In this section we’ll be discussing some of the currently available parking management systems and comparing the features they provide for admins and drivers with that of the candidate system. One currently available turnkey system with similar functionality to the candidate system is Sharvy. Drivers can create accounts and can access a calendar on a website or mobile app to view the availability of parking spaces and make bookings. They can also access a dynamic map which helps direct users to their reserved parking spaces. Sharvy is primarily designed for managing company car parks and therefore unlike the candidate system, it does not have a built-in payment method, nor can it notify the admin users when the drivers arrive or leave their reserved parking space. Sharvy also does not provide a means for the admins and drivers to communicate. Admin users can create and manage accounts for drivers and can assign spaces for visitor parking for events held on the campus. Admin users can also view graphs which visualise the occupancy of the car park and statistics which show trends. Unlike the candidate system, admin users in Sharvy do not receive and approve/reject parking requests as bookings are made directly by the driver nor can they receive notifications if the drivers should not arrive for their bookings or overstay their allotted time slot. Similarly to the candidate system, Sharvy has different graphical user interfaces for admins and drivers which provide a different view and level of access within the system. Sharvy is a highly scalable system, with the ability to add new car parks to the parking management system and its compatibility with third-party technologies such as parking sensors, electric vehicle charging stations and billing systems makes Sharvy a suitable system for an organisation that wishes to expand its parking availability and the technology it uses. Overall, Sharvy provides a decent range of useful features for accessing parking and managing multi-site carparks but lacks a number of the features outlined in the candidate system such as admins not being able to approve or disapprove parking requests and the lack of a built-in method for drivers to pay for parking. Thus, Sharvy is not an ideal solution for the parking management system. Another available PMS is Swarco. Like Sharvy, drivers can create accounts, view parking availability, make reservations and get directions to their parking space through a web browser or their “SwappAccess” mobile application. Swarco also allows drivers to make online payments and whilst they cannot communicate with the admin via text messages, they can get assistance using intercoms that are provided on-site. Unlike the candidate system, Swarco cannot notify the admins that the driver has arrived or left their space using their GPS coordinates. The admin users can manage user accounts and add new carparks to the system whilst Swarco’s parking management solution does not come with a means of monitoring the car park’s occupancy, the system can integrate other systems produced by Swarco that can allow the admins to view the occupancy of the car parks and individual spaces. However, unlike the candidate system, admins users do not approve or disapprove of booking request made by the driver, they also cannot block or reserve spaces for events nor can they communicate with the drivers through text messages. Similarly to Sharvy and the candidate system, Swarco has different graphical user interfaces for the driver and admin users and as it can manage multiple sites at once, it can be used to direct drivers to the car parks closest to their destination. Swarco is a scalable solution, capable of managing many separate sites in the same system and can implement a range of other technologies such as access control, occupancy management and charging points for electric cars. This makes Swarco a good solution if the university wishes to build new car parks or add new features to the current car parks. Overall, the system is good for helping drivers find spaces and make payments but lacks many of the admin features of the candidate system and therefore, is not a good solution for the parking management system. Smart Parking is another system with some features that are similar to the candidate system. It provides limited features for the drivers, allowing them to make payments but only through machine at the site and records their time of arrival and departure. It lacks many of the driver features of the candidate system such as the ability to create an account, view availability, make bookings, receive directions or communicate with the admin over text messaging. The admin users can view statistics on the occupancy of the car park and what individual spaces are currently in use, they can also receive notifications from the system if a driver should overstay their allotted parking time. Because unlike the candidate system, accounts and bookings cannot be created, the admin in the Smart Parking system is incapable of managing driver accounts, approving or rejecting bookings or directing the driver to a car park close to their destination. Whilst the system can integrate a range of technologies like sensors to monitor individual bays and cameras that record license plates, the system is designed for managing a single car park and does not provide online payments or bookings. Because of this, the system is very limited and not particularly scalable as it cannot be used by an organisation that wishes to expand the number of sites it manages. Overall, whilst the system produces a lot of information which is useful for assisting the admin in managing the car parks, as it lacks key features of the candidate system such as drivers not being able to create accounts to make bookings and payments, it lacks the functionality to be a viable solution for the university. Another available solution is Parkable, which fits many of the criteria for the proposed system. Users can make personal profiles which are used to allocate them to spaces. The profile section displays information such as a person’s assigned parking spot, how long they’ve spent there and their total cost with payment options. These three variables are displayed front and centre in blocks, making for a simple UI (and one which is different from the admin’s). Users can request spaces for a specific date, time and location. This is done via a Google Maps interface (which can also be used after purchasing a spot) with the available spaces displayed as small blocks on the map with their prices underneath. To choose a date and time, a simple calendar interface is used that displays days in boxes in one-week blocks. However, there are a few user features that the app is missing. The user is unable to communicate with the admin to resolve issues, however, a chatbot is provided to deal with user problems (which can be accessed by a box on the user’s profile). The system includes a few of our admin features. Admins can monitor the overall status of a car park using a green bar that gradually fills up as spaces are taken, as well as seeing the exact number of taken and available spaces. They can also add, remove, block and reserve spaces through a simple map that uses a drag and drop system. However, there is no mention of GPS features such as checking for when a user has different coordinates to their allocated space or does not arrive within an hour of / stays longer than their allocated time. Alternatively, their arrival and departure could be monitored via the “open gate” and “stop parking” buttons on their user profiles. In terms of scalability, the system works quite well. It has facilities to log EV charging station locations and their information, including payment options, should an organisation install them. Admin accounts can also sync with access control systems to closely control usage of spaces. Overall, Parkable satisfies many of our user, admin and general requirements for our PMS, and for those that it does not satisfy, there are workarounds. It also has additional features that could improve our PMS, such as freeing up reserved spaces when they are not being used or grouping together spaces (public, staff, EV spaces etc.). Workero’s parking solution meets a few of our PMS’s criteria. Users can reserve spaces for a specific date, time and location and can track the occupancy of the car park (along with admins). However, users cannot make profiles or text admins, and their arrival to a space is not monitored with GPS coordinates. The system only has a few of our required admin features. Admins can customise car parks to alter the states of spaces, give users specific spaces (e.g. disabled parking spots) and they can also monitor car park usage overtime. There are some features that are missing however, such as managing user profiles, texting users, and receiving various alerts (such as when a user’s coordinates and allocated space do not match or when they arrive late or stay longer than allowed in their allocated space). For scalability, the system has some useful features. It can sync with access control devices as well as other parking systems, should an organisation wish to control entry to its park or expand it. It can also log spaces with EV charging stations and their details in case an organisation should acquire some. Overall, this system is not suitable for our PMS, as despite having the basic features such as reserving spaces and payment options, it lacks many features. This includes creating user profiles, texting the admin or the admin receiving alerts. Wayleadr’s solution also fits much of our PMS’s criteria. Users can create profiles (displayed similarly to social media profiles, most notably X), with the profile picture to the left of the page, a name beside it and a cover image behind. Reserved spaces are presented as blocks underneath which contain booking information such as the date, the location, the time, the approval status and the cost. It also shows how occupied a monitored car park is. The social media inspired design makes for a familiar and easy UI to navigate, presenting the user with important information. When users make and view bookings (done through a simple calendar interface displaying days in monthly blocks), they can see where their space is on a map. However, a few features are missing, such as texting the admin and GPS notifications when a user arrives at their space (although a user’s entry time could be monitored with the app’s “open gate” function). The app has many of our required admin features. Users (and admins) can see the total car park occupancy through a gradually filling blue circle, alongside the number of taken and available spaces. Admins can also see useful metrics, such as the number of bookings and rejected requests. Admins can add, block, remove and reserve spaces as well as approve and reject parking requests. They can also manage accounts. As mentioned earlier however, admins cannot have conversations with users. Admins also cannot receive notifications about a user’s GPS coordinates not matching their allocated space or whether they stayed too long or did not arrive at their space. The system has good scalability prospects. It can monitor EV charging stations, should an organisation implement them. It can also sync with access control features, such as gates and cameras, to more closely monitor users. Regularly reserved spaces can also be freed up to boost occupancy, should an organsiation have these. Overall, Wayleadr meets many of our PMS’s requirements but is missing a few key features such as communication between admins and users as well as GPS tracking with users. The system also has a few additional features that could be useful for ours, such as notifying users when spaces available fall below a certain amount or giving a forecast of availability for future dates.