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Department of Computer Engineering,

St. Vincent Pallotti College of Engineering &amp; Technology, Nagpur,

**Smart Bus Management System (SBM)**

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*Abstract* - Smart Bus Management System (SBM) is an analysis- based React script project which aims to develop an application that helps in providing easy facilities to Students and Parents. This project is Dynamic in nature and updates the location of the bus after every thirty seconds. It is actually a React script that uses various React modules. This project is developed to help the Bus administration department of various schools and offices. This project has immense scope for development in the future.

**Keywords** – JS, API, IoT, LOCATION, GPS;

**I. INTRODUCTION**

It is an application designed for students availing of the bus facility. The basic objective behind developing this application is to provide ease to students and their parents regarding the bus facility because students have to wait for a long time for the bus to arrive at the bus stop at the time of departure to college. The students, as well as the parents, can track the status of the bus location, they can check the bus's timing, and if their bus has changed and the application will have the schedule and the information of the routes of the buses.

**A. Overview**

A tracker is a small device that you can attach, stick or hook up to your personal belongings and then connect to an app on your mobile device. When activated, it will start fetching the location in terms of the coordinates of the object it is attached to and submit this information to the database of the system. This can be done directly between the gadget and the device, or remotely through an external third party.

This facility can be used by students as well as their parents to track the live location of the bus at the time of departure to college. The parents also can track the location of the bus for the safety of their ward whether it has reached the college or not. They can contact the bus facility provider as well as the bus driver regarding queries. The admin will manage all the databases and user information along with the display of any notice or schedule of the route changing and the whole system for proper governance.

**B. Objective**

- To track the exact location of the bus.

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- To provide the schedule and routes of the bus.
- To minimize the workload of management and bus authorities.
- To provide easy tracking to the parents of the ward.
- In consideration of the future, a payment gateway through which bus fees will be paid is added and their fees paid receipt will be shown.

**II. LITERATURE REVIEW**

An examination of the literature on GPS tracking systems reveals that their use has increased significantly over the last decade. This technology is utilized in a variety of applications such as logistics and supply chain management, security and surveillance, asset tracking, vehicle fleet management, automatic identification systems, and emergency response services. The primary advantages of GPS tracking are increased operational efficiency and cost savings due to real-time visibility into location-based data. GPS trackers give the location information in a variety of ways, including route guiding and geo-fencing notifications when an object departs or enters a virtual fence-enclosed area. Our System offers the user a tracking system efficient enough to save the user's time. We use a set of hardware devices that will provide accuracy of location reliability combined with better integration capabilities. The system is compatible with mobile phones as well as laptops

**III. METHODOLOGY**

The project is basically divided into two major modules viz. Hardware (IoT devices) and Software (Website).

**A. Hardware (IoT Devices)**

IoT devices are used to track the location of the bus which will be installed in the bus. The location is in the form of coordinates (Latitude and Longitude). These coordinates are stored in the database which is fetched using the IoT devices. The IoT devices used in this project are as follows:

**1) Wi-Fi Module (ESP8266 NodeMCU):**

NodeMCU is a Wi-Fi module that is usually used to send data using a local network. It is a low cost and high integration device for the IoT domain. This module has a microcontroller IC which connects to 2.4 GHz Wi-Fi. The IC uses IEEE 802.11 standard. This 32-bit architecture IC has 160 KB of in-built RAM of which 64 KB is for instruction and 96 KB is for data. This device operates on a voltage of 2.5 to

3.3 volts. It contains two buttons - reset and flash. The reset button resets the NodeMCU and the flash button is used to enable GPIO0 (for General Purpose Input and Output pin 0) which takes input from data pins. The board has 4 power pins (one pin VIN for input power and three pins for 3.3 volts output power supply) and 3 GND pins for ground supply (or used to connect negative terminals).

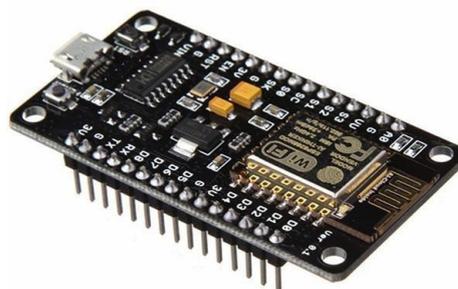


Figure 1. ESP8266 NodeMCU.

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2) *GPS Module (NEO-6M):*

GPS module is generally used to get the location coordinates, where the device is placed. It is a high-performance and strong satellite connection capability GPS receiver with an antenna connected to it. It has an in-built EEPROM to store the data parameters. It has power and signal indicators with a backup battery for data storage. It requires a power supply of 3.3 volts to 5 volts. The board contains 4 pins - VCC, GND, TX, and RX. VCC pin provides the power supply to the module. GND pin is for ground supply (and connection of negative terminals). TX pin is used to transmit the data from the GPS board to the RX pin of NodeMCU. RX pin is used to receive the data from the NodeMCU connected to the TX pin of NodeMCU.



Figure 2. GPS Module (NEO-6M)

Another main component is Arduino IDE. It is an open-source software generally used to write, compile and upload the sketch (code) into the Arduino boards. For this project, we require some additional header files like TinyGPS++.h, WiFiClient.h, etc. for the IoT devices.

**B. Website**

The website is a medium where users can access the features of this project. The website is designed and divided into two main modules viz. Frontend and Backend. The frontend will consist of several pages linked with each other. The home page will contain three components i.e., a navbar, a header and footer. The navbar will have the pages like location, routes, and contact. The location will be displayed in Google Maps using the Static Maps API provided by GCP.

The home page has a sign-up and sign-in facility for new as well as registered users. The backend is designed to store the data of hardware devices. It will also contain data of registered users and some useful data. Also, the backend will consist of logical programs required for tracing the location.

**IV. SYSTEM DESIGN****A. How hardware is connected?***Architecture*

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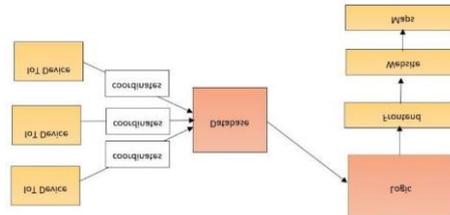


Figure 3. System Architecture.

The location fetched from IoT devices that are installed in the bus is stored in the MongoDB database. The logic in the webpage will fetch the location coordinates from the database and show the location of the bus. For this purpose, it requires the Static Maps API from Google Maps Platform. It helps to display the maps and access some features associated with it on our website. The location will be automatically updated in the database after a time loop of 30 seconds.

1) *Connection:*

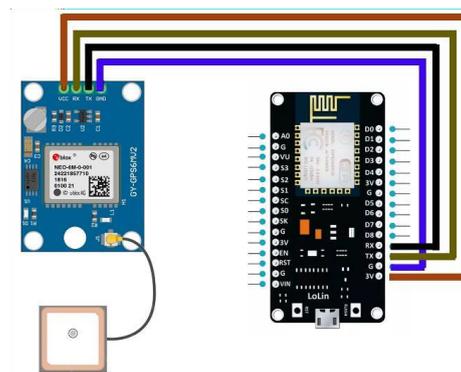


Figure 4. Circuit Diagram.

The connections are being made as shown in circuit diagram (fig.4). The power supply of 3.3 volts will be given to NodeMCU via a data transfer cable and adapter. The 3V3 pin of NodeMCU is connected to the VCC pin of the GPS module. The GND pin of NodeMCU is connected to the GND pin of the GPS module. The TX and RX pins of NodeMCU are reconnected to the RX and TX pins of the GPS module respectively. Connecting female wires are used for connections between two devices

B. *How the system is designed?*

The interface, as previously mentioned divided into two major parts i.e. Frontend and Backend:

1) *Frontend:*

The Frontend is designed by using ReactJS and Bootstrap. It contains all the elements that users interact with, such as the user interface, design, and layout of the website. ReactJS is a popular and efficient frontend JavaScript library for creating high-quality and responsive web applications. Frontend is further divided into 6 main pages as follows:

- 1) Home Page – The home component is a home page of a website that gives a description of the website. It contains a navigation bar, header and footer of the website which helps users to navigate and communicate with the website.

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- II) Login and Signup Page - Login and Signup Page are essential features of web applications that require user authentication. The Sign in component allows registered users to access the application's functionalities by providing their login credentials. On the other hand, the signup component enables new users to create accounts and gain access to the application.
- III) Location Page - Location Page is a component of a website which contain the map interface to shows the live location of the bus which are going to fetch from the backend with the help of IoT devices ESP8266 NodeMCU and GPS Module NEO 6M.
- IV) Routes Page - Routes Page is another component of a website which contains a list of all the routes.
- V) About Page - The About page gives a description about the website.
- VI) Contact Page - Contact Page gives the contact details to solve queries related to service by communicating with the website owner.

2) *Backend:*

The backend is designed by using NodeJS with API and MongoDB Database. NodeJS will provide the server to run the website on localhost. MongoDB is a NoSQL Database that will be used to create the cluster and to store the registration data of the user with the help of API. In Backend, API plays a critical role to connect the user-facing frontend with the backend functionalities and data. There are different routes that will be created in the backend to navigate the user on multiple pages of the website.

NodeJS contains an NPM (Node Package Manager) Registry where all the important dependencies are present which are used to connect and configure the database models, schema, routes and middleware in the backend. All Important Dependencies will install with the help of NPM. It will manage all the API's and logical functionality which are used to communicate with the database.

Location Coordinates will be fetched from the IoT Devices through API which will be created in NodeJS on the backend side. Location Fetch API was created by adding schema and Controller in the Backend Application in NodeJS.

**V. RESULT AND CONCLUSION**

The implementation will be done by keeping several physical entities in consideration like students, parents, bus drivers, and administration. The system is cost-effective, efficient and easy to understand for each new user. All operations in the system are performed effectively. This project may be generalized for all institutions and organizations which provides bus facility to their student or employees in the company. Advancements in this project will be done according to the need of the client. Also, some modifications are undertaken by considering surrounding factors.

**VI. FUTURE SCOPE**

- Further advancements in this may include functionalities like ping notification before the arrival of the bus, Online bus admission, etc.
- The functionality may be changed or modified according to the timely need.
- In the future, this project can also have a bus fees payment option which will generate a receipt if the fee is paid and if the fee is balanced, then it will send a notification to the user.
- Additional functions, such as speed monitoring and driving performance evaluation, can help to maximize resource utilization and reduce operational risks.

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