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Information And Communication Technologies For
Development (ICT4D) With Special Focus On Web 2.0 And
Mashups Of Existing Services

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Chapter 1

Introduction

Since the early 1990s, access to worldwide-created information and possibilities for world-wide communication have become easier and easier - at least in the Western world. Google, Wikipedia, social networks, blogs and countless contributors around the globe have made it possible for practically everyone to find different information or views and opinions on countless topics over the internet for hardly any price. Furthermore, suddenly it was possible to communicate almost cost-free with virtually everyone around the globe due to low telecommunication costs and the rapidly increasing coverage of mobile networks.

In this “age of information”, the gaps between developed and less-developed countries do not only consist of the large differences in infrastructure and society, but also in the difficulties for developing countries to get access to these means of information and communication, which in fact are freely available.

Since information today is seen as one of the major drivers of economic and social development, there is the fear that these already discriminated countries will be left even further behind. The term “digital divide” denotes exactly this development: the differences and unbalances between developed, less-developed and developing countries in their use of advanced technology.

On the other hand, contemporary technologies are seen as enablers for economic and social change in these less-developed countries and are even believed to be catalysts to leapfrog the former industrial revolution, immediately providing less developed countries with the possibility to catch up with the Western world.

Therefore, many initiatives of the international IT as well as economic community focus on providing less developed countries with access to modern information and communication technologies and train their inhabitants to use and adapt them for their purposes.

This approach is called “Information and Communication Technologies for

Development“ (ICT4D). In the second part of my thesis, I will describe in detail the concept with its current significance, potential benefits, lessons learned to date, but also its criticism.

Another concept which has evolved just recently is the one of web 2.0. It has supported the development of many tools and applications which have made it easier and easier to take part in and contribute to the information society independent from the own location. Since a key element in sustainable development of services is the involvement of local stakeholders in projects and content creation, participatory services which web 2.0 offers, are substantial tools for fostering development in the information sector, and, therefore, in the economy as a whole.

For that reason, in the third part of my thesis I will deal with the concepts of web 2.0 and outline the advantages of these concepts in the context of ICT4D.

Web 2.0, with its many independent services, tools and open application programming interfaces (APIs), is an open playground for web designers and programmers who combine and connect these diverse services to create “mashups” and eventually provide them to web users. These mashups profit from the features offered by the original services, but also add value by means of their interconnectivity.

In the fourth part of this thesis, the concept of mashups is explained in detail and the advantages in combination with ICT4D are outlined.

Subsequently, in the fifth part, different categories of mashups are identified based on a paper of Drášil et al [2007]. Furthermore, success factors in the context of ICT4D are identified, referring to an article of Heeks [2008].

In recent years, the two aforementioned concepts - web 2.0 and mashups - have gained a lot of popularity. Already, there exist several interesting services created to support the purposes of citizens in less developed countries. Often these services were programmed by these citizens themselves.

In the sixth part of my thesis, various successful projects based on the concepts of participation (web 2.0) and combination of services (mashups) are introduced and analyzed, and the stakeholders and sponsors who are responsible for the projects are presented.

As this work has been compiled not only for academic purposes, but also in order to serve as an introduction and explanation of two projects undertaken by myself, the seventh part of my thesis will deal with these projects.

The first project is the prototype of a tool for improved access to vital

services, based on the concept of mashups - NoisR. The prototype provides an improved visualization as well as an audible representation of information which should serve, on the hand, people with limited reading abilities or bad sight, on the other hand, people with no access to a computer.

The second project is the platform for the “Austrian Network for Information and Communication Technologies for Development - ICT4D.at” where information and projects on ICT4D are presented . Furthermore the platform should encourage people to participate and share their thoughts online.

Finally, I will draw my own conclusions and suggest further research.

The resources drawn upon for this thesis were primarily scientific papers from sources such as the database service of the University of Vienna¹ or Google Scholar². Furthermore research papers and periodical announcements of non-governmental organizations (NGOs), intergovernmental organization (IGOs), such as the United Nations (UN)³ and the World Bank⁴, governmental agencies, such as the Swedish International Development Cooperation Agency (SIDA)⁵ or research entities, such as the Zentrum für Entwicklungsforschung (ZEF)⁶ were utilized.

As the research area of ICT4D is relatively young and is closely related to the initiative for Open Access, many research results and articles were published on blogs and open repositories. At this point, I would like to draw special attention to the blogs of Ethan Zuckerman⁷ and Ismael Peña-López⁸ as they provide a worthy overview of current events and contemporary research.

¹<http://data.univie.ac.at/dbs/>

²<http://scholar.google.at/>

³<http://www.un.org/>

⁴<http://www.worldbank.org/>

⁵<http://sida.se/>

⁶<http://www.zef.de/>

⁷<http://www.ethanzuckerman.com/blog/>

⁸<http://ictlogy.net/>

Chapter 2

ICTs for Development

2.1 Definitions

2.1.1 ICT and the Digital Divide

According to the European Commission:

“Information and communications technologies (ICTs) is a term which is currently used to denote a wide range of services, applications, and technologies, using various types of equipment and software, often running over telecom networks.

ICTs include well known telecom services such as telephone, mobile telephone and fax. Telecom services used together with computer hardware and software form the basis for a range of other services, including email, the transfer of files from one computer to another, and, in particular, the Internet, which potentially allows all computers to be connected, thereby giving access to sources of knowledge and information stored on computers worldwide.

Applications include videoconferencing, teleworking, distance learning, management information systems, stock taking; technologies can be said to include a broad array ranging from ‘old’ technologies such as radio and TV to ‘new’ ones such as cellular mobile communications“ [European Commission, 2001].

Devices and tools used in every-day life in the Western world are often scarce and inappropriate in less developed countries (LDCs). Usually, these devices and tools are fueled by electricity and hence make it difficult to operate them in LDCs due to poor infrastructure.

Today, the large inequalities in the allocation of ICTs between developed and less developed countries are addressed by the expression “digital divide”. According to Katz & Aspden [1998, cited in Mehra 2004] the digital divide is “the obvious and troubling gap between those who have access to use computer technology and the Internet and those who do not”. Though this expression was intended to describe the inequalities between different groups within high-income countries, it expanded its scope to include the meaning it has today [Peña-López 2007-1]. In a paper for the World Wide Web Consortium (W3C), Boyera [2006] states the “digital divide is defined as the gap between those with regular, effective access and ability to use digital technologies and those without.”

2.1.2 ICT4D

Information and Communication Technologies for Development (ICT4D) refers to using ICTs for supporting social and economic development [Wikipedia 2008-2]. This can be either in a direct way, by giving the people in less developed countries access to such technologies, or in an indirect way by supporting development organizations with these technologies. In this paper, the term refers to the concept which aims at overcoming the worldwide digital divide by providing or supporting access to ICTs in less developed countries. This access to information and communication tools should also drive general development [Tiglao & Alampay 2004].

2.2 The Context of ICT4D

2.2.1 The rise of the “Information Society” and ICT4D

For many years, access to information and communication with other people were a matter of local constraints. It was not possible for people to connect to others who were beyond their physical reach. This was revolutionized by the rising feasibility and popularity of telecommunications beginning and carrying onward from the middle of the 19th century. When in the 1990s in the Western World, the usage of the internet and mobile phones spread, the ability of people to obtain information and to communicate with each other was detached from any physical influence [Masetti-Zanini 2007].

This “information revolution” was followed by various substantial social, economic and cultural changes. The omnipresent availability of information on countless topics led to a shifted focus in dealing with it. The challenge was not any more to obtain information, but to manage and filter it. As of then, the term “information society” stood for this phenomenon.

The rapid boost in available information on the one side of the globe naturally resulted in a relatively worse condition for those without access to contemporary ICTs. The so-called “digital divide” deepened the gap between developed and less developed countries, also due to the increasing importance of information for economic purposes.

Subsequently, many efforts to let LDCs take part in the “information society” were initiated. Intergovernmental organizations, such as the UN or the World Bank, quickly integrated this concept into their strategies. Other actors, such as private companies, NGOs, universities and governments followed their example. The term ICT4D was adopted as a generic term for the overall concept.

2.2.2 Important organizations

Intergovernmental Organizations - IGOs As already mentioned, IGOs, such as the UN or the World Bank, earlier on have repeatedly called for the spread of ICTs to lesser developed countries. ICTs are seen as an effective means to catch up with industrialized countries and even compete with them on the global market. As stated in the World Development Report 1998, “this new technology greatly facilitates the acquisition and absorption of knowledge, offering developing countries unprecedented opportunities to enhance educational systems, improve policy formation and execution, and widen the range of opportunities for business and the poor” [World Bank 1998].

On 18 September 2000, during a session dedicated to the Millenium Development Goals (MDGs), 189 member states of the UN passed a catalog of measures with eight compulsory aims for all member nations. The main focus is on fighting worldwide poverty, which is not only understood as material poverty but also as lack of chances and possibilities. These aims are to be addressed during the next 15 years and to be achieved by 2015.

In order to reach these aims with the aid of ICTs, the UN ICT Task Force was founded in November 2001, following the recommendations put forward by the Economic and Social Council (ECOSOC) on 11 July 2000. The formation of the Task Force was in fact a result drawing upon former initiatives taken by the G8’s Digital Opportunities Task Force and the World Economic Forum’s Global Digital Divide Initiative. Its mandate was to “help forge a strategic partnership between the United Nations system, government, private industry, civil society and other relevant stakeholders” [UN ECOSOC 2006].

The task force supported the integration of ICT topics in relevant summits and tried to sustain and strengthen the debate on ICT4D issues. Also, the UN development agenda was worked out in close cooperation with the task force. The task force further provided a platform for policymakers to share experiences

and exchange views on the topic. Furthermore, it also cooperated closely with the private sector, especially with companies in the information technology (IT) sector.

The mandate of the ICT Task Force lasted until the end of 2005, and was followed by the foundation of the Global Alliance for ICT and Development (GAID), which acts as a lobby group, think tank and network for organizations in the field of ICT4D. The priority areas for GAID are located in the area of education, entrepreneurship, governance and health. The organization is headed by a steering committee, chaired by Craig Barrett, who incidentally is also the chairman of Intel [GAID 2008].

The great enthusiasm of IGOs to promote ICTs especially in less developed countries has spurred criticism. Often, questions concerning neutrality and objectivity of these efforts were raised. As many independent NGOs claim, the business sectors and transnational companies (TNCs) have benefited the most from many ICT4D programs and do not help the poor population. Furthermore, there is doubt if the needs of local people were sufficiently taken into consideration.

OLPC - the One Laptop Per Child initiative The OLPC initiative is an important actor in the e-learning movement for developing countries. It is supported by many IGOs and NGOs, as well as the private sector, and receives extensive media coverage. Its aim is the development and production of cheap computers which should be distributed to children in developing countries [OLPC 2008].

First thoughts about knowledge transfer to developing countries by means of ICTs already appeared in the 1970s at Massachusetts Institute of Technology (MIT), where the OLPC project was subsequently started and brought forward by several professors. The project was introduced at the world economy forum 2005 in Davos, where MIT professor Nicholas Negroponte, who still chairs the foundation, announced the plans for developing a “Hundred-Dollar-Laptop”.

At that time, the first partner was the multinational hardware company AMD and over the next years more companies like eBay, Google and Red Hat joined. In the mean time, competing companies started their own projects to develop cheap laptops in order to to exploit this promising emerging market.

The first prototype was presented in May 2006 and production began in November 2007. Currently participating countries are Peru and Uruguay.

The target group is pupils from less developed countries, the laptops are designed intentionally for the conditions in less developed countries; they are robust, waterproof and the screen is readable even in direct sunlight. The hard-

ware requires little energy and the batteries can even be recharged manually, e.g. by a crank handle. Furthermore, special focus is laid on utilizing environmentally friendly material. The software is altogether open source. The ability to network with other devices is another bonus.

The laptop can be utilized as an e-book, an e-learning device, or generally as a modern communication device. It supports the formation of study groups for collaborative learning via a network [OLPC 2008].

Critics claim that this kind of laptop is not an adequate computer at all. Furthermore there is doubt that the allocation of computers to pupils may cause more negative than positive effects. Naturally, the project is also criticized by several companies who are competitors of those companies who partnered with the organization [Heise 2005].

Since the project was only launched last year, it is not yet possible to assess the outcomes.

2.3 Potential benefits

2.3.1 Economic and business development

As the World Bank Development Report of 2008 clearly points out, technology is both a critical determinant and an outcome of rising incomes [World Bank 2008]. This relationship varies widely across different countries, though overall “it is increasingly accepted that when applied strategically, ICT has the potential to increase growth in businesses of any size and in countries at any stage of development, thereby creating new sources of income and employment for the poor. ICT can reduce poverty by making a country’s economy more efficient and globally competitive” [UN-ECOSOC 2006].

In a paper of Eggleston et al published in 2002, the authors prove the economic effects of ICTs on some villages in rural China. The revenue for sold goods was significantly higher for citizens of villages with telephones than in villages without telephones. Also, in a paper of Bedia [1999], the author states that, though it is difficult to quantify, there is no doubt that ICTs foster growth. The author uses a mathematical framework to prove his claims. Further research on the impact of mobile phones on development in Africa was carried out by Waverman et al [2005] and came to the result that mobile phones have a substantial positive effect on economic growth, especially in developing countries.

In their paper, de Silva and Zainudeen [2007] study the positive effect of direct access to a phone. People in the five Asian countries India, Sri Lanka, Thailand, Pakistan and the Philippines were asked about the effects of this

direct access to means of communication on the efficiency of their daily activities and on their ability to earn more money. The overall results show that in all five countries the people questioned had experienced an improvement of their situation due to this asset, though they see the benefit more in the increased efficiency of their activities and not so much in the strengthened ability to earn money.

Another kind of income benefit is evaluated in the paper of Bayes et al (1999), i. e. generation of direct income through the sale of telecom services. Women from poor and rural areas of Bangladesh were trained to become entrepreneurs owning a mobile phone. They sold their services to fellow citizens who also received added value through improved communication. This business model worked so well that it has been exported to Uganda and Rwanda, [Grameen Foundation 2007-1&2] and Grameen Phone, the company which created the concept is now the biggest telecom provider in Bangladesh [Corbett 2008].

According to a BBC article in Nigeria “the mobile phone companies have done more to tackle youth unemployment than any government project” [Blunt 2006]. The new jobs that are created through mobile phones are mostly the “Telephone Entrepreneurs”. These - mostly young - people either own mobile phones and are offering phone services in their area and charge a small service fee or sell prepaid phone cards.

The future prospects for economic development are obviously also closely tied to ICTs. A belief held by several authors is that through mobile technologies and other ICTs, overall development could leapfrog the industrial age and directly result in a world wide “information society”. This can lead to substantial socio-economic impacts and help developing countries catch up with the developed ones.

This claim is currently being researched by Ismael Peña-López as stated in the proposal for his PhD thesis [Peña-López 2007]. Peña-López analyzes various development and technology indices and seeks to develop his own Digital Development Index.

2.3.2 Social development

The usage of ICTs has various effects on societies in different countries.

The case study of Bayes et al [1999] on the effects of the Grameen Village Phone project shows an empowerment of those disadvantaged women owning mobile phones. Their social status as well as power to decide inside their family increased and they became important and well-respected members of their villages which in turn boosted their self-confidence. Further findings include improved law enforcement and easier communication to officials in case of natural

disasters.

Another everyday task that was greatly facilitated by phones is the contact with family members and friends. The results of a study by Zainudeen et al [2006] include that financially limited users in Sri Lanka and India would rather use the mobile phone to stay in contact with their social network than for business or financial reasons. The aforementioned study of de Silva and Zainudeen [2007] shows that most people located in the observed area feel an improvement of their family and social relations through direct connection to phones. Furthermore, the study indicates that social status and recognition also improved through possession of a phone, especially for the most disadvantaged. As is stated in the study “phones, in particular mobile phones (...) help in reducing the ‘gap’ between the rich and the poor leading to a feeling of ‘upliftment’ among the poor” [de Silva & Zainudeen 2007]. Vodafone, one of the biggest mobile-phone investors in Africa, carried out a big study about mobile phones in Africa in 2004. The overall findings were, that mobile phones improved the family bonding and the relationship with friends [Waverman et al 2005].

2.3.3 Other sectors

There are several other sectors which can also profit from ICTs.

Education The educational sector can be made more effective and efficient, e. g. by supporting research and, therefore, educating more people at an elevated level. Given that there is a huge demand for highly skilled graduates, it can be expected that the enhancement of e-learning with ICTs in LDCs will result in substantial effects on the economy as a whole.

According to a project of SIDA in Uganda, the integration of ICTs in education and teaching at Makerere University raised not only the quality of education [Hydén 2006], but also research volume and the number of publications [Greenberg & Versluis 2005].

Democracy In my opinion, ICTs can cause for large impacts on young and unstable democracies all around the world. The anonymity of the short message service (SMS), the easiness to contribute to a weblog, or simply setting up a radio channel create countless valuable opportunities to spread information or organize gatherings. Furthermore, information spread via these channel is literally unstoppable, blocking telephones or access to certain pages is ineffective.

In the Philippines and the Ukraine, mobile phones have already helped bring political change and overthrow corrupt or undemocratic governments. In the Democratic Republic of Congo, there is a radio show called the “Interactive

Radio for Justice” which allows listeners to participate in the show and ask their questions. The questions are sent via SMS and are therefore, anonymous. That way, the listeners do not have to fear being exposed or having to suffer the consequences [Zuckerman 2007]. Collier [2007] identifies the radio as a key tool for achieving transparency in the “Bottom Billion” countries.

Following the Kenyan elections in December 2007, the portal “Ushahidi” was launched. This portal tries to track and report post-election violence, but also initiatives for peace in the region. Similarly, during the Nigerian elections in April 2007 *mobilemonitors.org*, a service to anonymously report suspicious observations, was propagated.

Health Another way in which mobile phones are used in Africa is to provide information on diseases. The “Phones-For-Health” program was announced in February 2007, a program geared to support health care workers. By means of an ordinary Motorola handset, these health care workers can access a database with critical health information. The primary aim is to fight the disease HIV/AIDS in Africa. In the future it is planned to address other infectious diseases, such as malaria or tuberculosis. The sponsors behind this project are several companies e.g. Motorola and Accenture, the government of the United States and the World Health Organization (WHO) [Reuters 2007].

A study commissioned by SIDA in 2005 revealed that ICTs can contribute substantially to the mitigation of HIV and AIDS. “In particular, ICT were identified as tools for documenting and sharing information and best practices on HIV and AIDS, as well as improving [the study’s participants] institutional capacity and effectiveness of their programs” [Geers & Page 2005].

Banking Most people in less developed countries do not have a bank account as their savings do not amount to levels which are economically interesting for banks. This leads to inconvenient situations for these people, as they do not have a secure place to store the money and, therefore, have to carry it around all the time. Furthermore it is very expensive to transfer money.

In several countries, this situation has lead to the utilization of the mobile phone for banking transactions. Prepaid air time is used as an exchange for money and can be easily transferred between customers [Mendes et al 2007].

This so-called m-banking has become a source of business for more and more mobile providers in the mean time. The Kenyan system M-Pesa¹, developed by Kenyan mobile provider Safaricom and English communications company Vodafone is one of the most popular systems.

¹<http://www.safaricom.co.ke/index.php?id=228>

M-banking has made the lives of many people easier and has helped them in saving money, for example by avoiding remittances for transferring money [Donner & Tellez 2008].

2.4 Criticism

The growing enthusiasm for ICT4D by international organizations has, in some cases, led to a somewhat boundless and uncontrolled practice of funding. Many pilot projects have been launched, simply to learn that preliminary assumptions were wrong and the project had no chance to become a success [Gundawardene 2005]. Several severe shortcomings in the conceptualizations of the projects were criticized and the general question was raised if the projects had the right focus to be capable of helping the people.

2.4.1 Planning not adjusted to local conditions

A big problem of assumptions made for projects in less developed countries is the western-dominated point of view. Often, the infrastructure in these countries is not developed and, therefore, not reliable. Under such conditions, projects with equipment relying on constant electricity or internet access are predestined to fail.

Furthermore assumptions on hierarchy and power structure are often wrong. Societies in other parts of the world are often very differently organized than in the western world.

As Howard [2008] states - “The failures of rural ICT4D projects were [...] not because they lacked utility to their beneficiaries. Rather, they failed because they were poorly designed and implemented.”

2.4.2 Lacking sustainability

Lacking sustainability of ICT4D projects occurs when the focus does not lie on financial success. These projects run on financial deficit and require constant funding.

As was animadverted after the UN World Summit of the Information Society 2005, too many projects are launched and supported without taking a look at their sustainability. They are criticized to “remain externally supported for years or decades, and never seem to stand on their own” [Gundawardene 2005]. The projects may have a slight impact during the years they are funded by third party donations, but after several years, when funding comes to an end, they just fade.

In fact such projects are even seen to have a negative effect, as they create an illusion of accomplishment for the funding agencies and, therefore, distort their investment priorities.

2.4.3 Too strong Focus on Technology

Finding the appropriate technology for the area a project should be carried out in is an important task in the planning phase. In some projects, however, the focus is on technology alone and additional factors are ignored. It is believed that, with adequate technology, all problems will disappear.

But, as is stated in Arunachalam [2002], “those that think that poverty in our countries is just a matter of not having access to information and technology are showing much ignorance about social injustice, human exploitation and inequalities not only between countries, but also among social classes within each country. Information is not the magic cure for hunger”. It is important to have a holistic strategy when applying ICTs in less developed countries, otherwise, the project may fail and the delivered technology is just a waste of money.

2.4.4 Unaddressed needs and capabilities of the population

Often, founders of projects have a very precise idea of the benefits they want to provide to the population in question.

The problem is that sometimes the achieved aims do not help the local population and that the ICTs delivered do not fit their needs. “Like all other development tools, ICT will have to adapt and fit properly within the environment in many areas, including language, user training and capability levels, and culture, in addition to having sufficient financial support” [ADB 2003; cited in Lynch & Szorenyi 2005].

Frequently cited examples are computers which are not used because the operating system is in a language nobody speaks or machines which serve as a source of spare parts since nobody knows how to work them otherwise.

2.5 Lessons learned

To date, several authors have tried to analyze the reasons why some projects fail and others succeed [bridges.org 2008] [Harris 2004] [Batchelor et al 2003]. Of course, different authors identify different reasons, but generally, the lessons learned can be summed up as follows:

2.5.1 Differences in infrastructure

Often, the view on ICTs and their application in less developed countries is quite “western”. What is not taken into account, are the basic, but significant, differences between industrialized and less developed countries. One of the most striking points are the differences in infrastructure [Wertlen 2007].

In LDCs, continuous water or electric power supply cannot be taken for granted. Several requirements for technical infrastructure are simply not available. Also, there significant huge differences between rural and urban areas. “In India for example, only 85 percent of rural villages have access to the power grid. In Sub-Saharan Africa, only 8 percent of the rural population has access to electricity, compared with 51 percent of the urban population. In South Asia, only 30 percent of the rural population has access to electricity, compared with 68 percent of the urban population” [Besant-Jones 2006; cited in World Bank 2008].

On the other hand, the diffusion of *newer* technologies, such as mobile phones or the internet, has increased rapidly since the introduction of these services. Internet usage has more than doubled in LDCs from 1999 to 2004 [World Bank 2008], and “developing countries now account for more than half of mobile subscriber growth worldwide, with the top 10 adding around 285 million new subscribers in 2006 alone” [Light Reading 2007]. According to the figures of the International Telecommunications Union, by the end of 2006, 68 percent of the worlds mobile subscriptions had been registered in developing countries [Corbett 2008].

The reasons for this boom in the mobile phones sector are easily explained. In comparison to land-lines, mobile phones do not require customers to have an address or a bank account. Furthermore, the network is easier to extend and maintain. In most countries, the cellular network market is open to private investors whereas the land-line network has always been in the state’s domain. Expectations and trust in this network are often very low².

2.5.2 Differences in usage

According to the study of the Chief Marketing Officer (CMO) Council published in 2007, the usage of mobile phones is quite different in developing and developed countries. Users in developing countries show a high demand for mobile phones with the ability to access the web, most probably due to the lack of other devices for that purpose. Other features, such as a calculator application or a built-in camera, are more appreciated by users in developing countries than in developed ones, since once again they compensate for the lack of devices like calculators

²Interview with Leonard Obiagwu, Universität Wien, (6 February, 2008)

or cameras. As a result, it appears that users in developing countries spend also far more time on their mobile phones than users in the Western world.

Another difference compared to western countries is pointed out by Marsden [2007] at a Google Tech Talk on 4 May 2007. Marsden explains that most of the people in developing countries only have access to one piece of technology in their whole life and that this one piece very often is their mobile phone. It is used for nearly everything and greatly valued. People use it for work, for taking photos, calculating prices, transferring money via airtime, or expressing their individuality, amongst others. Thus, the mobile phone has a far more central position in the life of these people than it has in developed countries, where there is a larger variety and number of technological devices.

Shared usage of computers for connecting to the internet is far more widespread in LDCs than it is in the western world. This obviously is due to the limited number of computer owners in general but also because sharing makes internet usage more affordable. This shared use, however, also leads to a lack of possibilities to personalize these devices. People often cannot bookmark pages, save desktop icons or self-created documents directly on the device they have just used. Therefore there is a call for other forms of personalization, for example on-line services which are capable of such functions.

2.5.3 Consideration of the context

During the last twenty years, there have been a great number of ICT4D projects with different results. In the beginning, a very western position was adopted which lead to several failures and unexpected outcomes. This approach was based upon the expectation that citizens from developing countries have similar needs to people from industrialized countries. More often than not, contents and devices were not adapted to these particular needs and in some cases were even provided in languages the citizens did not understand. Furthermore, cultural differences were often ignored.

In the meantime, several authors have tried to extract several guidelines and lessons learned for future projects. In the following, the findings of Harris [2004] are outlined:

- “- ICTs alone are insufficient for significant benefits to emerge
- ICTs will not transform bad development into good development, but can make good development better
- Effective applications of ICTs comprise both a technological infrastructure and an information infrastructure - "Poverty, not the digital divide is the problem"

- In rural settings in developing countries, it is always a challenge to install the technological infrastructure, but the task is relatively simple compared to establishing the information infrastructure
- The application of ICTs in the absence of a development strategy that makes effective use of them will inevitably result in sub-optimal outcomes
- While ICTs provide opportunities for development, desirable outcomes always arise from the actions of the people.”

To date, as the mobile phone market in less developed countries is booming, companies are already offering devices customized to the needs of people in these regions [Nokia 2008]. ICT4D projects now have to implement this approach as well.

Chapter 3

Web 2.0

3.1 Overview

The expression “web 2.0” first appeared in Tim O’Reilly’s article “What is Web 2.0” from 30 September 2005 [O’Reilly 2005]. It describes several interactive and collaborative elements of the internet, and the shifted focus to use these elements not only as consumers, but also as active contributors. The idea is to use the internet as a platform for various software solutions, thereby making them ubiquitous in the internet and collaboratively usable, further supporting creativity and information-sharing among users.

There are no technical details specified, the main aspect focuses on the user and how he or she interacts with the content. According to Wikipedia [Wikipedia 2008-1], the typical requirements for web 2.0 applications are as follows:

- It is an internet application that can be used already with an average computer over the web browser.
- Pages are not static but are created dynamically.
- The users are given the possibility to create their own content.
- There is a system of rights and roles which defines what the user can see and change.
- Every user has the possibility and often the obligation to create a personal profile to identify him- or herself.
- Most pages can be customized and personalized to the user’s own principles.

- Every contribution can be commented.

The services and applications created with web 2.0 are numerous and are developing steadily. Typical examples are

- Wikis - A wiki is a collection of web sites which can not only be read, but also changed online. These changes can usually be made by everyone, but are logged and can be undone to prevent vandalism and loss of information. The philosophy is to gather the knowledge and experience of all the contributors and make this knowledge available to everybody.
- Blogs - A blog (short form for weblog) is a journal or diary, which is managed on a website and is visible to the public. It is also possible for readers to comment on blog entries. Blogs are often used as agents to display aspects of one's life and share the views on certain topics. On the other hand, blogs are also used for communication and the exchange of thoughts with the readers.
- Photo- and Video-portals
- Social online-networks
- Social-bookmarking portals
- Web Services

On the technical side, the solutions used are often a combination of methods already developed in the 1990s, such as web-service APIs or Asynchronous JavaScript and XML (AJAX) and subscriber services, such as RSS (Rich Site Summary / RDF Site Summary / Really Simple Syndication).

3.2 Advantages in the context of developing countries

3.2.1 Web 2.0 is free of charge

In LDCs, the larger percentage of the population can be certified underprivileged. This means that the majority of their income is spent on basic supplies, such as food or transportation. If these people wanted to use ICTs, there would not be much money left for that. Even if there was enough money, the prices for software packages are still very high compared to their income. According to Defactoblog [2007], the average income in Moldova is \$110, whereas a copy of Windows XP Pro OEM amounts to \$135. Hence, these people have to utilize

devices and tools which can operate free of charge or at very cheap rates. For regular software there is often a black market where products can be purchased for significantly lower prices. These products, however, are not for free, whereas most of the web 2.0 applications are. Everybody can use them and it is very much appreciated if many people contribute. Due to the desire for an active user community, most web 2.0 platforms offer their services cost-free, thus resulting in a big advantage in this context.

The same arguments can be extended to the current extent of information available over the internet. Though it is difficult to define the border between web 2.0 and other initiatives, in recent years, there is no doubt that more and more information has become available freely. This is not only relevant for Wikipedia users, but also for researchers in developing countries. As most educational institutions have a limited budget, there is little or no access to high quality and state-of-the-art research publications [Suber & Arunachalam 2005]. On this account, open access to science and research in the developing world may substantially contribute to the enabling and promotion of high quality research in these countries, or, as Peña-López [2007] puts it, “the concept and tools around the web 2.0 harness clear opportunities for researchers, acting as individuals, to contribute and build a broader personal presence on the Internet, at the same time benefiting from a better diffusion for their work, interests and publications”.

3.2.2 Low prerequisites

In LDCs, technology is not readily available, and, if it is, it is often far too expensive. Frequently, the third world is even used as a “dump” for technical devices of the rest of the world. Equipment is thrown away in developed countries and subsequently repaired and set to use in less developed ones.

For many services of the traditional software portfolio, there are several required prerequisites. Computers have to have a special amount of storage space, memory or speed. These requirements clearly orientate themselves along the standards of state-of-the-art devices and the newest results in computer research. Therefore, users in less developed countries are often excluded from these services.

Web 2.0 services, on the other hand, generally do not have specific prerequisites concerning hardware. Disposing of an installed browser and access to the internet suffices. Of course, these prerequisites are not trivial and, especially in many rural areas, not yet present. However, as current development shows, mobile access to the internet is gaining pace and the coverage of developing countries with mobile networks is a promising substitute for land-lines and

fixed cable connections.

3.2.3 Everyone can participate

As already mentioned, web 2.0 services allow everyone to participate. There are countless weblogs from literally every region of the world. In Iraq, during the war, blogs were an important source of information, and nowadays, portals, such as Global Voices Online¹, gather entries from various areas of interest, especially from those which are not covered by mass media.

In addition to the sharing of personal views, opinions and information, there is the possibility for communities of like-minded people to contribute information on certain topics of interest. There are several databases, such as GFIS (a global forestry information service)² - or CELAC (a platform to collect and exchange agricultural information)³, where the locally required information is gathered and shared. The information can even be contributed in the native language of the people. This ensures that the information is tailored to the needs of the people. Furthermore, people who work on similar topics can easily interact and form a network with a shared private space. This way, duties can be performed faster and more efficiently.

3.2.4 The web is the platform

As already mentioned, many people using a computer in developing countries do not own one. The use of telecentres to access the internet is a widespread phenomenon.

Naturally, this makes it impossible for most users to personalize the device they use as well as locally save important personal data. With the possibilities of web 2.0 services and tools, personalization takes place within the web and is independent from the location of the user and the used device. Bookmarks can be saved online, instant messaging does not need any software or hardware installed, even own portals which gather and preprocess relevant data can be created. Commercial services can be developed and offered without the necessity of locally installed hardware or software.

The web is the platform for all these opportunities. Owning an own device is purely optional.

¹<http://globalvoicesonline.org/>

²<http://www.gfis.net/>

³<http://www.celac.or.ug/>

Chapter 4

Mashups

4.1 Overview

A mashup is a web application which generates content through the combination of services from different sources. The expression's origin is to be found in the music industry and means something similar to the term “remix”. It is closely linked to the aforementioned sector “web 2.0”.

According to Merrill [2006], the general architecture of a mashup consists of three logically and physically detached parts:

- The API/content provider is the source providing the data which is then used for the mashup-service. Sometimes, this data is explicitly exposed to any potential service that would use it, other times however, the data has to be parsed and transformed to fit the intended purpose. “Official” and explicit interfaces use technologies, such as Representational State Transfer (REST) web protocols, Web Services or RSS feeds. APIs are provided to make the access to these data sources convenient.
- The mashup site is the location where the mashup is hosted. It is possible to provide server-side mashups that execute the program logic on a remote server but often mashups are run on the client's machine by client-side script languages. This possibility is referred to as “rich internet application”.
- The client's web browser comprises the graphical interface for user interactions and the representation of the executed mashup.

The creation of a mashup is usually an easy and quick task, as the content providers often offer documentation and tutorials describing the usage of their

APIs. Services of other providers can easily be integrated into own pages and, today, there even are numerous commercial applications for mashups.

4.2 Advantages in the context of developing countries

4.2.1 Fewer problems with acceptance

Everywhere in the world, also in less developed countries, the introduction of new portals, new services or new tools is difficult. People's lack of acceptance often leads to ultimate failure of a product, independent from its benefits or abilities. Therefore, it appears a good idea to use existing services and extend their capabilities, and recycle existing and accepted interfaces through mashups. This could foster the combination of different platforms and the connection of user groups which in turn could result in additional value.

Of course, in order for this approach to work, it is important that existing services create and grant access to their APIs and refrain from pressing legal charges.

4.2.2 Services can be transferred between countries

Many less developed countries face similar conditions in terms of infrastructure and social composition of the population.

This means that IT services that are provided in some countries may also be of great use in other countries. Today, mashups make it very easy to transfer services between countries, since the underlying technology is provided in the web and the only thing left to do would be to adapt the interface to the other country in question.

4.2.3 Easier and less programming

One of the biggest advantages of mashups is the low entry barrier. There are relatively few skills required to start remixing services, as many supporting programs and tools are available online, free of charge. The leading IT companies Google¹, Yahoo² and Microsoft³ have all launched own mashup builder tools which make the creation of mashups an easy and fast process. The website ProgrammableWeb⁴ is one of the most popular repositories of links to open APIs.

¹Google Mashup Editor - <http://code.google.com/gme/>

²Yahoo Pipes - <http://pipes.yahoo.com/pipes/>

³Microsoft Popfly - <http://www.popfly.com/>

⁴<http://www.programmableweb.com/>

It can be used for mashing, but also introduces and ranks new and innovative mashup ideas.

Less developed countries traditionally have a problem with keeping high skilled people in the country, however, with all this assistance, it has become easier to use all the available services for one's own purposes. People do not have to know SOA (Service Oriented Architecture), AJAX or Java script, in order to create and use mashups. Furthermore, mashups are a good alternative in terms of saving time and money (compared to the development of own programs).

4.2.4 Internet Tools for everyone - power to the people

Mashups are available to everyone via the internet and represent solutions customized to certain user groups. As to date, the less developed world is not yet seen as an important sector for business development and therefore the demands of this user group have so far largely been ignored.

Due to mashups, it is now possible for everyone to create tools which fit personal needs and which even have the potential for time and cost savings, without having to wait for a company to explore the people's needs and define these as a possible source for income. The people themselves have the power to improve their livelihoods by utilizing their knowledge and the accessible APIs which are available on the internet.

Chapter 5

Mashup concepts and success factors

5.1 Concepts

As already stated, mashups are assembled of several other services with ideally open interfaces. In their article “Get ready for mashability!”, [Drášil et al 2007] provide a classification of these underlying web 2.0 services. Generally they can be differentiated into the six categories creating, sharing, storing and presenting content as well as coordination/communication and community. In the following these categories are presented and, if existent, examples in the context of ICT4D are given where the services are used.

Content Creation

Services in this section assist the users in the creation of any kind of content. Typical services are wikis, blogs or open databases.

In the context of ICT4D, there is for example the “Global Forestry Information System” (GFIS)¹ based on an open extensive markup language (XML) database, where information about virtually everything connected with forestry is gathered or the “Blog World Hunger”². The International Food Policy Research Institute posts news and relevant information on this platform.

Just recently, the blogging platform “Maneno”³ was launched, which provides a personal blog specifically designed for the requirements (low bandwidth, support for African languages) of less developed countries.

¹<http://www.gfis.net>

²<http://ifpriblog.org/>

³<http://www.maneno.org/>

Furthermore, there are various initiatives of the Busoga Rural Open Source & Development Initiative (BROSDI) utilizing tools to assist content creation, which are introduced later on, or the platform ICT4D.at providing a wiki and a blog, which is also presented in the following chapters.

Content Sharing

One of the main aspects of web 2.0 is the collaboration of different users. To enable this interaction, the created content has to be shared and made accessible. Services of this category are online photo albums such as FlickrR, video portals like Youtube or multimedia sharing services like Slideshare.

ICT4D examples include the FlickrR-initiative “Images For Africa”⁴, where free-to-use (according to a Creative Commons License) images of Africa are shared. Besides, many organizations such as the World Bank⁵ or Mobile Active⁶ have a Youtube channel where short documentaries, presentations and interviews are published.

Content Storage

Content storage services such as Amazon S3⁷ provide storage space and data management for several other services, but during my research I could not find any with a particular connection to ICT4D.

Content Contextualization, Presentation and Management

To find out something about a topic, the data from a plain database or text-only websites without filtering is often inappropriate. Therefore, several services offer the possibility to set this data in a context, customize it and present it in a certain way. This category of services is especially popular in the context of ICT4D.

To provide an overview of the geographical data connected to an event, the later on presented services Ushahidi and Tradenet both visualize data on a Google Maps⁸ instance. To get frequent updates on ICT4D from various sources, Christian Kreutz⁹ assembled an RSS-feed with the mashup-interconnector Yahoo! Pipes¹⁰. It can be subscribed to at the URL *<http://pipes.yahoo.com/crisscrossed/ict4dfeed>*.

To keep track of happenings all over the world in the ICT4D area, I subscribed also to several other feeds. In order to maintain order and organize

⁴<http://www.flickr.com/groups/images-for-africa/>

⁵<http://www.youtube.com/user/eDevTG>

⁶<http://www.youtube.com/user/MobileActiveOrg>

⁷<http://aws.amazon.com/s3>

⁸<http://maps.google.com/>

⁹<http://www.crisscrossed.net/>

¹⁰<http://pipes.yahoo.com/>

the feeds according to my own criteria, I use Netvibes¹¹, which provides the opportunity to create a web-based desktop.

Coordination and Communication

Services managing emails or instant messaging have been around for a long time, but only recently these services have opened their APIs to be mashed and combined with other tools.

Especially the services of the company Google are generally favored in this category. The Google Service Suite with services such as Google Calendar¹² or GMail¹³ is generally used by many organizations, also in the field of ICT4D (e.g. Global Voices Online, ICT4D.at).

Community

Community portals such as Facebook¹⁴ or Orkut¹⁵ have gained a lot of popularity recently, and also in the context of ICT4D some social network services have emerged.

There is for example Business Fights Poverty¹⁶, where people in the business area with an interest in development issues are brought together. Furthermore, there is BOP (Bottom of the Pyramid) Source¹⁷, with a more general approach. Here, innovation and communication at the base of the pyramid should be fostered.

5.2 Success factors

As Richard Heeks points out in his article “ICT4D 2.0 - ” [Heeks 2008], the development of ICT4D raises the need for “new technologies, new approaches to innovation, new intellectual integration, and, above all, a new view of the world’s poor”. He claims that ICT4D has reached a new stage where the lessons learned so far have to be addressed and a new view on the world’s poor has to be adopted. Beneficial applications should give people in less developed countries the opportunity to create content, interact with each other, offer useful services and also produce a business value.

According to this approach, the success factors mashups must fulfill in the sector of ICT4D can be divided in four sections - content, interaction, services and production.

¹¹ <http://netvibes.com/>

¹² <http://www.google.com/calendar/>

¹³ <http://mail.google.com/>

¹⁴ <http://facebook.com>

¹⁵ <http://www.orkut.com/>

¹⁶ <http://businessfightspoverty.ning.com/>

¹⁷ <http://bopsource.ning.com/>

Content

As already stated above, for the success of a service, it is substantial that the customers are given access to localized content. Whereas in the Western world it is easily possible to find relevant information over search engines and there exist many platforms which serve as an entry point, the problem in LDCs is often that the information is simply not available in digital format.

Therefore, many initiatives - like BROSDI or Ushahidi introduced in the following chapter - try to create and collect relevant data to offer it as a whole to the local community or interested people worldwide. Some tools even offer the possibility to contribute remotely.

For mashups, this means that the data source should be chosen according to the needs of the target groups and “integrating other available sources of information to offer a broader perspectives on the given context” [crisscrossed 2008] is desirable. Furthermore, services which provide the possibility to contribute information are a good choice for mashing, or services without it should be given this facility.

Interaction

As Hendler & Golbeck [2007] argue, the success of web 2.0 services strongly depends on the network effect, and platforms become successful only with a certain amount of users. The social capital generated through big networks and user interactions is highly valuable and motivates people to use a certain service. This applies even more to areas, where communication over large distances has been inhibited by physical boundaries in the past and only now becomes possible with technologies such as the mobile phone or internet.

So to attract as many users as possible to a product, it is desirable to support as many devices as possible. This can be achieved for mashups by integrating tools that support the sending and receiving of SMS or by providing information represented audibly.

Another strategy may be to integrate services with social networks and profit from the large user base of these networks.

Services

As it is stated in [Drášil 2007], “mashing data or information into a meaningful service requires a focus on customers”. This approach asks for reaching the customer on a suitable device as well as providing the information with an appropriate visualization and exploiting the current technology rather than demanding special requirements. The service should adapt to the customer, not the other way around.

Mashups can conform to this requirement by offering easily usable and low

level interfaces with clear visualization. Furthermore, the internet should not be expected to be the primary and only solution to access, but other possibilities like calls or SMS should be exploited to reach the consumers. As Richard Heeks puts it “currently, this means exploiting existing functionality such as use of SMS for tasks ranging from reminding people with AIDS to take their antiretrovirals to monitoring elections. In the future, it means adding further functionality, such as banking the unbanked: using mobiles to deliver financial and banking services to those currently excluded from the mainstream” [Heeks 2008].

Production

A key factor for services to be accepted, especially in countries with lower average income, is economic benefit. What Heeks sees as the most important generated values are income and jobs. He states that “a priority for ICT4D 2.0 will be conceiving new applications and new business models that can use the growing ICT base—of mobiles, telecentres, and so forth—to create employment” [Heeks 2008].

For mashups, this claim is certainly true, as they are already widely used in company environments to generate business value. The challenge is now to create suitable solutions not for enterprises, but for the inhabitants of less developed countries. This could happen in various ways like providing valuable localized information or enabling access to an existing service, like in the prototype NoisR presented later on.

Chapter 6

Example projects

6.1 Tradenet.biz

6.1.1 Function

*Tradenet.biz*¹ is an open source software product to manage information about various African markets. It is also an e-Marketplace which members can use as their platform to trade goods.

Services include real-time SMS uploads from markets, database customization for agricultural data, multi-currency price indexing, and various other tools. *Tradenet.biz* is specifically designed to obtain and visualize market data for farmers. The system is not only passive (data updates), but also active as it is possible to query the system via mobile phone by means of SMS messages with specific codes. It is also possible to receive updates via an RSS feed. Information and market studies are stored in a library which is accessible to everyone. Different offers are displayed on a map provided by Google Maps. Furthermore, there is a news section where relevant press releases are published.

For registered users, it is possible to create a profile and, therefore, create their own website. Furthermore, they can add friends, set SMS alerts, join groups, upload photos and post offers. All these services are offered free of charge, except for ordinary SMS charges.

The platform can be viewed in four different languages, viz. English, French, Portuguese and Spanish. Currently there are eighteen African countries being serviced, viz. Benin, Burkina Faso, Cameroon, Ivory Coast, Ghana, Guinea, Madagascar, Mali, Moçambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Tanzania, The Gambia, Togo, and Uganda. The service has expanded its activities to Honduras and Vietnam. Cooperation between the platform and these

¹<http://tradenet.biz/>

countries mobile phone operators remains strong in order to keep the services cheap.

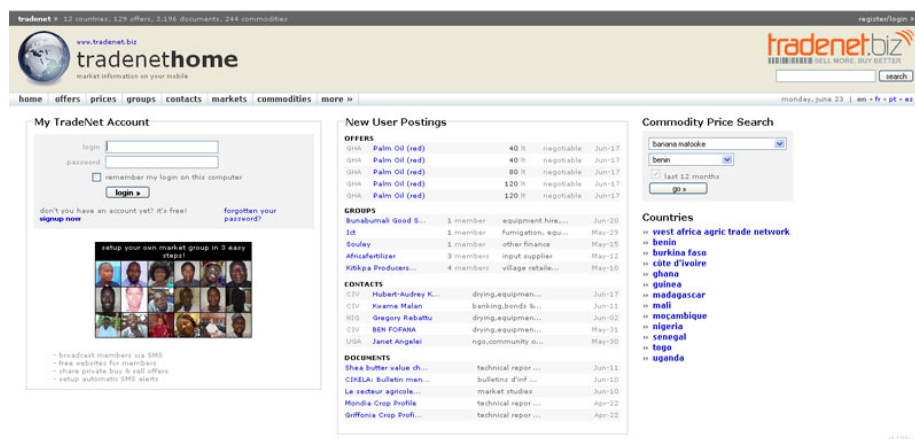


Figure 6.1: Tradenet

6.1.2 Results

E-Marketplaces like *Tradenet.biz* affect the way trade is done in various ways.

- **Easier and faster trading** - Through the creation of a central platform for everyone willing to sell or buy, everyone can quickly check the available offers and subsequently place orders. There is more information for everyone which makes the market more transparent and efficient. Producers are no longer bound to their stalls, waiting for a customer to eventually purchase their goods. Consumers can compare prices of producers and choose the best offer.
- **Additional marketing windows** - The platform supports individual profiles so that everyone can present him/herself online but can also check other users profiles.
- **Less price fluctuation** - As transparent markets follow the principle of supply and demand, traders are always seeking the best available offer. If geographically close markets have varying prices, traders can now choose in advance which deal is better for them and, therefore, unintentionally contribute to the harmonization of prices for a certain good in a certain regions.
- **Easier formation of groups and networks** - The platform facilitates receiving an overview over existing traders and producers in the near neighborhood. This also enables the formation of groups of producers producing

similar goods which can in turn foster knowledge exchange or the formation of production chains to ensure efficient production.

Success factors

- Content: *Tradenet.biz* provides localized content created by the users of the service themselves.
- Interaction: The users have the possibility to create their own profile and form a social network with other users. Furthermore, certain sections of the platform cannot only be accessed via computers with internet connection, but also via mobile phone.
- Services: A Google Maps instance has been integrated into the platform which provides basic visualization. Furthermore, there are additional services such as SMS alerts or customized RSS feeds.
- Production: The economic benefit created by *Tradenet.biz* is obvious - the bringing-together of buyers and sellers on a platform supporting negotiations and price comparisons creates advantages for both.

6.1.3 Stakeholders

The platform is “the brainchild of Mark Davies, a British dot com tycoon who gave up the rat race and went to Africa in 2000” [Economist 2007]. After some prototyping, the platform was launched Africa-wide in 2007. Partners and supporters are as follows:

- CGIAR - The Consultative Group on International Agricultural Research began its support with the platform’s introduction in Honduras and El Salvador.
- Mistowa - The network of regional Market Information Systems and Traders Organizations of West Africa partners with *Tradenet.biz* in West Africa.
- USAID - The United States Agency for International Development has funded the project with \$ 11 Million.
- FoodNet - The FoodNet Project is a regional agricultural research and development network and works together with *Tradenet.biz* in Uganda.

Right now, *Tradenet.biz* claims to be active in twenty countries around the globe with a strong focus on Africa. As of November 2008, according to the webtool on the website, the number of registered users has already exceeded 9,000.

6.2 Global Voices Online

6.2.1 Function

Global Voices Online² was founded in 2004 by bloggers and is hosted by the “Berkman Center for Internet and Society” at Harvard Law School. Within the portal, several bloggers from less prominent parts of the world present their views on political or social events and daily life in those areas. As is stated on the web page, “Global Voices aggregates, curates, and amplifies the global conversation online shining light on places and people other media often ignore” [Global Voices Online 2008].

From an operational viewpoint, the world is separated into six regions, viz. the Middle East and North Africa, Sub-Saharan Africa, South Asia, East Asia, the Americas, Eastern Europe, Russia, Caucasus and Central Asia.

Experienced and well-known bloggers from these regions are asked to keep track of happenings and put them online. These articles are then translated by a team of volunteers into the languages Spanish, French, Malagasy, Portuguese, Arabic, Farsi, Bangla, Chinese (simplified and traditional), Japanese, Albanian, German, Hindi and Macedonian.

The site publishes all content under the Creative Commons Attribution-Only license, which ensures that it can be re-published on other websites as long as the original source is given credit.

Global Voices Online uses an extensive range of integrated services from other providers.

- Google Maps³ is used for displaying the location of blog entries on the world map.
- Videos from the video portals Youtube⁴, Ku6.com⁵, Overstream⁶, Google Video⁷ and other video providers can be integrated in a blog entry.
- The calender for upcoming events is hosted by Google Calendar⁸.
- Social bookmarking sites can be directly addressed from any blog entry.
- Entries include integrated podcasts.
- Photos from Flickr⁹ can be included in posts.

²<http://globalvoicesonline.org/>

³<http://maps.google.com/>

⁴<http://www.youtube.com/>

⁵<http://ku6.com/>

⁶<http://www.overstream.net/>

⁷<http://video.google.com/>

⁸<http://www.google.com/calendar>

⁹<http://flickr.com/>



Figure 6.2: Global Voices Online

6.2.2 Results

Global Voices Online receives a lot of attention from the media and blogosphere. According to the web information company Alexa¹⁰, it is linked by over 4500 pages and has a traffic ranking around place 20000.

The site has won several prizes since its launch, including the “Deutsche Welle Award” in 2005 and the “Knight-Batten Award” in 2006 [Berkman Center 2008].

Also, it fell victim to a ban in Zimbabwe together with pages, such as CNN news or the Washington post. The ZANU-PF (party of dictator Robert Mugabe) referred to these sites, and ICTs in general, as “sources of virulent propaganda to delegitimise our just struggle against Anglo-Saxons” [Allafrica 2007].

¹⁰<http://www.alexa.com/>

Success factors

- Content: Global Voices Online specialized in making locally created content globally available.
- Interaction: The platform offers the possibility for everyone to get an insight in and discuss about topics which would not have been available otherwise.
- Services: -
- Production: The services of the platform do not directly translate into economic benefit, but increased attention towards a certain region may have positive effects.

6.2.3 Stakeholders

As already mentioned, the project was launched by bloggers under the lead of Ethan Zuckerman, a well-known blogger and web activist, and Rebecca MacKinnon, a former CNN journalist. The “Berkman Center for Internet and Society” at Harvard Law School, where Ethan Zuckerman works, serves as host. The contributing bloggers are usually rooted in two different cultures and serve as a “bridge” between these cultures [Boyd 2005].

In 2006, Global Voices formed a partnership with Reuters, one of the biggest international press agencies. Reuters utilizes the content of GVO for their own portal on African issues in order to keep track of happenings which until recently have not received much coverage [Sweney 2006].

The partnership with WITNESS, an “international human rights organization that uses video and online technologies to open the eyes of the world to human rights violations” [Witness 2008] enables Global Voices Online bloggers to upload videos [Berkman Center 2008].

6.3 Ushahidi

6.3.1 Function

Ushahidi¹¹ maps post-election violence in Kenya. It is a mashup between Google Maps and the database on Ushahidi which contains data about incidents related to the elections. The database consists of user reports and reports by NGOs. According to their category (e.g. riots, deaths, property loss, etc.) the different incidents are marked with different symbols and displayed on the map. On the

¹¹<http://ushahidi.com>

other hand, various initiatives for peace in the region are also listed. There is a blog in which news about Kenya are regularly updated.

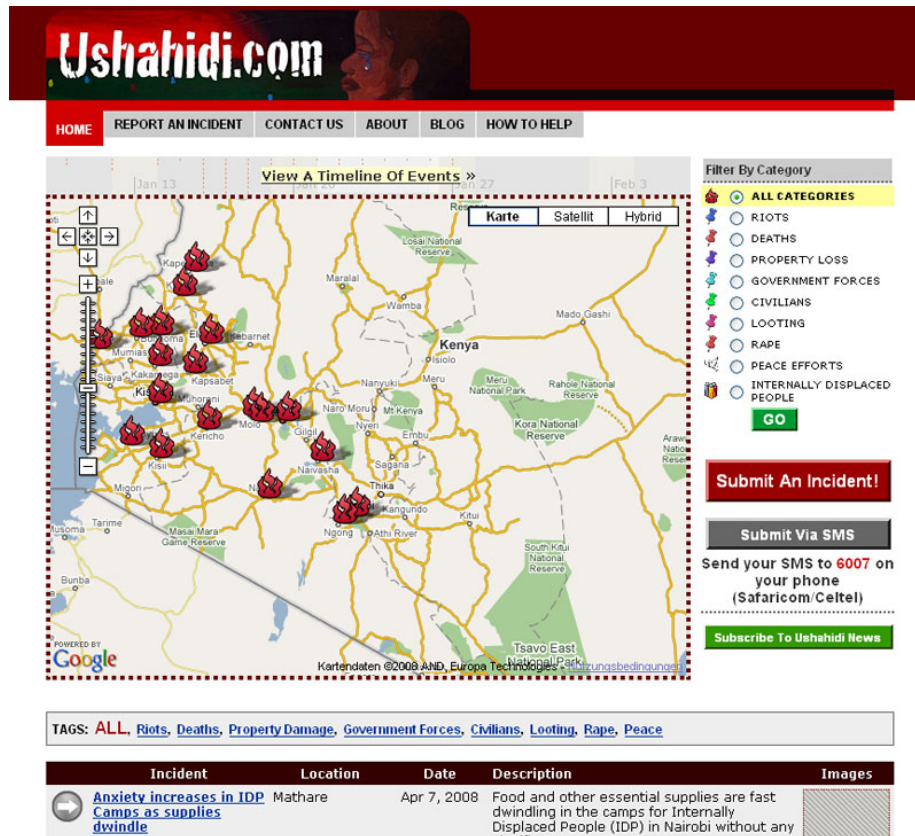


Figure 6.3: Ushahidi

The site was set up in the record time of less than two weeks after the outbreak of violence and its aim is to “bridge the gap between relief efforts and distress calls from around the country, as well as provide a more accurate picture of what was going on” [Kinyanjui 2008]. The word Ushahidi means “witness” in Swahili. Witnesses of incidents should be motivated to report incidents they have seen or experienced. After being posted, these incidents are verified by local Kenyan NGOs. Moreover, it is possible to follow an interactive time-line of all registered events.

6.3.2 Results

Ushahidi quickly acquired a huge user base and thus (through these users help) reported countless incidents. The site received a lot of coverage in the blogosphere

and won the N2Y3 Netsquared Mashup Competition¹², a competition for the best social web tools by social benefit organizations.

Without a doubt, Ushahidi inspired the creation of a similar service for the elections in Zimbabwe on 29 March 2008 (Sokwanele¹³) as well as a further attempt to map xenophobic attacks in South Africa (United For Africa¹⁴).

Success factors

- Content: The localized content is provided by the witnesses of the incidents.
- Interaction: The incidents can be reported via mobile phone or email. Social interest groups have been created on Facebook, Twitter, Flickr and Youtube.
- Services: The incidents are displayed on a map to make it easier to get an overview. Besides, a news-blog has been created which is frequently updated.
- Production: There is no direct economic benefit, but as the platform offers an overview of the events, help can be provided more easily and more effectively.

6.3.3 Stakeholders

The site was created by bloggers such as Erik Hersman¹⁵ or Ory Okolloh¹⁶ with the help of David Kobia's¹⁷ software company. Everyone can contribute to the map by submitting incidents to the homepage. This is possible through e-Mail, SMS or simply contacting people of Kenyan NGOs.

6.4 BROSDI

6.4.1 Function

BROSDI¹⁸ stands for Busoga Rural Open Source And Development Initiative. It is an NGO which works with the Ugandan government and the civil society to improve rural livelihoods with the help of ICTs. Their focus lies on the areas of health, agriculture and education.

¹²<http://www.netsquared.org/>

¹³<http://www.sokwanele.com/>

¹⁴<http://www.unitedforafrica.co.za/>

¹⁵<http://whiteafrican.com/>

¹⁶<http://www.kenyanpundit.com/>

¹⁷<http://www.kobia.net/>

¹⁸<http://www.brosdi.or.ug/>

The vision of BROSDI is to promote knowledge sharing in the Ugandan rural community with the use of ICTs. The ICT program supports the three main projects HCC (Hope Childrens Club) for education, CELAC (Collecting and Exchange of Local Agricultural Content) for agriculture and YOHAAP (Youth & HIV/AIDS Awareness Project) for health by “incorporating ICT in their planning, implementation, project monitoring, evaluation and accountability” [BROSDI, 2008].

HCC - Hope Childrens Club The HCC tries to empower rural children and orphans by giving them the opportunity to receive education and therefore boost personal development. Besides raising their self esteem and confidence, these children are also made familiar with a culture of knowledge sharing, which is achieved by frequently using the blog dedicated to HCC¹⁹.

CELAC - Collecting and Exchange of Local Agricultural Content CELAC²⁰ is a platform for rural farmers to share and exchange information on agricultural topics. The aim is to improve the livelihood of rural farmers and ensure food security. Ways to share knowledge include the following methods:

- *“CELAC Website. This website seeks to bring crop and animal farming practices that have worked for the farmers.*
- *The project has both a monthly online and quarterly off line Newsletter called the "CELAC News". In an attempt to include the grassroot farmers in this methodology, all articles are written in both English and Luganda. Luganda is the most widely spoken local language in Uganda.*
- *Phone Short text Messages (SMS) - The project has a database of phone numbers to whom local agro-related information is sent every Monday. The category in the database is composed of farmers, Community Development Workers, Agricultural Extension Workers and any other interested person.*
- *Radio call in programs. These will be on a monthly basis.*
- *Use of music, dance and drama to portray the farming practices and their challenges. These will be taped on video and burnt on DVD for use by farmers organizations, farmers and NGOs as tools to enhance further learning.”*

[CELAC, 2008]

¹⁹<http://childrensclub.wordpress.com/>

²⁰<http://www.celac.or.ug/>

YOHAAP - Youth & HIV/AIDS Awareness Project YOHAAP²¹ is a project “that aims at creating awareness on HIV AIDS among the rural communities with particular focus on the youth” [YOHAAP, 2008]. YOHAAP is actively promoted in Uganda, providing users with important information on HIV/AIDS which is posted on their blog. In addition, there are links to other organizations dealing with the disease.

6.4.2 Results

While the programs HCC and YOHAAP are running on a relatively low-scale level (with respect to both, technology and organization), CELAC has received considerable attention and has brought together a large and active user community.

The project was launched in 2004 by BROSDI with the partnership of Hivos, Linux Solutions, ICTARD and FICOM.

There are a number of success stories posted on the website, and the project is frequently mentioned by scholars, such as Salas Guzmán [Salas Guzmán 2007] or Peña-López [Peña-López, 2007-2]. The project envisages to ensure food safety as well as support equality between men and women in Uganda. Regrettably, up to now, no research on the overall economic and social impact has yet been carried out.

Success factors

- Content: One of the main aims of BROSDI is to obtain and disseminate local information related to the needs of the people.
- Interaction: The basic elements used for bringing information to the people is the creation of a blog for every initiative. CELAC also uses and integrates further services, such as Google Maps, a wiki, podcasts and Flickr.
- Services: The different initiatives of BROSDI offer access to helpful information free of charge.
- Production: More information on agriculture and health topics can help increase earnings and improve general well-being.

6.4.3 Stakeholders

The organization BROSDI was incorporated in 2003 and has acquired many institutional partners over the years.

²¹<http://yohaap.wordpress.com/>

- Linux Solutions - A Ugandan computer company which provides consulting, training and IT support with special focus on Free and Open Software (FOSS).
- Hivos - A Dutch organization for development cooperation.
- Syngenta - The Syngenta Foundation for Sustainable Agriculture is sponsored by one of the world's biggest Agribusiness companies and claims to "increase opportunities and choice for poor rural communities in semi-arid areas through sustainable innovation in agriculture" [Syngenta Foundation 2008].
- Uganda Communications Commission - The communications industry regulatory body in Uganda.
- CTA - The Technical Centre for Agricultural and Rural Cooperation is an institution under the guidance of the development cooperation between the European Union and the countries of the African, Caribbean and Pacific nations (ACP-EU).
- Teach a man to fish - A UK-based organization for sustainable development aid.

Chapter 7

Project suggestions

7.1 Extending and improving the functionality of an e-marketplace - the prototype NoisR

7.1.1 Overview and motivation

E-marketplaces, such as the aforementioned project *Tradenet.biz* or others such as *b2bpricenow.com*¹ and the Kenya Agricultural Commodity Exchange² have become very popular within the last few years. These sites appear to have mastered the tricky business of motivating people to post but also look for offers online. These platforms' future mission is to make them as easily writable and accessible as possible.

The services for easy access to a website are available online and free of charge. There are tools to transform text into speech, integrate maps into sites, automatize notifications on updates, and several other functions.

Taking a look at *Tradenet.biz*, there is lot of additional functionality already implemented. There are SMS alerts, RSS feeds, a kind of social network functionality, price tracking and basic visualization. Several other platforms, on the other hand, only provide basic features for posting offers.

In this context, it is possible to utilize the concept of mashups and “mash” additional services into the platforms in order to create added value.

In my opinion, there is no need for writing new “killer” applications, there is only a need for integrating and combining existing services. With this approach, the required amount of programming is minimized in regard to the achieved functionality. This prototype strives to be a proof-of-concept that extended accessibility and clear visualization of information is viable in short time and

¹<http://b2bpricenow.com/>

²<http://www.kacekenya.com/>

with limited effort. The simple concept of combining existing services only requires the programmer to adapt the interfaces of these services.

The basic idea for the prototype presented in this chapter was to make existing platforms accessible for people with limited reading abilities, either caused by illiteracy or by blindness.

Two services will be presented. One provides better visualization, the other is a service intended to create an audio version of information posted in writing.



Figure 7.1: The Prototype NoisR [Sturm et al 2008]

7.1.2 Services

7.1.2.1 Visualization

The existing visualization on *Tradenet.biz* is based on Google Maps and shows where offers (sorted by category) are located. This visualization is very basic and requires the ability to read in order to use it. Given high illiteracy rates in LDCs, the idea of adding symbols and a color code to the visualization would make information easier to understand for people who cannot read at all or at a very low level.

First, different product categories should be subsumed by a symbol representing this product (e.g. meat, fish, rice, corn). The aforementioned concept of Ushahidi could serve as inspiration.

Second, the visualization should provide information on the good's quoted price. One possible solution would be via color code. Since prices for goods are already tracked on *Tradenet.biz*, the mean price should be calculated and compared to the price of the particular offer. If the offer is cheaper than the average price, the color should be green, otherwise red.

7.1.2.2 Audible representation

To optimize the platform's usability, all services have to be available to everybody. To improve platform access for illiterate people or people with bad sight, it should be possible to provide information as an audible service.

To transform text into speech, there are many services which simulate a human voice reading the words and saving it into a file.

For providing the generated audio file, there is a service called Podlinez³, which enables the creation of a new telephone number on which a podcast is playing. These telephone numbers, however, are American, and, therefore, to call them you have to pay the same fees as if you were calling to America.

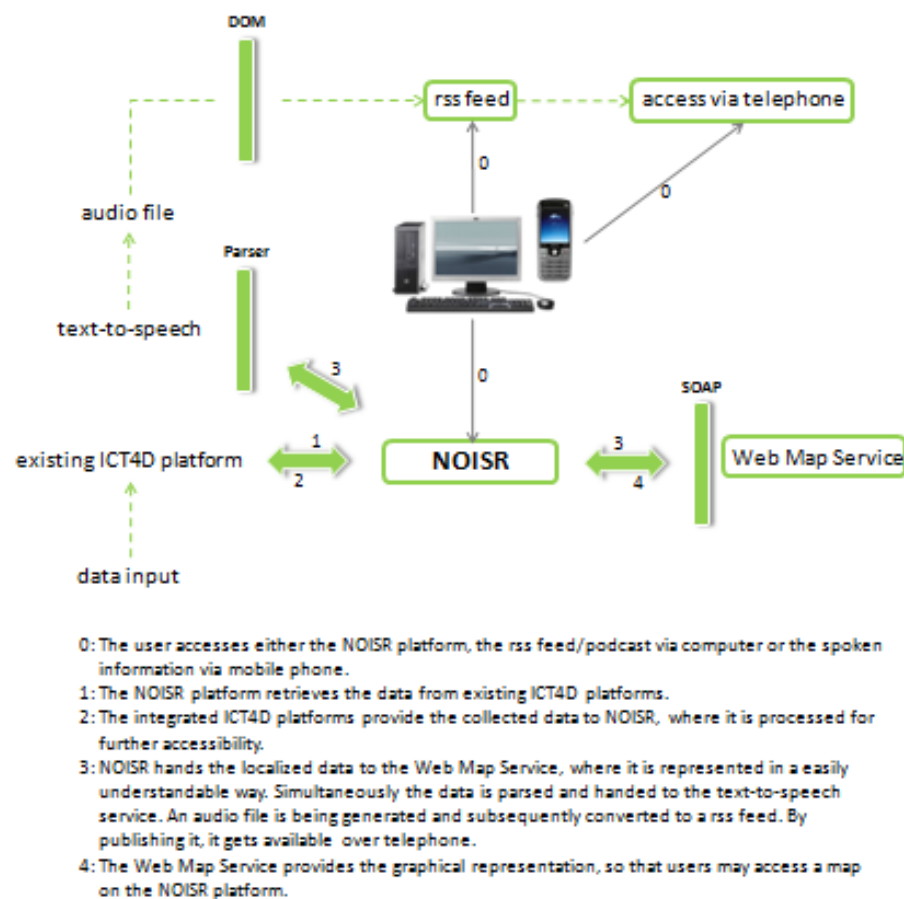


Figure 7.2: NoisR - Concept [Sturm et al 2008]

³<http://podlinez.com/>

7.1.3 Description of the prototype

7.1.3.1 In use

Overview

At NoisR, the user accesses the service via the main page, which provides a tabular representation of current offers registered in the database. The graphical visualization is accessed by a link in the main menu. A Google-Maps map section is then opened and the available offers are displayed, distinguished by category and price.



PRICE OVERVIEW

City	Address	Country	Product	Price	Change	Delete	Download Sound File
Mbour		Senegal	Corn	1.6	OK	Delete	Download Sound File
Mbour		Senegal	Rice	1.5	OK	Delete	Download Sound File
Bignona		The Gambia	Corn	3.7	OK	Delete	Download Sound File
Banjul		The Gambia	Fish	9.4	OK	Delete	Download Sound File
Kaoleck		Senegal	Fish	7.5	OK	Delete	Download Sound File
Dakar		Senegal	Meat	25.7	OK	Delete	Download Sound File
Mediabel		Senegal	Meat	46.4	OK	Delete	Download Sound File
Sokone		Senegal	Rice	1.3	OK	Delete	Download Sound File

City	Address	Country	Product	Price	Save
			Corn		Add Product

VISUALIZATION

PODCAST

CALL

Listen By
Phone
+1 (712)
318-9440

Figure 7.3: NoisR - Front page

The audio service is invoked by adding a new item to the database. The information is read by a computer voice and every offer is saved in mp3 format.

Afterward, an RSS-file, which references the mp3-files is created in order to include the new product in the podcast and, subsequently, on the telephone line. Once a podcast has been registered, there is no need for updating the telephone number, since the service is drawn upon the podcast-file itself.

By presenting the data graphically and distributing the offers via podcast and telephone, the information can finally be seen and heard.

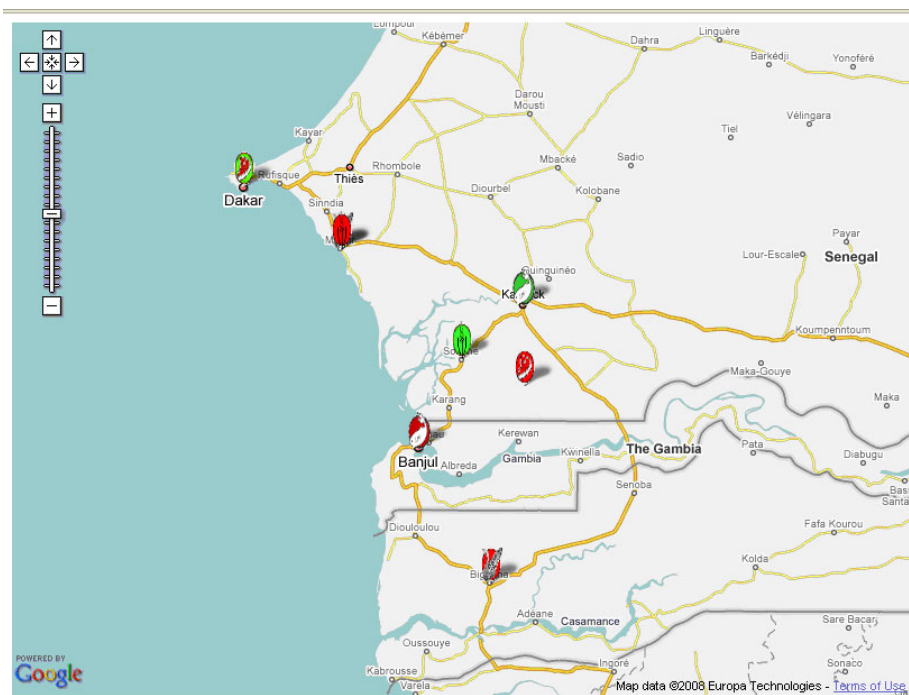


Figure 7.4: NoisR - Visualization

Use cases

To display the potential of NoisR, three typical use cases are described here.

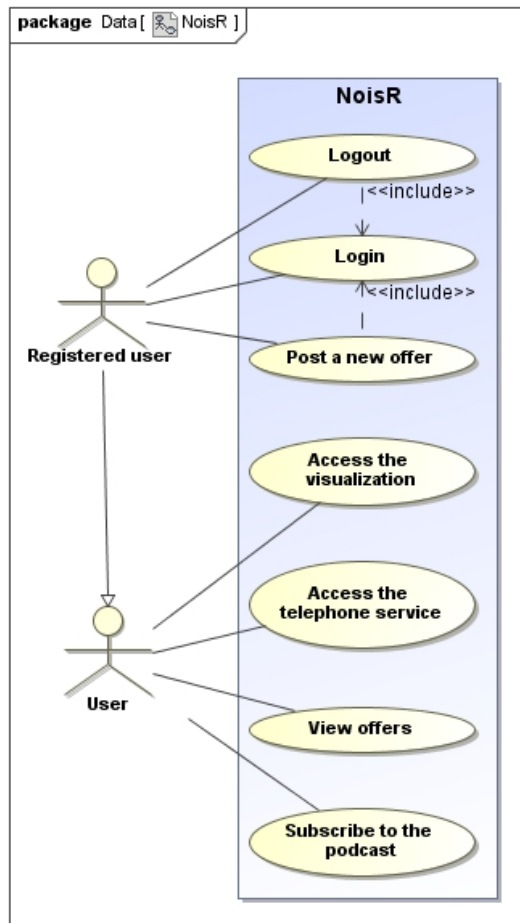


Figure 7.5: NoisR - Use cases

Access the telephone service

Use case name: Access the telephone service

Goal: To get an update on the newest offers in the database

Summary: The user calls a specific telephone number and is read the newest offers

Actors: User

Preconditions:

- The user has a functioning mobile phone and mobile network connection or access to a computer connected to the internet and a voice over IP (VoIP) capable program installed

- The service offering the telephone number is up and running
- The podcast file and the sound files can be accessed

Triggers: The user calls the phone number of the telephone service

Basic course of events:

- 1. The user calls the number and is connected to the phone line
- 2. In the background the podcast of the prerecorded files is loaded
- 3. On the phone, the user can listen to the offers provided and navigate through the sound file with his mobile phone buttons

- 4. The user hangs up

Alternative paths: -

Postconditions: The user is informed about the most recent offers

Post a new offer

Use case name: Post a new offer

Goal: To post a new offer for a good in the e-marketplace

Summary: The user adds a new good to the database of the e-marketplace and in the background the sound files and podcast are updated

Actors: Registered user

Preconditions:

- The user has access to a computer with internet connection
- The user has a registered account and logged in to this account
- The NoisR page and the database behind are up and running

Triggers: -

Basic course of events:

- 1. The user fills in the form for a new good (name, price, location) and clicks "Submit"
- 2. The data is attached to the database (XML file)
- 3. On the server, the service e-speak is invoked, which records a computer voice reading the submitted data into an mp3 file
- 4. The XML file describing the podcast is updated
- 5. The page containing the list with the goods is reloaded

Alternative paths:

- 2a. If the data is incorrect (missing entries, wrong values), an error message is displayed, the whole data is dismissed and the form is reloaded
- 3a. If the service e-speak is not functioning, an empty sound file is generated and the user is notified

Postconditions: The data has been entered in the database and is displayed on the NoisR page. The sound files have been created and the podcast has been updated

Access the visualization

Use case name: Access the visualization

Goal: To get an overview on the offers in the database

Summary: The user accesses the map on NoisR where the offers are visualized to quickly find out about interesting offers

Actors: User

Preconditions:

- The user has access to a computer with internet connection
- The database behind the NoisR page is up and running
- The web map service works

Triggers: The user accesses the URL of the map

Basic course of events:

- 1. The NoisR page displaying the map is shown and the map is loaded
- 2. The data is read from the database
- 3. For every offer a marker on the map is created and displayed. Depending on the category and price, this marker looks different

Alternative paths:

- 3a. If the address cannot be found, an error message pops up but the remaining offers are still loaded

Postconditions: The user is shown the map with the offers

7.1.3.2 Constraints

As already mentioned, for reasons of fast implementation, the system uses an independent XML-file to represent the location-based data in a tabular mode.

In order to test the application, one may add a product along with an existing address to immediately access the updated graphical representation as well as the generated audio-file and podcast.

The audible data is right now statically available at the American telephone number +1 (712) 3189440. It cannot be dynamically created, as the service Podlinez just offers a service for manual creation so far. Another problem is that this telephone number expires after time, so when this occurs a new manual request has to be carried out, which delivers another telephone number.

Currently, the text-to-speech service eSpeak is configured as an English male voice. Voice speed and pitch were optimized according to subjective judgment.

7.1.3.3 Technical implementation

As already stated above, the technical focus of the presented prototype lies on integrating existing services in order to generate added value. For this project, the concept of mashups is adapted. The utilized services are presented

in the following. For some details and for the state of simplicity, local services were chosen instead of services available on the internet.

XML database

Overview For the (simulated) database in question, XML was chosen as the representation language.

The reason for this choice is that XML can be generated out of any existing database. Even without an accessible interface, XML can be generated through screen-scraping. So, in case this service should be implemented on top of some existing project, no additional creation of interfaces would be necessary.

Furthermore, XML is the quasi-standard for web 2.0 applications and wrapped in a Simple Object Access Protocol (SOAP) message, the data can be provided through web-services.

Implementation The XML file looks as follows.

```
<?xml version="1.0" encoding="iso-8859-1"?>
  <offers>
    <offer id="1">
      <adr>
        <streetaddress>Bond Street 3</streetaddress>
        <locality>Banjul</locality>
        <region>Banjul</region>
        <countryname>Senegal</countryname>
      </adr>
      <product>Corn</product>
      <price>1.6</price>
    </offer>
    ...
  </offers>
```

To optimize understanding, the representation of the address was chosen referring to the microformat “adr” from the vCard standard (RFC2426⁴).

Visualization

Overview The offers registered in the e-marketplace’s database should be represented and visualized on the one hand geographically; on the other hand, distinguishing product categories and price differences should be facilitated.

⁴<http://www.ietf.org/rfc/rfc2426.txt>

For visualization, though there are several other platforms which provide similar services (e.g. Virtual Earth), the well-known and often-mashed Google Maps were chosen.

The visual representation and categorization was realized via self-created icons and a choice of background color dependent on simple XPath queries which compare the prices.

Implementation The easiest and most convenient language to integrate Google Maps into an Hypertext Markup Language (HTML) page is Java script.

Google offers the programmer to use a JavaScript file with the needed functions. To be able to access this file, it is required to notify Google of the URL the service will connect from. The following code sequence carries out this task.

```
<script src="http://maps.google.com/maps?file=api&api=2&key=ABQIAAAJSZa7qFmcQZJ_AwYLL_fBxR3S3U1P1XsCGNe_6C3-K0Rrr2LxQC1aiLpa2h1VL-FYX8EYV2F5rTPA" type="text/javascript">
</script>
```

Subsequently, to display the Google Maps instance, the functions of this file are used⁵. In NoisR, the key function looks as follows:

```
function load() {
  map = new GMap2(document.getElementById("map"));
  var description;
  geocoder = new GClientGeocoder();
  address = " Banjul";
  description = "
    <div style=\"font-family:arial, helvetica, sans-serif\">
    City: Banjul<br/>Country: The Gambia<br/>Address: Bond
    Street 3 <br/>Product: Corn<br/>Price: 1.6";
  product = "Corn";
  price = "1.6";
  showAddress(address, description, product, price);
  ... // for every product, a new marker is added via the
  ... // custom function "showAddress"
  map.addControl(new GLargeMapControl());
}
```

The values which are assigned to the JavaScript variables “address”, “product” or “price” on the client side, are read out of the XML file via XPath and in-

⁵The API where the functions are specified can be found at <http://code.google.com/apis/maps/>

serted into the JavaScript code with PHP commands on the server side. In the following piece of code, the JavaScript variable “id” is assigned a value.

```
<script type="text/javascript">
<?
$dom = new DomDocument('1.0', 'iso-8859-1');
$dom->Load($xml);
$xpath = new domXPath($dom);
$id = $xpath->query('//offer[last()]/@id')->item(0)
    ->nodeValue + 1; for example like the following.
echo 'id = "' . $id . '"';
?>
</script>
```

The final map is inserted into the “div” tag when the HTML page is loaded.

```
<body onload="load()" onunload="GUnload()">
<div id="map" style="width: 800px; height: 600px"></div>
</body>
```

Text-to-speech

Overview The text-to-speech service in the prototype is realized with open source software provided on a local server. eSpeak⁶ is a compact speech synthesizer for English and 40 other languages. It is run as a command line program, providing multiple switches which enable the user to alternate voice, pitch, and speed, among others. Due to reasons of simplicity, the service is hosted on a server especially set up for this purpose. There are several text-to-speech services available on the internet, but mostly they are not free of charge. Furthermore retrieving an mp3-file from these sites is usually difficult.

However, once having created an mp3-file on the local server, it can easily be distributed through various means, such as podcasts or telephone numbers which can be called from everywhere.

Creating a podcast is an easy task which, on the one hand, could be automated easily, as several services exist for this purpose. On the other hand, as it only resembles a certain XML-format (i.e. the RSS-format) it can also be assembled with a simple program (as it is the case for this prototype). The feed is accessed by the user with a podcast-capable program which then loads and plays the audio file. There are two general benefits of making information accessible via podcast. First, it allows subscribing to relevant information. Second, the information is updated automatically.

⁶<http://espeak.sourceforge.net/>

The service by Podlinez is used in order to make information accessible via a phone number. It provides the possibility to allocate an American telephone number to any podcast. According to information on the site, the audible information available is updated regularly so that information accuracy and relevance is ensured. Since the service can only be accessed manually and not by a web service, this step of the prototype has not been automated so far.

Implementation The creation of the podcast and the conversion of text to sound is carried out in two different PHP files.

A podcast is actually a simple XML file pointing to the location of the mp3 files, so the creation of this file basically does not differ from creating the price list serving as the database for NoisR. The created podcast file has standard format.

```
<?
// create the new XML document
$dom_feeder = new DOMDocument('1.0', 'iso-8859-1');
$dom_feeder->formatOutput = true;
$dom_feeder->preserveWhiteSpace = false;
// create the root element
$rss = $dom_feeder->createElement('rss');
$dom_feeder->appendChild($rss);
// create the channel element
$channel = $dom_feeder->createElement('channel');
$rss->appendChild($channel);
//create all the subelements for the channel
$title = $channel->appendChild($dom_feeder
->createElement('title'));
$title->appendChild($dom_feeder->createTextNode('NOISE'));
...
// here the directory where the mp3 files are located is
// scanned and for every mp3 file an entry is created
$mp3_dir = "./audio";
if (is_dir($mp3_dir)){
    if ($dh = opendir($mp3_dir)) {
        $filenr = 0;
        while (($file = readdir($dh)) !== false) {
            if ($file !== "." && $file !== "..") {
                $filetype = filetype($mp3_dir . "/" . $file);
                $fileending = substr($file, -3, 3);
```

```

        if ($fileending === "mp3"){
            $filenr += 1;
            $filesize = filesize($mp3_dir . "/" . $file);
            $item = $channel->appendChild($dom_feeder
                ->createElement('item'));
        }
    }
    //finally the result is saved to the XML file
    $xml_result = $dom_feeder->saveXML();
    $xml_file = fopen('./podcasts/price_channel.xml', 'w')
        or die("Can't open file!");
    fwrite($xml_file, $xml_result);
    fclose($xml_file);
?>

```

As already mentioned, for the creation of the sound files the Linux package eSpeak is responsible. It is called from a PHP file. The whole function looks as follows.

```

<?
function generate_audio($speech, $id) {
    $tmpdir = "tmp";
    $audiodir = "audio";
    $volume_scale = intval(50);
    if ($speech != "") {
        $filename = $id;
        $speech_file = "{$tmpdir}/{ $filename}";
        $wave_file = "{$audiodir}/{ $filename}.wav";
        $mp3_file = "{$audiodir}/{ $filename}.mp3";
        $fh = fopen($speech_file, "w+");
        if ($fh) {
            fwrite($fh, $speech);
            fclose($fh);
        }
        if (file_exists($speech_file)) {
            // pipe the result of the eSpeak command to the
            // desired file
            $text2wave_cmd = "espeak \" $speech\"
                > $wave_file --stdout -s 120 -v english";
            exec($text2wave_cmd);
            // create an MP3 version with the encoder Lame
            $lame_cmd = sprintf("lame %s %s", $wave_file, $mp3_file);

```

```

        exec($lame_cmd);
        // delete the WAV file to conserve space
        unlink($wave_file);
        // delete the temp speech file
        unlink($speech_file);
    }
}
}
?>

```

As already mentioned before, the final step of making the podcast accessible with a telephone number is currently carried out manually as there is no programming interface available.

7.1.4 Possible further applications

7.1.4.1 Further services for e-marketplaces

Prices in less-developed countries have a tendency towards substantial and rapid change. An important reason for this is the volatile number of offers which is directly related to annual harvests (the net outcome depending on weather conditions). Since on the one hand, information about weather conditions is accessible for everyone on countless weather forecast sites, and, on the other hand, the effects of weather on plants are generally known, the implications on harvest can - to a certain extent - be predicted.

This way, farmers could plan production and price development in their region. Moreover, this practice offers the possibility to mitigate scarcities (in advance) by fostering region wide trade and, therefore, even out imbalances. At the moment, a service which is drawing upon National Aeronautics and Space Administration (NASA) satellite data, is being developed for especially this purpose⁷.

7.1.4.2 Further applications of the prototype

I believe that especially the second service of the prototype, i.e. the creation of audible data which is accessible via mobile phone, has great potential for various areas of application.

This is, of course, not limited to the context of ICT4D. In combination with the automated creation of RSS-feeds with screen-scraping tools, almost any

⁷A short description can be found at
http://www.nasa.gov/vision/earth/everydaylife/famine_data_prt.htm

information can be made audible, whatever it is the current value of stock or the daily news.

In any case the context of ICT4D is a highly interesting area of application, taking into consideration the spreading usage of mobile phones combined with the number of illiterate people. By providing these people with information via mobile phones, they can be included in market activities. The mobile phone could have the power to bridge the gap between the literate and the illiterate and, therefore, also address the gap between the rich and the poor [Sturm et al 2008].

7.1.4.3 Other services with similar functionality

Of course this is not the first time, the idea to change words into sound was voiced. There are several platforms which provide comparable services and which could replace the currently used eSpeak tool. Also for the visualization there exist various services which could replace the utilized Google Maps.

Readspeaker Readspeaker⁸ is the market leader of "voice-on-the- web" services in Europe. It operates in more than ten countries and fifteen languages. The company has been in business since 2001 and its target group are dyslexics and elderly people who do not see very well. Documents which have been sent in are recorded by a human voice, that is why it can take several days to receive the final audio files. The service, however, can be included in every website and is not free of charge.

ReadTheWords ReadTheWords⁹ is a service which offers some of our prototype's features. It is possible to process text from various sources, such as pdf, doc or html files, into spoken language. The text files can be uploaded and an mp3 file is created. Furthermore, there are possibilities to create a podcast or embed an audio toolbar into an existing site. There are 14 different voices, including the languages English, French and Spanish. It is prohibited to use the created text for commercial purposes or to distribution.

The project is relatively new (launched January 2008). Initially, the target group was students with learning disabilities, but the creators realized that their service could ease the lives of many more people. The platform claims to have sought out "programmers, technologies, and research departments from around the world" for the creation of the service and to always use the latest technology.

ReadTheWords is free of charge, currently in its Beta-stadium and seems to be tested by many curious users.

⁸<http://www.readspeaker.com/>

⁹<http://www.readthewords.com>

Yahoo Maps Yahoo Maps¹⁰ is one of Google Maps' countless competitors. This site generally provides similar functionality and also offers a public API which - for private purposes - can be utilized free of charge.

Users may look for locations or addresses which are then displayed either on a road map or on a map with satellite images. The resolution of the presented satellite images is comparable to Google Maps', as both receive the majority of their data from similar providers. Furthermore, there are several rich internet applications with enhanced functionality for broadband users.

7.2 ICT4D.at

7.2.1 Overview and motivation

ICT4D.at¹¹ is the "Austrian Network for Information and Communication Technologies for Development". It was launched on 28 April 2008 by Martin Konzett and Florian Sturm. Since then, it has been promoted on several occasions, including Linuxwochen Wien 2008¹², PechaKucha night Vienna 2008¹³ and Bar-Camp Vienna 2008¹⁴.

The platform's aim is to bundle all ICT4D-related activities in Austria. On the next page, there is the front page.

¹⁰<http://maps.yahoo.com>

¹¹<http://ict4d.at>

¹²presentation in Gewerbehaus der Wirtschaftskammer, Vienna on 17 May 2008 - video on <http://www.youtube.com/watch?v=67j5uuZQ5Hk>

¹³presentation at Museumsquartier Wien on 10 June 2008 - video on <http://www.youtube.com/watch?v=89mgUtZJt24>

¹⁴presentation at the HP-building Vienna on 15 October 2008



Figure 7.6: ICT4D.at - Front page

To date, already over 150 blog entries have been posted on ICT4D related topics, including news, interviews or book reviews. In the future, as many people as possible should contribute to this page in terms of ICT4D-related topics, in general, and ICT4D-related research and activity in Austria, in particular. This way, an information repository for people who are new in this field is created. Furthermore, posted project ideas and planned activities should ideally lead to the creation of new projects.

The central vision is to establish real life contact of interested people. Online presence, however, plays a big part in acquiring new contributors and exchanging of information between interested parties. The web 2.0 services blog and wiki offer superior possibilities for this purpose and are therefore utilized for ICT4D.at. Also, the entries are posted in social networks such as Facebook, XING or LinkedIn.

7.2.2 Services

ICT4D.at is active on many platforms and offers several services. These services are listed in the following according to the aforementioned categorization of Drášil et al (2007).

Content Creation

Blog There is a blog where interesting and relevant information on the topic ICT4D is posted regularly. The blog is hosted on the content management system (CMS) “Wordpress” on an own server. To analyze the traffic on the page, Google Analytics has been integrated.

Wiki Furthermore there is a wiki which serves as a discussion corner. Registered users can contribute their own views and post information on personal projects. The wiki is hosted on an instance of the wiki software application “Mediawiki”. To analyze the traffic on the wiki, Google Analytics has been integrated.

Content Sharing

Content-sharing ICT4D.at has an own account on Youtube¹⁵ as well as on Flickr¹⁶ and Slideshare¹⁷ where videos, pictures and presentations can be uploaded. Furthermore the service Delicious¹⁸ is used, where interesting links can be published.

Content Contextualization, Presentation and Management

RSS feed There is an RSS feed¹⁹ for new blog posts provided. The number of subscriptions to the feed is monitored by the service Feedburner which is integrated in the site.

Community

¹⁵<http://www.youtube.com/ict4dat>

¹⁶<http://flickr.com/photos/ict4d/>

¹⁷<http://www.slideshare.net/florian.sturm/>

¹⁸<http://delicious.com/ICT4D.at>

¹⁹<http://feeds.feedburner.com/ict4d>

Social networks ICT4D.at is active in the social networks such as Facebook²⁰ or LinkedIn²¹ where - in a group - the blog entries are posted to a discussion forum. Furthermore every blog post is published as a tweet on the social network Twitter²².

7.2.3 Description of the platform

7.2.3.1 Overview

Generally the platform ICT4D.at consists of a blog and wiki software where only certain users have the possibility to create content.

On the front page there are links to the blog section, several links to different entries in the wiki, links to social networks where ICT4D.at is present and links to content sharing platforms.

Without special rights, the user can only view the content on the platform and add comments to blog posts and wiki entries. The blog posts and wiki entries contain content from content sharing platforms and the blog posts are published in social networks, but all this happens invisible to the user.

7.2.3.2 Use case diagram

The use case diagram displays, how interaction with the platform ICT4D.at takes place. As already mentioned, most of the enhanced functionality is provided by third-party services, so the use cases are quite basic.

²⁰ <http://www.new.facebook.com/home.php#/group.php?gid=31033330019>

²¹ <http://www.linkedin.com/groups?gid=149868>

²² <http://twitter.com/ict4ddotat>

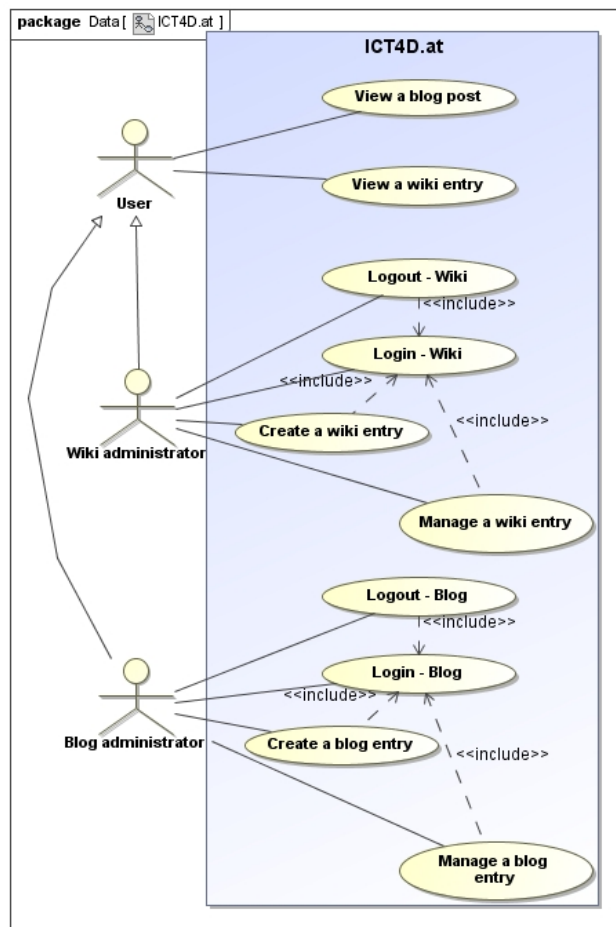


Figure 7.7: ICT4D.at - Use case diagram

Two of these use cases are described in more detail here.

View a blog post

Use case name: View a blog post

Goal: To get information about a special topic covered in a blog post on ICT4D.at

Summary: The user accesses the blog on ICT4D.at and views a certain blog post

Actors: User

Preconditions:

- The user has access to a computer with internet connection
- The platform ICT4D.at including data storage and blog software is up and running

Triggers: The user accesses the URL of the ICT4D.at platform and presses “Blog” in the navigation menu

Basic course of events:

- 1. The blog section of ICT4D is loaded and displayed
- 2. The user can select a certain blog post to also view the comments

Alternative paths:

- 2a. If the desired blog post is older and not displayed on the front page of the blog, the user can navigate to the pages where older posts are displayed;
- 2b. If the desired blog post is not displayed on the front page of the blog, the user can utilize the “Search” form by typing in a keyword

Postconditions: The user is informed about the special topic he required information about

Create a wiki entry

Use case name: Create a wiki entry

Goal: To create an entry in the wiki on ICT4D.at, displaying information on a certain topic

Summary: The administrator creates a page in the wiki, adds content, formats and saves it

Actors: Wiki Administrator

Preconditions:

- The administrator has access to a computer with internet connection
- The platform ICT4D.at including data storage and wiki software is up and running
- The administrator has logged in to the wiki of ICT4D.at
- The wiki does not contain an entry with the same title

Triggers: The administrator types the title of the article in the search engine and presses the “Search” button; as there are no results returned, the administrator presses the “Create this page” link

Basic course of events:

- 1. The wiki editor is loaded
- 2. The administrator types in text, formats it and adds pictures and videos
- 3. When he has finished, the administrator clicks the “Save page” button

Alternative paths: -

Postconditions: The article is saved in the data storage by the wiki software and the administrator is shown the final wiki entry

7.2.3.3 Class & object diagram

To show the interactions of the ICT4D.at platform with external services in a more detailed way, its architecture was modeled in Unified Modeling Language

(UML). There is a class diagram which depicts the architecture in an abstract way, and an object diagram for a more detailed illustration. Both diagrams can also be found in the appendix in a bigger size.

The models are not meant to show the modular design of the platform, but to provide an analysis of how and where third-party services are integrated. One purpose of them is to serve as input for other organizations who also want to integrate and mash third-party services into their online presence. The models should not provide an in-depth design guideline, but an analysis which objects in the platform communicate with which objects of the service provider.

Another constraint of the diagrams is that, on the one hand, it consists very small objects (blog post, wiki entry), whereas on the other hand several of the larger platforms or pieces of software are also designed as one class as a whole, without depicting the internal structure. One reason for this is that these large classes represent standard software packages where the internal structure is not observable without extensive effort. Another reason is that these classes usually have standard APIs or a graphical user interface (GUI) for the integration of other services, so information about the internal structure is not necessary to be able to use and expand them.

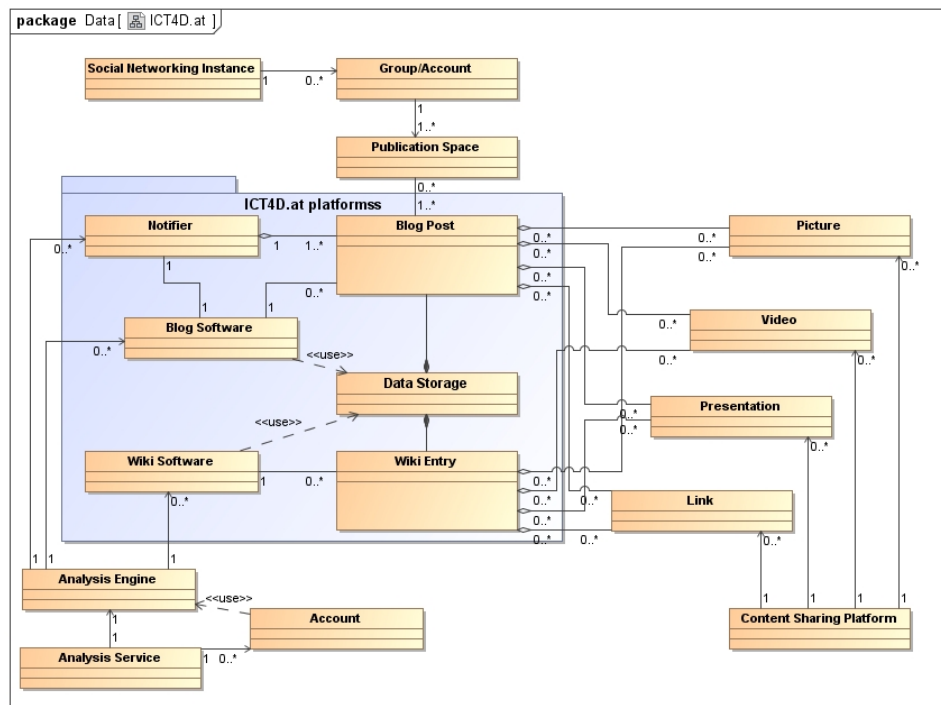


Figure 7.8: ICT4D.at - UML class diagram

The core classes of the platform are the blog entry and the wiki entry. Both consist of pictures, videos, links and presentations which are hosted on various content sharing platforms. The blog entries are furthermore published on the publication spaces of certain groups or accounts on several social networks.

The wiki entries are managed by a wiki software, the blog entries by a blog software and both have to be stored in a data storage. The traffic on the platform is analyzed by an analysis service. The blog software also generates a notification from the blog entries, which is as well analyzed by an analysis service.

What was hard to model, were the relations between the analysis service, the account of a certain registered user and how only on the account of this user the service is utilized for analyzing a specific object.

The chosen solution here was to create a separate class for each analysis service - the analysis engine. The account uses this analysis engine to analyze objects such as the notifier or the blog and wiki software.

In the UML object diagram, the implementation of the architecture illustrated in the class diagram with the specific services is displayed.

To simplify the graphic, only one sample blog entry and only one sample wiki entry were modeled which only contain one sample picture, video, link and presentation.

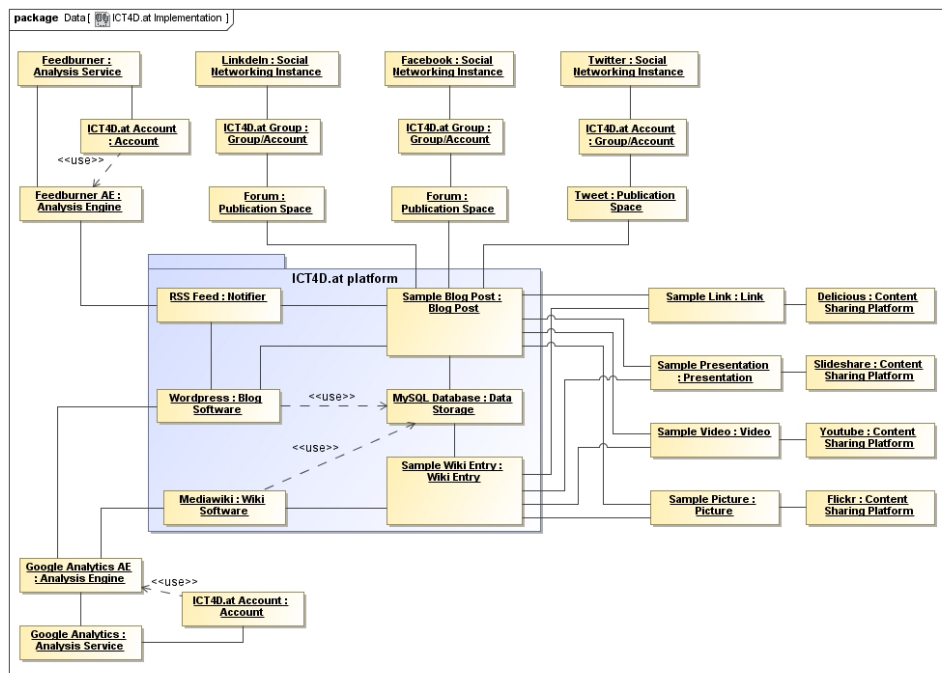


Figure 7.9: ICT4D.at - UML object diagram

7.2.4 Next steps

Produce a movie on mobile phone usage in Southern Africa Together with the Swedish DVD magazine UZI²³, in the near future a movie which focuses on the differences of mobile phone usage in Southern Africa and the Western World will be produced. This movie bases on the material shot during a six weeks travel through several countries in Southern Africa, by members of ICT4D.at and UZI during October and November 2008.

Acquire a large and active user base To gain a broad view on the research topic and keep track of news and developments in this area, it is important to have a large and active user group.

This should be achieved, on the one hand, by promoting the platform at official events, on the other hand by forming social networks of interested people through direct contact or special platforms like Facebook, Xing, LinkedIn or Twitter.

Organize the first ICT4D barcamp in Vienna To strengthen the bond between the contributors of the page as well as intensify discussions and the

²³ <http://www.uzi.se/>

exchange of ideas, people interested in ICT4D in Austria should be given the possibility to meet in person.

For this purpose, we have planned the organization of a “barcamp” in Vienna. This “barcamp” is a meetup where everyone interested in ICT4D can join - under the condition that every participant gives a presentation on the topic. This should encourage communication and knowledge exchange in an open atmosphere.

Chapter 8

Conclusion and Suggested Further Research

The concept of Information and Communication Technologies for Development (ICT4D) has received a lot of attention lately from IGOs, NGOs, national governments and the educational sector. It is seen as a unique opportunity for less developed countries to catch up with the industrialized world in economic and social terms.

The UN entirely integrated ICTs in their concept of reaching the Millennium Development Goals. The OLPC project where public and private stakeholders have joined forces in an e-learning project for less developed countries, is a prominent example.

However, the potential of ICTs cannot yet be estimated. A lot of projects have been launched, but success is yet to come. Many pilot projects were heavily financed, but did not lead to the expected results and, therefore, eventually faded [Gundawardene 2005].

Since the take off of the ICT4D “boom”, voices have been continuously calling for thorough preparation and careful investigation of existing projects in order to learn from the mistakes made and wrong perceptions taken during previous projects. In this paper, I identified three main lessons learned.

- Differences in infrastructure
- Differences in usage
- Consideration of the context

Based on these claims, the concepts of web 2.0 and mashups provide considerable advantages. Seen in the context of developing countries,

- shifting to the web as a platform for personal data
- the fact that almost all applications are free of charge, as well as
- low entry barrier to create own applications

obviously match several of the circumstances in less developed countries very well.

In this work, the articles of Drášil et al [2007] and Heeks [2008] were taken as a base to categorize “mashable” services and to identify their success factors.

Ushahidi, Tradenet, Global Voices Online and BROSDI are just some of recent initiatives which make use of these new technologies and concepts. They were presented and analyzed according to the aforementioned success factors.

Regrettably, my own experience during this research showed that the advantages of mashups and web 2.0 services over new platforms do not seem to be clear and many platforms and projects still work relatively independently from each other.

To show a possible service which makes use of several other existing services by the mashup-concept, the prototype NoisR was introduced. It can, with little configuration, be set up on every e-marketplace and provide additional ways to disseminate information. A lot of potentially beneficial services were discovered for this purpose, and several of these already existing services with very useful features were integrated in the prototype.

Another project carried out during the course of writing this work, which uses web 2.0 services primarily as foundation for a bigger cause was introduced subsequently. The platform ict4d.at should help creating a network of people in Austria interested in ICT4D and foster knowledge exchange and creativity to finally lead to the origination of projects.

Generally it can be said that the technology of web 2.0 services and mashups are contemporary in the western world and greatly integrated in everyday IT applications. What is missed out is that these technologies, though not primarily developed for that aim, provide many benefits for the usage in less developed countries, as they fit soundly to the different infrastructure there.

Further research is necessary, which effects the combination and mashing of further services to existing platforms has on the usage of these platforms. Also, I am not certain if the given infrastructure in less developed countries can handle the requirements of these tools. Therefore, it would be necessary to explore the situation on site, which I did not have the possibility for, yet.

Another interesting topic which goes beyond the scope of this work is the

potential of combining contemporary concepts such as mashups with older technologies such as radio or TV (which are already well accepted in many less developed countries).

Furthermore, as a more specific approach, in my opinion the usage of web 2.0 tools (such as the presented prototype NoisR) for the purpose of e-learning in less developed countries has large potentials, which are not yet fully tapped.

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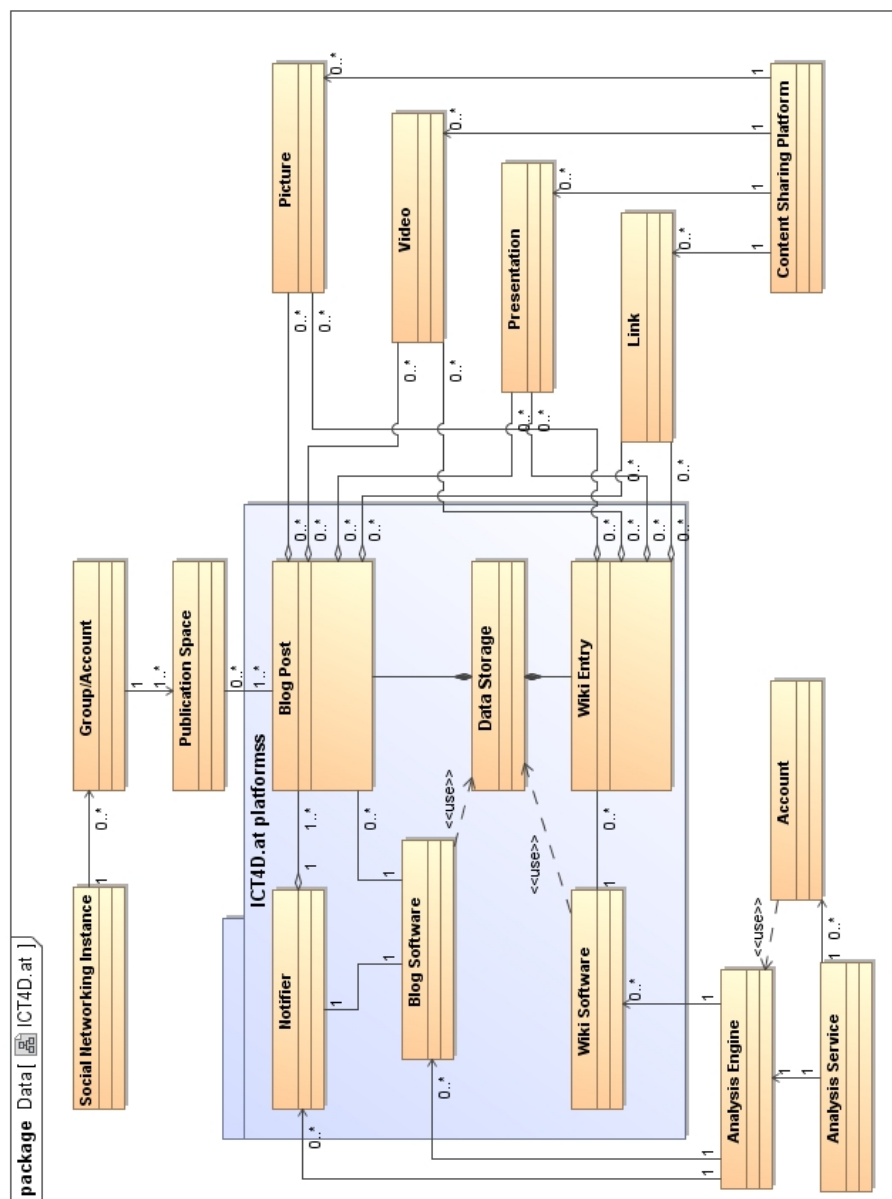
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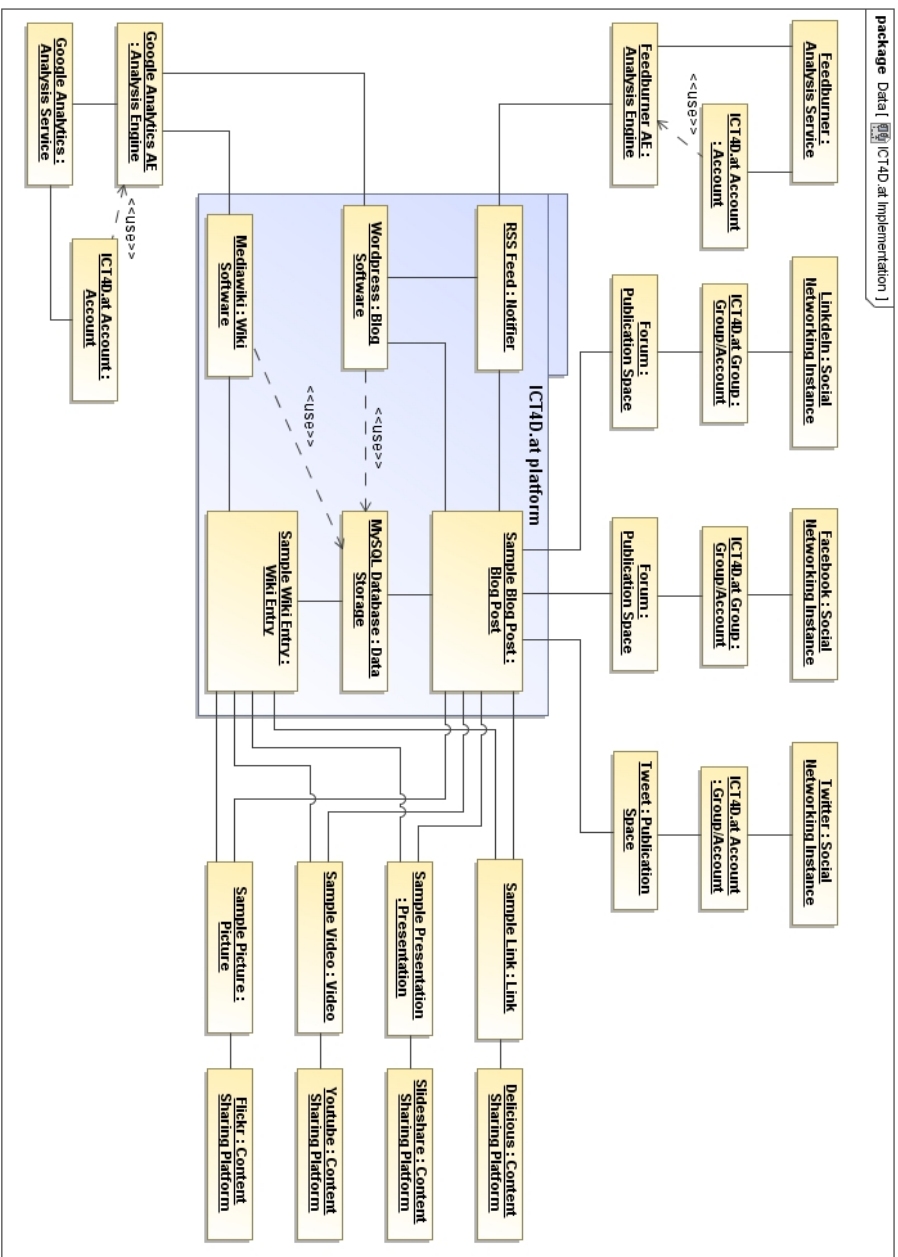
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Appendix I - Diagrams





Appendix II - English

Abstract

Since the early 1990s, access to worldwide-created information and possibilities for world-wide communication have become easier and easier - at least in the Western world.

In this “age of information”, the gaps between developed and less-developed countries do not only consist of the large differences in infrastructure and society, but also of the difficulties for developing countries to access these means of information and communication, which in fact are freely available.

But why in the first place would people living in areas where there is not even enough food or water require internet access, let alone the possibility to make long-distance calls?

Some years ago the research area “Information and Communication Technologies for Development” (ICT4D) emerged. This area of research is based on the claim that contemporary technologies enable economic and social change in such countries which are provided with access to these technologies. Hence, that could help less developed countries to catch up with the Western world. The idea has found many supporters and, after a general introduction in the first part of my thesis, the concept of ICT4D will be described in detail in the second part. Furthermore, its current significance, potential benefits, lessons learned to date, but also criticism will be mentioned.

Since not every technology has the quality to deliver benefits in less developed countries, the next two chapters will deal with two technologies which, as is claimed here, have certain advantages in the context of ICT4D.

The first technology is web 2.0, whose participatory services are substantial tools for fostering development in the information sector, and, therefore in the economy as a whole, since a key element in sustainable development of services is the involvement of local stakeholders in projects and content creation.

The second technology is mashups, which - in essence - are combined and connected services provided to users in the internet. These mashups do not

require much knowledge about programming, which is a substantial benefit as there exist few people with programming skills in less developed countries.

In the fifth part of my thesis mashups concept and success factors in the context of ICT4D are presented.

Subsequently, various successful projects based on the concepts of participation (web 2.0) and combination of services (mashups) are introduced and analyzed.

In the following chapter I introduce two projects I created together with colleagues during the course of writing this thesis. The first one is the prototype of a tool for improved access to vital services, based on the concept of mashups - NoisR. The second one is the platform for the “Austrian Network for Information and Communication Technologies for Development - ICT4D.at” which provides information about ICT4D and should encourage people to participate and share their thoughts online.

Finally, I draw my own conclusions about the topic and outline open questions and desired future research.

Appendix III - German

abstract - Zusammenfassung

Seit den früher 1990er Jahren wurde der Zugang zu weltweit erzeugter Information in der westlichen Welt immer einfacher möglich. Google, Wikipedia, Soziale Netzwerke, Blogs und unzählige Mitwirkende auf der ganzen Welt haben es möglich gemacht, über das Internet verschiedene Informationen, Ansichten und Meinungen zu zahllosen Themen kostenlos zu beziehen. In diesem „Zeitalter der Information“ besteht die Kluft zwischen entwickelten und weniger entwickelten Ländern nicht mehr nur in den großen Unterschieden in der Infrastruktur und der Gesellschaft, sondern auch in den Schwierigkeiten der unterentwickelten Nationen zu diesen kostenlos erhältlichen Informationen Zugang zu bekommen.

Aber wozu würden Leute die in Gebieten leben in denen es nicht einmal genug Essen oder Wasser gibt, Internetzugang oder die Möglichkeit Anrufe in weit entfernte Gebiete zu tätigen, benötigen?

Vor einigen Jahren entwickelte sich das Forschungsgebiet “Information and Communication Technologies for Development“ (ICT4D). Es basiert auf der Annahme, dass der Zugriff zu modernen Technologien ökonomische und soziale Veränderungen in den Ländern die diesen Zugriff ermöglichen, hervorrufen kann. Diese könnten unterentwickelten Ländern helfen, an die westliche Welt Anschluss zu finden. Diese Annahme hat mittlerweile viele Anhänger gefunden und in dieser Arbeit wird das Konzept des ICT4D, nach einer generellen Einführung, im zweiten Kapitel im Detail beschrieben. Weiters wird die derzeitige Wichtigkeit, potentielle positive Auswirkungen, gemachte Erfahrungen, aber auch Kritik, dargelegt.

Nachdem nicht jede Technologie das Potential hat positive Veränderungen in weniger entwickelten Ländern zu begünstigen, beschäftigen sich die nächsten beiden Kapitel mit zwei Technologien die, wie hier behauptet wird, spezielle Vorteile im Kontext von ICT4D aufweisen.

Die erste Technologie ist Web 2.0, wessen Zusammenarbeit fördernden Services substantielle Werkzeuge darstellen, um Entwicklung im Informations-Sektor

und damit in der Gesamtwirtschaft zu fördern. Dies ist der Fall, da die Beteiligung von lokalen Stakeholdern bei Projekten und in der Erzeugung von Inhalten ein Schlüsselement in der nachhaltigen Entwicklung von Services ist.

Die zweite Technologie sind Mashups, welche grundsätzlich kombinierte und verbundene Services sind, die Benutzern im Internet angeboten werden. Die Erstellung von Mashups benötigt keine extensiven Programmierkenntnisse, was einen substantiellen Pluspunkt im Kontext von ICT4D darstellt, da es in weniger entwickelten Ländern nur wenige Leute mit Programmierkenntnissen gibt. Im fünften Kapitel dieser Arbeit werden Mashup Konzepte und Erfolgsfaktoren im Kontext von ICT4D präsentiert.

Nachfolgend werden verschiedene erfolgreiche Projekte basierend auf den Konzepten der Partizipation (Web 2.0) sowie der Kombination von Services (Mashups) vorgestellt und analysiert.

Im folgenden Kapitel werden zwei Projekte präsentiert, die ich während der Arbeit an dieser Master-Arbeit gemeinsam mit Kollegen durchführte. Das erste Projekt ist die Erstellung eines Prototypen eines Tools, das basierend auf dem Konzept von Mashups verbesserten Zugang zu grundlegenden Services anbietet - NoisR. Das zweite Projekt ist die Plattform "Austrian Network for Information and Communication Technologies for Development - ICT4D.at", welche Information zu ICT4D anbietet und interessierte Menschen dazu ermutigen sollte mitzuarbeiten und ihre Gedanken online mitzuteilen.

Abschließend werde ich meine eigenen Schlüsse zum Thema ICT4D ziehen und offene Fragen vorstellen, sowie mögliche zukünftige Forschung anregen.

Appendix IV - Scientific CV

Florian Sturm

Moosgasse 3, A-4810 Gmunden

Personal Information

Telephone 0043 650 5361199
Email flosturm@gmail.com
Nationality Austrian
Date of Birth 09/09/1984
Gender Male



Education

Dates Since 10/2007
Subject Master program in Business Informatics (Wirtschaftsinformatik)
Institution University of Vienna
Curriculum Courses and exercises covering the following subjects:

- Business process management
- Web services & mashups
- Tax law
- Advanced programming (Java)
- Advanced statistics

Dates 08/2006 – 06/2007
Subject Studies in “Information and Communication Technologies for Development (ICT4D)”
Institution University of Stockholm
Curriculum Courses and exercises covering the following subjects:

- Introduction to ICT4D
- Global IT management
- Mobile technologies

Dates 10/2003 – 06/2006
Subject Bachelor program in Business Informatics (Wirtschaftsinformatik)
Institution University of Vienna & Vienna University of Technology
Curriculum Courses and exercises covering the following subjects:

- Introduction to economics and business studies
- Discrete mathematics, statistics and analysis
- Software development (C++, Java, PHP), software quality assurance and usability engineering
- Database management (SQL)
- System administration (Windows, Unix)
- Workflow and business process modeling
- Project management

Title awarded Bakkalaureus der Sozial- und Wirtschaftswissenschaften (Bakk. rer. soc. Oec.) equivalent to a “Bachelor of Social- and Business-Sciences”

Publications

Year 2008
Title “Fighting Hunger with Information – Mashups in ICT4D Increase Accessibility of Vital Services”
Authors Florian Sturm, David Hauer, Thorsten Hampel, Andreas Hornich
Conference SIG GlobDev’s First Annual Workshop – Paris, France

Work experience

<i>Dates</i>	10/2008 – 01/2009; 02/2008 – 06/2008; 02/2006 – 06/2006; 10/2005 – 01/2006; 10/2004 – 01/2005;
<i>Position held</i>	Tutor
<i>Employer</i>	University of Vienna & Vienna University of Technology – Vienna, Austria
<i>Responsibilities</i>	Helping and supervising students of the university courses: ● Software Testen (testing software) – creating, reviewing and improving tests of software ● IS-Technology – reviewing scientific essays, helping in the development of web 2.0 projects ● Software Quality Engineering – ensuring and testing the quality of developed products ● Interoperabilität (interoperability) – developing applications by combining other services ● Web Engineering – developing examples for the use of PHP and web services ● Einführung in die Programmierung (introduction to programming) – basic programming in C++
<i>Dates</i>	07/2008 – 09/2008
<i>Position held</i>	Student apprentice
<i>Employer</i>	Selmatic Ltd – Plovdiv, Bulgaria
<i>Responsibilities</i>	Working in the development department of an IT company, carrying out several projects: ● Development of a new website for the company based on the CMS Joomla ● Writing scripts with the database query language Firebird SQL ● Creation of a server monitoring tool and several automated reports with PHP

Personal skills and competences

Languages

<i>German</i>	Mother tongue
<i>English</i>	Fluent
<i>French</i>	Conversant
<i>Swedish</i>	Conversant
<i>Russian</i>	Basic knowledge

Social skills and competences

Good ability to adapt to multicultural environments, gained through my study experience in Sweden for one year, my internship in Bulgaria for three months, as well as through various travels .

Team spirit, gained through playing in a soccer team for 8 years and many team projects in university .

Organisational skills and competences

I am the **project leader of the computer section** in the international students' organisation **IAESTE** and the work includes organizing meetings, coordinating working with my colleagues and training new members who want to help me.

Computer skills and competences

- Good command of **Microsoft Office**
- **Programming** skills in **Java** (applications, servlets, RMI, JSP, EJB) and **C++** (basic)
- Experience with various **databases** (Oracle, DB2, MYSQL, PL/SQL)
- Experience with **using and configuring Microsoft Windows** and **Linux** operating systems
- **Web design skills** (XML, CSS, PHP, implementing and using Web Services)

Gained through my studies, personal interest and voluntary occupation as project leader for the computer section of IAESTE.

Other skills and competences

Playing the piano – gained through musical education from the age of 10 to 18

I am **founding member** of “**ICT4D.at** - Austrian Network for Information and Communication Technologies for Development” which involves keeping track of and writing about economic and social developments in lesser developed countries, as well as technological advances in general. Furthermore I am responsible for representing the network at events and conferences we attend.