GANDAKI UNIVERSITY
BIT PROGRAM
Mahendrapool, Pokhara

A
Project Proposal on
VTrack - Vehicle Tracking System With GPS

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Submitted To:
Saroj Giri
BIT Program
2024

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VTrack - Vehicle Tracking System With GPS

Executive Summary

The VTrack vehicle tracking system[1] is designed to revolutionise campus vehicle management at Gandaki University by providing real-time insights into vehicle movements. Aiming to address the challenges faced by students due to unpredictable arrival times, VTrack offers a range of features that include real-time location tracking, efficient route optimization, and geo-fencing capabilities. With VTrack, users will be able to access accurate and timely information about vehicle locations, improving overall fleet management practices. Additionally, VTrack prioritises driver safety and is expected to reduce operational costs associated with fleet management. Through its innovative use of Global Positioning System (GPS)[2] technology, VTrack will bring significant benefits to the campus community and set a new standard in vehicle tracking solutions.

The primary objective of the VTrack project is to provide a real-time vehicle tracking system for campus vehicles at Gandaki University, specifically to address the issue of untimely arrival of campus vehicles and to improve the overall campus transportation experience for students using technology.

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https://en.wikipedia.org/wiki/Global_Positioning_System

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Background

The need for real-time location of campus vehicles and their availability has been a real issue to the students. Sometimes, students have to wait for the bus for longer durations than usual arrival time. Individuals require reliable and accurate information about the location, status, and performance of their vehicles to make informed decisions, optimize operations, and ensure the safety of drivers and students.VTrack, is a response to this specific problem, aiming to develop a GPS-based vehicle tracking system that provides real-time monitoring and management of campus vehicles. By leveraging the power of GPS technology, VTrack seeks to address the limitations of traditional tracking methods and provide a robust, user-friendly solution that improves fleet management efficiency, ensures driver safety, and enhances the overall campus transportation experience for students.

The history of vehicle tracking systems dates back to the 1960s, when the concept of Global Positioning System (GPS) was first introduced. The inspiration for GPS came from the Soviet spacecraft Sputnik[3], launched in 1957. The US Department of Defense[4] began developing GPS technology in 1978, initially for military and intelligence applications. In the early stages, GPS was not affordable for commercial use. Fleet companies had to install large, expensive GPS tracking devices in each vehicle, and pay a significant fee to access the GPS satellite system. The 1990s saw the emergence of GPS tracking systems for fleet vehicles. These systems enabled fleet

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Commented [6]: https://en.wikipedia.org/wiki/United_States_Department_of_Defense managers to track vehicle locations, monitor driver behavior, and optimize routes. The technology continued to evolve, and by the 2000s, GPS tracking systems had become more sophisticated, offering features like real-time tracking, fuel usage monitoring, and driver performance analysis. Today, GPS vehicle tracking systems are an essential tool for fleet management. With the proliferation of GPS technology, vehicle tracking systems have become more affordable and accessible, benefiting not only fleet companies but also individual vehicle owners.

Literature Review

The literature highlights the importance of vehicle tracking systems, which can be considered a form of object tracking[5]. Many systems leverage GPS technology to determine vehicle locations and use GSM to transmit data.[6] Real-time tracking and monitoring are key features, allowing users to monitor vehicles remotely. Challenges include ensuring accuracy and reliability, scalability and integration, user experience and accessibility, cost and affordability, and data privacy and security.[7] Scholars have addressed these challenges by developing advanced, reliable, and user-friendly vehicle tracking systems.

Scope of The Work

The VTrack project aims to develop a comprehensive vehicle tracking system that encompasses a range of key features. These include real-time location tracking, which provides users with nearly real-time updates on the location and status of their vehicles. Additionally, the users will be able to view the bus on map if they are connected to the internet. Furthermore, the system will incorporate geo-fencing capabilities, allowing users to set virtual boundaries and receive alerts when vehicles enter or exit designated areas.

A web-based application with a beautiful user interface will be displayed when it is opened. The users are first displayed with real-time location of the vehicle at particular bus stations where students climb in or out. With vehicles passing each checkpoint, the data will be automatically sent to the user's feed. However, with the data transmission delay from one transmission to another every 20 seconds or so, the data will be updated on information display. A search bar will be available to the user to track a specific vehicle based on the plate number or driver's name. In VTrack, all the students, staffs with their unique identification number will be able to access the application online with restriction to users outside the accessibility of required resources to minimize the risk of any harm/risk/accidents to the bus users. The system will be web-based and maintained using PHP.

Project Objectives

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The objectives of this project are as follows:

- Campus vehicle monitoring: Provide the university administration with a comprehensive solution to monitor and manage the movement of campus vehicles, ensuring efficient utilization and improved security.
- Provide real-time vehicle position: Offer users with nearly real-time updates on the location and status of their vehicles, enabling them to make informed decisions and respond to emergencies effectively.

Feasibility Study

A feasibility study evaluates a project's success by assessing critical factors. A comprehensive feasibility study has been conducted to assess the economic, technical, and operational viability of the VTrack project.
That are:

Evaluation of Existing System and Procedure:

Since there is no existing vehicle tracking system at Gandaki University, this evaluation focuses on the current manual procedures used to manage campus vehicles. The study reveals that the current system is inefficient, leading to delays and inconvenience to students. The evaluation highlights the need for a technology-based solution to improve the management of campus vehicles.

Economic Feasibility:

The estimated cost for the hardware components, including GPS modules and related peripherals, is at the minimum of NRs. 10,000 budget. The software/hardware development and implementation costs along with memory resources are expected to be reasonable, considering the potential long-term benefits and cost savings that VTrack can provide to the university.

Technical feasibility:

The VTrack project will leverage well-established technologies, such as GPS, mapping APIs, and database management systems, ensuring compatibility, scalability, and performance optimization. The project team has the necessary technical expertise to develop and implement the system effectively.

Operational feasibility:

User acceptance testing has been conducted, and the feedback indicates a strong demand for a reliable and user-friendly vehicle tracking solution. The VTrack system is designed to be intuitive and easy to use, facilitating seamless integration into the daily operations of the university.

Methodology

Within this project the following methods will be used in order to achieve the main goal:

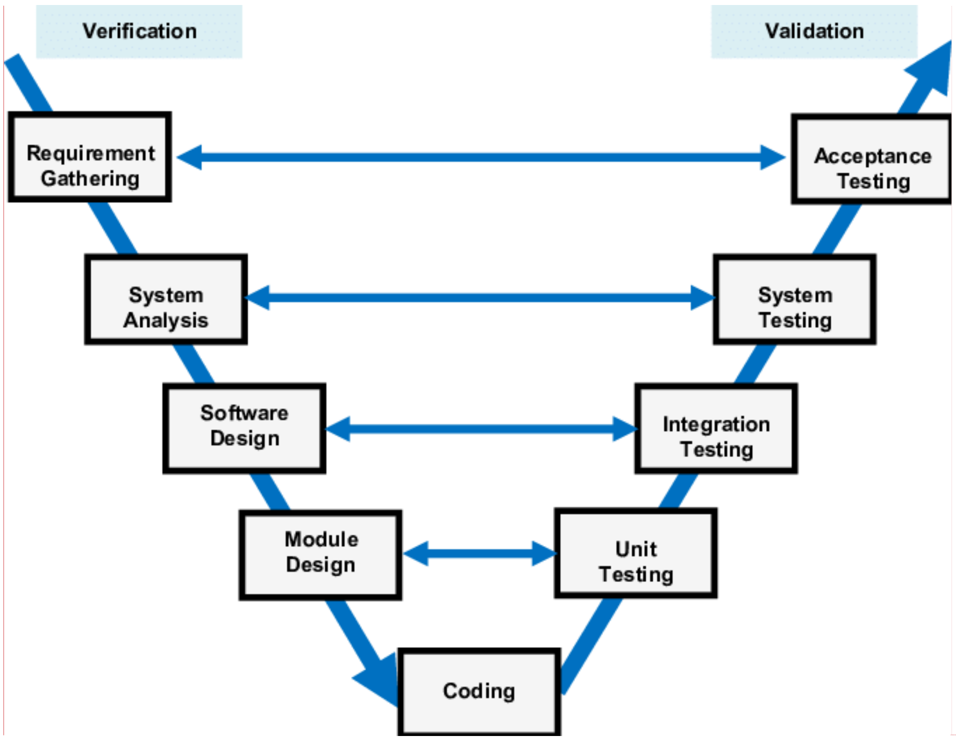

Figure 1: The V-Model.

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The VTrack project will follow the V-Model, a well-known software development lifecycle (SDLC) approach, to ensure a structured and systematic development process. The V-Model emphasizes the importance of thorough planning, design, and testing, which aligns with the requirements of the VTrack project. The key phases of the V-Model for the VTrack project are as follows:

1. **Requirements Analysis:** Gather and document the detailed requirements for the VTrack system, including functional, non-functional, and user requirements.

   Hardware Requirements: There are few of the hardware components required to build the chip that is the basis of this project - the circuit that provides the data for the system to track the vehicle.

- **Microcontroller Unit**: A small computer on an integrated circuit for memory and I/O peripherals. One of the common microcontrollers is Arduino.

Figure 2: Arduino UNO. Credit:https://upload.wikimedia.org/wikipedia/commons/3/38/Arduino_Uno_-_R3.jpg

- **GPS module:** A GPS device built with tiny processors and antennas to receive the satellite data and timestamps.

Figure 3: Neo-6M-0-001 V2 with ceramic antenna (GPS Module). Credit: https://breadfruit.me/wp-content/uploads/2022/04/5_22_1.jpg

- **GSM module:** A global system for mobile communication that works as a mobile device establishes contact with a computer.

Figure 4: GPRS-GSM Module. Credit: https://www.electronicsforu.com/wp-contents/uploads/2021/08/SIM900-Gsm-Module-500x500.jpg

- **Relay circuit:** An electronic control device integrated with a GPS tracker app to communicate with the vehicle's engine.

Figure 5: Relay Module 5V 1 Channel. Credit: https://static-01.daraz.com.np/p/4986524665c0aba888afd72c505a5f78.jpg

- **Jumper Wires**: Jumper wires are wires with connector pins at both ends, enabling the connection of two points without the need for soldering. These wires are commonly used with breadboards and other prototyping tools to facilitate convenient circuit modifications. (Hemmings, 2018).

Figure 6: Jumper Wires. Credit: https://res.cloudinary.com/rsc/image/upload/b_rgb:FFFFFF,c_pad,dpr_2.625,f_auto,h_535,q_auto,w_950/c_pad,h_535,w_950/R2048241-01?pgw=1&pgwact=1

- **Breadboard**: The breadboard is a rectangular board with embedded holes designed to insert electronic components. Widely utilized in electronics projects, the breadboard serves as a prototype and functions as a foundational platform for constructing electronic circuits. (Javatpoint, 2023)

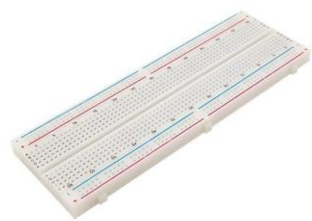


Figure 7: Breadboard. Credit: https://static.cytron.io/image/cache/catalog/products/BD-BB-0617-R/BD-BB-0617-R%20(6)-800x800.jpg

Software Requirements: The software components required to build the application are following:

- **Arduino IDE**: The Arduino Integrated Development Environment (IDE) includes a code editor, a message section, a text console, a toolbar with frequently used functions, and various menus. It is used to connect to Arduino devices to upload programs and communicate.

Figure 8: Arduino IDE. Credit: https://www.instructables.com/How-to-Install-the-Arduino-IDE-Application-on-Wind/

2. **System Design:** Develop the high-level and low-level design of the VTrack system, including the architecture, hardware and software components, and data flow.
3. **Implementation:** Implement the VTrack system based on the design specifications, using the selected programming languages and technologies.
4. **Unit Testing:** Conduct thorough unit testing to ensure the individual components of the VTrack system are functioning as expected.
5. **Integration Testing:** Integrate the various components of the VTrack system and perform comprehensive integration testing to validate the overall system functionality.
6. **System Testing:** Perform end-to-end system testing to verify that the VTrack system meets the specified requirements and delivers the expected performance.

7. **Acceptance Testing:** Conduct user acceptance testing to ensure the VTrack system meets the needs and expectations of the target users.
8. **Deployment:** Deploy the VTrack system in the target environment and provide comprehensive user training and support.
9. **Maintenance:** Implement a robust maintenance plan to address any issues, provide updates, and ensure the continuous operation of the VTrack system.

Following are the block diagrams and flowchart diagrams for our project:

Implementation

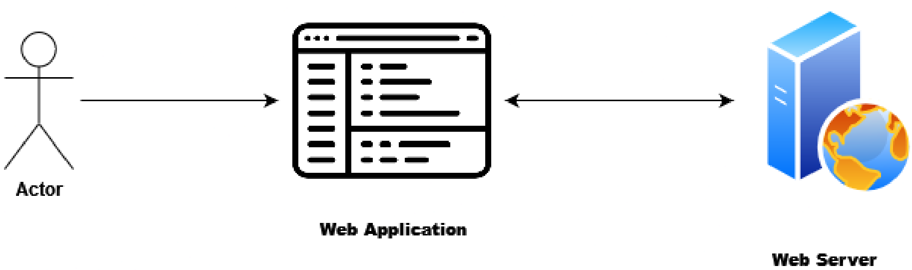


Figure-9: Block Diagram of V-Track. The image shows a user trying to access the web application. The web application communicates with the web server and fetches necessary data and displays to the user.

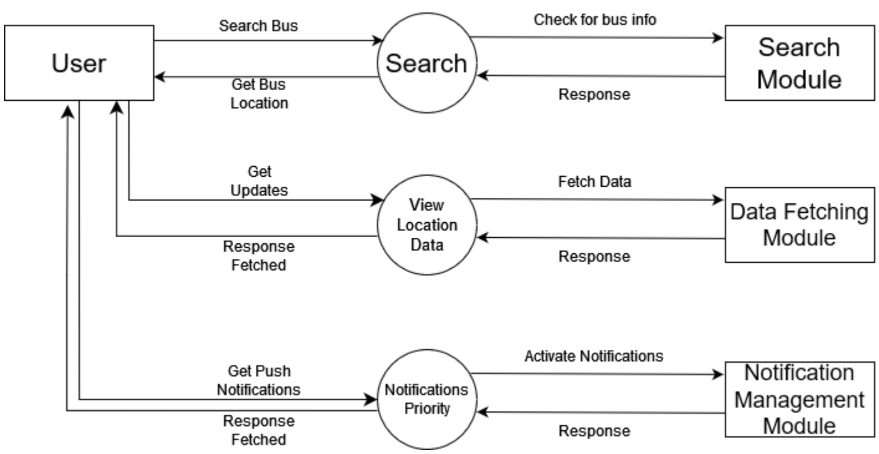


Figure 10: Flowchart diagram for user query and response to the real-time updates of the vehicle's position.

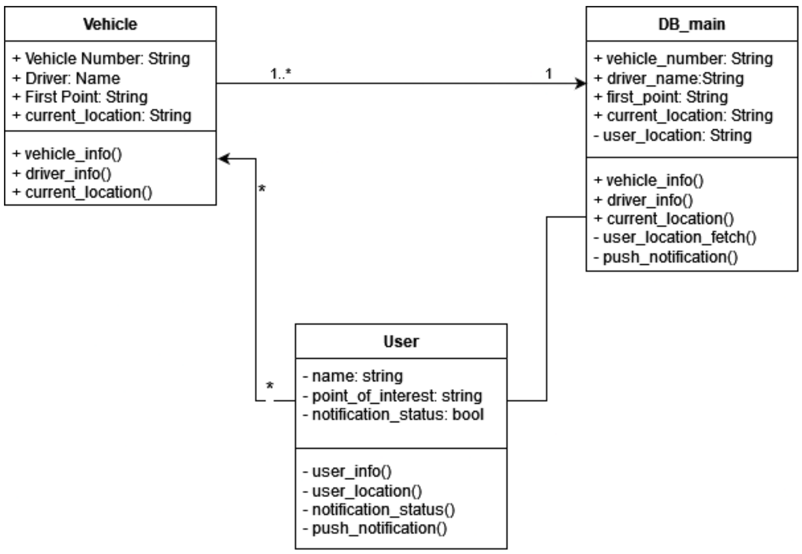


Figure 11: Class Diagram of VTrack. The diagram features three classes with their objects and the methods.

Limitations

While the VTrack project aims to deliver a comprehensive vehicle tracking solution, there are a few potential limitations and challenges that may arise during the development and deployment phases:

1. **Data Privacy Concerns:** Ensuring the protection of user data and addressing privacy concerns related to vehicle tracking will be a critical consideration.
2. **Regulatory Compliance:** The VTrack system must comply with relevant regulations and guidelines governing the use of GPS technology and vehicle tracking systems.
3. **Connectivity Challenges:** Maintaining reliable and uninterrupted connectivity in remote or rural areas may pose technical challenges that need to be addressed.
4. **User Adoption:** Ensuring widespread user adoption and overcoming any resistance to change may require comprehensive user training and support.

The project team will actively monitor and address these limitations throughout the development and deployment phases to mitigate any potential risks and ensure the successful implementation of the VTrack system.

Programming Language Requirement
The VTrack project will utilize the following programming languages and technologies:

- **Front-end:** HTML, CSS, JavaScript, TypeScript
- **Back-end:** PHP, C++
- **Database:** MySQL
- **Mapping and GPS:** Leveraging third-party APIs and GPS modules

The selection of these programming languages and technologies ensures compatibility, scalability, and performance optimization for the VTrack system.

Tools to Use
The VTrack project will employ the following tools and software applications:

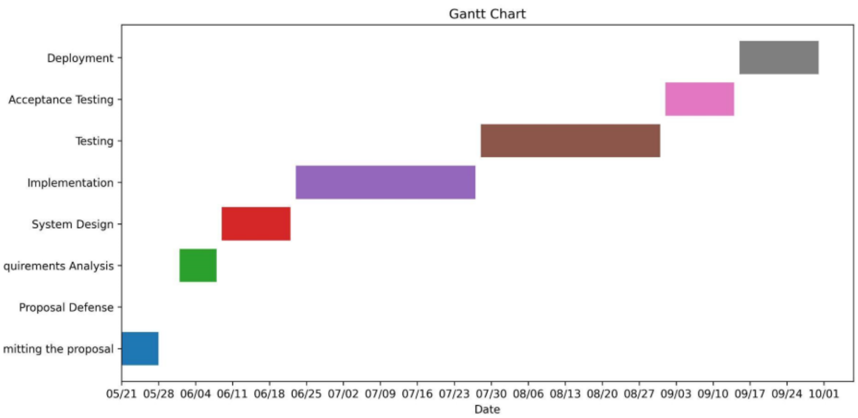
- **Proteus:** A PCB design and circuit simulation software for the development and testing of the hardware components.
- **MySQL:** A robust and widely-used database management system for storing and managing the vehicle tracking data.
- **Mapping APIs:** Third-party mapping and location services, such as Google Maps or OpenStreetMap, to integrate real-time mapping and navigation capabilities.
- **GPS Modules:** Specialized GPS hardware components for accurate vehicle location tracking and data collection.

The use of these tools and software applications will enable the project team to create a comprehensive and reliable vehicle tracking system.

Project schedule
The VTrack project is scheduled to be completed by the end of September. The key milestones and deliverables are as follows:

Phase	Milestone	Deliverable	Timeline
Requirements Analysis	Finalize system requirements	Detailed requirements document	1 week
System Design	Complete high-level and low-level design	System architecture and design specifications	2 weeks
Implementation	Develop and integrate system components	Functional VTrack prototype	6 weeks

Testing	Conduct unit, integration, and system testing	Test reports and quality assurance documentation	5 weeks
Acceptance Testing	Obtain user acceptance	User acceptance test results	2 weeks
Deployment	Deploy the VTrack system	Fully operational VTrack system	3 weeks



The project team will closely monitor the progress and make necessary adjustments to ensure the timely completion of the VTrack project.

Expected Output

The successful implementation of the VTrack project will deliver several key outputs and benefits. The VTrack system will provide users with nearly real-time updates on the location and status of their vehicles, enabling them to make informed decisions and respond to emergencies effectively. Additionally, the system will improve campus vehicle monitoring, allowing the university administration to efficiently manage and monitor the movement of campus vehicles, ensuring improved security.

The VTrack system will also bring about various benefits, including enhanced fleet management efficiency, increased driver safety, and cost savings. Businesses and organizations will be able to optimize their fleet operations, reduce costs, and improve overall productivity through the system's fleet management tools and features. The system's route optimization and fuel consumption monitoring capabilities will help users reduce operational costs associated with fleet management. Overall, the VTrack system is expected to have a significant impact on the management and monitoring of vehicles, leading to improved efficiency, safety, and cost savings.

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