Improving Navigation for Street Data Using Mobile Augmented Reality

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ABSTRACT

The popularity of smart devices and Location Based Services is increasing in part due to users demand for personalized information associated with their location. These services provide intuitive and realistic information by adopting Augmented Reality(AR) technology. This technology utilizes various sensors embedded in the mobile devices like Global Positioning System(GPS), Compass, Accelerometer, Gyroscope. Current mobile AR applications using Location based service which contain POI data only display location information. MAR is usually constrained by the local storage and computing power of the device as well as the latency and bandwidth of the underlying wireless channel. We proposed the Local Cache Management (LCM) problem to manage the computation and communication work of a mobile device and harmonize the local and remote workloads. We use strategy to pre-fetch higher-priority objects from the server and replace lower-priority objects in the local cache.

Keyword : *Augmented Reality, Navigation, Location Based Service(LBS), GPS, Cache hit ratio*

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1. INTRODUCTION

With the spread of smartphones and the development of wireless technology, data communication is increasingly important than voice communication. Users of mobile devices want ubiquitous connectivity to the Internet and obtain query results in text, image, or video clips. Current implementation of data search on mobile devices exhibits many obstacles for conveniently displaying local data. Location data is acquired by means of mobile relay station data or global positioning system (GPS) and used in applications. Such applications showed data primarily in text or on maps in their early versions, however, an increasing number of applications have adopted augmented reality to display more intuitively by exploiting the many sensors attached on more recent devices [1].

In augmented reality, the image layer of physical world is overlaid with computer graphic elements (conventionally in real time). When informative data is displayed along with the physical world, the provided data is more intuitive to the user. LBS uses data from the gyroscope, accelerometer, and compass to determine to which direction the user is facing. Then information pertinent to the view on the phone camera is searched for. The obtained data is displayed in perspective on screen based on the distance to the elements and the user can intuitively perceive the distance and direction to each displayed element. As the user's position or the camera view changes, the icon of the location-based element on screen moves accordingly in real time so that the presented data feels more intuitive. Some recent work proposed different techniques but most of them have a limitation of providing faster response and higher cache hit ratio So, proposed technique gives lower response time with higher cache hit ratio.

2. MOBILE AUGMENTED REALITY

Mobile augmented reality has been introduced rapidly through various mobile applications ever since smart phones became widespread. Geographic information system applications, especially those using location based service, have adapted this new computer vision technology.

Many researchers have explored indoor positioning systems while other researchers have investigated how to combine AR interfaces with locational information. Technologies such as Assisted GPS (A-GPS), Infrared, Ultrasonic, and Radio Frequency Identification (RFID) are commonly used for indoor positioning. Augmented reality (AR) at first branched from virtual reality by overlaying a virtual computer image on top of the real-world image [1]. In its early days, augmented reality used head-mounted display (HMD) or hardware devices attached with various sensors. As mobile devices, have evolved quickly in recent years, augmented reality has been adopted in the mobile environment. Unlike the previous generation of AR of which the focus was primarily rendering three-dimensional graphic objects on real-time videos, AR in the mobile environment seeks to provide enhanced user experience by combining location data from the sensors along with regional data retrieved from the Internet. Users can retrieve information on shops, tourist attractions, movie theaters, etc. via this mobile AR service app.

2.1 Mobile Augmented Reality Tracking

Areas to which virtual images or tags are attached on top of real-world images captured with the camera. An approach to AR tracking can be based on data from sensors, visions, or a combination of both. Sensor-based AR tracking pays attention to the position, movement, speed, and direction of the object, and relies on data from sensors such as GPS, digital compass, and accelerometer. Vision-based AR tracking on the other hand focuses on identification of markers, non-markers, regular objects, and image. Hybrid AR tracking combines sensor-based and vision-based approaches.

2.1.1 Vision-based AR tracking

Vision-based tracking is the most active area of research in AR. In vision-based tracking, computer vision methods are used to calculate the camera pose relative to the real-world objects. Early vision-based tracking used fiducial markers in prepared environments. Currently, vision-based tracking research is based on marker less approach.

In marker-based tracking, fiducials (artificial markers) are placed in the scene for augmented reality applications. Visual markers are widely used in the AR systems. These markers have some specific properties that make them easy to identify their position in the real world. The fiducial design allows having thousands of different codes, thus enabling uninterrupted tracking throughout a large building at very reasonable cost. Marker-based AR tracking was presented that tracked and identified real-time known 2D markers made up of corners to estimate the accurate camera pose. Robustness at a large range of distance and reliability under severe orientations are the advantages of tracking corners. This system improved stability, convergence and accuracy of the pose parameters.

In marker-less tracking, technique minimizes the amount of data that needs to be extracted from the video feed. From the known visual features, first the camera pose is calculated so the system dynamically acquires additional natural features and uses them to a continuous update of the pose calculation. This method provides robust tracking even when the original fiducials are no longer in view.

2.2.2 Sensor-based AR tracking

The processing power of mobile devices has increased exceedingly during the past few years. Additionally, mobile devices include several hardware features nowadays, like GPS positioning, motion-sensing accelerometers and compasses. Applications for mobile devices can determine the position of the mobile device, its orientation and its inclination. Thus, it is possible to use mobile devices for augmented reality applications. Active sensors are used in sensor-based tracking, which are then used to track the position of camera movement. Sensors may be optical, magnetic, inertial, acoustic or ultrasonic. Each sensor has its own advantages and disadvantages. The selection of a sensor depends on different factors including accuracy, calibration, cost, environmental, temperature and pressure, range and resolution.

3. RELATED WORK

3.1 Mobile Augmented Reality based on Street Data to solve issue of Overlapping

Author [1] proposes a Mobile Augmented Reality Model with the application of Street Data. The model consists of two layers- "Real-world layer" and "Information layer". In the model, a user creates a query by scanning the nearby street with a camera in real space and searches accessible content along the street using the information space. Furthermore, the results are placed on both sides of the street to solve the issue of Overlapping.

3.2 Location Recommendation System based on mobile Augmented Reality

The system consists of the modules of user location, marker detection, 3D display and location guide by combing AR with navigation technology. Experimental results demonstrate that the proposed system is both efficient and effective in helping people location their position. Also, author [2] evaluated the proposed system's location performance through comparing it with a traditional GPS based location system. Experiments results show that compared to the traditional GPS location services system, this system can be easily applicable utilizing existing maps, and it is simple and computationally low and gives better location accuracy.

3.3 Self-guided context-aware navigation system on Mobile Augmented reality

Author [3] propose a multi-purpose self-guided system that is able to disseminate highly specific local information using a context aware android-based application. In addition to tracking location and heading, our system provides information on surrounding POIs within a specified distance. The user interface is enhanced by displaying an overlay GPS-enabled map and a live view employing augmented reality techniques. The system provides a content editor. POIs as well as new maps can be created, edited, or removed through an easy-to-use interface. The system was evaluated and criticized by expert committees. Majority of the testers commented positively on its ease of use.

3.4 Mobile Augmented reality of Tourism-Yilan Hot Spring

The AR module uses the point of interest (POI) with two-dimensional virtual image in the real scene that allows people find the location. In addition, author [4] provide the Quick Response code (QR code) for each of the POI, which assists the users to link to the original website of Yilan hot spring by scanning the QR code. The APP also provides the function of camera that allows its users to capture the photos and record the videos in this APP. By using this Mobile AR APP, people can search the information about Yilan hot spring anywhere and anytime. For users, they can obtain detailed information from the website faster when they are using the QR code module.

3.5 Outdoor Localization AR system ACMG compared with GPS

Authors [5] present a reliable and energy-efficient localization system using inertial sensors commonly found on today's smartphone. In order to prevent accumulated error, location correction mechanism based on local map information and A-GPS is introduced. Results show that ACMG uses 24.7% less power consumption than GPS, and get a mean location accuracy of less than 6.7m in our test.

3.6 Local Cache management strategy for Augmented Reality

Authors [6] investigates the Local Cache Management (LCM) problem to manage the computation and communication work of a mobile device and harmonize the local and remote workloads. We present strategies to pre-fetch higher-priority objects from the server and replace lower-priority objects in the local cache based on temporal and spatial access locality. We verify the effectiveness of our strategies in term of cache hit ratio, response latency, and remote requests via simulations. The cache hit ratios of LRU (Least Recently Used) and PRI(Priority-based) are about 25%, while Proposed system is about 39%. The results show that proposed method is better than the other methods.

3.7 Physical navigation with Augmented reality

Authors [7] investigates user experiences when using augmented reality(AR) as a new aid to navigation. We integrate AR with other more common interfaces into a handheld navigation system, and conduct an exploratory study to see *where* and *how* people exploit AR. also, define the necessary improvements for tracking technology. And use a *forward-up map* that shows the user's position and the path to be followed. And, provide hints as *glyphs* and, for eye-free usage, as *audio instructions*. tilting motions trigger transitions between map and AR: tilting the phone down shows the map, tilting it up transitions to AR.

3.8 Mindful navigation for pedestrians

Authors [8] suggested that a mindful walking navigation system could reduce the errors and improve the overall exploration experience. Specifically, tested the hypothesis with an Augmented Reality system, with information directly projected on the path, in comparison with a standard device. Moreover, author tested the hypothesis that when users feel they are in control of their path, both performance and overall experience would improve. And found that both conditions increased the navigation performance and experience, decreased travel time, errors, and confusion and it increased the number of landmarks noticed.

4. COMPARATIVE STUDY

Table -1: Comparison between different navigation techniques invented in Augmented Reality

No.	Technique Used	Strong Points	Weak points
1	Method to solve Overlapping	Solve overlapping of regional content	Inconvenient for the user to view the data outside the vicinity.
2	Location Recommendation System based on mobile Augmented Reality	Better location accuracy than GPS, computationally low	Does not give real time AR map
3	Self-guided context-aware navigation system	New maps can be created, edited or removed	Rely on only SD card
4	Mobile Augmented reality of Tourism-Yilan Hot Spring	Faster information retrieving from website	Response time is high
5	Outdoor Localization AR system ACMG compared with GPS	Less power consumption than GPS	Not provide location accuracy
6	Local Cache management strategy for Augmented Reality	Cache hit ratio high	lower response time
7	Physical navigation with Augmented reality	Gives real time AR map	Not accurate
8	Mindful navigation for pedestrians	Performance improve, decreased travel time	Required more effort

5. PROPOSED WORK

As seen all the methods that are invented for navigation, most methods navigate to standard maps when we select the specific route to reach the destination. To enhance the user sense experience, a new navigation technique has been proposed and following are the steps.

Step 1 : Activate camera.
Step 2 : Retrieve current location and direction of current position.
Step 3 : Display the pre-fetch data from cache.
Step 4 : Synchronize local data with server data using search range.
Step 5 : Search and display data from current location in accordance with the intended direction based on search range.
Step 6 : By clicking the icon, view detailed information like timing, distance, reviews, website link, route link along with images
Step 7 : Route link redirected to Google Map
Step 8 : Website link redirected to website of the regional content.

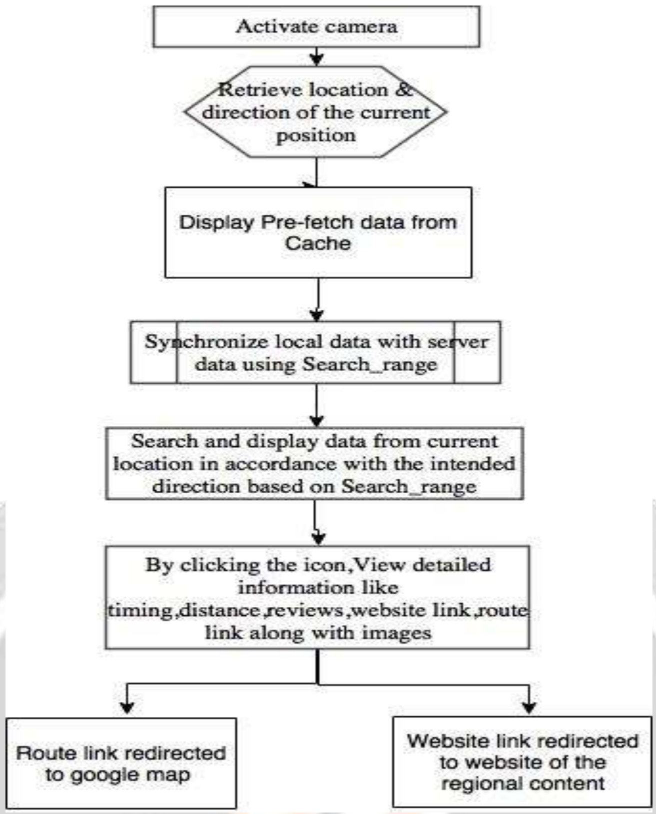

Fig-1: Proposed System

6. RESULT ANALYSIS

For implementation of proposed Flow work has been experimented through Android Studio, which is running on laptop with a 2.30 GHz Core processor with 4GB RAM and Windows 10 Operating System.

For experiment we use Least recently used(LRU) and prefetching priority based(PRI) technique for cache management strategy.

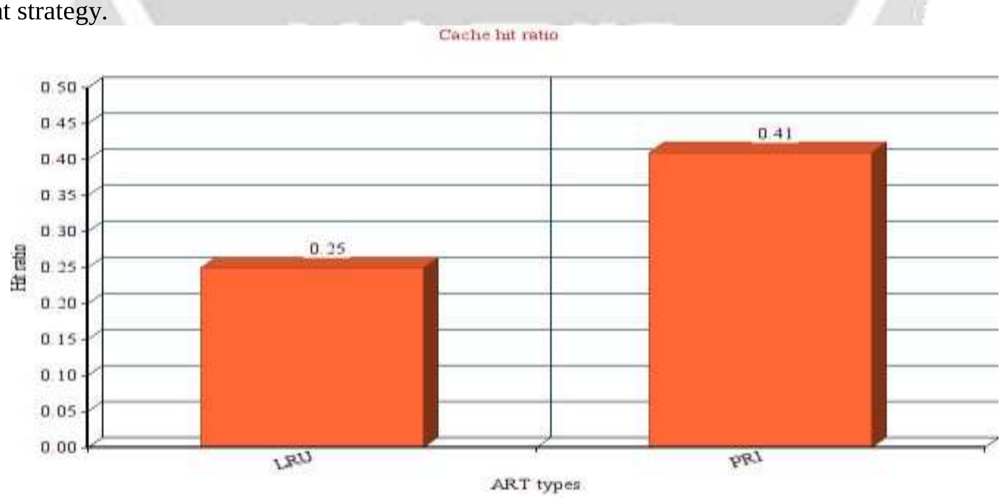

Fig -2: Result analysis of different ART types

By this result, we can say that PRI based prefetching technique gives hit ratio of 0.41% and Least recently used technique gives hit ratio of 0.25%.

7. CONCLUSION

According to literature survey cache management strategy is important for location based mobile augmented reality. Response time is main parameter to achieve better performance of any MAR system. So, we reduce the response time and higher the cache ratio by 0.41% using pre-fetching cache strategy and replacing lower priority objects.

8. REFERENCES

[1] Jun Lee, JeongHwan Lee, Sora Lim, KWON and YongJin "A Mobile Augmented Reality Service Model based on Street Data, and its Implementation" IEEE 39th Annual International Computers, Software & Applications Conference, 2015, vol. 3, pp 240-247.

[2] Zhenghao Shi, Xia Zheng and Minghua Zhao "A Novel Individual Location Recommendation System Based on Mobile Augmented Reality" International Conference on Identification, Information, and Knowledge in Internet of Things, 2015, pp 215-218.

[3] Piyanuch Silapachote, Ananta Srisuphab, Rasita Satianrapapong, Warat Kaewpijit, Nuttaporn Waragulsiriwan "A Context-Aware System for Navigation and Information Dissemination on Android Devices" TENCON 2013 - 2013 IEEE Region 10 Conference (31194) , 2013 ,pp 1-4.

[4] Lin Hui, Fu-Yi Hung, Yu-Ling Chien, Wan-Ting Tsai and Jeng-jia Shie, "Mobile Augmented Reality of Tourism-Yilan Hot Spring" 7th International Conference on Ubi-Media Computing and Workshops, 2014, pp 209-214.

[5] Anhua Lin, Jianzhong Zhang, Kai Lu and Wen Zhang, "An efficient outdoor localization method for smartphones" IEEE 2014, pp 1-8.

[6] Chien-Cheng Wu, Li-Ping Tung, Chih-Yu Lin, Bao-Shuh P. Lin and Yu-Chee Tseng "On Local Cache Management Strategies for Mobile Augmented Reality" IEEE 2014, pp 1-3.

[7] Alessandro Mulloni, Hartmut Seichter and Dieter Schmalstieg "User Experiences with Augmented Reality Aided Navigation on Phones" IEEE International Symposium on Mixed and Augmented Reality 2011 Science and Technolgy Proceedings 26 -29 October, Basel, Switzerland ,2014, pp 229-230.

[8] Jaewoo Chung , Francesco Pagnini and Ellen Langer "Mindful navigation for pedestrians: Improving engagement with augmented reality" Technology in Society 45 , 23 February 2016, pp 29-33.

[9] Tomotaka Nagaosa and Shun Hozumi "A Proposal of the Rendezvous Navigation System" 13th International Conference on ITS Telecommunications (ITST), 2013, pp 367-371.

[10] Jorge Joo Nagata, José Rafael García-Bermejo Giner and Fernando Martínez Abad "Virtual Heritage of the Territory: Design and Implementation of Educational Resources in Augmented Reality and Mobile Pedestrian Navigation" IEEE Revista Iberoamericana De Tecnologias Del Aprendizaje, February 2016, vol. 11, pp 41-46.

[11] Chhaily Moun and Chayakorn Netramai "Localization and Building Identification in Outdoor Environment for Smartphone Using Integrated GPS and Camera" IEEE 2014, pp 327-332.

[12] Supeno Djanali, Misbachul Huda and Ary Mazharuddin Shiddiqi "Location Finder using Augmented Reality for Railways Assistance" 2nd International Conference on Information and Communication Technology (ICoICT), 2014, pp 487-492.