City Builder Simulator

Stark Industries

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Introduction

Urban development and city management play a crucial role in creating organized, sustainable, and livable cities. As cities expand, they require well-managed systems for buildings, utilities, transportation, and public services to support citizens' needs and economic growth. This report explores how various components, such as government departments and public services, work together in a city simulation. By applying design patterns, the simulation models how these elements interact, illustrating their impact on urban growth and citizen satisfaction.

Google docs link: Report - Stark Industries

Slideshow link: Slideshow

Research Brief

Urban development and City Management Principles

Urban development involves the planning and growth of city spaces to accommodate increasing populations, economic activity and infrastructure. It works hand in hand with city management principles, which focuses on solving problems to ensure a good quality of life for residents. This includes aspects such as infrastructure, utilities, transportation systems, employment opportunities, public services, a functioning government, management of resources and citizen satisfaction.

Key Components of a City

Buildings: Provides housing, entertainment and employment. It encourages economic and population growth and is a key component of a functioning city.

Utilities: Provides essential services such as water, electricity and waste management. Utilizes resources to provide utilities to citizens.

Transportation system: Public transport allows citizens to travel through the city, this includes roads, railways and runways. It affects the economy and citizen wellbeing by allowing access to jobs and entertainment.

Government: A properly functioning government is important to any city. The government is responsible for various things such as the city budget, local and national laws and policies, setting and collecting taxes and providing public services. All of this directly affects the economy, population and city growth.

Public Services: Healthcare, education, law enforcement and other public services are important for the wellbeing of citizens. These various public services can help mitigate crime, disease and poverty if properly allocated.

Taxes: The city is dependent on the taxpayers money to be able to operate the government, build infrastructure and improve public services.

All of the above components are vital for the running of a successful city. They work together and often overlap in order to produce the best results.

Influence on Design

As mentioned, the above components are necessary for a functioning city. As a team, we considered how all of these components work together to produce a result.

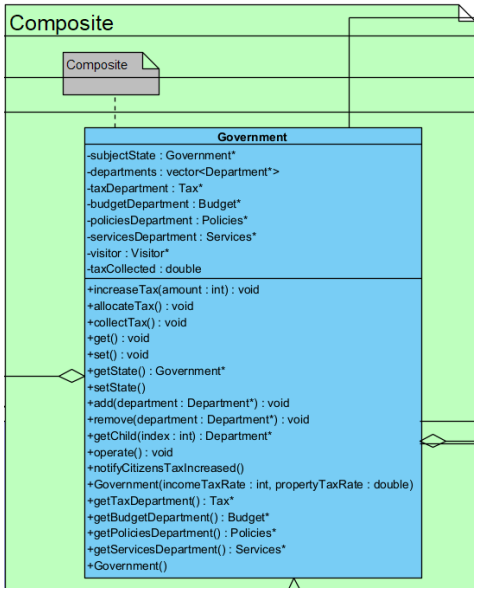
- Scalability due to city growth was considered and design patterns would allow for a scalable system.
- The creation and destruction of buildings and infrastructure needed to be accounted for.
- The dependency of certain aspects on others would require the use of design patterns such as the Chain of Responsibility.
- Creating a functioning government would require a design pattern such as Composite to model the different departments.
- Unique citizens would need to be created and shown.
- Citizens would have various attributes which would affect population growth, city growth and the economy

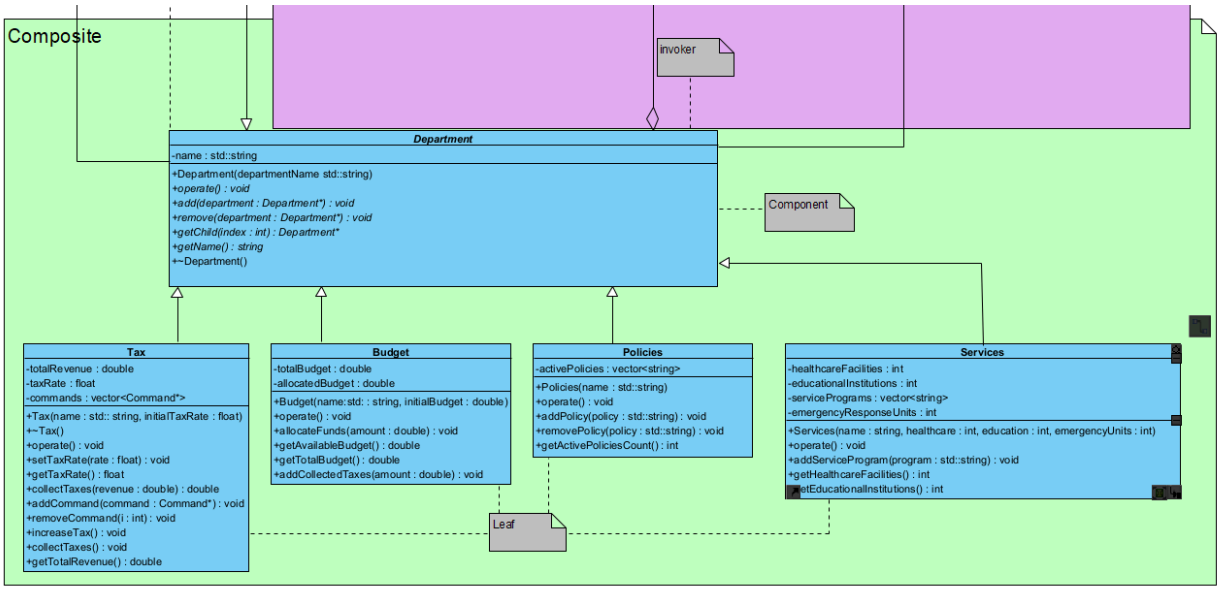
All of the above considerations were incorporated into our design, which will be outlined in the following report.

Design Pattern Application Report

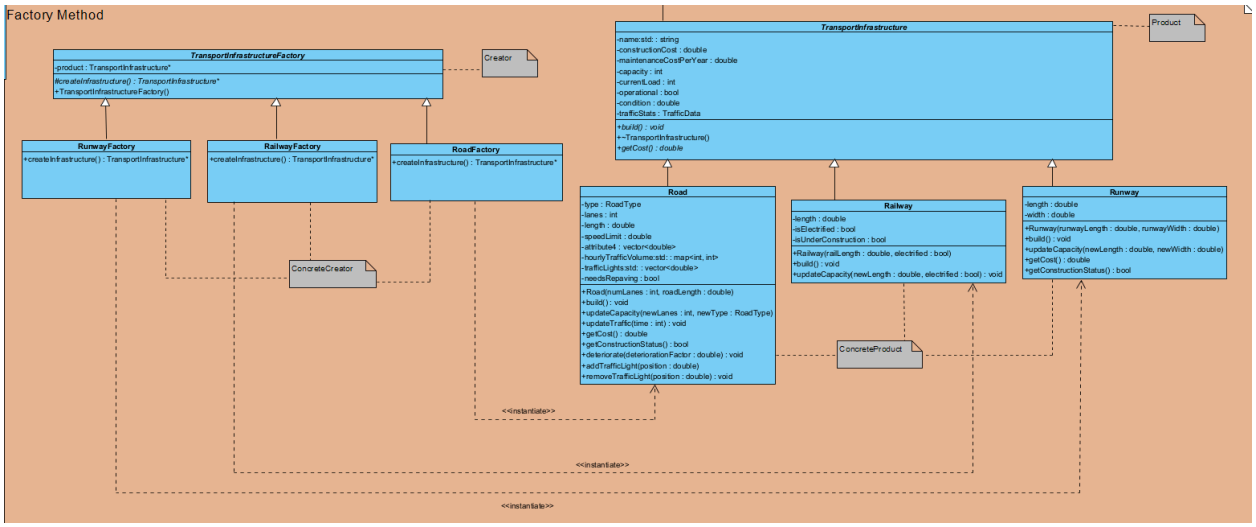
Application of Design Patterns

Composite Pattern: The government has different departments which handle different components such as taxes, budget, policies and services.

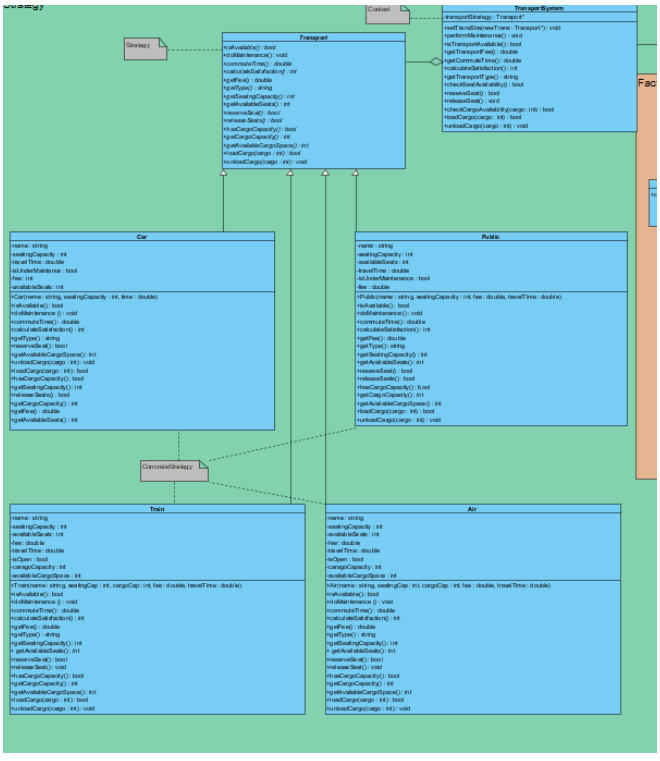
1. 



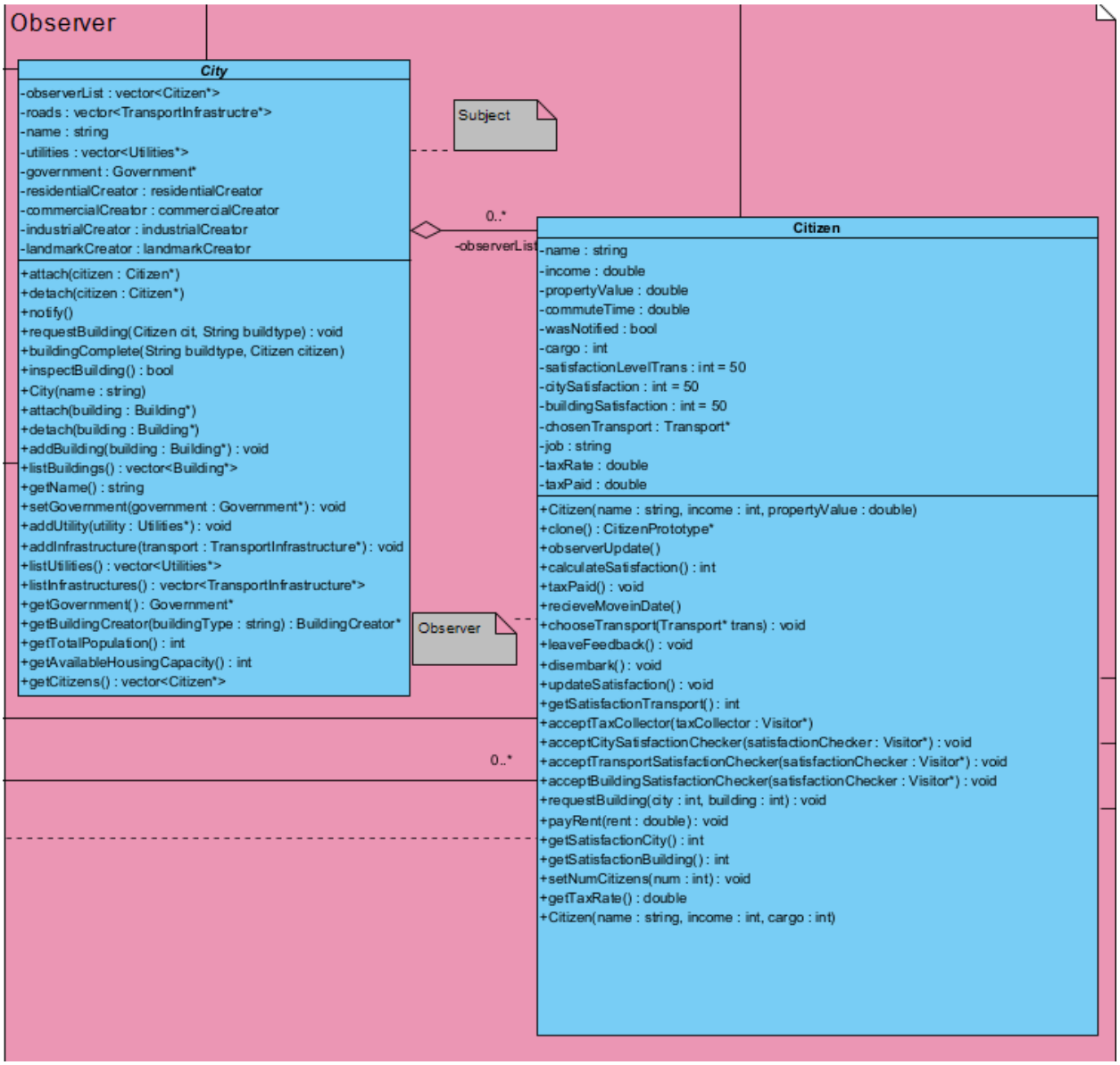
2. Factory Method: Building infrastructure is an integral part of creating a city. The Factory Method design pattern was used to build buildings, utilities and transport infrastructure. Attached is the Transport Factory, the other factory methods work



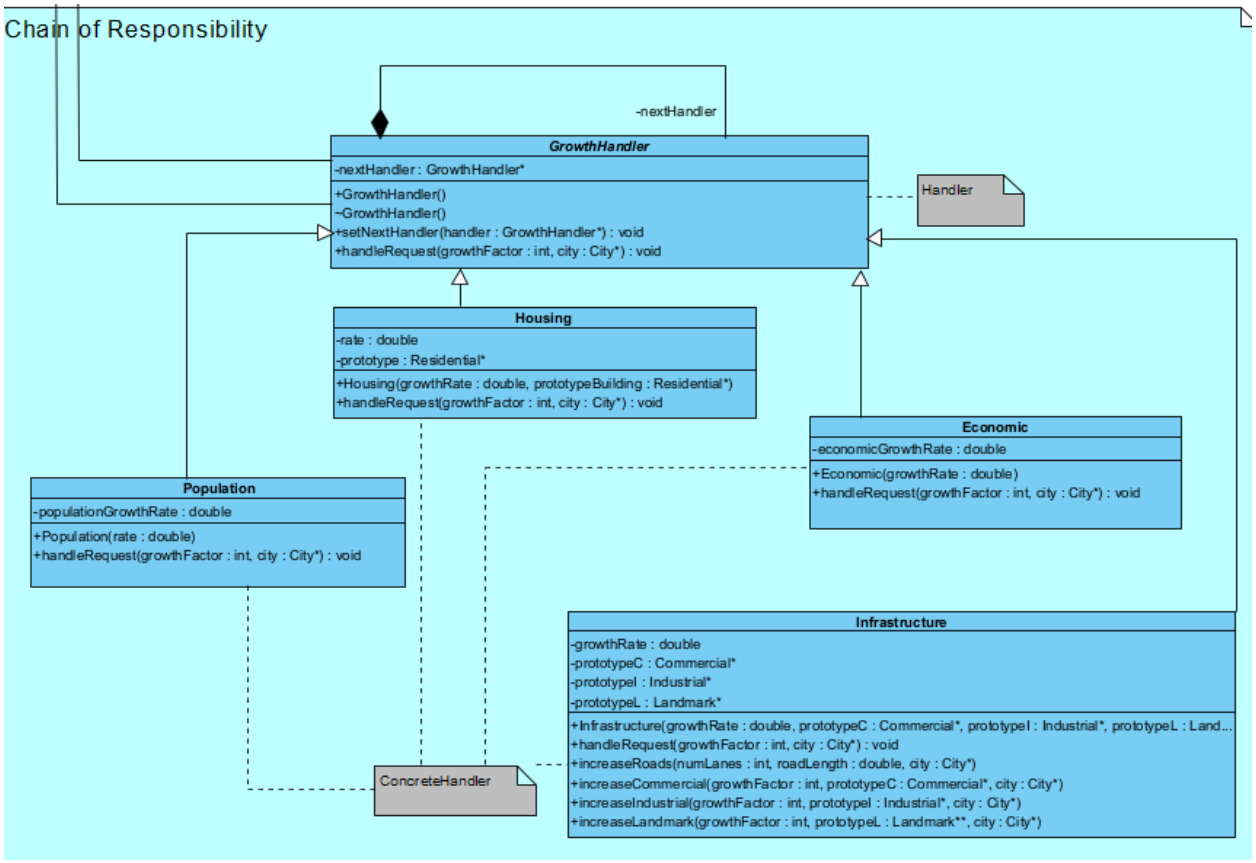
3. Strategy: Public transport is necessary for citizens to move around the city. They should be able to choose their preferred transport method based on various factors, thus the Strategy method was used.



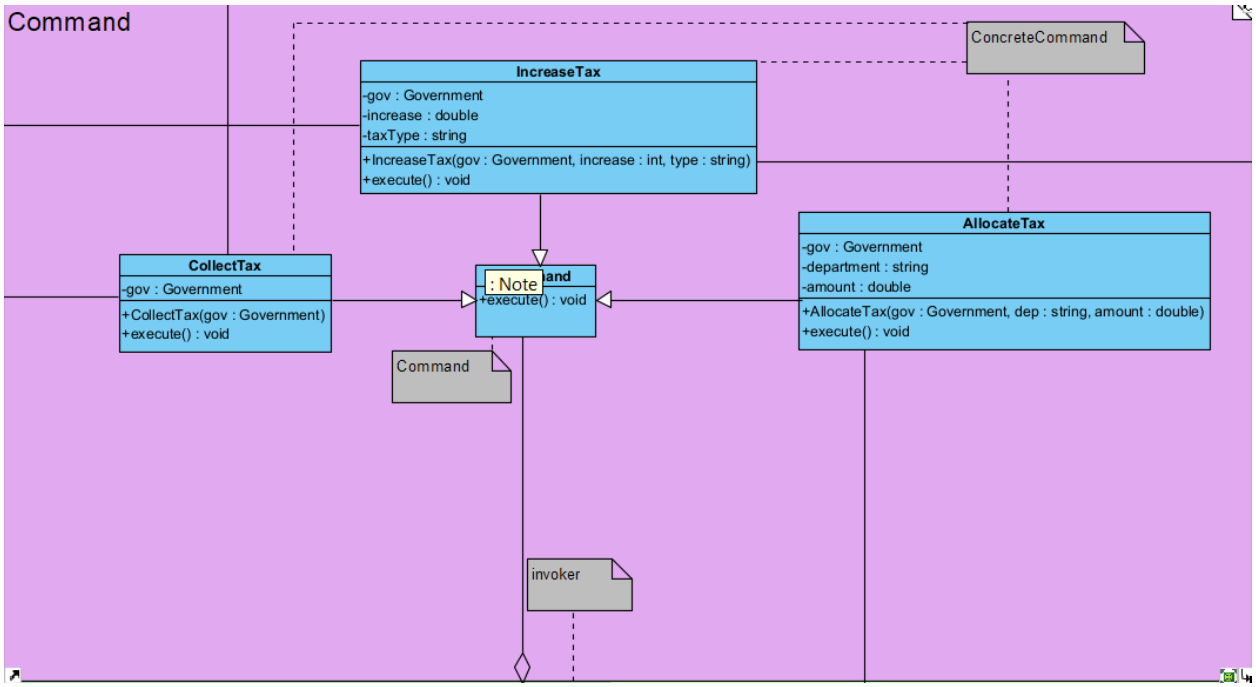
4. Observer: The general wellbeing of citizens is an important part of running a successful city. Citizens should be able to voice their complaints. The Observer pattern was used so that citizens could rate their satisfaction levels. A low satisfaction score would hinder city growth.



5. Chain of Responsibility: City growth needs to be tracked in order to ensure that the city is functioning as expected. This pattern was used because each factor of city growth affects the other in a cascading effect.

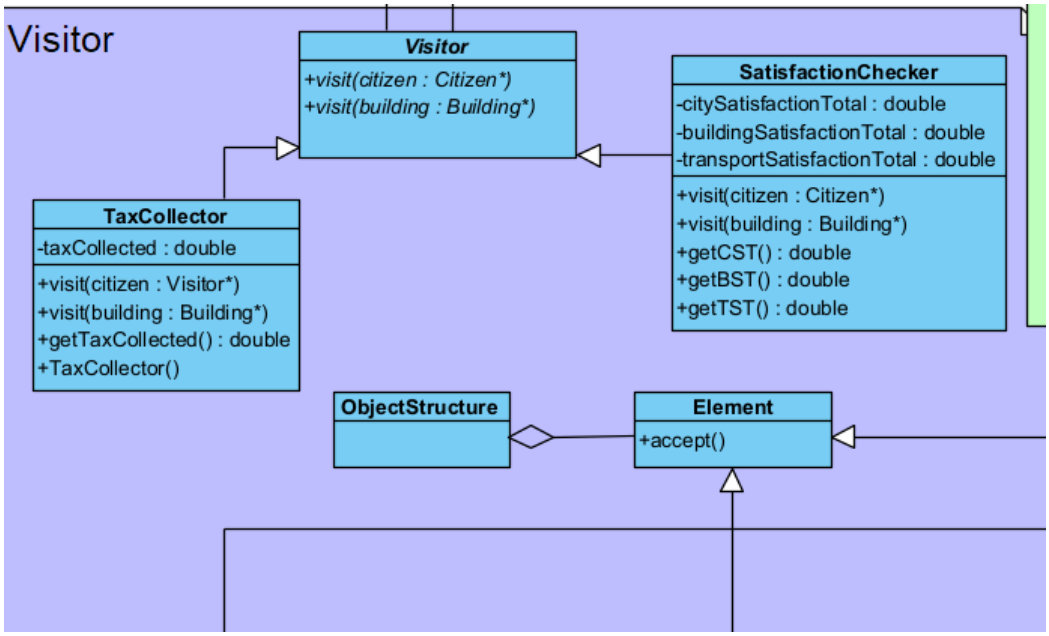


6. Command: Tax collection is necessary to fund public services and projects. The Command design pattern was used to ensure timely collection and a consistent flow of events.

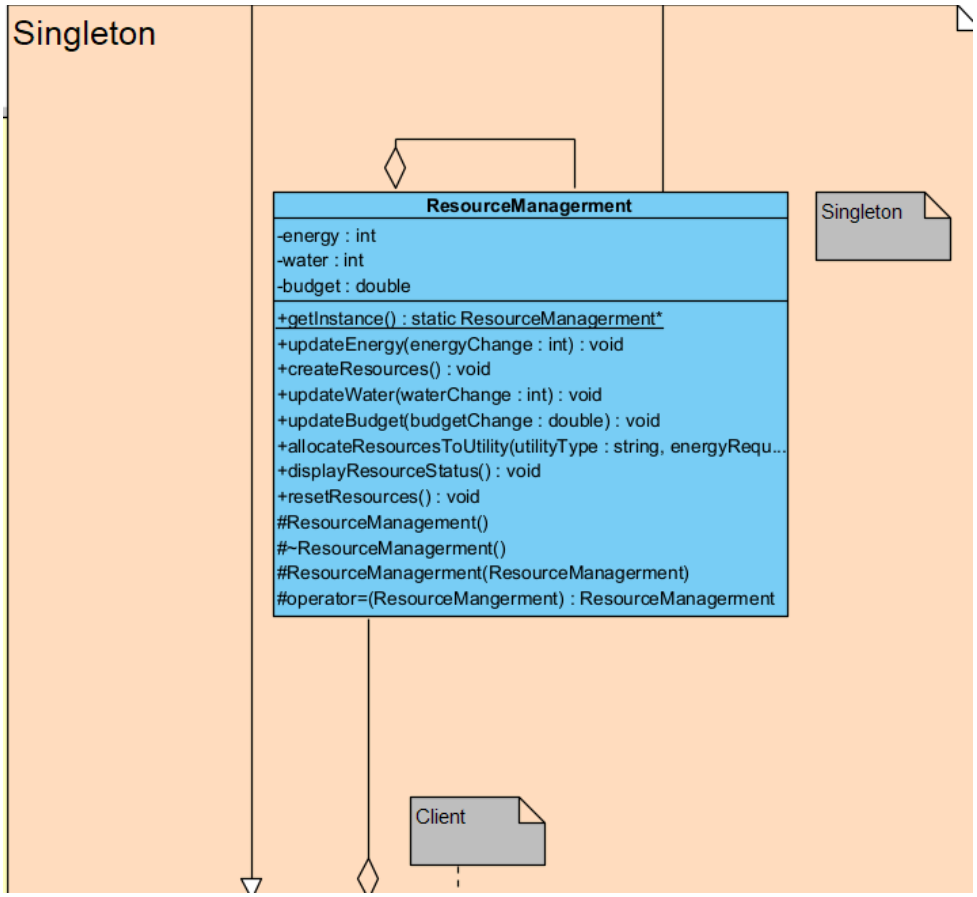


7. Prototype: By taking into account the large number of infrastructure that would need to be built, the Prototype design pattern seemed fitting to clone buildings instead of creating new ones.

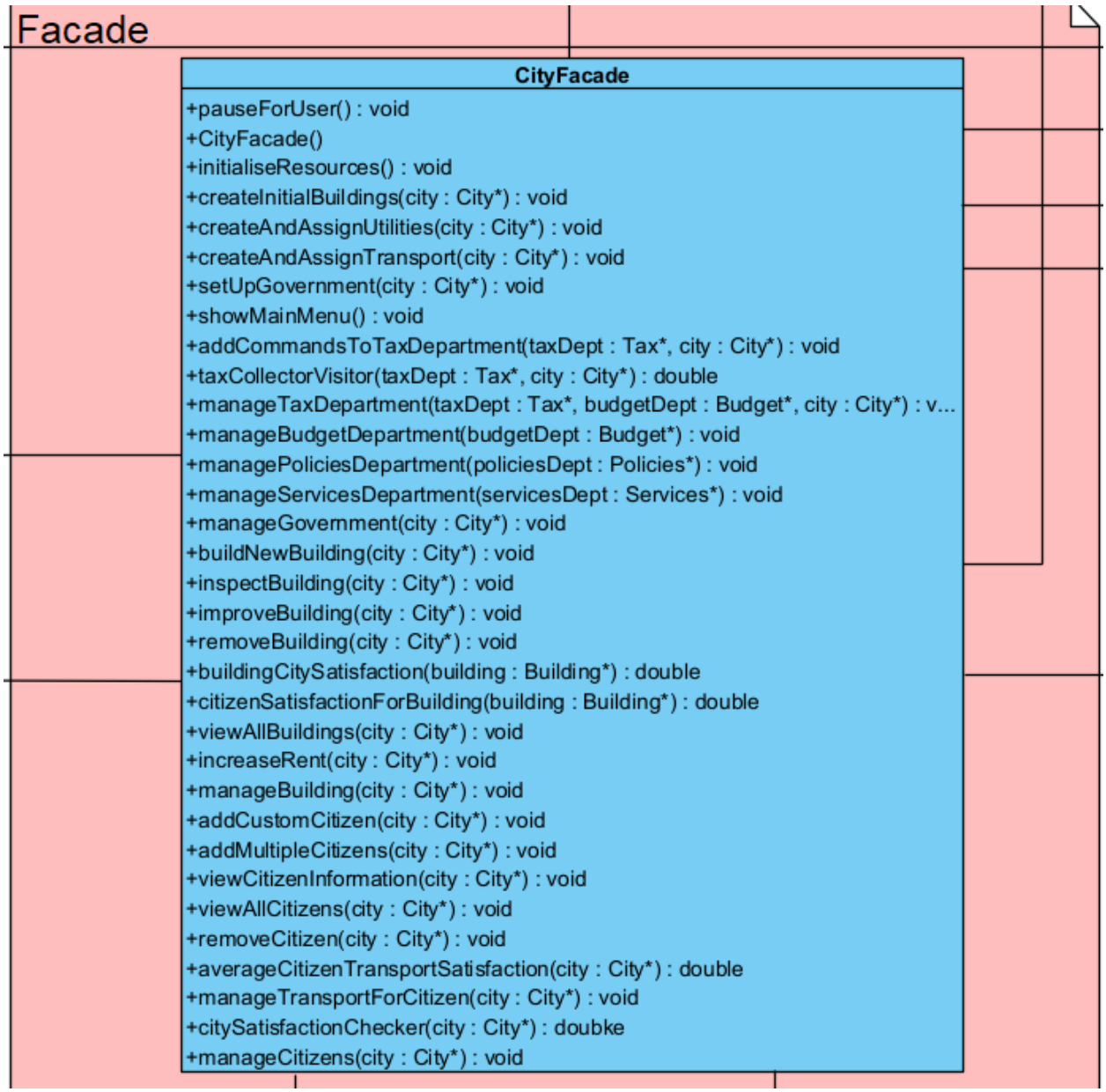
8. Visitor: This allows the citizen satisfaction levels to be collected and managed.



9. Singleton: Resources should only have one instance when created. By using the Singleton design pattern, it avoids confusion and errors when managing resources.



10. Facade: The Facade design pattern is used to create a cohesive way to run the city and integrate all of the classes.



Branching Strategy (GitHub)

A branch named “dev” was created off of main for all members to work from.

The group of seven was subdivided into three smaller groups. Each subdivision created a branch.

From that branch, each member of the subdivision created a branch to work on individual design patterns.

Individual branches were first merged to the subdivision graphs to minimize merge conflicts.

A separate branch called UnitTesting was created for unit testing. Subdivisions were created again where individual members could work from. Everyone contributed equally to the unit testing.

Separate branches were created for small bug fixes and Doxygen comments.

References

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