



INCUMBO

Concentration monitor for MindGames

Spring 2012

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1. Preface

This project was done in collaboration with MindGames. The representative from MindGames was Deepa Iyengar and the team's instructor was Bjarki Guðlaugsson.

As stated on the MindGames website (MindGames, 2012) MindGames are “developers of iPhone/iPad games which users control by relaxing and concentration, via consumer brainwave headsets which are powered by NeuroSky technology”. (NeuroSky, NeuroSky, 2012).

The work began January 6th 2012 and finished May 11th 2012.

2. Introduction

The project is about creating a prototype of a computer program which helps people to become more aware of their concentration. Sometimes people realize when they have been reading a book for some time, that they find it difficult to stay focused. This prototype is going to help people to recognize when they lack concentration, and offer a list of games to play to recover their focus.

The tools the team used to develop the prototype were:

- Visual Studio 2010 C# (Microsoft, Visual Studio)
- ZedGraph (Champion, 2012)
- Microsoft SQL Server Compact 4.0 (Microsoft, Microsoft SQL Server Compact 4.0, 2012)
- XNA Library (Microsoft, XNA Library, 2012)
- ThinkGearNet (Peek, 2012)

The Incumbo name was chosen because it means *to concentrate* in Latin.

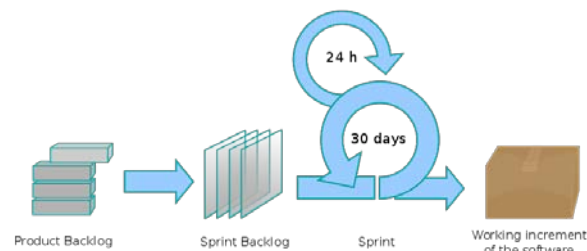
3. Project Analysis

3.1 Method (Scrum)

The team used Scrum to plan and execute the software development. Scrum is an iterative and incremental software-development method and is a part of the Agile Software Development method, Figure 1 shows the process.

In Scrum every team member is assigned a special role.

Figure 1



(Lakeworks, 2012)

These were the roles assigned to the team:

Product owner:	Deepa Iyengar
Scrum master:	Lúðvík Bjarnason
Scrum team:	María Hlín Steingrímsdóttir Helgi Siemsen Sigurðarson Lúðvík Bjarnason

The project started with sprint zero, where the product backlog was created. Before each sprint the team created a sprint backlog containing user stories. The stories were assigned points with planning poker; the points were 1, 2, 4, 5, 8, 13 and 20. If a story got 20 points, it was broken down into smaller stories.

The product owner then confirmed the sprint backlog. When the sprint backlog had been confirmed the stories were broken into tasks and assigned to the team members.

The team had daily meetings. Often the team met in Reykjavik University, except on Thursdays when the meeting was online. In the daily sprint the team members reported what they did the day before and if any problems had occurred they discussed them. Furthermore, they shared with the team what they had planned for current day. In the last weeks of the project the team worked so tightly together that daily scrum meetings were unnecessary.

The team also met with the team's instructor, Bjarki Guðlaugsson, to get advice on status meetings, project planning and some minor problems. The team ended the sprint with a sprint review where Deepa Iyengar reviewed the tasks and verified that they had been completed.

Then the team conducted the sprint retrospective where the team reviewed the sprint and listed what went well, what was bad and what should have been done better.

3.2 Work Schedule

The schedule was organized as seven two week sprints and three one week sprints. The team had a different schedule for the first seven sprints and made sure that at least two people were working together at a time. Table 1 shows the work schedule for the first seven sprints. Note that meetings are not taken into account in the schedule

Table 1

	Mon	Tue	Wed	Thu	Fri
María			8		8
Lúðvík		8			8
Helgi		8	8		

Note. The table shows the first seven sprints where each sprint lasted for two weeks.

In Table 2 the schedule for the last three sprints are shown, the team tried to work every day however weekends were added also in the last two sprints to finish all reports.

Table 2

	Mon	Tue	Wed	Thu	Fri
María	8	8	8	8	8
Lúðvík	8	8	8	8	8
Helgi	8	8	8	8	8

Note. The table shows the last three sprints where each sprint lasted for one week.

Here you can see the overall hours that the group spent in total, divided into sprints:

Table 3

	María	Lúðvík	Helgi	Total	Days
Sprint zero	30,58	38,42	26,92	95,92	21
Sprint one	36,58	34,34	30,73	101,65	14
Sprint two	26,51	27,06	22,92	76,49	14
Sprint three	20,24	21,9	23,92	66,06	14
Sprint four	17,33	16,17	20,67	54,17	14
Sprint five	38,26	47,74	37,72	123,72	14
Sprint six	27,00	27,9	25,25	80,15	14
Sprint seven	59,66	61,07	63,58	184,31	12
Sprint eight	43,08	42,53	47	132,61	5
Sprint nine	49,50	42,39	37,42	129,31	6
Total	348,74	359,52	331,13	1044,39	128

Note. The table shows the hours spent on the project for each sprint

3.3 Risk Analysis

The purpose of the risk analysis was to identify for problems that might occur during the sprint and then make plans for how to deal with them, as seen in table 4.

Table 4

Odds	Description	Effects	Response	Responsibility
10%	Illness.	Hinders work.	Work from home or reschedule the work.	Lúðvík
50%	Other school work gets in the way.	Hinders work.	Work from home or reschedule the work.	Lúðvík
20%	Personal reasons.	Hinders work.	Work from home or reschedule the work.	Lúðvík
60%	Group members can't attend meetings.	Hinders work.	Meeting conducted through emails or msn.	Lúðvík

Odds	Description	Effects	Response	Responsibility
40%	Lack of knowledge.	Hinders work or the user story becomes unachievable.	Work from home and do more research otherwise drop the user story.	Lúðvík
5%	Headset does not work.	Hinders work.	Get a new Headset.	Helgi
15%	Transportation difficulty.	Late for a meeting or can't make it.	Work from home or make the meeting longer.	Lúðvík
1%	Bitbucket does not work.	Can't commit code.	Wait for it to go back up or change to google.code.	María
10%	Computer problems.	A group member can't work independently.	Get a spare computer or use pair programming.	María
10%	Headsets interfere with the program.	The headset uses too much memory.	User story 31 gets higher priority.	Lúðvík

Note. The table shows the risk analysis.

3.4 Workspace

The team worked mostly from home or in Reykjavik University, but all meetings with Deepa were conducted in MindGames, Lækjargata 12, 4th floor.

4. Sprints

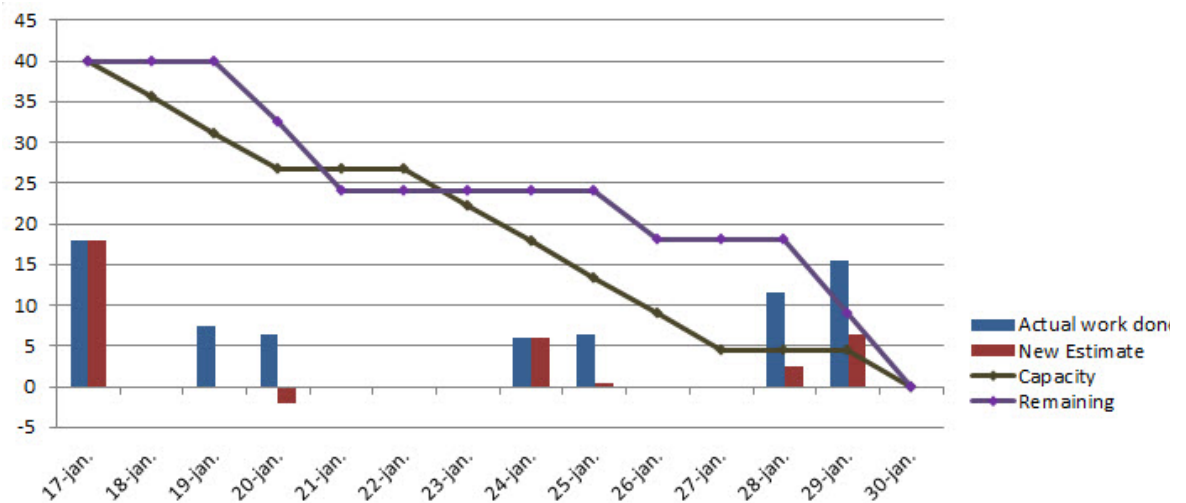
Following is a description of the nine sprints that were conducted throughout the period.

Figures 2 - 11 show how the team planned the sprint (capacity), how the work progressed (remaining), the hours spent working on the tasks (actual work done) and the change in estimated hours for the tasks (new estimate).

4.1 Sprint zero

In sprint zero, the team created a product backlog and planned for the next sprint. Additionally, the team set up programming environment.

Figure 2

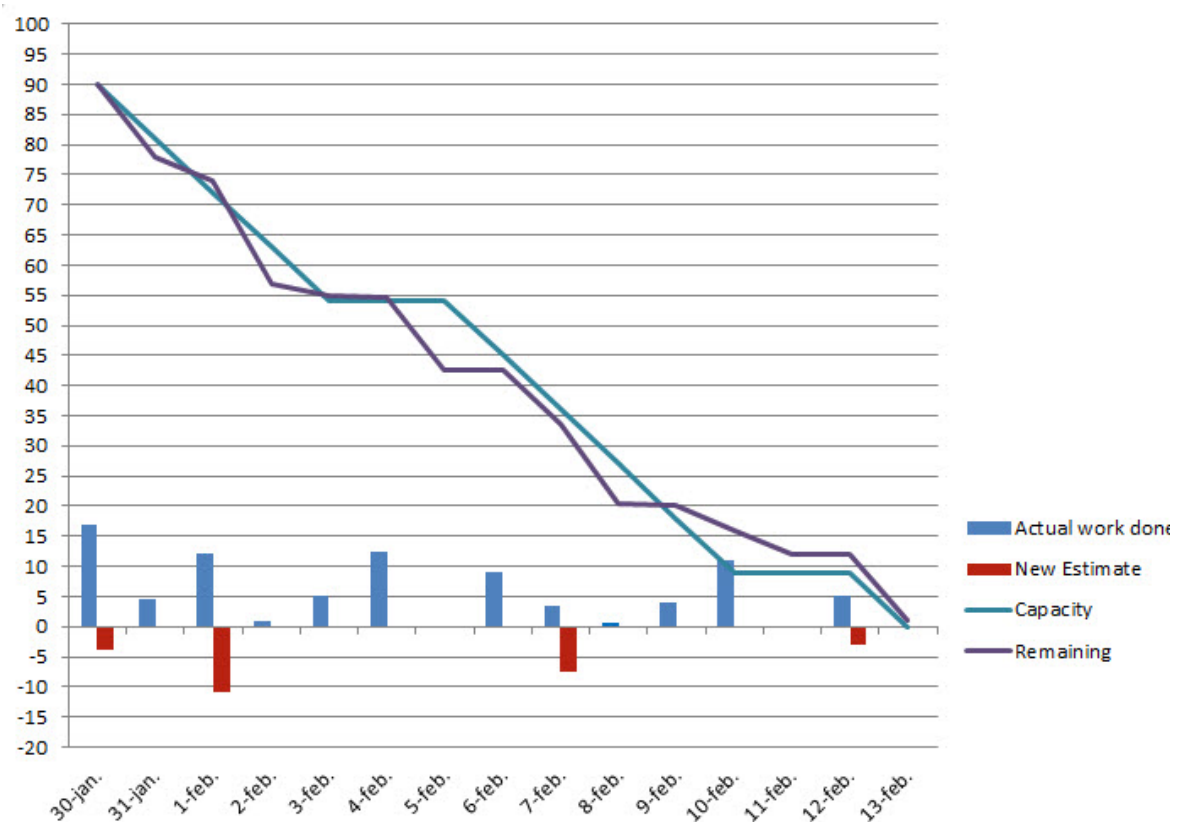


Note. The figure shows progress of sprint zero.

4.2 Sprint one

In sprint one, the team created the layout for the prototype and connection to the headset. The team also prepared for the first status report.

Figure 3

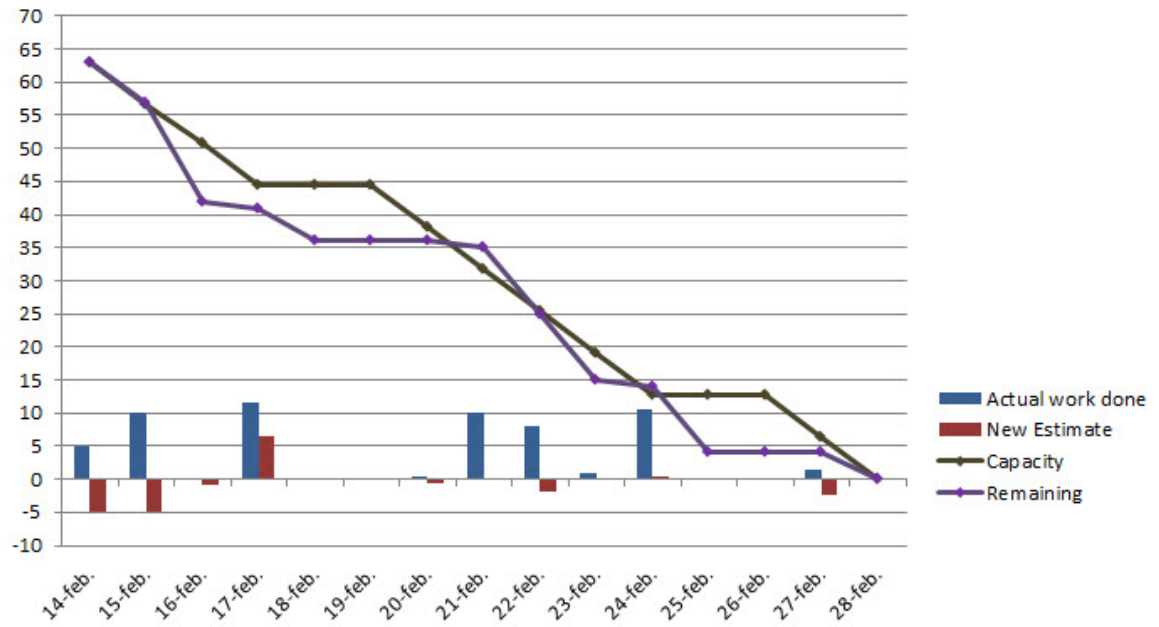


Note. The figure shows progress of sprint one.

4.3 Sprint two

In sprint two, the team started recording and storing concentration to XML and added taskbar icon.

Figure 4

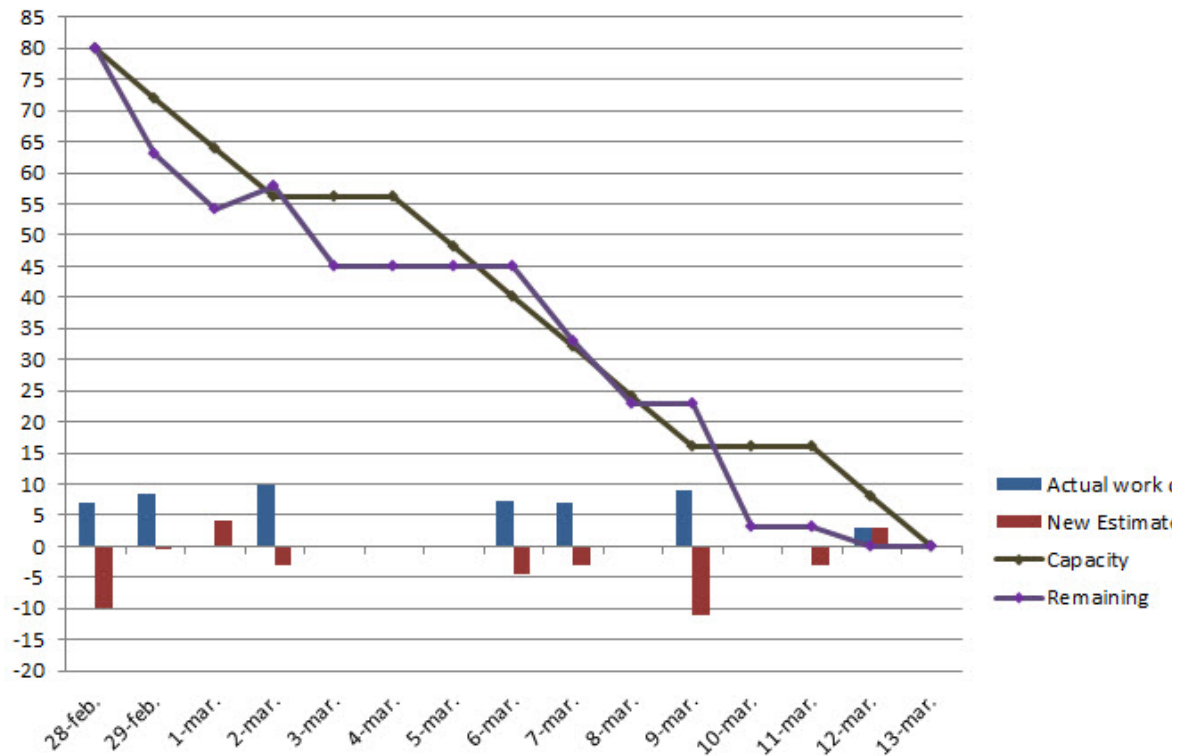


Note. The figure shows progress of sprint two.

4.4 Sprint three

In sprint three, the team added a popup window for alerting the user if his concentration was low. Linear graph handling was implemented; a library called ZedGraph (Champion, 2012) was used to display the current concentration level. Moreover, there was a preparation for status report number two.

Figure 5

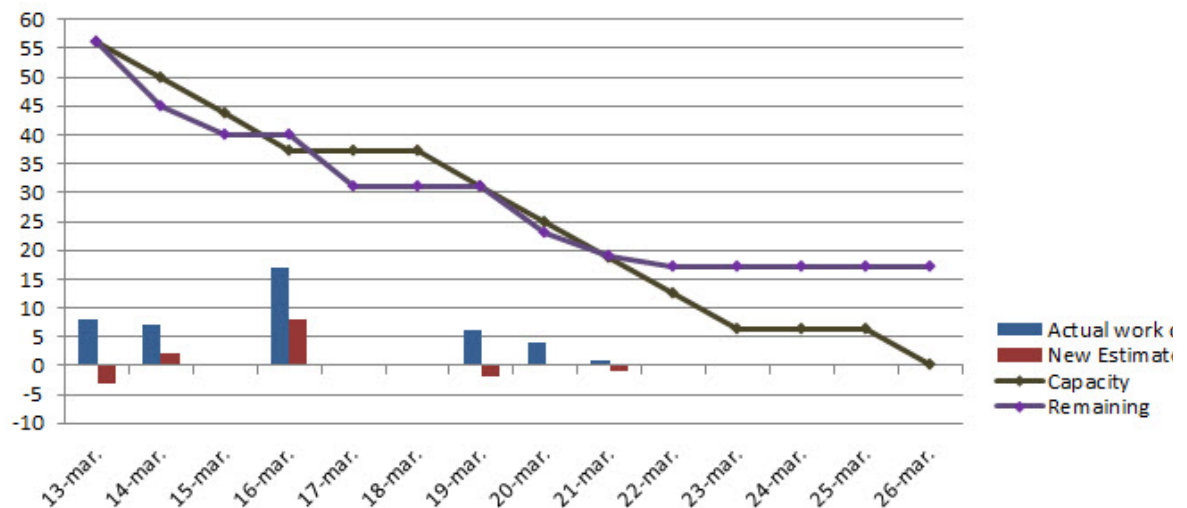


Note. The figure shows progress of sprint three.

4.5 Sprint four

In sprint four, a real data from the headset was plugged into the ZedGraph (Champion, 2012), instead of previous dummy data. Furthermore the team started designing an achievement system. At this time, there were other school projects the team members had to attend to and thus, due to lack of time, they did not manage to finish all the stories

Figure 6

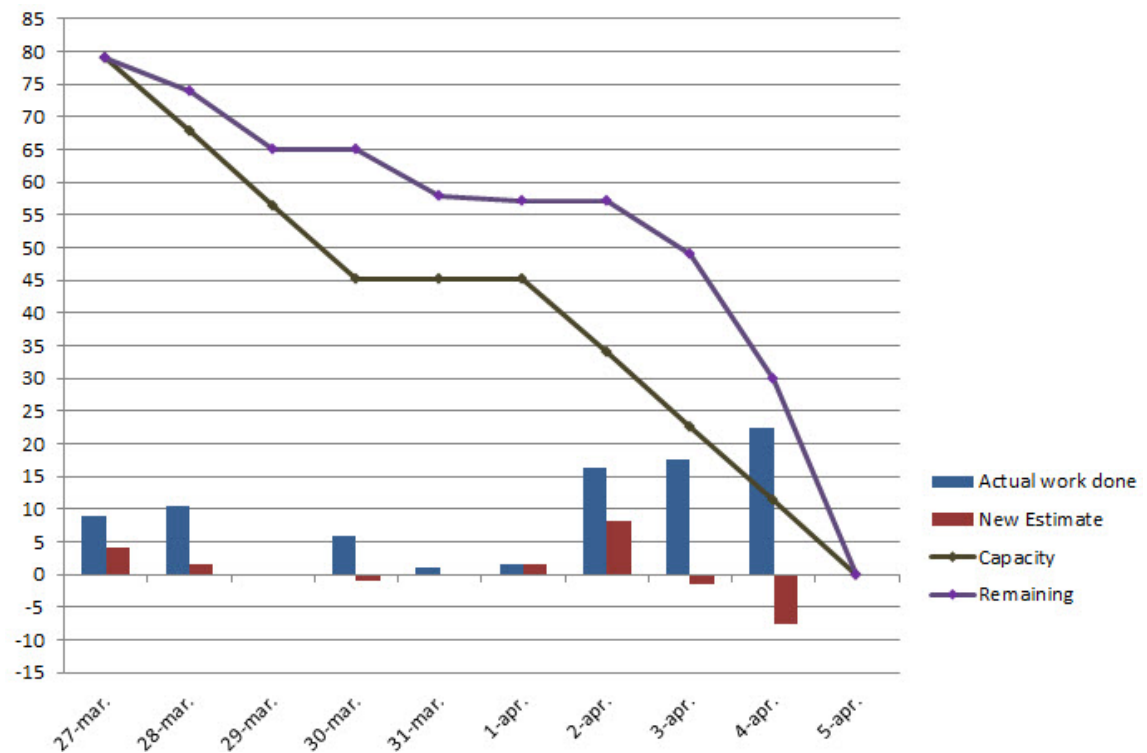


Note. The figure shows progress of sprint four.

4.6 Sprint five

In sprint five, a problem had risen from XML data handling and therefore the team began using Microsoft SQL Server Compact (Microsoft, Microsoft SQL Server Compact 4.0, 2012). In addition; the achievement system was implemented into the prototype and the team started the game design for the first game

Figure 7

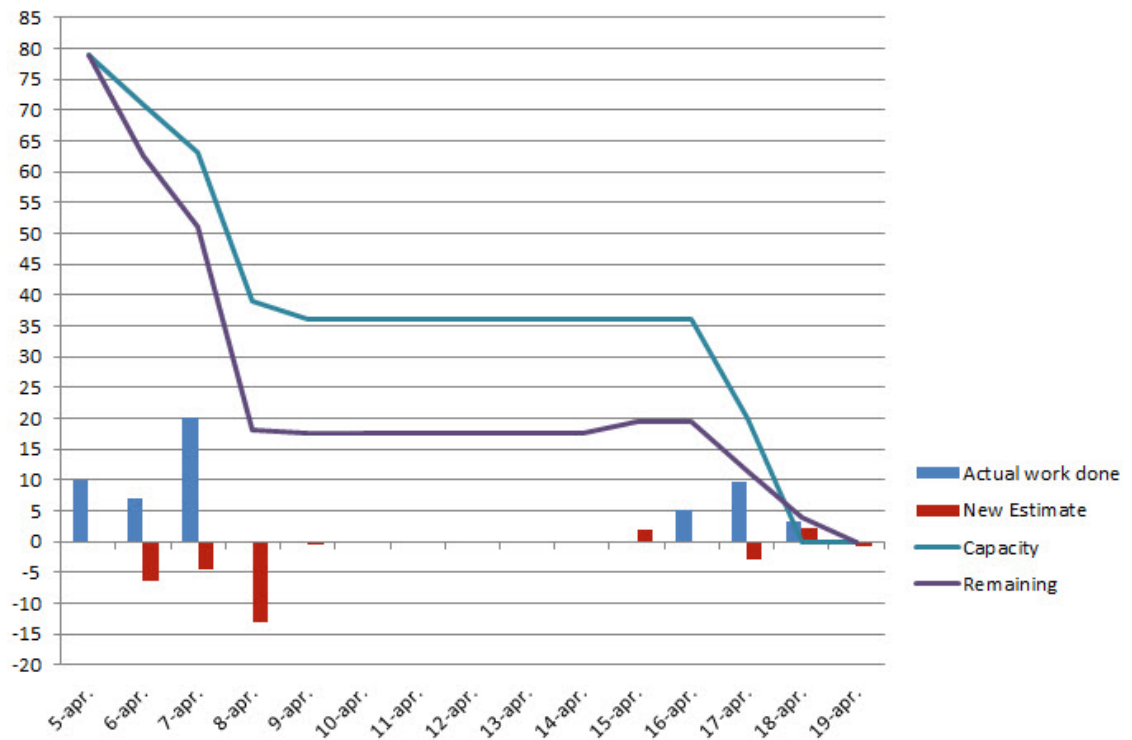


Note. The figure shows progress of sprint five.

4.7 Sprint six

In sprint six, a work on the first game Chase using XNA library (Microsoft, XNA Library, 2012) began. As it can be seen on Figure 8, the group did most of the work at the beginning and at the end of sprint whereas in the period in between the team had exams.

Figure 8

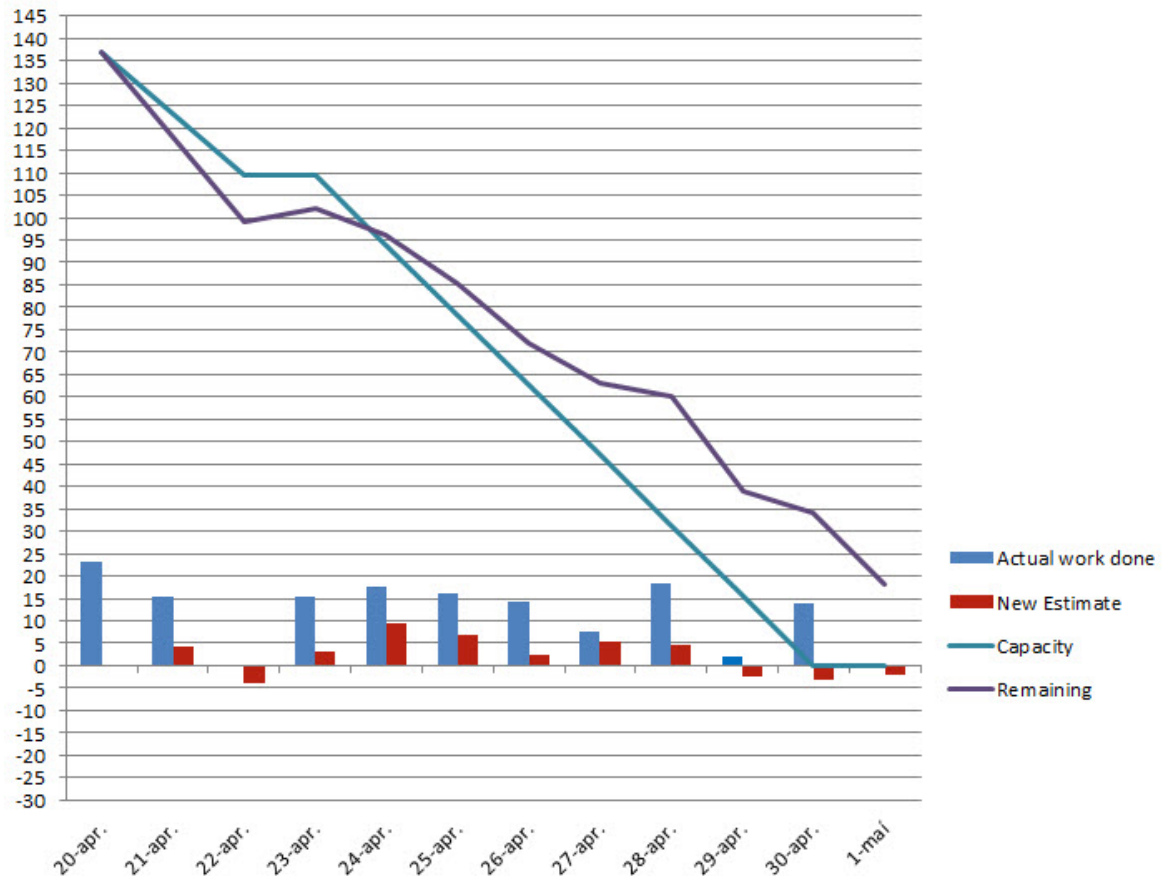


Note. The figure shows progress of sprint six.

4.8 Sprint seven

In sprint seven, the team finished working on the game Chase, and started working on the next game, Archer. Moreover the team finished the third status report. The last tasks were preparation for the last status meeting; hence they were moved to next sprint

Figure 9

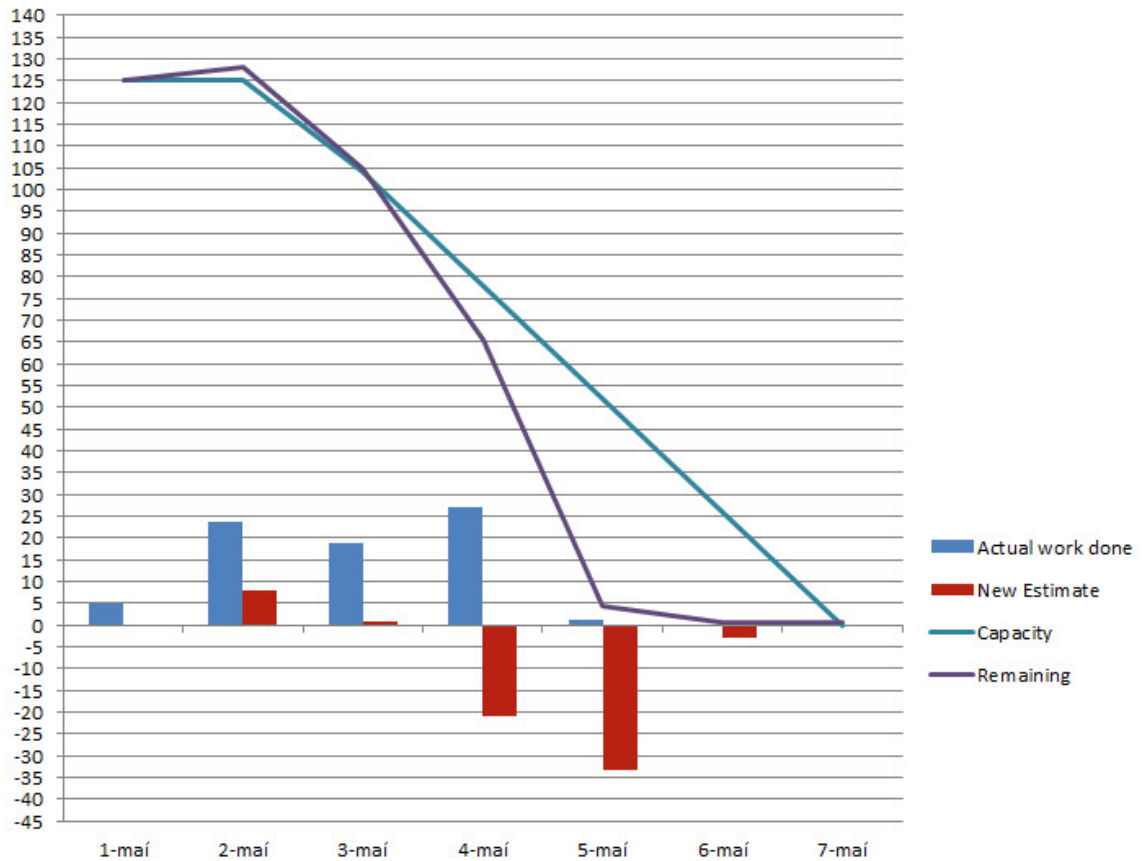


Note. The figure shows progress of sprint seven.

4.9 Sprint eight

In sprint eight, the team finished Archer and started to work on the third and final game Operation Balloon, which the team completed in this sprint. In addition to that, the team finished preparation for third and final status meeting.

Figure 10

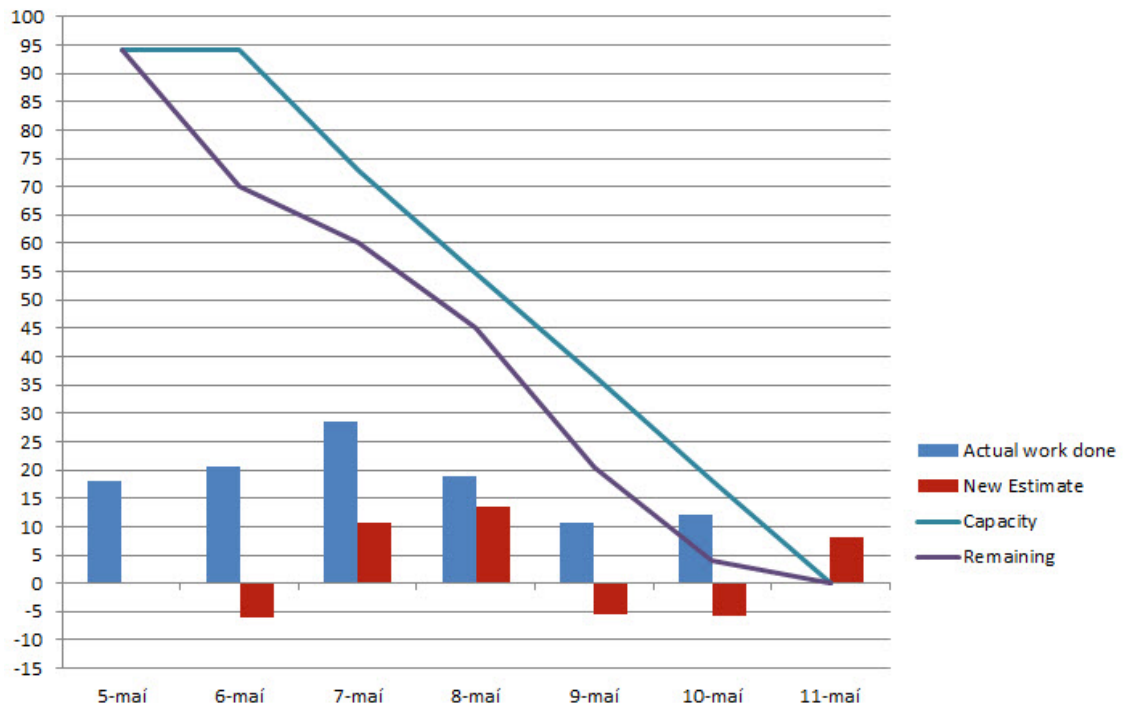


Note. The figure shows progress of sprint eight.

4.10 Sprint nine

In sprint nine, the team created the final report, the user manual, the design report and the three status reports. Moreover, layout was improved and bug fixes were fixed.

Figure 11

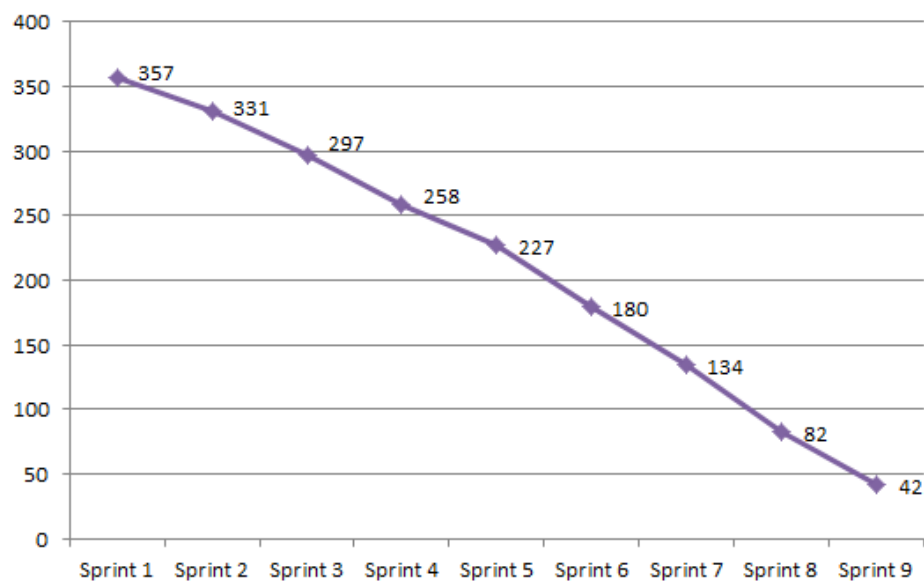


Note. The figure shows progress of sprint one.

4.11 Release burndown

Here is the release burndown chart.

Figure 12



Note. The figure shows progress of the release.

5. Design and development

When discussing the design of the prototype the team focused on that the user should be able to control all the levels of concentration easily; hence the levels were set to high, medium and low. The team believes that it can be different for each individual what the high, medium and low focus is.

The program could be adaptive for the user and the user could then set the bar higher when the user felt that his concentration was pretty high. Moreover the user can also control the level of alarm and whether the pop window would be more “strict” or “moderate”. This flexibility would address to different kinds of users; in addition this could be helpful if this prototype would be used for user testing.

The team discussed what should appear in the pop up window when the user lost his concentration. The consensus was that the pop up window would have a list of mini games which could help the user to increase his/her concentration.

In the game design process the team sat down and after discussing many ideas the team agreed on three games: Chase, Archer and Operation Balloon. These games are very different from each other; their goals however are to be simple and fun to play.

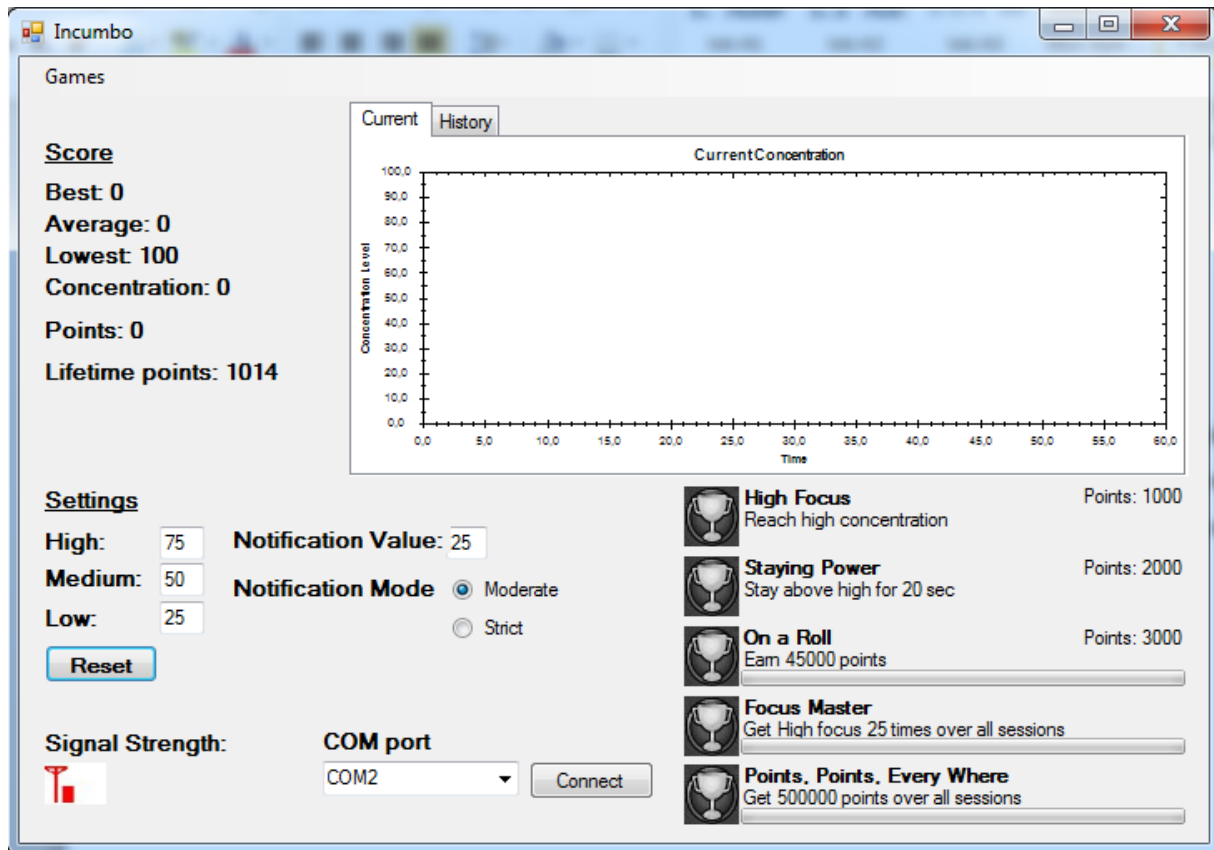
5.1 Incumbo

This is the main program of the prototype; it displays the concentration value in real time and gives feedback on how the user is doing.

If the user minimizes the program the program will go to the notification area (bottom right corner); in the notification area the program icon will change into stop lights. The stop lights display green for good, yellow for medium and red for low concentration. Moreover the program will display a warning in form of tooltip when the user is declining in concentration.

The user has the option to view the concentration in a graph; the graph will display his concentration when the user is in session; the user can view his past progress by selecting history tab.

Figure 13



Note. The figure shows the main window for Incumbo.

The user can start, pause and stop session whenever he likes. The user earns points in every session; the higher the user goes in his concentration the more points he gets. Furthermore the user has lifetime points; these points are earned in session, games and in achievements. The prototype displays trophies if user has finished some of the achievements, in addition the user can view how far he is from earning a trophy. The tasks are different and can be earned during a session or in the long run.

5.2 The games

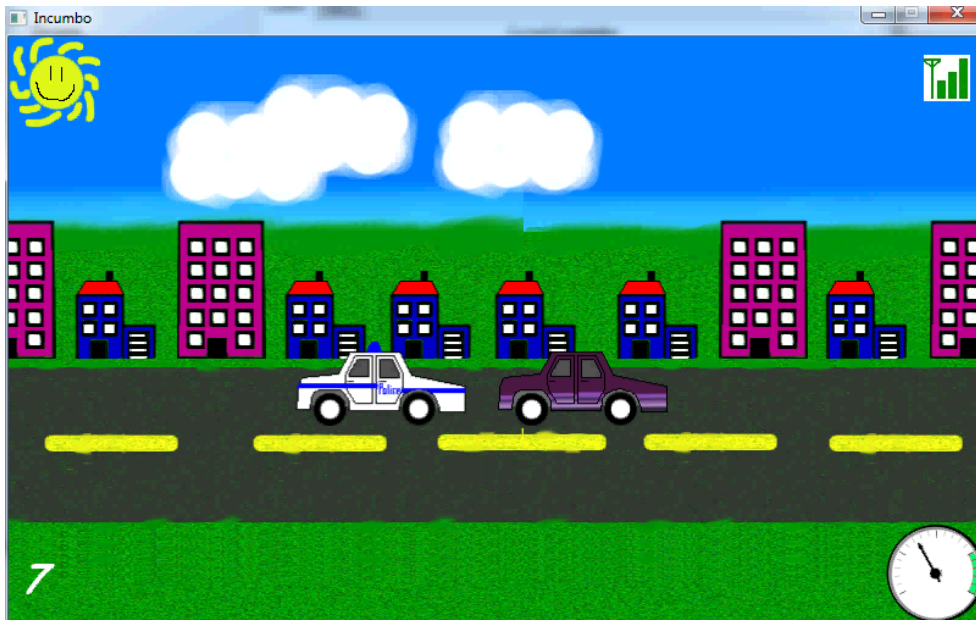
5.2.1 Chase

Chase is a car chasing game where you are the robber and you are trying to escape from the police. The user uses his concentration to make the robber's car go faster. In the game, there is a speedometer which shows in real time current concentration of the user.

The game was the first game the team programmed using the XNA library (Microsoft, XNA Library, 2012); with respect to that, programming went pretty well. Group's product owner

wanted more movement of the cars and something visual for the user to concentrate on. As a result of that, the team made the cars to bounce a little and inserted a speedometer instead of only the concentration value.

Figure 14



Note. The figure shows a screenshot of the game Chase.

5.2.2 Archer

The game is an archery game where you see an arrow going up and down, as if someone were aiming with a bow and arrow. The concentration value is the power bar, hence the more concentration the more power the arrow will get to fly. Points will be given considering where the arrow landed; as in many archery games if the arrow goes near the middle you get more points.

The problems the team tried to solve in Archer were:

- Calculation of the movement of the arrow
- Arrow's gravity
- Location of the arrow's tip when it was flying
- Arrow's tip location when it hit the target.

The team needed to cooperate effectively to be able to solve these problems and did so with great success. The team members got an additional insight in how difficult game programming can be.

Figure 15



Note. The figure shows a screenshot of the game Archer.

5.2.3 Operation Balloon

Operation Balloon is the last game the team created. In this game the user controls an airplane and shoots missiles at balloons with a bomb hanging from them. When the user has high concentration he gets more fuel and ammo for the plane; however as the game progresses the user needs increased concentration to get more fuel and ammo.

Figure 16



Note. The figure shows a screenshot of the game Operation Balloon..

This is a game the team created when they had acquired more knowledge on XNA (Microsoft, XNA Library, 2012) programming, thus it is probably the best designed game of the three games they created. The team did not run into difficult problems when creating the game and everything went smoothly in the implementation.

5.3 Testing

In the user stories, which involved coding, the team added testing task which tested all the functionality which the story provided. The testing task was always performed by team member who had not worked on the code.

When the team started to work on the project they wanted to test the prototype without the headset's data, a lot of work went to find tool which would act similar to the headset. The team did not find any such tool and decided not to do anything further. However, in the end, the group implemented similar functionality when the team wanted to have backup data if headset would not function in the final presentation.

6. Summary

6.1 ThinkGearNet

In sprint zero the team did some ground work before the team started sprint 1 which was very important. For instance, the team discovered the ThinkGearNet (Microsoft, XNA Library, 2012) library which turned out to be crucial for the functionality of the prototype and very easy to work with.

6.2 XML

The team had decided to use XML as storage for concentration data; however in sprint five when the team was implementing the achievement system, the team ran into some problems:

- Searching in XML.
- Updating values.
- XML data file size increase.

At this time the members of the team were working on a project in Web programming II; in this project the Code-First-Approach (Guthrie, 2012) was implemented using the Entity Framework (Asp.net, 2012) and Microsoft SQL Server Compact 4.0 (Microsoft, Microsoft SQL

Server Compact 4.0, 2012). The members saw that this approach could also be used in the prototype, thus the team added this functionality into the prototype. This solved our problem and made the prototype even better and more flexible.

6.3 ZedGraph

It was very important to find a good graph handler to draw the graph in real time. After some research the team found out that ZedGraph had all the functionality needed. The library is very easy to use and implement.

6.4 ThinkGear Mindset

ThinkGear Mindset (NeuroSky, MindSet, 2012) headset was one of the unknown factors as the team had heard rumours that it was had malfunctions. This component was of course the most important one to work on and crucial that any problems the team would face would be identified in the beginning of the development.

The team did not run into any serious problems with the headsets apart from two occasions of blue screens. This was a minor problem, considering that the team started using the headset in January. Another minor issue that the team faced was that, it took the headset some time computing the concentration value; the team noticed that, if the headset had 100% signal for couple of seconds it started computing values.

Moreover, when the team thought something was wrong with the headset, it was often just that it was low in battery.

It is important to mention that it will take users some time to get a feeling of how the headset works, just like any new technology and especially this one where the output is not very obvious.

6.5 IncumbLibrary

After the team had created the first game it became obvious that to keep score in the game and to transfer it to the lifetime points the team had to have one database for the whole solution.

The team had added the XNA game into the Incumbo solution; but all the database functions were stored in the Incumbo project. If the team would add Incumbo project as reference in the XNA game then the team would have Circular reference (Wikipedia, 2012).

Therefore the entire database functions were transferred to a new library project called IncumboLibrary, and this easily solved the problem.

The team also discovered in the end that making of an IncumboGamesLibrary would have been useful from beginning of the project because there were some classes created with exactly the same functionality in all the games.

6.6 Setup

The team learned a very important lesson, that when you are creating a product which needs to be installed on computer, you should have an installer program set up from the beginning.

The team decided to create a setup project in sprint 7 for the third status meeting; however some unknown problems occurred which did not happen during development. The program did not start after installation; after some troubleshooting the team found out that after the database functions had been moved to IncumboLibrary another App.config file had been created within the IncumboLibrary. The team removed that App.config file and made some changes so that the database is created where the Incumbo.exe file is. This is to ensure that when user starts up the program the database will be created in the right place. This is something that team members could have figured out earlier in the process; had the team set up an installer project in the beginning.

6.7 Communication with MindGames

The team had excellent experience in communication with Deepa Iyengar in MindGames; Deepa, which also was the product owner, provided a lot of help with her Scrum experience and product development. She always wanted to help if the team had any issues. She replied e-mails quickly and commented if she saw errors in the backlog. The team is aware that product owners are, in many cases, not as active as Deepa was and the team was very thankful to her for that.

6.8 Bitbucket

Bitbucket (Bitbucket, Bitbucket, 2012) provided us with a great environment for storing code. The group used TortoiseHg (Bitbucket, TortoiseHG, 2012) workbench for committing and pushing code. It took some time for the team to get a hang on it because all the team members are used to SVN (Tigris.org, 2012). However it proved to be a very good tool and the team recommends it for other projects.

7. Conclusion

The team is very proud of what it has achieved in the past 15 weeks. It has managed to deliver a prototype which monitors the concentration level of the user, and provides warning when the user loses his concentration.

Moreover the team programmed three entertaining games for the user to increase his concentration. The team worked very well together and each member got an opportunity to shine. However there are some things the team feels that might have done better

- Unit testing

The team members are used to start coding right away without unit testing and thus there was no unit testing.

- Stories were often too connected and not specific enough

Team members had to wait for other team members to finish before they could start working on their own stories. In the implementation of the game Operation Balloon the team became aware of that that some stories shared same functions, therefore tasks were already finished when members started working on them. However the team worked tightly so the problem became very obvious.

- Final design of the Incombo form

The final design of Incumbo form was done in the last sprint, the team is aware that the design process should have been done in the start of the semester. Because of that the final design of the Incumbo form was not really clear until the team sat down towards the end of the project period.

As in other projects, the team members faced some problems but managed to tackle them as a team and work their way out of the problem. Importantly, the team learned a lot from those problems, how to avoid them in the future and different strategies to tackle them. The team also felt that it handled things pretty good such as:

- Scrum planning

The team followed all the Scrum principles. At the beginning the team set up daily meetings so everybody would be at the same pace and ready to tackle any problems. The team members were always on alert and often exchanged to being Scrum master very unconsciously; which is good and shows how responsible everyone was.

- Designing and implementing games

The team took good amount of time for designing the games; the team had a lively discussion on what games should be implemented and then the team voted and narrowed the selection to three games.

The team designed the games on a whiteboard which helped to get the feel on how the games should look like.

The team decided on using XNA as a game library; there were many speculations how to implement the games because nobody knew anything about XNA. However with a help of the book Learning XNA 4.0 (Reed, 2010) the team quickly got a hang of it. Therefore in the last sprint the team found it easier to evaluate the time for implementation.

- Teamwork

The group was combined to three different individuals with different backgrounds; however the team chemistry was good. Therefore the teamwork was very good, everyone got chance to express their opinions and their ideas. Trust is very important for teamwork and everyone had full trust in each other. In some occasion there were arguments how to do things, but the team solved them together and moved on.

7.1 Review from MindGames

“The team has been extremely good in project management (including defining actionable user stories and tasks) and at accomplishing the plans they have made. The resulting work is robust and well-structured. It is impressive how quickly they were able to design and implement 3 mini games activities for the purpose of helping the user to increase concentration in a fun way!”

Deepa Iyengar, May 4th 2012.

7.2 The future of the project

This is a prototype which MindGames can show to prospective clients interested in software applications to assist with personal productivity. In addition there are many opportunities to add functionality such as creating a website which displays scores for the user; also it will be possible to create web services which will provide functions to keep concentration values. Thus the user could easily see his data displayed in convenient manner. The team is hopeful that the basic idea of at least one of the games can be developed further.

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