Geollery: A Mixed Reality Social Media Platform



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UMIACS



VIRTUAL AND AUGMENTED REALITY LAB AT THE UNIVERSITY OF MARYLAND



Introduction

Social Media



image courtesy: plannedparenthood.org



image courtesy: huffingtonpost.com

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Motivation

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image courtesy: instagram.com, facebook.com, twitter.com

Motivation





invite friends to Pinterest



A BATHROOM?
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Chiagrad

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Geometric tattoo

10 Dly Great Kitchen Storage Anyone Can Do 2

This 3D printed prototype shows an LED brick stacked on a bridge brick stacked on a power brick //









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Placing Flickr Photos on a Map

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ABSTRACT

In this paper we investigate generic methods for placing photos uploaded to Flickr on the World man As

or pin-pointed on a map to iden ar examples for our methods April 5-10, 2008 · Florence, Italy every phot in practice

CHI 2008 Proceedings · Works In Progress

Content Visualization and Management of Geo-located Image Databases

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In the last years, several algorithms and platforms for photo sharing have been developed. Usually, in order to index huge quantities of images for a fast and intuitive retrieval, additional textual tags attached to the pictures are considered. In this paper, we present a set of solutions for an effective management of geolocated images, i.e. pictures equipped with tags indicating the geographical coordinates of acquisition. This brings towards an intuitive content visualization and management of large geo-located image databases.

Image categorization, geo-located images, interfaces

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. H3.1. Content Analysis and Indexing: Indexing methods.

mong the social networking platforms, those ones that Introduction

PhotoStand: A Map Query Interface for a Photos-

Hanan Samet Michael D. Lieberman Marco D. Adelfio Center for Automation Research, Institute for Advanced S Department of Computer Science, University of Maryla College Park, MD 20742 USA {hjs, marco, brendan, codepoet, jagan}@cs.umd.

ABSTRACT

PhotoStand enables the use of a map query interface to retrieve PhotoStand enables the use of a map query interface to retrieve news photos associated with news articles that are in turn assonews photos associated with news articles that are in turn associated with the principal locations that they mention collected categorith the principal locations that they mention conected as a result of monitoring the output of over 10,000 RSS news as a result of monitoring the output of over 10,000 news feeds, made available within minutes of publication, and stored teets, made available within minutes of publication, and stored in a PostgreSQL database. The news photos are ranked accordin a resigned diameter. The news photos are mined according to their relevance to the clusters of news articles associated ing to their relevance to the clusters of news articles associated with locations at which they are displayed. This work differs with locations at which they are displayed. This work dimers from traditional work in this field as the associated locations and topics (by virtue of the cluster with which the articles containing the news photos are associated) are generated aucontaining the news photos are associated are generated au-tomatically without any human intervention such as tagging tomatically without any minan intervention such as tagging, and that photos are retrieved by location instead of just by and that photos are received by location instead of Just by keyword as is the case for many existing systems. In addition, keyword as is the case for many existing systems. In audition, the clusters provide a filtering step for detecting near-duplicate

1. INTRODUCTION

A demo is presented of PhotoStand (see also the related A gemo is presented of Photostana (see also the related April (19) 1, 17, 21, 29), TwitterStand [6, 24], and STEW Newsotand [9, 11, 21, 23], I witter train [0, 24], and SILVI-ARD [12] systems) which is an example application of a general ALL [1.2] systems) which is an example application of a general framework we are developing for retrieving multimedia data tennework we are developing or receiving manuscula data (e.g., text, images, videos) using a map query interface from (e.g., text, images, viacos) using a map query internace iron a database of news articles, photos, and videos (i.e., by loa tratables of news arrices, photos, and vacos (i.e., by to-cation in real-time which differentiates it from Google where cation in real-time which engineerintates it from Google where static photos are retrieved which rely on human geotagging). static photos are retrieved which rely on milinan georagging).

The photos are associated with news articles [23] collected by the photos are associated with news arrices [25] conected by monitoring the output of over 10,000 RSS news feeds and made monitoring the output of over 10,000 n.35 news recos and made available for map-based retrieval within minutes of publication. available for map-based retrieval within minutes of publication.

These feeds are processed by the NewsStand system which conthese reeds are processed by the NewsStand system which con-stantly polls them, downloads the new articles that they constancy pons them, nowmouts the new actions that they contain, performs a variety of tasks on them, and stores the results tant, personus a variety of tasks on them, and stores the results in a PostgreSQL database. This is motivated by our prior work m a rosigred dualabase. This is motivated by our prior work on indexing spatial and temporal data. [4, 5, 18–20] and similar to 20 oct. on meeting spatial and temporal data [4, 0, 16–20] and same larity searching in the serial domain [16, 22, 25], as well as in a distributed domain [28].

The three major processing modules of NewsStand are its The three major processing modules of Newsyland are as cleaner module, which extracts the text, images, and videos, ctemer module, which extracts the text, images, and videos, as well as discards irrelevant objects in the feed; its geotogas well as discards irrelevant objects in the leed; its geotag-ger [7, 8, 10, 11, 14], which extracts locations mentioned in the

This work was supported by the NSF under Grants IIS-09-48548, IIS-10-18475, and IIS-12-19023. Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee oravided that contains the not made or distributed for profit or commercial advance bear this notice and the full citation on the

articles, enabling them to b as windowing or simple poin which groups articles about t Stand database system is its processing modules by assign NewsStand's user interface en news articles for display using ing what we term top-k window handles about 50K articles per database of articles currently co

The PhotoStand and TweetF the sense that PhotoStand uses NewsStand, while TweetPhoto us TwitterStand [24]. In addition, t strates the database querying cap as its capability to do similarity where the first step in the similarit on the text associated with the ph involves use of the actual image feat enable detecting near duplicates, the natorial complexity of comparing ev

The rest of this paper is organiz discusses related work. Section 3 i cles (and consequently news photos) how captions are identified and extrac near-duplicate image detection. Section scenario and some underlying interact while concluding remarks are given in s

2. RELATED WORK Most of the work in associating geog images has dealt with images that corre involves tags generated by humans (ofter the associated article in the case of news device built into the camera (e.g., Flickr nately, user generated tags are not always s precise latitude-longitude coordinate values require additional human intervention to ic although gazetteers do help. We limit ourse accompany news articles and use the often contents of article documents to help us fit These feature vectors are often sufficient to documents and the images that the



Related Work

3D Geospatial Visualization

UIST 2001 (ACM Symp. on User Interface Solina

View Management for

Blaine Bell Departr. 500 W

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We describe a view-management component 3D user interfaces. By yier managem maintaining visual constraints on the project on the view plane, such as locating related 9 other, or preventing objects from occluding view-management component accomp modifying selected object properties, in size, and transparency, which are tagged constraints. For example, some objects m properties that are determined entirel simulation and which cannot be mod objects may be annotations whose pos

We introduce algorithms that use extents to represent on the view pla efficient approximation of the occupi the projections of visible portions of the unoccupied space in which obje

Photo Tourism: Exploring Photo Collections in 3D

Noah Snavely University of Washington

Steven M. Seitz University of Warhington Microsoft Research



Figure 1: Our system takes unstructured collections of photographs st and viewpoints (b) to enable novel ways of browsing the photos (c).

We present a system for interactively browsing and exploring large unstructured collections of photographs of a scene using a nove 3D interface. Our system consists of an image-based modeling front end that automatically computes the viewpoint of each phot graph as well as a sparse 3D model of the scene and image to mo graph as wen as a spanse 313 naxier of the scene and mage to me correspondences. Our photo explorer uses image-based render techniques to smoothly transition between photographs, while enabling full 3D navigation and exploration of the set of images world geometry, along with auxiliary information such as over maps. Our system also makes it easy to construct photo to scenic or historic locations, and to annotate image details, are automatically transferred to other relevant images. We d strate our system on several large personal photo collections as images gathered from Internet photo sharing sites.

CR Categories: H.5.1 [Information Interfaces and Prese Multimedia Information Systems—Artificial, augmented. tual realities 1.2.10 [Artificial Intelligence]: Vision a Understanding—Modeling and recovery of physical attri

Keywords: image-based rendering, image-based mode browsing, structure from motion

Introduction

A central goal of image-based rendering is to evoke a of presence based on a collection of photographs of last several years have seen significant progress to through view synthesis methods in the research con unough view symmens memors in the research co-commercial products such as panorama tools. On

Social Snapshot: A System for Te **Social Photogra**

Robert Patro, Cheuk Yiu Ip, Sujal Bista, and Ami

ince the invention of phot pictures of people, places, a become integral to our liv only purposeful, precious mome mary subjects of photography. advances have brought photograday lives in the form of compact cell phone cameras.

The next ph Social Snapshot actively acquires and reconstructs temporally dynamic data. The system enables spatiotemporal 3D photography using commodity devices, assisted by their auxiliary sensors and network functionality. It engages users, making them active rather than passive participants in data acquisition.

raphy revolute phy, can brin socialize and pictures in a However, tr tographic so requires intr ages of the ometry from The recons etry from images is from-moti

computer struments used to acquire pl calibrated to produce precise To simplify 3D photogra

3D Wikipedia: Using online text to automatically label and navigate reconstructed geometry

Ricardo Martin-Brualla² ¹Intel Labs

Daniel J. Butler²



Figure 1: Given a reference text describing a specific site, for example the Wikipedia article above for the Pantheon, we automatical above for the Pantheon, we automatical to where they are mentioned in the text. The aver interface enables cool Figure 1: Given a reference text describing a specific site for example the Wikipedia article above for the Pantheon, we automatically a labeled 3D reconstruction, with objects in the model linked to where they are mentioned in the text. The user interface enables coon Abstract

We introduce an approach for analyzing Wikipedia and other text. we introduce an approach for analyzing wrightenia and other way, logether with online photos, to produce annotated 3D models of famous fourist sites. The approach is completely automated, and famous tournst sites. The approach is completely autumated, and electrages online text and photo co-occurrences via Google Image severages outnie use and pinno to-occurrences via charge image. Search, It enables a number of new interactions, which we demonstrate the contractions of the contractions of the contractions of the contractions. search. It enables a number of new interactions, which we uenam-strate in a new 3D visualization tool. Text can be selected to move state at a new star standardour root. Lease and so societies to move the camera to the corresponding objects, 3D bounding boxes proure tailers to the text describing them, and the overall naryou anchors back to the text describing them, and the overall nar-rative of the text provides a temporal guide for automatically flying through the scene to visualize the world as you read about it. We show compelling results on several major tourist sites.

Bryan C. Russell1

CR Categories: H.5.1 Information Interfaces and Presentation]: Mulimedia Information Systems—Artificial, augmented. tion]: Mutumenta information Systems—Artificial, augmented, and virtual realities 1.2.7 [Artificial Intelligence]: Natural Language and virtual readities 1.2./[Artificial intelligence]: Natural Language
Processing—Text analysis 1.2.10 [Artificial Intelligence]: Vision riocessing—test anarysis testiv tentiment management, vision and Scene Understanding—Modeling and recovery of physical at-

Keywords: image-based modeling and rendering, Wikipedia, nat-Links: DL PDF

1 Introduction

Tourists have long relied on guidebooks and other reference to learn about and navigate sites of interest. While guidely are packed with interesting historical facts and descriptions of are personal to the state of th specinic orgenes and species, it can be difficult to the second from images provide second from images provided to the second from images provided to the second from images provided to the second from the s with the text, but coverage is sparse and it can be difficult to t war the text, but terrange is spined and a van or continuous we derstand the spatial relationships between each image viewpoil occasions are spatial remainings between our range very port. For example, the Berlitz and Lonely Planet guides [Berlitz In For example, the Deville and Lonely France guides 10 clinic in ternational 2003; Garwood and Hole 2012] for Rome each con tain just a single photo of the Pantheon, and have a similar lack and pass a surger paner on one randomera, and there a automate on of photographic coverage of other sites. Even online sites such to panuscianus curvage to time and, and the small and a similarly as Wikipedia, which do not have space restrictions, have similarly

Instead of relying exclusively on static images embedded in text. inocau or retying excusively on static images ensecuted in seas, suppose you could create an interactive, photorealistic visualizasuppose you could create an interactive, photoreansite visualiza-tion, where, for example, a Wikipedia page is shown next to a detailed 3D model of the described site. When you select an object tance as moved in the described site. Then you served an object (e.g., "Raphaels tomb") in the text, it flies you to the corresponding location in the scene via a smooth, photorealistic transition. Similarly tocation in the scene via a smooth, particular transmiss. Juni-larly, when you click on an object in the visualization, it highlights tany, when you take on an object in the vibountamon, a rigingular the corresponding descriptive text on the Wikipedia page. Our goal the corresponding descriptive text on the wirkipedia page. Our good is to create such a visualization completely automatically by and is to steem such a visuanzation completely automatically by analyzing the Wikipedia page itself, together with many photos of the

Automatically creating such a visualization challenge. The text and photos in i



























Our signism phows users to see that, and collaborate with more paragrants with the same applied context in an immersive virtual environment.

Conception, architecting & implementation

Geollery

A mixed reality system that can depict geotagged social media and online avatars with 3D textured buildings.

Extending the design space of



Progressive streaming, aggregation approaches, virtual representation of social media, co-presence with virtual avatars, and collaboration modes.

Conducting a user study of



Geollery vs. Social Street View

by discussing their benefits, limitations, and potential impacts to future 3D social media platforms.

System Overview Geollery Workflow

```
= array_replace($qs, $query);
          eryString = http_build_query($query, '', '&');
        $queryString = $components['query'];
           ry = $qs;
  ) elseif (Squery) {
     Sourcestring = http_build_query($query, '', '&');
  surver['QUERY STRING'] = $queryString;
  meterm self::createRequestFromFactory($query, $request, array(),
  and callable able to create a Request instance.
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```

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System Overview





internal and external geotagged social media



shaded 3D buildings with 2D ground tiles





virtual forms of social media: balloons, billboards, and gifts

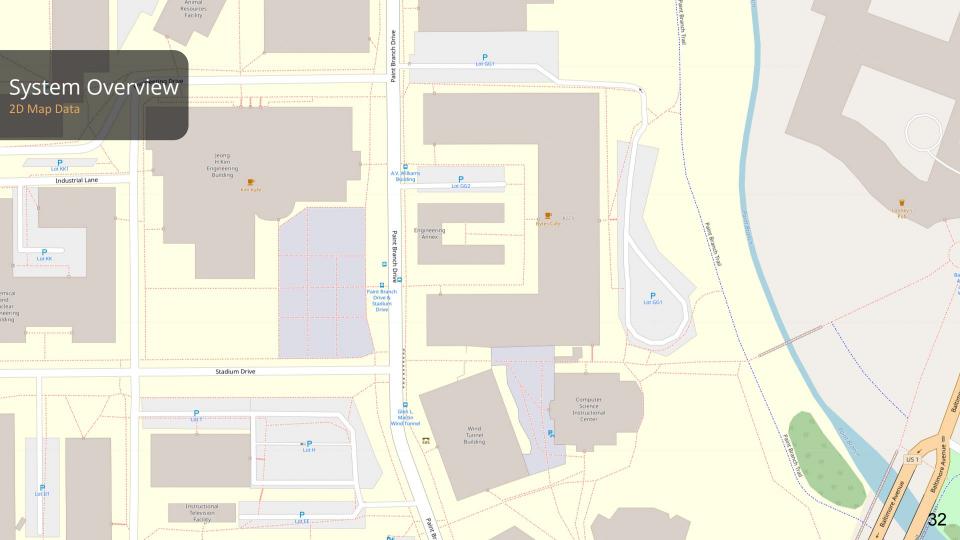


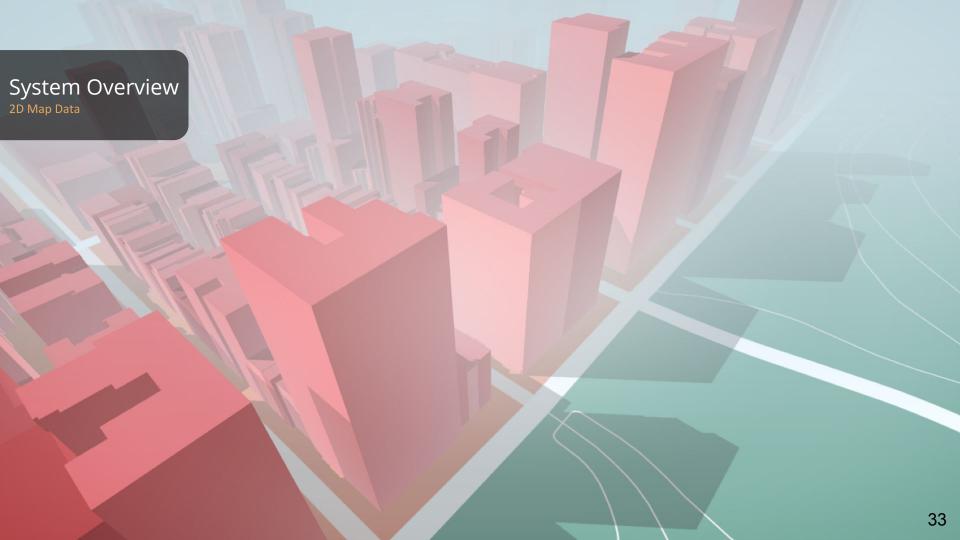
added avatars, clouds, trees, and day/night effects



Geollery fuses the mirrored world with geotagged data, street view 360° images, and virtual avatars.







Female

Male

Other

















System Overview

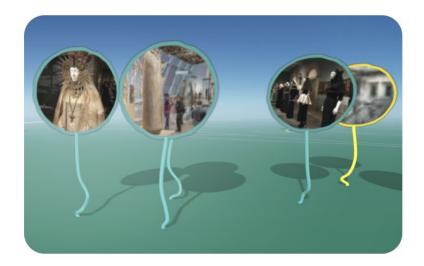
















System Overview

Geollery Workflow

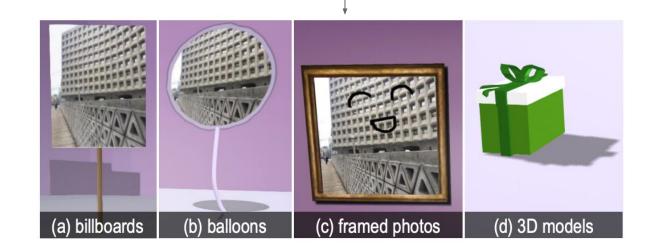




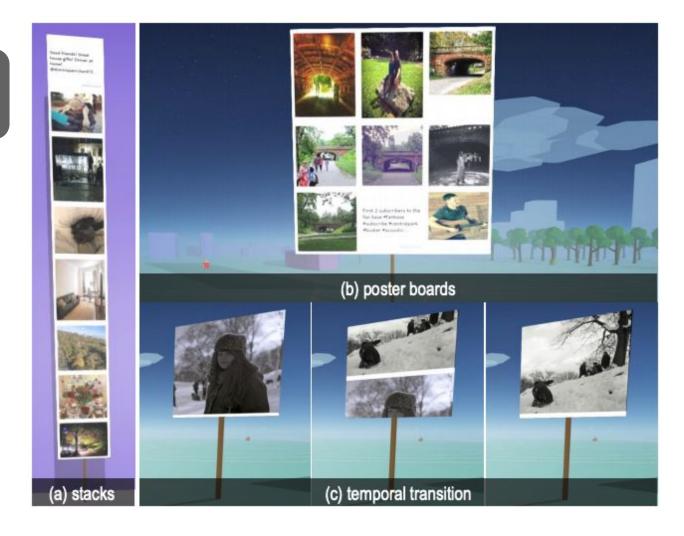






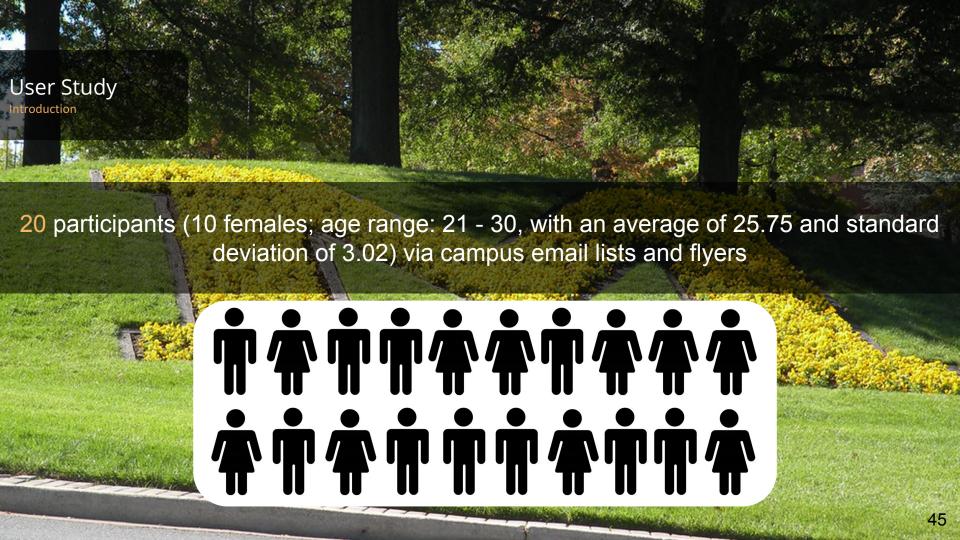


System Overview Geollery Workflow



Design Space Geollery vs. Social Street View

Variable	Geollery	Social Street View	
Mesh	Ground, 3D Buildings, trees, and clouds	Sphere	
Textures	Geollery v1: No texture Geollery v2: With 360° street views	Textured by 360° street views	
Availability	Almost always available	Only available for the locations with 360° street view data	
Motion	6 DoF	3 DoF + Teleport	
Virtual Avatar	Available	Not applicable	
Collaboration	Available	Not applicable	
Social Media Location Accuracy	Almost the exact location in the world	Estimated by distance and orientation	
Virtual Representation	Billboards / Balloons / Framed photos / Doodles / Gifts	Billboards (v2: added balloons and gifts)	
Aggregation	Based on spatial relationship	Based on direction and distance	











Geollery & Social Street View Study

Semi-structured Interview and In-person User Study

[Introduction]

Start timing!] Hello, my name is	I'm	in	at the	First, I
rould like to thank you for your participa	ation. Today, you	will be a partic	ipant in a user study	with a semi-
tructured interview. Our goal is to explo	ore your experier	nce using Geoll	ery and Social Street	t View, the
hallenges and limitations of the inter	faces, as well as	the types of de	cisions it could influ	ence and potentia
npacts it might have. Then, we will co	mpare and rate	the advantages	and disadvantages	of both systems in
ifferent aspects.				

Before we begin the interview, we need to complete a consent form. After this, we will begin. Your data will be kept anonymous. Additionally, as a researcher I have no position on this topic and ask that you be **as open, honest, and detailed** in your answers as possible. Do you have any questions before we begin?

[Begin Interview Study]

- --> The interview is broken down into three components:
 - → Your background in using social media platforms.
 - → User study of the Geollery and Social Street View platforms
 - → Survey about future of 3D social media platforms.

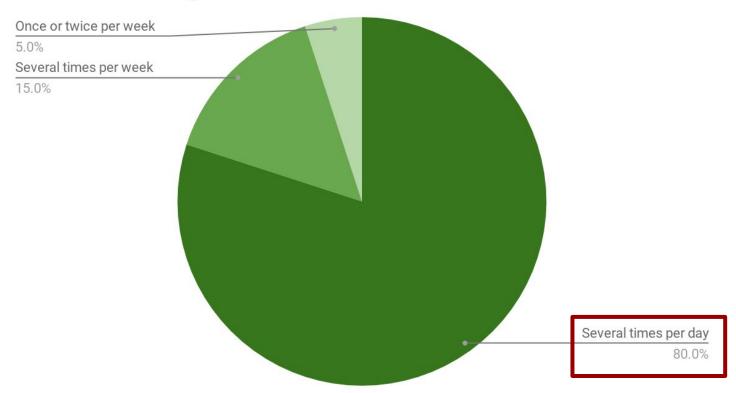
[Background]

Main goals:

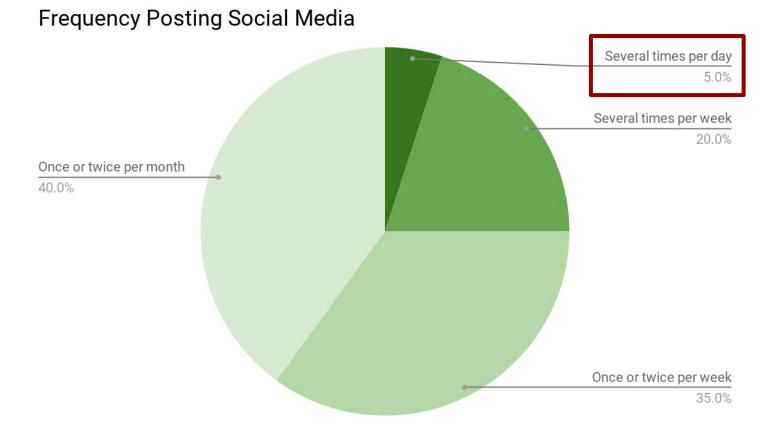
- (1) Get people comfortable with answering questions and creating a rapport.
- (2) Assessing how they are accessing social media in real life, and gain an understanding of their experience.
- 1. What are your views on social media platforms like Twitter and Facebook, how important are they to you?
- 2. Can you talk about your social media experience? How often do you use social media platforms? And how often do you post on social media websites?
- 3. What do you usually use social media platforms for?
- 4. Have you ever viewed social media in a map?

Background Interview (5 min

Social Media Usage

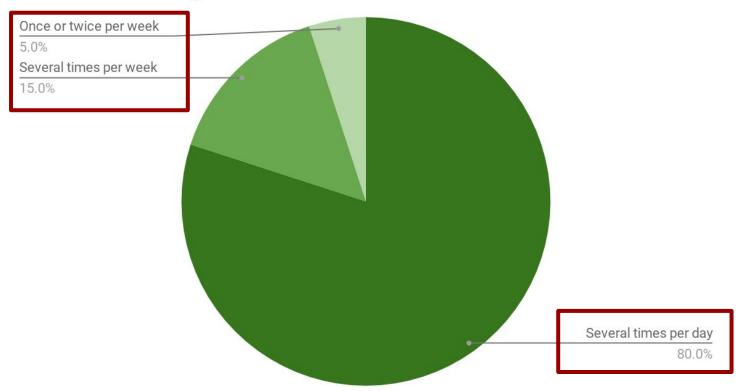


Background Interview (5 min)



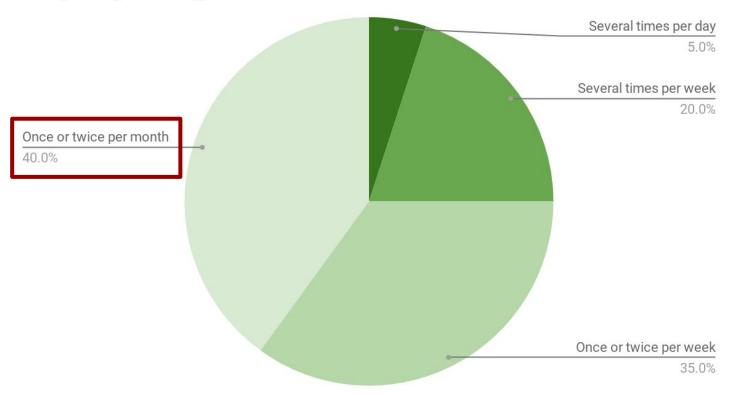
Background Interview (5 min

Social Media Usage



Background Interview (5 min)

Frequency Posting Social Media



I post news about sports and games every day.



I majorly use Instagram, I post from my own portfolio.





User Study Social Street View vs. Geollery

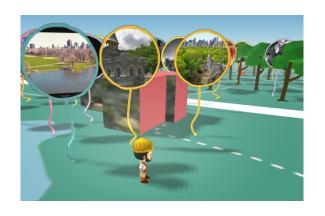




Latin Square Desigr







University Campus

New York City

Washington D.C.

Female Male Other





What's Next? Research Question 3/3

What's your first impression?



I think it's a very good start, it's very good experience to walk around.

I believe I am in a museum.





I like that the buildings are forming while I am walking.



It's cool to see posts by people in *real time*, along with the *establishment* they're in.



It's like you don't have to be there.



Please compare the two systems and indicate the degree to which you agree with the following description. For example, for the first question, 4 is most immersive, -4 is most **Quantitative Evaluation**

unengaging, 0 is neutral.

Geollery

Straightforward -1 Unengaging 0

Creative Cumbersome 3 Pleasant 0 Unimaginative -1

Practical 0 -1 Unpleasant -2

Immersive

3

-3 1 -2 -1 0 Simple Impractical -3

.4 -3 -2 -1 0 1 Complicated

Social Street View

Unengaging

-3 -2 -1 0 1 Immersive

Cumbersome

-3 -2 -1 0 1 2 Straightforward

Unimaginative

-2 -1 0 1 Creative

Unpleasant

Appealing

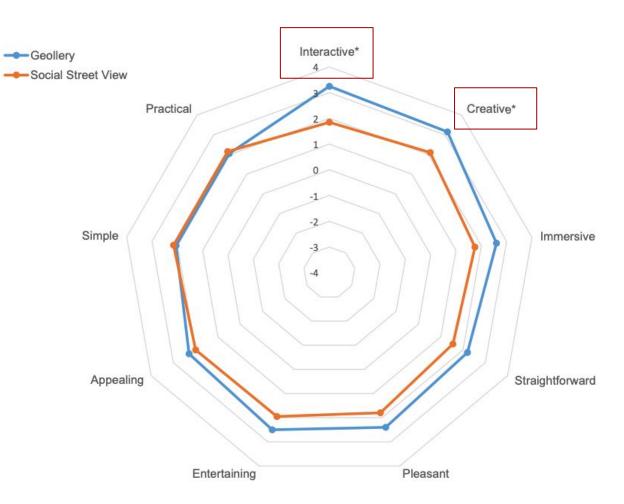
-3 -2 -1 0 1 2 Pleasant actical

-2 -1 0 1 Practical -2 -1 0 1 2 Simple

Appealing

-2 -1 0 1 2 3

Quantitative Evaluation





Post Interview

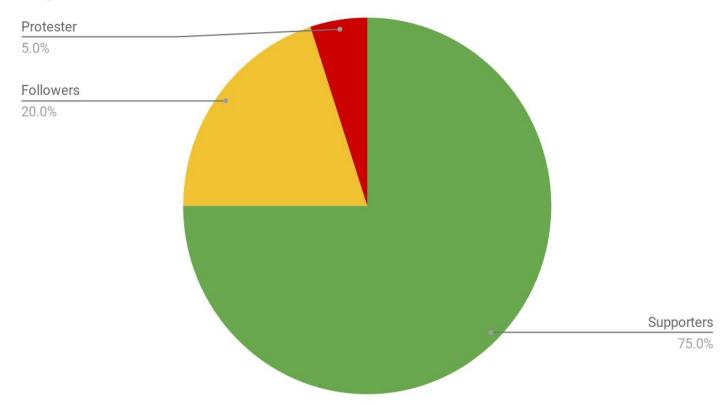
Question 1/3

Suppose that we have a polished 3D social media platform like Geollery or Social Street View, would you like to use it? If so, how much time would you like to spend on it?

Post Interview

Question 1/3

High-level Attitude Towards 3D Social Media Platform



I would like to use it every day when I go to work, or travel during weekends.



If it's not distracting like Facebook and Instagram, I would use it every day on a couple of things. I am a follower on most social media sites. I would only join a 3D social media platform once my friends are there. 66

If my friends are all on this, I can see myself spend a couple of hours every week.



I don't think I will use this. I prefer to use Yelp to see comments [of nearby restaurants]

Post Interview

Question 2/3

Can you imagine your use cases for Geollery and Social Street View? What would you like to use 3D social media platforms for?

I would like to use it for the food in different restaurants. I am always hesitating of different restaurants. It will be very easy to *see all restaurants* with street views. In Yelp, I can only see one restaurant at a time.

[I will use it for] exploring *new places*. If I am going on vacation somewhere, I could *immerse myself* into the location. If there are avatars around that area, I could *ask questions*.

I think it (Geollery) will be useful for families. I just taught my grandpa how to use Facetime last week and it would great if I could teleport to their house and meet with them, then we could chat and share photos with our avatars.

... for communicating with my families, maybe, and distant friends, [so] they can see New York. And, getting to know more people, connecting with people based on similar interests.

Post Interview

Question 3/3

If you were a designer or product manager for Geollery or Social Street View, what features would you like to add to the systems? 66

A mapping of the texture, high-resolution texture, will be great.



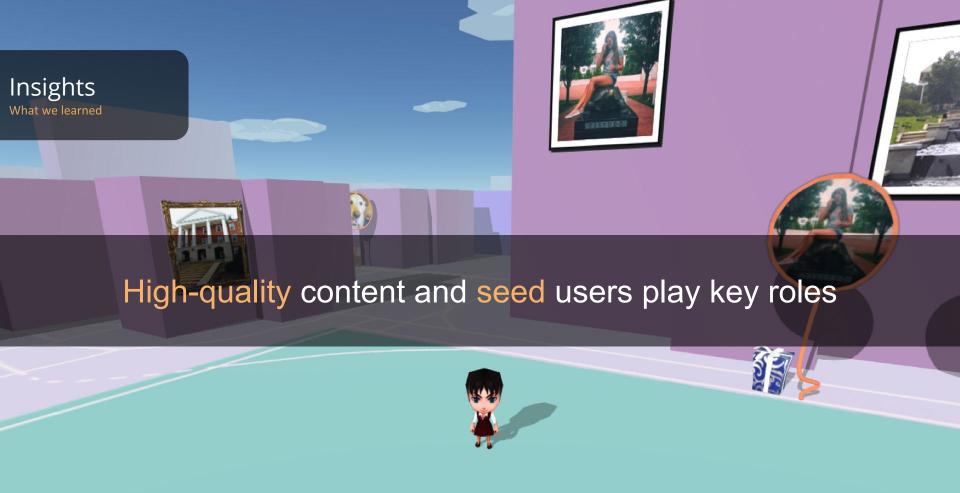
if there is a way to unify the interaction between them, there will be more realistic buildings [and] you could have more roof structures. Terrains will be interesting to add on.

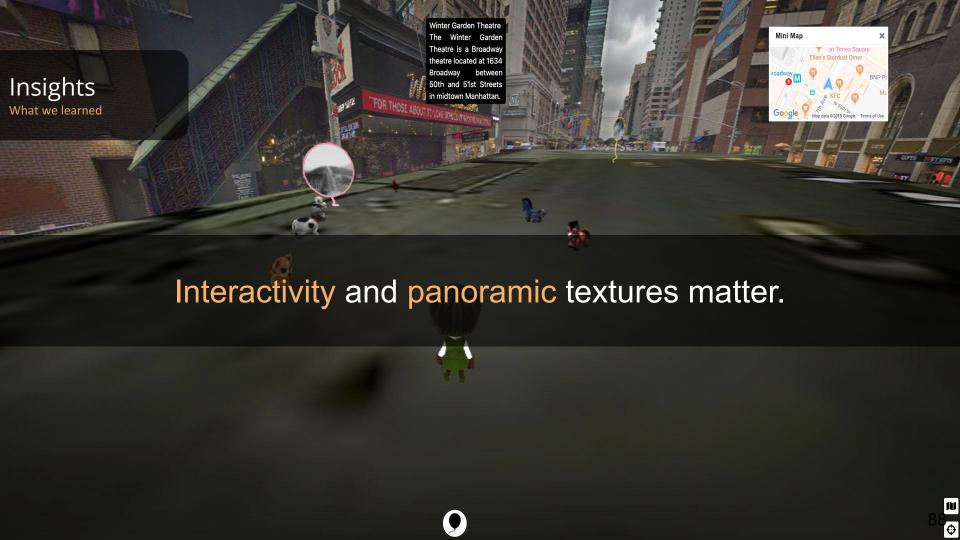
66

I would like to see kitties and puppies running around, and birds flying in the air



I could also add a bike, add a vehicle, a motorcycle in Geollery, this will add some fun.





Insights



Facebook Messenger



Discussion

Geollery v2, Web3D & VR 2019

Interactive Fusion of 360° Images for a Mirrored World

Ruofei Du*, David Li*, and Amitabh Varshney! Fellow, IEEE PHOTER LUT., LIAVIG LIT, and Armitabin Varsinibey; Pelvow, IEEE
Augmentarium, Department of Computer Science, and University of Maryland Institute for Advanced Computer Studies







r system is available at https://geollery.com.

rom the satellite imagery. On the other hand, classic highroaches to modeling the 3D world have concentrated on obscies to modeling the 31, world have concentrated on 3D meshes using raw input data with the structure-from-[4] pipelines [13, 15, 16]. Despite the effectiveness of systems, their data requirements and processing requirethem unsuitable for mobile and web applications with nd bandwidth constraints.

uce an interactive pipeline of fusing 360° images for orld at two levels of detail (Fig. 1). At a fine level of se-up views, we incorporate multiple Google Street nas and depth data to reconstruct textured meshes GPU. At a coarse level of detail when viewed from e extruded boxes with the building metadata from and texture the meshes with street view panoramas. web-based architecture to stream, cache, reconstruct, nirrored world in real time. Our system, Geollery [8], ttps://geollery.com.

ALGORITHMS

f detail for close-up views, we reconstruct an aptry based on the depth maps associated with each ropose ways of seamlessly aligning the adjacent tries. As illustrated in Fig. 2, this approach takes high resolution of the street view images while resolution depth maps to generate an approximate

el of detail when viewed from afar, we source eetMap using the Overpass API3 to obtain 2D ngs. While these polygons are not as widely riew images, we find that in urban areas such 2D building polygons often come with useful e height in meters or the number of floors for e neight in ineters of the number of noors for meer these 2D polygons into 3D, we extrude eight based on the information provided in the es where metadata is not available, we extrude height of 16 meters to represent a 4-story thod requires any server-side preprocessing essing can be done in background threads for

ps://openstreetmap.org wiki.openstreetmap.org/Overpass_API

Geollery: A Mixed Reality Social Media Platform Department of Company Science
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Figure 1: Ceallery creates an interactive mirrored world where users are immerced with 3D in a consistent of the cortest models. The cortest models are quantized as hallower hillborror hillborrors. Francisch models are quantized as hallower hillborrors. Figure 1: Geollery creates an interactive mirrored world where users are immersed with 30 h is social media. The notial media are "visualized as balloons, billhoards, framed photos, and gif

responses, we discuss

system and derive key

mirrored world with

from our study reve

ing travel planning.

CCS CONCEPTS

· Human-center

reality; Virtual

virtual reality.

view, visualiza

ACM Referen

Mixed Reality

Factors in Con (doLorg/10

We present Geollery, an interactive mixed reality social mewe present veoucry, an interactive mixed reamy such and dis platform for creating, sharing, and exploring geolagged one plantorm for creating, sugaring, and explaining processing information. Geolety introduces a real-time pipeline to peramonianon. George auroques a rearrime pipeine to progressively render an interactive mirrored world with duree

gressively renuer an interactive nutriness work white successful dimensional (DI) buildings, internal user-generated content. unnensonai (31) puisonngs, internal user-generated content, and external geotagged social media. This mirrored world and external georagged social media. Inis mirrorea world allows users to see, chat, and collaborate with remote parallows users to see, chat, and collaborate with remote par-ticipants with the same spatial context in an immersive vit-tual environment. We describe the system architecture of

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2 2015 Copyright hold by the owner! author(s). Publication rights locensed. to ACM. ACM ISBN 978-1-4503-5970-2/19705...\$15.00

Figure 1: Geollery creates an interactive mirrored world in real time, in which users are immersed with 3D buildings, live chats, and geotagged social media. The social media are visualized as balloons, billboards, framed photos, and gift

Experiencing a Mirrored World with Geotagged Social Media in Geollery

Ruofei Du, David Li, Amitabh Varshney Augmentarium, UMIACS, and Computer Science Department University of Maryland, College Park, MD, USA Contact:me@duruofei.com,varshney@cs.umd.edu

We demonstrate the online deployment of Geollery [5], a mixed reality social media platform. We introduce an interactive pipeline to reconstruct a mirrored world at two levels of detail: the street level and the bird's-eye view. Instead of using offline 3D reconstruction approaches, our system streams and renders a mirrored world in real time, while depicting geotagged social media as billboards, balloons, framed photos, and virtual gifts. Geollery allows multiple users to see, chat, and collaboratively sketch with the spatial context in this mirrored world. We demonstrate a wide range of use cases including crowdsourced tourism, interactive audio guides with immersive spatial context, and meeting remote friends in mixed reality. We envision Geollery will be inspiring and useful as a standalone social media platform for those looking to explore new areas or looking to share their experiences. Please refer to https://geollery.com for the paper and live demos.

Ruofei Du, David Li, Amitabh Varshney. 2019. Experiencing a Mirrored World with Geotagged Social Media in Geollery. In CHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI'19 Extended Abstracts), May 4-9, 2019, Glasgow, Scotland UK, ACM, New York, NY, USA, 4 pages, https://doi.org/10.1145/3290607.3313273

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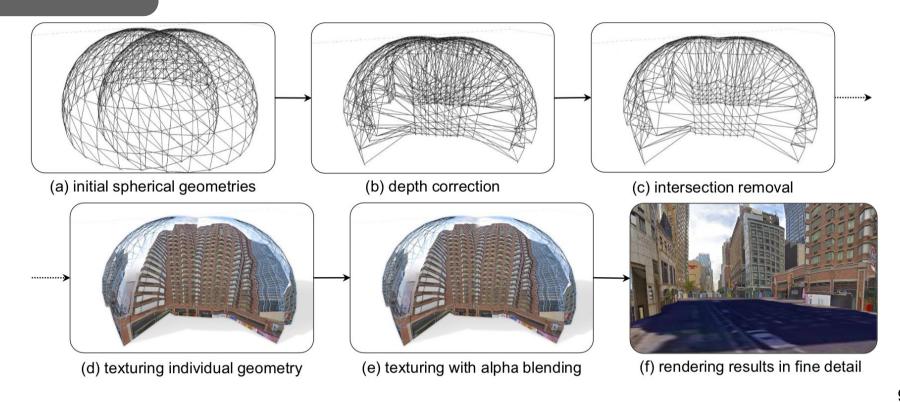
Discussion

Taking the Feedbacl

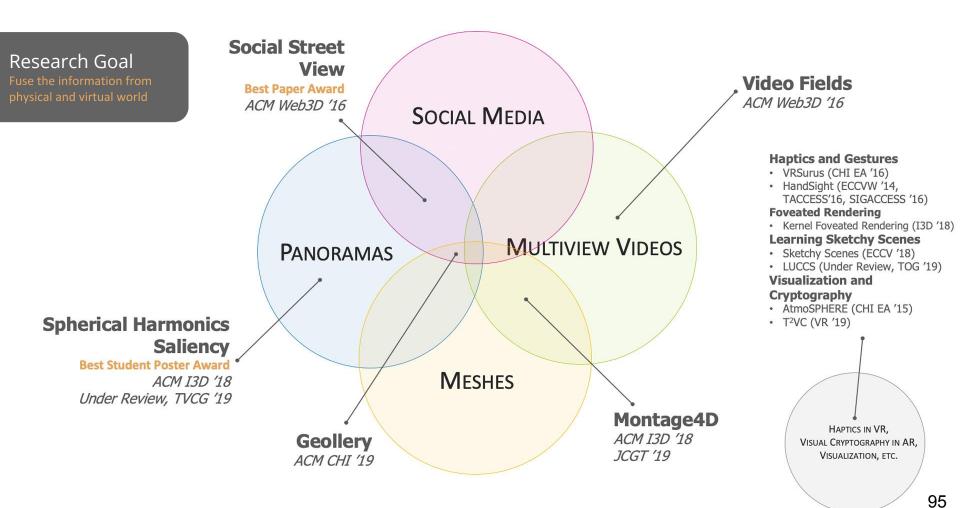


Discussion

Taking the Feedbac



Challenge Global Market Constraints: Weak Content for XR















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UMIACS

University of Maryland Institute for Advanced Computer Studies

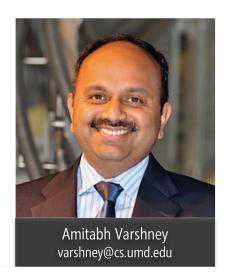


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Coauthors











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