TellUs – Leveraging the power of LLMs with visualization to benefit science centers.

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Abstract:
We propose to leverage the recent development in Large Language Models, in combination to data visualization software and devices in science centers and schools in order to foster more personalized learning experiences. The main goal with our endeavour is to provide to pupils and visitors the same experience they would get with a professional facilitator when interacting with data visualizations of complex scientific phenomena. We describe the results from our early prototypes and the intended implementation and testing of our idea.

Science centers and museums increase accessibility to scientific findings, raise interest in science endeavours, and foster evidence-based impacts on societal issues such as sustainability. They are one of the main mediums to communicate deeper understanding of complex phenomena [1] and engage the general public in societal challenges and solutions [2]. They further promote science to communities that might not have resources, a sense of inclusion, or direct access to scientific developments [3]. For these reasons, science centers are often seen as a promising candidate to help combat the waning interest in science that has been observed recently [4]. With the advent of digital tools, science centres have evolved to propose new ways to explore data and spark curiosity and interest in a diverse set of visitors. Yet, while it is often acknowledged that learning and understanding of scientific findings is both personal and complex [5], visits to science centres generally consist of a predefined path through several exhibits. This experience is, de facto, made generic and only facilitators or guides can leverage the potential to personalise visits and adapt to visitors' needs, knowledge, or curiosity. However, conversational experiences with guides do not scale well due to cost and availability of skilled facilitators.

For this reason, we hope to leverage the recent development in Large Language Models, in combination to data visualization software and devices, to provide a setting in which visitors of science centers would directly interact with an AI-based avatar in a conversational fashion. We envision that the AI, based on most recent LLMs, would be able to understand, parse, and act on visitors' questions and queries by coupling automated manipulations of the visualization with verbal answers to visitors. In providing this coupling, we thus hope that the conversational agent could foster a guidance and learning experience that would be similar to the one provided by a professional facilitator (see Image 1).

Image 1: A facilitator guiding the exploration of a scientific dataset

As a proof of concept we have in recent work still under review [6], made initial and pragmatic steps towards combining verbal and visual interaction and evaluated this prototype for educational scenarios based on the feedback from educators. We explored the capabilities of existing LLMs, in particular GPT3 and GPT4, in serving as an assistant in a visualization system that is integrated with LLMs only at the level of prompting and fine tuning, without the necessity of retraining the model itself. The three educators who have tested our prototype (two of them being co-authors of this report) highlighted that the coupling of verbal explanations with visuals was particularly powerful and interesting. In particular, educators highlighted that the system could be used in two different scenarios that are relevant to science centers. The first and most obvious one is the one that we previously highlighted where we wish to create a conversation between the AI and the system without a facilitator. The second is the potential for the AI conversational agent to be a co-pilot or assistant and interact with the system while a real guide or facilitator explains a concept such that they can solely focus on what they are saying without interacting with the system themselves. Further, our three expert educators, who all had knowledge in and experience of teaching biomolecular concepts, highlighted that the accuracy of the answers was impressive while the possibility to verbally interact with the system was entertaining and likely to foster longer interaction times at exhibits.

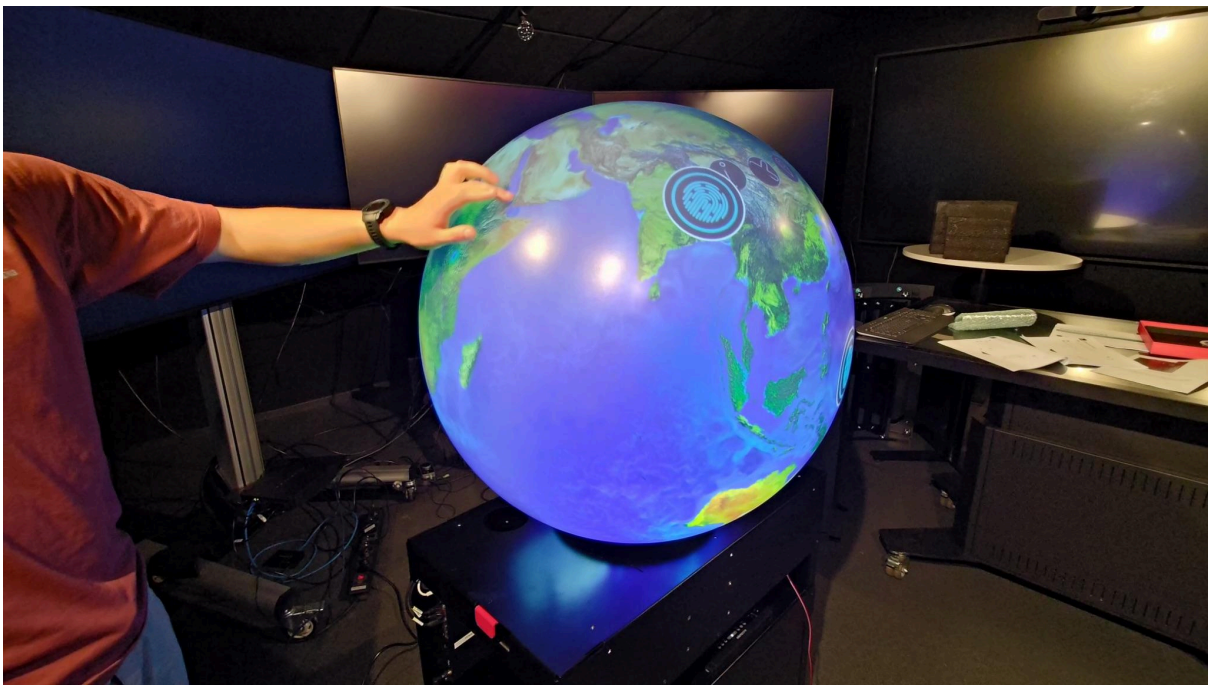

Image 2: The portable globe that we aim to bring to schools

Despite these positive aspects, we have not yet evaluated the tool formally in a controlled setting to explore the accuracy of its responses or its most important limitations in an ecologically valid environment. While we are developing more proofs of concepts with both self-exploration and guided scenarios in mind (e.g., our recent prototype integrating a pilot of the Open Space software for interactive space shows in planetariums), we have formulated a four-year research project to deploy and test AI-conversational agents for interactive visualization of scientific concepts both on site at the Visualization Center C in Norrköping, and in schools. Our plan involves mainly to develop, and bring to schools, portable globes (see Image 2) that will incorporate a touch screen and our implementation of the conversational agent in order to let students explore scientific datasets linked to their school programs.

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