University of Huddersfield

MEng Group Project

Cryptic Crossword Solver

Problem Analysis Document

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Problem Analysis

An initial problem analysis has been conducted to ensure that the overall project remains focused upon the original problem.

This chapter will discuss key topics and will recommend that these topics are researched further to help support the project. The problem analysis will also define the problem in more detail, to help with understanding the project and its purpose.

1.1 Problem

A typical crossword involves a grid with black squares, not to be filled in by the solver, and white squares used by the solver to input their answers. The input comes from the solver working out the answer to given clues. These clues have an orientation, a length and a number associated with its related position within the grid. The fundamental difference between a typical crossword and a cryptic crossword are the clues themselves.

Cryptic crosswords are a popular type of puzzles found in many parts of the world. Most common-wealth national newspapers will print cryptic crosswords of varying difficulty on a daily basis.

Cryptic crosswords are a unique style of crosswords, in which the answer to each given clue is a word puzzle. An answer can only be obtained if the cryptic clue is read in the correct way. Often when the clue is surface read, the clue makes no sense at all. The challenge is to find a way in which the reading of the clue leads to a solution. To aid with solving cryptic crosswords, the clues are written to be within specific categories, such as reversals and anagrams, which have individual characteristics.

Many users can often become frustrated when a clue appears to be unsolvable. It is the vast range of possible clues that often makes solving not only challenging but interesting as well.

Fundamentally, the overall aim of this project is to develop a piece of software that is able to solve any given type of cryptic crossword clue.

1.2 Product

Within this group project, three components will be delivered. The first deliverable is the final, working piece of software. Whilst the second and third deliverables are written reports. The second deliverable is a group written report comprising of the all research and implementation details of the software product. The final deliverable will be each member's individual analysis and evolution of the project as a whole.

Based upon the given background and problem information it could be possible to develop a product that is able to solve the given problem.

The final product would be a piece of software that is able to understand a given clue and try to deduce what the answer to the clue is. This would require the software to have some form of natural language processing component as well as one or more cryptic crossword algorithms. Once a clue has been correctly "guessed" it can simply be returned to the user. It is the "guessing" of the answer that this project will primarily focus upon.

In order to gain maximum user coverage, the software must have an easy to use interface. The main reason for this is that the computer literacy of the intended users is not known - although basic computer literacy is assumed.

1.3 Client & Stakeholders

Dr Hugh Osborne, a lecturer from the University of Huddersfield will be the client for the group project. Dr Hugh Osborne has a keen interest in cryptic crosswords and the problem in the area which the group intends to help to eliminate. The role of the client for the group project will be to input ideas and potential requirements which Dr Hugh Osborne, as an experienced solver of cryptic crosswords, would consider to be necessary. As a client for the project, Dr Hugh Osborne will also be present for academic demonstrations.

Dr Gary Allen, Sotirios Batsakis and Colin Venters, all lecturers at the University of Huddersfield, will act as stakeholders for the group project. Dr Gary Allen will be the most involved external individual as the project supervisor. The role of project supervisor requires frequent meetings with the team to monitor the development of the project, provide guidance as well as opinion on certain aspects of the life cycle.

Sotirios Batsakis and Colin Venters, will have a less active role within the project during the project life cycle than the role of the client or the project supervisor. These stakeholders will play active roles at particular milestones of the group project such as providing guidance

for the proposal of the project and at the project demonstration approximately half way through the life cycle.

1.4 Users

Kathryn Friedlander and Philip Fine (Friedlander and Fine, 2009) carried out an investigation into whether the amount of cryptic crosswords completed by a solver determined how successful they were at solving them. To complete this study they gathered data from 241 people and have deduced the following facts about the user base (Friedlander and Fine, 2009):

- "209 M, 32 F"
- "mean age=53 years, range=23 – 83"
- "mean time spent=8 hours per week, range=1-30"

To support decisions made within the project life cycle an additional quantitative research method has been utilized to gain a larger understanding of the types of users the deliverable will attract. The research method used by the team is in the form of a survey.

The survey results gathered were seen as additional justifications for the purpose of the project. Moreover, data collected from the survey was expected to indicate the locations in which users complete cryptic crosswords to understand the potential need for the deliverable to be of a transportable nature.

The following questions were asked:

1. Do you play Cryptic Crosswords?
2. How often do you play?
3. Where do you play?
4. Do you often finish them?
5. If no to the previous question, what reason don't you finish them?
6. What is your age group?
7. When do you play Cryptic Crosswords?
8. What gender are you?
9. What is the Highest qualification you have?
10. What platform is your mobile phone on?

The survey was conducted between (date) and (date). It was distributed across the the University of Huddersfield portal message board, Facebook and Twitter. The results of this survey are shown in figure 1.1 and figure 1.2.

1.4.1 Results

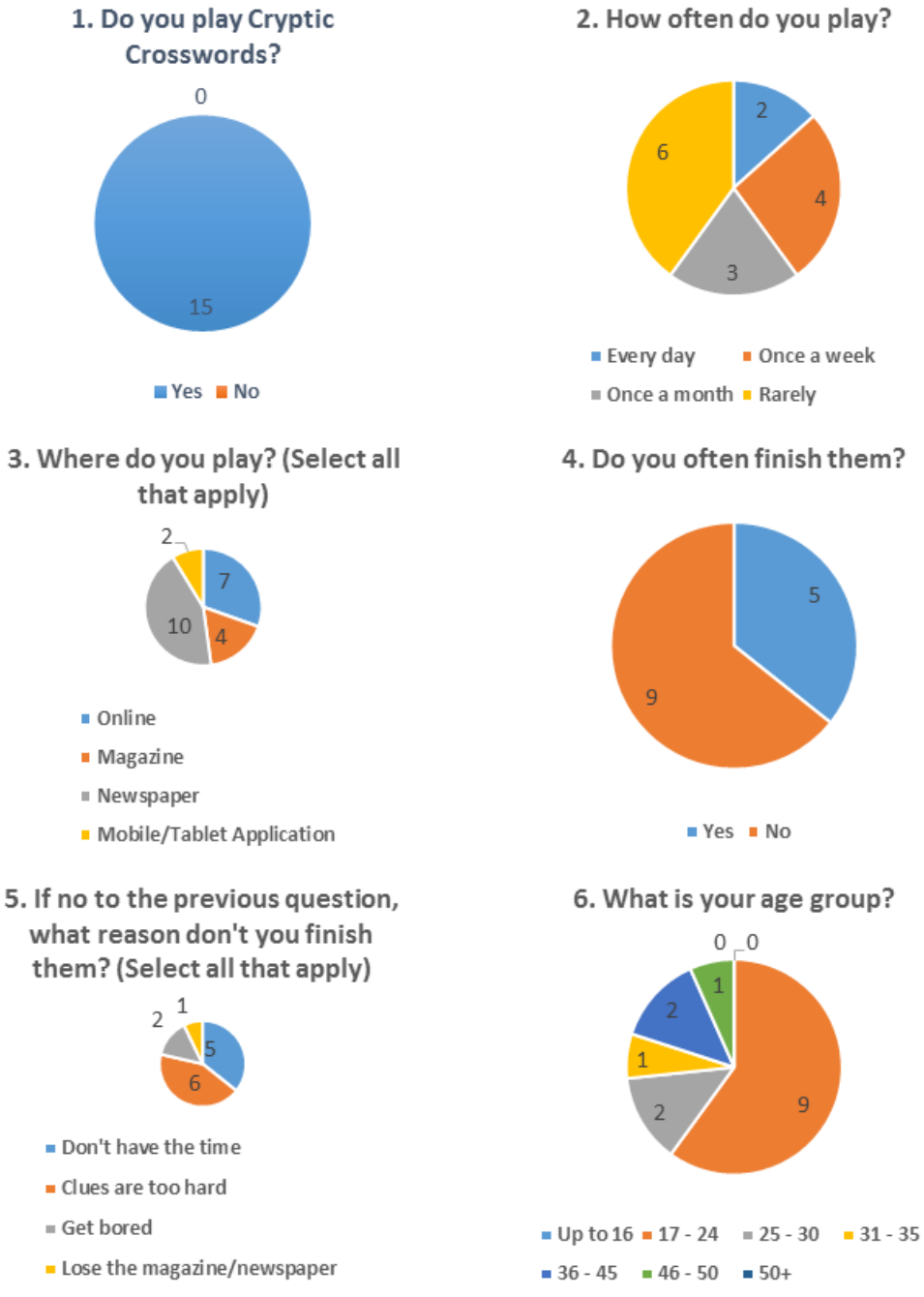

Figure 1.1: Results for survey questions 1 - 6

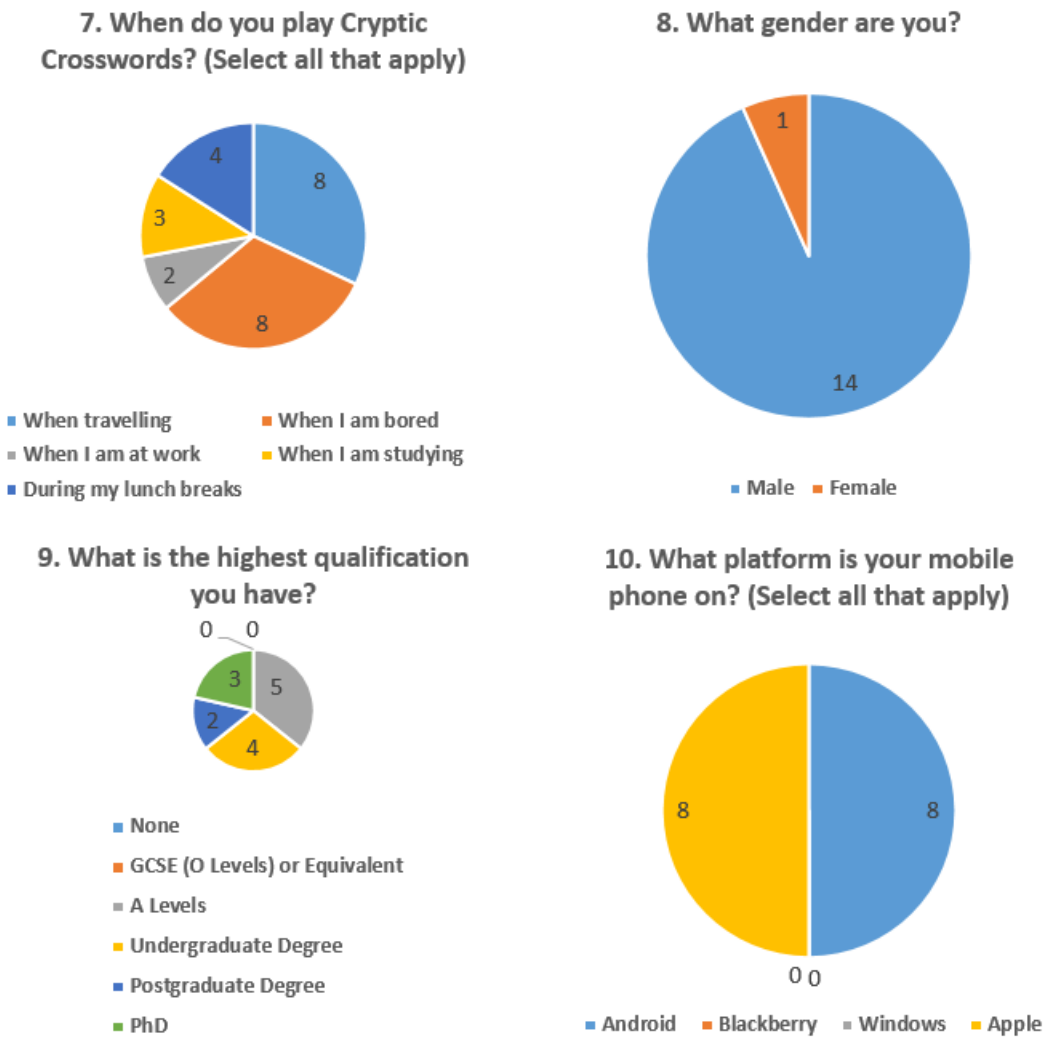

Figure 1.2: Results for survey questions 7 - 10

From these results it can be deduced that .....

1.5 Research Areas

Before undertaking the project an initial review was conducted. The review's objective was to determine the feasibility of the project as a whole. The review also covered whether or not the project has been completed before.

From the outlined background and problem information it is clear that cryptic crosswords are a popular form of entertainment. It is also clear that some clues are particularly difficult to solve, and users may often ask other people for help in solving a given clue.

1.5.1 Cryptic Crosswords

A review of the national UK newspapers was conducted to determine whether or not there is a pattern in cryptic crosswords. Of all the newspaper's websites that were reviewed (The Guardian, The Times, The Independent and The Mirror) it was clear that all cryptic crosswords are of the same style.

Each clue is categorised as being either 'across' or 'down' with its corresponding grid number, as well as containing the number of letters the answer should be. An example is show below:

12. The seamstress's sensation? (4, 3, 7) =>PINS AND NEEDLES

The Guardian's website utilises web standard technologies such as HTML and CSS, and also provides an option to solve a clue. The Mirror's website follows a similar approach to the Guardian's website; however solutions can only be obtained by dialing a premium telephone number.

The Times and the Independent both utilise a different approach and that is to serve a Java applet. Both Java applets allow the user to solve a clue should they get stuck. The Times provides puzzles as part of their paid subscription service.

All of the above newspapers publish cryptic crosswords upon a daily basis, with the solutions to the crosswords appearing in the next day's newspaper.

Following from the crossword review, a second review into cryptic crossword solvers was undertaken. The objective of this review was to determine whether or not computerised cryptic crossword solvers exist. The three cryptic crossword solvers that were identified were One Across, Crossword Tools and Cryptic Solver.

Each of the solvers manages to solve some clues with the same answers, with other clues providing a range of possible answers.

Crossword Tools (Crossword Tools, 2013) is a paid subscription based service, which allows users to enter a clue and a pattern. A pattern can contain part of the answer or the number

of letters the answer has. If multiple answers are available, they are displayed. An example is shown below:

Kind of dog (10) =>the answer is 10 letters long.

Kind of dog (?????????r) =>the answer is 10 letters long, final letter is 'r'.

Cryptic Solver (Cryptic Solver, 2013) is a free service that offers the same functionality as Crossword Tools. Although Cryptic Solver does provide the correct answer, it does not necessarily provide the correct answer at the top of the list.

Finally One Across (One Across, 2013) provides all the same functionality as the previous two solvers, along with a score. The score is linked to the number of people who have used the given answer (effectively it's a ratings system). One Across uniquely highlights how it has managed to deduce the answer, showing the break downs of each sentence. As with Cryptic Solver, One Across is a free service that doesn't require a subscription.

1.5.2 Natural Language Processing

In order to correctly solve a clue, some form of natural language processing may be required. It is the natural language processing that could try to deduce the meaning of a clue. It is the meaning that can then be aligned with possible answers.

An example of natural language processing can be found within the One Across application. Given a clue (and a pattern) it will try to provide an accurate solution:

Spin broken shingle (7) =>ENGLISH

In order for the answer to be obtained, One Across will follow a natural language processing path and will provide it's trace path. The trace path shows how the clue has been broken down to get to the answer. The trace path for the above clue can be found below:

'spin' is the definition.

'broken' means to anagram 'shingle' to get ENGLISH.

ENGLISH matches 'spin' with confidence score 100%.

1.5.3 Application Platform

The existing products that have been discussed within this problem analysis have all been accessible via a browser. Although this is an acceptable platform, there could be a better platform that allows uses to utilise the technology easier.

As previously mentioned, most crosswords are designed for users who have a few minutes to spare on the move. With the recent trends in owning a smartphone or tablet, there may be a gap in the market for a high quality mobile cryptic crossword solver.

An in-depth review will need to be conducted in order to deduce the viability of this proposal.

Glossary of Terms

The following section contains a glossary with the meanings of all names, acronyms, and abbreviations used by the stakeholders.

Term/Acronym	**Definition**
The Guardian	A newspaper with a website featuring cryptic crosswords
Blackberry	A mobile phone platform by Blackberry
iOS	A mobile phone platform by Apple
Android	A mobile phone platform by Google
NLP	Natural Language Processing
SRS	Software Requirements Specification
App	Short for application

Bibliography

Crossword Tools (2013). Clue solver. Retrieved from `http://www.crosswordtools.com/cm/`.

Cryptic Solver (2013). Solver. Retrieved from `http://cryptic-solver.appspot.com/`.

Friedlander, K. and Fine, P. (2009). Expertise in cryptic crossword performance. In *An exploratory survey*, Auckland, New Zealand. International Symposium on Performance Science.

One Across (2013). Crossword puzzle help. Retrieved from `http://www.oneacross.com/`.