

## Exposing connections to support serendipitous discovery

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"SerenA: Chance encounters in the space of ideas" is a research project<sup>1</sup> that aims to transform research processes by creating unexpected and valuable connections between researchers and between researchers and ideas. Versions of SerenA will support academic researchers making connections across disciplines, and also the broader public accessing cultural data. SerenA will provide recommendations for resources that adapt to the different interests, goals and needs of its users. These resources may include people to talk to, papers to read[1], or events to attend. SerenA will be usable in different contexts. Our first prototype will be available on mobile devices, and it will focus on creating unexpected links between people that are relevant, timely and sensitive to location. We also expect to provide versions for a desktop and for public installation.

In order to make interesting and unexpected connections, SerenA explores and combines information from many different sources, especially the increasing amounts of information from different domains that are being made available as Linked Open Data(LOD). LOD uses emerging syntactic and semantic standards such as The Resource Description Framework (RDF) and OWL, and is available for query across the web. We also rely on the Semantic Web ontologies that are currently being developed and integrated to express information in different domains, such as FOAF<sup>2</sup> to describe people and relationships, DBpedia<sup>3</sup> for general knowledge, GeoNames<sup>4</sup> for geographic locations and Dublin Core<sup>5</sup> for publications. These ontologies are being realised in individual web-accessible databases which can be searched by tools such as Sindice or merged into larger databases of machine-readable information such as FactForge<sup>6</sup>. As a result of these initiatives it is now possible to combine information from many different sources, for example to link location data obtained from a mobile device to information about nearby places of interest.

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<sup>1</sup> <http://www.serena.ac.uk>

<sup>2</sup> <http://www.foaf-project.org>

<sup>3</sup> [wiki.dbpedia.org](http://wiki.dbpedia.org)

<sup>4</sup> [www.geonames.org/](http://www.geonames.org/)

<sup>5</sup> [dublincore.org/](http://dublincore.org/)

<sup>6</sup> [factforge.net/](http://factforge.net/)

While public information is gathered from the Semantic Web, individual information is also gathered (with agreement) from SerenA's users. The user model itself uses RDF and standard ontologies such as the Cognitive Characteristics Ontology<sup>7</sup>. Rather than asking users to list their interests explicitly, SerenA infers users' likely interests from a range of sources. Users can tag web sites that they find of interest; key concepts are derived from an automated natural language analysis of those websites, and these concepts are added to the user model. Where users have published papers, inferences may be made about their research interests from the metadata attached to those papers and available in databases such as DBLP<sup>8</sup>. Users may also give more detail by supplying texts, such as a thesis proposal or personal web pages for automated analysis. The user's feedback on SerenA's own suggestions is added to the user model. Networks of existing contacts with other researchers can be inferred from publications databases, and included in the user model. SerenA balances search and recommendation techniques so that the model of the user's interests, goals and needs is gathered over a period and is used to extend queries and to provide recommendations. Up-to-date information is gathered from automated analysis of the user's tweets, and immediate location information from the user's mobile device.

It is recognized that explanation mechanisms are needed in systems that recommend resources to users [2,3]. In order for users to trust SerenA's recommendations and continue to use SerenA, various kinds of explanation are needed[4]. Information is taken from multiple sources and combined, so that it will be important to track provenance. Different sources of information have different degrees of reliability. The user model itself must be scrutable as inferences about user's interests may be incorrect or out of date, and users will need to understand the basis on which recommendations are made and be able to correct mistaken inferences in the user model.

The initial studies undertaken within SerenA to identify requirements for technologies which could facilitate serendipity identified a range of system functions, usability and social and contextual conditions[5]. Users wanted a system that could engage them with the information on offer, stimulate their curiosity and maintain their interest. In particular, users felt that it was important that a system could highlight the significance of a discovery and its relevance to their own interests and goals.

Serendipitous discoveries typically involve making connections which are both unexpected and valuable, and they require insight on the part of the user[6]. Unexpected information is often especially interesting and requires further explanation[7] and this is all the more important for potentially serendipitous connections, which may be missed because unlike other recommendations, the value of a serendipitous connection may not be immediately obvious. Serendipitous connections are made across different domains of interest. They may connect apparently unrelated ideas or researchers who work in different disciplines. A solution to a problem may be encoun-

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<sup>7</sup> <http://smiy.sourceforge.net/cco/spec/cognitivecharacteristics.html>

<sup>8</sup> <http://dblp.uni-trier.de/>

tered serendipitously while exploring a different problem. When people and ideas that could be useful in one context are encountered in a very different context, their significance may be missed altogether. It is important to highlight the potential significance of the connection to avoid this. Conversely, connections across very disparate domains are likely to carry a high risk of failure. Users must have enough information to judge whether a connection is likely to be valuable before they put a large amount of effort into following it up. In particular, if people are advised to connect with other researchers they are likely to need good reasons to do so before potentially wasting their own and other people's time.

Our initial prototype presents suggestions as a simple list (adhering to mobile platform design guidelines and best practice), without providing an underlying explanation to the user regarding why the suggestion was made, and leaving it up to them to explore and act upon the suggestions using web tools such as their browser. In more fully functioning prototypes the presentation of the suggestions and overall user experience will be explored through 'Classic' and 'Delightful' interface designs. Drawing on research primarily in the field of psychology, which links emotion, such as open-mindedness and the individuals creative process, here in research and discovery, Russ [8] describes how affective processes influence divergent thinking and transformational abilities. She specifically talks about openness, affective pleasure in challenge and problem solving, and cognitive integration, and has found that emotion broadens search and mood relevant cognition "triggers a broad associative network" highly relevant to making serendipitous connections.

It is widely acknowledged that creative practices in visual fields such as art, design, film and games are able to involve people affectively. We aim to draw on our extensive applied experience in these disciplines as well as participatory user design to 'design for affect'[9]. Later versions of mobile SerenA will be presented in two main streams, namely, a 'Classic' interface and a more novel, experimental, 'Delightful' interface. The 'Classic' approach will use established interaction components and conventions, whilst the 'Delightful' variant will attempt, through its design, (which includes visual, sonic and gestural features, native platform affordances, as well as typeface, setting, animation, language) to support the SerenA model of serendipity, and reveal more fully, intuitively, and playfully, the underlying semantic reasoning and connection power of SerenA.

Fundamentally, however, the two interfaces will provide identical functionality. By embedding longitudinal observation and evaluation studies with core user groups into the design process across both 'Classic' and 'Delightful' design paradigms, we hope to make reasoned judgments on the impact user interfaces might have on users' perceptions of the level of serendipity of suggestions. Our evaluation methods will include implicit feedback collection and logging, with interviews using the feedback and logs to ascertain how much 'serendipity' users perceive in the connections they have made through SerenA. Our mobile studies will allow us to make use of a contextual testing environment which shifts away from the artificiality of a computer lab,

and can make full use of the bundled data recording capabilities of mobile devices (for example, user-aware logging, image capture, note taking, and location detection). The inherent native functionality of mobile devices can of course be used not only for evaluation purposes, but may be harnessed in the conceptualization and development of the ‘Delightful’ interface, for example locative capabilities (e.g. GPS, wifi, digital compass), connection technologies (e.g. Bluetooth, NFC) and gestural input (e.g. multi-touch screens, accelerometers, gyroscopes and sensors).

In addition to SerenA’s mobile aspect, there will be a public installation which will expand upon the network of possible connections and suggestions from the system, introducing the potential for serendipitous connections to a site and context specific, new and wider audience. It is anticipated that the information public SerenA presents (possibly as an interactive exhibit with projected data visualisations triggered by visitor movements through the space) will either be anonymised or temporal, responding to real time visitor engagement.

In later prototypes we intend to include explanation to increase trust and expose the connections that SerenA has made. Connections might be exposed via a diagrammatic interface showing the chains of relationships (e.g. [10]) or through brief text summaries that describe the most important connections between the user and the recommended resource or person. We intend to implement these explanation interfaces and test them with users. In order to encourage users to continue to use SerenA and to follow up the suggestions that SerenA makes, it is important to expose not just the recommendation itself but also the connections that have been made which have led to the recommendation.

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