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Indoor Navigation System Using Augmented Reality

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Abstract: In today's life, when the cities are rising, usage areas of mobile phones have increased in the last ten years. Although there have been significant improvements in many areas, most of the developments are in the field of positioning systems. Although the people's lives continue in indoor circumstances, location-based information system receives details from the satellites, which can detect a person's location in the outdoor region alone. However, for indoor areas, no efficient and perfect technology has been developed for navigation or positioning. In this paper we have come up with an exceptional solution that is indoor navigation mobile application which works with augmented reality, in our proposed solution, we will be using the mobile camera as the scanner for getting the path and extracting the features from various objects in the pathway. We use ARCore SDK, which is the heart of this project, which has an inbuilt property called area learning, which helps the system to extract and learn about the features present in a particular outline using Machine Learning.
Keywords: Mobile application, augmented reality, ARCore SDK, indoor positioning, and navigation.

I. INTRODUCTION

The booming enhancement of mobile technology in today's 21st century is one of the prime factors of the growing technological environment in every country. One of the critical concerns has always been the development of mobile applications, and researchers have put in a lot of effort into compatible operating systems for supporting these applications[3]. Thanks to modern-day technologies, android has emerged as one of the top-notch mobile operating systems, which even has a more straightforward development interface for application developers as compared to other OS. This paved the path for the more effortless development of complex applications for developers [4]. One of the many essential requirements in our day to day life is positioning and navigation of oneself, i.e., where the person wants to go and his actual position. With the advancement in mobile technologies, there has been an urge for the improvement of navigation-based technologies, in which mobile applications can play a crucial role. With the advancements in above-said technologies, outdoor navigation has enhanced ten-folds. Nevertheless, with the lives of people who are indoor oriented, a complex indoor scenario like office space, IT-campus, hospitals, malls navigation becomes a significant concern [5]. Going to a new campus and getting used to the campus environment takes time for a fresher. In thesetypes of conditions, an indoor navigation system is a must and becomes a friend in need.

A. Bluetooth Beacons:

Bluetooth Beacons broadcast their identifier to nearby portable electronic devices [6].

Disadvantage: But this technology enables smartphones/tablets and other devices to perform actions and navigation only when close to a beacon

B. Wi-fi positioning system (WPS):

WPS uses the characteristics of nearby wi-fi hotspots and other wireless access points to find where a device is located. It is the most conventional and considerable localization technique used for positioning is based on measuring the power of the received signal and the procedure of fingerprinting [7].

Disadvantage:But the accuracy depends on the number of access points whose positions have been entered into the database[8].

C. Radio Frequency Identification Tags (RFID):

Radio Frequency Identification uses electromagnetic fields to recognize and track tags fixed to things instinctively.

Disadvantage: But a large amount of data may be generated that is not useful for managing indoor navigation or other applications and makes the system inefficient [1]

II. LITERATURE REVIEW

In 2016, Verma, S., Omanwar [11] represented a system for indoor navigation using off-the-shelf mobile phones. In the first phase, a user creates an inside map of the world by linking panoramic images using our web application, Map Maker. This indoor map is then employed by our smartphone-based Navigation application to estimate a user's location, calculate the shortest path and help in navigating the user to a destination. In future work, we decide to extend our smartphone application to automate the method of step counting when capturing panoramas. We also decide to explore real-time image matching techniques using smartphones to extend the accuracy of our indoor navigation system.

In 2018, Jain, V.[12] introduced the concept of this approach shows the potential for future upgradations. It can be a revolutionary step in an indoor navigation system. This work incorporates visual technology, which is proliferating. The accuracy of the AR toolkit in detecting a marker depends on lighting conditions. If the lighting condition is almost the same as the lighting condition in which the marker is developed, then the AR toolkit will work correctly. In the future, there can be various modifications made to the navigation system, such as using an audio module for helping in navigating, and also, the processing and calibration of the camera can be improved. AR toolkit can be trained in detecting colored markers too. As a part of future tasks, we would like to work on building a system for the preprocessing of the indoor floor plan of the building. This will directly work towards the idea proposed in this work.

In 2017, Bin Abdul Malek[13]paper represented an alternative navigation tool that can be used in an indoor environment. This is due to restrictions on Global Positioning System signals that cannot be detected in indoor locations. The work presented here shows the event of an interactive indoor localization system that uses live input video capture and may identify location markers to point its current location. Besides, augmented reality also can superimpose augmented reality objects above the situation markers to point the direction to be taken by the user, which assists the user in navigating to the chosen destination. The developed system was implemented on a Raspberry Pi, an embedded computing platform, with a USB camera and display glasses for live video capture and display devices, respectively. It was tested in Universiti Teknologi PETRONAS' Information Resource Center, across multiple locations and different floors of the middle.

In 2006, Jong-Bae Kim[14]described the personal location method in image order using a wearable computer for an Augmented Reality-based indoor navigation system, which allows the user to navigate an unfamiliar and unknown spot in an indoor environment. The system uses a color histogram matching technique to recognize the personal location in the image sequence. Individual locations are recognized by the suggested method in real-time. The results are overplayed on the user's view through the Augmented Reality technique. The plan presented in this system applies to a navigation system.

In 2017, Li's[15]study indicated that the proposed Augmented Reality and Virtual Reality systems effectively induced anxiety in subjects. Moreover, by measuring the subjective scale scores, skin conductance, and heart rate, no significant difference was found between the proposed Augmented Reality and Virtual Reality systems in terms of inducing anxiety. Future research will further quantify the contribution of each type of stimulus from human perceptions (visual, auditory, haptic, or smell) and investigate whether Augmented Reality or Virtual Reality system is more effective in inducing anxiety.

III. RESEARCH METHODOLOGY

In our proposed system, the heart of the project goes with ARCore SDK, which takes the real-world objects as input through the camera and converts them into logical and unique features. ARCore SDK has an exclusive property called Places learning model, which is based on Machine Learning that helps it to extract the features from real-world objects. It uses motion tracking that is useful for feature extraction following the movement and orientation of the phone. So this is how our proposed system works:

A. Firstly, the user will open an application based on AR.
B. This app will intimate the user either to create his own map/route or will ask him/her if the user needs assistancewith navigation.
C. If the user clicks on the create map, then the user automatically will be asked the name of the source and destination and will be asked to start his/her camera.
D. After the camera is initialized, the application using ARCore will start extracting features from the

camera input, and the user will be asked for marking waypoints at the place where feature extraction has been completed.

E. This will complete the mapping phase.

F. If the user clicks on 'assist me' for indoor navigation, the user will be next asked for a destination.

G. Once the destination has been taken, the camera will be initialized, and features from the current location of the user will be extracted.

H. These features will be matched with the various features already present in the database, and if a match is found, the system will get the user's current location.

I. After this, the system will start the route planning algorithm and will find the best route from various routes that have already been mapped.

J. If no route is to be found to the destination, the user will get a prompt message that either the entered destination is wrong or no route has been found for the entered destination.

K. This route will lead the user to the destination.

The most exceptional advantage that our system has is that it is adaptive because the user input will be taken as a video feed other than AR camera feed and will be analyzed if the place has added some new objects or features, if yes then those features will also be added to the database. Furthermore, another major problem that exists is if there is an environment where no noticeable/unique objects are present, for example, stairs of a building, then we will be taking the help of QR codes, which will act as features for these kinds of environments.

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In our proposed system we have two phases:

Mapping Phase: - In this phase, the real-time mapping of the route occurs; we map the features present on the route and place them in a JSON format in the database.

Below given is the implementation level milestones for this phase: -

A. Extraction of features

B. The initialization of the camera for real-time scanning of objects

C. Features will be uploaded in the database in JSON format.

D. Marking of waypoints

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Testing Phase: - In this phase, we will take the user input from the user for the destination, and then the route planning algorithm will map the most suitable route from the user's current position to the destination. Below given is the implementation level milestones for this phase: -

(a)User input will be taken.

(b)The camera will be initialized for showing the route to the users.

(c)The route planning algorithm will find the best route possible from the current position.

(d)The marked waypoints will be shown on the mobile screen using arrows.

Below given is the architectural diagram of our proposed system: -

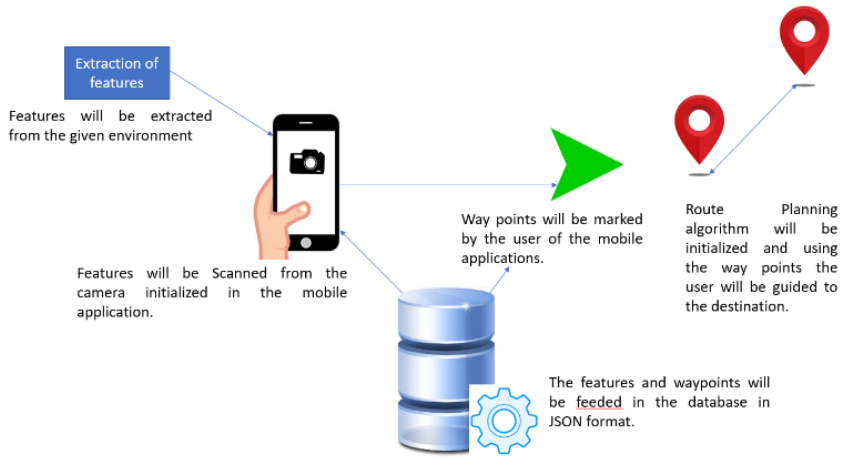

Fig .1 Architecture Diagram

IV. EXPERIMENTAL RESULTS

ARCore SDK normalized detection parameters

These parameters symbolize the average distance required for object detection. The object recognition accuracy of our system is affected by the camera-object separation. The minimum distance recommended by the ARCore SDK manufacturers is 30 cm. As the separation increases, the quality of the depth data deteriorates 1¼ times, and beyond 1 m, texture details of target objects are hard to capture [9]. The SDK capitalizes on any error with the help of unique features like machine learning models and motion testing from various angles. From reliable observations, to achieve reliable sensing and good quality visualization, we set an acceptable score of 0.5-1 for both the metrics [9].

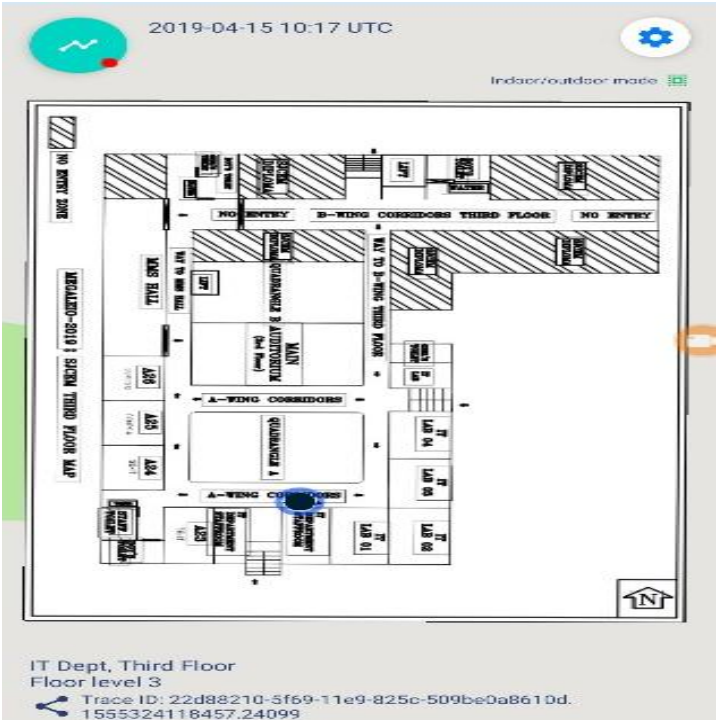

Fig .2 Real-time indoor navigation

Fig.3 Feature point extracted

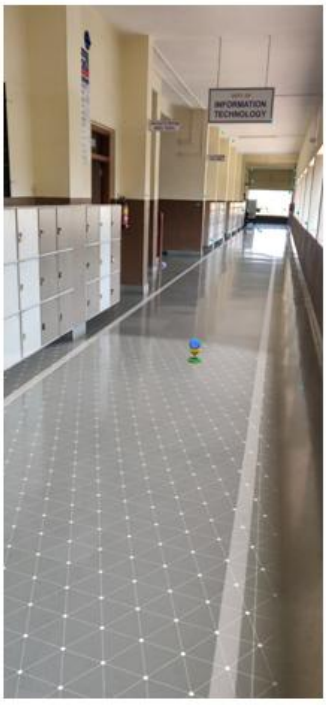

Fig .4 Visible AR object

The above figure shows the feature extraction from the location of theLabs/Classroom/Staffrooms by indicating AR object on the ground using plane detection. It superimposes a AR object in real world with the help of ARCore SDK and Unity.

V. CONCLUSION AND FUTURE SCOPE

This propose system, we have developed a system for indoor navigation based on augmented reality, which is supported on the android platform. We have kept in mind the tiresome work that goes into individuals' mind for looking through the map to navigate themselves in indoor environments. We have also kept in mind the complex scenarios that can be found in various indoor environments where one cannot find a real-world object which acts as a feature for the navigation; hence we have introduced the QRcode based feature which helps users in scenarios such as the above mentioned. As future work, we are planning to make this application cross-platform by using native environments for development. This would be helpful not only for android users but also for users who use iOS and other OSes. We would also work on how the system will be able to differentiate between similar objects placed at different places in the same indoor environment. We would also try to integrate outdoor environment navigation techniques with our system to navigate from one room in one part of the campus to the other room present at some other part of the same campus.

REFERENCES

[1]. O. Köroğlu, "En Yaygın Yeni İletişim Ortamı Mobil İletişim Ortamında İçerik ve Yayıncılık", Civilacademy Journal of Social Sciences, vol. 8, no. 2, pp. 55-86, 2010.

[2]. Z. T´oth, "Ilona: indoor localization and navigation system," Journal of Location Based Services, vol. 10, no. 4, pp. 285–302, 2016.

[3]. A. Serra, D. Carboni, and V. Marotto, "Indoor Pedestrian Navigation System Using a Modern Smartphone ", in Proceedings of the 12th International Conference on Human Computer Interaction with Mobile Devices and Services, pp. 397-398, (2010).

[4]. C. G. Low and Y. L. Lee, "SunMap+: An intelligent location-based virtual indoor navigation system using augmented reality," International Conference on Frontiers of Communications, Networks and Applications (ICFCNA 2014 - Malaysia), Kuala Lumpur, 2014, pp. 1-6

[5]. Z. T´oth and J. Tam´as, "Miskolc iis hybrid ips: Dataset for hybrid indoor positioning," in Radio elektronika (RADIOELEKTRONIKA), 2016 26th International Conference. IEEE, 2016, pp. 408–412.

[6]. Harter and A. Hopper, "A Distributed Location System for the Active Office," IEEE Network, January 1994.

[7]. N. Z. Naqvi, A. Kumar,A. Chauhan and K. Sahni, "Step Counting Using Smartphone-Based Accelerometer," International Journal on Computer Science and Engineering, vol 4, no 5, pp. 675-681, May, 2012.

[8]. B.Ozdenizci, V.Coskun, andK. Ok,"Nfc internal: An indoor navigation system," Sensors, vol. 15, no. 4, pp. 7571–7595, 2015.

[9]. Jaewoo Chung, Matt Donahoe, Chris Schmandt, Ig-Jae Kim, Pedram Razavai, Micaela Wiseman, "Indoor location sensing using geomagnetism", MobiSys '11 Proceedings of the 9th international conference on Mobile systems, applications, and services.

[10]. A.R. Pratama, Widyawan, and R. Hidayat,"Smartphonebased Pedestrian Dead Reckoning as an Indoor Positioning System", International Conference on System Engineering and Technology (ICSET), pp.1-6, (2012).

[11]. Verma, S., Omanwar, R., Sreejith, V., & Meera, G. S. (2016). A smartphone based indoor navigation system. 2016 28th International Conference on Microelectronics (ICM). doi:10.1109/icm.2016.7847886

[12]. Yadav, R., Chugh, H., Jain, V., & Baneriee, P. (2018). Indoor Navigation System Using Visual Positioning System with Augmented Reality. 2018 International Conference on Automation and Computational Engineering (ICACE). doi:10.1109/icace.2018.8687111

[13]. Bin Abdul Malek, M. F., Sebastian, P., & Drieberg, M. (2017). Augmented reality assisted localization for indoor navigation on embedded computing platform. 2017 IEEE International Conference on Signal and Image Processing Applications (ICSIPA). doi:10.1109/icsipa.2017.8120589

[14]. Jong-Bae Kim, Jeong-Mi Lee, & Hee-Sung Jun. (n.d.). AR-Based Indoor Navigation System for Personal Locating. 2006 Digest of Technical Papers International Conference on Consumer Electronics. doi:10.1109/icce.2006.1598388

[15]. Li, Y.-Y., Chiu, P.-H., Yeh, S.-C., & Zhou, C. (2017). Effects of Virtual Reality and Augmented Reality on Induced Anxiety. 2017 5th International Conference on Enterprise Systems (ES). doi:10.1109/es.2017.28