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1. Introduction

"You just come along with me and have a good time. The Galaxy's a fun place. You'll need to have this fish in your ear."
"I beg your pardon? asked Arthur, rather politely he thought."

"Ford was holding up a small glass jar which quite clearly had a small yellow fish wriggling around in it. Arthur blinked at him."

"Suddenly a violent noise leapt at them from no source that he could identify. He gasped in terror at what sounded like a man trying to gargle whilst fighting off a pack of wolves."
"Shush! said Ford. Listen, it might be important."

"Ford, with a lightning movement, clapped his hand to Arthur's ear, and he had the sudden sickening sensation of the fish slithering deep into his aural tract."

"Ford, he said."
"Yeah?"
"What's this fish doing in my ear?"
"It's translating for you. It's a Babel fish."

—Douglas Adams (1979)
1.1. Motivation

The Babel Fish is a fictional creature used for instantaneous language translation in the novel “The Hitchhiker's Guide to the Galaxy” written by Douglas Adams (1979). It reverses the problem defined by its namesake; according to the Biblical narrative, the original Tower of Babel, by which men sought to scale the highest heavens, inspired God to make humans unable to understand one another (McLuhan, 1964). Mankind's unity, ambition, and resolve offended the Deity, who, to prevent the project from succeeding, made each man speak a different language. Because they could no longer communicate, work could not proceed and people scattered over the face of the whole earth (Goldstein, 1890).

The Tower of Babel allegorically explains the existence of the many different languages. The story also illustrates that the human drive towards communication -as it is realized through such vehicles as literature, art, music, and architecture- is among the oldest and most universal of human desires.

The Babel Fish symbolizes mankind's effort to improve the intellectual effectiveness of the individual human being (Engelbart, 1962). By promoting information exchange between people, it multiplies the potential for knowledge acquisition and exposure; by allowing individuals to interact, even when they do not speak the same language, it contributes to the formation and growth of groups of people that share interests (Cutler, 1995). Humans are most happy and productive when they can influence their living environment and contribute to solving problems together (Palme, 1999).

The Tower of Babel was an interactive and collective endeavour, undertaken in an extraordinary condition of universal understanding and unity. Once unable to understand one another, people scattered over the face of Earth -diffusing rather than condensing knowledge. Once unable to communicate, mankind could not complete the task -powerless as isolated individuals.
1.2. The Problem

The French sociologist Pierre Bourdieu (1993) describes how groups of people form so-called cultural fields, areas in which insiders follow certain behavioural rules and outsiders are kept outside, unless they learn to adhere to the insiders' thinking and behaviour. In any area of communication the number of cultural fields is large. The insiders are able to exchange information and efficiently get their messages across. Outsiders to this group struggle and more or less succeed in communicating.

The world is vast as well as culturally rich and diverse. Exploration of the world in all its variety is limited by the boundaries of time, space, and lack of a common language. In an average lifetime, it is impossible to travel everywhere and acquire knowledge of every language and local dialect. The linguistic diversity adds new dimensions to communication, but the limitations imposed by the language barrier remain a situation of concern because:

- People cannot interact in their preferred language if they do not share their mother tongue (L1).
- People that do not share a common language cannot communicate.

Thus, insiders are those who communicate in their preferred language; outsiders are those who are either limited by the reduced expressive power of communication in a second language (L2), or unable to communicate for lack of a common language.

This situation of concern can only be resolved by somehow supporting the needs and activities of communication outsiders.
1.3. Supporting Human Activities

The imaginary Babel Fish overcomes the language barrier but requires both parties to be physically present, in the same place and at the same time, in order to engage with each other -that and the disturbing requirement of having a living creature inside one's ear. The number of people we can reach with our ideas is limited if we all need to be present at the same time and place (Bittner, 1989). In the past, mankind made use of a variety of visual and audio techniques, such as drums and smoke signals, to communicate over distances to groups of people. The modern approach to assist and augment human communication capabilities over distances uses digital hardware as the medium: computers and computer networks mediating human communication. Computer-Mediated-Communication (CMC) technologies break down geographical barriers and overcome individual bias and limitations, allowing a large number of people to communicate and collaborate closely -thus leading to more efficient and reliable action. This coordination and convergence of the activities and actions of a plurality of subjects ensures that otherwise disparate forces will all pull in harness (Engelbart, 1962; Lévy, 1994).

Several existing CMC systems facilitate communication, collaboration, and coordination via the exchange of information between people:

- Electronic mail (E-mail) has become a mainstream form of communication replacing traditional letters. It allows asynchronous -occurring at different times- communication between geographically dispersed parties.
- Instant Messaging (IM) allows synchronous -occurring at the same time- communication between parties without requiring them to be physically present at the same time and place.

Both E-mail and IM enhance human communication capabilities by eliminating the spatio-temporal constraints. Yet, neither technology, in its present form, overcomes the limitations imposed by the language barrier.

IM can break down the language barrier by translating, to the preferred language of each participant in a conversation, the instant messages exchanged. Translation can be achieved via Machine Translation (MT) systems: computer software that translates text from one language to another without human intervention. Thus, from the combination of IM and MT technologies, a language-agnostic communication medium that supports cross-linguistic activities can emerge. Such cross-lingual communication medium enables everyone to collaborate with everyone else by crossing barriers and connecting cultures.
1.4. Goals

Overcoming the language barrier via automatic translation of every instant message is only part of a user-centred, cross-lingual IM solution. Besides addressing both the limited quality of existing MT technology when used with monologue documents, and the lack of research and sound understanding of the communication patterns of cross-linguistic IM, a thorough user-centred solution needs to answer the following questions:

- What do users want for cross-linguistic IM support?
- What are their expectations?
- How, when, and where can they specify their language preferences?
- How will the interaction be and what will it look like?
- What are the ideal interfaces and interface components for cross-lingual IM?
- Which IM interface components require redesign?
- What are the appropriate interaction techniques?

The aim of this project is, then, to meet the need for unconstrained communication by supporting cross-linguistic IM activities. This will be achieved by:

- Designing an interactive IM system that allows reading and typing of instant messages in a preferred language, improving communication between people that do not share a mother tongue, and enabling communication between people that do not have a common language.

The success of this project will be measured by the extent to which people can, effectively and efficiently, communicate and collaborate cross-linguistically through the system developed.
1.5. Contribution to Human-Computer-Interaction

A popular definition of usability is the extent to which a product can be used to achieve specific goals with effectiveness, efficiency, and satisfaction in a specified context of use (Shneiderman, 1998). The user-centred design, development, and evaluation of a functional, cross-linguistic IM system will contribute to:

- Gain an understanding of the communication patterns and differences between standard and cross-linguistic IM.
- Provide a taxonomy, comparison, and discussion of successful and unsuccessful design elements and methods in the context of cross-linguistic CMC.
- Provide a taxonomy, comparison, and discussion of successful and unsuccessful interface components of cross-linguistic IM.
- Advance the level of usability of cross-linguistic IM by criticizing the prototypes developed on the grounds of usability.

But why should we care?

- Because the tools we use to work should not only be well designed but vibrant enough to engage us emotionally -improving usability by improving the user experience.
- Because an important way in which human society is evolving is by having many people making small and large decisions to try out new and better ways of doing things -improving usability by improving task processes and user productivity.
- Because people will be able to communicate in their preferred language when they do not share a mother tongue -improving usability by improving user satisfaction.
- Because people that do not speak the same language will be able to communicate -widening the accessibility of the IM medium.
- Because cross-lingual IM will be available sooner or later and we should be prepared to match that what users want and expect -HCI research to anticipate and predict future developments, and for gaining and disseminating knowledge.

Last but not least, as it will be shown in the following chapters, because users unequivocally want cross-lingual support.

The problems caused by the language barrier are even written in the Scriptures. By meeting a clear human need, the contribution of this project to HCI is justified.
1.6. Overview

The remainder of this book is organized into eight chapters.

Chapter 2, *Background*, provides information that is essential to understand communication, human communication, computer-mediated-communication, and instant messaging in context. Chapter 3, *Literature Review*, explores existing research and technologies within the fields of computer-mediated-communication, instant messaging, machine translation, and cross-linguistic communication.

Chapter 4, *Groundwork*, presents the development of the proof of concept, low-fidelity prototype based on the documented research and existing technologies examined in chapter 3. Chapter 5, *Informing Design*, presents, analyses, and discusses the qualitative and quantitative data collected through ethnographic fieldwork, survey, and IM log analysis. The implications and recommendations of these findings to the final prototype are also discussed here.

Chapter 6, *Design*, introduces the high-fidelity software artefacts built on the foundations laid on chapter 4, and tries to articulate principles for the design of cross-linguistic CMC systems. The high-fidelity prototype developed supports the claims of this thesis.

Chapter 7, *Evaluation*, presents and discusses the user evaluation trials and their implications to the prototype design. This chapter concludes by introducing a set of goals inspired by both the successes and shortcomings of previous prototypes, and the requirements that must be satisfied by any cross-linguistic system using real-time translation of synchronous communication.

Chapter 8, *Conclusion*, synthesizes the findings and results of the thesis, presents a section on directions for further research and work in the field, and provides a set of recommendations for similar work.

After Chapter eight follow four Appendices.

*Appendix A* provides additional supporting material for *Chapter 4*, containing the preliminary project specification, set of requirements, use cases, Personas, case studies, risk assessment, and risk management documents.

*Appendix B* contains additional supporting material for *Chapter 5*, including the interview outline, the survey guide, and the survey data and reports.

*Appendix C* contains additional supporting material for *Chapter 7*, providing the evaluation task outline and questionnaire.

*Appendix D* includes a CD with all the source code developed and executable files used.
1.7. Summary

Both the Tower of Babel narrative and the Babel Fish fictional character illustrate the human drive towards communication and its effort to surpass itself.

The need for unconstrained communication is bounded by the language barrier—a consequence of the world's linguistic diversity. Because of the limitations imposed by the language barrier, people are either unable to communicate if they do not share a common language, or constrained in their communication capabilities if they do not share a mother tongue.

Throughout history, mankind has made use of a variety of techniques to support communication activities and overcome their limitations, breaking down geographical and other barriers. Recent developments in information technologies introduced computers supporting human communication activities.

This project aims to meet the human need for unconstrained communication by designing a computer system that allows communication in a preferred language—thus, improving communication between people that do not share a mother tongue, and enabling communication between people that do not speak the same language.

Its contribution to HCI is many-fold: help understand the differences and communication patterns of standard and cross-linguistic IM; provide a taxonomy and comparison of successful and unsuccessful design elements and interface components of cross-linguistic IM; improve IM usability by improving its user experience and satisfaction; improve cross-lingual IM task processes by optimising cross-linguistic interactions; widen the accessibility of the IM medium; and, through the cross-lingual system developed, enhance human communication capabilities by overcoming the language barrier.
1.8. References


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