

NavAuto

Assignment 1

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- **Abstract**

In our today's world there have been challenges faced by Users which includes wasted time and stress trying to find their parked cars in packed or unfamiliar regions, which may be inconvenient and stressful. There also have been concerns about theft or illegal use of their vehicles which later on creates anxiety and security challenges for users.

To prevent this hardship, I have tried integrating the Internet of Things (IoT) solution of Location Beacons for Vehicle Tracking where users can remotely access their car's location, receive instant alerts, and optimize fleet management, enhancing security and efficiency. This solution changes automobile location by using the power of the Internet of Things, providing the highest level of simplicity and security.

These are small, discreet devices installed in automobiles that aid in location and tracking through the use of the NavAuto application. A single beacon would be affixed to each vehicle, enabling users to easily identify and track their vehicles in real time. To give users exact location information, the NavAuto app would receive the signals generated by the beacons and use that information. By serving as internal vehicle IDs in the tracking system, these position beacons provide simple and efficient automotive location. As an actuator, I have planned to have the location beacon equipped with an LED indicator that changes colour or blinks to indicate various status conditions, such as vehicle locked/unlocked, engine running, or alarm triggered. Secondly also as an actuator, it will have a buzzer or speaker into the beacon which allows for audible alerts, such as alarm sounds or notifications, to be emitted when specific events occur, enhancing user awareness.

The location beacon has an integrated GPS module sensor to accurately determine the vehicle's position and provide real-time location updates to the NavAuto application. There is also another called the accelerometer sensor within the

beacon which has also been setup which detects changes in the vehicle's motion, allowing for detection of events such as sudden stops, collisions, or towing attempts. When NavAuto is aligned with GPS trackers that are mounted in cars, customer can locate their car precisely—even in areas where GPS service is weak. It is compatible with OBD-II devices, which provide useful diagnostic information on the condition and functionality of the car in addition to location tracking.

I have also tried providing support for users in areas with limited GPS coverage, NavAuto can connect with Bluetooth trackers attached to the car, providing proximity-based locating within a certain range. The data transmission between the IoT devices and the application is encrypted, ensuring the security and privacy of user information. NavAuto offers customizable alerts for various events, such as when the vehicle leaves a designated area or when the battery of the IoT device is low.

Most importantly, users need proper and timely support during emergency situations. A dedicated SOS button within the app allows users to quickly call for assistance or emergency services if needed. NavAuto supports voice commands, allowing users to control the application hands-free through the car's built-in voice recognition system, enhancing safety and convenience. The Mobile Application, support a wide range of vehicle types, including cars, motorcycles, trucks, and scooters, ensuring inclusivity for users with different transportation needs. I have found it useful because implementing customizable vehicle profiles within the NavAuto app, opens doors for users to specify the type of vehicle they own or frequently use. This ensures that the app's features and recommendations are highlighted to the specific characteristics of each vehicle type. RFID (Radio-Frequency Identification) tags can be fixed in vehicles or attached to key fobs. They can be scanned using RFID readers to determine the vehicle's location within a specific area, example: a parking lot or a garage.

This enables vehicle location by providing a solution that is universally usable for drivers of automobiles, motorcycles, trucks, and scooters. NavAuto guarantees comfort and peace of mind for all customers, irrespective of their mode of transportation preference, by means of its customizable features and seamless connection with IoT devices.

- **Architecture**

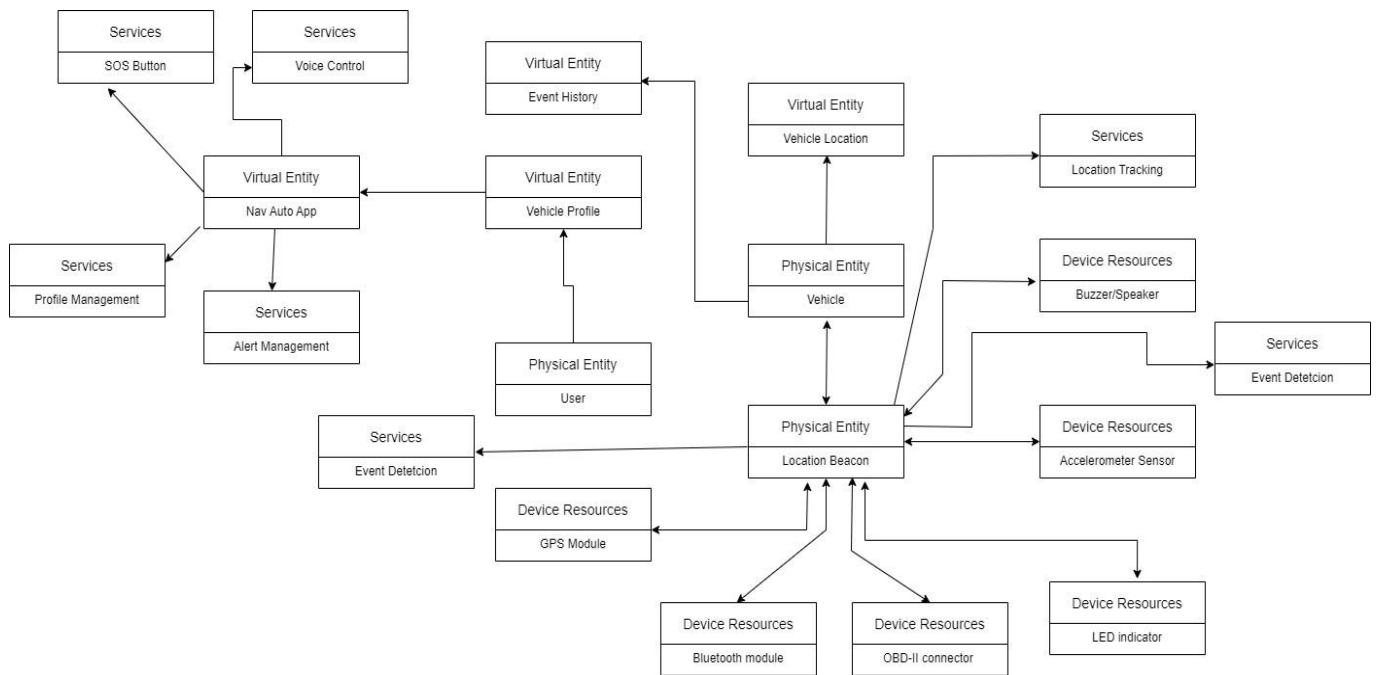
This concept which I have planned and integrated its functionality is mainly important to provide a peace of mind to vehicle owners to by offering real time tracking and anti-theft features reducing car theft or illegal use. NavAuto provides quick response in emergency situations which allows user to send distress signals and contact emergency services. This will be beneficial for the society as it

supports law enforcement efforts by providing accurate vehicle location data for investigation purposes, aiding in the recovery of stolen vehicles and apprehension of suspects. Lastly this concept saves time and stress for users to find their parked vehicles in urban and congested areas especially.

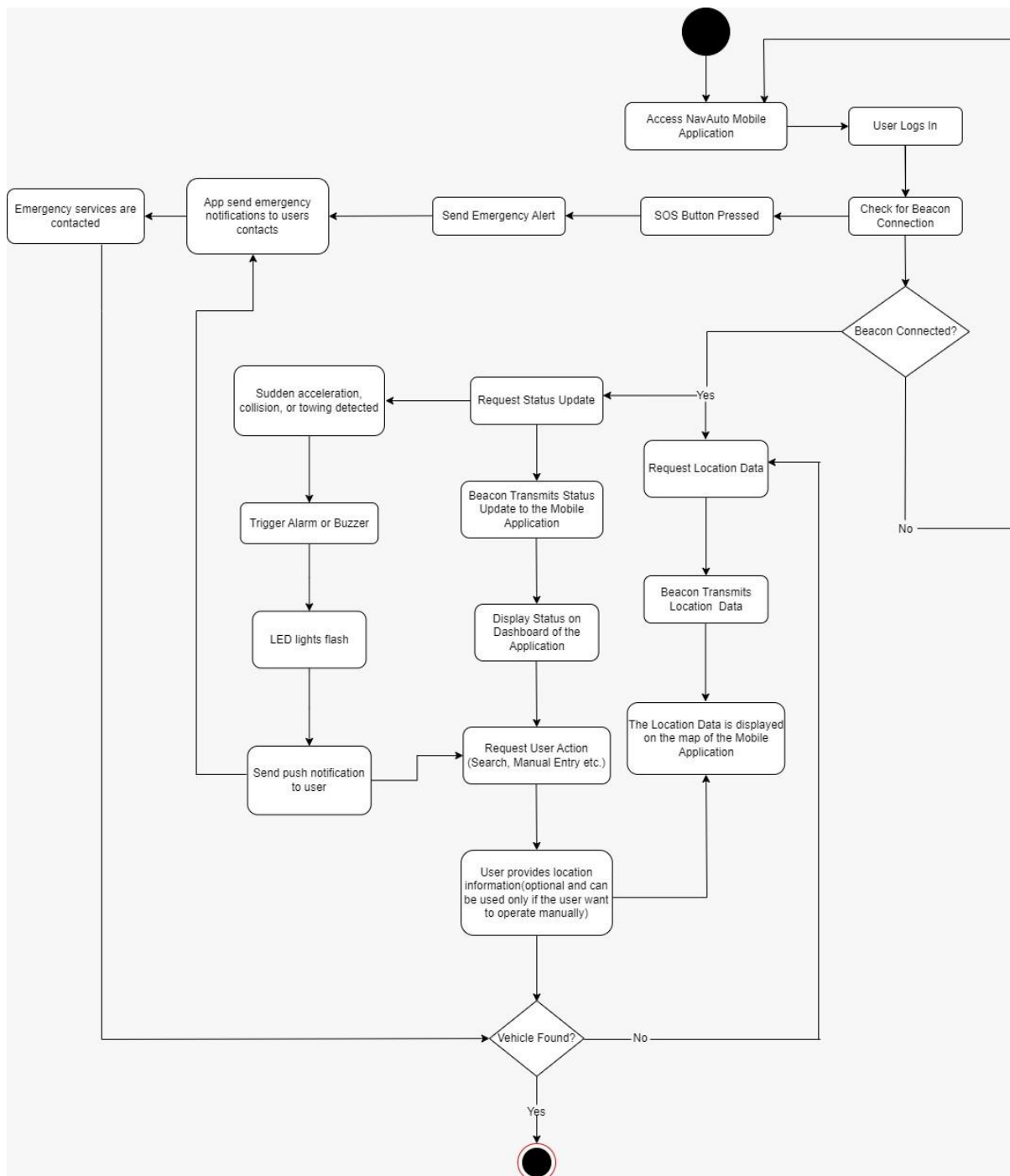
Entity table and diagram

Category	Entity	Description
Physical Entities	User	Individual using the NavAuto App to track their vehicle.
	Vehicle	Car, motorcycle, truck, or scooter being tracked.
	Location Beacon	Device installed in the vehicle for location tracking and status indication.
Virtual Entities	Vehicle Profile	User-defined profile containing information about their vehicle.
	Vehicle Location	Real-time geographic location of the vehicle.
	Event History	Record of events detected by the location beacon (e.g., sudden stop, collision).
	NavAuto App	Mobile application used to access vehicle data and features.
Device Resources	GPS Module	Sensor within the location beacon that determines the vehicle's position.
	Accelerometer Sensor	Sensor within the location beacon that detects changes in vehicle motion.
	LED Indicator	Light on the location beacon that changes color or blinks to display status (locked, engine running, alarm).
	Buzzer/Speaker	Device within the location beacon that emits audible alerts (alarm, notifications).
	Bluetooth Module	Module in the location beacon that enables proximity-based tracking.
	OBD-II Connector	Connector that provides diagnostic information from the vehicle.
Services	Location Tracking	Service that retrieves and displays the vehicle's location in real-time.

	Event Detection	Service that analyzes accelerometer data to detect events like sudden stops or collisions.
	Alert Management	Service that sends notifications and triggers alarms based on events and user preferences.
	SOS Button	Feature within the NavAuto App for users to request emergency assistance.
	Voice Control	Functionality within the NavAuto App allowing hands-free control through voice commands.
	Profile Management	Service for users to create and customize vehicle profiles.



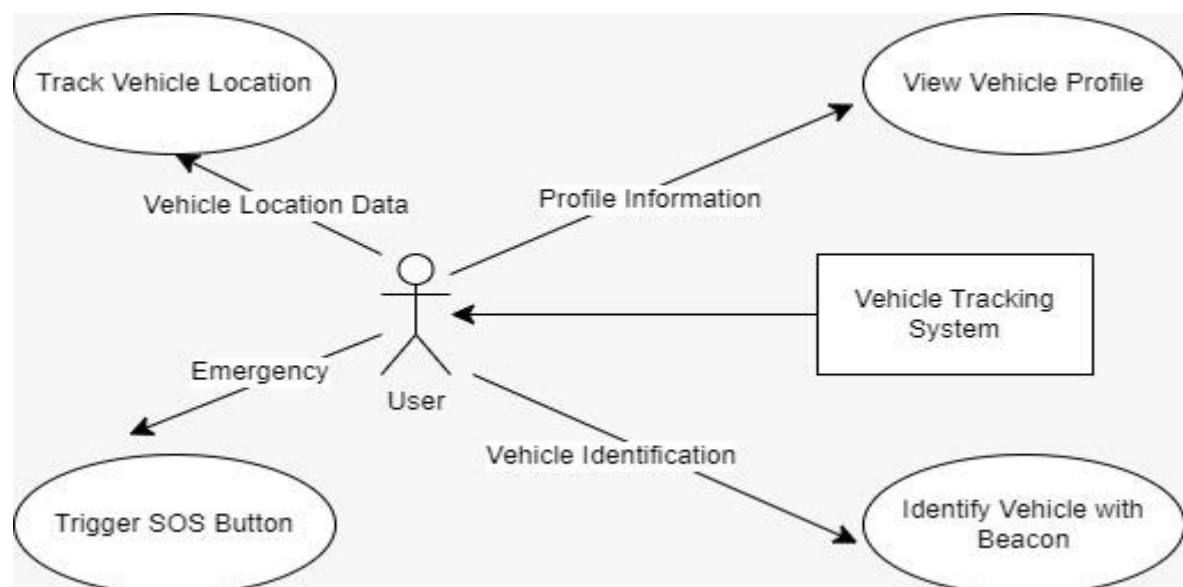
Activity diagram



The process starts with the user logging into the mobile app. The app checks if there's a connection to the vehicle beacon. If the beacon is connected, the app request's location and status data from the beacon and displays this information on the map and dashboard. If the beacon is not connected, the app prompts the user

for actions, such as searching for the car or manually entering a location. The app continuously monitors the accelerometer data from the beacon. If sudden movements or towing is detected, the beacon triggers an alarm, flashes LED lights, and sends a push notification to the user. The user can manually trigger an emergency alert by pressing the SOS button, which sends notifications to their contacts and calls emergency services. After displaying the location on the map, the app checks if the user has found their vehicle. If the car is not found, the app offers additional options such as providing search assistance or allowing the user to report the vehicle as stolen. If the car is found or the user's purpose is achieved, they have the option to quit the application. The system continuously loops back to normal operation, monitoring the beacon, and updating location and status information, unless the app is stopped, or an emergency alert is triggered. If there is no emergency and in case of normal scenarios, the beacon provides navigational information to the user through the application so that the user can locate their vehicle easily.

Use Case diagram



- Actors: Driver, Administrator (optional).
- Use Cases: View Vehicle Location, Track Vehicle History, Manage Users & Vehicles.
- Interactions: Driver views location, tracks history, sets alerts
- System Boundary: Encloses actors and use cases.

- **Requirements**

Stakeholders	Interactions
Drivers, Vehicle Owners	Drivers and vehicle owners receive navigation instructions through the NavAuto application, guiding them to their parked vehicles using the beacon's location data.
Fleet Managers	Tracking the locations of multiple vehicles is very important and each with its unique profile using the NavAuto Application with the help of the beacon attached.
Programmers, Developers	Programmers and developers ensure seamless integration of the beacon, while vehicle owners benefit from diverse tracking options.
UI/UX Designers	They want the users to find the application easy to use, with simpler navigation and clear instructions.
Localization Teams, Multilingual Users	Worldwide users need to access the application in their preferred language, enhancing usability and accessibility.
Engineers	The people who builds the beacon gadgets that run smoothly and don't over drain the car's battery, guaranteeing extended use.

Functional Requirements

A. Vehicle Location Tracking

A1. The mobile application ought to exhibit the user's parked car's current position on a map interface.

A2. The mobile application should respond when there is a major shift in the position of the car, users need to be able to get warnings or notifications.

A3. To facilitate users in finding their parked cars quickly, the application needs to offer navigation assistance within the mobile app.

B. Mobile Application

B1. The mobile application should support the management and tracking of multiple vehicles for users with multiple vehicles.

B2. Users should be able to add, remove, or edit vehicle profiles within the mobile app.

- B3. NavAuto must ensure that users can easily switch between different vehicle profiles to track each vehicle separately.
- B4. Users should receive notifications or alerts such as movement or unexpected events.
- B5. The mobile application must provide real-time updates on the location of the user's parked vehicle, ensuring accuracy and timeliness.
- B6. The mobile app should display essential vehicle health information, such as battery status, fuel level, and engine diagnostics (for vehicles equipped with OBD-II devices).

C. User Interaction and Customization

- C1. The mobile app must provide a user-friendly interface for easy navigation and interaction.
- C2. Users should have the option to customize their preferences within the app.
- C3. Notification settings and map display options will be available in the app.
- C4. NavAuto must allow users to set up personalized alerts or reminders related to their parked vehicles.
- C5. The mobile app must support voice commands for controlling basic NavAuto functionalities, such as locating parked vehicles or setting up alerts.

D. Offline Functionality:

- D1. The mobile application should provide basic functionalities, such as viewing parked vehicle locations, even without an internet connection.
- D2. Users should be able to access cached data or previously viewed information when offline.
- D3. The application must ensure that offline functionalities are available and reliable for users in areas with limited or no network coverage.

E. Location Beacon:

- E1. The location Beacon is lightweight and compact, which will be helpful for easy installation within the vehicle.
- E2. The beacon is equipped with a high-capacity battery to ensure longer operation between charges, with a minimum battery life of 30hrs on a single charge.
- E3. The beacon will have a LED indicator will have different colours or blinking patterns to indicate various status conditions, such as vehicle locked/unlocked, alarm triggered, or low battery.
- E4. During any unusual changes in vehicle motion, the beacon is attached with a buzzer which emits a loud and attention-grabbing alarm, and the information is sent rapidly to the mobile application.

E5. The beacon will have a GPS module within which provide the real time updates and location tracking constantly.

E6. The accelerometer sensor within the beacon will detect changes in vehicle motion, providing information rapidly.

Non - Functional Requirements

Reliability and Accuracy:

1. The system must efficiently manage concurrent user requests while preserving performance under high load scenarios.
2. To minimise delays in location updates, data synchronisation between the application and the Beacon should occur in near real-time.
3. The application should have a recovery plan in place to switch to backup servers or alternative communication routes in case of network issues.
4. The sensors must have a high level of reliability during any kind of emergency.

Scalability:

1. It should ensure smooth expansion to handle a growing user base and rising data volumes. The design for the application architecture will have horizontal scalability in mind.
2. Regular scalability testing is needed to assess the limits of the application to endure traffic and increasing load without seeing a decline in performance.
3. When extra server capacity is required to ensure optimal performance, the system will automatically distribute it.
4. The application will have load balancing systems which would be set to distribute incoming traffic evenly across different servers and reduce constant respond time.
5. The application should have provisions for modular architecture, allowing for easy integration of new features and services as the platform evolves.

Portability:

1. The NavAuto mobile application must be compatible with major mobile operating systems, including iOS and Android, ensuring broad accessibility for users.
2. The application interface must be adaptable to different screen sizes and resolutions, providing a greater user experience across various devices.
3. The Location Beacon that NavAuto support need to work with an array of car makes and models, enabling compatibility with different car systems.

4. The application backend must be deployed and managed in cloud computing environments and cloud-agnostic. This helps deployment across various cloud providers and on-premises environments as needed.

Performance:

1. The application must load within 3 seconds and not more than that with standard network connectivity for users.
2. The response time for navigation and location instructions should be under 1 second so that the users receive timely information.
3. The database and the data retrieval management should be optimized to enhance overall system responsiveness.

Security and Privacy:

1. The communication between the Beacon, the mobile application and the cloud platform must be always encrypted to prevent unauthorized access.
2. The vehicle tracking, and location system should be accessed only through multi-factor authentication process.
3. The multi-factor authentication will require users to authenticate themselves by providing credentials such as username and password which then continues with OTP's (One time Password).
4. The location Beacon will use TLS (Transport Layer Security) protocol to provide secure communication.
5. The protocols such as WPA2 (Wi-Fi Protected Access 2) or WPA3 will be providing encryption and authentication for the beacon and the mobile application.

Usability Requirements

1. The NavAuto application interface must provide clear instructions and steps or tutorials on how to interact with beacons for locating vehicles.
2. The application must have voice commands and screen readers, to assist users with disabilities.
3. The app interface must offer customizable font sizes and contrast settings for improved readability.
4. The NavAuto application must support multiple languages to cater to users from diverse linguistic backgrounds.
5. The NavAuto application must feature a clean and intuitive user interface, ensuring simple navigation for users of all experience levels.
6. The Beacon LED lights should be visible, and the alarm system should be audible alerting the environment during any sort of emergency.

7. The application must provide offline functionality for basic functions if the user is in areas with no or limited connectivity.

- **Evaluation**

Category	Description
Usability Testing	<ul style="list-style-type: none">- Clarity and Intuitiveness of User Interface for tracking your parked car using the NavAuto Mobile Application.- Proper navigation flow to ensure users easy access to essential features.- Accessibility features must be supportive of users of determination.
Security Testing	<ul style="list-style-type: none">- Secure data transmission between the application and the Beacon.- Alarm feature must be functional at all times to ensure proper triggers during security breaches.- LED indicators must be clear on the Beacon to indicate status.
Performance Testing	<ul style="list-style-type: none">- Delay in data transmission between the Beacon and the application must be non-existent.- Functionality of application must be smooth under heavy loads.- The Beacon must be operational at all times to report any and every incident to the mobile application.
Compatibility	<ul style="list-style-type: none">- Seamless integration between various Beacon hardware models and manufacturers.- Must provide clear guidance to allow for user's compatibility with their respective hardware.- Affective integration with hardware for people of determination.

Beta Testing	<ul style="list-style-type: none"> - Stability during Beta Testing stages must be good in order to retain most accurate results and satisfy Beta Testers and future users. - User feedback can be analysed to improve user experience. - Based off of results obtained the during Beta Testing, successful application launch should be conducted by addressing key issues and its fixes.
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For the smooth running of the concept and adherence to user standards and experience, the testing and evaluation for the NavAuto mobile application as well as the Beacon can be done through Usability Testing, Security Testing, Performance Testing, Compatibility and Beta Testing.