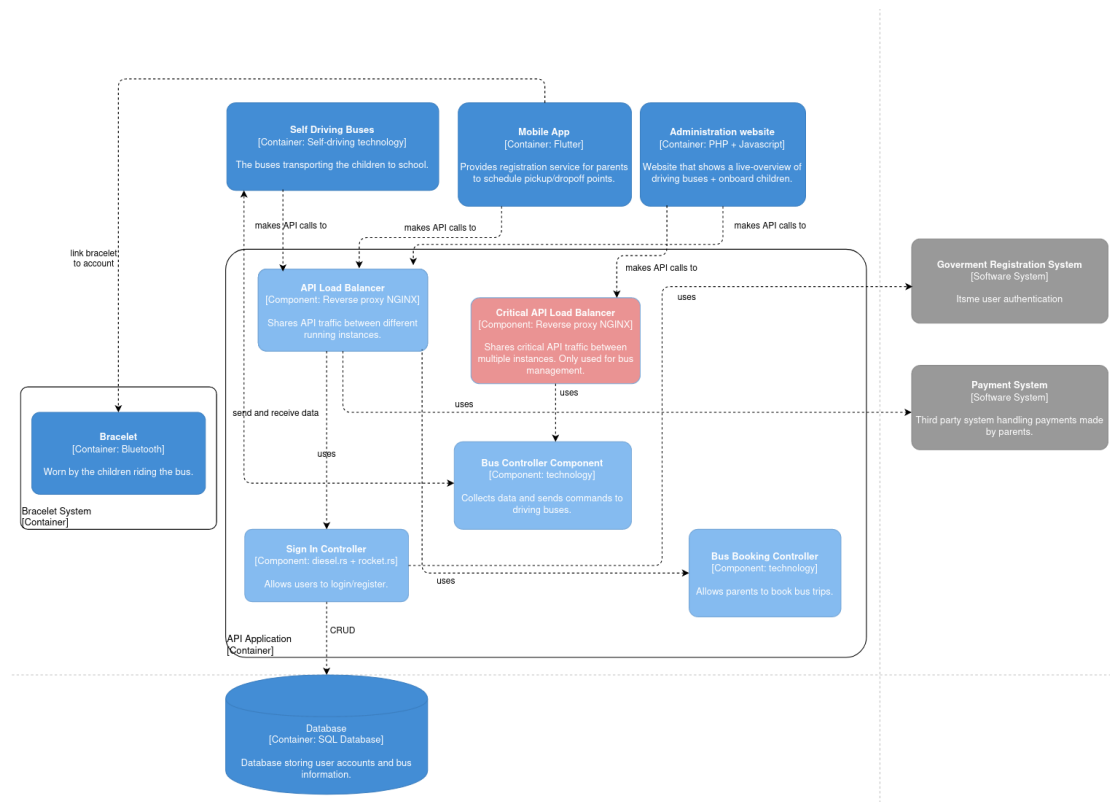
Legend C4 diagram



5.2 Layer 2: Container Diagram



5.3 Layer 3: Component Diagram



The creation of a "Layer 4: Code diagram" was out of scope for this assignment.

6 Ethical Problems

6.1 Should we allow young children to ride on self-driving AI buses?

6.1.1 Virtue

[Yes, because]

There are several potential virtues that can be achieved by using a system like “Bruges Toddler Transport”:

Our self-driving buses are designed with security and safety in mind. Potential hazards can be more quickly detected by a computer than by human drivers.

The buses can be programmed to use the most optimal route, considering factors like traffic and road blocks. The children will get to their destination faster and more efficiently.

The self-driving buses are fully electric and are more ecologically sustainable by preventing the emission of green house gasses.

6.1.2 Utilitarian

[Yes-no, because]

People will lose their jobs if buses get automated by AI systems. However, there will also be a gain in new job opportunities, for example engineers and monitoring personnel.

Self-driving buses can be overall more efficient than human-driven buses by calculating the most optimized routes beforehand. This means there will be less fuel usage or in this case electricity usage.

Self-driving buses have the potential to be more safe by removing the need for a human driver. The risks of accidents caused by human error can be removed drastically.

6.1.3 Common good

[Yes, because]

As stated before, self-driving buses have the opportunity to be more efficient, ecologically sustainable and safer overall.

Because of these benefits, the buses will provide huge benefits to society overall.

6.1.4 Rights

[Yes, because]

Passengers of the self-driving bus should expect a safe and reliable transportation experience and that the vehicles are operated in a responsible manner. The correct measures need to be taken in case of accidents.

6.1.5 Fairness or Justice

[Yes-No, because]

The privacy implications of using Bluetooth- and WiFi- enabled devices (bracelets in this case) worn by children cannot be ignored. Parents and guardians should be informed about the use of these devices. It is also important to ensure that any data collected by the bracelets is kept secure and not shared with unknown third parties.

Ultimately, they are a necessary tool in ensuring the safety and security of the children, but they must be implemented in a transparent and responsible manner.

6.1.6 Conclusion

In conclusion, allowing young children to ride on "Bruges Toddler Transport" self-driving AI buses offers numerous benefits in terms of safety, efficiency, and sustainability.

With the implementation of this technology, privacy must be considered with the certainty of transparency and responsibility. While there may be potential job loss for human drivers, there are also new job opportunities to consider.

Ultimately, it's the parent's decision to allow their children to ride the self-driving buses.

6.2 Should we allow the collection of medical information from children driving Bruges Toddler Transport self-driving buses?

6.2.1 Virtue

[Yes, because]

collecting medical information from children driving Bruges Toddler Transport self-driving buses can be justified based on the following virtues:

- Justice: Ensures safety for all passengers.
- Beneficence: Promotes well-being and inclusivity.

- Non-maleficence: Prevents potential harm.
- Autonomy: Respects informed decision-making.
- Privacy: Safeguards privacy rights with appropriate measures.

6.2.2 Utilitarian

[Yes, because]

collecting medical information from children driving Bruges Toddler Transport self-driving buses offers utilitarian benefits such as enhanced safety, efficient resource allocation, improved accessibility, cost reduction, and community well-being.

6.2.3 Common good

[Yes, because]

collecting medical information from children driving Bruges Toddler Transport self-driving buses can be considered beneficial for the common good. By ensuring the safety and well-being of the children and other passengers, promoting inclusivity (allowing everyone with different capabilities to ride the bus), optimizing resource allocation, and reducing costs, it contributes to the overall welfare and betterment to the people of Bruges.

6.2.4 Rights

[Yes-No, because]

collecting data, including medical information, should be done in a manner that respects everyone's rights and privacy. It is important to adhere to legal and ethical guidelines, like GDPR, regarding data collection, particularly when it involves minors. Safeguards and data protective measures should be implemented to protect the confidentiality and security of user data.

Parents or legal guardians should be fully informed about the purpose and extent of any data collected, used, and which parties have access to it.

It is essential to prioritize the protection of children's rights while still ensuring that necessary information is gathered to provide a safe and functional working of the 'Bruges Toddler Transport' service and system.

6.2.5 Fairness or Justice

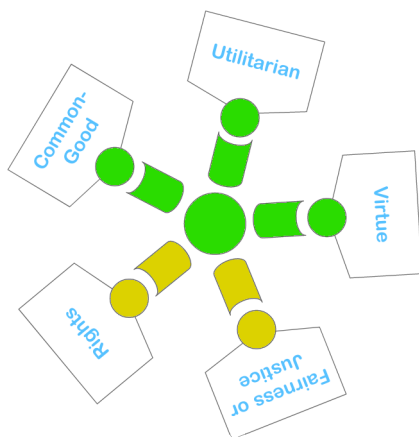
[Yes-No, because]

from a fairness standpoint, allowing the collection of medical information from children naturally raises privacy and social concerns. When this data is used correctly however, children can have a fairer and more comfortable experience if the bus they ride on is specifically designed for their needs.

If collecting medical information is necessary for safety, it may promote justice, but privacy and discrimination concerns must be balanced. Clear guidelines, informed consent, and exploring alternative solutions are essential for addressing this ethical dilemma while striving for fairness and justice.

6.2.6 Conclusion

In conclusion, allowing the collection of medical information from children driving Bruges Toddler Transport self-driving buses involves a lot of regulation from an ethical perspective. Respecting rights and privacy is crucial, requiring adherence to legal guidelines, informed consent, and data security. Fairness and justice must be balanced with privacy concerns. Ultimately, the decision should prioritize children's well-being, involve transparent consent, and implement safeguards for responsible data collection and usage.



7 Wireframes

Wireframes can be found in PDF files located at:

Wireframes for the mobile app:

https://bramderaeve.be/files/HOWEST/2023/application-prototyping/schoolbus/WireframesBrugesToddlerTransport_Final.pdf.

Wireframes for the admin panel:

https://bramderaeve.be/files/HOWEST/2023/application-prototyping/schoolbus/WireframesBrugesToddlerTransportAdmin_Final.pdf.

8 Links

Flowcharts - Bus drives to school (morning) - Attendee check

https://lucid.app/lucidchart/987d1b5f-7a42-45cc-aaf8-e111e9d78d78/edit?viewport_loc=-2101%2C-36%2C3328%2C1684%2C0_0&invitationId=inv_0e2323c5-fe22-4657-8b6c-68952a194d92

Flowchart - Bus drives from school (evening)

https://lucid.app/lucidchart/483a29d9-1f29-4e43-81fc-acb94fa1bddd/edit?viewport_loc=-512%2C-64%2C3033%2C1465%2C0_0&invitationId=inv_42874236-2ffb-4736-a0d8-953e42cf9529

Use Case Diagram

https://lucid.app/lucidchart/c917cde3-31e0-4401-9ffe-4a7ac2defc2f/edit?invitationId=inv_1cdc0924-70b7-41cf-8400-cb00d67fec72