

EmSe: Initial Evaluation of a Child-friendly Medical Search System

Carsten Eickhoff, Leif Azzopardi, Djoerd Hiemstra, Franciska de Jong, Arjen de Vries, Doug Dowie, Sergio Duarte, Richard Glassey, Karl Gyllstrom, Frea Kruisinga, Kelly Marshall, Sien Moens, Tamara Polajnar, Frans van der Sluis

PuppyIR (<http://www.puppyir.eu>)

ABSTRACT

When undergoing medical treatment in combination with extended stays in hospitals, children have been frequently found to develop an interest in their condition and the course of treatment. A natural means of searching for related information would be to use a web search engine. The medical domain, however, imposes several key challenges on young and inexperienced searchers, such as difficult terminology, potentially frightening topics or non-objective information offered by lobbyists or pharmaceutical companies. To address these problems, we present the design and usability study of EmSe, a search service for children in a hospital environment.

Categories and Subject Descriptors

H.5.4 [Information Interfaces & Presentation]: Hypertext / Hypermedia—*User Issues*; H.1.2 [Models and Principles]: User/Machine Systems —*Human Factors*

General Terms

Human Factors, Experimentation

Keywords

Children, Web search, Medical information needs

1. INTRODUCTION

For children, illnesses and other undesirable medical conditions can be very confusing and frightening. Children faced with such problems will often express an interest in learning about their medical case, what is happening to them, and what to expect. However, finding information related to medical conditions is often a difficult and sensitive task. Consequently, designing and developing search services for children presents a number of challenges, including: children's problems expressing complex information needs, finding and identifying relevant information, and ensuring that information is understandable, appropriate, and

sensitive to the child's physical and emotional state. To address these challenges, we developed the Emma Search engine (EmSe) for the Emma Kinderziekenhuis (EKZ) at the Amsterdam Medical Centre¹. The goal of the EmSe service is to improve the accessibility of information, in particular from the medical domain, along with the services provided by the patient information centre by:

1. providing an engaging interface that encourages children to explore and learn,
2. facilitating query formulation,
3. improving the understandability of content, and,
4. enabling moderated and trusted web and medical site search services.

To this end, we developed and integrated a series of related search applications that were designed for children aged 8-12 years. We focus on this age group as they already show a sufficient degree of literacy skills to operate and understand textual search interfaces while still facing significant challenges when searching. The services are accessible to hospital patients via bedside computers and the information centre, and to outpatients via the web. In the remainder of this document, we will introduce relevant threads of related work (Section 2), describe the services and components offered in EmSe (Section 3), discuss the outcome of the preliminary usability evaluation by the EKZ staff (Section 4) and, finally, conclude with an outlook on future evaluation and application of the system (Section 5).

2. RELATED WORK

There is a substantial body of work dedicated to children's behaviour when interacting with search engines, both over local collections as well as on the web. To motivate the design decisions taken in this work, we will briefly summarize their main findings. (1) Query formulation has been found to be a major source of frustration for young searchers [1]. Due to their smaller active vocabularies, children are not as proficient as adults in finding the right keywords to express their information needs. This becomes even more important in domains with inherently difficult terminology such as medical topics. (2) After query formulation, the returned result page needs to be evaluated. Distinguishing organic search results from advertisements and sponsored results is an easy task for adults. Children, however, have been shown

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¹<http://www.emmakids.nl/>

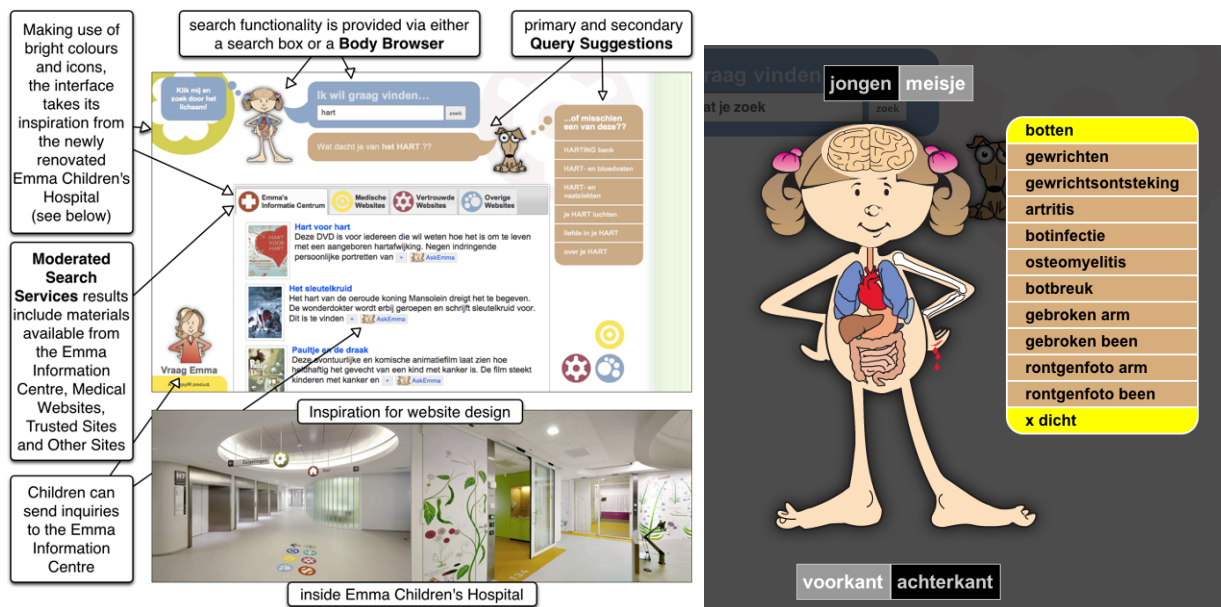


Figure 1: An annotated screenshot of the EmSe search service (left) and the Body Browser overlay that appears after clicking on the child avatar (right). The Body Browser offers the child query suggestions as they mouse over the body.

to struggle with the step [9]. (3) Even without the problem of advertisements, identifying relevant search results has been found to be a challenging task for children. They were observed to significantly more often click on irrelevant high-ranked results without critically questioning the presented material [4, 2]. (4) A specific habit that has often been observed for children is a preference for browsing over searching [3, 2]. Where adult users often explore a given topic by iteratively refining the search query, children tend to browse through the results of the initial query to find the desired pieces of information. This finding can be related to their previously-mentioned difficulties in query formulation.

In this work, we will outline the design of a child-friendly search system that takes into account these findings in order to mitigate their effects by employing dedicated search support services.

3. THE EMSE SEARCH SERVICE

EmSe is built using the PuppyIR Framework [7], which provides a suite of components that can be combined to build child-specific search services. Component types range from interfaces to various search resources (e.g., Bing, YouTube, Twitter) to a collection of information processing components that filter and modify both queries and results to support the user and their search tasks. Fundamentally, EmSe enables searching the information centre’s local information repository, trusted medical sites as well as the web, over which the following services are built: (1) the Body Browser, a novel visual querying interface, which lets children explore the patient information centre, (2) a multi-site search service of recommended and related medical sites, which lets children find out more about medical conditions from high-quality sites, and (3) a moderated web search service, which lets children safely search the web via moderated queries and results. (4) To help children understand difficult medical terms, returned documents are augmented such that known medical terms are annotated with simplified explanations. The interface is kept clean and minimalistic to avoid over-

whelming the child with information or distractions. EmSe only shows a limited number of graphically enhanced search results, incorporating cover images of books and DVDs from the information centre. Figure 1 shows the EmSe user interface. In order to make the interface more appealing and to enhance the user experience, the search process is guided by a number of comic avatars representing different search metaphors. The boy and girl characters represent the child operating the search engine while the puppy character represents the search system. The child engages the system through a dialogue box which prompts, “I would like to find ..” The puppy retrieves result sets and continues the dialogue by providing search and spelling suggestions (through the use of a “dogalogue” box). As a fallback, Emma (an adult) is also included and enables the child to contact the staff of the information centre for further guidance and support, if the puppy cannot fulfil the child’s request, or if they would like to physically borrow an item from the information centre. Figure 2 shows the different avatars in EmSe. In the following section, we provide a brief description of the different components with the Emse Search Service.

The Body Browser: The Body Browser enables exploration of the patient information centre’s repository of books, DVDs and other media via an interactive illustration of a body, where users can zoom to various levels of detail

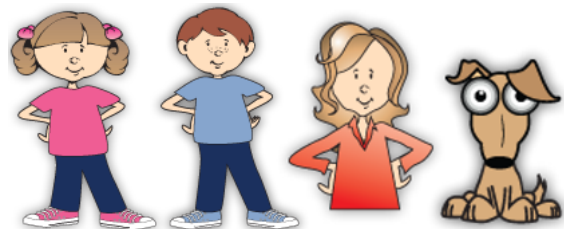


Figure 2: EmSe avatars: Girl, Boy, Emma and the Puppy.

from the entire body to specific organs [6], which triggers medical web searches related to the body parts and organs in focus. This metaphorical interface is expected to reduce vocabulary difficulties in the query formulation step, which are particularly salient with children and health information. Furthermore, it emphasises a browsing paradigm rather than requiring the user to search for information. For each selected body part, subparts, related diseases and treatments are shown as query suggestions. The interaction has been kept deliberately simple: a point-and-click paradigm is used for both selecting and zooming in, with immediate feedback to make the functionality intuitive. In order to allow for greater personalisation of the search experience, the Body Browser, along with the child avatar can be selected to be either male or female.

Query moderation: The query moderation component identifies and enhances queries that are unlikely to yield content that is child-oriented by applying simple, real-time technology [8]. The focus is not explicitly on removing mature content, but rather on making the results of general queries more suitable for children. The component breaks up queries into n-grams and examines the children’s appeal of these grams by checking Google Suggest for the co-occurrence of these n-grams with child-oriented modifier terms (e.g., “for kids”). We adapted this technique for the Dutch language (“voor kinderen”). In case of n-gram co-occurrences with known children’s terms, the query is dispatched unmodified. Otherwise, it is appended with Dutch kids modifier terms (“voor kinderen”) before being dispatched. Despite its simplicity, this technique has been previously shown to result in strong performance of ensuring child-friendly results [5]. Additional filtering components can be configured to reject queries containing explicit language or undesired content requests.

Result moderation: Even given moderated query formulation, returned result sets from a Web search engine may contain unsuitable items. A particular example from the medical domain are non-objective and sponsored pages authored or influenced by pharmaceutical or medical companies [10]. In order to address this challenge, EmSe offers the possibility to maintain a black list of known biased hosts or suspicious terms. Pages originating from such undesired hosts, or mentioning certain keywords can automatically be excluded from being displayed to the children.

Query suggestions: To further mitigate children’s problems with the query formulation step, EmSe offers spelling corrections and query suggestions. They help children explore and query the recommended and related medical sites by providing suggestions that reflect the specific content on these sites. They are generated by extracting meaningful and informative phrases from the anchor text of the recommended resources.

Content Simplification: Children often face significant difficulties understanding texts of advanced reading levels. Previous work has developed techniques for identifying and subsequently filtering out difficult material [5]. This approach, however, can result in poor coverage of certain, inherently difficult, topics. Manual inspection of resources with high reading level showed that often the text was understandable except for few occurrences of specialised terms. Instead of *a priori* rejecting difficult content, requested pages are checked for difficult terms, which the system augments with brief definitions. When hovering over the term with the



Figure 3: Textual content simplifications.

mouse cursor, a tooltip containing the definition appears. In this non-intrusive way, the text can be read without the child having to leave the page to look up external information. The simplifications are accompanied by hyperlinks to local and web searches if the child should be interested in finding out more about the term. The definitions can either be manually maintained in a server-side dictionary or can be dynamically extracted from external resources such as Wikipedia or Wiktionary. Figure 3 shows the interactive content simplification dialogue available for result page snippets as well as external pages. The example shows the simplification of “migraine” as “a bad headache”.

4. EVALUATION

The first version of EmSe was released in early 2012. It is accessible to staff and patients within the hospital (via bedside computers and other terminals), and also to outpatients via the web. The planned evaluation consists of three main stages. The first stage is to collect feedback from the staff at the hospital. From this initial study we will be refining the demonstrator to incorporate suggested changes before obtaining patient feedback, and then, in a third phase, we shall examine the long term usage of the service.

At this point, Stage 1 has been completed and its outcomes influenced the further development of the current version of EmSe. In March 2012, we visited the children’s hospital and interviewed a total of 11 staff members in 8 individual sessions. Of these eleven, three were nursing staff, two were in-house teachers, three pedagogues, two paediatricians and one member of the information centre staff. At the start of each session, the participants were shown a brief explanatory video, introducing the features and functionality of EmSe. Afterwards, they were encouraged to use the system themselves. Due to scheduling reasons, some participants interacted with the interface in groups rather than individually. The participants were encouraged to think aloud while operating the system and the interviewer did not interfere with their search activities unless directly asked for assistance or clarification. Afterwards, all participants were asked for their general opinion on the system and any aspects that they particularly liked, disliked, or missed. Finally, they were asked to comment on major aspects such as search result quality, interface design, the Body Browser and the content simplifications. Sessions typically took 15-20 minutes each.

There were a number of minor bugs as well as localization issues (the interface is Dutch and not all developers were Dutch native speakers) that were spotted in this early stage of evaluation. They have been addressed in the current version of EmSe. In the following, we will discuss the

participants' feedback concerning EmSe's main components as well as additional features that were suggested and that remain to be investigated in the future.

Search result Quality: The participant's all felt the provided results were of high quality and presented in appropriate manner (i.e., results from the patient information centre first, as these are specifically designed for children, then results from recommended medical sites, before backing off to results from trusted web sites and then all the web). Two participants suggested that the distinction between results for children and adults should be more explicit. Either by separating out the general web results not specifically designed for children from those that were, or by highlighting the more child-friendly results. Additionally, there was a concern that some topics, such as death or cancer, should only be reachable when explicitly being queried for. This form of search moderation represents one of the major challenges for future additions as it involves **a)** identifying sensitive topics that require special treatment, and, **b)** based on query, user context and session information, deciding whether or not to display sensitive information.

Interface design: While all participants appreciated the clean minimalistic interface, they encouraged further personalization and integration of the user into the search process by adopting a login concept so that the user could be individually addressed by the system. This could for example happen in the form of the puppy avatar (representing the search engine) calling the child by its name in the search prompt and the interactive steps such as query modification. We envisage that the avatars could be used to help establish a rapport between the child and the puppy - so that it could illicit information such as the child's name, how they are feeling at particular point in time, find out their favourite things (through a guessing game, etc.) so that the puppy could go off and find interesting and/or entertaining information for the child. An additional request for mobile device compatibility of EmSe was already partially addressed in the latest version which conforms with systems like the iPad. However, full functionality on small-screen mobile devices is currently not supported.

The Body Browser: All participants liked the idea and implementation of the Body Browser. They considered it one of the key features to facilitate browsing-driven information discovery. However, there were a number of issues with this component. They suggested several additional anatomical structures (e.g., the appendix and the genital tracts of the children) to be included for greater coverage. Also, as the Body Browser opens as an overlay over the default EmSe screen. Three users were confused by this interaction style and would have preferred to have been able to more seamlessly switch between the Body Browser and the search results. We appreciate their concerns as the current solution aims to preserve the layout, whereas trying to integrate the Body Browser within the page (instead of on top of it) would require moving elements around and down. This would mean that to access results the child would have to scroll up and down (which introduces a similar problem). Nonetheless, we consider different integration paradigms in future versions.

Content simplifications: All participants found in-line content simplifications helpful and non-intrusive. It was suggested to offer the simplification service independently of a term's expected difficulty in order to account for different

user preferences and needs. More concretely, this would mean to not highlight difficult terms but also offer an interface through which arbitrary term simplifications could be requested on-line.

5. CONCLUSION

In this paper, we discussed a number of the challenges children typically face when searching for medical information in a hospital setting and described the EmSe search service which aims to address some of these challenges. Our initial evaluation with staff at the EKZ hospital was generally positive and staff were excited by the arrival of this service. Given their feedback, we have improved the EmSe Service and now plan to move to user/patient evaluations. In the next stage, we will focus on the patients. We will actively solicit feedback from patients, parents and visitors to the hospital. Finally, in a more long-term perspective, we will use built-in interaction logging mechanisms to get a better perspective of how and how frequently the system is used.

The EmSe Demonstrator is currently hosted at: <http://wickham.dcs.gla.ac.uk:8080/hospital/> and the code base (along with the underlying framework) can be downloaded via sourceforge at: <http://sourceforge.net/projects/puppyir/>. Feedback questionnaires are accessible via the demonstrator, and we would appreciate any comments or suggestions on how we might improve this service.

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²<http://www.puppyir.eu>