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Designing an online domain driven Q&A system with using the StarCraft II domain as implementation example

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Abstract

Question and answer (Q&A) systems are and will always be crucial in the digital life. Famous Q&A systems succeeded with having text, images and markup language as input possibilities. While this is sufficient for most questions, I think that this is not always the case for questions with a complex background. By implementing and evaluating a prototype of a domain-tailored Q&A tool I want to tackle the problem that formulating complex questions in text only and finding them consequently can be a hard task. Testing several non-text input possibilities including to parse standardized documents to populate metadata automatically and mixing exploratory and facetted search should lead to a more satisfying user experience when creating and searching questions.

By choosing the community of StarCraft II it is ensured to have many questions with a complex background belonging to one domain. The evaluation results show that the implemented Q&A system, in form of a website, can hardly be compared to existing ones without having big data. Regardless users do see a potential for the website to succeed within the community which seems convincing that domain-tailored Q&A systems, where questions with metadata exist, can succeed in other fields of application as well.

Acknowledgements

I would like to thank Blizzard for inventing such a complex, thrilling real-time strategy game which inspired me to write this thesis.

Many thanks to all friends and all StarCraft II players who played a role in the development process of the thesis and the prototype implementation.

I am grateful for my little daughter and my wife who have supported me along the way and believed in my ideas.

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1. Introduction

1.1. Goal

By being part of the StarCraft II community I saw the potential that it could benefit from a tool which allows players to formulate complex questions about StarCraft II gameplay and to make them accessible without the need of textual search queries. After I have been thinking about how such a tool could look like, I saw the potential to use such a tool in different domains as well. My goal is to create a prototype of this tool for the StarCraft II community to provide an example of how such a system could be used in any domain with certain requirements.

By looking at several other domains which could benefit from an adapted version of the above mentioned tool, I want to show the potential of this approach to help people finding and sharing solutions to questions with a complex background. By structuring and organizing user generated content within the software, users should additionally have the chance to get an overview of their knowledge about the domain.

The implementation for the StarCraft II domain should give players of the game a chance to solve their StarCraft II related problems, coming up during gameplay, after playing a match by asking other players for advice in an extraordinary way.

1.2. Overview

This thesis is about a web-based approach of a Question & Answer (Q&A) system, which helps people to deepen their knowledge in a topic with

asking very specific, structured questions and with reflecting collaboratively on them. Users should be able to identify in which areas of the topic questions exist and to find complex ones without formulating a search query respectively.

A lot of research has been done in the fields Communities of Practice (CoPs), Q&A systems and in collaborative reflection to find satisfying solutions for exchanging and for supporting further growth of knowledge. I hope to motivate for further research in these areas to help structuring the huge amount of existing exchanged information, in form of questions and answers, to minimize people's effort which has to be put in search queries.

By addressing a community of a real-time strategy (RTS) computer game called StarCraft II, I will evaluate my approach with a web-based implementation of a Q&A system designed specifically for this community.

1.3. Motivation

Exchanging and reflecting on knowledge has and will always be important in everyone's life. I try to ease these tasks and try to motivate people to share their experiences in their domains of interest.

> "... there is a great chance that users learn from each other instead of discovering information by themselves ...".
>
> Noll et al. (2009)

Due to the ongoing changes in many areas of knowledge I want to point out that when spreading and sharing knowledge it is very important, where to store this knowledge, in order to keep it sustained, retrievable and valuable over years. Online Q&A tools used by communities of practice are, at least in my opinion, a good start to put ones knowledge about a certain topic by answering other people's questions. In such tools people who are into the same topic will eventually read your created content, up vote it, if your content is great, which will lead to a higher probability that more users are able to read your created work and depending on their engagement they will improve it as well.

1.3.1. Complex questions get lost

By targeting especially questions which are very complex and hard to describe, I want to demonstrate that it is possible to structure, find and ask these kind of questions without too much effort. I experienced that a lot of complex questions get lost in the web over time. I found that one big reason why they get lost is that people have a hard time formulating and searching questions with a complex background. By tackling this issue with using metadata one can help users to structure, find and ask questions more easily.

1.3.2. StarCraft II

I chose to address the StarCraft II community within my implementation, because it fulfills the premise that very complex questions exist and will arise at least in the next few years, depending on how long the game will be interesting for players. Additionally I am part of the community as well.

In the context of StarCraft II the metadata mentioned above consists of important details, relevant in every played match, which are altering fixed values. Before StarCraft II players compete against each other they choose one out of three races. Each match takes place on a specific map. This means in every match it is very important who played which race and on which map the match did take place. When talking about questions about a StarCraft II match the race and the map could be considered as metadata, because it is valuable information for the answerer. Without the use of metadata questioners would have to add this information in textual form.

1.3.3. Real-time strategy genre

Another personal motivation factor is that games of the RTS genre are in danger of extinction. The threat of a whole genre dying out is sad, because as Glass, Maddox, and Love (2013) found, training in RTS games like in StarCraft II can train your brains' overall cognitive flexibility, due to the

game state complexity. This is the reason why I want to motivate game developers to pick up this genre before it gets displaced by others totally.

1.3.4. Other fields of application

The tool I have been developing can be used in different areas when adapting it slightly. To make use of the advantages this tool offers, the only premise is that questions about a certain topic should be very complex and should have some kind of metadata, which means some altering information they have in common. Examples can be found in the discussion.

2. Background around StarCraft II

2.1. Real-time strategy games and their complexity

To understand why the StarCraft II community is interested in asking complex questions a few details about a Real-time strategy (RTS) game have to be explained. The goal of an RTS game like StarCraft II is to eliminate all the opponent's virtual structures. This can be achieved by executing commands like training units, gathering resources, building structures, defending your base or attacking the enemy's base. When comparing to turn-based strategy games like chess, a player in a real-time strategy game does not have endless or a specific amount of time for each move. Everything can be done simultaneously - in real-time. An enemy player will never wait for his opponent to complete any of his moves. To compare the state complexity of an RTS game to a turn-based one, the players' actions per minute (APM) can be measured. With APM one can compare how often a player uses a key on his keyboard or clicks his mouse in order to execute an action in the game. While not every action will lead to a significant game state change, most of the actions will at least slightly change the state of the game. As Krajewski estimated[1] most StarCraft II players have an APM between 81 and 100, which means more than one action per second is executed by each player on average. When compared to speed chess, the fastest version of chess, one player has at least one minute to think about his next action, which is equal to 1 APM. For better imagination how many actions a StarCraft II player is able to perform think about a huge virtual terrain, called map, where structures can be built freely, mostly on every part of this map. Units can be sent around without any limitations on

[1] Krajewski, 2014.

ground and on air. Due to these free choices of a player nearly every game differs from another.

A lot of StarCraft II players spend much time to optimize their strategies for upcoming matches, which can help them to beat opponents. There are a lot of ongoing discussions about the game, because there is an endless number of good or bad decisions a player has to make during a game, which can lead him either towards a victory or a loss. To clarify in which cases players would benefit in asking a question in the Q&A tool I categorized questions into four different types including examples from reddit[2], a famous Q&A platform:

1. questions about game facts
   - example: "How many Mothershipcores does it take to kill an Archon?"[3]
2. questions about planned strategies with hardly considering enemy's reactions - so called build orders (BOs)
   - example: "Relevant current BO's I can practice for each race as I get back into the game?"[4]
3. questions concerning a specific game situation and further decisions from this point on
   - example: "Should I ever go storm instead of disruptors? - Watching matches and playing P myself, I don't see a situation where I would go storm for aoe instead of disruptors."[5]
4. questions not related directly to the game
   - example: "Does anyone know how to fix the random black screen that occurs randomly when in ultra settings?"[6]

Questions about game facts, BOs or questions not related to the game itself are comparable to normal questions - when talking about their complexity -

[2] reddit, 2017a.
[3] reddit question, 2015a.
[4] reddit question, 2015b.
[5] reddit question, 2015c.
[6] reddit question, 2015d.

which people use in their everyday lives. By contrast I found that describing a specific game situation of an RTS game in form of a question is a very hard task as can be seen in chapter User studies. Depending on the game history, any player who tries to answer such a question needs more or less information in order to judge a game situation and the possible decisions accordingly. A comparable example for a turn based game like chess would be a fixed game state where all the chessmen are in a specific position. Hence chess players are able to see every detail of a certain game situation, which are "just" the chessmen's positions, good players are able to imagine every possible, valuable move until the game ends. To describe every detail of a game situation in a real-time strategy game text-based, one would need to write a lot, where some details are not even necessary for other players to be able to judge the occurring game situation in a reasonable way.

Is it surprising that players are interested in such complex questions even if exact game situations will repeat rarely? No, as already mentioned, not every action leads to significant changes in the game, which means similar situations will reoccur, where answers could still help players to get a "meta"-understanding of the game. "The term metagame literally means 'beyond the game' and refers to any planning preparation, or maneuvering that a player does outside of actual gameplay to gain an advantage"[7]. The more knowledge a player has about the metagame, the higher the chance that he or she is able to respond with a good reaction, due to the high diversity of possible decisions, when facing any specific game situation.

As a non StarCraft II player one can compare describing the game history of a StarCraft II match and asking a question about what to do in a specific game situation with a so called wicked problem introduced by Rittel and Webber (1973). A wicked problem is a very complex problem in society i.e. the adjustment of a tax rate. There are a lot of factors which play together and even when a decision has been made it is still not sure that it was the best possible solution. A wicked problem has several attributes where some of this attributes are similar to a question in an RTS game like StarCraft II which occurs in a specific game situation.

Attributes of wicked problems are marked by "A". After each attribute a comparison to StarCraft II follows.

[7] TeamLiquid, 2015.

- The improvement of a small part of the problem is a specification of a solution to the problem.
  - In StarCraft II every little improvement can lead a player closer towards victory which is an indication to a solution.
- There is no stopping rule.
  - There is no criteria that tells you "the" or a solution has been found. The best approximated solution will be used.
- Solutions are not true or false, they are either good or bad.
  - Some players think i.e. a strategy is a good solution some think it is not, that is why there is no true or false in solutions. Either the solution helps the player having a better chance when facing a similar game situation next time or it does not help, which means it is good or bad.

2.2. Present situation regarding StarCraft II

As I mentioned in the Introduction the RTS genre gets replaced by others. The StarCraft II community needs help to stay alive and even flourish over the next years. As seen in figure 2.1 the rank, which is calculated via the total subscriber count to the "StarCraft" subreddit, dropped continuously over the last years. A "subreddit" can be seen as a single online forum about exactly one topic.

This leads to the assumption that the community needs support and even more tools which help to exchange strategies, ideas and other knowledge about StarCraft II. The subreddit has about 177.000 subscribers today meaning there still exist many questions and answers all around the game on the platform.

Even if there exist a lot of questions, due to the state complexity and the ongoing changes in the development of the game and in the community there are still plenty of questions missing. As introduced in RTS games and their complexity I defined four main types of questions which are asked at times by a StarCraft II player. As I found only one of these is thought of to

be very hard to describe - describing a game history of a StarCraft II game and asking a question similar to ”what to do now?”.

In common used Q&A platforms like reddit[8], a StarCraft II player can describe a game history of a StarCraft II game via text only like in a forum including markdown. No metadata can be added except tags. Additionally the questioner has the possibility to post a link to a video or to add a replay file, which contains the whole game history. The problem is, this file can only be opened in the game and then it has to be forwarded manually in order to find out what happened at a specific point in the match. While these possibilities work great for answering questions in many different ways there is no structure behind the questions except the tags. This means that the very useful information, generated by users, will be lost over time or rarely be found in the future. To find such an unstructured question a user has to guess the exact words with his text-based search query, which have been used in a question. Due to the ongoing balancing changes in an RTS game and in RTS player tactics a question will also be outdated very likely, but players are still able to find outdated questions.

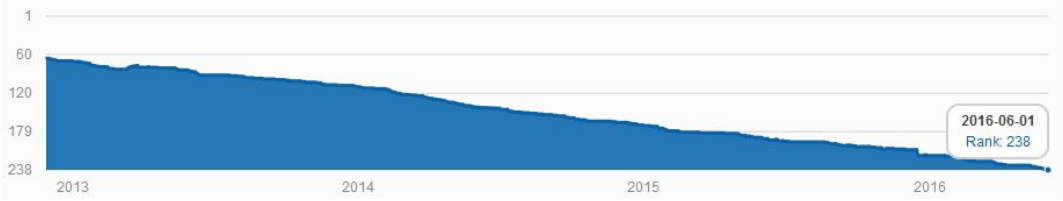


Figure 2.1.: StarCraft subreddit.

[8]reddit, 2017a.

3. Related work

Since humanity started communicating via language, knowledge has been shared and experiences have been reflected in order to improve them. Due to our limited memory it is hard to manage the ever growing knowledge without taking notes. Back in the days without computer support people wrote experiences down and spread their written words in form of books or newspapers in order to communicate with people having the same interest. While people still use all of these and more communication forms, written communication is mainly done via the web nowadays. StarCraft II players do also exchange their knowledge and other information mainly over the internet.

Many people take a great interest in a certain topic, hence they browse the Internet to find information about it. They ask and answer questions, try to deepen their knowledge and exchange thoughts with others. In order to keep knowledge around one topic structured and accessible for a large group of people, categories and metadata are used often. To help a community of humans to manage user-generated questions and answers, the content needs to be findable via multiple search options and its quality has to be good enough to be useful for the majority of the participants. Some topics are very complex, therefore questions have to be very specific and described in detail in order to get useful answers to these. Due to the complexity of such questions, it is hard to find them via the wide spread text-based search.

There are many tools in the web which support the growth of communities of practice, like the StarCraft II community. These tools help to make collaborative reflection on a certain topic possible. To ease formulating a search query or to make search queries evitable, the web holds various facetted search engines and exploratory search interfaces.

3.1. Communities of Practice

As Henri and Pudelko (2003) state, a community of practice consists of people who share the same interest and want to improve their knowledge about a certain topic via exchanging information and helping each other. It emerges over time from collective activity. The difference to a community of interest is, that all participating members gain expertise and become more professional in mastering activities corresponding to the topic of the community of practice.

> "Communities of practice need familiarity and trust in order for participation and growth to happen".
>
> Mojta (2004)

To imagine what communities of practice are about Ehrlich et al. (2014) puts it in a nutshell:

> "If I can help others, I will be the happiest person. Helping others is helping ourselves."
> "A community is as strong as you make it ... the more I put in the more I get out."
> "There is a lot of information I would like to have and the only way of getting it is to have others participate."
> "The more I share the more I learn."

Wenger (2004) describes *domain, community and practice* as the three fundamental characteristics of communities.

- Domain in this term means that there is some topic or interest for all of the participants - "... a community of practice is not just a personal network: it is about something".
- The "community" is all about the people who are part of the community of practice, the quality of the relationships and how strong are the connections between the members.
- "Practice" includes methods, tools, documents and everything which brings participants together in doing something concerning the domain.

For this work the most relevant communities of practice are so called "virtual communities of practice" (VCoPs). These are communities which use web-tools where individuals are able to exchange knowledge about a certain topic and gain expertise over time, while the information is stored and can be found every time wherever an internet connection is available. Online collaboration tools used in virtual communities of practice got categorized[1] into social networking sites such as Facebook or LinkedIn, virtual worlds like Second Life, information sharing tools like Wikis or Blogs and the most important category according this work: decision making.

A famous example for a decision making VCoP tool is reddit. As described earlier the platform has so called "subreddits", which work like forums about a single topic. According to[2] there are more than one million subreddits today.

3.2. Collaborative reflection

One can get an idea what collaborative reflection could be, but what does it mean exactly? According to Woerkom and Croon (2008), the most important reflection indicators are:

1. critical opinion sharing
2. challenging groupthink, asking for feedback
3. experimenting with alternatives
4. openness about mistakes

There are millions of online forums where parts of collaborative reflection take place every day. A very famous forum and online community is called Somethingawful[3] which is all about comedy. Users are able to discuss if their comedy is funny or not by reflecting on written paragraphs. Comedians all over the world want that knowledge exchange happens on this site to get inspired.

[1] Wikipedia, 2016.
[2] reddit, 2017b.
[3] Somethingawful, 2017.

The point is even if people are reflecting in forums, most of the times they discuss certain things in one thread, about one specific question without a connection to a big overall topic. Most likely the gain when reading an answered question in a forum is, that you are able to solve a problem you had, or you now just know a fact you did not know before. Most people forget acquired information after a while, especially when this information does not have much context or some connection to a known topic. Additionally it has to be considered, that even if a user thinks it is, an answer to a question, written in a forum, does not have to be correct at all.

> "For collaborative reflection to occur, people must share their experiences and communication about them".
>
> Prilla, Degeling, and Herrmann (2012)

This is the reason why people got inventive, because someone had to figure out how to show a user of a forum, whether an answer is worth reading or not. There are methods where moderators mark questions or answers as useful, but these are known to be very expensive and hard to manage, especially in free forums, due to the growth of content and the according moderators one has to pay. The most common method to distinguish if a question or an answer is useful is to allow users to up- and down vote on questions and answers. Websites which offer this feature were no longer just forums, they are called question and answering (Q&A) systems.

While online forums and especially Q&A systems support critical opinion sharing and are sometimes challenging groupthink with asking for feedback (see reflection indicators 1 and 2) they do not have the possibility to experiment with alternatives (see r.i. 3) and not all users are open about mistakes (see r.i. 4), which can lead to disputes. While (see r.i. 4) gets tackled via introducing badging and ranking systems to encourage people to provide sophisticated content, r.i. 3 is not part of a Q&A system.

To reflect collaboratively the best possible option one can have is obviously to meet as a group in personal. While nowadays this is not always possible people are prone to use video chat tools which support group conferences.

While most of these tools i.e. Skype[4] or Gotomeeting[5] offer the opportunity to take notes, share screens and record whole video conferences, the information which has been introduced by doing the collaborative reflection is shared only between the participants of the video chat and may be useless for other people in the future. Even though there has not been much research for reflecting collaboratively via chat conference tools it is still a common used method and these tools are fulfilling all typical indicators defined by Woerkom and Croon (2008).

3.3. Learning in virtual communities

The relation between the strength of social bond and the gatherings' intentionality of different forms of virtual communities has been shown by Henri and Pudelko (2003). The more of both a group of people has the more likely it is that the community is a community of practice. They call virtual communities with the lowest amount of gatherings' intentionality and weakest strength of social bond "community of interest". By increasing both, gatherings' intentionality and the strength of social bond, the next type of community is called a "goal-oriented community of interest". By increasing both even further they get to the so called "learners' community" followed by the "community of practice", which has the maximum of both.

3.4. Question & answer systems

Over the last years researchers gave a lot of attention to Q&A systems. In order to rank questions and answers for users Hieber and Riezler (2011) tried to identify high-quality content of answers with using feature engineering and learning algorithms. Feature engineering in this context means i.e. counting a number of non-stop adjectives in an answer that do not show up in the corresponding question to measure its informativeness or counting the number of syllables or words in the text in order to measure readability.

[4]Skype and/or Microsoft, 2017.
[5]LogMeIn, 2017.

Taking a closer look to question recommendations and expertise determining Pedro and Karatzoglou (2014) introduced an algorithm called RankSLDA which identifies a user's expertise in relation to a question. They "... exploit the inherent collaborative effects that are present in collaborative question answering communities where users tend to answer questions in their topics of expertise".

In every user-generated content, spam or computer-generated content distracts users from the useful information and has to be dealt with accordingly. A lot of researchers try to tackle the high number of fake identities in any system where users are able to register and do not have to proof their identity. An interesting, promising approach has been done by Xuan et al. (2016). He tries to detect malicious accounts in location-based social networks by comparing the percentage of check-ins on a daily and on an hourly basis. "... we can see that malicious accounts are more active on weekdays, while legitimate accounts are more active on weekends." The key to their success was that, due to their findings, malicious accounts check-in more often, check-out faster, move faster and are not that old when comparing to legitimate user accounts.

A key part of any Q&A system is to determine user expertise correctly. This helps to motivate users on the one hand and to find sophisticated content, i.e. by looking at an answer of an expert, on the other hand. Noll et al. (2009) tried to determine experts and to avoid spam in the first place with a different approach by using a graph-based algorithm, called SPEAR, which means "SPamming-resistant Expertise Analysis and Ranking". They identify an expert by checking a user's resource quality, while the quality is measured by other users who assigned tags on the resource. Additionally a user's expertise gets measured by the fact that an expert finds valuable resources before others. According to their results, the SPEAR algorithm has more spam-resistance than a well-known one called HITS introduced by Kleinberg (1999).

Due to the fact that a Q&A system lives or dies with its users, attracting newcomers is obviously key to success. To higher the chance that newcomers do not leave a just joined online community, Jackson et al. (2016) suggests to design such a system very careful and not to overwhelm newcomers. "As with physical exercise, one could hypothesize that people start a session

with some lighter work before they dive into the heavy lifting, followed by some less strenuous activities before they stop."

What motivates members of a community to contribute has been discussed by Ehrlich et al. (2014). "... access to informational resources" and as one might not expect "... help others" are two high motivation factors for contribution to online community platforms.

There have also been made attempts to motivate users to contribute high-quality content when using Q&A systems. As Grant and Betts (2013) show that StackOverflow[6], a Q&A system used by software developers, rewards users with badges in order to raise the user-generated content quality.

3.5. Facetted search

With facetted search one can access information organized with using filters. One of the most famous examples where facetted search is used is Amazon[7]. After searching a product a user is able to filter different transport options and depending on the product there are many additional filters. For example a user has the opportunity to filter a TV search for technology like Plasma, OLED, LCD. This technique has become popular on various shopping websites. A good model to use as a reference implementation of facetted search has been introduced by Acm et al. (2009). "... a formal model for describing faceted classification systems, complete with a search and ranking algorithm. The model is based on Set Theory, and is able to express various kinds of facet types, depending on the nature of metadata." Another very good example showed Kajiyama and Satoh (2013) by using facetted search effectively in a graphical search interface for TV users to provide them the opportunity to create dynamic search hierarchies by combining various attributes like channel, time zone or genre.

[6]Stack Exchange, 2017.
[7]Amazon, 2017.

3.6. Exploratory search

Exploratory search can be described as a task where a user gets offered several options. From these options he has to choose one and gets offered several options again. One can imagine it like going through one of several doors and suddenly be in an unknown world with many new different doors. By using an exploratory search a user explores the offered content by deciding which direction he wants to go.

As Krestel, Demartini, and Herder (2011) states exploratory search is one way to acquire knowledge in digital information spaces. While the use of a common search field does not support exploration of information sufficiently, he showed that different visualizations are needed in order to stimulate a users' exploration experience. An overview should be provided for users to " ... allow for easier narrowing down towards specific aspects". When using exploratory search either the user does not know what he is looking for and just wants to browse and find something interesting, or he does not know how to formulate a specific question, but gets lead to his topic of interest by exploring.

> "Exploratory search makes us all pioneers and adventurers in a new world of information riches awaiting discovery along with new pitfalls and costs".
>
> Marchionini (2006)

According to Marchionini's work, more exploratory search tools are needed. He discusses the usefulness of such tools with a very good exploratory search example: the platform "Open Video".

4. Problem statement & approach

To help the StarCraft II community to stay alive and flourish I want to provide players to access a tool to exchange knowledge, reflect collaboratively on certain strategic decisions and to find this user-generated content with very low effort, especially in the case when the questions are very complex and thus even harder to find when compared to non-complex questions. Within this thesis I want to find out how questions with a complex background could be created by using as little text input as possible, how users can find such questions without a text-based query and how these kind of questions do not get lost in the web.

In order to provide users an accessible and usable system I want to include members of the community in the design process. By providing multiple non-text input fields and a parser of a standardized document used by the community I offer the opportunity to add metadata to a question with low effort. By providing an interface mix of facetted and exploratory search users should be able to find questions without a text-based query. By categorizing questions and adding some information regarding currentness users should be able to filter, sort and identify up-to-date questions and still be able to find old questions.

To understand what the needs of the StarCraft II community are I will do user studies. To find out if a question and answering (Q&A) tool will be used by StarCraft II players I will start with observing players on how they improve their selves outside of the game. To offer virtual communities of practice an opportunity to structure and organize their discussed topics and reflect collaboratively on upcoming problems, I will develop a web-based question & answer (Q&A) prototype, called ”nowwhat” while keeping the design close to the community. To evaluate the prototype I will populate the tool with data and ask StarCraft II players to create and to find one question in the system.

5. User studies

5.1. Goals

To help StarCraft II players to improve their selves in their gameplay I had to understand how they improve their selves in general. Mostly players formulate text-based search queries to find some kind of useful information. The information I needed was where, that means on which websites and how users improve their selves. Additionally I had to find out how users formulate search queries and if users are satisfied with the existing tools to find information about StarCraft II.

5.2. Methodology

In the beginning of my work I observed a few players after playing StarCraft II during their online search attempts for solutions to their occurred problems in the just played StarCraft II match. Due to the existing knowledge of players they do not need to look up information after every played game, even if they lost. I also interviewed these few players, but figured out that my target audience is spread around different countries and I had to change my plans to get in contact with more players. Due to the huge distances between players and because observations were not meaningful enough I came up with the idea to create an online questionnaire. Via the web platform Typeform[1] I designed a questionnaire to find out how StarCraft II players acquire information outside of the game to improve their gameplay.

[1] Typeform, 2017.

I tried to understand the current search behavior of players and the necessity of the planned question and answering (Q&A) system for the community.

To find out exact search queries of players and if players have a hard time to formulate text-based questions I did additional interviews.

5.3. Participants

Via the questionnaire 8.6 I collected information from 40 anonymous StarCraft II players who live in the countries Hungary, Austria, Belgium, United States, Germany and Australia. Even though they had the chance to stay anonymous a lot of the players added their email address that I will be able to contact them when the web-based tool is online. As I expected due to my experiences the majority of the participants are male players. For the additional interviews I contacted three players who already did the questionnaire.

5.4. Results

5.4.1. Where and how do users improve their selves outside of the game?

As shown in figures 5.1 and 5.2 I mainly found, that players watch a lot of StarCraft II games to learn from other players behaviors. How much they learn can be seen in figure 5.3

Even though players watch a lot of StarCraft II games to learn from other players, there are still a lot of ongoing discussions about the game as mentioned in chapter background, which means players do not only use video content to improve their knowledge about the game.

As shown in figure 5.4, players do browse reddit from time to time but do not ask a lot of questions on the famous platform.

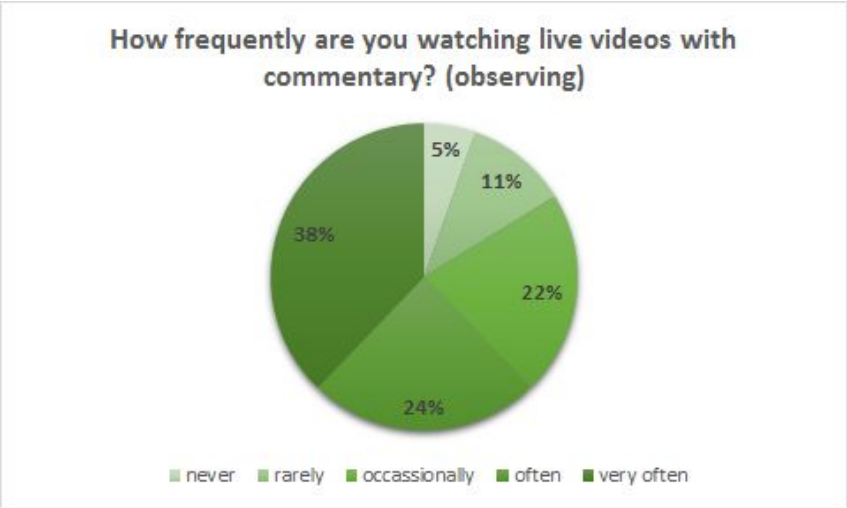


Figure 5.1.: Results about players' frequency of watching StarCraft II live videos with commentary.

Nearly half of the players at least ask questions rarely on other forums as Figure 5.5 shows.

5.4.2. Are users satisfied with the existing tools to find information about StarCraft II?

While they still ask a few questions and browse other forums as well, players do not find a fast solution to their answers. As illustrated in figure 5.6 41% of the players do not find a solution within 5 minutes by browsing the internet.

The finding that players do not post a lot of questions on their own lead to an assumption. Players' search queries are effective and they get satisfiable answers. While this is true for some non-complex questions, it contradicts partly with the finding that players do not find a solution very fast. This led me to another assumption that players do not like to describe their game

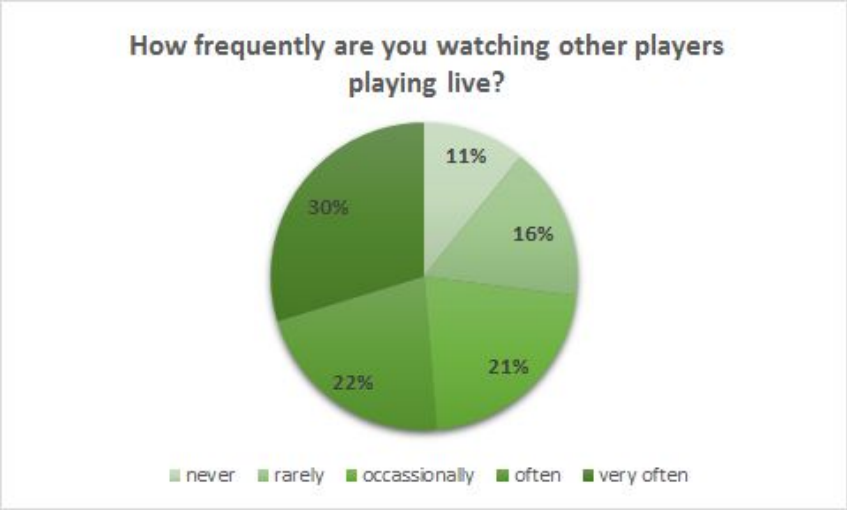


Figure 5.2.: Results about players' frequency of watching StarCraft II players playing live.

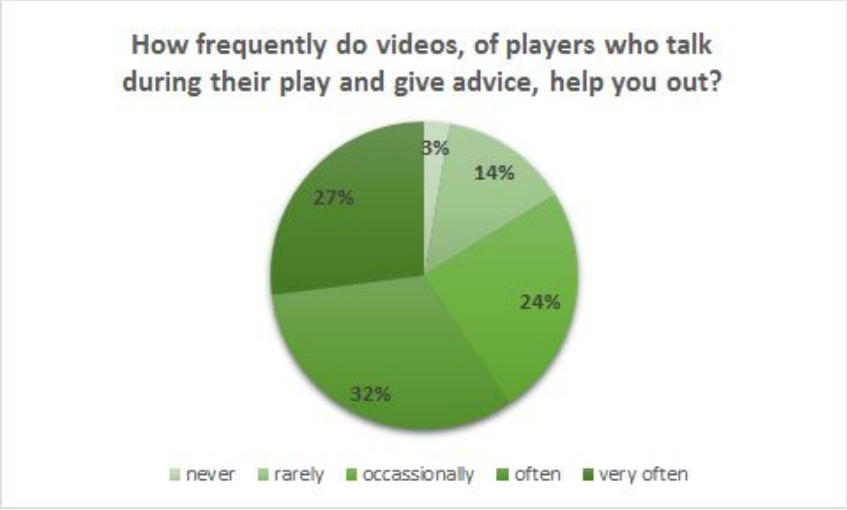


Figure 5.3.: Results about frequency of advice found in StarCraft II videos that helps players.

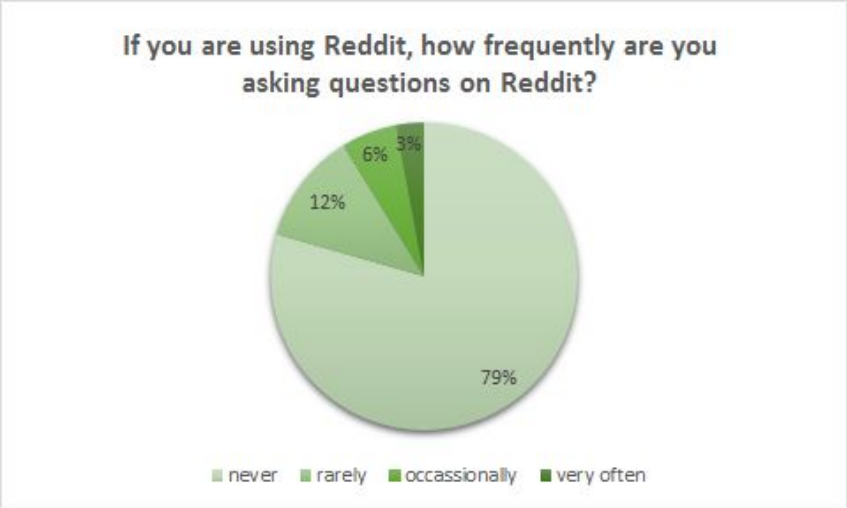


Figure 5.4.: Results about players' frequency of asking questions about StarCraft II on reddit.

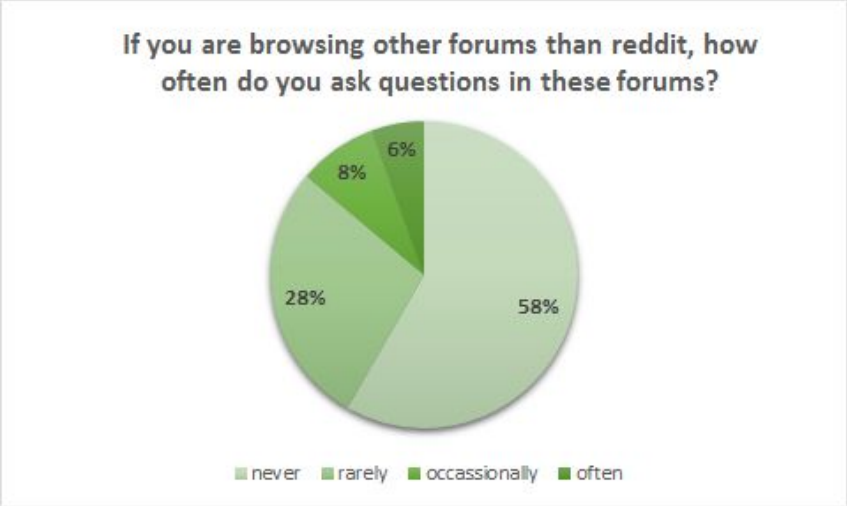


Figure 5.5.: Results about players' frequency of asking questions about StarCraft II in other forums than reddit.

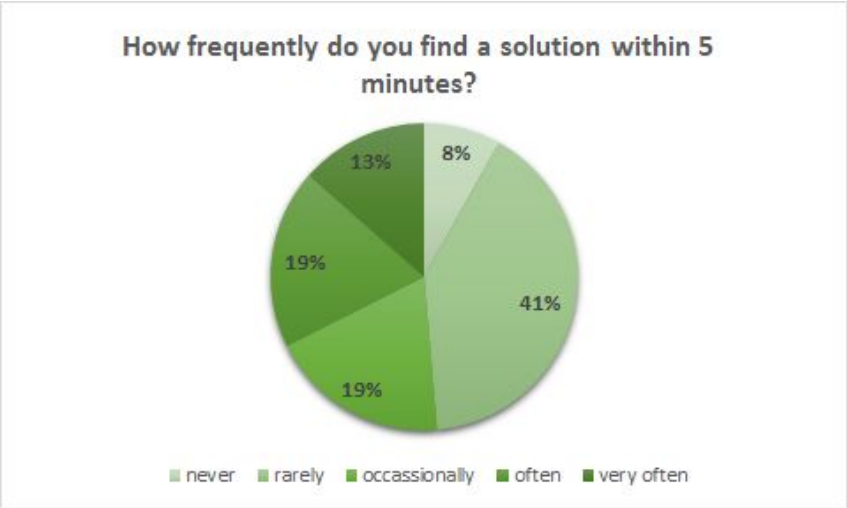


Figure 5.6.: Results about how often solutions are found in online forums.

history in a text-based manner.

To prove this assumption I did contact some players for an additional interview.

5.4.3. How do StarCraft II players formulate web search queries?

In three interviews of players who already did the questionnaire I found that all of them do not want to take the effort to describe their game history in text-only. It even exhausts them more when they cannot expect their long question to be read and answered accordingly. The interviewees did tell me that it is really hard to mention all the necessary details of a played game in a ”what to do now” question in order to provide other players everything they need to give useful answers. Players do try to find such ”what to do now” questions, but they use short search queries. One of the interviewees reported he entered the text search query ”fast switch from ground to air”

- meaning a strategical change from building ground units to air units - which did not lead to satisfying results, because the whole background of the played game has not been mentioned. As one can see in this example, by formulating short search queries players are only able to find parts of the answers due to the complexity of the background of these kind of questions. I also talked freely with the players for a few minutes what they think about the idea to create tags and filter questions by metadata.

5.4.4. Discussion

The questionnaire results show that a StarCraft II question can be complex and will not be answered in a short time period very often. This is why I think that a tool for StarCraft II players to exchange knowledge and keep it organized will help and will be used by the community. The findings that players have a hard time to find complex questions led me to the decision to implement a mix of an exploratory and a facetted search interface. In the free talk of the interviews I found what the really important game information is one needs to answer a question. I was able to use these suggestions i.e.: ”matchup, map, game time when a question occurs, current resources income, current number of workers, current number of buildings, army composition, upgrades, what has been scouted . . . ” as filters or as existing tags for the initial population of the Q&A system.

5.5. Use cases regarding the StarCraft II community

5.5.1. The helpless player

Imagine a player playing the computer game StarCraft II versus another player. He loses the game and is frustrated about the loss. If he wants to get better at the game he will probably not just start another game without thinking about the match he just played. At first he will probably think about some obvious mistakes he did in the end, because such scenes will still

be in his short term memory. Whatever he thought his mistake was or was not, he should definitely watch the replay to analyze his decision making. To watch a replay a player is able to start a played match like a movie within the game application. The match can be rewound or forwarded to a specific time where points of interest, like a battle, happened. Depending on the experience of a player he will be able to learn a lot from analyzing his own replay and will do less similar mistakes more likely. No matter which skill level, except for pro gamers – which live for the game and dedicate their whole life for it – a player will reach a certain point in a match where he is not able to have a really good answer to the question "what to do now?". By using the tool he has the chance to look for similar questions to his own without formulating a text-based search query. When no similar question can be found he is able to look through his replay, jump to a specific time and ask a "what to do now?" question on the nowwhat-website without writing too much, because the added replay gets parsed and important information about the match gets automatically added to his question. Due to the state complexity of the game, several good answers could be possible. If the questioner has an idea, but still needs a confirmation of how he could react in his specific game situation, he is able to answer his own question and wait for other players to vote the answer up- or down. Other users are also able to answer the questioner's very specific issue. In this way the player will get many different opinions to his game situation - hopefully some he would not even have thought about.

5.5.2. The perfectionist

Imagine a player which wants to be on top of every game situation and wants to know about every little advantage he can get in any game situation. By using the tool nowwhat this player is able to browse through the exploratory search interface and find out which topics (=tags) he is not very good at and can improve his meta-game knowledge by reading through questions and answers. There are several players out there which are specialists in their race match-ups (i.e.: Protoss vs Zerg, Protoss vs Protoss, Protoss vs Terrran), but still want to know more about other match-ups to understand the think processes of their enemies better. These kind of players are also

prone to use an auto-generated quiz, described in section Planned features for a specific skill level.

5.5.3. The teacher & the high regard addict

As in any other topic there are a lot of StarCraft II players who like what they do and they want to share it with as many people as possible. By asking questions which can be interesting for other players or by answering questions of lower skilled players, users get reputation. This reputation will mainly help other players to find sophisticated content, but can also be treated as a mark of respect for players.

5.5.4. The communicator

People like to communicate, especially when the communication is about their hobbies or interests. The tool offers the opportunity to share well-arranged information and to get in contact with other players of the same skill level. When enough users register on the website nowwhat a ”replay match”-button will be added to each question which makes it possible to contact any player to replay a certain match starting at a specific time to try out answers and solutions related to any question.

6. Prototype

By using domain-tailored metadata and a structured search interface combined in a Q&A tool I want to prevent the loss of user-generated content in the web. Especially for users who do not formulate complex text-based search queries and hence would probably not find a similar question of any other user I want to offer a question overview in form of an exploratory search to find questions by navigating from one tag to another with using filters simultaneously.

This will most likely increase the chance that players are able to strengthen their knowledge of the meta-game of StarCraft II by exchanging gained knowledge and reflecting collaboratively on upcoming problems and ideas. Based on the assumption that players tag their questions wisely, the mentioned exploratory search interface, which also acts as a topic coverage overview, will help to decrease the chance that a question gets asked twice without much doubt. Hence it is hard to describe a specific game-situation text-based, different input methods will be offered to describe a game-situation fast with formulating as little text as possible. To ensure that the quality of the content meets the user's expectations I use an approach of a Q&A system, which I call "nowwhat", including a question and answer voting system and the resulting user ranking.

To create an accessible system for the community I did an iterative prototyping by asking three StarCraft II players for advice again and again. After these iterations I contacted all of the players who left their email address when filling out the questionnaire and some additional players I was able to get in contact with, to test the prototype and to give some feedback respectively. The decision to do user centered design, using the well known triangle of analysis, design and evaluation, was definite when starting with the project. Spaulding and Faste (2013) convinced me that this is the best way to go.

The website sc2nowwhat[1] is based on the prototype implementation. The features described in this chapter will probably differ from the online version, because I am going to provide patches for the tool from time to time.

I tried to design the system in a way, that documentation should not be necessary to understand and to be able to execute all possible tasks. Nevertheless at some point users will struggle using the tool. Therefore over time I will add a wiki as documentation where I try to cut on previews, introductions and most pictures of screens to enrich training experience and to use what readers already know by continuously linking new information to it as Rettig (1991) suggests. By following the tip of Rettig to keep some information incomplete intentionally, I hope to achieve that users explore the system actively to find this missing information.

By constantly asking users for feedback I avoided to implement too many functionalities I do not need in the end. Mamykina experienced that constant feedback was a key design decision to get highly satisfying results. Even when the tool is in a final version I will not stop to ask users for feedback. Due to the success of StackOverflow, nowwhat will use a forum-like approach for discussions about the site when a first user base has been acquired. Additionally this forum will have a feature request and accept module.

6.1. Structure & navigation

6.1.1. Workflow

When visiting the tool the first time a user gets to a welcome page which shortly describes the main goal of the website. It's an entry point to get started. The "gl & hf" button should attract players as it's a a well-known abbreviation in the StarCraft II community and in a lot of video gaming communities as well. It means "good luck & have fun" and after pressing this button a player gets redirected to the questions page. Users who visit

[1] *"sc2nowwhat" by Andreas Müller* 2017.

the welcome page are able to dive into the website without reading further. Because some users want to read more about a certain system before creating an account and starting to contribute, users are able to read further about how the tool works and even further documentation. Users are also able to register or to login. As long as the website is in alpha state there is an additional evaluation button which users can click to do an evaluation to help me finding usability problems.

The expected work flow is that a user presses the button "gl & hf". When reaching the questions page a sortable list of all question titles including question data about votings, answers, views and patch version of the game when the question has been created is shown. A user is able to choose certain filters which represent the metadata of a StarCraft II match. By adding tags on the right side of the question list a user is able to narrow the questions of interest down. The mentioned filters can also be used on the "explore" page where a user is able to explore tags. By selecting none, one or multiple tags assigned to a question, a user is able to navigate between tags to find questions of his interest. Clicking on a question tag will either lead a user to more tags or to the questions page, depending on the spreading of tags through questions. After selecting one or more tags, questions for selected tags can be shown or a selected tag can be removed. The tags are shown as tree map elements. Before explaining how the tags on the "explore" page work, first a brief explanation what a tree map is:

Tree map A tree map splits a rectangle into several other rectangles. Typically it is used for visualizing sub-topics in percentage where the overall topic has 100%. An example visualization of a tree map could be statistics which are relevant worldwide. The tree map would contain 4 or 5 rectangles depending on which continents are considered. All of these would have different sizes according to their amount of the statistics data. Shneiderman (1992) presents a recursive algorithm to represent trees with weights or sizes on the leaf nodes by creating a colored tree map in a 2-d space. In figure 6.1 you can see an example of a tree map.

You can see how a tree map of tags within the tool is used on page 35. Due to this users are able to see how many questions are marked with a certain tag. A user is able to see which filters have been selected above the question list.

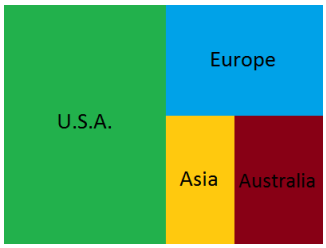
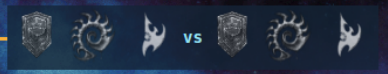


Figure 6.1.: Tree map example. Think about the world map where green represents data for the USA holding about 50% of all data, blue represents Europe with about 25%...

The create question button leads to a page where the user is able to ask a question including metadata. When clicking on a question the question detail with its metadata and its answers is shown as you can see on page 36. Depending on the question creator a user is able to edit or answer the question. Additionally any question or answer can be up- or down voted if the question or answer has not been created by the current user. Anonymous users get prompted to sign in or register to be able to answer a question or vote on a question or answer, but they are still able to see the question detail.

explore

matchup  map gametime early mid late gametime no time replay included Yes No OFF

reset filters

explore famous tags of questions

add tag show questions

tags

Unit Composition X

Defense Counter	10%
Base Defense	10%
Getting Ahead	5%
Stay Ahead	5%

question

matchup  map Vaani Research Station gametime early mid late gametime 00:06:51 replay included Yes No OFF

0 4 2 3.6.0

I just scouted a spire building ~ 20%. How to react the best way in this specific situation I was?

- question text
- game history
- build orders

What I did and I think this was wrong:
I tried to snipe the spire with a warpprism zealot attack - I only used 5 warpgates instead of 6, that's why the spire did not die, it was nearly down.
Still there have been 8 Mutalisks out before I could have sniped the spire.

Base Defense | Unit Composition | Defense Counter

#1	1	3.6.0	Snipe the spire with the warpprism zealot attack by usage of all 6 warpgates and attack the expansions with immortal zealot stalker mix and tr…
#2	0	3.6.0	Build a Twilight council and get blink to defend the mutas.
#3	0	3.6.0	Build 2 x Stargate and try to train as many phoenix as possible to counter the mutas.
#4	0	3.6.0	Build a Twilight council, templar archives and get archons.

Answer text

edit question

add answer

6.1.2. Menu

Through the menu the exploratory search interface can be found by clicking ”explore”. The ”about” page explains why the website exists, what it is about and how it works. This page also includes copyright, author and important links. The f.a.q. and wiki pages are for helping users how to use the page in a proper way and of course answer additional frequently asked questions. Any user can see his account settings, as illustrated on page 38, via the ”account” button, where you as a user are able to change your account details or to delete your account.

anxn

member since 09/22/2016

user points	9
user rank	
#questions	15
#answers	8

e-mail	[redacted]
password	**********

deactivate account

6.2. Pages

6.2.1. Explore

Manage user-generated content of StarCraft II players by combining tags, metadata, a facetted and an exploratory search should help to find complex questions without formulating a text-based search query. Users are used to search questions via text based queries. This tool has a different approach by intention, because it is really hard, sometimes impossible, to formulate a question in textual form. By using filters to select questions via metadata a user is able to find specific game situations more likely than with a very long text-based query. The exploratory search interface on the "explore" page uses the tags of all questions and displays the most famous in form of a tree map. The tree map is drawn by using the well known matplotlib[2]. The results are converted to SVG HTML elements via d3js[3] as shown in the following code snippets:

Listing 6.1: Draw tree map

```
def draw_treemap(rectangles, annotations, session):

    # create matplotlib figure
    fig, axis = init_figure()

    # draw rectangles of treemap
    draw_rectangles_with_annotations(rectangles,
       annotations, axis, session)

    # convert drawn treemap to html
    html = mpld3.fig_to_html(fig)
```

After they have been added to the DOM the SVG elements get wrapped in anchor tags via JavaScript in order to be clickable and styleable.

[2]Numfocus, 2017.
[3]Bostock, 2017.

Listing 6.2: HTML DOM with SVG tree map element

```
<g class="mpld3-axes">
    <rect class="mpld3-axesbg"></rect>
    <a id="nodeContainer_0" xlink:href="addTag('<<
       tagname>>');submitForm();" class="svg_element">
        <path class="mpld3-path" id="path_0"></path>
        <text class="mpld3-text" id="percentText_0"><
           <percentage>></text>
        <text class="mpld3-text" id="tagText_0"><<
           tagname>></text>
    </a>
</g>
```

For the sake of usability there will be a normal search interface in a future release too, but on this page I explicitly point out that users will have better chances to find very specific ”what to do now?” questions via the exploratory search interface, because of the difficulty to formulate such long text-based queries. I plan to experiment with a mixture of both search techniques in later stages of development.

6.2.2. Question creation

The question creation is intentionally divided into two steps. The first step as illustrated on page 43 includes the players and the opponents race, the game time when a specific problem occurred and when the ”what to do now” question arose, the chosen map of the played game and one or more tags. All the data of the first question creation step is mandatory question metadata which is used for structuring questions. The only exception is the upload replay field which can be used when a player wants to add a replay file. This file will automatically be parsed, with a replay parser as demonstrated in 6.2.2, to populate a lot of the question creation fields which saves plenty of the users time. The use of metadata opens other users the possibility to find questions after creation by filtering and searching through questions.

The second question creation step consists of a title and a text input field as can be seen on page 44, which are mandatory but no metadata. Additionally a user is able to add the income of players at the selected game time and or build orders until the selected game time in step two. The two can be added manually or by automatic replay parsing as demonstrated on pages 45 and 46. How and which additional information gets added to the question?

Additional information

Additional information contains data like income or build orders. To get information about what happened in a played StarCraft II game programmatically a user is able to upload a replay file to a question when creating it. Replay files contain all the information of the played match which is stored in the so called "mopaq" format. Olbrantz[4] describes the "mopaq" archive file system in detail. They are designed for watching a played game within the game application after it has been played. To save time of the user and to make contribution to the website more attractive, the uploaded replay will be parsed and certain relevant game information will be added automatically. The information is split up into 2 parts:

- Income - In the prototype income consists of how many workers and how many and which resources a player and his opponent have at a specific time.
- Build orders - As explained in section RTS games and their complexity the build order is the major task plan a player has for a specific match from the beginning of the game until a certain point.

The user is able to change any added additional information, after it has been added through uploading a replay file, in case something important is missing which can't be read out of the replay file. When uploading a replay file what does exactly happen? How does a replay file get parsed?

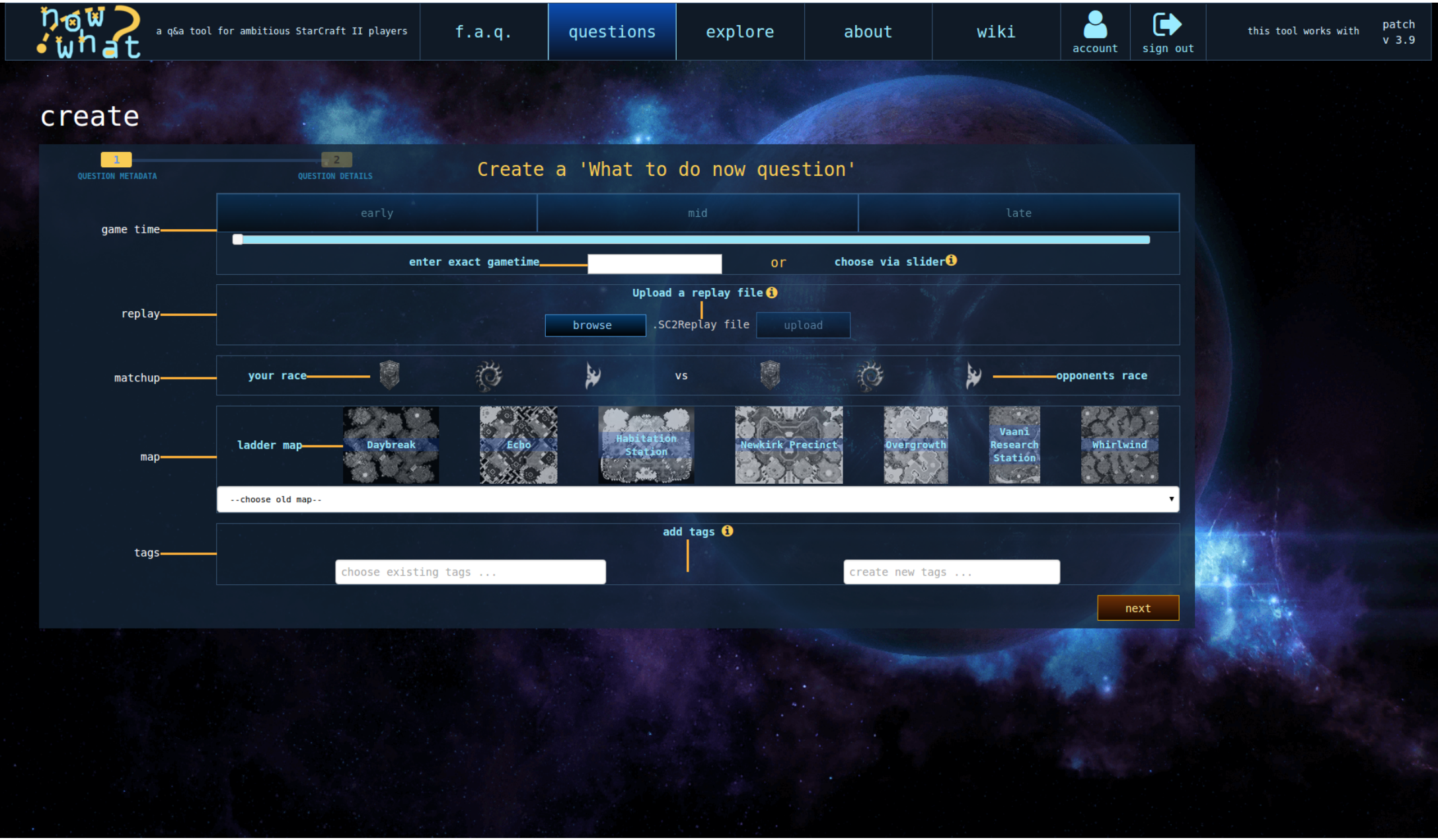
[4]Olbrantz, 2002.

Replay parsing

A real-time strategy game usually is built upon consecutive events. I.e. player 1 builds a unit, player 2 loses a unit, player 1 moves a unit and so on. In the replay parser of nowwhat the information at a specific game time is calculated by adding every important event information to a match object, including the current in-game time. This means when contemplating a specific point in the match, by knowing how many units a player has been building and how many units a player has been losing, the current amount of alive units can be calculated. To imagine the idea take a look at the following code snippet:

Listing 6.3: Parse replay

```
def parse_replay(self, contents):
    for event in self.protocol.
       decode_replay_tracker_events(contents):
        event_id = event['_eventid']
        self.event = event
        if event_id in NEEDED_EVENTS:
            if event_id == 0:  # SPlayerStatsEvent
                self.add_player_stats()
            elif event_id == 1:
                self.add_initial_objects()
                self.add_build_order_element()
                self.add_born_units()
            elif event_id == 2:
                self.add_died_units()
            elif event_id == 6:
                self.add_init_units()
                self.add_built_structures()
                self.add_build_order_element()
            elif event_id == 7:
                self.add_finished_structures()
    self.remove_unfinished_structures()
    self.remove_died_objects()
    self.sort_build_orders_by_game_time()
    self.sort_supply_by_game_time()
```


now what?
a q&a tool for ambitious StarCraft II players
f.a.q.
questions
explore
about
wiki
account
sign out
this tool works with
patch v 3.9
create
1
QUESTION METADATA
2
QUESTION DETAILS
Create a 'What to do now question'
game time
early
mid
late
enter exact gametime
or
choose via slider
replay
Upload a replay file
browse
.SC2Replay file
upload
matchup
your race
vs
opponents race
map
ladder map
Daybreak
Echo
Habitation Station
Newkirk Precinct
Overgrowth
Vaani Research Station
Whirlwind
--choose old map--
tags
add tags
choose existing tags ...
create new tags ...
next

create

1 QUESTION METADATA — 2 QUESTION DETAILS

Create a 'What to do now question'

question title*

question text*

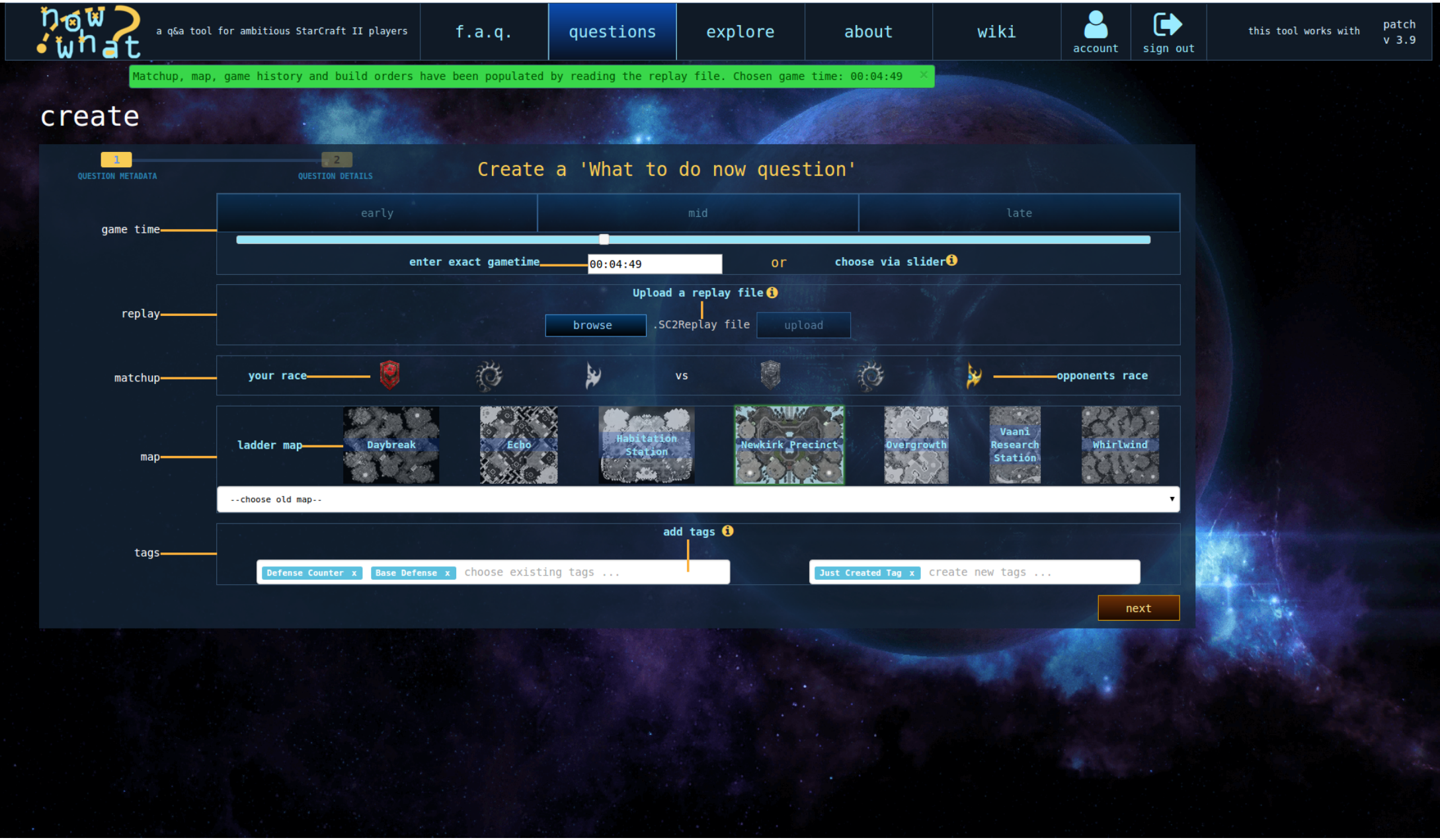
additional info

> game history

build orders

back

create question


now what?
a q&a tool for ambitious StarCraft II players
f.a.q.
questions
explore
about
wiki
account
sign out
this tool works with patch v 3.9
Matchup, map, game history and build orders have been populated by reading the replay file. Chosen game time: 00:04:49
create
1 QUESTION METADATA
2 QUESTION DETAILS
Create a 'What to do now question'
game time
early
mid
late
enter exact gametime
00:04:49
or
choose via slider
replay
Upload a replay file
browse
.SC2Replay file
upload
matchup
your race
vs
opponents race
map
ladder map
Daybreak
Echo
Habitation Station
Newkirk Precinct
Overgrowth
Vaani Research Station
Whirlwind
--choose old map--
tags
add tags
Defense Counter x
Base Defense x
choose existing tags ...
Just Created Tag x
create new tags ...
next

Matchup, map, game history and build orders have been populated by reading the replay file. Chosen game time: 00:04:49

create

1 QUESTION METADATA — 2 QUESTION DETAILS

Create a 'What to do now question'

question title*

question text*

additional info

```
------------------------------------------------------------------------------------------
Players:
------------------------------------------------------------------------------------------
  Player 1:
    name: lllllllllll
    minerals: 390
    mineral collection rate: 867
    vespene: 406
```

> game history

build orders

back

create question

6.3. Ranking

6.3.1. Expertise determining

The user ranking system is a key feature which has to work quite well to lead the tool to success. This is why I will evaluate how good the user ranking works over time. In case the ranking is not fair at any time all data for recalculating the user points will be saved to use it for adapting changes in the algorithm. The currently used algorithm calculates the points any user A can get as following:

Question - point increase cases

Question voting cases

- User B votes a question of user A up
  - Points depend on the expertise of user B - the higher the rank the more the points

Answer post cases

- User B posts an answer to a question of user A

Question view cases

- User B views a question of user A the first time

Answer voting cases

- User B votes an answer of user A up
  - Points depend on the expertise of user B - the higher the rank the more the points
- An answer of user A reaches a specific positive vote amount (PVA), meaning up votes minus down votes.
  - Additionally the answer gets marked as very useful
- An answer of user A is the best answer of a question for a specific amount of time

Question - point decrease cases

Question voting cases

- User B votes a question of user A down
  - Points depend on the expertise of user B - the higher the rank the more the points

Answer voting cases

- An answer marked as very useful of user A loses a specific number of PVA and gets unmarked.
- User B votes an answer of user A down
  - Points depend on the expertise of user B - the higher the rank the more the points

The question increase and decrease cases and the number of added or subtracted points will be changed over time to be as fair as possible. If this approach of determining user expertise will not satisfy users or my expectations over time I consider to change to a completely different approach which basic idea is to count how many people a user helps instead of counting the number of votes a user gets. Using this technique means that when a user gets up voted again and again by the same users he does not receive that much points as he would get when different users up vote his questions. This approach is all about reaching as many users possible. The statement of Wang et al. (2013) "... a users expertise level should be higher than those users whom he or she is able to help." was convincing to use this approach in case the current implementation fails.

Pal, Chang, and Konstan (2012) inspired me to increase a user's points in the case when one of his answers is the best answer for a specific amount of time, because he states that this is one of the most important measures to estimate the expertise of a user.

When the user ranking seems stable enough to me there will be an information page for users to inform users how they are able to improve their reputation within nowwhat, simply designed to motivate them.

6.3.2. Expertise ranking

In order to find out how valuable a question is users are able to vote for or against it. When another user adds an answer the answer can also be up- and down voted. The best answer will most likely have the most up votes. Users also gain or lose points when other users vote on their questions. When reaching a specific amount of points a user gains a rank which helps other users to see how well a user performs within the tool. The ranking system will be adapted from time to time, depending on how good it works in production. StackOverflow[5] shows how effective a reputation cap "... the maximum number of points one could earn in one day..." is. To prevent users from gaining too many points in a short period of time a reputation cap will be added to nowwhat in the near future. Another advantage of such a cap is that it prevents users from abusing the ranking system in an unexpected way - at least there is some limit of exploiting.

6.3.3. Question & answer ranking

To provide multiple accurate and useful answers for questions like the ones from StarCraft II players, it is necessary that users are not able to accept answers, and are not able to mark only one as a "correct" answer, like in many other Q&A systems. Mamykina et al. (2011) states that questions on StackOverflow without a clear best answer, and thus invite to discussion, remain unanswered or are answered slowly. In the case of StarCraft II "what to do now" questions it is also very important to prevent a discussion directly in the question & answer system. When a user does not agree with the content of an answer he should down vote it, if he does agree he should up vote it and in case he knows a better answer he should add his own. In later stages of the tool a user would additionally be able to do an edit suggestion. Answers which have the most up votes, where up votes are weighted depending on the user's rank in the Q&A system, are considered as very useful and will get visibly marked as such. A question ranking is planned to help users finding questions for their according skill level. This will help experienced players not to read nondescript questions and

[5] Mamykina et al., 2011.

will help newcomers not to get overwhelmed by information they cannot understand yet. To be fair answers with an equal amount of up votes minus down votes will be displayed in random order. According to Mamykina et al. (2011) StackOverflow added this randomness after several iterations, which lead to a higher probability of getting secondary questions, that were really good, voted up.

6.4. User Motivation & Accessibility

As mentioned in chapter Exploratory search interface I will add a traditional text based search in later stages of the tool. Bateman, Teevan, and White (2012) state that there is a potential that reflective interfaces will help people learn to better utilize search engines. His statement convinced me to implement a search query suggestion system sometime. Depending on the results a search query gives, the suggestion system shows users how to improve their query for improving the chance to get better results in future queries. Returning information rather than links can be very useful as Bernstein et al. (2012) shows, in the case of questions with a complex background I felt like it is not wise to show a whole question in-line immediately after a search query, because every detail could be important which means that there would not be enough space to show the whole content of a question, not to mention all its answers.

To attract newcomers a demo mode of the system is planned to show users how to use the systems full potential. This demo mode will need a lot of JavaScript, therefore it has to be evaluated if it's worth it, because using more JavaScript hurts the robustness of the whole system. Karumur, Nguyen, and Konstan (2016) state that "... the lower the number of activity types tried in the first session, the greater the percentage of users in that category who drop out of the community...". That is why in nowwhat all possible activities can be reached with no more than two clicks. Due to the fact that the community I address is a gaming community, the idea of Narayan et al. (2015) to create a game on the website for new users is great. Even if it would attract more newcomers it is still not a key feature to success, hence it will not be part of the first version of the tool.

To motivate users I try to take care about the feelings of the users when using the tool. As Harrison et al. (2013) explains that "... valence (positive or negative feelings) and arousal (the intensity of those feelings)" can be manipulated by affective priming. Of course I don't want to manipulate users, though I still want to motivate them and try to make them "happier" when using the website. Lallemand and Gronier (2012) state that the context of use and the knowledge about target users is important for the design of an interactive system in order to provide users with the best usability. Thus I implemented images and other visual elements which are similar to elements of the game interface. The main colors are similar to the colors used in the game. By adding things to the tool that remind and somehow connect users of their domain, I hope to achieve that users will have more fun when recognizing existing patterns they know and like. Talking about motivation, the user ranking has the nice side effect to motivate users participating in the system. It is explained in detail in section Expertise determining.

To attract newcomers and to make them feel that they are part of the community without registering, I will give users the chance to browse questions. In later stages of development I plan to allow anonymous users to ask a question even without registering. Before question creation they will be informed that the question will be marked as anonymous and that any registered user is able to mark this question as "his" or "her" question if he or she likes to. If no user takes the question as "his" or "her" question it will be deleted in the next 24 hours. I got inspired by Lu and Farzan (2015) as they state "... having the opportunity to participate in the community before sharing personal information to other members can lead to positive affection on members' subsequent effort and commitment to the group." Unregistered users are not able to answer existing questions because most likely spam bots would exploit this feature. Nevertheless they are advised to register or login to be able to answer a question.

When a user enters the website and sees other users' activities he feels as a part of the community and not on a static website without others participating. As[6] states "... our findings around the effect of others' activity suggest that liveliness is an important characteristic that affects one-timers' contributions". To take this good idea into account in a future release I will

[6]McInnis et al., 2016.

add a small info area where a user is able to see how many users are logged in and what were other users' latest activities.

To increase accessibility I try to use community norms as Kuksenok, Brooks, and Mankoff (2013) suggests. The metadata I used for the questions satisfy the community norms in terms of what information is relevant for answering a question concerning a specific game situation. By deciding not to allow HTML editing, I want users who ask a question to get their answers as fast as possible and the content is kept readable. In the next version of the prototype I will add a very limited version of a build-in text editor with simple format options. This decision was based on the simplicity and the limited options of an editor like this. The structure of different questions will be more similar than it would be with HTML editing, but it is still possible to highlight important things and to create headings which improves readability.

6.5. Usability

In the beginning of the design process I considered using format specifications without additional examples as Bargas-Avila et al. (2011) suggests. Nevertheless AJAX (Asynchronous JavaScript and XML) was not considered in this study, probably because it was not as famous in 2011 as it is today. Due to the possibilities of inline feedback I decided to not use format specifications at all. I came to the conclusion that every form field, where a format specification is needed has to be redesigned to clarify the input. In case a format specification is still needed the format specification is shown as a placeholder in the input field, because this cannot be ignored. Pauwels et al. (2009) suggests a different background color for required fields as an additional marker of a required field. I did not use different colors for the background of required fields, because of the high color density I already have in the system. Instead I use different colors for the labels of required fields. Additionally required fields have been marked with an asterisk, because this is what users expect.

Seckler, Tuch, et al. (2012) found that "...error messages near the erroneous field lead to the best performance...". They concluded that error messages

on the right side are the most satisfying and expected for users. I considered both pieces of advice in all of my forms. As J.A. Bargas-Avila et al. (2010) suggests, after an error occurred in any form field I never cleared the already completed fields. As Al-Saleh et al. (2012) found that "..immediate inline feedback in web forms especially for the case of error handling..." should be considered in the design process. Therefore I implemented inline feedback for some input fields, which I considered as non-simple input fields, like typing a game time in the format "hh:mm:ss".

Seckler, Heinz, et al. (2014) suggest many web form design guidelines. While most of them are considered as a matter of course, I attached great importance to:

- All input fields with multiple options have been ordered in an intuitive sequence or alphabetically.
- Matching the size of an input field to the size of the expected answer.
- After the form has been sent, show a confirmation site, which expresses thanks for the submission.
- Do not separate a form into more than one column and only ask one question per row.

6.6. Content improvement

To improve the content in the Q&A system it is necessary to think about how to measure the quality of the content. As Li et al. (2015) states, "... the quality is high if the posts are informative, polite, complete, concise and useful".

6.6.1. Answers & Comments

Regarding answers I decided that it is not possible to add comments to answers, because answers should be "...treated as discrete, independent pieces of information that can be reordered to express relevance..."[7]. The

[7]Mamykina et al., 2011.

approach leads to the following scenarios. When a user wants to add any comment to an answer, because he likes the answer, he just up votes the answer, without adding a comment. More likely users want to add comments to improve existing answers. Instead of commenting an existing answer a user should add his own answer with adding his idea. If his idea is considered to be good, his answer will be up voted. Due to the fact that answers could complete each other I have been thinking of introducing the feature to add links between answers, but left this out in the first version of the tool.

6.6.2. Constructive suggestions

All of the above mentioned attributes regarding the quality of a post can be reached by adding, as Huang et al. (2016) calls them, ”constructive suggestions”. This inspired me to add hints for users in a future release to tell them that in any written conversation they should try to use constructive suggestions, which means telling the conversation partner politely what he or she could do better and not telling the conversation partner what he or she did wrong. If the latter is necessary, a user should still stay polite and focus on the point of possible improvement.

6.6.3. ”me too”-votes

To speed up getting answers for questions, the so called ”me too”-votes on questions in the tool LemonAid[8] inspired me to think about a feature which allows users to bump a question by clicking on an ”I’m interested in this question too”-button. The more bumps a question gets the more likely it will be found by users and hence get answers faster. This feature will be added as fast as possible, because there is no reason at all not to have it. In the course of the functionality described above I will add a ”hot” question marker to questions which have reached a specific amount of ”me too”-votes.

[8]Chilana, Ko, and Wobbrock, 2013.

6.6.4. Unsatisfied button

Piccardi et al. (2014) showed that a 2-year dataset of questions from StackOverflow had 29% unsatisfied questions. This convinced me that in nowwhat there will be a lot of unsatisfied questions too. To tackle this problem, I want to add an "unsatisfied" button to questions which haven't been answered for a specific amount of time to bump the question and to minimize the total unsatisfied question amount. If the question gets to this unsatisfied state a second time, the creator will be informed that the question will be deleted and that he or she should create a new question with using a different formulation if an answer to this question is still wanted.

6.6.5. Edit suggestions

In further discussions I will use the word post meaning either question or answer.

Human kind does make mistakes from time to time - this is also the case when formulating a post. Due to this probability of errors and to improve the quality of user generated content, I thought to add an "edit suggestion" button in one of the next releases where users are able to edit existing posts. Instead of being able to save the edited post, this edit suggestion will be shown to the creator of the post.

As an alternative I am thinking of implementing a messaging module that enables a user to send a message describing which part of the authors text contains mistakes and what the user thinks the author should change.

In the former scenario the author is able to accept the edit suggestion to publish it. In the latter scenario the author is able to answer the users request. In either case he or she does not have to accept the suggestion. Especially for case two the hint mentioned to use constructive suggestions is very useful. Li et al. (2015) shows in a study about StackOverflow that editing of questions by other users can increase the number of up votes of questions by 181%. The increase of number of up votes when talking about answers edited by other users is much lower, but with 119% still worth the effort. These numbers look like that in the example of StackOverflow users edited

posts tremendously, but the subsequent contribution of post authors did not decrease by more than 5%.

As Zhang, Ackerman, and Adamic (2007) state "...the first few replies may actually not answer the question but try to clarify the problem ...". This lead me to the idea that edit suggestions are not just for pointing out mistakes and to improve quality - these could also be used to clarify a question if users do not understand what the questioner means. This increases the value of edit suggestions tremendously. This will also tackle the existing problem, that users will write answers to clarify other answers or a question, which should be avoided.

"Collaborative problem solving" (2014) states that "...a flat number of reputation points could be awarded to evaluations of either the question or answers...". Keeping this in mind I thought users should be motivated to use the above described edit suggestions feature, which improves the quality of content. To achieve this I plan to implement a reputation pool separated from the user rank points pool. When an edit suggestion has been accepted a user would gain points for helping other users. This reputation pool would have influence to the overall user rank.

6.6.6. Duplicate questions or answers

Not every user will read all answers of a question before he adds his own answer and a user will never read every question before adding his own. This can lead to similar questions and answers getting separate votes. To prevent these posts being active for too long any user will be able to suggest deleting a post due to duplication. The user who created the post will get a notification and a link to the already existing post to compare it to his post. After reading the notification he is able to accept the deletion of his question or answer. If he does not accept the deletion he is able to show other players the "duplication" problem. This means the two posts will show up on top of a specific page where users are able to mark the later posted question or answer as duplicate. If enough votes got reached, the post will be deleted. This feature will not be added in the first version of the prototype.

6.6.7. Question & answer recommendation

Questions could be recommended to users of an area of specific expertise. By comparing contribution to questions with specific tags a user's area of expertise could be determined. By recommending questions this way, experts of an area will on the one hand contribute to their field of expertise more likely and on the other hand the content quality will be improved more likely. To improve the quality of the user generated content even further "Collaborative problem solving" (2014) suggests that it will be valuable when users would be able to review an answer which is in one of their areas of expertise. A promising algorithm for recommendation of massive open online courses (MOOCs) introduced by Yang, Adamson, and Rosé (2014) could be used as a base for the question recommendation of nowwhat.

6.7. Trust

6.7.1. Anonymity

Kang, Brown, and Kiesler (2013) states "Online pseudonyms allow users to build reputations inside single communities or websites such as eBay while keeping their real identities hidden." In nowwhat users are given the opportunity to decide if they either want to be anonymous or want to show parts of their identities. When registering an account users have to enter their username and their e-mail address. The former can be anything hence only the e-mail address can have a connection to the real identity of a user. This e-mail address is never shown to other users, it is just used for account verification and to have some point of connection to a user in case of important system notifications. When an account has been set up and verified by an activation e-mail, the user is able to add user details like an avatar. By contacting other users via the tool in form of i.e. edit suggestions, mentioned in subsection Content improvement, users will never reveal their e-mail addresses to other users. Via the "replay match"-button, discussed in section Use cases, players are able to reveal their BattleTag[9] to other

[9]Blizzard Entertainment, 2017a.

users, which is a step in the opposite direction of anonymity. The BattleTag is used to uniquely identify a user in the BattleNet[10] system of Blizzard, which is used to play StarCraft II matches together online. By revealing the BattleTag to another user, this user is able to find the player, who revealed his BattleTag, in BattleNet and add him to his friends list. If the other player accepts the friend request, the two players are able to play a StarCraft II match against or with each other.

6.7.2. Spamming & inappropriate content

Handling inappropriate content is an important factor of any Q&A system[11]. In case posts contain or just consist of spam or inappropriate content other users will be able to mark the post as such. If enough users marked a post as spam or inappropriate content it will automatically be deleted. A user who created a post, which has been deleted due to spam reports, will be informed via e-mail and is able to complain by answering the automated e-mail.

To keep off bots from creating accounts or creating anonymous questions I will use captchas designed by Bursztein et al. (2014). He created these schemes for Google with having his focus on maximizing usability.

After the system has been in production for quite a while I will add both of the above mentioned spam tackling systems. When already having some spam in the database of the system it is a lot easier to test if the algorithms work.

6.7.3. Terms of service

For Terms of service the way of Fiesler, Lampe, and Bruckman (2016) and Luger, Moran, and Rodden (2013) is the way I want to go. Former suggest that "Website designers could go a long way towards helping by simply including plain language explanations of their terms and intentions." Both

[10] Blizzard Entertainment, 2017b.
[11] Mamykina et al., 2011.

think that using terms of service that can be understood immediately by every user who visits the website is necessary.

6.8. Technical work

The website has been created with django[12], "... a high-level python web framework that encourages rapid development and clean, pragmatic design...". It is known for its fastness, good security and scalability. One big reason why django has been used for nowwhat is the django admin. When set up correctly one can call the django admin URL and manage all created, models which are stored in a PostgreSQL[13] database. The django admin of the project nowwhat can be seen in figure 6.2. All CRUD operations considering all relations can be done in a web GUI without using SQL statements. Additional to python, JavaScript has been used whenever it was necessary. To generate the tree map of the exploratory search interface the famous matplotlib has been used, which has a lot of graphical and mathematical potential. The replay parser s2protocol created by Blizzard Entertainment[14], also written in python, is used as base for parsing StarCraft II replays. To automate the deployment of the django project docker has been used[15] with static and media files located in amazon web services.

Depending on the growth of user numbers and if I find people who want to contribute I consider to make this tool open source someday. The whole application will be tested via unit and GUI tests and be integrated into a continuous integration server.

[12]Django Software Foundation, 2017.
[13]The PostgreSQL Global Development Group, 2017.
[14]Blizzard Entertainment, 2017c.
[15]Docker, 2017.

6.9. Planned features to increase user numbers

6.9.1. Reward system via badges

To motivate users in participating and contributing in the question and answering (Q&A) system I want to implement a reward system which grants badges to users for participating in different parts of the website. As Mamykina et al. (2011) states a reputation and a badge system that reward activity are extrinsic motivating factors. One could earn badges for creating a specific amount of questions where other users added at least one answer, for contributing to topics which have less coverage and for several other tasks, which help the community growing. That a reward system via badges pays off has been shown by Cavusoglu (2015). "All these results state that users who earn badges for answering questions subsequently answer more questions after earning these badges."

6.9.2. Automated quiz generation

When the tool is live for quite a while, the major bugs have been fixed and the user ranking has been adapted to a satisfiable level I want to add a big feature to attract more people to use nowwhat. The main idea is that existing questions will be used as a base for an auto generated quiz. Questions must fulfill the following requirements to be added to the quiz where X, Y and Z are not set yet:

- it has been viewed at least X times
- it has at least 4 answers with a PVA of Y
- it has at least 4 answers with a negative vote amount (NVA) of Z

A quiz-question is a multiple choice quiz and has the following metadata:

- match-up
- map
- game time
- question title
- question text

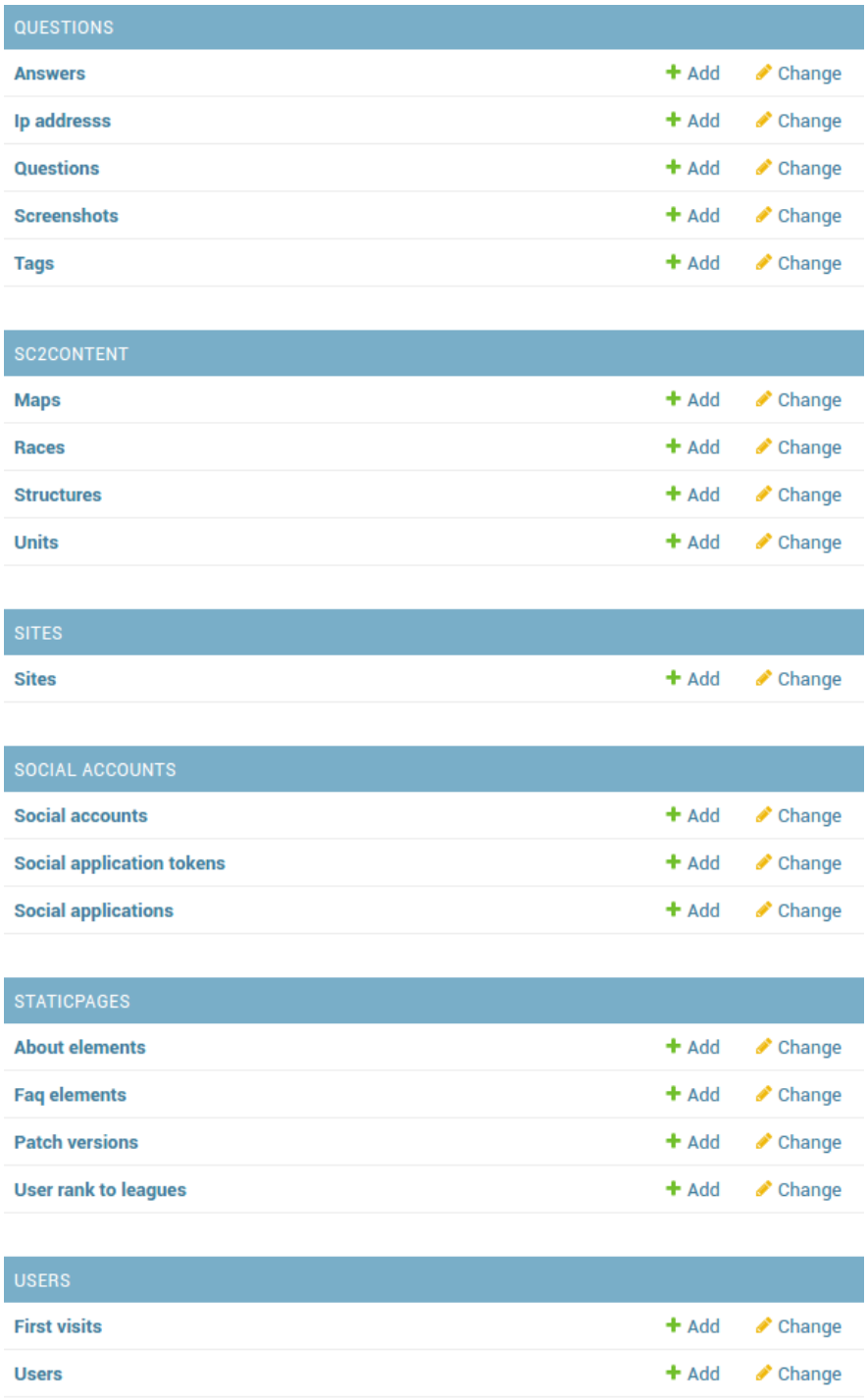


Figure 6.2.: Django admin.

- additional information
  - Same elements as described in section Additional information.
- tags
- replay
- question rank
  - The question rank range is the same as the user rank: bronze, silver, gold, platinum, diamond and master.
  - The rank is the rank of the user, who asked the question, at the moment the question gets added to the quiz.
- useful answers
  - Useful answers are the ones with a PVA $\geq$ Y.
- useless answers
  - Useless answers are the ones with NVA $\geq$ Z.
- possible answers
  - Possible answers are all correct and all wrong answers.

When a user wants to do a quiz, auto generated questions for his user rank would be suggested. The question or the answers of a question do not have been up- or down voted by the user, or the question will not show up for this user. To improve the quality of the already "solved" question even further, every user is able to open all questions after he did the quiz to add an answer or to do something else to improve the content of the question. During a user is doing a quiz, voting on a question or an answer is still possible and may affect an already generated quiz. Additionally every participant is able to suggest the current question rank to adapt the rank to an adequate level. To provide the most up2date questions, a user is able to choose questions by patch version.

In the end of every quiz users are able to write a short text how the auto generated quiz could be improved.

All users get points when doing a quiz in a separate quiz pool. To motivate players leader-boards for users who did quizzes to get points would be offered on a separate page. The suggestion of Stanculescu et al. (2016) that, the leader-boards may decrease motivation when the users on top of the list

have a score that the current player considers to be out of reach, would be considered.

6.9.3. Multiuser question creation tool

Even though StarCraft II's most famous played mode is 1 versus 1, players often meet in groups and watch each other playing. Before they ask a question in a Q&A system like nowwhat they often discuss mistakes and get to a solution without posting a question. But when no solution comes up in such a discussion these players would benefit from a multiuser question creation tool. This feature should offer players the opportunity to create a question together while one player sees the editing changes of another player. In case of nowwhat a question would have multiple instead of one creator. The rank shown at the question would be an average of all users, who participated at the creation. Besides from nowwhat this feature would also be beneficial when used in Q&A systems about different domains. Additionally the user generated content would be more sophisticated due to the probability of less mistakes when more eyes are watching the question creation task. When formulating a question together, a lot of misunderstandings can be prevented and asking a question together could even be more fun than doing this alone. This idea could even lead to a collaborative answer editing feature - as "Collaborative problem solving" (2014) states "Tools to gather ideas into an answer and share ownership might take people less hesitant about adding to other people's work.".

6.9.4. Multiuser strategy creation tool

In many areas strategic planning is key to success. This is also the case in any strategy game, because your victory stands or falls with the underlying strategy. That's why strategies evolve to counter other strategies. In terms of StarCraft II there are plenty of player created strategies, which have been published and at least have been viewed very often which takes me to the assumption that they have been used successfully in games. One of the

websites offering such strategies is called SpawningTool[16]. Due to the fact that there exist this many strategies and that they are used, a tool where players could create such strategies together would be most likely accepted with pleasure. A good example how collaboratively creating ideas could look like can be seen in the tool IdeaHound[17]. It uses an "..."organic" human computation approach, where community members contribute feedback about ideas..". As already suggested in chapter Multiuser question creation tool users should be able to edit content collaboratively.

6.9.5. Domain-tailored planned features

Automated screenshot generation by use of StarCraft II replay files

StarCraft II replay files can be useful to find relevant facts of the game history. These files can be opened in the game itself and can be used to watch a game from either players' perspective. To provide more accessible information of a game history without text and without forcing a user to watch such a replay himself, one could crawl a replay and extract crucial information and add it i.e. in form of pictures to a question. The following example of this extension shows how this could be used. A player describes a specific game situation which occurred at minute 4 second 15. He adds all non-textual information while creating a question in the Q&A system. He uploads a replay file, but not only for giving other players the opportunity to go and watch the played game on their own, but also to automatically add a game history in form of generated screenshots to his question as the replay file is used for adding additional information as described in section Features.

Understanding the above example indicates the necessity of some game knowledge: There are some facts in the game which occur in most of the played StarCraft II games like "getting a second or a third expansion". When a player makes the choice to expand, this changes the game drastically. To expand means that the player has to use resources to get more resources in

[16]K. Leung, D. Paskert, 2017.
[17]Siangliulue and Chan, 2016.

the future, but it also means he is more vulnerable to enemy attacks due to the lack of resources, which means that he cannot afford defensive structures or an army respectively. When and where a player gets an expansion could be found out by an automated replay parser, which could be used to generate a screenshot by adding a building to a specific position to a game map provided as a static image without any buildings or units on it. This would describe parts of a specific game situation in a matter of seconds without formulating any text, just by uploading the corresponding replay file.

Build order creation with timelines combined with existing questions

In StarCraft II players often create so called ”build orders” (BOs) which contain a specific strategy starting at the beginning of the game and helping against a specific race on a specific game map. Most of these BOs are written without incorporating enemy behavior. A part of a BO can start like in the following example:

supply	game time	action
14	00:18	Pylon
15	00:37	Gateway + check proxy buildings
16	00:48	Assimilator
17	00:55	Assimilator
18	01:07	Pylon
20	01:21	Gateway

Every BO contains 3 columns

- supply - indicating how many units a player has
- game time - indicating when an action should be performed
- action - indicating what should be done (i.e.: training a unit, constructing a building)

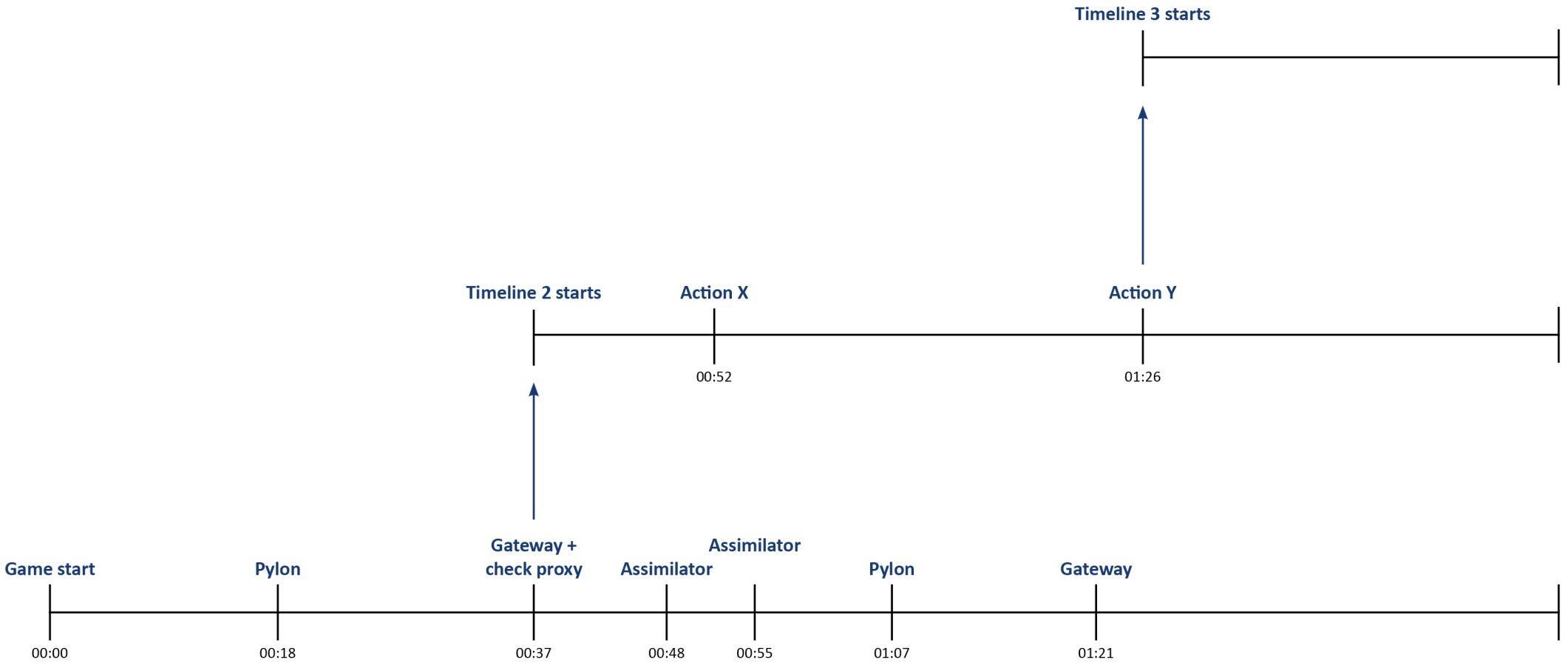
That means i.e.: row one tells the player to build a building called ”Pylon” at 14 supply after 18 seconds game duration.

Most of the BOs, found on the web, are thought through very well. Thus, given points in time provide the optimal time to do a specific thing, when a player executes his actions in the best possible way. To follow a BO during the game is still useful, even when a player made a small mistake and the timings are not exactly the ones given.

Nearly every player who plays StarCraft II competitively uses BOs from time to time or invents his own BOs, which he tries to follow more or less until a certain enemy action at a specific point in the game disrupts his plans.

Although there are a lot of really good websites providing BOs, I still see room of improvement regarding how a BO changes over time. The idea is to provide an input opportunity to add parallel multiple timelines to one BO to get adaptable strategies. Looking at the above example, the BO is not shown as a timeline. To illustrate multiple timelines the main timeline could be the above example illustrated in a timeline. Because there are a lot of counter strategies to BOs, it should be possible to add other timelines to the existing one, which start at a specific game time when a specific action occurs. In the above example the specific game time where a new timeline starts could be 00:37 and the specific action could be "proxy building found". The newly added timeline could contain a complete different strategy, because i.e. finding a proxy building often means that a player has to defend his existing buildings and workers to get a resource income advantage and outnumber the opponent's army in later stages of the game. Page 67 shows an example how such a timeline could look like.

Why should this feature benefit users of the web-based Q&A tool? Because they would be able to create such BO timelines and add these when creating a question regarding a specific game situation. The big advantage of this connection would be that players would be able to find questions where players used the same or a similar BO when compared to their own question. That means that players are able to find such questions of other players, which played similar games, more easily due to the additional metadata.


Timeline 3 starts
Timeline 2 starts
Action X
Action Y
00:52
01:26
Gateway +
check proxy
Assimilator
Game start
Pylon
Assimilator
Pylon
Gateway
00:00
00:18
00:37
00:48
00:55
01:07
01:21

7. Evaluation

7.1. Evaluation 1 - Usability heuristics

By doing a usability heuristics evaluation I wanted to find out if the general usability does satisfy popular heuristics.

7.1.1. Used heuristics

Simple but Crucial User Interfaces in the World Wide Web: Introducing 20 Guidelines for Usable Web Form Design

J.A. Bargas-Avila et al. (2010) created a guideline for web form design including if a certain statement is supported by empirical data. To identify to what extent the forms used on the website fulfill these guidelines I did a form heuristics evaluation with four evaluators.

247 web usability guidelines

Dr. David Travis provides 247 web usability guidelines[1] which are categorized into the topics "Home page", "Task orientation", "Navigation & IA", "Forms & Data Entry", "Trust & Credibility", "Writing & Content Quality", "Page Layout & Visual Design", "Help, Feedback & Error Tolerance". To identify where the website lacks usability I did a web usability heuristics evaluation with two evaluators.

[1] Dr. David Travis, 2014.

7.2. Evaluation 2 - Field trial

By evaluating the web-based tool nowwhat I want to find out if users use the tool as I expect. I hope to gain information on how fast a question could be created and found and if the advantage of non-textual input tools is worth the effort. Additionally I want to find out how fast a user is able to understand the forms and user interfaces I provide and where improvement is needed. By doing the field trial I want to tackle the following questions:

1. Is the task of creating a complex question easier than in text-only systems?

   How long was the average time for creating a question within my system?
   Did users enjoy the question creation task more than in text-only Q&A systems?

2. Can the task of finding a complex question be done faster when using nowwhat?

   How long was the average time for finding a question in the system?
   Do users think that they are able to find similar questions to their own question faster than in text-only Q&A systems?

3. What was the user experience and which usability problems have been found?

   What do users think about the experience on the website?
   Did users get stuck, because they did not know what to do, if yes where?
   How many players out of 10 players were able to create a question?
   How many errors did the 10 players encounter when creating a question? Which errors did the players encounter?
   Which interactive elements should be improved?

7.2.1. Evaluation method

The users' tasks looked like the following:

1. task 1 - getting started

   users had to...

   ... make their selves familiar with the website by browsing it and having a look around
   ... register on the website

2. task 2 - searching a question

   users had to...

   ... watch a complete StarCraft II match by opening a given replay file A with the game
   ... rewind the replay to a given game time and pause it
   ... analyze the game situation from a given player's perspective
   ... click a link with the text "I start searching a question"
   ... try to find a question about a similar game situation (from the given player's perspective) on the nowwhat website
   ... click a link with the text "I finished searching a question"

3. task 3 - creating a question

   users had to...

   ... watch a given replay file B by opening it in StarCraft II until a given game point and not further
   ... analyze the game situation from a given player's perspective
   ... click a link with the text "I start creating a question"
   ... create a question for the game situation at the given point in the game
   ... use the replay file in the question creation process
   ... click a link with the text "I finished creating a question"

4. last task - contacting me for a short interview

7.2.2. Usage data in field trial

For the evaluation I implemented a user behavior logging system. In any speed measures I calculate the average speed of a user to get useful numbers, because some users are faster than others, depending on their perception and on their input device handling skills and general experience with web platforms. How this works for several pages is described in the following example:

- a user does a get request on a page including a form - the current time gets saved
- a user submits the form - the current time gets saved
- the difference between the two times gets calculated to find out how long a user needed to fill out a form
- interactions with form elements get logged
  - find out which elements users interacted the most with
    - find possible accessibility improvements of these elements to save users time
  - find out which elements users interacted least
    - find possible accessibility improvements of these elements if they should be interacted with more often
- log user errors which occur during filling out a form
  - find out possible improvements to decrease the error-proneness

7.2.3. Participants

The evaluation has been done by 10 StarCraft II players from various skill levels. The skill level in StarCraft II is measured by a player's rank which is calculated by using the win rate of the player considering the rank of enemies. The exact algorithm to calculate the ladder rank of a StarCraft II player has been summarized precisely by TeamLiquid[2]. Two players reached the highest rank which is grand master, three players reached the rank diamond, one player reached the rank platinum, two players reached the

[2]TeamLiquid, 2017.

rank silver and two players did never get higher than the lowest rank which is bronze. The evaluation participants have been kept anonymous, except for the e-mail addresses, which they needed to register.

7.3. Evaluation results

7.3.1. Results of evaluation 1 - usability heuristics

Form evaluation based on the work of J.A. Bargas-Avila et al. (2010)

The results table shows the statement and the average degree of validity (DOV) given by four evaluators. The DOV lies between 1 and 5, where 1 means that the guideline statement has been completely fulfilled and 5 means the guideline statement has been completely ignored. An "i" means the guideline statement seems irrelevant. Guideline statements with a DOV above 2 have to be extended by an explanation why the DOV has been assigned, the ones with a DOV below or equal to 2 can have an explanation optionally. Explanations can be found in the detailled version of the heuristic evaluation in the appendix. Guidelines marked with an asterisk are supported by empirical data.

Table 7.1.: Heuristic evaluation 2

Statement/Explanation	DOV
1: Let people provide answers in a format that they are familiar with from common situations and keep questions in an intuitive sequence.	1.75
2: If the answer is unambiguous, allow answers in any format.	1.5
3: Keep the form as short and simple as possible and do not ask for unnecessary input.	1.5

4*: If possible and reasonable, separate required from optional fields and use color and asterisk to mark required fields.	3.25
5*: To enable people to fill in a form as fast as possible, place the labels above the corresponding input fields.	3
6: Do not separate a form into more than one column and only ask one question per row.	2.25
7*: Match the size of the input fields to the expected length of the answer.	1.75
8: Use checkboxes, radio buttons or drop-down menus to restrict the number of options and for entries that can easily be mistyped. Also use them if it is not clear to users in advance what kind of answer is expected from them.	1.5
9*: Use checkboxes instead of list boxes for multiple selection items.	i
10*: For up to four options, use radio buttons; when more than four options are required, use a drop-down menu to save screen real estate.	2
11: Order options in an intuitive sequence (e.g., weekdays in the sequence Monday, Tuesday, etc.). If no meaningful sequence is possible, order them alphabetically.	2
12*: For date entries use a drop-down menu when it is crucial to avoid format errors. Use only one input field and place the format requirements with symbols (MM, YYYY) left or inside the text box to achieve faster completion time.	1
13*: If answers are required in a specific format, state this in advance communicating the imposed rule (format specification) without an additional example.	1.5

14*: Error messages should be polite and explain to the user in familiar language that a mistake has occurred. Eventually the error message should apologize for the mistake and it should clearly describe what the mistake is and how it can be corrected.	1.5
15: After an error occurred, never clear the already completed fields.	1.25
16*: Always show error messages after the form has been filled and sent. Show them all together embedded in the form.	2
17: Error messages must be noticeable at a glance, using color, icons and text to highlight the problem area and must be written in a familiar language, explaining what the error is and how it can be corrected.	1
18: Disable the submit button as soon as it has been clicked to avoid multiple submissions.	2
19: After the form has been sent, show a confirmation site, which expresses thanks for the submission and states what will happen next. Send a similar confirmation by e-mail.	2.75
20*: Do not provide reset buttons, as they can be clicked by accident. If used anyway, make them visually distinctive from submit buttons and place them left-aligned with the cancel button on the right of the submit button.	1.25

Many of the guideline statements reached a good score, which indicates that no urgent improvement is necessary. The following points should be considered in future versions of the implementation due to a bad DOV score (> 2):

- The separation of required from optional fields should be improved. Although there are already asterisks to mark required fields they could not be recognized at a glance which suggests to use better colors.

- Confirmation sites are not good, or not there at all. A message only does not seem to be satisfying enough.
- Even though I did this by intention, the labels are not positioned above the corresponding input fields but should.
- Some fields are separated into two columns where one column would be easier to read and fill out.

The following textual feedback differs from the findings above, is very useful and will be considered as well:

- The input is not in a format people are familiar with.
- Required fields are marked with asterisks, but are not necessary at first and asterisk symbol is not described as required.
- Map input field seems to be to large.
- Choosing existing tags should be a drop-down menu with searching feature and not just a field with searching feature and autocompletion.
- Tags and maps are not sorted alphabetically; game version number under 'sort by up-to-dateness' is misplaced.
- Time format is not entirely clear.
- Some error messages are shown before the form has been sent.

The average DOV of the 20 guideline statements considering all four evaluators is **1.88**.

Website evaluation based on the work of Dr. David Travis[3]

The 247 guideline items were assessed by two evaluators as following: An item got the value negative one when it didn't comply with the guideline, it got positive one when it complied with the guideline and zero if it kind of complied with the guideline. Irrelevant guidelines have been left blank. The guideline includes a topic about search which had to be completely ignored by the evaluators, because the website does only have an exploratory search and not the wide-spread text search which the topic is mainly about. The lack of the search category is the reason why the following two figures have a big empty space in the lower right.

[3]Dr. David Travis, 2014.

In figure 7.1 the results of the first evaluator show that ”Home Page”, ”Trust & Credibility”, ”Task Orientation” and ”Navigation & IA” outvalued the others. Figure 7.2 shows the results of the second evaluator. When looking at the results of both evaluators one can see that similar results have been achieved in the categories ”Navigation & IA” and ”Task Orientation”. ”Visual Design” and ”Forms & Data Entry” got the worst results which suggests that the usability can definitely be improved in various ways. Overall one can see that all categories reached a decent percentage in both evaluations.

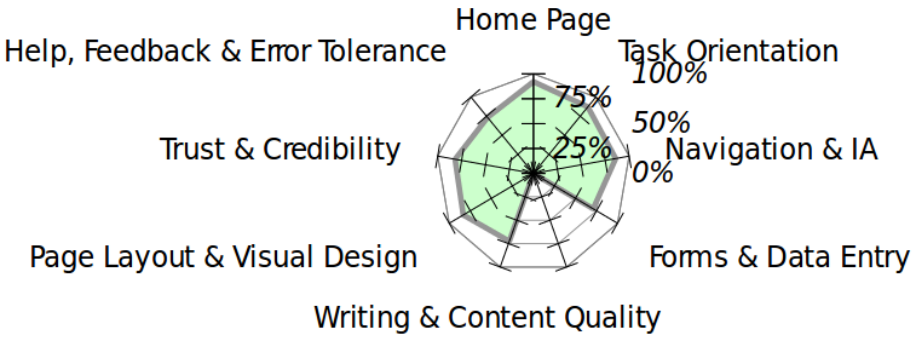


Figure 7.1.: 247 web usability guidelines - heuristics evaluation results of evaluator 1.

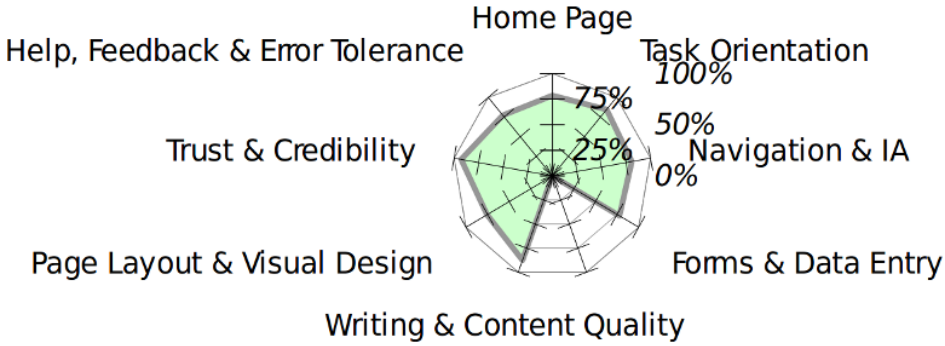


Figure 7.2.: 247 web usability guidelines - heuristics evaluation results of evaluator 2.

7.3.2. Results of evaluation 2 - field trial

Most of the users had a good first impression when visiting the website while some told me that the design does not look professional.

When looking at the result times of the question creation and question finding task one should consider that the users were not familiar with the platform and would be a lot faster once they are. Additionally I think that one can subtract a delta of seconds, because it is very likely that some users did not focus on the evaluation only or forgot to press the stop button after doing a task.

To tackle the enumerated questions the corresponding sub questions starting with "..." have to be answered first.

1. Is the task of creating a complex question easier than in text-only systems?
   - ... How long was the average time for creating a question within my system?

     The average time for creating a question was 6 minutes and 8 seconds.
   - ... Did users enjoy the question creation task more than in text-only Q&A systems?

     The question creation task has been enjoyed by the majority of the users.

I could not find any evaluation data about complex question creating in text-only systems. This leads to the result that it is hardly possible to find out if users using the question & answer (Q&A) tool nowwhat are able to find or create questions faster than they would in text-only Q&A systems. Even though users told me that they see a potential in the website including the question creation page. Compared to other Q&A systems like reddit users told me that the question creation process is very useful.

2. Can the task of finding a complex question be done faster when using nowwhat?
   - ... How long was the average time for finding a question in the system?

     The average time for finding a question was 3 minutes 45 seconds
   - ... Do users think that they are able to find similar questions to their own question faster than in text-only Q&A systems?

     Almost all users reported that especially the structure of the questions helped them to find a question very fast. Some users had bad experiences in finding up-to-date questions in other systems and think that the sorting by up-to-dateness feature is a big advantage in nowwhat.

A very positive result is that all users where able to find a question to the given game situation in a few minutes without getting stuck on any page. Sadly the main part of the users used the ”questions” page and not the ”explore” page to find a question. I think this happened, because users are used to search in a list of questions rather than i a tree map of tags. This is the reason that the results do not tell me if people like to use the right click to show questions on the explore page and if they would use the exploratory search to find complex questions in a bigger database. Nevertheless users reported that the systems handling of tags is very unique and that they see a potential.

3. What was the user experience and which usability problems have been found?
   - ... What do users think about the experience on the website?
     All users had a good user experience except for one player who has a background in web-design. He told me that the design and the logo is not professional enough to get a high user count.
   - ... Did users get stuck, because they did not know what to do, if yes where?
     No.
   - ... How many players out of 10 players were able to create a question?
     10
   - ... How many errors did the 10 players encounter when creating a question? Which errors did the players encounter?
     The distribution where errors occurred can be seen in Figure 7.5.
   - ... Which interactive elements should be improved?
     Several improvements have been suggested by field trial and heuristic evaluation participants. Due to overlaps there is a whole section called usability feedback which contains which elements should be improved.

To answer the first part of question 3 one can say that the user experience was satisfying for the majority of the users. The second part, which usability

problems have been found, is discussed in the following paragraphs.

Figure 7.3 shows the numbers of used filters. The game time filter has been used very often, because every change of the slider has been logged. As the question used in the evaluation was not really map specific there was a high probability that the map filter will rarely be used.

Figure 7.4 shows how tags have been added on the questions and explore pages. When users clicked a tag with the left mouse button on the explore page or typed the tag via the search bar the users stayed on the explore page and saw more suggested tags to limit their search results. When users clicked a tag with the right mouse button they could see the questions page with the already chosen tags and the just clicked tag.

Figure 7.5 shows the average number of encountered user errors when creating a question. An error would be for example when a user forgets to choose the game time before uploading a replay file or when a user does not choose a map before submitting the question creation form. While tags and game time errors did rarely occur the map and the replay upload form fields should be improved somehow, because a lot of the users did not understand these right away.

- What did users tell me besides answering the field trial questions?
  - The premise for all users to succeed with the website is a big amount of existing up-to-date questions and answers created by players from various skill levels. One user told me that he sees a lot more potential to use this kind of Q&A system for another game where players play 5 versus 5 and are therefore more communicative than in the most famous 1 versus 1 matches in StarCraft II. All players reported that on the question detail page enough information was given to answer a question, while one user told me he still likes to watch the replay before giving an answer to have every possible chunk of information.
  - Talking about the question creation process one of the participants said "It is a lot of text and hard to describe, which means a lot of effort. That's why I don't post questions on reddit." Another user told me that finding a fitting thread where a similar game situation is discussed is very hard. Nearly all users said that they

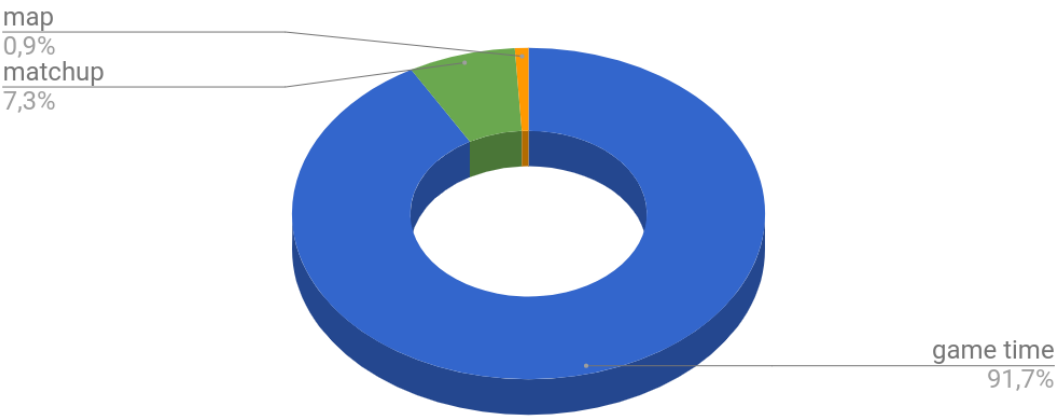


Figure 7.3.: Used filters on the pages questions and explore

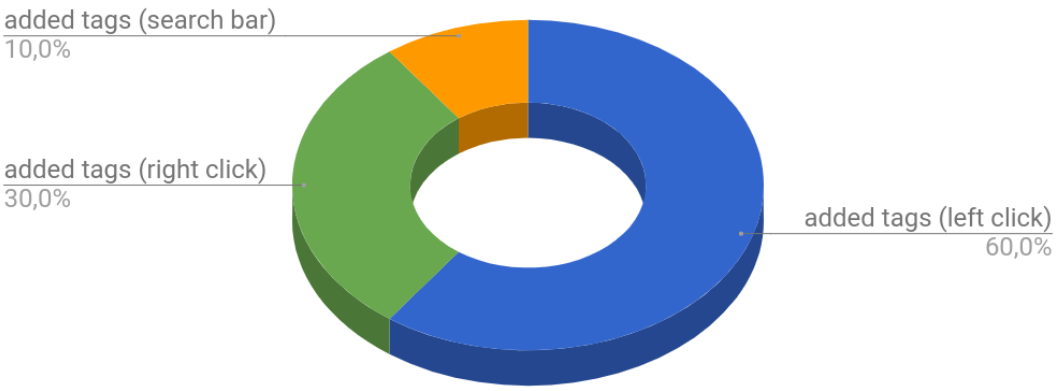


Figure 7.4.: How tags have been added

like to learn how to play the game by watching VoDs (videos on demand) or live streams, but they also think that when you have a specific question in your mind VoDs or streams are useless.

– As expected players answered the question "What is hard in StarCraft II to get better?" very differently. Players with a lower rank answered that it is hard to know every detail of the game like stats and counter units. The players with a medium rank told me that you need a lot of time, you have to know all established tactics in every matchup of your race and that it is very hard to always react with the correct choice after your enemy did

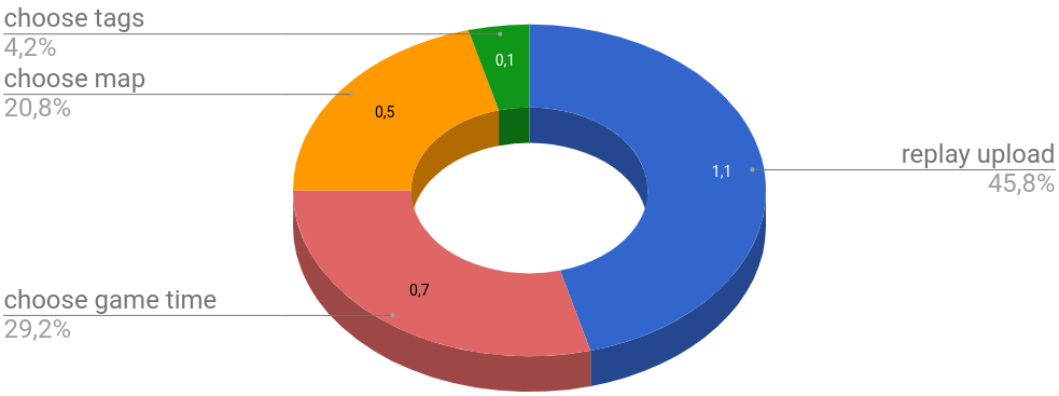


Figure 7.5.: Average number of user errors on the question creation page

some action. The higher level players told me that even when you know a lot about the game you have to practice not to make mistakes and that it is kind of impossible to know everything about StarCraft II which means that acquiring knowledge will always be an issue.

– As one of my goals is to vivify the community of StarCraft II I also asked people what they think how this could be possible besides the Q&A website. The first answer by many players was that the game creator should add more content to the game. As this is done by Blizzard Entertainment from time to time and I have no influence in adding more game content I asked players to think from a non Blizzard Entertainment perspective. The best answers I think so far were to create a lot of small tournaments with little but attractive prices, to let famous youtubers play the game together to attract players who don't know StarCraft or don't know how much fun it could be. One user told me "The community is very elitist which means the barrier to entry is very high. In general it is really hard to vivify the community, because there are a lot of people who at least think that they are not good enough to get better and they have no teammates to blame if they lose, that's why people quit too fast".
– Due to the reason I think about making the website open source someday I asked players if they are programmers and would be

interested to help in further development. Surprisingly one of the evaluators is a computer scientist from Germany who would like to support me.

7.3.3. Usability feedback

The higher level items in the following list are the improvement suggestions of all players doing the field trial and all heuristic participants. A probable realization of a suggestion is added in the lower level of the list if a solution is not obvious.

- The error, warning and info messages on top are not well arranged and could be overlooked. Especially the blue info message has been sensed way too dark.
  - better positioning and different colors of all messages.
- Delete question is not possible.
- Thumbs up/thumbs down symbols are inverted compared to well known forums.
- Design and logo is not professional enough to get a high user count.
- Show the game time format before typing or using the slider in the question creation process.
- Add the StarCraft II logo somewhere on the page to help users recognize that the website has to do something with the game if this is possible in terms of permissiveness.
  - I already had the logo in a local version of the prototype, but dismissed it after reading the policy of Blizzard Entertainment which does not allow to use the logo. I will ask Blizzard if they have some suggestion which would satisfy both sides. Maybe they will agree that the website can be seen as an advertisement for the game and therefore accept it.
- Use filters additionally to sortings on the questions page.
- Show the user who created a question and make it clickable.
- One user reported that it took him a while to understand the metadata filters, especially because they are positioned from the left to the right side of the screen

  - I will think about a general design change and try not to avoid scrolling, as I do now, to get more free space and thereby more clarity.

- When using a high resolution things are very small.

  - The design is not fully responsive yet, for now all resolutions with a minimum resolution of 800 x 600 and a maximum resolution of 1920 x 1080 pixels should not have major usability issues.

- The add tag and show questions symbols on the explore page are not correct if a left-handed mouse is used by a player.

  - The symbols will be changed to some other symbols. I am still not sure if using a right click on a website leads to too much confusion.

- The filters should somehow include older maps too, not ladder maps only.
- Connect the BattleTag with a users account on a voluntary basis

  - I already had this idea as can be seen in subsection Anonymity. As this is not trivial and I will have to correspond with Blizzard Entertainment - I am afraid that this will never be possible.

- Show build orders (BOs) on the question detail page in a format that could be read faster.

  - I already had the idea to change the BOs and the income tabs in the question detail from a list of text to a list of images with text to perceive the content more easily.

- Extract existing useful questions from reddit.
- A more simple design with clear format
- No scroll bars at all.
- Let the user resize the content.
- A text search should be possible.

7.4. Evaluation discussion

I got a lot of useful feedback in terms of usability. Feedback in textual form as well as the automated logging system provided useful information to improve the system in many ways. The logs showed exactly where and how often problems occurred, which was especially helpful. This will definitely lead to a better and usable version of the system. I see three ways to find out if structuring questions in a Q&A system like in this approach is useful:

1. Comparing the system with similar systems
   ... To compare the system with existing ones, evaluation data about complex question creating in text-only systems would be needed. It is still hard to compare two systems that work completely different. As discussed in the end of the section a speed comparison may not be useful at all.
2. Use the system for a long time in production
   ... At first one needs a lot of users, which is hard to get without advertisement and a stable, tested system. Secondly a lot of time is needed to find out if the system performs well and if the major part of the users benefit from the tool.
3. Ask users for feedback
   ... The user feedback was mainly positive, as this is the only indicator for now if the system approach works, this is not a bad result.

Overall one can say that there is no evidence to make a statement that structuring complex questions with multiple tags and filters works better than without structuring it. Nevertheless I am still convinced that the main idea could work in a community of a Real-time strategy game and in other areas as well, because users reported that they like the system approach and that they see a potential in it. As described in section Problem statement & approach I wanted to find out if users are able to find questions with a complex background without a text-based query. The results indicate that players are able to find such questions in a reasonable amount of time without a text-based query. If players find different questions asked by other players is, of course, still unclear. One part to tackle the goal that questions

should not get lost in the web is the up-to-dateness feature which links every question with a patch version of the game. As many evaluators liked this feature, it seems like a step in the right direction that relevant questions do not get lost in the web.

To get meaningful results about the question finding speed the tool would need thousands of questions created by experienced StarCraft II players. I considered to add questions and answers in a generic way, but these would not be useful at all for players. To get meaningful results about a speed comparison in creating a question logs of other Q&A systems like reddit would be needed, but I could not find any which are open to the public. Even when such results would be on hand, potential questioners of nowwhat are ”forced” do reveal more information about a specific match than users of other Q&A systems, which could be worth the effort of a longer question creation task. This lead me to the conclusion that a speed comparison may not be meaningful anyways.

The goal to strengthen the StarCraft II community came up, because I thought that the player numbers diminish. I presented a figure in section Background which shows the dropping rank of the StarCraft subreddit. To my surprise one of the players with a very high rank told me in the evaluation interview that the situation is not that bad actually. He told me that the game flourishes quite well at the moment and that the current player base does not shrink. As he is involved in a lot of ongoing discussions in the scene I believe his statement is true.

Overall users who used the system reported that they would use it in the future when there are more questions and answers available. This convinced me that the potential I saw before developing the tool is actually given.

8. Discussion & Conclusion

To reach the goal to save a user's time when creating a complex question in a Q&A system I was looking for ways to provide as little text input as possible. By not offering a text-based search I wanted to find if users are able to find complex questions with a non-textual query approach. Additionally I wanted to ensure that questions are still useful after a while and can still be found in the web.

8.1. Effort & Insights

By implementing a domain-driven Q&A system for a real-time strategy (RTS) community I tackled the goals above. I provided several different input fields for question metadata in the question creation step and offered an exploratory search interface for tags combined with facetted filters to find a question by it's metadata and it's tags. Over time the implementation has been optimized by using heuristics, getting user feedback and using an automated logging system.

In terms of the StarCraft II community I was able to show that players of different skill levels see a potential in the Q&A tool, which leads to the assumption that this kind of Q&A system is usable and that there is a great chance to use it in other fields of application, where complex questions arise, successfully. I found that players are able to find a question with a complex background in the system within a few minutes. Of course, this does not make sure that users would find all complex questions in a short time period. By autopopulating metadata in the question creation step by parsing a standardized document, which is familiar to the StarCraft II community, I learned that the average player enjoys the question creation task more

than in established Q&A systems like reddit, because the very important metadata must not be typed manually. Although all players were able to find a question without a text-based search query, many reported that they miss the conventional text query. I had to tell them that I omitted the well known text-based search in order to find out if tags and filters are a usable way to find complex questions. With the structure of questions via metadata and the linking of questions to patch versions of the game, I convinced most of the evaluation users that questions do not get lost.

8.1.1. Effort estimation

The prototype I implemented within this master thesis is far near to a final state than I thought I could get alone in this time. Nevertheless I underestimated the need of time to get a stable system which can be used in production. For the next project of this extent I would hire at least one additional developer.

8.2. Technical view

Python and django with a PostgreSQL data base as backend have been used for implementing the prototype and I would definitely use this robust, secure and elegant framework again. Hence I just started with python with the beginning of this thesis, I do not fully understand all of the design concepts - at least I did not understand a lot of them in the early stages of development. That's why I used a lot of JavaScript where it would not have been necessary. In future development I will try to get rid of as much JavaScript as possible, due to the problems it leads to[1]. For now I do not have a lot of registered users, but hopefully I will get more and more over time. Depending on how good the prototype actually scales, I will stick with the used technologies or maybe switch to an alternative some time.

[1] Schee, 2013.

8.3. The correct approach?

I think the idea to structure a Q&A system is at least a step in the right direction. Maybe the structuring with metadata, which allows filtering and using an exploratory search in tags in combination is not enough. Creating questions with a complex background by using as little text input as possible by adding some automation process with existing parse-able input will always minimize the users' effort. The approach to find complex questions without a text-based query sounded great, but I am not sure if this approach can become accepted in our world of loads of optimized search algorithms. What I assume from what I have learned so far is that a mix of a very short text query including filters and tags could probably be a very good solution, because people are used to the wide-spread text-based query and are skeptic about other search methods and this will still minimize the typing effort.

8.4. Method analysis

8.4.1. Memo to other developers of any question & answer system

After the first few iterations of the prototype I thought that it is crucial to have a very good design to reach enough players for the evaluation. It turned out that reaching users for a system they do not want to use in the first place, because it has no information which can actually help them, is very hard - no matter what kind of design you have. I would recommend to any other developer starting with any kind of a Q&A system that it is much more important to get an interesting base of questions and answers by experienced people rather than a good design. I think that users would have been more excited when they already got useful information when using the system the first time. I would even recommend to search for very experienced people to create initial questions and answers to not lack quality.

8.4.2. Starting a similar project with the experience of this work

From the current perspective I would definitely recommend applying user centered design in any other project that addresses a community of practice. In my user studies I found that reaching players from other countries is very important which lead me to contacting potential users mainly via the internet. If I would do a similar project again I would try to reach players in person by attending live tournaments. When meeting players as a player myself in an environment they connect with a domain of their interest I think the interviews and evaluations would have been a lot more relaxed and I would have got the chance to get a higher number and more detailed results.

Regarding the implementation I got bogged down in details over and over again. Even when I think I should not have done this and focus on the core functionalities, I am still happy that I did, because now the registered users could already imagine how the question and answer tool looks like in a near-to-final state and are not deterred by a minimalist design. To stick with my own community driven design I put a lot of effort in front-end development, because it was not always possible to use existing JavaScript and Cascading Style Sheets libraries like bootstrap[2]. When starting with a design from scratch again I would definitely do the design by taking a look at existing libraries, especially which fully responsive elements they provide, before I even start programming and stick to the concept of flat web design, because users are used to it nowadays and it is much easier to maintain.

Sadly I did not separate all of the domain specific parts from general functionalities of the Q&A system right away. Over time I separated the logic, but there are still elements which are intertwined. When starting a project of this extend again I would definitely take care of this separation and keep functionalities more dynamic.

After doing the evaluation I could not compare my time measurements with a usual Q&A system like reddit, because I could not get any data. In a

[2]Bootstrap, 2017.

similar project I would create a small simple Q&A system similar to existing ones to have a better comparison. I still think that even with a comparison system I would have needed a big amount of quality questions to make a statement about which type of system works better.

8.5. Further motivation

Even without proven positive results I hope to motivate other developers of question and answering (Q&A) systems, especially developers of domain-driven ones, to think about using different approaches of question creation to ease the question creation task which saves a user's time. The less amount of time a user needs for content creation, the more likely he will use his time for it. I think creating questions via multiple input possibilities different from text, tailored to a user's domain will motivate people to share their knowledge. I am convinced that there are many ideas out there to improve the non-textual part of question creation apart from the automated parsing of standardized documents and choosing well-arranged metadata.

By offering people an overview over all user generated content in a domain tailored Q&A system by listing the major tags with percentages in an exploratory search, I want to support the thinking in categories, which is what our brains do even if we do not want it. The combination of the exploratory search with tags could additionally be used to show people in which topic they are experts and where they have to improve their knowledge. Even though in nowwhat it is not possible to show which topics have been covered I think this could be a big attracting factor for Q&A systems and that is why I hope to see other developers and researchers considering this.

8.6. Fields of application

The tool developed in the context of this thesis has been tailored to a specific domain. Myself and users of the system, as I found in the evaluation, see more potential for this tool in other games and other fields of application.

Think about any area where questions have something in common, are complex and thereby have to have some metadata. Metadata is a relevant factor when talking about written questions in general. People all over the globe formulate questions and add metadata in textual form to give readers every relevant detail. Most likely people do not even recognize that their questions have something in common when asking multiple questions in a specific domain.

To get the idea of how useful such a system could be in different areas think about problems in the society. No ”correct” answer exists for such questions. Depending on the problem probably the best answer will be to satisfy as many people as possible and to not harm any other people, animals or plants. The tool could be used for such society problems if they have something in common, some metadata, which is shared among the questions. The following examples demonstrate very specific possible fields of application, besides the most obvious field of application - any other RTS game.

As one can see in figure 8.1 in questions about what people can do when having certain symptoms or diseases such a Q&A system could be useful. A requirement for these questions would be that there is no reason to run to the doctor immediately like acute pain or high temperature and that the answerers are qualified to answer these serious kind of questions. When formulating such a question it is of relevance that people describe things like ”what are their symptoms”, ”how long do they already have these symptoms”, ”do they want to get answers from a school medicine or i.e. a homeopathic perspective”, ”if the symptoms are visible, do they add images of their symptoms”... This or similar information has to be in every question about what people can do when having certain symptoms or diseases. By providing users an interface to input the relevant information as metadata, they do not forget to mention it and other users are able to find questions and already existing answers more likely by filtering these, if they have similar problems. The human body is part of an individual and hence not comparable to a machine. Therefore different doctors will often have different answers to a question about the behavior of the human body. By offering qualified users to provide multiple answers and by allowing all users to vote on these, a questioner will get multiple good advices without being driven to choose one ”correct” solution. Regarding this example,

which information is really relevant for a question should of course be discussed with a group of doctors.

Another usage example would be a Q&A system for scouts about survival in the wilderness. As one can see in figure 8.3 scouts in different areas of the world could be able to ask questions similar to ”how can I survive out here” with adding metadata such as ”where do I want to survive”, ”in which season do I want to survive”, ”how long do I want to survive”, ”what tools am I allowed to use”... By adding standardized documents of information of the surrounding environment, the most important data like which fruit grows in a specific area or which berries are poisonous could be parsed and added to a question automatically. As in the case of complex RTS questions many answers can be helpful for the questioner without having only one ”correct” answer as it would often be the case for simple questions.

The application could also be used in the field of language learning. There are many translation tools out there, but asking a native speaker has most likely at least some advantages. As illustrated in figure 8.2 questions could look similar to ”how to formulate this in <my preferred language>”. The metadata of such a question could be ”which language is your question about”, ”which type of answer do you want to have (text format, audio format)”, ”do you want to have answers with full conjugation of verbs” et cetera. Most languages provide multiple ways to formulate a sentence containing the same information. Therefore many answers are possible and appreciated, without having one ”correct” answer, but it could still be very helpful when the better answers get up voted more often. To explore these kind of questions one could use tags for ”which vocabulary field is your question about”.

Imagine the application used in art when thinking of questions about why people think a painting is worth its price or not. Phrases like ”from which era is the painting”, ”which painter did draw it”, ”which technique of painting/materials has/have been used”, ”what is the price segment”, ”what’s the size of the painting”, ”what’s the current location of the painting” could be used as metadata for any kind of painting. As known art has subjective perception, which can lead to multiple good answers by different people. By uploading a standardized existing art record, information of the painting could be parsed and added to the question automatically.

I am sure that there are many other fields of application where the main concept of the Q&A system introduced in this thesis can be successful.

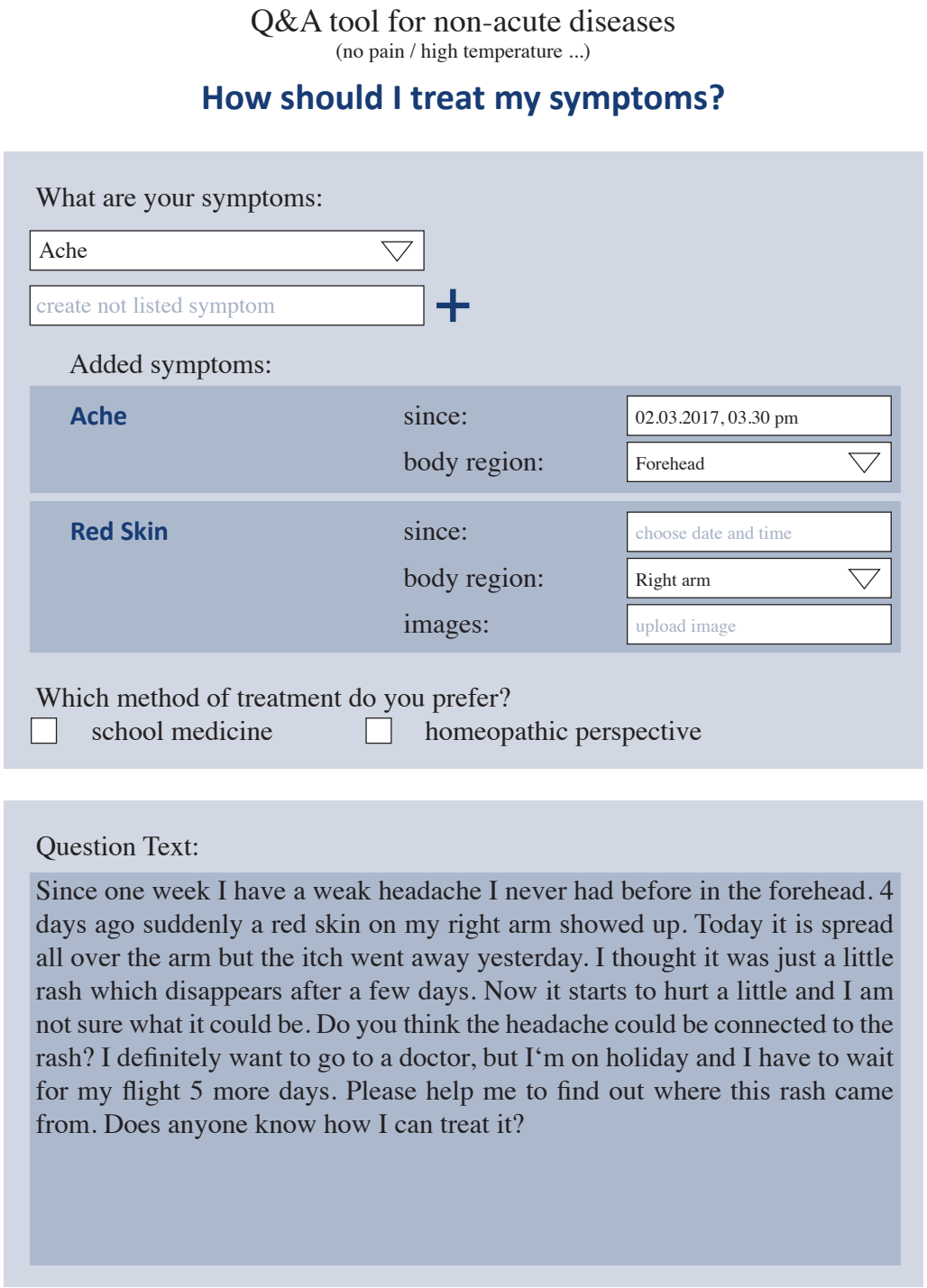


Figure 8.1.: Possible non-acute symptoms Q&A system.

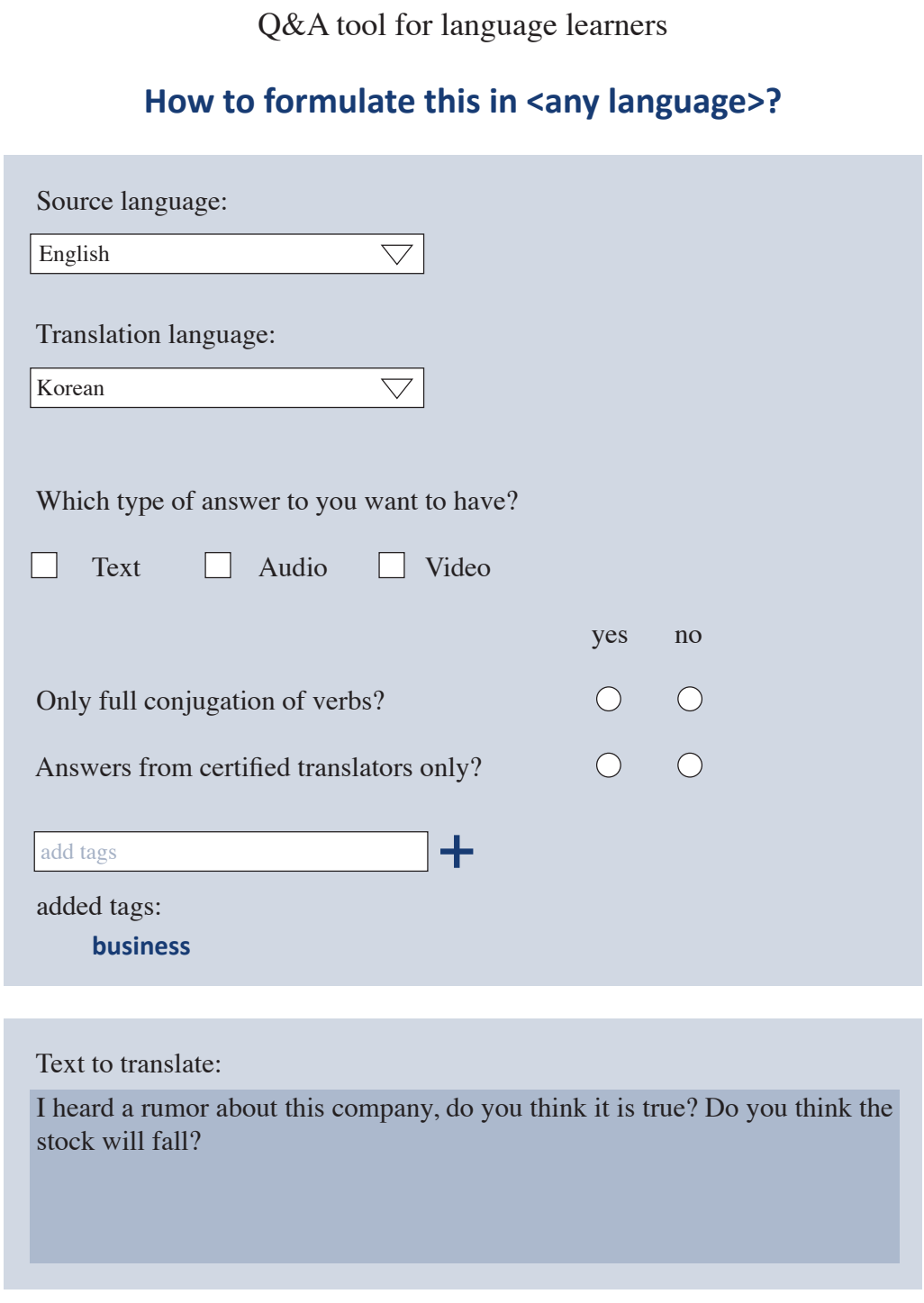


Figure 8.2.: Possible language learning Q&A system.

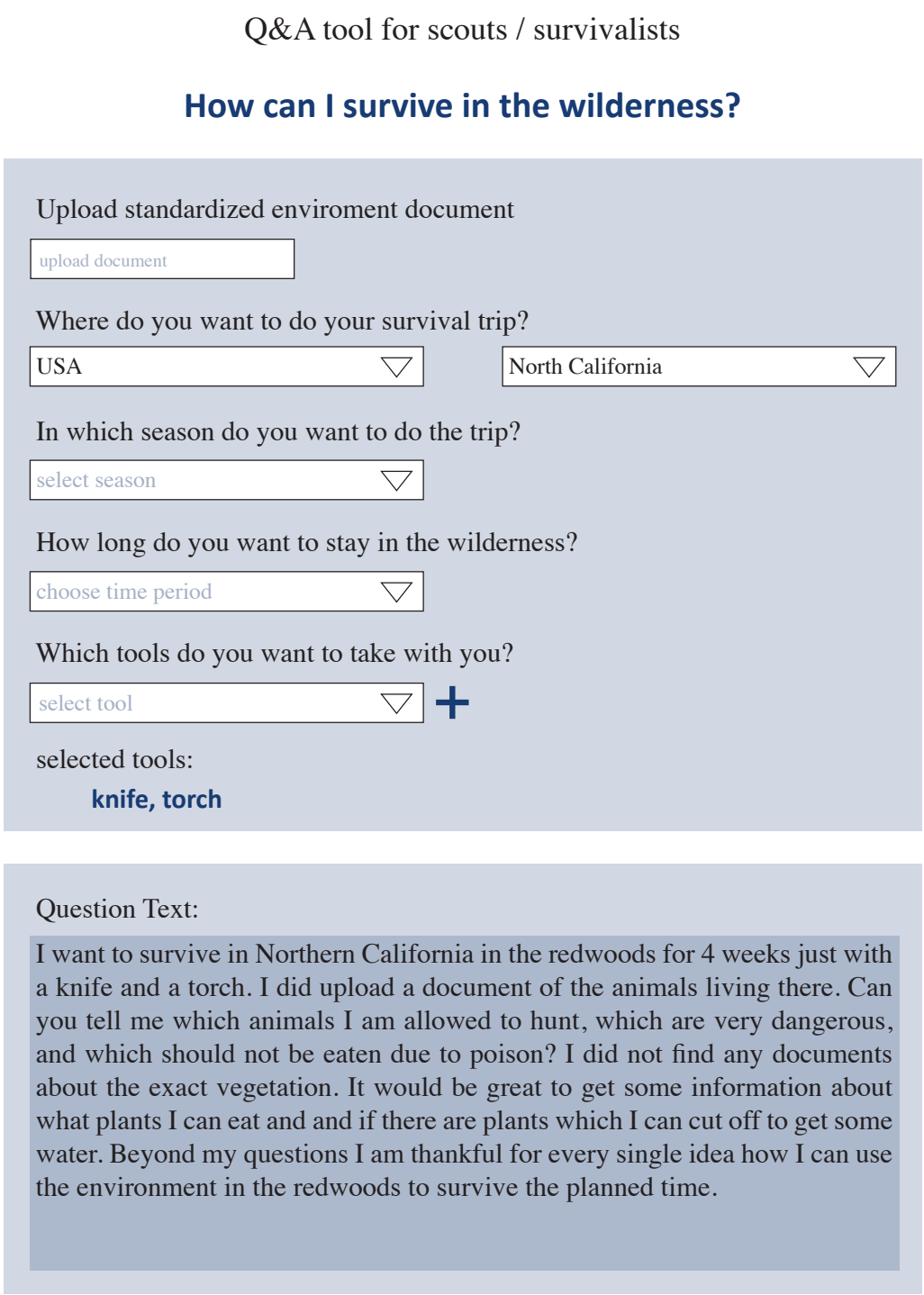


Figure 8.3.: Possible Q&A system for survivalists or scouts.

Appendix

Appendix A.

Questionnaire

Questionnaire about
Starcraft II - How to get information

Dear Starcraft II player,

thank you very much for participation!

My name is Andreas Müller and I study „Computer Science“ at Graz University of Technology. In my master thesis I will develop a web-based tool, which helps Starcraft II players, to improve their skills faster as before. To find out, if such a tool is interesting for Starcraft II players, I created this questionnaire.

Which information am I interested in?

What are you going to do after a lost Starcraft II game, outside of the game, to be able to win a game in the future which went similar to the lost one?

gl & hf press ENTER

1 → Which country are you from?*

2 → Gender*

A Male

B Female

3 → Which is your favorite race in Starcraft II?*

A Protoss

B Terran

C Zerg

D random

4 → If you want me to send an email when the tool is online, put it in here:

Your email address will not be used for anything different, not shared with third parties and all the results will be handled anonymously.

5 → **Forums/Search Engines as Source of Information**

a. Are you using the internet to look up information about Starcraft II? *

If you tick **NO** here, you don't need to continue. You can leave the questionnaire right here.

Y Yes

N No

b. How frequently are you using Reddit after playing Starcraft II?

1	2	3	4	5

Never Very Often

5 → **Forums/Search Engines as Source of Information**

b. How frequently are you using Reddit after playing Starcraft II?

1	2	3	4	5

Never Very Often

c. If you are using Reddit, how frequently are you asking questions on Reddit?

You do not have to answer the question if you are not sure.

1	2	3	4	5

Never Very Often

d. How frequently are you browsing other forums than Reddit?

1	2	3	4	5

5 → **Forums/Search Engines as Source of Information**

d. How frequently are you browsing other forums than Reddit?

1	2	3	4	5

Never — Very Often

e. If you are browsing other forums than reddit, which forums are you browsing?

To add a paragraph, press **SHIFT + ENTER**

f. If you are browsing other forums than reddit, how often do you ask questions in these forums?

1	2	3	4	5

Never — Very Often

5 → **Forums/Search Engines as Source of Information**

g. How frequently are you browsing Starcraft II fanpages?

1	2	3	4	5

Never — Very Often

h. If you are browsing Starcraft II fanpages, which?

To add a paragraph, press **SHIFT** + **ENTER**

i. How frequently do you find a solution within 5 minutes?

1	2	3	4	5

Never — Very Often

j. How frequently do you find solutions via Google without being redirected to a forum or a Starcraft II fanpage?

6 → **VODs (Videos on Demand) / Streams as Source of Information**

a. How frequently are you watching **live** videos with commentary? (observing)

1	2	3	4	5

Never — Very Often

b. How frequently are you watching **recorded** videos with commentary? (observing)

1	2	3	4	5

Never — Very Often

c. How frequently are you watching other players playing **live**?

1	2	3	4	5

6 → **VODs (Videos on Demand) / Streams as Source of Information**

d. How frequently are you watching **recorded** videos of other players playing the game?

1	2	3	4	5

Never — Very Often

e. How frequently do videos, with commentary, help you out? (observing)

In this and in the 2 following questions "live" or "recorded" is not relevant.

1	2	3	4	5

Never — Very Often

f. How frequently do videos, of players who talk during their play and give advice, help you out?

1	2	3	4	5

Never — Very Often

g. How frequently do videos, of other players who do not or who talk rarely during their play, help you out?

1	2	3	4	5

Never — Very Often

7 → **Search direction - What are you looking for in forums and videos?**

a. How frequently are you searching the internet for information regarding Starcraft II which concerns **facts of the game** (i.e.: size of a building or which unit is a „counter-unit“ to which other unit)?

1	2	3	4	5

Never — Very Often

b. How frequently are you searching the internet for information regarding Starcraft II which concerns **a specific game situation** and you have been unsure while playing the game what to do next? („what to do if“-questions)

c. How frequently are you searching the internet for information regarding Starcraft II which concerns **strategies**, which are especially **relevant** in the **beginning of a game** (i.e.: build order at the matchup PvZ)?

1	2	3	4	5

Never — Very Often

8 → **Self-Analysis / Strategies for Improving Game Performance**

a. How frequently are you analyzing your own replays?

1	2	3	4	5

Never — Very Often

b. How frequently are you talking to other Starcraft II players about strategies and ask them questions about Starcraft II respectively?

1	2	3	4	5

8 → **Self-Analysis / Strategies for Improving Game Performance**

c. If you are talking to other players about Starcraft II, how frequently do you find a solution without searching the internet?

1	2	3	4	5

Never — Very Often

d. Do you generally want to improve yourself/your gameplay in Starcraft II?

- [Y] Yes
- [N] No

9 → **Satisfaction with Search Results**

a. How frequently would you like to have a better solution/strategy even when you found a solution?

You do not have to answer the question if you are not sure.

9 → **Satisfaction with Search Results**

b. How frequently do you think, that you are only partly satisfied with a found solution?

You do not have to answer the question if you are not sure.

1	2	3	4	5

Never — Very Often

c. If you are browsing answers to questions of other players, how frequently have all relevant things (i.e.: game history or a replay) been included?

You do not have to answer the question if you are not sure.

1	2	3	4	5

Never — Very Often

d. How much effort do you spend on improving your Starcraft II performance?

9 → **Satisfaction with Search Results**

e. How frequently are you using other information resources, which are not mentioned here, to improve in Starcraft II? (apps, guides, other websites, etc.)

1	2	3	4	5

Never — Very Often

f. Type the first information resource you are using in here:

If you do not use other information resources you can leave this empty.

g. How frequently are you using your first information resource?

Please answer this question only if you entered a first information resource above.

1	2	3	4	5

Never — Very Often

9 → **Satisfaction with Search Results**

h. Type the second information resource you are using in here:

If you do not use other information resources you can leave this empty.

i. How frequently are you using your second information resource?

Please answer this question only if you entered a second information resource above.

1	2	3	4	5

Never — Very Often

j. Type the third information resource you are using in here:

If you do not use other information resources you can leave this empty.

k. How frequently are you using your third information resource?

9 → **Satisfaction with Search Results**

l. Which other strategies for becoming better at Starcraft II do you have?

m. How frequently are you looking up a problem a couple of times, when you do not get confronted with it regularly and have forgotten the solution?

1	2	3	4	5

Never — Very Often

n. How frequently are you using known tools like websites, forums and similar tools to find fast and accurate answers to your questions?

1	2	3	4	5

Never — Very Often

9 → **Satisfaction with Search Results**

o. How frequently are the search results in the web up 2 date regarding Starcraft II Balancing-Patches (on average)?

1	2	3	4	5

Never Very Often

p. How frequently do websites offer the opportunity to describe a game situation not only by using text?

1	2	3	4	5

Never Very Often

q. How many websites are there in your opinion, which can answer nearly every question concerning Starcraft II in detail?

1	2	3	4	5

r. How many websites are there in your opinion, which allow you to ask a question to a specific game situation and which gets you an useful answer as well?

1	2	3	4	5

way too few — more than enough

10 → **Time spent for Starcraft II improvement**

“ I think that most of the Starcraft II players reach a certain point where they “give up”, because they are not able to improve their selves without the help of others. The tool should give players the opportunity to connect and learn from each other. My goal is that players do not lose their enthusiasm about Starcraft II and are able to improve their knowledge about the game outside of the game.

In case you already typed in your e-mail address in the beginning of the questionnaire I will contact you by the time the tool is online.

Thank you very much for your help and your time! If you like my idea please recommend this questionnaire to a friend.

GG press ENTER

11 → In the next months I will start creating the first prototypes, if you are interested in what's going on and maybe want to suggest improvements you are welcome. Do you want me to send you an email to test a prototype when it's ready? If yes, please do not forget to fill in your e-mail adress in the beginning of the questionnaire.

Y Yes

N No

Appendix B.

Heuristic Evaluation

The results table shows the statement, the degree of validity (DOV) and optional or mandatory explanations of the four evaluators. The DOV lies between 1 and 5, where 1 means that the guideline statement has been completely fulfilled and 5 means the guideline statement has been completely ignored. An "i" means the guideline statement seems irrelevant. Guideline statements with a DOV above 2 have to be extended by an explanation why the DOV has been assigned, the ones with a DOV below or equal to 2 can have an explanation optionally. Guidelines marked with an asterisk are supported by empirical data.

Table B.1.: Heuristic evaluation 2

Evaluator	Statement/Explanation	DOV
	1: Let people provide answers in a format that they are familiar with from common situations and keep questions in an intuitive sequence.	
evaluator 1	*The input is not in a format people are familiar with.*	4
evaluator 2	-	1
evaluator 3	-	1
evaluator 4	-	1
	2: If the answer is unambiguous, allow answers in any format.	
evaluator 1	-	1
evaluator 2	-	2

evaluator 3	-	i
evaluator 4	-	i
	3: Keep the form as short and simple as possible and do not ask for unnecessary input.	
evaluator 1	*The question create form is very long but it has to be that long. Nearly all the input is necessary. The additional info fields could be unnecessary depending on the question, but this input can be added automatically*	3
evaluator 2	-	1
evaluator 3	-	1
evaluator 4	-	1
	4*: If possible and reasonable, separate required from optional fields and use color and asterisk to mark required fields.	
evaluator 1	*Only asterisk has been used to mark required fields and required have not been separated from optional fields, but this was not possible, because the replay could be used to populate required fields but is itself optional.*	3
evaluator 2	*Asterisk are used but there is no color difference to optional fields. Required and optional fields are not separated.*	3
evaluator 3	*There is no separation of optional and required fields.*	4
evaluator 4	*Required fields are marked with asterisks, but are not necessary at first and asterisk symbol is not described as required*	3
	5*: To enable people to fill in a form as fast as possible, place the labels above the corresponding input fields.	
evaluator 1	*The input labels are on the left of the input fields.*	5
evaluator 2	-	2
evaluator 3	*It's a wild mixture of label placement - the majority is placed left of the input fields.*	4
evaluator 4	-	1
	6: Do not separate a form into more than one column and only ask one question per row.	

evaluator 1	-	2
evaluator 2	-	2
evaluator 3	*All forms have just one column but in two cases two questions are asked per row.*	3
evaluator 4	-	2
	7*: Match the size of the input fields to the expected length of the answer.	
evaluator 1	-	1
evaluator 2	-	1
evaluator 3	-	2
evaluator 4	*Map input field seems to be to large*	3
	8: Use checkboxes, radio buttons or drop-down menus to restrict the number of options and for entries that can easily be mistyped. Also use them if it is not clear to users in advance what kind of answer is expected from them.	
evaluator 1	*Choosing existing tags should be a drop-down menu with searching feature and not just a field with searching feature and autocompletion.*	3
evaluator 2	-	1
evaluator 3	-	1
evaluator 4	-	1
	9*: Use checkboxes instead of list boxes for multiple selection items.	
evaluator 1	*There are no checkboxes.*	i
evaluator 2	*I didn't see any checkboxes.*	i
evaluator 3	-	i
evaluator 4	-	i
	10*: For up to four options, use radio buttons; when more than four options are required, use a drop-down menu to save screen real estate.	
evaluator 1	*There is only one case where 7 radio buttons are used, but these are not actual radio buttons but images.*	2

evaluator 2	*I didn't see any radio buttons.*	i
evaluator 3	-	2
evaluator 4	-	i
	11: Order options in an intuitive sequence (e.g., weekdays in the sequence Monday, Tuesday, etc.). If no meaningful sequence is possible, order them alphabetically.	
evaluator 1	-	2
evaluator 2	-	1
evaluator 3	-	1
evaluator 4	*Tags and maps are not sorted alphabetically; game version number under 'sort by up-to-dateness' is misplaced*	4
	12*: For date entries use a drop-down menu when it is crucial to avoid format errors. Use only one input field and place the format requirements with symbols (MM, YYYY) left or inside the text box to achieve faster completion time.	
evaluator 1	-	i
evaluator 2	-	1
evaluator 3	-	i
evaluator 4	-	i
	13*: If answers are required in a specific format, state this in advance communicating the imposed rule (format specification) without an additional example.	
evaluator 1	-	2
evaluator 2	-	1
evaluator 3	-	i
evaluator 4	*Time format is not entirely clear*	3

	14*: Error messages should be polite and explain to the user in familiar language that a mistake has occurred. Eventually the error message should apologize for the mistake and it should clearly describe what the mistake is and how it can be corrected.	
evaluator 1	-	2
evaluator 2	-	1
evaluator 3	-	1
evaluator 4	-	2
	15: After an error occurred, never clear the already completed fields.	
evaluator 1	-	1
evaluator 2	-	2
evaluator 3	-	1
evaluator 4	-	1
	16*: Always show error messages after the form has been filled and sent. Show them all together embedded in the form.	
evaluator 1	*Some error messages are shown before the form has been sent.*	3
evaluator 2	-	2
evaluator 3	-	1
evaluator 4	-	2
	17: Error messages must be noticeable at a glance, using color, icons and text to highlight the problem area and must be written in a familiar language, explaining what the error is and how it can be corrected.	
evaluator 1	-	1
evaluator 2	-	1
evaluator 3	-	1
evaluator 4	-	1

	18: Disable the submit button as soon as it has been clicked to avoid multiple submissions.	
evaluator 1	-	2
evaluator 2	-	2
evaluator 3	-	i
evaluator 4	-	1
	19: After the form has been sent, show a confirmation site, which expresses thanks for the submission and states what will happen next. Send a similar confirmation by e-mail.	
evaluator 1	*There is never shown a confirmation site, but always a confirmation message which does thank for the submission and what will happen next if this is necessary. A confirmation is not sent per e-mail in every case.*	4
evaluator 2	-	1
evaluator 3	-	1
evaluator 4	*neither a confirmation message is shown nor an e-mail is sent when creating a question*	5
	20*: Do not provide reset buttons, as they can be clicked by accident. If used anyway, make them visually distinctive from submit buttons and place them left-aligned with the cancel button on the right of the submit button.	
evaluator 1	*There is one reset button, but it is only used for filtering forms. It has to be right aligned due to the context positioning around it. Users do not lose input data, therefore there is no cancel option after pressing the reset button. It is visually distinctive from submit buttons.*	2
evaluator 2	-	1
evaluator 3	-	1
evaluator 4	-	1

The ∅ DOV of all statements considering the 4 evaluators is **1.88**.

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