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# Indoor Navigation System for Museum

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***Abstract: Although various solutions have been suggested for indoor navigation systems, most methods require the support of external physical hardware infrastructure. Due to the increase in complexity and cost of the set-up of supporting hardware requirements, scalability will always be an issue with such systems. In this paper, we present the design of a smartphone-based indoor navigation system. The proposed method uses on-device sensors for Computer Vision and is supported by a web-based architecture, for easily creating indoor maps and providing an indoor location's information for navigation and localization.***
***Keywords: Global Positioning System, Indoor Positioning Systems, Wi-Fi.***

## I. INTRODUCTION

Existing navigation systems can be broadly classified into two major categories, indoor and outdoor. Most outdoor navigation techniques use satellite-based navigation systems such as GPS, GLONASS, etc. to locate an object in any outdoor area. Such techniques work well in open spaces with a clear line of sight to the satellites, but may
not perform well in an indoor environment, as the signals get scattered and attenuated by physical objects. Museum visitors typically use paper brochures and signage to navigate around halls, missing many amenities and attractions. In addition, museums seek effective ways to engage millennial visitors influenced by technologies like smartphones, sensors, and social networks. Fortunately, museums can stay relevant by utilizing indoor navigation for Museums. Museum authorities or managers can boost visitor experience by providing interactive maps and driving engagement. The proposed method is supported by a web-based interface for users to easily create a map of the museum's indoor location by capturing panoramic images. A smartphone application can then request this map data from the webserver to localize and navigate the user to a destination via the shortest route.

## II. LITERATURE SURVEY

Global Positioning System (GPS) has practically solved the problem of outdoor localization. However, the limitation of GPS leads to a challenge in developing a new tracking system for indoor environments. Hence, the demand for accurate indoor localization services has become important. Until now, research related to IPS is still being conducted to improve the performance of positioning techniques.

Tracing back to the old days when people used to follow the ancient guiding-star navigation, the positioning system has always been in people's thoughts throughout history. Since then, a lot of technological growth has been seen and finally, Global Positioning System (GPS) has practically solved the problem of outdoor localization. A major challenge in developing a new tracking system for the indoor environment was the limitation of GPS. GPS functions through satellites, which are located a thousand miles away from the ground. When signals from satellites are transmitted to devices, they are obstructed on the way resulting in weak signals. Different barriers such as trees and buildings transmitting weak signals are reflected which causes multipath interference. In addition, the building materials cause extra problems that make it very difficult to perform indoor tracking through GPS. As a result, to provide a similar system to GPS for indoor environments a lot of studies have been done but have yet to dive full-featurette effective and accurate Indoor Positioning System (IPS). A navigation system that is made of network devices to locate objects or people with the capability to localize the position of a wireless capable device within a particular space inside an indoor environment is referred to as IPS. Developing IPS has become a popular research area due to its increasing demand after the great success of adopting GPS which is very effective and accurate for outdoor environments. People want to use indoor positioning systems for various purposes such as security and finding the location of materials in emergencies. Traditionally, different infrastructures such as Wi-Fi, Bluetooth, and RFID are designed based on location estimation or positioning frameworks for indoor environments [2]. Many techniques can be used for localization. GSM is known mostly for technology for the localization of handheld devices. Probably, the most known system combines different technologies, combines GPS, Wi-Fi, and GSM beacons. Systems using Wi-Fi alone already have been implemented in the current real-time, but the technology used is very dependent on the Wi-Fi access point placement and RF fingerprint since they only use Wi-Fi and do not integrate any other sensors.

 

Challenges in developing any indoor localization and navigation system include map generation, indoor localization, software development for the client platform, etc. In this paper, we intend to present the design of an end-to-end solution that allows for map generation, indoor localization, and navigation with the help of an off-the-shelf smartphone.

TABLE I. Literature survey

| SR.NO | PAPER NAME | PUBLISHER | LINK | DESCRIPTION |
|---|---|---|---|---|
| 1 | Methods for developing an indoor navigation system | Dimitrina Deliyska, Nikolay Yanev, and Mariana Trifonova University of Mining and Geology "St. Ivan Rilski". **January 2021 E3S Web of Conferences 280(5):04001** | https://www.researchgate net/ publication/ 352864580Methods for developing an indoor navigation system | The methods offered include map digitizing, determining a user's location, and selecting the shortest path. |
| 2 | Implementation of an Indoor Location System for Mobile-Based Museum Guidance | Dennis N´u˜nez-Fern´andez : International Conference on Information Management and Big Data SIMBig 2019 **August 2019** | https://www.researchgate.net/publication/335320540_Implementation_of_an_Indoor_Location_System_for_Mobile-Based_Museum_Guidance | An indoor location system that makes use of a mobile phone and levels of WiFi signals to determine the location of a person in the museum |
| 3 | A Smartphone-Based Indoor Navigation System | Shivam Verma∗, Rohit Omanwar∗, Sreejith V∗, Meera GS BITS Pilani - K K Birla Goa campus, Goa, India {f2009680, h2012060, **December 2016** | https://www.researchgate.net/publication/313540154_A_smartphone___based_indoor_navigation_system | On-device sensors for Dead-reckoning and are supported by a web- based architecture, for easily creating indoor maps and providing an indoor location's information for navigation and localization |
| 4 | Indoor Navigation/Indoor Positioning with Mobile Devices | Lennart Oldenburg ,Jan Meznari˘c , Eridy Lukau , Andreas Hechenberg **Erxperiment Findings · February 2016** | (PDF) Indoor Navigation/Indoor Positioning with Mobile Devices (researchgate.net) | To research possibilities for indoor navigation. |
| 5 | An Indoor Navigation System For Smartphones | Abhijit Chandgadkar **Imperial College London June 18, 2013** | https://www.doc.ic.ac.uk/teaching/distinguished-projects/2013/a.chandgadkar.pdf | Smartphones capable of guiding users accurately to their destinations in an unfamiliar indoor environment |
| 6 | Indoor Navigation System for Handheld Devices | Manh Hung V. Le **October 22, 2009** | https://web.wpi.edu/Pubs/E-project/Available/E-project-102209-164024/unrestricted/Indoor_Navigation_System_for_Handheld | A new approach that uses data from the device's wireless adapter, accelerometer, and compass to determine user position |

## III. ARCHITECTURE

The architecture diagram explains the flow of the process by which the user requests the location and the mechanisms used to find the path between the source and the destination areas and the path assistance along the path. The database in return generates the Floor map and it creates the route map with the use of the coordinates. Tracing back to the old days when people used to follow the ancient guiding-star navigation, the positioning system has always been in people's thoughts throughout history. Since then, a lot of technological growth has been seen and finally, Global Positioning System (GPS) has practically solved the problem of outdoor localization. A major challenge in developing a new tracking system for the indoor environment was the limitation of GPS. GPS functions through satellites, which are located a thousand miles away from the ground.

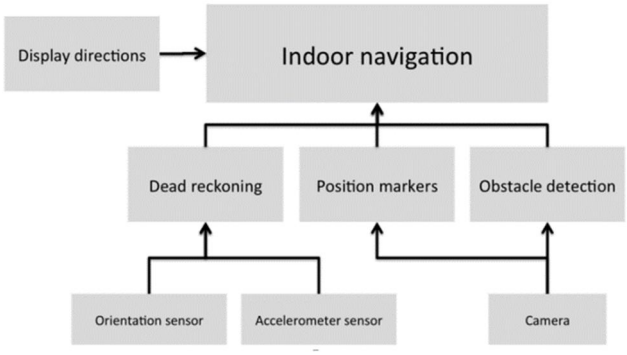


Fig 1 System architecture

## IV. RESULT

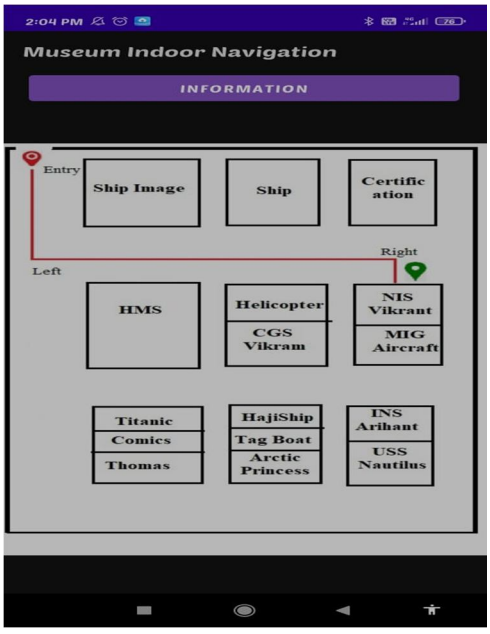


Fig 1 Navigation Map

## V. CONCLUSION

This paper introduced the implementation of a Wi-Fi-based indoor location system to guide visitors at the museum on the premises of Anantrao Pawar College of Engineering and Research. To accomplish a high positioning accuracy, a fast response time, and low computational power consumption, the proposed system makes use of Computer Vision's Augmented Reality. The proposed methodology is not limited to this work, but can also be applied to similar localization tasks such as robot control, immersive experiences, and asset tracking, among others.

## VI. FUTURE SCOPE

In this paper, we have presented a system for indoor navigation using off-the-shelf smartphones. In the first phase, an indoor map of the area by linking panoramic images using map plotting software like Unity or Euphoria. This indoor map will then be used by our smartphone-based Navigation application to estimate a user's location, calculate the shortest path, and help in navigating the user in the Museum. In future work, we plan to extend our smartphone application to automate the process of step counting when capturing panoramas. We also plan to explore real-time image-matching techniques using smartphones to increase the accuracy of our indoor navigation system. As well as in the next phase of Localization and Navigation we will implement Augmented Reality and its Virtual Assistant for Users.

## VII. ACKNOWLEDGMENTS

We would like to sincerely thank the individuals who guided us through our Major Qualifying Project and who made our experience a memorable one. We would like to thank our project guide, Prof. Pranjali More, for providing us with the necessary information and resources to complete our project, also guiding us along the way with her constant support and showing confidence in us. We would also like to thank Professor Rama Gaikwad for their continuous help and support throughout the project.

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[2] Implementation of an Indoor Location System for Mobile-Based Museum Guidance Conference Paper · Dennis N´u˜nez-Fernandez(B) Universidad Nacional de Ingenier´ıa, Lima, Peru August 2019 DOI: 10.1007/978-3-030-46140-9_7- https://www.researchgate.net/publication/335320540_Implementation_of_an_Indoor_Location_System_for_Mobile-Based_Museum_Guidance

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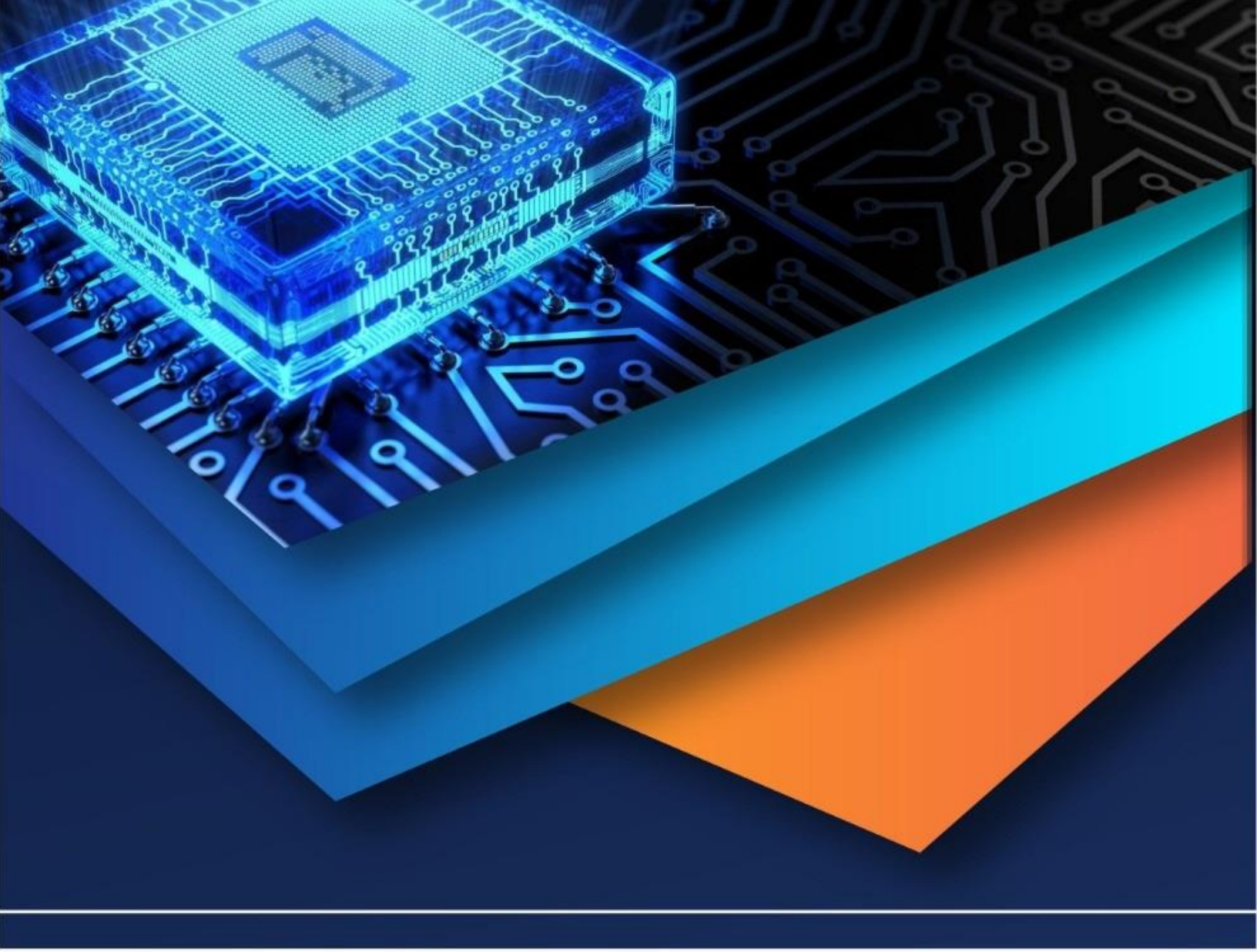

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