Panel Discussion
Future of VL Research and Sentient Systems

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Panelists
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Panel Description: The success of visual languages especially iconic languages is evident to everyone because most smart phones these days use iconic languages to communicate with the end user. Ironically the success of visual languages in practice has led to doubt and uncertainty about the future of visual languages research. The advances of sentient systems can motivate more research on visual languages. Therefore panelists are invited to explore the future of VL research and sentient systems. Panelists can discuss the theoretical implications as well as practical implementations of next generation visual languages, investigate the relations between visual languages and visualization, the impact of big data research and other related topics. Description of example research projects and the introduction of new research paradigms are especially welcome. The panelists will present their views. Comments from the audience are also welcome.

Position Statements from the Panelists

Gennaro Costagliola: *A graphical review of visual language research* (co-authored with Vittorio Fuccella and Stefano Perna)

We summarize two decades (1995-2014) of research on visual languages through a timeline of terms, similar to the work done by Panisson and Quaggiotto in [1]. To this end, we extracted terms from the titles of the papers published in the considered twenty years on the journal *Journal of Visual Languages and Computing* (JVLC) and on the proceedings of the *IEEE Symposium on Visual Languages and Human-Centric Computing* (VL/HCC).

Basically, the methods used for creating the visualization can be summarized as follows:

• **Data Gathering and Processing**. We downloaded titles from DBLP digital library and extracted terms from them using Apache Lucene [2].

• **Graph Creation**. A graph is created with two types of nodes: *year* and *stemmed term*. The former type represents the year of publication (for a total of 20 nodes), the latter type represent the terms resulting form the stemming process. Each *term* node is connected to one or more *year* nodes through an edge whose weight is equal to the frequency of the term in that year.

• **Graph Visualization**. The graph layout was built through the Gephi visualization tool [3]. The *year* nodes were positioned linearly in fixed, equally spaced locations. The position of the *term* nodes, was established through a force-directed layout exploiting the frequency information.

The final visualization is shown in Figure 1. The nodes of the timeline are colored in red, while the color of the nodes corresponding to terms expresses, together with the size, the term frequency. In order to avoid cluttering, the edges are omitted. Due to the particular adopted visualization technique discussed above, the position of terms along the timeline is close to the weighted average year of occurrence. As an example, the appearance of the term *grammar* in a medium/small sized font and close to year 1997 means that grammars were moderately considered in visual language research through 90's and at the beginning of year 2000.

As we can see in the graph, the research of the late 90's was characterized by topics as search queries and video databases. In the first decade of the 2000s the researchers mainly worked on topics such as virtual reality, modeling of diagrams through UML and semantic Web. In recent years emerged, among others, topics such as sketch recognition and visual representation of source code.

References

[1] A. Panisson and M. Quaggiotto. From cortisone to graphene: 60 years of breakthroughs in pubmed publications. *WebSci 2014 Data Visualization Challenge*, 2014.

[2] The Apache Software Foundation. Apache lucene - ultra-fast search library and server. https://lucene.apache.org/, 2015.

[3] The Gephi Consortium. Gephi - the open graph viz platform. http://gephi.github.io/, 2015.

DOI reference number: 10.18293/DMS2015-053

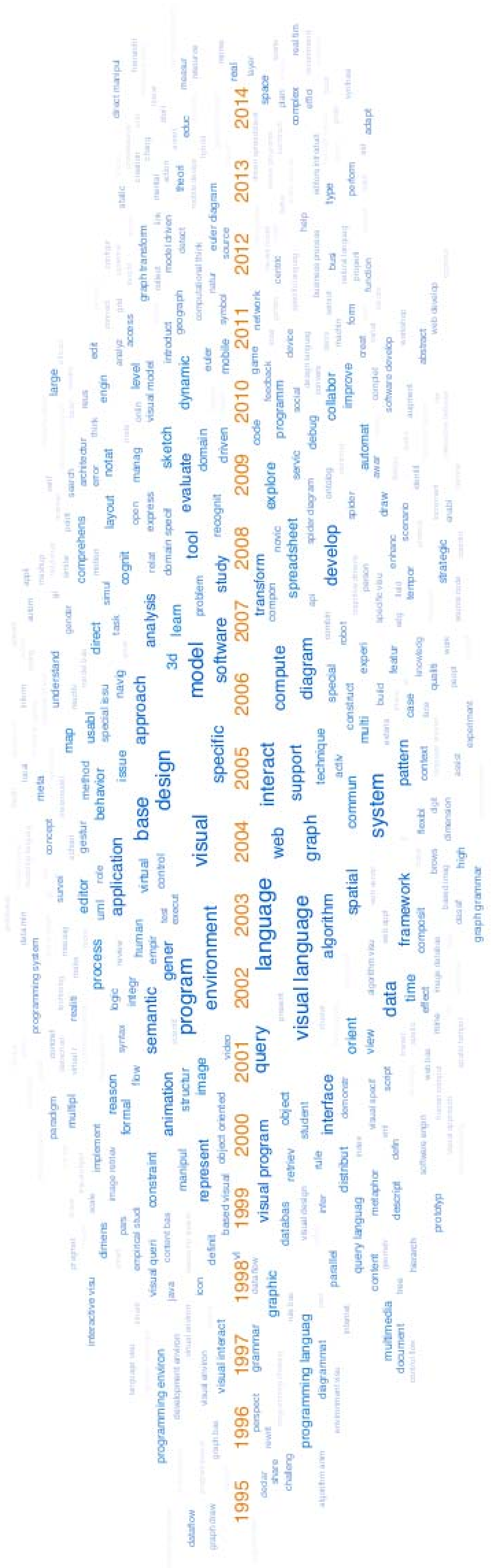

Figure 1. Timeline 1995-2014 of terms for research on Visual Language

Gem Stapleton: ***Developing New Visual Languages for Practical Applications***

The development of visual languages has a long history and this field has evolved considerably over the last few decades. The research community has reached a stage where we can identify advantages and pitfalls of existing visual language designs and we have insight into the infrastructure needed for their use. Such infrastructure can include automated theorem proving (reasoning) support, automated diagram layout, and sketch recognition interfaces.

A major goal of much visual languages research is to provide end-users with accessible notations that allow them to perform tasks effectively, accurately, and with ease. Often, visual languages are developed in response to limitations and difficulties with competing sentential or symbolic methods to solving problems. Some visual languages have been devised in order to turn a symbolic or stylized textual representation of information into a format more accessible to end-users.

There have been many successful visual languages developed in the past, with UML being a prominent example, but also cases where such languages may not have delivered their full potential. To effectively translate research on visual languages into practice, target end-users need to see, and be convinced of, the benefit of adopting a new approach.

As designers and developers of visual languages we, as a community, have a responsibility to ensure that new and existing languages are clearly targeted at end-users and that their needs are met. By acknowledging this responsibility, we can increase research quality and ensure more widespread recognition of the important work in this area.

It is suggested that the community could benefit from a methodology that can be used for designing, developing and evaluating new visual languages. Such a methodology should support the process from conception of the visual language to end-user take-up. The development of visual languages should pay due regard to the types of support needed to make them practically useful. There could be clear benefits of such a methodology: the development process would be more robust and less likely to overlook key elements that are necessary for the resulting language to be truly fit-for-purpose. Of course, it is perhaps unlikely that one methodology could be sufficiently comprehensive and flexible enough to support all types of visual languages and application areas, but step in this direction could reap dividends.

Thus, it is proposed that the time is right for providing an overarching framework that guides visual language design, development and evaluation.

Franklyn Turbak: *Visual Languages and the Future of Programming*

The convergence of desktop computers, mobile phones, cameras, GPS navigators, web browsers, high-resolution touch-sensitive displays, and other personal electronic devices has resulted in smartphones and tablets — powerful personal computers that we carry with us everywhere and use constantly. At the same time, the entities we want to control in our environment have exploded — including these devices themselves, the social/communication networks and Internet-based information sources to which they're connected, and a host of objects in the emerging Internet of Things (e.g., home appliances, robots, wearable computers, sensor networks, large displays, 3D printers, drones).

In this new situated and ubiquitous computing landscape, there is an increasing need for everyone to specify computational behaviors involving all of these kinds of entities. Smartphone and tablet owners want to at least customize and compose existing apps for their devices and in some cases create new apps for themselves and their communities. Artists, scientists, business people, and civil servants need domain-specific ways to create artifacts and to gather, generate, simulate, analyze, and visualize information specific to their interests.

Spreadsheets, visual dataflow languages, and blocks-based syntactic representations of control-flow languages have emerged as popular ways for those without a programming background to specify computational behaviors.

But these only scratch the surface of what is possible. How can we leverage other advances from the visual languages community (including sketch and gesture recognition, diagram understanding, tangible user interfaces, informative animations, and programming by example) to make programming systems that device users find understandable, easy-to-use, and sufficiently powerful? Some key challenges include the relatively small displays of these devices relative to computer screens, effectively utilizing the sensors and actuators of these devices for programming purposes, providing high-level composable computational abstractions, and developing new visual models of the dynamic aspects of computational processes that enable end users to create and debug programs.

Paolo Nesi: *Sentient Multimedia Systems*

The era of artificial intelligence is probably overcome or revitalized by a number of new challenges and research lines. Among them, the autonomous vehicles, the personal assistant, the smart cities, the resilient solutions. I feel that these issues and topics are only a few of the new research areas that are going to appear, while are those in which I feel to be more confident and making some observations. In most of these activities, the human behavior is observed and modeled by using several different technologies and mathematical instruments. Some of them can be called cyber-physical and/or sociotechnical systems. Most of them are distributed systems in which some capabilities of reasoning are enforced. The enforcement is performed by modeling, via machine learning, semantic computing and deductive system, mathematical and statistical and heurist approaches, etc. In most cases these systems are acquiring large amount of data, to create evolving models on the basis of which, at the presentation on new or similar situation, they may produce outputs. The data are acquired continuously observing the users and as well as positing questions to the users as in the last generation of voice answering systems. To this end the models constructed for representing the knowledge are evolving as well. The recent technologies are capable of processing huge amount of data and thus disciplines as Big Data, data analytics, and statistic are getting a new momentum, together with data visualization and visual analysis tools. A new generation of models and applications of visual languages connected to this world would be needed to cope with manipulating and evolving data related to user profiles, conceptual models, questions and answers, data processing and analytics, recommended system, adaptive system, etc.

The new solutions are going to expose step by step more capabilities of smartness, adaptability and resilience to unexpected events and conditions. One could think that we are becoming more intelligent. In the common belief there is the idea to see as the next implied/expected step the construction of sentient systems, but only when the computer system will be much faster and capable to store more information, and thus not earlier than 10 years. To this end, there is a demand of Quantum Artificial Intelligence or in any way of quantum computing capabilities. It is not clear if this massive capability is needed to really create an intelligent system or just to study the phenomena and learning how to do it. Probably the second, since our computers are already capable to do things that we are not capable to do. Thus, the real computational needs and storage would be probably demonstrated much limited when the first really sentient system will be developed. A change of paradigm is needed to dominate the new challenge; we need new instruments and may be to advance the former instruments of knowledge modeling, expressive languages, decision making and executable models, heuristic and probabilistic engines, etc. To this end, large and multidisciplinary teams could be needed to conquer the new domain in which computational aspects and human factors are going to be fuse and enrich each other.

Shi-Kuo Chang: *Future Directions for Journal of Visual Languages and Sentient Systems*

The interesting ideas and proposed directions discussed in this panel will lead to special issues, focused topics and special sections in the journal of visual languages and sentient systems (*VLSS*). Anyone who has ideas and thoughts on future directions for VL is welcome to write a Viewpoints article for *VLSS*, and the length of such articles shall not exceed three double-column formatted pages.