

The Global Interaction Research Initiative at the IT University of Copenhagen, Denmark

Jakob E. Bardram, Pernille Bjørn, Arne John Glenstrup, Thomas Pederson
IT University of Copenhagen
Rued Langgaards Vej 7, 2300 Copenhagen. Denmark
{bardram,pbra,panic,tped}@itu.dk

ABSTRACT

This showcase paper describes the Global Interaction Research Initiative – GIRI – recently inaugurated at the IT University of Copenhagen. It presents the motivation for this initiative, namely that the use of information technology is the core enabling factor for global collaboration and business. We argue that there is a fundamental need for understanding and providing next generation technologies for this ultra large-scale interaction paradigm. GIRI is organized around a set of research themes and projects, focusing on different application areas. Themes and projects are loosely coupled in the sense that each research project is defined in its own right with a specific set of challenges, vision, approach, partners, and funding scheme. At the time of writing, GIRI has 3 research themes and are hosting 6 projects, but these numbers are expected to increase as GIRI grows. GIRI is an open research initiative, and we invite other researchers to join.

ACM Classification Keywords

H.5.3 Information Interfaces and Presentation: Group and Organization Interfaces—*Computer-supported cooperative work*

General Terms

Management

Author Keywords

open research, research initiative, global interaction, distributed interaction, ultra-large scale interaction, CSCW

INTRODUCTION

The Internet is now connecting extremely large numbers of people, loosely organized groups, organizations, and computing devices on a global scale. As a result, we are witnessing new ways of interacting and collaborating which go far beyond what the technologies and their interaction model were originally designed to support. In many respects, we are moving from small-scale group work to ultra-large scale global collaboration.

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This paper describes a new research agenda entitled “Global Interaction”, as well as the motivation, overall scientific approach, partners, and organization of the *Global Interaction Research Initiative* – GIRI – which has been undertaken at the IT University of Copenhagen in Denmark¹. This is a new initiative, and we present the current research themes and projects being undertaken at the time of writing. As described below, GIRI is made up of a set of research themes and a set of more specific cross-disciplinary research projects. As the initiative evolves, new themes and projects will be added in the years to come.

By using the term ‘initiative’ we want to underline that GIRI is larger than a research project; the latter having more specific goals and deliverables. As a research initiative, GIRI collate a set of related research challenges, visions, approaches, and methods, which in concert points toward addressing global interaction – epistemological as well as technological.

The goals and expected contributions of GIRI are to achieve a detailed understanding of the human-to-human and human-to-computer interaction that takes place on a global scale, and use this insight in the research of new technologies that are suited for large-scale global interaction. Specific technologies addressed are programming language support, distributed infrastructures, collaboration technologies, and user interface technology for distributed human-computer interaction.

From a scientific point of view, GIRI exists in the intersection of the Computer-Supported Cooperative Work (CSCW), Human-Computer Interaction (HCI), Ubiquitous Computing (UbiComp), distributed computing, software architecture, and programming language research communities, and have faculty members representing these disciplines. From a methodological standpoint, GIRI lends itself towards an experimental computer science tradition trying to ground theoretical insight and technological innovation in detailed studies of the particular interaction taking place in real-life settings. In this sense, GIRI is – to a large degree – an epistemological child of the CSCW research tradition.

GLOBAL INTERACTION

Information technology is at the very core of modern human activity; business, social life, engineering, science, production, transport, health, education, research, democracy, gov-

¹<http://www.global-interaction.org/>

ernance, and transportation. Information technology is the indispensable engine powering the global world. In his analysis of the ‘flatteners’ of the globe, Thomas L. Friedman [6] argues that globalized trade, outsourcing, supply chaining, and political forces have changed the world permanently for good and bad – and that the ‘flatteners’ are all tied to the advent of core digital technologies like the Internet, the PC, the web, workflow software, video-conferencing, etc.

By coining the concept of “Global Interaction”, this research initiative wants to put focus on two fundamental megatrends of information technology; its role in ultra-large scale global collaboration and its interactive nature.

First, from an application perspective, information technology is core to globalization, global collaboration, and large-scale social interaction amongst people, organizations, and societies. The word “global” in global interaction emphasize this type of application of information technology; that interaction takes place on a very large-scale and between different countries, cultures, and organizations, potentially around the whole globe. This research initiative takes its outset in this megatrend and wants to understand and design technologies for global interaction. For example, by studying the fundamental interactive and communicative processes in globally distributed software engineering we want to create programming and debugging environments, which to a much greater extent foster the tight collaboration and mental commitments from a distributed team of software engineers. And by studying the nature – benefits and pitfalls – of moving the diagnosis, treatment, and care of patients from a local to a global scale, we want to understand and create the technologies used for global healthcare. Thus, from an application point of view, GIRI wants to study and create technologies that are designed for large-scale and globally distributed interactive, collaborative, and social processes.

Second, from a computer science perspective, global interaction points toward a new frame of reference within computer science. The word “interaction” in global interaction emphasizes a novel scientific – theoretical as well as experimental – view on information technology. As argued by Peter Wegner, interaction is a more powerful paradigm than rule-based algorithms, for describing what we do with computers today [10, 11]. The paradigm shift from algorithms to interaction captures the technology shift from centralized mainframes to distributed, ubiquitous computing; from number-crunching systems to advanced visualization and interaction design. Due to the advancement of computing technology including multi-core processors, distributed computing, virtualization, grid and cloud computing, and ubiquitous computing, the theoretical model for understanding and creating these new technologies need to move from a computational to an interactional perspective. At the same time, the growing pains of software technology are due to the fact that programming in the large is inherently interactive. This calls for new methods, tools, and theories for handling such highly interactive software development processes. Hence, from a scientific point of view, GIRI wants to focus on interaction

as a unifying concept for understanding, designing, running, and programming the information technologies of the future.

Other related research project and initiatives exists. The “Global Infrastructure” group at the University of Oslo² is maybe what comes closest to GIRI. Like us, their research agenda focuses on complexity in relation to globalization where information infrastructures are deeply implicated in, and fundamental to, the workings of our current world. From a more technical point of view, other research projects have been investigating technologies for large scale collaboration, such as the Globus Alliance³ on grid computing and Clean Slate project⁴, focusing on creating a new scalable internet. But, to the best of our knowledge, this research initiative on global interaction is quite unique both in terms of topic and approach, but

BACKGROUND, MOTIVATION AND APPROACH

Background: Denmark in a Globalized World

Why is a research initiative on global interaction inaugurated in Denmark? Firstly, because Denmark is, as a country, already highly globally interactive. According to many surveys, Denmark is one of the most globalized countries in the world meaning that a large percentage of the Danish GDP is based on foreign trade of goods and services⁵. As an old naval trading country, Denmark has always had a large shipping industry, which today is most visible in the Maersk Line company. But due to the small home market, the business of most Danish companies are based on export. This is true for all the visible industry icons like LEGO, Bang&Olufsen, and Vestas, but is equally true for other companies, including small and medium sized companies. Moreover, like most Western countries, the industry in Denmark has been undergoing a process of outsourcing, and many Danish companies have now outsourced a large part of their production – and research and development is following. Examples include the pharmaceutical industry where companies like Novo-Nordisk (diabetes) and Lundbeck (depression) is operating on a global market and have outsourced a considerable part of their activities. Since this global interaction of the companies is based on information technology, there is a substantial demand for people that master such global processes; independently of the trade of business. Hence, it is absolutely essential for the IT University of Denmark to research these fundamental global processes, and to use this insight in both helping Danish industry and in the education of students who master them.

Secondly, global interaction is inherently a research challenge that requires researchers to study, understand and create innovative technologies by taking an outset in a detailed understand of, and collaboration with, users and their organization context. The Scandinavian and Danish computer

²<http://www.ifi.uio.no/research/groups/gi/>

³<http://www.globus.org/>

⁴<http://cleanslate.stanford.edu/>

⁵Worldwide, Denmark is ranked no. 6 in the KOF Index of Globalization (2010); no. 5 in the A.T. Kearney/Foreign Policy Magazine globalization index (2006); and no. 1 in the Economist Intelligence Unit’s Global Business Environment Ranking (2006)



Figure 1. Professor Frank Tung presenting the Jingling Genie project for a set of Chinese companies at the Danish Embassy in Beijing.

science research tradition lends itself as a suitable approach for this; there has always been an extensive degree of end-user involvement and participatory design tradition both in technologies aimed for users (i.e., within HCI, CSCW, and Ubicomp), but equally in the design of other technologies like programming languages and software infrastructure; they are always designed and evaluated with users. As such, experimental computer science – which is core to GIRI – has a long-standing tradition in Denmark.

Thirdly, there is a long tradition in Scandinavia and in Denmark to do public-private research partnerships and projects. As such, research are taking an outset in real-world challenges and is continuously formulated and refined in close cooperation with industry and end-users. A substantial amount of the funding from the Danish research agency are tied to such collaborative research projects, initiatives, and centers.

In sum, a research initiative focusing on global interaction is highly relevant and timely in a Danish context, and the Scandinavian computer science research tradition and funding scheme is suitable for pursuing this research agenda.

Approach: Globally Interactive Research

While focusing on Global Interaction as an object of research, GIRI also seeks to apply global interaction as a research methodology; the aim is to engage in highly collaborative constellations with other researchers around the globe. While international collaboration is not uncommon in academic research, closely integrated teamwork on a global scale is still fairly rare. A vision of GIRI is to master globalized research, where tasks are consciously delegated to the location that adds most value, and where the global collaboration between project partners is given prime focus.

The research is based on close yet global interaction between the project partners using global IT tools (teleconferencing, online document editors, global software repositories, etc.), as well as face-to-face meetings and extended visits. The outcome at this level is expected to be a deeper insight into

models for globalized research, based on concrete experiences. The PhD students of GIRI are guided by global supervision in the sense that there is a stronger focus on exchange of Foreign and Danish PhD students, all within the same project, and for extended periods of up to one year. It is envisioned that these students will graduate with competencies particularly strong in global interaction.

Similar to engaging in global academic collaboration, GIRI wants to engage with a global set of companies as well. As an example, one of the projects (the Jingling Genie project described later) held a match-making event hosted at the Danish embassy in Beijing. The purpose of the event was to establish contact with Chinese companies who might be interested in participating in the research project. Figure 1 shows our Chinese colleague Professor Frank Tung presenting the overall visions of the project at this event, where more than 25 companies participated. The core idea is, that international collaboration with global companies are good for the research and for our Danish industry partners.

Partners

In GIRI we are collaborating with a set of international partners; academic, public, and commercial ones. Academic partners include institutions from Asia like the School of Software and Microelectronics at Peking University and India Institute of Management in Bangalore (IIMB), and European Universities like ETH in Zurich. Academic institutions are normally involved in specific research projects, and we are continuously expanding the set of academic partners as we embark upon new projects. Similarly, the different research projects involved a set of public and commercial organization, including both local (Danish) ones as well as highly global ones. We are, for example, working with Danish companies working on a global scale (like Novo-Nordisk) as well as global companies like Tata Consulting Service (TCS) and Siemens.

ORGANIZATION

As illustrated in figure 2, GIRI is organized around a set of *research themes* and a set of *research projects*, where each of the latter typically addresses a specific *application area*. Themes denote research areas and approaches that are core to understanding global interaction and constitute GIRI on a long-term basis. Projects are specific, focused research projects that focus on a specific set of challenges or problems, and their solution in a specific context. Projects work within one or more research themes. Since most external organizations and companies work within a specific area of application (like banking or healthcare), application areas are typically tied to the collaborating partners of GIRI.

At the time of writing, GIRI has 3 themes, 6 projects, and 4 application areas, but as the initiative expands, the number of themes, projects, and application areas are expected to grow.

Research Themes

The current three research themes of GIRI are: (i) Distributed Interaction; (ii) Global Software; and (iii) Intercultural Participation and Design.

Themes Projects	Distributed Interaction	Global Software	Inter- cultural
ABC	✓		
Genie	✓		✓
GSD	✓	✓	✓

Figure 2. The organization in GIRI. A set of research projects are working within one or several of the GIRI research themes. More themes and projects are expected to come, and not all ongoing projects are shown in the figure.

Distributed Interaction

The theme of distributed interaction takes its outset in the observation that human-computer interaction is becoming increasingly distributed across several dimensions;

- Across multiple devices – the one-to-one interaction between a user and his or her personal computer (PC) is being replaced by a many-to-many interaction between users and computers; the same user is using many computers, and the same computer can be used by many users.
- Across time and space – interaction is no longer tied to the local office or people, but is increasingly distributed across geographical space and in time. For example, global software development takes place across the globe and in many different time zones.
- Across people and organizations – interaction with computers are no longer tied to personal use within one organization, but is instead distributed across several cooperating, complementary, and competing people in many organizations.

The research theme of “distributed interaction” researches concepts, theory, technology, and applications, which helps users to manage and cope with this increasingly complex and distributed interaction across time, space, people, and organizations. Scientifically, we propose the concept of ‘distributed interaction’ as a unifying concept for HCI, CSCW, and Ubicomp research, and one of the core theoretical goals of GIRI is to research this theoretical idea.

Specifically, we are working with the theme of distributed interaction in several research projects. In the Activity-Based Computing (ABC) project⁶, we have been investigating how next-generation technologies based on the concept of an ‘Activity’ can be designed to support human-computer interaction ‘beyond the desktop’ [1]. This includes researching, amongst other things, the underlying infrastructure support

⁶<http://www.activity-based-computing.org/>

and software architecture (see e.g. [4]), user interface technology [3], and activity recognition [9].

So far, activity-based computing as a concept and as a technological infrastructure has been studied and designed with a special emphasis on supporting hospital work [2], but the application of activity-based computing has proven useful in a limited software engineering setup [3] and the concept and technologies are now being researched within a new project on global software development.

In the Collaborative Mini-Grid project⁷, distributed interaction is also a core research theme in terms of investigating how biologists in a biology laboratory can use their existing computers in a mini-grid to run bioinformatics algorithms (interaction distributed across several devices) [5]. Moreover, the project is investigating new forms of collaborative awareness [7] within the biology lab, as well as integration of physical material and devices in the lab with the digital world of bioinformatic data and algorithms.

Global Software

Globalization changes the working relationships of technology production and use. Software today is developed by globally distributed teams to support the collaborative work of globally distributed users located in various settings such as healthcare, businesses, productions, or software construction. This change in both software development organizations as well as in user organizations and communities implies new challenges for current methods, techniques, and tools for software design and development. We need to embrace the distributed nature and intercultural aspects in geographically dispersed teams.

Global software development has been a research topic for decades, but there are still significant challenges remaining and we need to better understand how to support global software teams. The globalization of usage is, however, less discussed; we must re-think design methods emphasizing users’ situated needs when user communities become increasingly diverse, heterogeneous, intercultural, and global. Software might initially be designed for western-European countries, but is then later re-configured to be used in developing countries such as Africa and India, or vice versa.

Both of these challenges are radicalized in the emergence of community-based development practices, like Open Source development. Here, users are part of the development. The internet is used to facilitate User-Driven Innovation. The borders between software development and usage become opaque and blurred. Who is designing what together with whom and to support which kind of needs is part of the negotiation.

Under the theme of ‘Global Software’ we are addressing a number of research challenges within global software development as well how to design and develop software for global use.

⁷<http://www.itu.dk/research/mini-grid/>

Intercultural Participation and Design

In this research theme we explore the global collaborative practices related to the design and use of information technology. This is done in close collaboration between ITU researchers and researchers from China, India and Japan. For example, GIRI is collaborating with Ishida Lab, Kyoto University and the National Institute of Information and Communications Technology (NICT) on the Language Grid project⁸. The Language Grid is a multilingual platform that allows users to register and combine user-created dictionaries and bilingual corpora with existing machine translations to realize user-oriented translation programs with greater accuracy.

User-centered design and appropriation of software emphasizes the role of situatedness and locality for the successful appropriation of IT. Especially in Scandinavia, methods have been developed to design and develop IT together with the future users. These methods are therefore highly relevant when developing software for cultural diverse and heterogeneous settings. User participation and its facilitation are, however, subject to cultural re-interpretation as well. For example, the suitability of methods that have proved well suited for a Scandinavian context has been discussed as problematic in a US context. We investigate this aspect further, by not only comparing appropriation of design methods in similar western countries, but in particular investigate design methods through comparison of design in highly cultural diverse parts of the world such as Scandinavia and Asia.

This theme have three guiding questions: What constitutes (participatory) design and development practices in intercultural settings and how are methods appropriated across different cultures? How do we investigate global work and design practices through ethnographic work? How do we construct and connect diverse local practices enacting new technologies and practices? The intent is to investigate cultural differences and dependencies in the particular cultural practices when trying to extend and create global software design and use practices.

Research Projects

The specific research projects within GIRI are focusing on a set of specific challenges and research problems, and are typically done in close collaboration with external public organizations and companies. Each project is funded from different sources, including internal funding from the participating universities, national research agencies, and the European Union (EU). Projects constitutes the main hub of research in GIRI, and all faculty and students are associated with, and contributing to, specific projects. Since projects are funded from different sources, and are done in collaboration with a wide range of partners, projects are as such not defined top-down from the research themes. Instead they constitutes a whole in themselves, focusing on specific research challenges, which then again may be associated with one or more research themes. Hence, the research themes does not specify the project – one must expect some inconsistency between themes and projects. On the other hand, the

⁸<http://langrid.org/>

concept of global interaction and its research themes helps identify and choose which project to embark upon as part of GIRI.

At the time of writing, GIRI is hosting 6 research projects, which are described on the web site⁹. Here, we will focus on three of them in order to illustrate the linkage between themes, projects, and application areas.

Activity-Based Computing

The traditional desktop metaphor has proven well suited for office work at a desk, but the personal and task-oriented approach provides little support for the aggregation of resources and tools required in carrying out higher-level activities. It is left to the user to aggregate such resources and tools in meaningful bundles according to the activity at hand, and manual reconfiguration of this aggregation is often required when multi-tasking between parallel activities. Research shows that these problems are highly exacerbated when moving out of the office and into a highly distributed, mobile, and collaborative working environment like a hospital or any non-office working setting. Mobile and collaborative work amplify the reconfiguration overhead when users move from one work context to another, potentially using different computers and different types of devices.

To meet these challenges, we are pursuing the concept of activity-based computing (ABC). In activity-based computing, the basic computational unit is no longer the file (e.g. a document) or the application (e.g. MS Word) but the activity of a user. The end-user is directly supported by computational activities which can be initiated, suspended, stored, resumed, and shared on any computing device in the infrastructure at any point in time, handed over to other persons, or shared among several persons asynchronously or in real time. Furthermore, the execution of activities is adapted to the usage context of the users, i.e. making activities context-aware.

The goal of the project is to research, design, and implement proof-of-concepts for activity-based computing, which includes an underlying infrastructure and user interfaces for end-users. These technologies are designed and evaluated in close collaboration with end-users.

As already touched upon above, ABC is central to the research theme on distributed interaction and a candidate for a unifying concept for understanding and supporting interaction across time, space, people, and devices. Hence, the connection between ABC and Global Interaction is that activity-based computing – in our view – is a well-suited proposal for the kind of next-generation technologies, which are needed to support global interaction. Its support for mobility in space and time, for collaboration, and for context-aware computing is central in enabling users to handle the challenges of working interactively over distances in time and space. Specifically, activity-based computing is used as a conceptual and technological foundation in several other GIRI projects.

⁹<http://www.global-interaction.org/>

Jingling Genies

The majority of present-day IT systems only allow users plain query-response based interaction, not utilizing the great potential of knowing the context of the user and the numerous devices in use. Moreover, most of this interaction is visually oriented, which is impractical in many everyday scenarios – both in the traditional office setting as well as in other non-office, industrial settings.

The Jingling Genies project aims to grow knowledge and competencies at three levels: Interaction in globalized research, IT frameworks for context-sensitive services, and global supervision of PhD students [8]. The object of the globalized research in the Jingling Genies project is the development of theories and implementation of a framework for context-sensitive services [12]. This framework will consider the notion of context as a prime factor for providing trustworthy, useful and pervasive interaction with the user via mobile and generally pervasive units. This novel interaction is based on the concept of ‘genies’, disembodied conversational agents, that suggest and provide useful services, based on relevant context. Additionally, the framework and user interface is envisioned to support interaction between users and service providers at a global scale, for instance allowing staff located in China to guide Chinese tourists in Denmark by having access to their immediate context.

Next Generation Global Software Development

The software development paradigm is changing with the rise of geographically distributed software development. Increasingly, organizations shift all or part of their software development off-shore. It is no longer debatable whether software companies – including the industry partners in this project – will develop software on a global scale; it is only a question of the degree to which they do it. Compared to collocated projects, such global software development (GSD) projects are, however, more likely to be unsuccessful, because geographical, temporal, cultural, organizational, and stakeholder distances can have negative impact on communication, coordination, collaboration, and knowledge exchange.

This project is developing next generation technologies – infrastructure, tools, and methods – that bridge geographical, temporal, and cultural differences in software development. The project aims to create a solid, interdisciplinary research foundation for understanding and improving global software development practices and technologies.

This is done by (i) studying challenges and opportunities in temporal, geographical, and cultural distances and developing new ways of thinking of cultural differences in managing complex GSD projects; (ii) designing and empirically evaluating next generation GSD technologies that help software developers and end-users maintain a global awareness and commitment to bridge across differences during software development; and (iii) developing and empirically evaluating a software engineering framework of processes, practices, cultural norms, and guidelines suited for GSD projects.

The two core ideas are; (i) to view cultural diversity not solely as a challenge but also as an opportunity for increased innovation; and (ii) to build technologies that help companies to move from an outsourcing to a collaborative model of GSD. Overall, the project aims at providing knowledge and tools for organizations to excel in software development on a global scale. The project is scientifically anchored within Cross-Cultural Communication and Management, Software Engineering, HCI, and CSCW.

CONCLUSION

In this showcase paper, we have described the Global Interaction Research Initiative – GIRI – recently inaugurated at the IT University of Copenhagen. We have presented and discussed the motivation for this initiative, namely that the use of information technology is – beyond any doubt – the enabling factor for global collaboration and business. There is a fundamental need for understanding and providing next generation technologies for this ultra large-scale interaction paradigm. GIRI is organizing the research around a set of research themes and projects, focusing on different application areas. Themes and projects are loosely coupled in the sense that each research project is defined in its own right with a specific set of challenges, vision, approach, partners, and funding scheme. But the research themes – and the concept of Global Interaction – is what gives direction to GIRI, and help us identify which projects we want to pursue and engage in. At the time of writing, GIRI has 3 research themes and are hosting 6 projects, but these numbers are expected to increase as GIRI grows.

GIRI is an open research initiative and all input is welcome. We encourage individuals and groups of researchers with overlapping research agendas, ideas, challenges – or simply an interest in researching the concept of Global Interaction itself – to not hesitate in contacting us.

More information on GIRI can be found on our website; <http://global-interaction.org/>.

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