City Scale Augmented Reality

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ABSTRACT
This report describes the development of a "City Scale Virtualization Augmented Reality" using Junaio Browser which uses back camera of the device that allows displaying the real environment through the camera view and the application will render and display objects that are overlaid on top of the real world camera view. After successful implementation a short user evaluation test was conducted, and a few lessons learnt regarding Junaio interaction and future development are discussed.

KEYWORDS
Augmented Reality, City View, Outdoor AR application, Android, IOS, User Interaction, and Christchurch.

I. INTRODUCTION

Augmented reality is essentially the overlay of computer graphics composited with the real world, providing a combined view of the real and the virtual world [1]. Ever since early experiments with head mounted displayed by Ivan Sutherland in the 1960's [4], researchers have been fascinated by the idea of augmenting the real world with computer graphics. Augmented reality has many different application areas. These include entertainment, games, advertising, education, military and medical purposes, and after many decades of research, augmented reality is now starting to be seen in commercial applications as well [2]. For a walkthrough of the history of augmented reality and its applications, see [3].

With the expansion of smart phones in the market, high processing power of GPS and orientation sensors, location based tracking has become feasible to be used with outdoor Augmented Reality (AR) applications. AR applications are numerous, and allow the user to visit places that they never visited before.

The purpose of our project is to develop an outdoor city scale AR application to overlays points of interest (POI) information into the real world. These point of interest are mainly the buildings that were affected after the earthquake in Christchurch, or images, videos of historic places. Our application will use mobile phone as an interactive device. Users would be able to get the information of POIs on their mobile phones. This project focuses on methods and technologies which are available for merging real world with virtual objects/information and deciding whether built-in sensors in mobile devices can deliver meaningful data for planning.

An important element of the project is the ability for users to interact with the augmented reality content, in order to provide a fully immersive experience for the users to understand the interesting places of the city.

The report is structured as follows. The next section provides background research with the related area, followed by a section describing the main project goals. Then follows a walkthrough of the technical implementation, before the project is evaluated and concluded upon.

II. RELATED WORK

Four papers that are relevant to this project were reviewed and discussed. A brief summary of the paper, relevance to our project and a critique on the paper are covered.

The first paper mentioned is "Mobile Augmented City: An evaluation of existing mobile augmented reality with various examples in urban planning" [7]. The second is "CityViewAR: Introduces an outdoor augmented reality application to provide information visualization on a city scale" [8]. The third paper is titled "AR application prototyping: Exploring Design and Prototyping Techniques" [9]. The fourth paper is "Annotation in outdoor AR: is an introduction on how to do annotations for outdoor AR application" [10].

A. Mobile Augmented City: An evaluation of existing mobile augmented reality with various examples in urban planning.

1) Review

This paper focuses on methods and technologies which are available for merging real world with

virtual objects/information and deciding whether built-in sensors in mobile devices can deliver meaningful data for planning. It talks about how development over time has beneficial i.e. How mobile devices make it possible to communicate with the whole world at nearly any time and place, creation of virtual worlds through computers or the blending of the virtual objects into the real world and how new mobile techniques merge the real and virtual world into a new "extended real world" or "augmented reality" possible. It talks about human perception i.e. due to immense hardware requirement for the augmented reality system in the past what visualization methods were developed, Different technological areas are discussed, for e.g. Information systems in Mobile (tracking via GPS), Android OS (Android's Efficiency on Mobiles as an OS), Different augmented reality software's (Browsers such as LAYAR and JUNAIO).

Besides which various use cases and their potential benefits for urban planning are examined, how the things are carried out and the collection of data such as information gathering for objects and the structure of a building in the test cases is elaborated stating how the link between an overall database and a collective and individual intelligence, with personal profiles of human beings and augmented reality technology, could revolutionize the experience and interaction with the world. Hence an evaluation of existing mobile augmented reality applications and gives various examples for urban planning.

2) Relevance

This paper shows how augmented reality experiences can be accessed with different augmented reality browsers, offering a new form of information presentation for the user experience.


Fig. 6: Sample RADAR geocontents as shown in the list view of ALOQA, the map view of WIKITUDE, and the reality view of LAYAR

3) Critique

The benefit that augmented reality is more than just a new form of visualization. Augmented reality technology has nearly no limits. Augmented reality offers a lot of possibilities and fields of applications for urban design processes and therefore increasing human awareness. The developers of AR browsers are allowing an openness which can be compared to the openness of the internet itself. Everyone will be able to define his or her own augmented reality. Considering the fact that there are various AR browsers available and demonstrating a different test case showing what each can do is satisfying. Each relevant study was given for same which supports their points well.

B. CityViewAR: Introduces an outdoor augmented reality application to provide information visualization on a city scale.

1) Review

This This paper talks about the earthquake that occurred in Christchurch and how the city has changed since then and how augmented reality technology can be used to go back in time and see the city as it was, both before and after the devastating earthquake, hence introduces an augmented reality application CityViewAR for providing visualization for the city of Christchurch and also considering that users can watch a virtual 3D model of the building on the real site where it once was. It mentions the existing technology available and implementing augmented reality on it to achieve the application to be built. The interface design built upon after studying the factors involved and the design for the same i.e. the structure for navigation and the map with the point of interest is also stated in the design interface and talks about the modes in the application namely AR view and Map & List View showing images for the same. It talks about its implementation mentioning the structure of the application. User studies were carried out to evaluate the design of the CityViewAR in the form on online survey from the users who

downloaded the application with details and based on this another formal study elaborating further. Questions and observations is also included in this paper.

2) Relevance

This paper talks about the developing of the application based on a city scale and provides guidelines that will be useful for developing mobile augmented reality applications for city scale tourism or outdoor guiding, underlying technology can be used for applications in other areas.

Figure 1: CityViewAR showing virtual building on-site in AR view

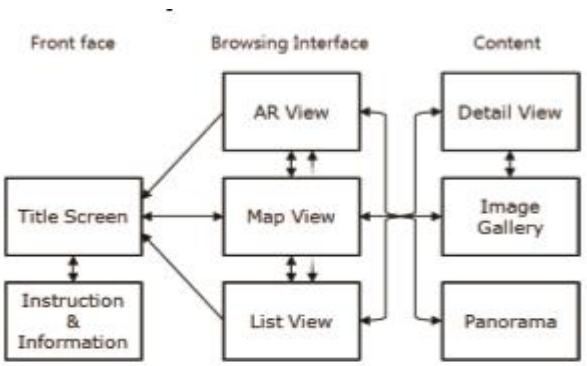


Figure 2: Navigational structure of CityViewAR

Figure 3: The Map view showing POIs as icons on the map

Figure 7: Views for different types of content: (a) Detail view, (b) Image Gallery, and (c) Panorama view (from top to bottom)

3) Critique

This paper outlined the requirements for a successful application and provided a good description of the CityViewAR and the development process. Overall the design was well described and presented, and is definitely of use to anyone developing an augmented reality city scale mobile application. The idea of taking the view was a good move of understanding user experience.

C. AR application prototyping: Exploring Design and Prototyping Techniques

1) Review

In the paper "Mobile Augmented Reality: Exploring Design and Prototyping Techniques" described the methods they used to prototype their AR application. Three methods are discussed: "Low-fidelity mocks", "Mixed-fidelity video" and "high-fidelity prototype". Low-fidelity mocks approach is to build a non-functional system to show user the basic concept of the product. Mixed-fidelity video approach use an edited video to show people how the user experience will be like with final product. The high-fidelity prototype targets at present user a limited functional application to show user how final product will be like. As the final output of these three approaches the Low-fidelity approach is cost least time but also the worst for users to understand the final product, the high-fidelity approach is make sense to most users who have experiences with smart phone before but not for users never had a smart phone, and high- fidelity also cost longest time to implement. Surprisingly the mixed-fidelity approach get most positive feedbacks from users and it cost less time than high-fidelity approach.

2) Relevance

AR is a relative new topic to general users, not a lot develop tools can be used in current stage especially for make an AR application prototype. These paper shows three general methods to make an AR application prototype. These three methods are all useable for our project. However the mixed-fidelity approach seems to be more attractive and could deliver the most of final user experience to users.

3) Critique

This paper is only discussed hand hold device prototyping. However the trend for AR implementation is more like to use a wearable device such as a hand wear device. The prototyping for hand wear device may quite different from hand hold device. Also the users for evaluation stage is random picked. However a product should have it target group. One reason mixed-fidelity approach is the most popular approach may because the test user is from different levels even people never had a smart phone before so an edited video will make more sense than a functional prototype to them. If the test group are all developer then a high-fidelity prototype may become more popular as it provide more detail than an edited video. So the prototype should present to the people the final product target at, in this case should be people use smart phone daily and willing to take new technology.

D. Annotation in outdoor AR: is an introduction on how to do annotations for outdoor AR application

1) Review

"Annotation in outdoor augmented reality" presented an introduction on how to do annotations for outdoor AR application. This paper discussed two categories of annotation: direct and indirect annotations. Direct annotation is the information direct linked to a real world object such as dimensions of a building, if target building is no longer exist then the annotation is no longer make scenes any more. Indirect annotations normally used for additional information such as speed of navigation system, it not directly link to any real world object but it is valuable information. This paper also discussed annotation taxonomy and the process for creating an annotation.

2) Relevance

AR is a relative new topic, not a lot guidelines and documentations about AR application development. This paper presented a guideline on how to do annotations on outdoor AR application which is applicable for our project. The paper pointed out the things we need to pay attention on when we create annotations for POIs in our project and a general steps we could take for creating annotations.

3) Critique

One good point of this paper is that it pointed out a direction on AR application development which suggest the content of application should be editable. However, in this paper not talking about the changeable real world annotations. For example if the application is used on an on build building. The real world object is changing so the annotations system need to be able to update and recognize the change of the object. A real time image tracking system [11] was proposed by another article a solution on that but it still not perfect.

E. Related Work – Conclusion

The first two papers reviewed contributed ideas and information that can be correlated to our own project and this provides background research to how they work and the fundamental principles and validation behind using them.

The paper outlined "*Mobile Augmented City: An evaluation of existing mobile augmented reality with various examples in urban planning"* gives an idea with Information systems in Mobile (tracking via GPS), Android OS (Android's Efficiency on Mobiles as an OS), Different augmented reality software's (Browsers such as LAYAR and JUNAIO).

The paper outlined "*CityViewAR: Introduces an outdoor augmented reality application to provide information visualization on a city scale"* on a city scale gives an idea for the steps involved in making application based on AR and shares the same aim of this project.

The papers three and four give an overview on two different parts of outdoor AR application's development.

The paper "*AR application prototyping: Exploring Design and Prototyping Techniques"* shows the possible methods we could use for our project and pointed out that the mixed-fidelity video method could give most users a good view of final product's user experience.

The paper "*Annotation in outdoor AR: is an introduction on how to do annotations for outdoor AR application"* proposed a guideline for creating annotations of AR application.

Reading the papers three and four helps us on building our project's prototype and also get a direction on how to creating our application's annotations.

III. PROJECT GOALS

The goal of the project is to create an Augmented Reality City Scale Virtualization that aims on using the Junaio Browser platform to develop a city scale application that overlays points of interests in the real world. These point of interest are in particular buildings that were taken down after the earthquake in Christchurch, or images and videos of historic places. The development of this project should focus around the following concepts: Besides Junaio Browser.

A. Have POI's [Point of Interests]

The Junaio browser running on the user's device can guide the user to the various point of interests in the city which are created and stored on the web server.

As Junaio has various options for displaying the POI's in the form of an image, 3d model, etc. hence the focus is on setting a user environment looking into options to enhance the experience by making it easy to understand.

These POI's are the locations in the city of Christchurch and so the locations need to be created accordingly.

B. Website

Junaio Browser along with other features has the ability to open a website as an option to the selected point of interest hence making the website with details.

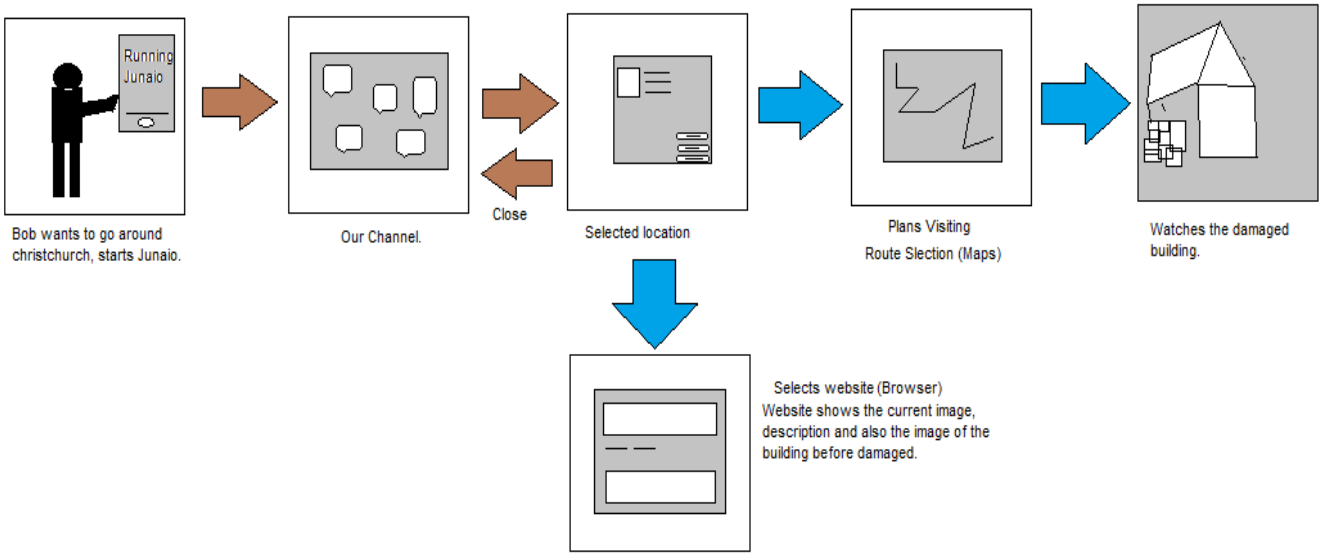


Figure shows the user experience

C. User Experience

The sketch above shows the expected experience from a user's prospects. This is indeed the main goal apart from the development in a project.

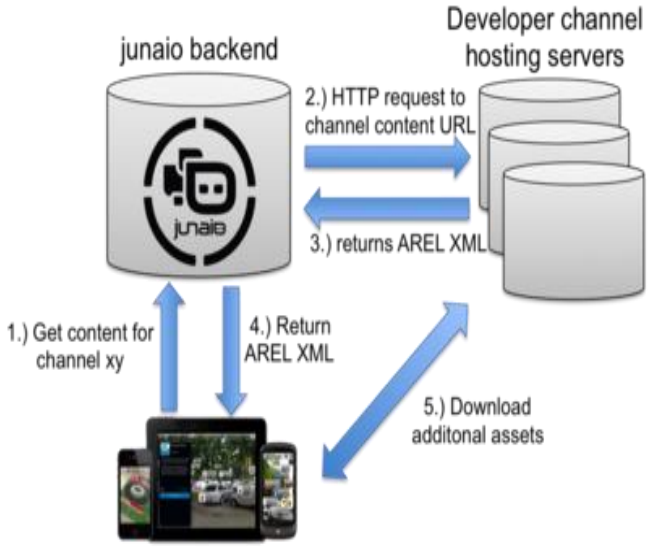
For our channel we selected the website and maps as our options available to the user.

IV. IMPLEMENTATION

A. Setting Junaio

Technically, a channel is an entry in the junaio backend that registers a specific AREL experience with the channel ID.

Much like a website, the source of this AREL experience is defined by the channel content URL. This URL is supposed to deliver valid AREL XML that will be then parsed by the client application.



When a client application opens a channel, the following steps are taken:

The client sends an HTTP request to the junaio server to get the channel content for a specific channel ID

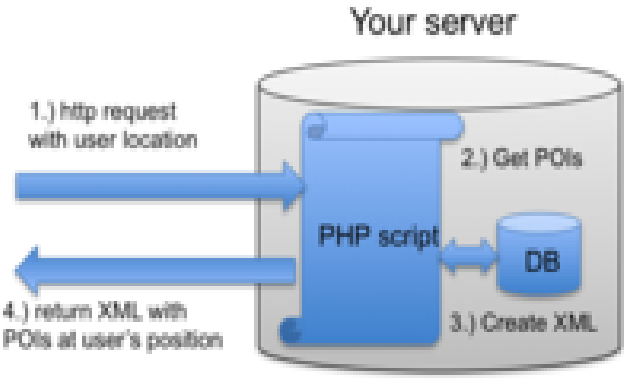
The backend looks up the respective channel content URL and send a HTTP request to the channel content URL.
This request can contain the location of the user, as well as the device type.

The channel server then responds to the request with XML. This can be either a static XML file, or dynamically created XML through PHP (e.g. using the PHP Helper library)

The junaio server forwards this XML to the client, which parses the response.

The client then goes on and downloads all remaining assets like AREL HTML and JavaScript, 3D models, images, movies, etc. (in case they are not cached yet).

Each channel gets its unique channel ID. When an application like junaio or your metaio Cloud Plugin accesses as channel, it passes the channel ID to the server, which then forwards the request to the channel's content URL. The content server URL (formerly 'callback URL') is the HTTP address of where the channel XML is created. Though there are two types of channel, the one we used for our project is the Dynamic Channel.



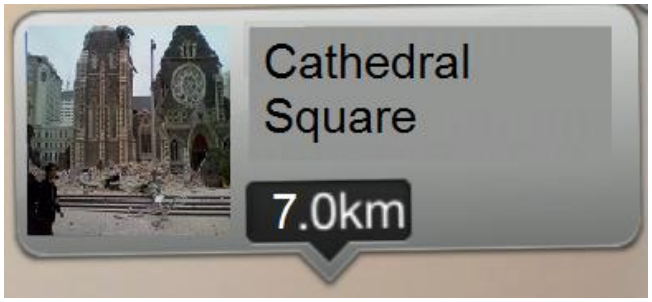
Based on the input, PHP code performs a database query, returning all POIs close to the user's position. Using the Arel PHP helper, the PHP script then creates AREL XML and returns it to the user.

After creating the Channel and creating the point of interests and the appropriate website links for the POI's. The next step is to test it.

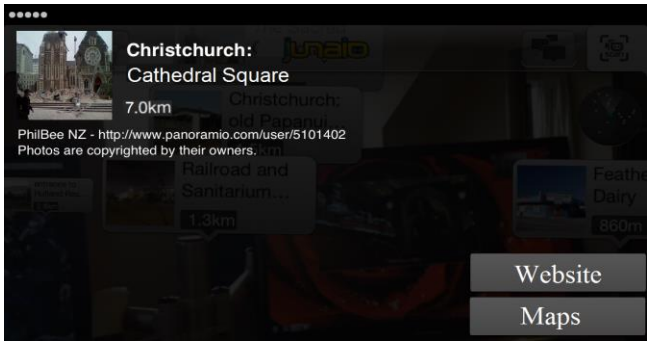
B. Setup and Testing

The user is expected to hold a mobile device supporting junaio. The device must have a back camera that allows displaying the real environment through the camera view. The application will render and display objects that are overlaid on top of the real world camera view. The user is expected to interact with the objects on the screen. These objects display

the name of the location and the distance from the user's current location. On interacting with the object there are a list of options available to the user, such as website, maps, etc.



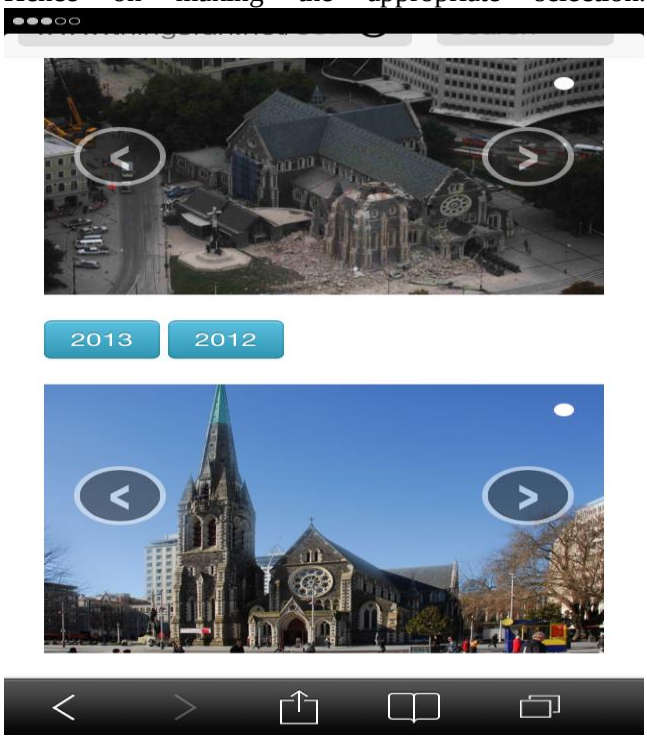
Point of interest created as shown above.



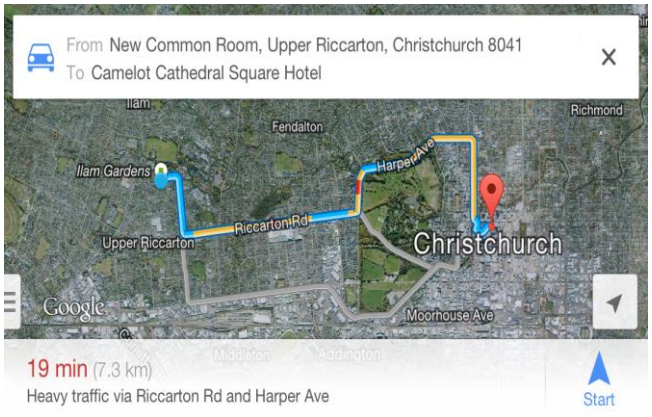
On selecting the POI the option available to the user.

It displays the details available for the POI along with the option of Website and Maps.

Hence on making the appropriate selection.



As shown above the website available to the user when selected. In the same manner on selecting Maps.



It shows the user the map and direction estimate accordingly.

There is also an option for the user to create its own location provided, so the user can take an image of the location along with some other fields and once added, needs to refresh the channel for visibility.

As shown above Hagley Park is added by the user.

V. EVALUATION

In order to evaluate the experience of using the Junaio browser and testing out channel, a simple experiment is set up to highlight the main usability of the system. The experiment focuses primarily on the interaction with the point of interests and the options associated with each of them accordingly. Currently very few locations are put in the system but the important criterion is its usability. This gives the participants to get an understanding of how the system works.

The participants were given a tablet device with the basic requirements of having junaio installed and setting the channel up and asked to try it. The brief

understanding of features was provided before they start the test.

After finishing the test the participants were asked for their experience individually to understand of how users interact with the system and what changes need to be made accordingly.

Though they were asked about any frustration points they may have like junaio crash or freeze, or something during the experience. On a scale from 1 to 5 where 1 is “Strongly Disagree” and 5 is “Strongly Agree” the participants rated the simplicity and usability. In general the participants found the system easy to use.

VI. DISCUSSION

Because of time constraints, the evaluation described in the previous section has been highly superficial. The questionnaire questions were biased by nature, and have potentially provided more positive results than in the real case. A more thorough evaluation would include a list of more complicated tasks. Further, the questionnaire should seek to avoid positively biased answers by asking more neutral questions. Having the lecturer and students from the COSC426 course providing additional feedback, has allowed us to identify the points to remember in developing our system.

This second part of the evaluation can be considered as a short heuristic evaluation, which has provided a clear indication of which usability issues should be improved immediately. In order to gain full advantage of a heuristic evaluation, using Jakob Nielsen’s complete set of heuristics [6] could be useful, even though these heuristics are based on WIMP-based interfaces, not always suitable for augmented reality environments [5].

VII. FUTURE WORK

Given more time to develop the application, there are many different opportunities to improve an AR. Such as have: -

A. Social Media Integration

Social media are media for social interaction, a set of methods to enhance social communication, using techniques that allow the creation and exchange of user-generated content. The common link between social media is that users are able to interact with the website and with other visitors.

Getting involved with social media is essential in today's world. For organizations, social media participation can help maintain contact with users even when they have left their website, and learn more about their preferences and habits. For individuals and professionals it is a great tool for getting to know new interesting people, keep in touch with website users and make professional contacts. Adding social buttons to a website helps visitors to share the content more easily with their networks and increase the amount of traffic to the site in question.

B. Image Based Tracking

Have the Junaio GLUE (or SCAN) mostly refers to junaio's capabilities to recognize images and enhance images and pictures with virtual content without the need of using special markers. This is also called 2D Natural Feature Tracking (NFT). Additionally junaio also supports 3D object tracking, marker tracking and 2D image recognition. Junaio GLUE Channel can attach or "glue" virtual 3D models, images or movies to any real world object. Those 3D models can be linked to sound or video files as well as websites or images. Also additional textual information can be given or the 3D models can be linked with phone numbers, email addresses or more.

Use the Junaio GLUE to scan the map of the city and track the point of interests on them.

C. POI’s

Use 3D models of the buildings to display the point of interests.

D. Evaluation

The user evaluation considered as part of this project was informal and on few number of users. Further evaluation is required to understand more about the usability of Junaio and the possibilities associated with it.

VIII. CONCLUSION

This report has described the development of our project “City Scale Virtualization Augmented Reality” using Junaio Browser which uses back camera of the device that allows displaying the real environment through the camera view and the application will render and display objects that are overlaid on top of

the real world camera view. The idea that every individual having an interest in the history of the city would benefit from our application. As it is an example of how the city is overcoming the drastic hit over the years but also taking into account that the past is not lost. The website showing the past images or videos for the location is how we preserved the past.

For future work it is important to do a more thorough user study to highlight the issues. Further implementations include social media integration, image based tracking which requires switching between channels, evaluation of user feedback and look for further possibilities with Junaio and 3D models as point of interests for location.

This report implemented and presented the idea of developing the city scale virtualization. A description of the application and the process of implementing it was described in this report.

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IX. ACKNOWLEDGMENTS

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