Personalized Trip Planning by Integrating Multimodal User-generated Content

Om P. Patri[1], Ketan Singh[1], Pedro Szekely[1,2], Anand V. Panangadan[1], Viktor K. Prasanna[1]
[1]University of Southern California, Los Angeles, CA 90089
{patri, ketansin, anandvp, prasanna}@usc.edu
[2]Information Sciences Institute, Marina Del Rey, CA 90292
pszekely@isi.edu

***Abstract*—We address the problem of record linkage and semantic integration in the context of large collections of user-generated content. These datasets are often large since it contains the contributions of millions of Internet users. We present an approach based on approximate string matching between the metadata associated with such data. The discovered linkages are stored in an ontology for answering queries on the integrated data sources. We demonstrate this approach in *Photo Odyssey*, an interactive web application which integrates multimodal content from image hosting and travel websites to create a user interface with a graphical trip plan and personalization options. We discuss several practical challenges faced in building such an application – integrating and mining large-scale multimodal user-generated data, resolving semantic heterogeneity, and machine learning for matching and ranking items. Photo Odyssey operates in an online manner without using any previously stored knowledge base. We also describe methods to compute relevance of images, remove bad data instances and duplicates, perform contextual filtering, and assign a category to uncatalogued images which enable an interactive application even on Big Data with real-world characteristics.**

***Keywords*-Information Integration, Metadata, Ontology, Semantic Heterogeneity, Photography**

I. Introduction

User-generated content (UGC) [12] encompasses a variety of data, information or media contributed voluntarily by open collaboration through users in a web community. This rapidly emerging pool of Big Data is rich in metadata as well as links to other data sources, gradually enabled through Linked Data. UGC is characterized by the wide variety of the forms of data and metadata content – text, images, numeric as well as its scale in large-scale applications. In this work, we explore the use of metadata to automatically integrate multimodal UGC data collections. Specifically, we use the metadata associated with different data types to address the record linkage problem [6] (identifying similar entities in different knowledge bases when the data is not represented using a consistent schema) in UGC. Our approach makes use of approximate string matching algorithms to identify related instances in different online data sources. The linkages are represented in an ontology which enables applications to use Semantic Web standards to make use of the discovered relationships between the data sources.

We illustrate our approach of integrating UGC across different sources on publicly available multimedia data to build a Web-accessible application for personalized trip planning. Specifically, we focus on user-contributed images (from hosting sites such as Flickr) and user-written travel information such as points of interest (POIs) from travel sites (such as TripAdvisor). With the advent of digital photography equipment, the number of photography enthusiasts has also largely increased. When embarking upon a trip to a new city, tourists spend time searching for information, typically reviews, photos, and suggestions in order to plan their itinerary. In particular, photographers are interested in (i) searching for travel information (such as points of interest and their reviews), and (ii) searching for photographs taken at these locations, and analyzing technical information about these photographs (such as equipment make/model, camera settings, ratings and subject categories of photographs). Finally, the tourist needs to plan his/her itinerary and travel times between destinations. However, there is no existing tool which automatically performs this integration across multiple sources in near-real-time to provide a unified interface to the user and which enables users to personalize the path-planning process on the basis of the metadata of photographs.

We present *Photo Odyssey*, a web application (mashup) which integrates multimedia content from image hosting and travel websites to provide the user with an automatic trip itinerary overlaid on a map of the target city. Given a specific city, *Photo Odyssey* provides a map of the city with several top-rated photographs overlaid at their geographical location on the map. An automatically planned itinerary is also plotted for the user. This itinerary can be personalized by the user to only display those images (and the corresponding routes) satisfying user-specified preferences of camera model, lens type, exposure settings, and ratings of other parameters. Our ultimate aim is to help users take their preferred type of photographs and spend less time searching and integrating trip information from disparate sources. For instance, consider a user with a Nikon camera and a wide angle lens who is interested in nature photography. With *Photo Odyssey*, this user can specify low focal length numbers as a criteria for the search (to ensure wide angle photos). The aperture and ISO sensitivity values can also be adjusted to ensure that the user sees most of the photographs in the desired lighting scenario (daytime or night) to match with his/her travel time. Further, the category and ratings of pictures can also be chosen

IEEE ICSC 2015, February 7-9, 2015, Anaheim, California, USA
978-1-4799-7935-6/15/$31.00 ©2015 IEEE

to ensure both *relevant* and *highly-rated* photographs being displayed.

A preliminary demonstration of *Photo Odyssey* was presented in [16]. In this paper, we give a more detailed description and analysis of the system. In particular, we describe the ontology that forms the knowledge base for the system, the approach based on approximate string matching to identify relevant records across disparate data sources, and the user interface.

Challenges. Integrating the variety of the data poses the greatest challenge – it includes multimedia, ranging from image files (image data), tags and descriptions (text data) to ratings (numeric data) and other metadata such as exposure information and equipment used (categorical data). Even the same type of data from two different sources is represented quite differently. Further, this integration step is performed online in Photo Odyssey (no knowledge base is stored prior to the search). We address this integration challenge by adopting an ontology-based approach and using interoperable semantic web standards. Second, near-real-time applications have to provide end-users with a rapid useable response. Waiting until all the available data is completely processed precludes an interactive application. Our approach therefore ranks the retrieved linkages with respect to the end-user's query in order that relevant results can be returned in a relatively short amount of time. Third, ensuring data quality of crowd-sourced is a recognized problem [13]. We developed methods to remove incorrect data instances and duplicates, perform contextual filtering, and categorize uncatalogued instances to address real-world data characteristics. Fourth, photographs have to be matched with the location they were taken in, and tags associated with the photographs have to be checked if they actually reflect the intended location. We utilize approximate string matching methods to address this issue.

Contributions.

- **Online Integration of Multimodal Data**: our ontology-based approach integrates categorical, text, numeric and image data from different sources in an online manner. Irrespective of the original type of the data instance, it is stored in the ontology repository in the format of semantic web triples, which makes integration feasible. This repository is built only after a user query is sent.
- **Incorporation of UGC**: we demonstrate how online integration of multimodal data enables the use of UGC stored in distributed online collections for applications not possible with the use of a single data source.
- **Matching and Ranking Images**: we use machine learning approaches for finding relevant as well as highly-rated photographs, including string matching techniques for relating images to tags and descriptions.
- **Personalized Trip Planning**: our system enables users to customize their travel itinerary according to their individual preferences, including options about image metadata (e.g., category, rating, camera, lens, and aperture).

II. Related Work

Semantic approaches and travel planning. Plnnr[1] is a website which creates customizable trip plans based on user input. Photo2Trip [14] is a related approach which uses dynamic programming to automatically find travel routes from geotagged photographs. TravelBuddy [7] is an analogous approach but is not geared towards photography enthusiasts. It provides realtime route recommendation with a visual interface based on popularity, typical stay times and visual scenes at different times.

Zheng et al. [21] also used geotagged photographs to find tourist movement patterns and topological characteristics of different routes. Tip [9] uses a semantic network of sightseeing information and travelers' interests to provide a personalized information delivery system for tourists. Several methods for ontology-based photo annotation are presented by Schreiber et al. [20]. Methods on ontology-based processing of image data, such as detecting event semantics from Flickr tags in Rattenbury et al. [19], can be used to extend our work. Rabbath et al. [18] combine information from social media and blog posts to build semantic photo books. Unlike these works, Photo Odyssey puts photographs at the center of its integration efforts to suit photography enthusiasts and performs ontology-based information processing in an online manner.

Image and tags analysis. Analysis of user-generated Flickr images and metadata (such as tags) has been explored for various data mining tasks [1], [2], [4], [8], [10]. However, none of the existing methods aim at analyzing, searching or filtering image metadata based on photography parameters such as camera used, focal length, aperture, shutter speed and ISO information. De Choudhury et al. [4] build travel itineraries from geotagged Flickr photographs. Clements et al. [2] predict a user's favorite locations in a city based on her Flickr geotags. Other applications include finding city cores (specifically the usage of the term *Downtown*) [10] and digital footprinting of tourists (from cellphone location and geotagged photographs taken) [8]. Kennedy et al. [11] present a location-tag-vision-based approach to retrieve images of geographical landmarks, and extract place semantics from Flickr tags.

III. Approach

To build the proposed application, we need to combine and aggregate information from multiple photograph streams. This requires scraping/crawling web photograph streams from multiple sources (and pre-processing them). To have a unified view of the data and overcome semantic heterogeneity, we use ontologies and semantic information integration [15]. We integrate with other semantic sources such as the Photography Ontology [5], which contains useful information about equipment (e.g. cameras and lenses), concepts (e.g. scenes, shapes, aperture, ISO) as well as rules (e.g. good bokeh[2] is circular and not polygonal).

[1]http://plnnr.com
[2]http://en.wikipedia.org/wiki/Bokeh

We need an intelligent approach which makes the best decision for various application requirements within time constraints, such as:

- How to obtain points of interest (POI) and photographs for a city?
- How to find relevance and category of photographs?
- What personalization options should be available?
- How to obtain an optimized itinerary?

The itinerary suggested by our application is personalized to tastes or preferences of users. Such preferences are typically reflected by categorical photography interests e.g. nature, art, macro, street etc. or specific range of technical parameters such as aperture, ISO and camera model. The user may also specify driving or walking directions preferences.

A. Data Sources

We use several data sources for our mashup, including:

- 500px.com and Flickr for obtaining photographs and metadata
- LonelyPlanet and TripAdvisor for travel and photography destinations
- Photography Ontology [5] for photography concepts and equipment
- Google Maps API for geo-coding and route finding

TripAdvisor and LonelyPlanet are popular travel information websites with plenty of user-generated content. Flickr is a very popular image hosting website. 500px (pronounced five hundred pixels) is an online photography community, aimed at aspiring and professional photographers. All of these data sources have tens of millions of active users (Flickr has more than a million public photographs uploaded everyday). The Photography Ontology [5] by Nick Drummond is an effort to add structure in representing photography concepts, cameras and equipment. While building our own ontology, we link to the appropriate concepts in the Photography Ontology to enable reuse. We use Scrapy (http://scrapy.org) for web crawling. The crawled data is added as ontology instances on Sesame triple store.

B. Architecture

The proposed architecture for our application is shown in Figure 1.

The numbers in the figure represent the 10-step flow of information, and delineate the complete architecture as described below.

1) User sends query with name of input city and country to Photo Odyssey web application/mashup interface.
2) Mashup interface transfers the query to web server. We use a Python-based web server framework called Tornado (http://www.tornadoweb.org/) which is a scalable, non-blocking web framework. Thus, a large number of users can connect to the mashup and have their queries running simultaneously.
3) The web server sends the query to the information integration component (IIC), which contains the central ontology/knowledge repository. The IIC is the most crucial component in Photo Odyssey.
4) The IIC interacts with data sources - first with travel websites (TripAdvisor and LonelyPlanet) to obtain a list of points of interest (POIs) in the city.
5) For each POI in the list, the IIC queries image hosting websites (Flickr and 500px) with the name of the POI to obtain images and all relevant metadata, as predefined by the ontology schema. Several images are obtained for each POI, only a limited number of which are chosen for display in the application.
6) The images and metadata obtained from multiple sites are converted into semantic web triples (in RDF and inserted into the ontology to form the data portion of the ontology. This step ensures that semantic heterogeneity between different data sources is resolved in our knowledge repository. Pre-defined rules can also be inserted into the knowledge base (ontology) in this step.
7) After building the ontological knowledge base, we can return the results to the web server for output and display. If the user modifies the query (by changing the personalization options on the user interface), then the appropriate query (semantic web queries in SPARQL) is evaluated over the knowledge base and only the filtered results are returned.
8) The web server provides the geolocations of the photographs to be displayed to Google Maps for displaying them on a map.
9) Google Maps builds an optimized tour itinerary based on the locations given, covering all of them in the shortest path, and returns the trip route to the web mashup.
10) The mashup displays the results to the user, with the map, pictures, metadata, personalization options and sequential travel segments in the route. The user can customize the results by choosing from the filters provided and submitting a new query. The results are changed according to the user's requirements, and the route is also optimized to the new results.

C. Data/Ontology Model

We build the Photo Odyssey ontology (`odyssey:` is the prefix). Using the Photography Ontology [5] (`photography:` is the prefix) enables us to express rich domain knowledge about photography in our application. The data model for each photograph consists of (i) basic information about the source, city, country and point of interest (POI), (ii) photograph metadata including title, image URL, category, tags and geolocation, (iii) photograph rating information such as views, favorites, comments, pulse and rating score, and (iv) technical information such as aperture, ISO, shutter speed, camera, lens and focal length for the photograph. These concepts can help us evaluate simple rules, for e.g. from the combination of aperture, shutter speed and ISO, we can determine whether the photograph was taken in daylight or night/indoors, since more light is required for a photograph to be taken at night. Additional concepts can be linked to

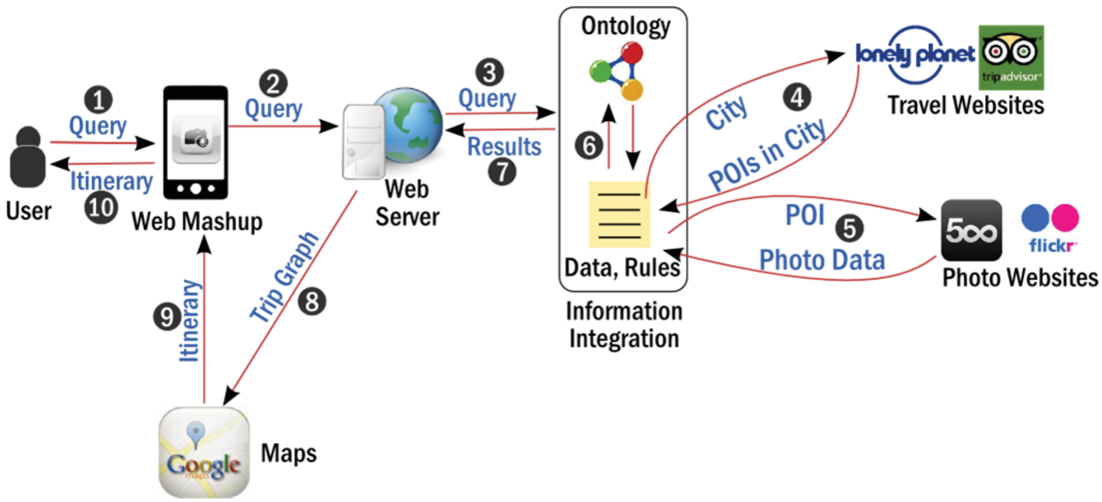

Fig. 1: Photo Odyssey Architecture

represent more complex rules. We can further link to concepts from event models such as PoEM [17] to extend the scope.

The ontology structure is shown in Figure 2. The class `odyssey:Photo` is the central point of the ontology schema and brings together all the other classes and properties. The object-type and data-type properties of this class taken together form the description of the complete metadata for any image. Certain object-type properties are further linked to classes in the Photography Ontology as their range for even more details. For instance, `odyssey:takenWithCamera` links to `photography:Camera` and `odyssey:takenWithLens` links to `photography:Lens`.

D. Learning for Matching and Ranking

1) Ranking Photographs and Route Computation: From a large number of photographs for each POI we can choose only a few to display. The rank of a photograph depends on several factors: number of views, comments and favorites, the user-rated current and highest pulse, (only for 500px photographs) as well as the popularity of the POI itself and the equipment used for the photograph. As a simple heuristic, the ratio of number of favorites to the number of views is considered as a basic score metric. In 500px photographs, the current and highest pulse is included as well. We eliminate those POIs which do not have any highly-ranked photographs, thus incorporating feedback and learning from the image data, and re-ranking the POIs obtained from travel websites based on photographic interestingness (determined by our application).

The user can further tune these rankings based on categorical interest topics, equipment used or technical parameters desired for photography. SPARQL is used for on-the-fly semantic queries over the ontology, e.g. the filter part of a SPARQL query which shows photographs from Canon 7D or Nikon D80 with ISO range 20-99 is shown as:

```
FILTER(xsd:float(replace(?iso,"ISO ", ""))>20).
FILTER(xsd:float(replace(?iso,"ISO ", ""))<99).
FILTER regex(?camera, "(Nikon D80|Canon 7D)" ).
```

In future work, we intend to categorize or group these parameters to classes, i.e. cameras may be divided into phone-cam, amateur, semi-professional and professional. Relevant metadata is shown with each photograph to provide an intuition to the user about what creates top-rated photographs. Once we have decided upon the points of interest and photographs to display, we ask Google Maps for an optimized driving route covering all POIs. Note that finding an optimized route is essentially solving the Traveling Salesman Problem (TSP) which is NP-hard. Google Maps does a good job of finding an approximate route for us here.

2) Record Linkage and Fuzzy String Matching: A prominent portion of the record linkage problems we face in the application are solved by smart fuzzy string matching (otherwise known as probabilistic record linkage) methods.

Assigning Categories to Photographs. The photographs from 500px have a category while Flickr photographs have no categories assigned to them. We assigned the Flickr photographs to one of the 500px categories by matching the strings of photograph tags and title to each of the category strings and choosing the best match. If our classifier had a confidence level under 50 %, then the photograph stays uncategorized. We used the FuzzyWuzzy[3] package for Python to implement the string matching distance metrics. The classifier here is the maximum similarity out of four popular distance measures [3]: (i) Levenshtein distance, (ii) Partial Ratio (analogous to Smith-Waterman distance), (iii) Token Sort Ratio (analogous to sorted string token distance), and (iv) Token Set Ratio (based on Jaccard distance). The intuition behind choosing the maximum out of the four is to maximize the chances of obtaining a category result.

Computing Relevance of Photographs. We calculated the relevance of each photograph (to the corresponding POI and search keyword) by using the **Jaro-Winkler distance** [3] as

[3]https://github.com/seatgeek/fuzzywuzzy

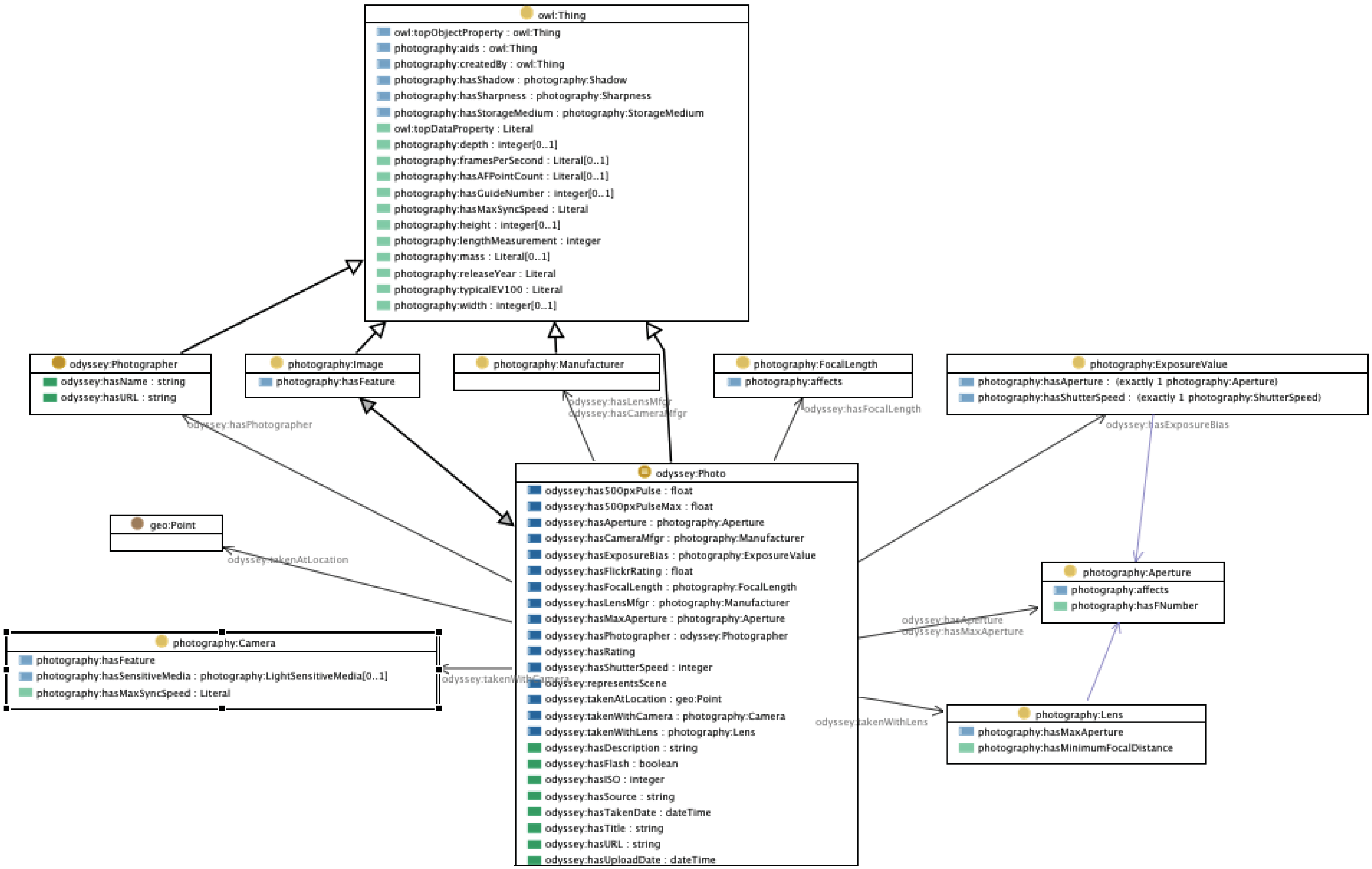

Fig. 2: Concepts and Schema of the Photo Odyssey Ontology (`odyssey:`)

a metric. The arguments to match were (i) the concatenated strings of photograph title and tags on one side, and (ii) concatenated strings of the city name and POI name on the other. This makes sure that we account for all parameters. As expected, there is a tradeoff between selecting the most relevant photographs (measured by our Jaro-Winkler metric) and choosing the highest community-rated photographs (measured by number of views, favorites and user ratings).

Eliminating Duplicates and Bad Data. While crawling images, we do not consider those items which do not have a title describing them. Since the names of several POIs are common across different cities (e.g. Cathedral of Santa Maria in Berlin v/s Cathedral of Santa Maria in Rome), we want to ensure that the POIs picked in Step 4 of our information flow architecture are valid POIs. To cross-check this, we use the Google Maps geocoding/decoding API to search for the latitude and longitude of the POI and compare the obtained city with the input query argument. To eliminate duplicate POIs, we used a token set ratio, which is based on the **Jaccard distance**. We eliminate POIs which were crawled multiple times and merge them to one, i.e. 'olympic stadium olympiastadion' and 'olympic stadium', 'casa de la muerta' and 'casa la muerta', and so on.

IV. User Interface

HTML and Javascript are used in the frontend to build the user interface (UI). Suppose the user enters Berlin as city and Germany as country. The core UI portion is as shown in Figure 3, which shows the map with POIs, travel route segments and driving directions on the right (in yellow), and personalization options at the bottom.

Clicking upon any POI pointer on the map reveals a relevant and top-rated photograph for that point of interest. This can be observed in Figure 4 which shows an image of the holocaust memorial in Berlin. Note that all the metadata of the image (including our computed relevance and rating scores, category of image, and technical photography information) is displayed along with the image itself.

The various personalization options offered can be seen in detail in Figure 5. These options are offered to the user in the form of check boxes for nominal/categorical data (e.g. photograph category, camera) or sliders for numeric/interval data (e.g. ISO, aperture, relevance of photograph). Suppose a user is interested in artistic black and white photographs. Then upon selecting only the black and white check box, the map as well as the route is refreshed to filter only images and POIs of the user's choice. This can be seen in Figure 6 which shows a similar top-rated and relevant photograph of the holocaust memorial POI, but is black and white (the category of the image also reflects it). The route/itinerary for the user is also updated as seen in Figure 7 as compared to the previous route in Figure 3. The customization options can be recursively applied to perform filtering based on even more features while retaining the original filter.

Fig. 6: UI for Berlin showing a photograph at the same POI after filtering for black and white photographs

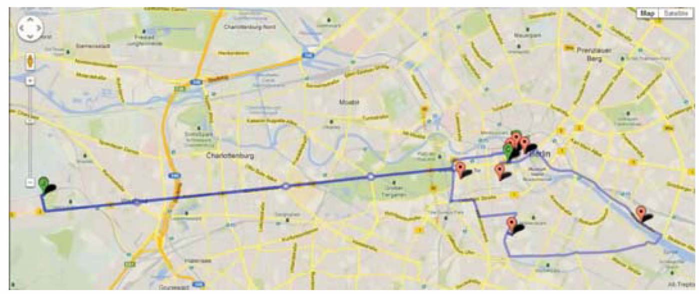

Fig. 7: UI for Berlin showing an updated route after customization by user

V. Conclusion

We presented an approach for linking multimodal data distributed across multiple UGC sources. The method is based on applying approximte string matching methods between the metadata that is stored with the different types of data. The discovered linkages are stored in a Semantic Web ontology and functions as the knowledgebase for answering user queries. We demonstrated the use of this approach in *Photo Odyssey*, a web application which integrates multimodal content from image hosting and travel websites to provide users with an automatic trip itinerary on a map of the target city. The application operates on popular Internet websites hosting large amounts of UGC including Flickr and 500px.com. Photo Odyssey uses the camera and location metadata stored along with the image files to enable the user to personalize his or her search. In order to ensure that the application is interactive even when the underlying data sources are large, a ranking algorithm was applied to the retrieved results. In this way, end users can view results within a few minutes of submitting a personalized search even when online Big Data needs to be integrated.

Acknowledgments

This material is based upon work supported by the National Science Foundation under Grant No. 1339756.

References

[1] G. Cai, C. Hio, L. Bermingham, K. Lee, and I. Lee. Mining frequent trajectory patterns and regions-of-interest from flickr photos. In *System*

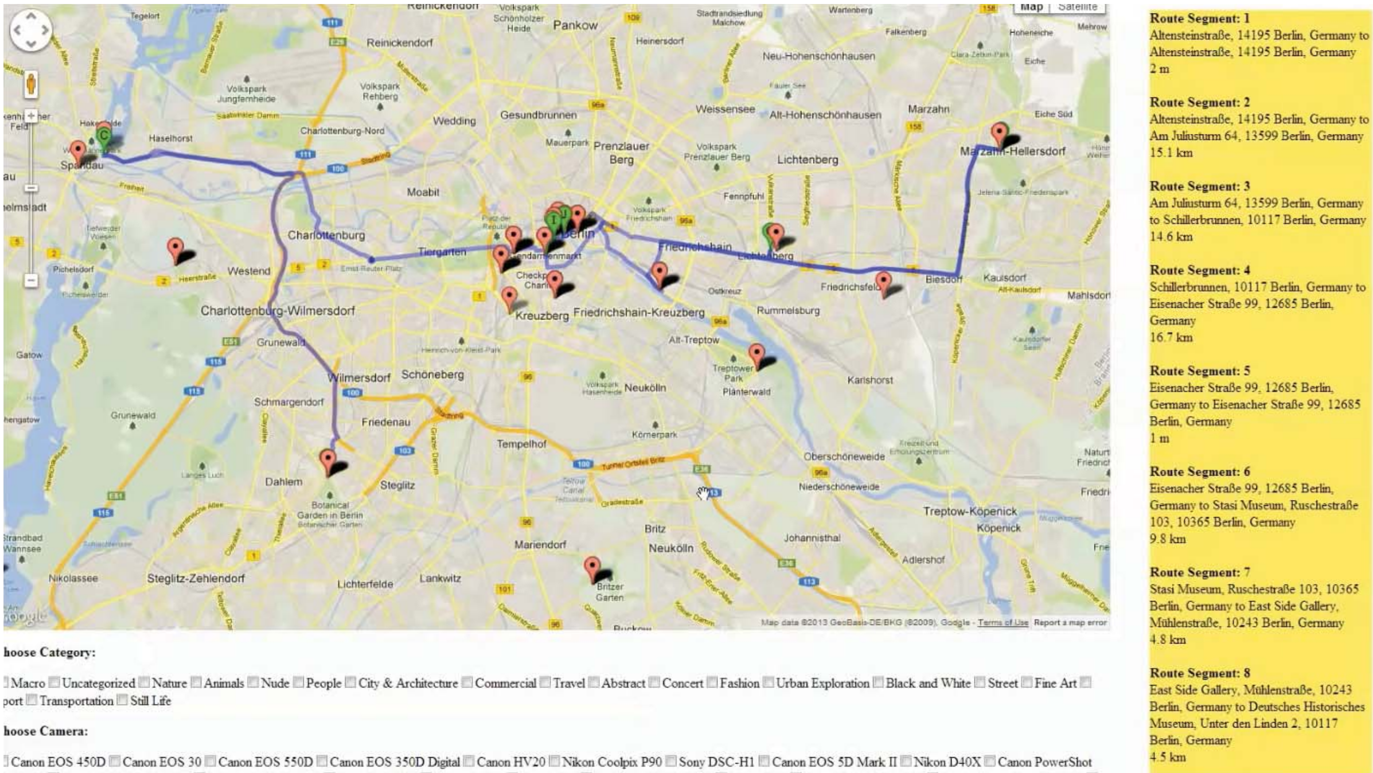

Fig. 3: UI for Berlin showing map, itinerary and customization options

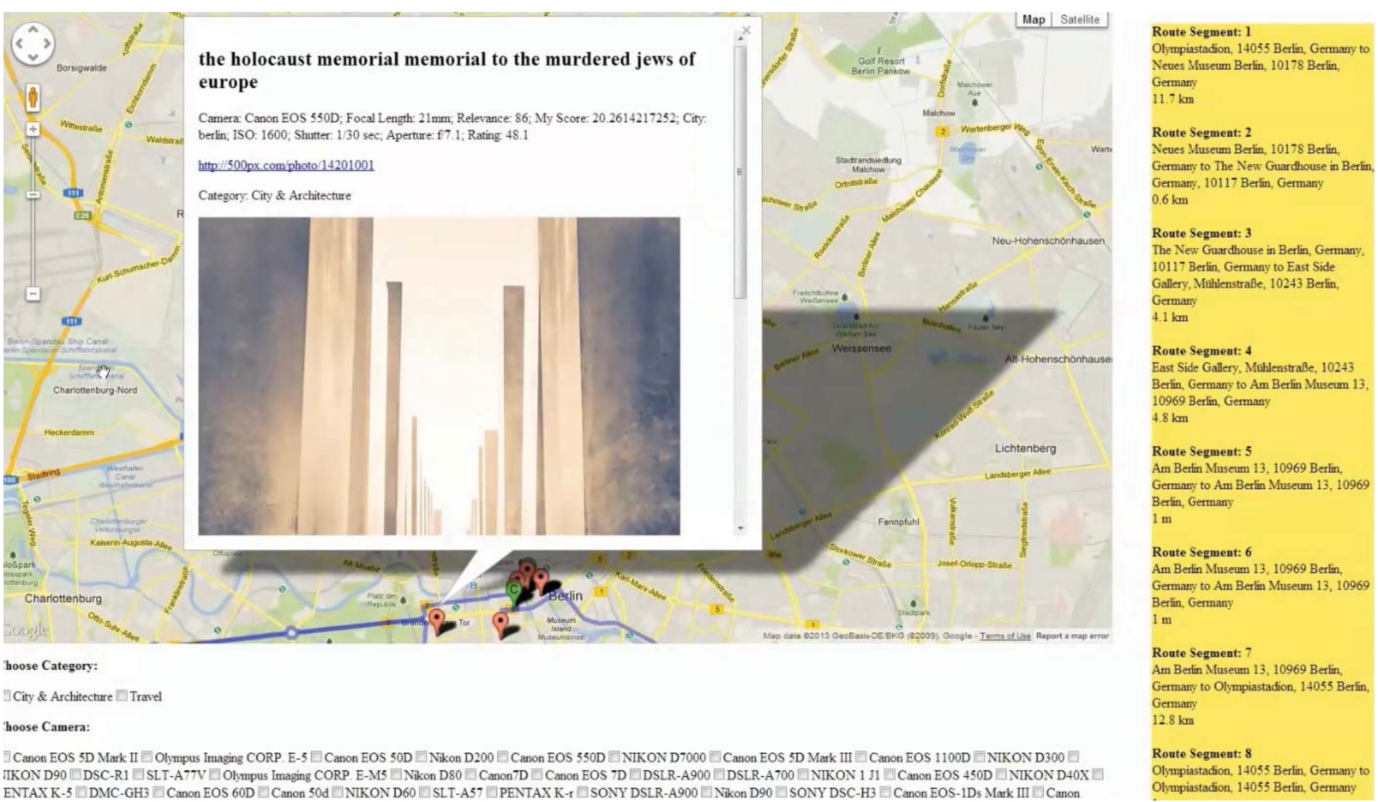

Fig. 4: UI for Berlin showing a photograph with its metadata for a POI

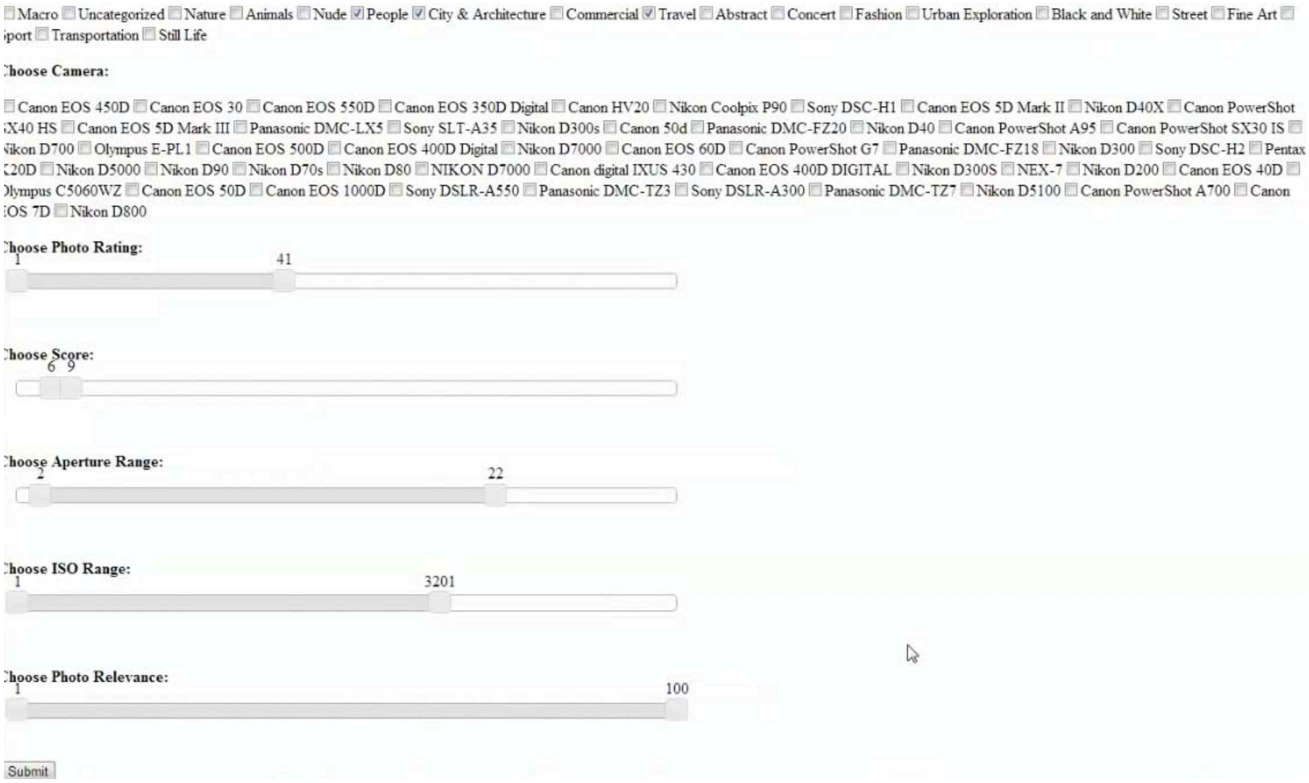

Fig. 5: Personalization options available to users. The first row is the category of the photograph.

Sciences (HICSS), 2014 47th Hawaii International Conference on, pages 1454–1463, Jan 2014.

[2] M. Clements, P. Serdyukov, A. P. de Vries, and M. J. Reinders. Using flickr geotags to predict user travel behaviour. In *Proceedings of the 33rd International ACM SIGIR Conference on Research and Development in Information Retrieval*, SIGIR '10, pages 851–852, New York, NY, USA, 2010. ACM.

[3] W. Cohen, P. Ravikumar, and S. Fienberg. A comparison of string metrics for matching names and records. In *KDD Workshop on Data Cleaning and Object Consolidation*, volume 3, pages 73–78, 2003.

[4] M. De Choudhury, M. Feldman, S. Amer-Yahia, N. Golbandi, R. Lempel, and C. Yu. Constructing travel itineraries from tagged geo-temporal breadcrumbs. In *Proceedings of the 19th International Conference on World Wide Web*, WWW '10, pages 1083–1084, New York, NY, USA, 2010. ACM.

[5] N. Drummond. The photography ontology, http://www.nickdrummond.co.uk/photographyontology/, 2010.

[6] A. K. Elmagarmid, P. G. Ipeirotis, and V. S. Verykios. Duplicate record detection: A survey. *Knowledge and Data Engineering, IEEE Transactions on*, 19(1):1–16, 2007.

[7] C.-Y. Fu, M.-C. Hu, J.-H. Lai, H. Wang, and J.-L. Wu. Travelbuddy: Interactive travel route recommendation with a visual scene interface. In C. Gurrin, F. Hopfgartner, W. Hurst, H. Johansen, H. Lee, and N. OConnor, editors, *MultiMedia Modeling*, volume 8325 of *Lecture Notes in Computer Science*, pages 219–230. Springer International Publishing, 2014.

[8] F. Girardin, F. Calabrese, F. D. Fiore, C. Ratti, and J. Blat. Digital footprinting: Uncovering tourists with user-generated content. *Pervasive Computing, IEEE*, 7(4):36–43, 2008.

[9] A. Hinze, A. Voisard, and G. Buchanan. Tip: Personalizing information delivery in a tourist information system. *Information technology & tourism*, 11(3):247–264, 2009.

[10] L. Hollenstein and R. Purves. Exploring place through user-generated content: Using flickr tags to describe city cores. *Journal of Spatial Information Science*, pages 21–48, 2014.

[11] L. Kennedy, M. Naaman, S. Ahern, R. Nair, and T. Rattenbury. How flickr helps us make sense of the world: Context and content in community-contributed media collections. In *Proceedings of the 15th International Conference on Multimedia*, MULTIMEDIA '07, pages 631–640, New York, NY, USA, 2007. ACM.

[12] J. Krumm, N. Davies, and C. Narayanaswami. User-generated content. *IEEE Pervasive Computing*, 7(4):10–11, 2008.

[13] M. Lease. On quality control and machine learning in crowdsourcing. In *Workshop on Human Computation, Twenty-Fifth AAAI Conference on Artificial Intelligence*, 2011.

[14] X. Lu, C. Wang, J.-M. Yang, Y. Pang, and L. Zhang. Photo2trip: generating travel routes from geo-tagged photos for trip planning. In *Proceedings of the international conference on Multimedia*, MM '10, pages 143–152, New York, NY, USA, 2010. ACM.

[15] N. F. Noy. Semantic integration: a survey of ontology-based approaches. *ACM Sigmod Record*, 33(4):65–70, 2004.

[16] O. P. Patri, K. Singh, and P. Szekely. Photo odyssey: Create personalized photography itineraries in realtime. *Demo at the AI Mashup Challenge, 10th Extended Semantic Web Conference (ESWC)*, 2013.

[17] O. P. Patri, V. S. Sorathia, A. V. Panangadan, and V. K. Prasanna. The process-oriented event model (PoEM): a conceptual model for industrial events. In *Proceedings of the 8th ACM International Conference on Distributed Event-Based Systems*, pages 154–165. ACM, 2014.

[18] M. Rabbath, P. Sandhaus, and S. Boll. Semantic photo books: leveraging blogs and social media for photo book creation. *Proc. SPIE*, 7879:78790I–78790I–10, 2011.

[19] T. Rattenbury, N. Good, and M. Naaman. Towards automatic extraction of event and place semantics from flickr tags. In *Proceedings of the 30th annual international ACM SIGIR conference on Research and development in information retrieval*, SIGIR '07, pages 103–110, New York, NY, USA, 2007. ACM.

[20] A. T. Schreiber, B. Dubbeldam, J. Wielemaker, and B. Wielinga. Ontology-based photo annotation. *Intelligent Systems, IEEE*, 16(3):66–74, 2001.

[21] Y.-T. Zheng, Z.-J. Zha, and T.-S. Chua. Mining travel patterns from geotagged photos. *ACM Trans. Intell. Syst. Technol.*, 3(3):56:1–56:18, May 2012.