INFO262 – Interaction Design

Assignment 1

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Vision

The goal of this project is to create, at least in prototype form, a safe source of information for people seeking medical advice. To help them navigate the complex world of medicine, a symptom checker can be a helpful tool to narrow down what the issue is. A key concern is understanding the kind of activities people are doing when using your product (Sharp et al, 2007, p.6). This can be generalized to a need for both understanding what the users want and understanding the users themselves. But what does that entail? Sharp et al (2007, p.46) calls this “describing the problem space”.

The problem space

This symptom-checker is aimed at non-healthcare professionals, that is to say people with little or no medical training. That means that rather than focusing on speed or presenting one specific diagnosis, the focus should be on accuracy and factual information.

Medical language and terms are difficult for the layman to understand as most of us don't speak Latin beyond “Carpe Diem”. Avoiding medical terms where possible seems like an obvious choice when many conditions also have names in English, like calling it “fainting” rather than “syncope”. It also seems worthwhile to use, where possible, short explanations rather than Latin names where there is no English equivalent, like calling it “difficult or labored breathing” instead of “dyspnea”. Of course, using this approach you run the risk of overly simplifying things to a point where the information is no longer accurate.

One important factor to consider is the power of suggestion. Most people have heard of hypochondriacs, and tools like an online symptom checker can make that condition worse according to Arthur Barsky, MD, of Harvard Medical School (in WebMD, 2002). Even people who are not hypochondriacs can be lead down a path by suggesting symptoms that may or may not fit their condition (Garry, 2012). This means that if you're experiencing a symptom like heartburn and the symptom checker asks whether or not your pulse is quickened, you may start to feel your heart start to race, or otherwise misinterpret a normal heart rate as heightened because you are afraid.

This brings us to another important factor: don't scare the users. It seems like an obvious point, but since medical symptoms themselves can cause anxiety (Crosta, 2013), users may already be in a state of distress when visiting your site. This makes it even more important that the symptom

checker does not contribute to what may become, in a worst case scenario, a state of panic. It is therefore safe to assume that the user is to some degree concerned.

At the same time, it is important not to give a false sense of security. Brushing every concern aside with results that are benign is potentially dangerous if the user decides not to see a doctor on the basis of the information you give them. But, a headache can be symptom of poor sleep the previous night, or it could be a sign of a brain tumor. Presenting only one option seems like a poor choice because the symptom itself is so vague.

It is a tight rope to walk, between providing too much and too little information. But even more poignant is that the information they are presented with is as relevant as possible. Asking for as much information as possible seems prudent. At the same time, how you ask is just as important. Asking questions that are relevant to the information we already have is also a good way to avoid wasting the users time, as well as avoiding confusion. Further confusion can be avoided by not giving overly broad diagnoses by asking follow-up questions, and clarifying what a symptom entails as much as possible.

The goal must therefore be to provide a source of information on medical symptoms rather than giving a conclusive diagnosis. The language should be friendly, but to the point and as clear as possible. The service should also be designed to be used as a supplement to seeing a doctor, and the information should be presented in such a way that it is informative and enlightening rather than frightening. How do we accomplish this? The main claim is that by explaining the symptoms and how they work in relation to diseases and various other symptoms, the user will be better equipped to decide what to do next.

Establishing requirements

Data gathering

Many methods for determining requirements exists, each with their own advantages and and disadvantages. For this project I have chosen to gather data by three different methods:

1. Studying existing symptom checkers myself to discover their approach to the same problem as I am trying to tackle. I tried keeping in mind the points I have outlined in my vision for a symptom checker should do, and how the existing ones handle those challenges.
2. Direct observation: I let three users, each with their own diagnosis, use the various symptom

checkers and observed their experiences.

3. Interviewing the users after their attempt at diagnosing themselves.

Studying existing systems is a good way of getting a baseline idea of what features, and therefore requirements, your service needs (Sharp et al, 2007, p.395).

Direct observation in a (semi) controlled environment: I provided the computer with which they tested the symptom checkers and was present in the room while they used it. Direct observation lets user focus on the details of task, but results may have limited use in normal environment (Sharp et al, 2007, p.343). In order to understand their thought process I encouraged them to "think aloud" as suggested by Sharp et al (2007, p.335). What constitutes a normal environment varies greatly. It is one thing to use a symptom checker in a well lit room, mid day, with other people present, for a diagnosis you know you have. It is easy to imagine that stress levels are different when waking in the middle of the night in a dimly lit bedroom with a symptom like muscle pains.

Sharp et al (2007, p.343) describes interviews as good for exploring issues, promotes contact between developer and user. They also list possible disadvantages as interviews being time consuming, and that the interview situation may intimidate the interviewee or in some way cause them to alter their behavior. I attempted to mitigate these negative factors by making the interview as casual as possible.

The biggest concern I have with the value of my data gathering is that all three of my interview subjects already had a diagnosis and as such were less prone to be frightened or confused by the information they discovered. Furthermore, in addition to a group of three people being a very small sample size, the group of testers is also concernedly homogeneous in that they all possess average or better computer skills. Uncovering confusing interface elements is therefore less likely.

Studying existing systems

Many online symptom checking tools exist. I have chosen to study the top three sites by global traffic volume, as ranked by Alexa.com (2015), that both

a) offer a symptom checker, and;

b) offer their own symptom checker as opposed to using one run by for example *WebMD.com*

The three sites that match these criteria are *WebMD.com*, *MayoClinic.org*, and *Drugs.com*. I also

chose to include the symptom checker provided by the National Health Service (NHS) in the United Kingdom because it is the largest government run symptom checker I could find. Below is my findings for *WebMD.com*. The reports for the rest of the sites can be found in Appendix I.

All of the sites were tested with the following scenario: The user is an adult male that has developed a rash on both hands, manifesting in red, itching skin with small itching "bumps". This is caused by an allergic reaction after exposure to a dog, but the user is unaware of being allergic to dogs.

WebMD.com

The *WebMD.com*[1] symptom checker first presents you with a form that takes general background information like gender and age. You are then presented with a model of the human body and asked to "point to where it hurts". Selecting skin and then adding "Itching or burning" as a symptom on hands and arms correctly suggests an allergic reaction. Next on the list is "contact dermatitis" which is a form of allergic reaction. However, adding more symptoms adds more possible conditions, and pushes allergic reaction further down the list. When I reached four symptoms, all allergy related, allergic reaction had been pushed down to tenth place or so on the list.

While exploring the tool I happened to select "irregular heartbeat", without selecting any other symptoms, and suddenly a somewhat scary message appears that overlays the entire site (Figure 1). It does specify that it is cause for concern in combination with the other symptoms listed, but it does not mention that arrhythmia is extremely common and harmless in most cases (Heart.org, 2014). In any case, while irregular heartbeat in combination with the listed symptoms in Figure 1 is extremely serious, they have potentially already scared the user by jumping them with a gloom-and-doom prophecy with red borders and a warning label icon before the user even has had a chance to read the text.

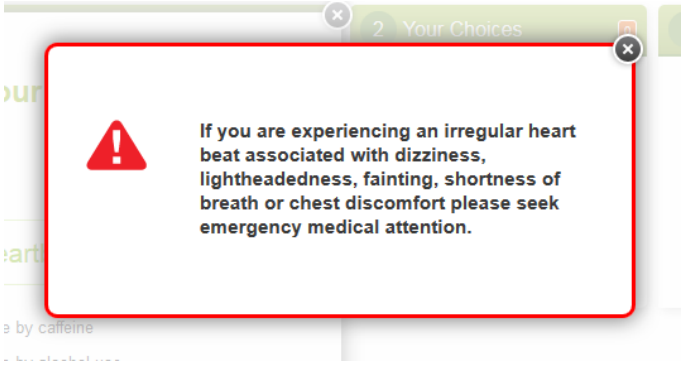

Figure 1: WebMD.com overlay that appears if you click the symptom "irregular heartbeat"

1 http://symptoms.webmd.com/#introView

User testing

In order to better understand the user experience of people trying to use a symptom checker, and their reaction to the information presented, I let some users, individually, try their real life conditions, each on a different symptom checker, without interference. Once they had completed their attempts at gathering information about their condition, I had a short, individual interview/conversation with each of them where I raised questions along the lines of:

- How easy was it to find the information you were looking for?
- How relevant were the questions you were asked?
- How did the experience/information affect your stress levels?
- Did you find the site easy to navigate?
- How was your overall experience with the site?

I also tried to allow them room to bring up topics and issues on their own. A summary of the interview with the user that tried the one from *WebMD.com* follows below. I chose to omit the symptom checker provided by the NHS from user testing because of the lack of utility I found in my own testing combined with time limitations.

Observing the user

The user, being familiar with computers, had no apparent problems navigating the site on a basic level. However, when looking for symptoms that were not included in the list displayed, he was unable to immediately locate a way to find a more general list. Even though this is an experienced user of both computers and web sites, it took him a while to find the link called “more symptoms here”, and the symptom search field below it. It was hiding under a heading called “don't know where to point?”.

Summary of the interview with the user

This user is a 28 year old male who was recently diagnosed with Hodgkin's Lymphoma, a form of cancer. After trying out the symptom checker from *WebMD.com* he raised several issues:

- The interface is a mess. Scrolling gets old really fast. Everything seems to be confined to small windows with too much information.

- The results give the impression of being computer generated by a machine with little medical understanding.
- The fact that they suggest specific illnesses and rank them in order of likelihood suggests that it has weighed the symptoms against each other to arrive at the most likely illness. However, after giving it a list of six symptoms that are very characteristic of a lymphoma, it gives a list of 99 possible illnesses. Lymphoma had been pushed down to around number 80, ranking things like dementia higher.

Functional requirements

Functional requirements describe what the service should be able to do rather than how it should do it (Sharp et al, 2007, p.478). After studying the existing system I established the following functional requirements:

- Present information in a factual, non-threatening way
- Ask as relevant questions as possible
- As far as possible, don't give diagnoses based on incomplete information like a single symptom
- Provide a search function that lets you look up symptoms
- Display a list of symptoms already selected by the user to allow them to easily keep track of what symptoms the have already included
- Not lead the user down a path for a specific disease by suggesting symptoms
- Explain terms and expressions as much as possible

After interviewing the users' about their experiences with the existing symptom checkers I added these requirements:

- Give information rather than definite answers, but not to the point of being useless
- Provide an alternative to the search function for looking up symptoms
- Provide a link to a help section easily visible from all pages
- Provide illustrations to clarify what symptoms entail where relevant

Non-functional requirements

Non-functional requirements are generally less interesting when creating a prototype. Examples of non-functional requirements that a live system might have are:

- low response time when loading pages
- high degree of reliability

An important non-functional requirement to note is the usability of the service, which Sharp et al, (2007, p.20) defines as: Effective, efficient, and safe to use. Has good utility, is easy to learn, and is easy to remember how to use. These points are discussed in the section “making the prototype” starting later on.

Environmental requirements

Environmental requirements describe the surrounding infrastructure that the service needs. These requirements are less interesting when creating a prototype. Some of the more important environmental requirements are:

The user needs

- A computer/tablet/smart phone with an Internet connection and a browser installed

The system needs

- A web server running: server software like for example Apache, a database software like MySQL, and a framework for running something like php/ASP
- A good sorting algorithm that finds relevant symptoms based on those you've already selected
- A comprehensive database of illnesses, symptoms and their relationships to each other, which could also be referred to as a *data requirement*

Making the prototype

Conceptual model

As a conceptual model, a metaphor can be a useful tool in explaining functionality by

exploiting users' existing knowledge (Sharp et al, 2007, p.543). A suitable metaphor for this project could be to see it as asking a friend that's knowledgeable about medicine for advice on what a symptom or list of symptoms might mean, even though he or she is not necessarily a doctor.

Once a suitable metaphor has been selected, the value of said metaphor can be approximated by asking five questions proposed by Erickson (in Sharp et al, 2007, p.544):

1. How much structure does the metaphor provide?

   The chosen metaphor supplies structure in the sense that a conversation with a friend involves questions, and the possibility that no clear answer may come of it. Ready-made illustrations of symptoms are less natural in a conversation between friends unless they're actively looking up symptoms using an external source.

2. How much of the metaphor is relevant to the problem?

   It exonerates slightly the medical advice the system provides from being taken as absolute fact coming from a doctor. However, the language when explaining a symptom may somewhat break the effect of simulating talking to a friend if it's worded in a very concise, encyclopedic manner.

3. Is the metaphor easy to represent?

   Yes, because asking questions is relatively straight forward in a web site setting

   No, because the way the questions, as well as the results, are formulated to not necessarily give associations to a conversation with a friend. Attempting to use that kind of informal tone and structure might cause loss of precision in the formulations.

4. Will your audience understand the metaphor?

   Most people have asked for advice at some point in their lives. It is safe to assume that many have also asked advice from friends and family on medical issues.

5. How extensible is the metaphor?

   This metaphor is not very extensible. It could perhaps be extended to include other topics than medicine. Also, speech recognition software and the development of better Artificial Intelligence could perhaps closer mimic a conversation rather than this text based approach.

Design principles

Sharp et al (2007, p.29-33) outlines some important principles guide the design process:

- **Visibility**; It should be clear what actions are available, and how can they be performed. The more visible the function, the more likely that the user will figure out what to do next. Good visibility makes the system easy to learn, which improves usability.
- **Feedback**; Informing users about what has been done. Quality feedback makes the user feel safer that the system will behave in a predictable fashion.
- **Constraints**; Restricting possible actions helps prevent user from selecting incorrect options
- **Consistency**; Interfaces should have similar operations and use similar elements for similar tasks. Consistency makes the system easier to learn, and makes it easier to retain what you've learned, which improves usability.
- **Affordances**; Attributes of objects that allow people to know how to use the objects

How I've tried to implement these principles is discussed in the next section.

The graphical user interface

It would be really tempting to start with a simple form to gain some background information like male or female, old or young. But many diseases do not have risk factors like age or sex. Therefore it seems like a better idea to ask those questions once they become relevant. This, however, means we face the challenge of initially narrowing down the possible illnesses.

Using the *Pencil*[2] prototyping tool by *Evolus*[3] I've made some drafts of what the GUI might look like. Upon entering the site, the user is faced with a search interface as shown in Figure 2 and Figure 3 on the next page. This is done on the assumption that most users will know how to describe their symptoms to some degree. The simplistic setup of a search bar, a submit button, and a few links, while not scoring any points for creativity, has become something of a standard when encouraging users to search for information. This is demonstrated by large search sites such as *Google*[4] and *Bing*[5] using designs very similar to this.

2 http://pencil.evolus.vn/
3 http://evolus.vn/en-US/Default.html
4 www.google.com
5 www.bing.com

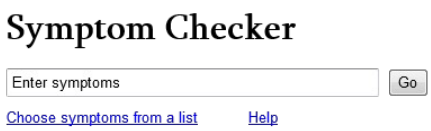

Figure 2: The first page that greets the user

Figure 3: A drop-down field makes suggestions as you type for convenience

Steve Krug (in Sharp et al, 2007, p.253) argues that there is a mismatch between how web designers and users view the same site. The designers have a tendency to assume users read more of each pages content than they actually do. Reducing unnecessary information and Graphical User Interface (GUI) elements could help users focus on the important parts. At the same time, some degree of redundancy can help make sure that important elements are noticed. It can also facilitate easy use for different user types. This design, despite it's minimalistic design, provides at a minimum four different ways to find information. A power user might type the symptom name in the search field and hit Enter on the keyboard, expecting that to send the query even though the Enter key-bind is not explicitly stated. A less experienced user might enter a symptom name and press the “Go” button. Still another way would be to begin typing a symptom name, and then selecting one of the suggestions that appear below the search field. The last option is of course the link to a list of clickable symptom names.

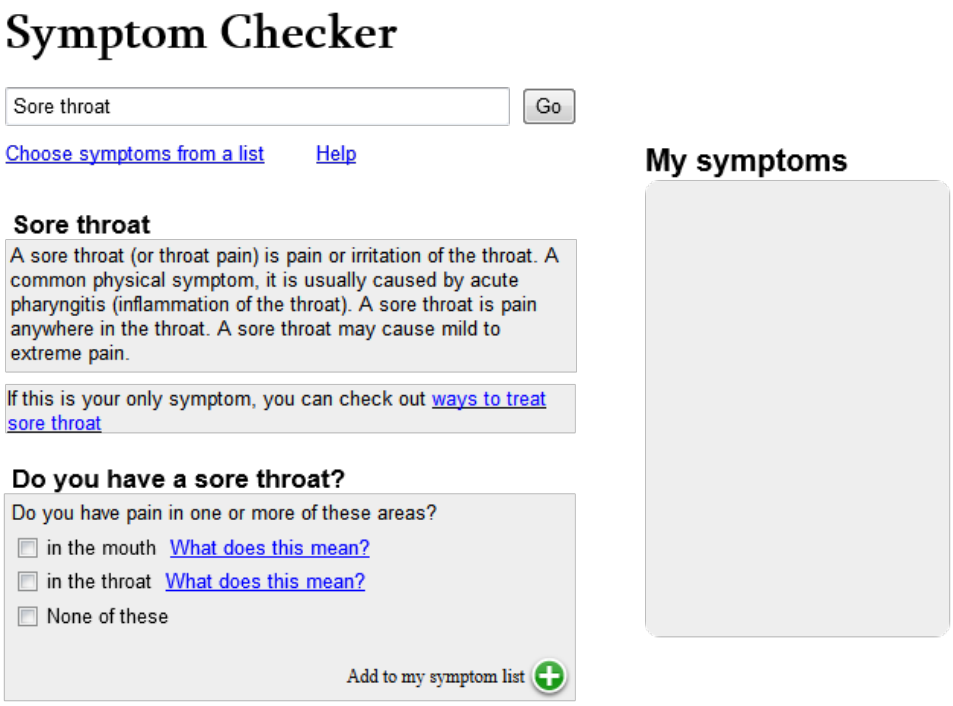

Figure 4: The system displays the results of searching for a symptom

Not included in this sketch is other hits that the search returns. These could easily be placed below the box asking whether the user has a sore throat, possibly on the form <clickable symptom title>, new line, <short description of symptom> to further mimic the behavior of a search engine such as *Google*. Clicking these would then bring up a page similar to Figure 4 for the respective symptom. However, mimicking a search engine results page contradicts the metaphor of a conversation with a friend.

To provide consistency, questions should be formulated in such a way that checkboxes can be utilized as options on all questions. None of these seems redundant, but allows the system to verify that an answer has been given, as opposed to the user leaving all the boxes unchecked.

The “if this is your only symptom, ...” appears only because the symptom list is empty. I've included the “My symptoms” list on the right hand side even though it is empty at this point. This is to create predictability as to the outcome of clicking the “add to my symptoms list”. Users can clearly see a link between the what happens when you click “add” and the list on the right hand side. Failing to select an option will give feedback, for example in the form of a label appearing

next to the button that informs you that making a choice is required. Removing the button instead seems like an inconsistency and provides no feedback to users with only one or two symptoms.

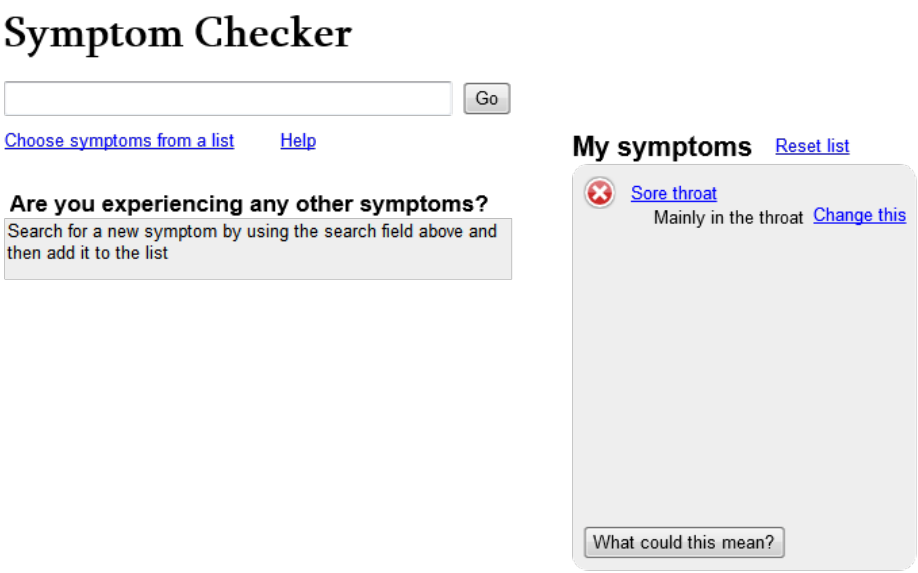

Figure 5: The system has added the symptom to the list

To avoid leading the user down a path by suggesting symptoms, the system does not ask if the user “has any following ...”. This could be regarded as a constraint because it disallows the ease of selecting yes to a simple question and forces the user to find the symptom themselves. Clicking the “What could this mean”-button with only one symptom selected will result in a message that the symptoms selected are too general to make any guess as to what could be the cause.

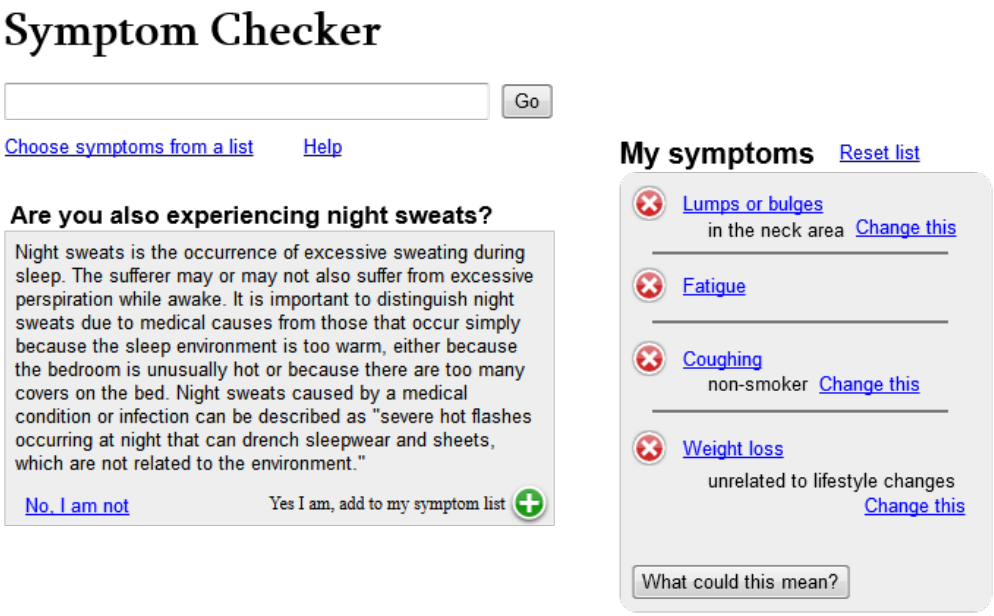

Figure 6: The system asks follow-up questions because it has several symptoms

In Figure 6 the system suggests a symptom based on previous symptoms. This is done because the user has already gone down a fairly specific path of symptoms that can be further clarified by asking this question. Since both answers could be relevant, this could be altered so that both options place the answer in the symptoms list, and this is made clear in the text.

The “My symptoms”-list can act as a form of navigation, allowing users to easily go back and change their previous answers, as well as remove. It also serves as a reminder of what symptoms you've already entered, and what you answered to the in-depth questions. It is “stuck” in place and shown on every page so that the user knows that their answers are being registered.

None of these pages, by design, provide links to information about specific illnesses. This is in order to avoid the user digressing, but also to avoid unnecessarily scaring user with information diseases they may or may not have.

Missing from the GUI mock-ups is the page that is generated when you press the “What could this mean?”-button in the “my symptoms” list. This page would be an appropriate place to provide links to more information about the suggested conditions that match your symptoms.

Feedback

After explaining the conceptual model metaphor and showing the GUI drafts to the same users I interviewed when establishing requirements, I gained some valuable suggestions and feedback:

- A link to more information about the symptoms on the symptoms explanations page (Figure 4, page 13). An oversight that would have made sense to add.
- A way to add a symptom to the list without answering the questions in Figure 4 (page 13). This could be useful in cases where none of the options apply. Such situations are avoided as much as possible, but may still arise.
- The site looks tremendously colorless and boring. Agreed, but this is due to the site being a prototype.
- The language is dry. This is due to being excerpts from *Wikipedia*[6] which is written in an encyclopedic style. Formulating the symptoms would be better left to for example doctors rather than myself.
- The “What does this mean” link next to questions in Figure 4 (page 13) could be swapped for a question mark symbol that many forms use to indicate more information is available. This would probably remove some clutter, especially if there are many options.
- Inconsistency between options in Figure 6 on page 15. One is a link and one is text with an icon. In the next iteration, both options would probably have been swapped for two similar looking buttons.

Evaluation

To evaluate my prototype I have selected to use an heuristic approach as described by Sharp et al (2007, p.686-695). This is largely due to constraints posed by the lack of functionality of the prototype since it consists of only pictures, making a usability study unfeasible. Much of the user experience is dependent on functionality that is reliant on the system finding relevant information. That means using an algorithm to search a database, neither of which exists. The ideal user would be someone seeking advice on an actual medical concern, where the result the web site provides could be compared to advice from an actual doctor. This falls way beyond the limited resources

6 https://en.wikipedia.org/wiki/Main_Page

available for this project. To conduct the heuristic evaluation I had only one expert at my disposal. More would have been better, but resources for this project are non-existant.

Heuristic evaluation

- *Internal consistency*

  The search bar is always available, making it predictable to the user. Lack of graphics should make the pages very light to load.

  A very limited number of actions are available, like looking up a symptom. These are consistent with experiences from other websites with forms and search fields.

- *Simple dialog*

  Good use of language that avoids complicated terms.

- *Shortcuts*

  Not explained, but assume that common shortcuts like navigating the suggestions with the keyboard arrows work like elsewhere.

- *Minimizing the users memory load*

  The use of a symptom list with a static placement means that the user does not have to remember any of their previous steps.

- *Preventing errors*

  The option to go back and alter previous symptoms, and to easily remove them all together using familiar symbols makes users errors well handled. The help feature is not described at all.

- *Internal locus of control*

  Symptoms you select, and your answer to questions asked with regards to them, are conveniently available at all times making it very easy to leave unwanted states without a longer dialog with the system.

Conclusion

The lack of more than heuristic inspector most certainly means that there are undetected

usability issues lurking.

A second iteration of the prototype based on the findings of the feedback from users and the evaluation would have been greatly beneficial, but time limitations meant only one iteration was completed.

If this project were to be developed further, a series of challenges would have to be addressed. Things like getting doctors to develop the questions to be asked in connection with symptoms, extensive user testing by a varied group of users, extensive work on the symptom database, study user behavior. A number of details that play a significant role would also have to be worked out, like how many symptoms are enough to make a guess at what it could mean, and figuring out how to handle multiple possible search hits in the context of a conversation.

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Appendices

Appendix I – Reports from studying existing symptom checkers

Drugs.com

Drugs.com[7] does not offer any option for, rash, itching or skin problems. They do ask questions in a friendly tone, seemingly in an attempt to mimic a conversation rather than a questionnaire. The questions are relevant to the symptom you've selected. They also proceed to tell you why they asked the previous question after you've answered. However, the result given at the end feels inconclusive. It does not give any definite suggestions about illnesses, only common causes of symptoms (including ones that have been ruled out by the questions you answered, which feels kinda arbitrary).

MayoClinic.org

The symptom checker provided by *MayoClinic.org*[8] offers a long list of symptoms right off the bat, separated into two lists: one for adults and one for children. The list for adults does not contain any option for skin rash or even skin problems in general even though it is used as an example of what the service can help you with.

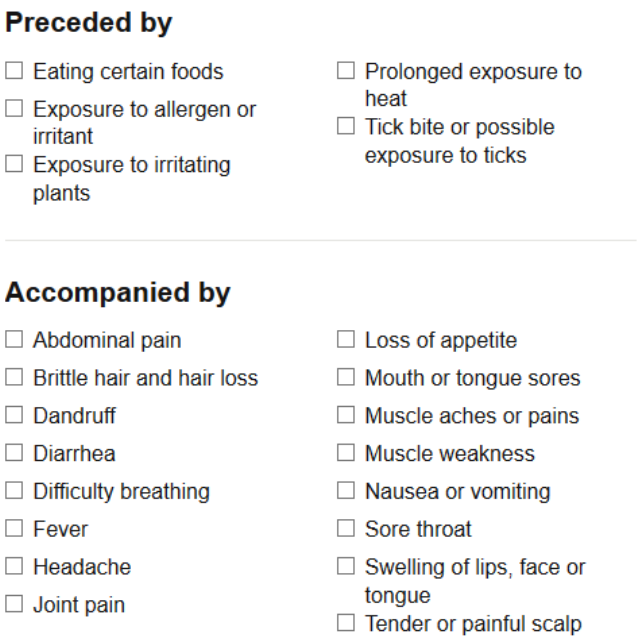

Figure 7: Excerpt from MayoClinic.org asking for more information regarding the skin rash

On the next page after clicking the link for skin rash it does ask whether you've been exposed to an allergen or irritant, but offers no help as to what these might be (Figure 7). They seem to be banking on someone who does not know they're allergic to dogs to make the leap that the rash might be dog related. The relevant questions also seem to be somewhat hidden amongst a lot of irrelevant questions.

7 http://www.drugs.com/symptom-checker/
8 http://www.mayoclinic.org/symptom-checker/select-symptom/itt-20009075

NHS

The symptom checker from the NHS[9] bombards you with questions on your background before it actually starts the symptom checking. It does a good job of explaining things like what the symptoms entails. It does give the reason for asking questions before you answer, which could be problematic with regards to suggesting symptoms that the user could start to feel even though they weren't before you asked. After 20 questions it tells me to schedule a routine checkup with a doctor.

9 https://www.nhs.uk/symptom-checker/