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Internal Navigation to Track Railway Coach

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ABSTRACT: Most people rely on the Global Positioning System (GPS) to provide location information, weather forecasts, and navigation. Devices with GPS capability can determine their location by connecting to four or more satellites, and the system works accurately in outdoor environments, providing essential information to users globally. However, because GPS requires an unobstructed line of sight connection with satellites, it is inefficient in indoor conditions. With the increasing construction of buildings with over 3 million sq ft floor areas worldwide, there is a developing opportunity for indoor positioning and navigation. As a result, alternative systems that use popular wireless technologies such as Bluetooth, Wi-Fi, RFID, and Infrared are being researched and developed for indoor spaces. This project proposes to create a mobile application that utilizes Wi-Fi technology to track the exact location of train coaches and help users navigate to a specific train.

KEYWORDS*:* Navigation, wireless Fidelity (Wi-Fi), indoor spaces, Location, tracking.

I.INTRODUCTION

The utilization of Wi-Fi for internal navigation has the potential to significantly transform the way railway coaches are tracked and managed within train stations and yards. This technology works by relying on the signals emitted by Wi-Fi access points to pinpoint the location of each coach, enabling a more efficient approach to railway operations. By strategically installing Wi-Fi access points, the location of every coach can be determined depending upon the signals received by these access points. This information can then be used in a proper way to design a map of the train yard or station, which enables operators to keep track of the movement of each coach. Internal navigation using Wi-Fi technology can also be used for monitoring the condition of railway infrastructure, such as tracks and signals.
This technology functions by measuring the signal strength of Wi-Fi access points in proximity of the coach and utilizing algorithms to estimate its position. The resulting data can then be utilized to construct a map of the train yard or station, facilitating the tracking of the movement of each coach by operators. Such internal navigation is particularly valuable in sizable train stations or yards where it may be challenging to visually track the location of each coach. By adopting Wi-Fi positioning, operators can swiftly and precisely determine the whereabouts of each coach, which leads to an improvement in the efficiency and safety of railway operations.

Internal navigation using Wi-Fi is not exclusively advantageous for railway operations. This technology can also be implemented in other industries, including aviation and logistics, where monitoring the movement of individuals and assets within a vast area is essential. Moreover, Wi-Fi positioning quality has a capacity to get adopted by factors like interference from other Wi-Fi devices and modifications in the surroundings, such as the movement of people and objects.In general, the use of Wi-Fi for internal navigation is a technology that offers significant promise and has the potential to transform the approach to tracking and managing railway coaches within train stations and yards. As this technology progresses, it is obvious that it might face difficult to accept a situation in companies where monitoring the movement of individuals and assets in a vast area is crucial. The technology has different difficulties that should be resolved to release its complete potential.

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II.LITERATURE REVIEW

For numerous years, internal navigation has continuously with the objective of offering guidance to individuals who move within indoor settings. The subsequent analysis of literature will examine some of the latest studies on internal navigation and the various methods employed for indoor localization and navigation.

Wi-Fi fingerprinting is a often used method which helps the indoor localization. This approach entails measuring the signal strength of Wi-Fi access points at various locations within the indoor environment and creating a map based on these measurements. The map is used to identify user's location by calculating the strength of the signal of the Wi-Fi access points surrounding them. In a recent paper [1], a hybrid approach utilizing both Wi-Fi and Bluetooth Low Energy (BLE) fingerprinting has been designed for indoor localization. The findings also point out that the combined method facilitates greater quality compared to the wifi.

Another technique for indoor localization involves using Bluetooth beacons. This approach requires the placement of Bluetooth beacons at different locations throughout the indoor environment and utilizing the signal strength of these beacons to determine the user's location. In a recent study [2], a probabilistic model was introduced for Bluetooth beacon-based localization. The results shows that the demonstrated that the suggested model facilitates greater accuracy than the current method for Bluetooth-based localization.

Indoor localization techniques have mainly relied on Wi-Fi fingerprinting and Bluetooth beacons. Wi-Fi fingerprinting involves measuring signal strengths of Wi-Fi access points within indoor environments, while Bluetooth beacons are used to determine a user's location based on signal strength. Several years ago, visual based method has been discovered using computer vision algorithms to determine location through images. Indoor navigation often employs a map-based approach, where users follow a map to their destination. In a recent study, researchers proposed a map- based navigation system makes use of augmented reality(AR) for intensifying the user experience. The proposed system was widely used in guiding users to their desired location.

To sum up, indoor navigation is a dynamic field of study that is exploring different methods for indoor localization and navigation. Wi-Fi fingerprinting, Bluetooth beacons, visual-based techniques, map-based navigation, and audio- based navigation are among the prevalent methods utilized for indoor navigation. Every technique consist of their own importance and shortcomings, and researchers are persistently exploring new strategies to enhance the accuracy and efficiency of indoor navigation systems.

III.METHODOLOGY OF PROPOSED SURVEY

Fingerprinting has become is widely used for indoor positioning and navigation due to several benefits it offers over other techniques. Firstly, wi-fi points can be accessed in indoor spaces, including airports, shopping malls, and office buildings, making it a practical option for users who don't want to carry any additional hardware like sensors or beacons for localization. Furthermore, wi-fi signals can gain access to wall and other hinders, providing extra protection for indoor environment and making it easier to locate a user's position. Along with benefits mentioned earlier, wi-fi fingerprinting has another advantage that it can achieve high accuracy in indoor localization because due to the large number of access points available in indoor environments. This results in a reliable source of location data, where this location data can be used to develop precise localization models. Moreover, wi-fi signals have consistent stability, making them essential for developing accurate localization models. Wi-fi fingerprinting is non-invasive and it will use small number of infrastructure, such as beacons or cameras. The movement of equipment can be both costly and time- consuming.

Therefore, wi-fi fingerprinting offers a cost-effective solution for indoor navigation.

Despite its advantages, wi-fi fingerprinting has some limitations that need to be addressed for an effective indoor navigation system. These include signal interference, changes in signal strength due to environmental factors, and the need for frequent calibration. These limitations can affect the accuracy of the system, and careful consideration is necessary when developing an indoor navigation solution. To overcome the limitations of wi-fi fingerprinting, researchers have been investigating hybrid approaches that combine wi-fi with other techniques such as bluetooth low energy (ble) and visual-based techniques. These hybrid approaches take advantage of the strengths of multiple technologies to improve the accuracy and reliability of indoor localization and navigation systems. By combining the benefits of different techniques, researchers aim to achieve higher accuracy in indoor navigation..

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Fingerprinting:

Indoor navigation using Wi-Fi is commonly done through the technique of fingerprinting. This technique involves the collection of signal strength data from Wi-Fi access points located at different points within a building. The data collected is then used to design the map . The map can be widely used to identify a user's location under the influence of the Wi-Fi signals they receive.

To create the map, a Wi-Fi scanner is utilized to gather data signal from each wifi points positioned at different locations throughout the building. The data collected is then analyzed and used to design a unique fingerprint for each access point. The fingerprint includes information such as signal strength, signal-to-noise ratio, and other characteristics that can be utilized to identify each access point.

After creating the fingerprints for all access points inside a building, they are stored in a database. Once a user with a Wi-Fi enabled device enters the building, the device scans for nearby Wi-Fi signals and the signal strengths are compared with signals present in the database. The recent research noted that the device can determine the user's location within the building. Fingerprinting can be grouped with the other techniques, such as trilateration or time of flight, to enhance accuracy. However, it is distinguished that fingerprinting can be affected by environmental changes, such as the addition or removal of furniture, which can alter signal strengths and adversely impact location determination accuracy.

Machine learning:

Machine learning is a powerful methodology for indoor navigation using Wi-Fi. This methodology makes use of machine learning algorithms to identify the signal strength and patterns of Wi-Fi signals inside a building. The algorithms are trained using a large dataset of Wi-Fi signal strength measure the machine learning algorithms can be used to develop a model that can exactly analyze a user's location based on the Wi-Fi signals they are receiving. This model is then used in real-time to determine the user's location as they move through the building.

One of the uses of machine learning is that it can adapt to changes in the environment and improve its accuracy over time. As more data is collected and analyzed, the machine learning model can be trained again to improve its predictions.

Machine learning makes use of excessive amount of data to be effective. In addition, the model accuracy can be affected by factors such as interference, signal strength, and difference in the building's environment. Therefore, it can be combined with other methodologies, such as fingerprinting or trilateration, to achieve the highest possible accuracy in indoor navigation using Wi-Fi.

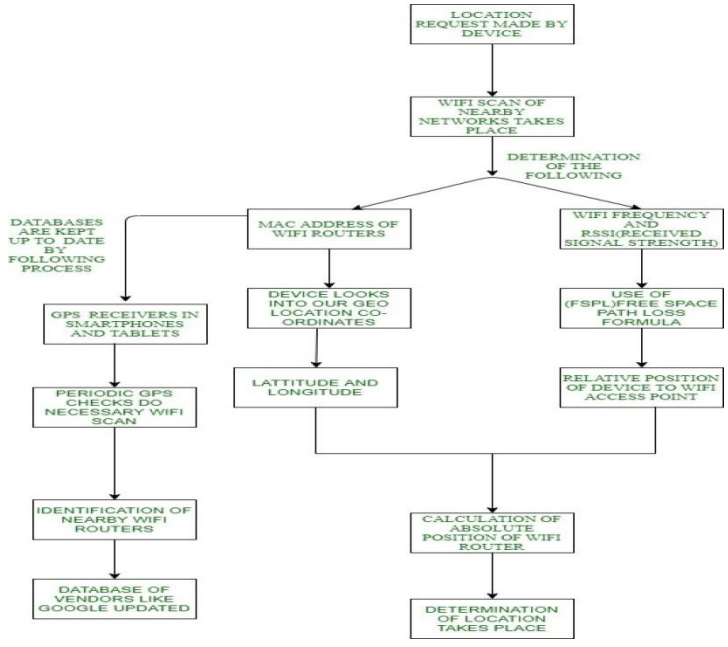

Figure 1 Flowchart indicating working of Internal navigation.

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IV.CONCLUSION AND FUTURE WORK

Internal navigation using Wi-fi can be a useful tool for tracking railway coaches within a specific area. By utilizing Wi-fi signals from access points, it is possible to accurately determine the location of a coach at any given time. This can be particularly useful for monitoring the movement of coaches within a rail yard or depot, or for tracking their progress along a specific route.

However, it is important to note that implementing an internal navigation system for railway coaches would require careful planning and consideration. Factors such as the number and placement of Wi-fi access points, the range of the signals, and the accuracy of the location determination would all need to be carefully evaluated and optimized to ensure the system's effectiveness.

Additionally, it is important to consider the potential privacy implications of tracking railway coaches using internal navigation. Proper measures would need to be taken to ensure that any data collected is used only for its intended purpose and that appropriate safeguards are in place to protect individuals' privacy. Overall, while internal navigation using Wi-fi has the potential to be a valuable tool for tracking railway coaches, it would require careful planning and consideration to ensure its effectiveness and address any potential privacy concerns.

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