Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Dublin Dashboard

Sustainable City Management

Group 2 –

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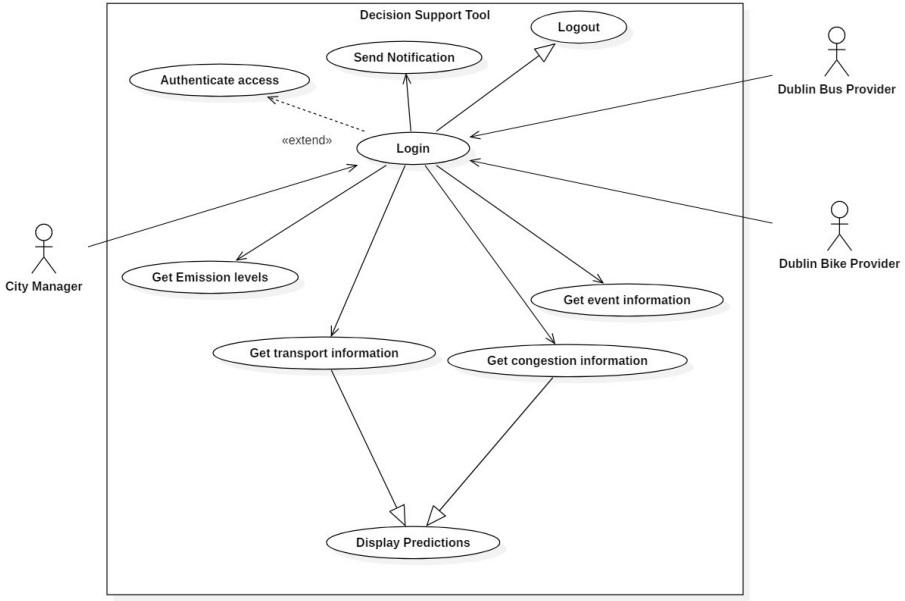
Objective

The goal of this project is to provide a decision-support tool for city managers and city service providers.

To build a Dashboard to provide information to mobility service providers on the current volume of usage and potential areas of over- or under-use.

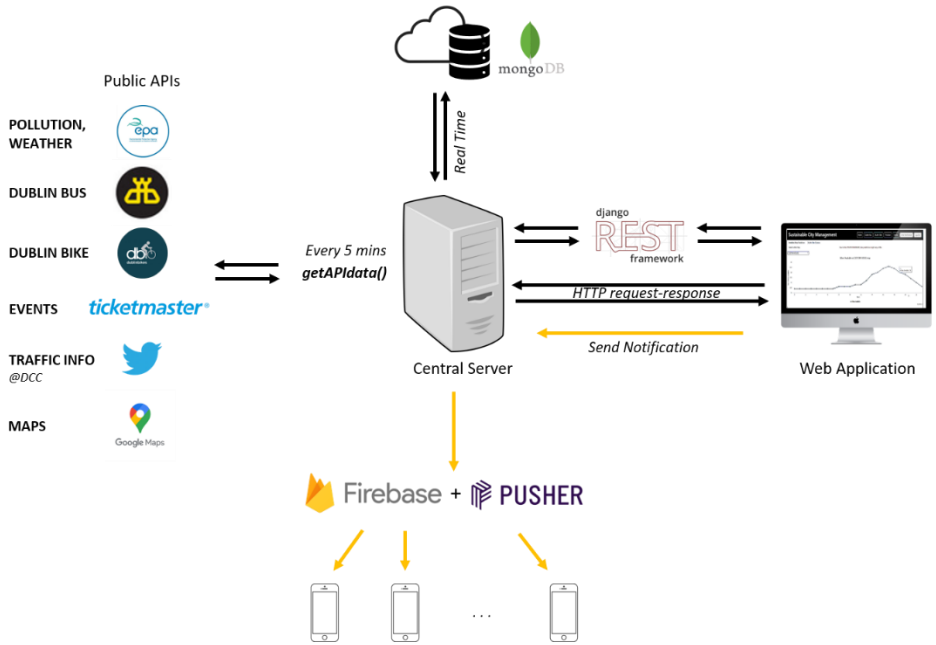
SOURCE - *https://thumbs.dreamstime.com/z/red-push-pin-map-ireland-europe-round-placed-city-dublin-47254783.jpg*

Use Case Diagram



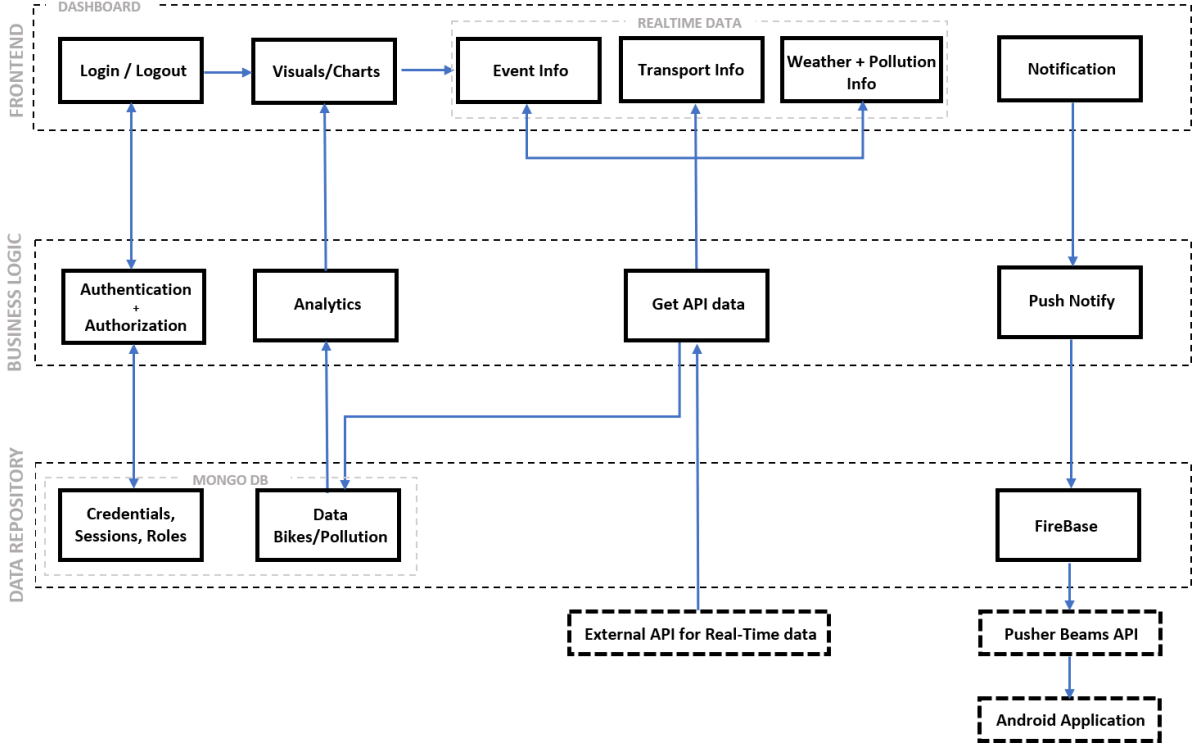
- To provide a **single platform** for all transport and event related information in Dublin
- To provide **decision support interface** to City Manager to control traffic activities in the city
- Involve **Machine Learning to predict** Dublin Bike usage to efficiently **facilitate optimal use**

Technical Architecture



- Central **Django server** for all the **business logic**
- Server *GET*s all API data every 5 minutes and **cache them** to prevent too many API calls ***(API throttling)***
- Real-time sync between Django server and cloud-hosted MongoDB to store information for data analysis
- React-based web application communicates with Django server via the **Django Rest Framework and REST calls**
- Send Notification to mobile devices using **FireBase + PusherBeams** platforms

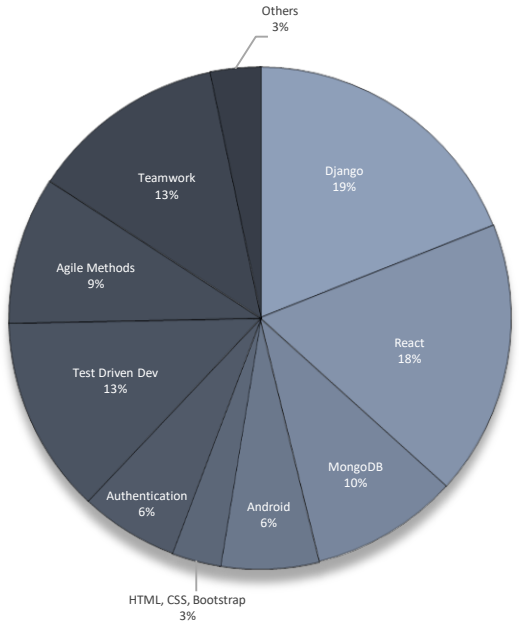
Functional Architecture



What we learnt

- Django Web Framework
- React JS
- MongoDB
- HTML, CSS & Bootstrap
- Token-Based Authentication
- REST Framework
- Android
- Agile Methodologies
- Test Driven Development
- Planning and Teamwork

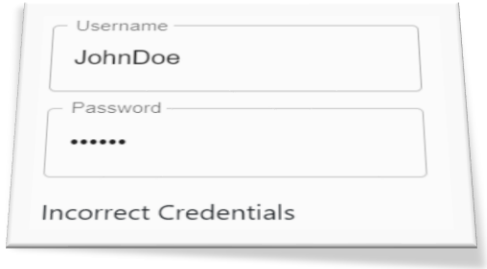
and many more (including Social Distancing!)



Some Key Features

Django-Rest-Knox based authentication –

- Enhanced security in sign-in, one token per client
  (versus one token per user in DRF, meaning all devices to be logged out if a server-side logout is required)
- Token expires after preset time (client logs out automatically)
- Tokens are encrypted before storing in Database (reduced chance of unauthorized access even if Database is compromised)



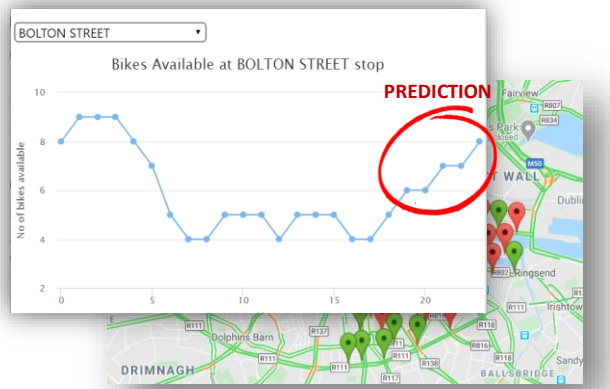
One Portal for multiple Transport information –

- Provides a single platform for most of the travel options across Dublin
  (LUAS and DART as a future work)
- Get bus timings at every stop and bike availability at every Bike Station across the city.
- View bus stops and bike stations on Dublin map
- Get traffic information on Traffic map *(powered by Google)*

Some Key Features contd...

Machine Learning to provide insights on data

- Chart displays available bikes at each station with prediction of bike availability at different hours of the day, so that city manager can efficiently handle over- or under-usage.
- Bike clustering clusters bike stations based on usage and direction of use, helps visualize usage patterns.
- Chart shows pollution level trends for past 30 days.
- More Machine Learning as part of future work!

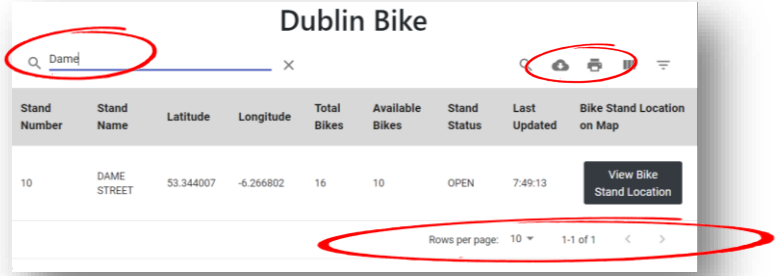


Send a Notification to Service Providers -

- Notify Service Providers about any incident across the city, right from the application.
- The Send Notification service opens up as a pop-up modal, so it is accessible from anywhere in the application.
- A dedicated Android application has been built for the purpose.
- Option to choose whom to send the notification.

Small details (to enhance the user experience)

- Pagination to load data faster
- Ability to search for particular record
- Download / print the data



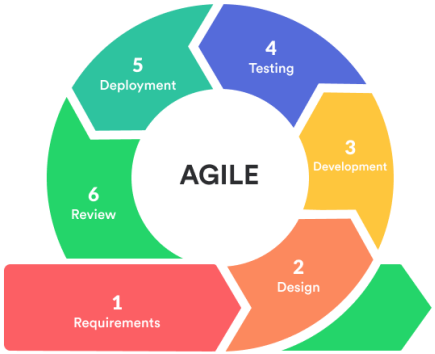
- API throttling to prevent unnecessary network load initiated by huge number of API calls. Background scheduler runs function to GET API data every 5 minutes. The data is cached locally for re-use.

```
[2020-04-25 07:56:40.669788] Getting API data
[2020-04-25 08:01:42.808960] Getting API data
[2020-04-25 08:06:41.196275] Getting API data
```

- System refreshes and recovers by itself after any unprecedented network incidents.

- Get transit data from one place to another from within the application

The Development Life-Cycle

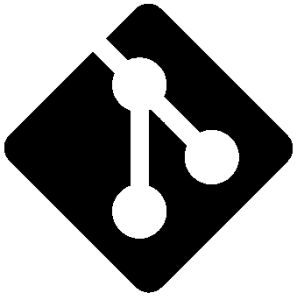


Agile Methodologies –

- Followed various scrum ceremonies like Sprint Planning, Retrospect Meetings.
- Followed **Extreme Programming** practices ** –
  - **Test-driven development** – Development was done with a test-first approach.
  - **Pair Programming** – Two people working on one story, pair changed every two weeks
  - **Code Refactoring** – Code refactored at the end of each completed feature to fix missed coding standards, improve performance and/or fix bugs.

** **NB –** Post COVID-19 lockdown situation, in order to maintain Social Distancing, communication was made virtually over WhatsApp and Skype.

The Development Life-Cycle



Version Control –

- Version Controlling was achieved through **GitHub**.
- The code changes were committed to respective branches upon passing all unit-tests and one round of code review by peers.
- **Branches** -

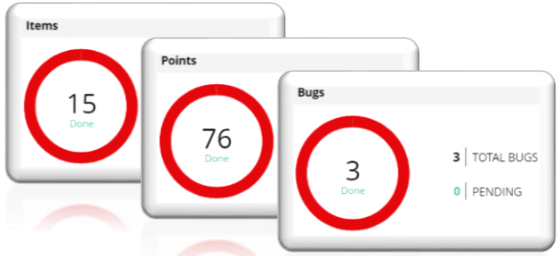
  Dev Branch - *All code changes were merged with dev branch as part of Continuous Integration process.*

  Test Branch – *Test branch was sync'ed from dev at regular intervals. The test branch underwent regression testing via a test-suite (prepared, modified, appended as a part of test-driven development)*

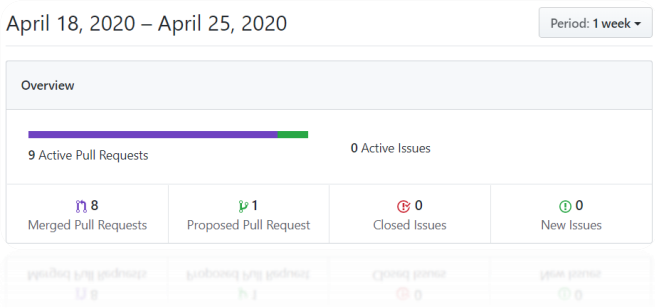
  Master Branch – *The code was finally sync'ed to masterNew branch before submission.*

NB – All merge conflicts were resolved with highest priority!!!

Before we wrapped up . . .



Burned 76 points over 15 new and few spilt over items in the last 2 sprints.
Moved 3 bugs to Resolved.



Merged 8 Pull requests in last 1 week.

Challenges

- **Became short of a team member around the end of Semester 1.**
  Had to revise whole plan from scratch. Everyone stepped forward to take extra responsibilities.

- **COVID-19 pandemic enforced people to maintain Social Distancing. It was difficult for team members to be on same page without proper physical meeting.**
  Followed guidance provided by Prof. Siobhán Clarke. Prioritized functional requirements over non-functional ones. Organized sync-up calls over WhatsApp and Skype. Focused on continuous code integration.
  Sending progress updates to Professor and TA ensured that we kept ourselves on track with the latest updates.

- **Most of the technologies chosen to work on were new to us.**
  Learning on the go as we worked on developing the project.

- **Extreme Programming and Test-First approach was tricky at first.**
  Managed to get used to it pretty fast!

- **Code merge conflicts.**
  Conflicts arose because of multiple commits on the same file.
  Tasks were better planned to avoid overlaps, conflicts were resolved using GitHub's conflict management with highest priority.

Where we challenged ourselves

Using machine learning skills and knowledge to build a prediction model.

Since most of our team members are from the Data Science strand, with the consensus of the entire group, we decided to take up the challenge of **building a prediction model for transport-related statistics**. It seemed straightforward at first, but we wanted to integrate it in a way that would add to the merit of the project.

As our **application collects data with the scheduler** that we have scripted by ourselves, it will **create a dataset** that will enable the building of a prediction model. The scripts that we have included for predictive analytics, makes use of this data collected over time, **analyses it and gives a prediction for the upcoming time period** that enables the user to identify key patterns of usage and helps in decision-making for any re-arrangements of logistics.

Database Replication - We also have a **backup plan** in the form of a **cloned database** that assists the **application in times of no connectivity**. When the application is **offline**, it can still load the most recent historic data pertaining to every data source from its APIs and show the user.

Role-based access - Since the city manager is at the apex of this pyramid of public services, it **has the access and control over every single feature of this application.** The individual subordinate entities such as the bus and the bike providers have access only to their specific domain and hence, cannot override any authoritative action that might otherwise be in control of the city manager.

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Thank You