

## Bridging the virtual and the physical space: Kornelia – a chatbot for public libraries

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### ABSTRACT

This paper reflects the collaboration of a network of public libraries, a student group, and three SMEs in order to develop a chatbot in a cost-effective manner.

The project, managed by scholars of information science and their academic mentor, has yielded fruitful results.

Chatbot technology can enable digital natives to access public libraries in a new way. Progressive libraries need to take this new public into account and adapt the services to their needs.

A considerable number of chatbots has been implemented in libraries, particularly in German-speaking countries. Those chatbots are generally set up in order to serve as an extension of the help desk and to teach information literacy skills.

The chatbot Kornelia  
(<http://www.kornhausbibliotheken.ch/index.php?option>

[=com\\_wrapper&view=wrapper&Itemid=64](#)) described in this paper is not only the first Swiss library chatbot but also the first to be implemented for a public library (Kornhausbibliotheken, <http://www.kornhausbibliotheken.ch/>). By means of Kornelia, the hosting institution hopes to appeal to people essentially active in the digital world and invite them to visit the physical media collection.

The paper depicts the cooperation between public libraries, universities and the private sector that could work as a new model for mutual knowledge transfer and collaboration.

The acceptance of the public will show, whether or not chatbots will guide digital natives from the virtual world to the physical spaces of the library.

**KEYWORDS:** Chatbot, software agent, public libraries

## 1. INTRODUCTION

In order to improve the library customer information service, a network of 21 public libraries in Berne - the Kornhausbibliotheken – decided to implement a new information system: A chatbot hosted on the homepage which would answer the users 24/7 in an anonymous way.

This virtual agent is assumed to help bridging the gap between libraries and digital natives: Digital natives apt in new forms of communication would be inspired to chat with the conversational agent. As this chatbot is the first one for libraries nationwide, another benefit for the hosting institution is the perception as a meeting point between information, people and technology. Hopes are high that the new offer appeals to people active in the digital world in such a way that they might consider visiting the physical collection.

Students of Information Science at the Haute Ecole de Gestion (HEG) in Geneva were mandated to develop the chatbot in a student project within two semesters. Afterwards, the project was to be transferred to the library that would maintain and improve it.

It was a challenge to coordinate the different groups involved with this project: a programmer in charge of the engine and the hosting, the students who provided the content of the conversation in collaboration with librarians of the Kornhaus libraries, a graphical artist who created the graphical outlook of the avatar and a group of students who finally tested it in terms of usability.

Three kinds of questions and answers exist for this chatbot: The social chat, the one about libraries in general and one specifically about the Kornhaus libraries.

## 2. CHATBOTS IN LIBRARIES

### 2.1. DEFINITION

The term chatbot is a combination of „chat“ and „robot“. These bots are server applications replying to questions posed via internet in a way that motivates the inquirer to continue the conversation. Questions are entered in an input field and the bot answers to it immediately.

However, before a chatbot can reply to questions properly, it has to be fed with information. With help of AIML (Artificial Intelligence Mark up Language), which will be explained later, the application can recognize keywords enabling it to access to the right answer.

### 2.2. RELATED WORKS

An increasing number of chatbots are set up in libraries, especially in Germany. But until now they are all scientific, academic libraries. Thus, the Kornhaus libraries are the first public libraries to introduce a chatbot.

The mission of public libraries is slightly different from the academic ones. It is worth to take a closer look at

their ambitions because they influence expectations towards chatbots as well as the motivation to install one. University libraries have different tasks and other user's needs to satisfy.

In general chatbots offer a 24/7 accessibility of support and serve as an extension to the help desk. They shall respond to a change of user behavior, in particular of the digital natives, since many people now handle things online and are used to being served immediately. ASKademicus, the chatbot of the library of the Technische Universität Dortmund (<http://www.ub.uni-dortmund.de/chatbot/>), is in addition to that supposed to make finding information an enjoyable experience and is therefore used as a marketing instrument (PUSHILAL).

Another chatbot named Stella, offered by the Bibliothekssystem Universität Hamburg (<http://www.sub.uni-hamburg.de/>), is more focused on e-Learning and information retrieval and literacy (BACHFELD). She was conceived to explain the access to databases and full text sources. (CHRISTENSEN).

Both of the chatbots follow the mission of the corresponding institution by teaching their users how to access to the right information, since research is often very complex at this academic level.

Customers of public libraries have other needs. They expect to find what they are looking for within seconds and are usually not interested in knowing with which strategy and database they can access information (LI). Moreover, users of a public library have rather punctual requests, such as "Is the library open today?" or "Is this book available right now?". They want to have the exact answer without being redirected to another website. An access from the chatbot on the catalogue's database is hence essential for the users' satisfaction.

Unfortunately, this project did not have the resources to create a connection between the chatbot and the library catalogue, which is not only a link but a way to consult it and access the database directly via the chat panel. Instead, Kornelia answers such requests with a hyperlink to the site of the catalogue.

### 2.3. FUNDAMENTAL ELEMENTS

A language specifically for developing chatbots has been invented by Richard Wallace. It is called AIML (Artificial Intelligence Mark-up Language). The creator of this XML derivate also elaborated the famous chatbot A.L.I.C.E.. This bot was originally written in a non-XML grammar but adapted in AIML at the emergence of XML (WALLACE).

This means that the content is structured with the help of so called tags. The fundamental idea was to create a language so easy that it can be learned by anyone. The simplicity is to such an extent that it is theoretically possible to build a chatbot based on only three different kinds of tags.

The content of a chatbot is based on rules containing requests and their corresponding answers. These rules

are distinguished from one another through a category tag.

The question (input) is placed between pattern tags and the response (output) between template tags.

An example:

```
<category>
  <pattern>What is your name</pattern>
  <template>My name is Kornelia.</template>
</category>
```

Additional tags help to make the chatbot appear intelligent. With so called wildcards for instance, the chatbot can recognize the phrase structure in order to respond to a question in a way which is most likely correct.

Wildcards are the characters star (\*) and underscore (-) which replace one or more words. This permits to encode only a fraction of the input.

Example:

```
<category>
  <pattern>Who is *</pattern>
  <template> I don't know who that
  is.</template>
</category>
```

The dialog might look like this:

*User: Who is Harry Potter?*  
*Kornelia: I don't know who that is.*

Meanwhile, programs more sophisticated than AIML have been developed. However, they are not freely available in Open Access.

### 3. BUILDING A CHATBOT

#### 3.1. TECHNICAL DEVELOPMENT

In the chatbot Kornelia, questions and their corresponding responses are saved in AIML files. For the construction of Kornelia for the Kornhaus libraries, a social chat file was copied from the bot GermanAlice created by Christian Drossmann (<http://www.drossmann.de/GermanAlice/>), adapted for the institutional purpose and used as a base of the new chatbot. This was possible because the content of GermanAlice is under the General Public License.

As a technical environment for creating the chatbot, the Program E was chosen (<http://sourceforge.net/projects/programme>).

It is written in PHP and uses MySQL. The platform contains "a converter which loads the AIML files into the database, a core rule engine that adheres to the AIML 1.0.x specification and several chat interfaces: HTML, Flash and XML-R" (SOURCEFORGE). The chat quality is assessable with the help of so called log files. All past chats are saved into them in an environment protected by a password.

In order to generate additional content, the first step was

to study the mark-up language AIML.

At the same time, information about the Kornhaus libraries was mainly collected from the official website of the institution. Eventually, it became increasingly evident that the information available there was not exhaustive. This created a divergence between the knowledge of the chatbot and the expectations of the library collaborators about it. However, its level depended on a close collaboration between the group of students and the librarians. Generally, the staff was rather reticent throughout the first phase. Searching for information on the library, the complexity of the library network became evident with the many exceptions and the peculiarities of the specific libraries.

Furthermore, some technical issues had to be dealt with: Unfortunately, "Program E" had many bugs in the beginning which had to be fixed by an IT professional.

As the chatbot-engine was developed in the United States, umlauts were not supported in the beginning. In response to that, the used character set was adapted. Now, Kornelia can ask and understand words with "ü", "ä" or "ö".

A big problem to solve concerned the way to address the chatbot. In German, people are addressed differently: either in a formal or in an informal manner. The rules copied from the GermanAlice contained only answers which were written in an informal style. The decision was taken that Kornelia should understand both formal and informal questions but always respond in a formal way. This decision had as a consequence that the whole social chat of over 3200 questions had to be revised.

Because of a lack of time, only the answers were adapted, since the customers always have to be addressed in a polite form. This had as a consequence that the chatter who, now addressed in a formal manner, used the polite form back in return. The chatbot was not always ready for questions in this form and could (and can) still not answer to all questions. The chatbot needs to be continually adapted.

#### 3.2. GRAPHICAL DESIGN

The look of a chatbot avatar is crucial to its user acceptance. Before deciding on it, the different parties involved in the project discussed about their ideas. The group of students proposed a male chatbot in order to fight against the stereotype that librarians are usually women. In the end, a female avatar was chosen: according to experiences made by the library staff, women look more trustworthy.

For the students in charge of the content of the chatbot it was important to know the gender of the chatbot as soon as possible because it potentially influences the social chat.

During another meeting, the graphical artist presented five character types: Each of these faces were shown with and without glasses and drawn in different styles.

The choice of the character was not an easy one: the

Avatar is supposed to be suitable for the Kornhaus libraries and with a timeless appearance. After a long discussion and different suggestions for improvement, the decision on the look was taken: it is neither too young, clichéd or skinny, nor too sexy. In Figure 1 you can see on the left the first choice and on the right the same after some enhancements.

The style of the avatar is artificial rather than natural: the users should always know that they are talking to a machine and not to library staff.



**Figure 1: Development of the Chatbot design**

After the choice of the chatbot's gender, the team brainstormed its name. The student group came up with the name "Kornelia", which incorporates the name of the library network. Since it is in line with the corporate design, the director instantly decided to keep it.

#### 4. EVALUATION

##### 4.1. GENERAL USER ACCEPTANCE

A study about the chatbot Alice carried through by Richard Wallace indicates that most users react to a chatbot in a dominant way. The source of this behaviour lies in the user's power to punish it (by switching off the computer) and in the intellectual superiority of the human. The chatbot is unconsciously taken for a human. The study unveils two main attitudes. Half of the test persons had a competitive attitude and wanted to test its competence and its limits. The other half had a cooperative attitude and was more willing to get to know the chatbot and communicate with it on the same level. (DE ANGELI).

The acceptance of a chatbot is very individual and is based on individual preferences, age, computer skills and past experiences with other bots. Many users prefer to ask a librarian directly for help; others prefer to look for information themselves. Some people need support but hesitate to ask an information specialist. For these, a chatbot can be a solution.

The disadvantage is that some people overestimate the knowledge and the technical abilities of a chatbot; whereas others will probably never be satisfied with the given answers (ZICK).

A number of studies have shown that "virtual Figures

can activate, meaning that they provoke a depreciative reaction, they polarize and they emotionalize" (BÜHLER, p. 117). According to this study, there will never be a moment when all users of a chatbot are consent, whether the chatbot is good or not.

A chatbot ought to be regarded as a service. In the end, only the people who can benefit from it will keep using it.

##### 4.2. INTERNAL TESTING (FURTHER MAINTENANCE TOOL)

After having implemented the most important answers, the knowledge of the chatbot was continually tested and improved thanks to log files. As different people started to chat with Kornelia, new impulses were set. The more people talk to her, the more likely it is to know what kind of questions could be asked. Thanks to the log files documenting the chat, a control of the discussions is possible. Falsely answered questions were noted down and then integrated in the memory of the bot. This way, the number of chats effectuated in the past has a direct influence on the quality of Kornelia's responses.

It became increasingly visible that the expectations of the Kornhaus libraries towards the chatbot were different than the expectations the student group had.

In consequence library staff was initially rather unsatisfied. A negative first reaction towards a new chatbot is nothing new. When ASKademicus was presented for the first time internally, he was harshly criticized: He was described as irritating, rude, too cheeky, ignorant, with a weird sense of humour and giving strange answers (PUSHILAL).

In fact, Kornelia had exactly the same effect on the library staff. This common occurrence is due to the deviation from the staff's expectations and the developers' idea of it, which leads inevitably to the chatbot not meeting the requirements of the demanding institution.

An increased collaboration of the two groups was indispensable. In addition to that, the library staff was asked to chat with Kornelia in order to get an idea of her current knowledge and its limits. This enabled an improvement of its content and missing information was added.

During the internal testing, a means to assess the bots quality after updates was integrated in the working environment. This so called quality gate consisted of 50 questions from the library field which the Kornhaus libraries defined as essential. These were then integrated into the working environment. The quality gate can be executed/ carried out by clicking a button: as an output, all the predefined questions with the current answers of the chatbot are given. This tool is especially helpful to control, whether a new integrated rule invalidates an old rule.

Thus the quality gate verifies whether Kornelia responds to the minimum requirements imposed by the Kornhaus libraries.

In order to find out whether the percentage of the

correctly answered questions is increasing the log-files were analyzed and the answers quantified on a monthly basis. Throughout the project the error rate was decreasing.

Month	Number of questions	Incoherently answered questions	Error rate in %
February	1294	402	31,1%
March	1980	525	26,5%
April	953	183	19,2%

**Figure 3: Log-file Statistics**

Generally a chatbot is put online/made publicly accessible when an error rate below 30% is achieved. In this project it was decided to wait a little bit more until the questions concerning the Kornhaus libraries are almost completely covered.

#### 4.3. USABILITY TESTS

A usability test was carried out in order to test Kornelia's ability to answer, her design and the quality of her user-friendliness. It was important that this test was conducted by people who were neither involved with this project nor had further information about it. Students of a course on evaluation and usability were assigned with this task and organized one user focused and one expert focused evaluation. Following are the major results of the usability tests:

- Concerning the competence to answer questions, it was criticized that the chatbot asks irrelevant questions, sometimes gives too vague answers and lacks professional knowledge.
- Concerning the design the chatbot, it was perceived as old-fashioned and unattractive.
- Concerning the usability a chat-example as initial guide was missing.

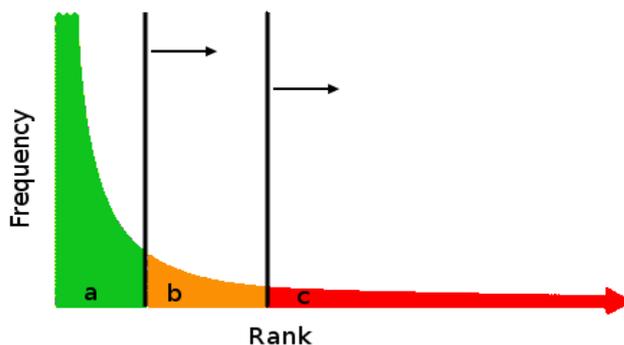
However, usability tests are to be taken with a pinch of salt: "experience [has] shown that test persons in the discussion with bots don't produce any very significant results. The kind of question and their targets differ immensely from the ones of "real" users who usually go on a website with a specific goal. Bots which were developed responding to the results of the tests run in an online-operation the risk of only being able to use a fraction of their knowledge bases" (VETTER).

For this reason the Kornhaus libraries agreed to run tests with actual users during the second half of the second phase: during two days, users of the libraries had the possibility of chatting with Kornelia. At the first day, the bot was tested in the main library, the second day in a smaller branch. The resulting log files were a big help in improving, analyzing and adjusting its knowledge.

## 5. FINDINGS

### 5.1. ZIPF'S LAW

As Dr Richard Wallace, the inventor of the chatbot Alice, found out, Zipf's law applies to users question to chatbots (WALLACE). The frequency of the entry is indirectly proportional to its rank. This means that only few entries are very frequently said like "Yes" or "No" and that on the other hand many questions are asked only once.



**Figure 2: Distribution according to Zipf's Law**

The prior mission of a chatbot builder is to implement the few but very frequent questions. In Figure 2 these questions can be easily identified by the height of the curve in sector (a). The answers given to these questions should be a hundred percent correct. There will be a lot of questions which will only be entered once or which will be impossible to anticipate. The social chat of Kornelia catches some of these questions. It works on the basis of phrase structures to give a linguistically correct answer without being specific. This kind of answers is represented in sector (b). But there will always be questions a chatbot answers wrong, shown in sector (c) because of the complexity of language and the richness of vocabulary. The goal is to optimize the chatbot by pushing its capacity limits back towards the long tail.

### 5.2. BENCHMARKING

Kornelia's ability to respond was tested and compared with six other library chatbots.

A number of questions were asked and their answers were assessed. To analyze the results, the answers were classed by the same categories from the Zipf's Law: The category (a) where the question was replied correctly or the correct link to the library offer was given, the category (b) where the chatbot somewhat understood the question but didn't give a clear response and the category (c), where the given answer was false.

After discussions with different people involved with the project it was found that the judgement of the answers was rather subjective. There was no possibility of objectively classify the answers. The problem lies within the fact that the chatbot always gives an answer. So the main dispute was whether to put a question in category (b) or (c). As an example, when a chatbot answers "Maybe", is this linguistically correct, or shall

it already be judged as wrong? Or when a chatbot answers “I didn't understand that. Could you reformulate your question?”, it is an answer which fits into the conversation, although the chatbot didn't at all understand the question. In addition to these difficulties, it was as well a challenge to find questions to ask which were suitable for every library type. In consequence, the question of how long a DVD can be borrowed can't be answered correctly by a chatbot whose library doesn't lend DVDs.

Different methods were applied in order to achieve the most objective result. One time, only questions from the log files of chats with Kornelia were used, another time questions which should suit every institution were chosen. The outcome of these two methods was contradictory. Therefore, a further interpretation of the results was waived.

### 6. CONCLUSION

The importance of the Web for libraries will still grow within the next years and a lot of new functionalities emerge within this context. This paper shows how students can be an active part of this process, by learning to manage projects under real-world conditions and by developing library services that correspond to the needs of their generation.

Cooperation between public libraries, universities and the private sector could work as a new model for mutual knowledge transfer and collaboration.

Despite the low budget and the limited amount of time given, the chatbot quickly showed good results. The quality will further improve the more people will chat with Kornelia.

However, the final implementation had to be postponed due to an initial strong resistance of the library staff towards the answering skills of the bot. These difficulties were overcome with further work on the knowledge base after some usability tests so that the chatbot will finally go online as of July 2009.

The main future problem will be that the chat panel is mistaken for a search field of the library catalogue. It will be crucial that the users can put up with the chatbot not having access to the catalogue's database.

The acceptance by the public will also show, whether chatbots will guide digital natives from the virtual world to physical spaces in public.

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