# Cerberus: The Mars Crowdsourcing Experiment

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## Summary

This article discusses the use of crowdsourcing in a serious game. A computer game, called Cerberus, which allows players to tag surface features on Mars, has been developed. Developing the game has allowed us to investigate the effects of different help levels in supporting the transfer of knowledge, and also how changing the game features can affect the quality of the gaming experience. The performance of the players is measured in terms of precision and motivation. Precision reflects the quality of the work done and motivation is represented by the amount of work done by the players. Games with an explicit help function combined with a "rich gaming experience" resulted in significantly more motivation among the players than games with an implicit help function combined with a "poor gaming experience". There was no significant difference in the precision achieved under different game conditions, but it was high enough to generate Martian maps exposing aeolian processes, surface layering, river meanders and other concepts. The players were able to assimilate deeper concepts about Martian geology, and the data from the games were of such high quality that they could be used to support scientific research.

## Introduction

Crowdsourcing science uses many individuals (the crowd) to process scientific data and is mainly used with datasets where human perception exceeds the capabilities of computers. Humans are still often better and faster than automatic devices at recognising shapes and objects (Hoffmann, 2009). This project investigates whether the crowd can recognise and apply high level semantic concepts to features in photos of the Martian surface and thus support scientific research. In this research project, crowdsourcing was conducted using a serious game. Different types of help function were investigated to establish the level required to provide players with enough knowledge for them to identify surface features on Mars. Another research goal was to investigate which game features are needed to motivate players.

### Gaming for science

Because crowdsourcing demands a certain effort from its contributors, the players must be motivated to participate. Two methods are utilised: 1. Small financial rewards are offered for processing data units. 2. The computer game environment is made sufficiently entertaining that players will process data for free.

The concept of crowdsourcing has proven itself in serving science. The quality of the data analysis performed by crowds within certain fields of research is superior to the results obtained by individuals and even sometimes to those of the experts involved (Hoffmann, 2009).

An example of a serious crowdsourcing game used for science is Foldit, a game in which players create new protein chains. The goal is to contribute to cancer research. Players are encouraged to play the game by earning points and the chance to earn "scientific glory" (Viñas, 2008; *The Economist*, 2008). Another example is Galaxy Zoo, an initiative in which galaxies and their behaviour are classified by users (Darg et al., 2009). Astronomers can only cover a small portion of the amount of data that needs to be analysed, so the data is prioritised, and new discoveries may remain hidden in the lower priority data. This is where Galaxy Zoo comes in. The players analyse the photographs collectively, so that each time a photograph is analysed the reliability of the classifications in the galaxy database increases. The results prove to be just as accurate as if the analysis had been carried out by expert astronomers. By the end of the year 2009 over 220 000 people had participated in this project and they had contributed to the discovery of a new type of object (Charles, 2009).

### Exploring Mars
Since November 2006 NASA's Mars Reconnaissance Orbiter (MRO) has used the High Resolution Imaging Science Experiment (HiRISE) to acquire data about the surface of Mars. The MRO transmits colour imaging data back to Earth, covering objects with sizes down to 25 centimetres. This high level of detail generates a vast amount of data that needs to be analysed (McEwen, 2010). The first research phase, or Primary Science Phase (PSP), ran until December 2008 and has photographed approximately 0.55% of the planet's surface, consisting of 8 terapixel of data (McEwen et al., 2009). The scientific research covers 18 themes, such as different types of erosion, with each theme processing specific surface features to learn more about Mars.

The non-academic world can participate in HiRISE via an Education and Public Outreach (EPO) initiative (McEwen et al., 2009). The Clickworkers project is an example. This was a "citizen science" initiative whereby internet users had to classify and annotate geological objects such as dunes and craters to generate a searchable database (McEwen et al., 2009). NASA's researchers assumed that the average person had enough commonsense knowledge to accurately screen photographs for craters. Starting in November 2000, over 80 000 people measured two million craters and classified the age of 300 000 craters in a year (Szpir, 2002).

### Become a Martian
In November 2009, the website, *Become a Martian* (BaM), was launched on Microsoft's Developers Conference as a cooperation between Microsoft and NASA. Two games are offered through this interface and which allow users to simultaneously learn about Mars and contribute to planetary exploration. Microsoft and NASA emphasise that BaM does not only inform people about Mars and NASA's activities, but that it enables large groups of people to analyse data in a field where computers still lag behind (Brown, 2009; Microsoft, 2009). An introductory movie is shown in the Martian Map Room and then the first game introduces the user to measuring and counting craters. In the second game photographs have to be aligned; a task that is difficult to do automatically because Mars does not have a GPS network. Fragments of satellite images are overlaid to generate a rich Martian map. As a reward the user earns experience points and rewards in the form of medals, badges and "inside" NASA information (NASA & Microsoft, 2009).

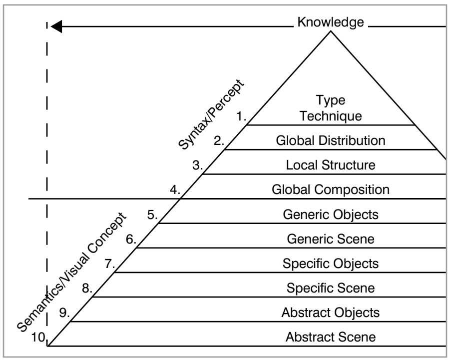

*Figure 1. Ten-level model (Jaimes, 2000).*

### Knowledge levels
Jaimes (2000) presented a model which describes images in terms of ten different levels of perception and semantics. The model is shown schematically in Figure 1, with the first four perceptual levels at the top of the pyramid. The topmost level describes the image in terms of its most basic properties, such as the JPEG 2000 file format of the HiRISE images (HiRISE, 2009). The next three perceptual levels go deeper into the superficial features of the image and describe colour, shape and texture, distinguishing between characteristics of the image as a whole, its distinguishable elements and the composition of these elements (Hollink, 2004; Jaimes, 2000). The general image characteristics described by these perceptual levels show a strong resemblance to the way in which the types of feature that have to be picked out and annotated in Galaxy Zoo and Be a Martian are categorised. Whether crater counting or classifying galaxies the user has to recognise circles or varieties of them. The user also has to align patterns, and both these tasks can be carried out without specialist knowledge (Charles, 2009; NASA & Microsoft, 2009).

The six "lower" semantic (or conceptual) levels are divided into generic, specific and abstract levels, each of which is further subdivided into "object" and "scene" categories. Working down through this hierarchy, within the generic level, objects and actions are generally tagged; within the specific level these objects and actions are named individually; and within the abstract level contextual information or symbolism is added. These levels are derived from Panofsky's (1962) and Shatford's (1986) models, but each differentiates between individual objects and the scene as a whole. In order to describe these six conceptual levels, from general to specific, an increasing level of knowledge about the subject is required (Hollink, 2004). The annotations for BaM are confined to the perceptual levels (levels 1 to 4, Figure 1) with the occasional cautious foray into the first conceptual level (NASA & Microsoft, 2009), as, for example, a crater would be categorised as a generic object within Jaimes's model.

However, when we look at the HiRISE research themes, annotations that are confined to the perceptual levels are no longer sufficient. The themes, for example, describe specific geological processes and therefore demand a deeper level of knowledge to be able to recognise and describe them (McEwen, et al., 2009). In terms of Jaimes's model (2000) the HiRISE research themes would position themselves within the specific and abstract conceptual levels (levels 7–10 in Figure 1). The specific levels could describe processes like wind erosion, while the abstract levels could concern hidden craters buried beneath the planet surface, which cannot be seen directly with the eye (HiRISE, 2009).

The current generation of Mars games created by NASA and Microsoft (2009) only extends to the generic levels (levels 5 and 6 in Figure 1), which do not go deep enough to make annotations within the HiRISE (2009) research themes. But can users reach a deeper semantic level without possessing expert knowledge? (Darg, 2009; Bulletin of the Atomic Scientists, 2001)

## The problem

The investigations into whether crowdsourcing using a game can be used to make annotations within the specific levels (levels 7 and 8 in Figure 1) or even within the still higher abstract levels (levels 9 and 10 in Figure 1), and using the HiRISE research themes, have covered three aspects.

### Motivation
Firstly, it is important to define how a player can be motivated to apply knowledge to the HiRISE photo data. How important are the game elements in motivating the player? In BaM and the other examples

described above, the motivating elements are point counts, a share in the scientific glory, winning medals and having objectives (NASA & Microsoft, 2009). But are all these elements required or would a single element suffice to motivate the players?

**Providing the user with enough knowledge**
Secondly, it is important to provide the player with enough specialist knowledge to make annotations within the specific levels (levels 7 and 8 in Figure 1). Can someone acquire the necessary knowledge, i.e., without explicit instruction by just playing the game? In this situation knowledge is transferred implicitly with minimal support and a player is then expected to be able to apply the acquired knowledge correctly. The alternative is to transfer knowledge explicitly by instructing the player, as in the BaM games, where the player is offered educational movies and other kinds of help (NASA & Microsoft, 2009).

**Validity of the results**
During the game players annotate MRO photos, and it is important that the data (the annotated photos) can be used in the context of the HiRISE research themes (McEwen et al., 2009). The validity of the results depends on the reliability and significance of the annotations (factors). The reliability is measured by the precision of the annotations made by the players. The significance relates to the number of players who make similar annotations on the same objects. Both reliability and significance are important if the generated data is to be used for scientific research.

**The research questions**
The primary research question is:
- Is crowdsourcing in the form of a serious game applicable for annotation in a semantically-rich research domain?

The secondary research questions are:
- Are the players motivated enough by a poor game experience, or is a rich game experience essential?
- Can we transfer the domain specific knowledge in an implicit manner, or is explicit instruction essential?
- Will the annotations made by the players be usable for science?

**The hypotheses**
Based on the research questions the following hypotheses can be derived:
- H1: Motivation of the players will be higher given a rich game experience than given a poor game experience.
- H2: Precision of the players will be higher given explicit knowledge transfer than given implicit knowledge transfer.
- H3: The validity of the crowdsourcing results will be highest where knowledge transfer is explicit with a rich game condition.

## Method

A two by two factor design was created resulting in four possible game conditions shown in Table 1. The independent variables were implicit or explicit knowledge transfer and a poor or a rich gaming experience. The dependent variables were the levels of motivation and precision the players were able to achieve, while validity indicated the performance as a collective.

A computer game was constructed matching the four game conditions and their independent variables (Table 1). Other than these differences all the game conditions were identical in every aspect. This section will first describe which data were analysed, then it will discuss the game functions that were similar for each game condition, and it will conclude with a description of the differences between the conditions.

**A. The dataset and knowledge to be applied**
The dataset consisted of photos that had been pre-processed and described by researchers using criteria related to the 18 HiRISE research themes. The photos then had to be annotated with Mars features by the players and compared to expert descriptions to test how the players had performed both collectively and individually. Specifically, players were asked to recognise four important types of feature occurring within the 18 themes on the Martian surface (McEwen et al., 2009).

The first type of feature, Aeolian Processes, covers the study of landforms formed by wind. The players were asked if they could find two different types of these structures: Transverse Aeolian Ridges (TARs) and honeycomb bedforms. TARs describe three levels of linear wind erosion in the form of ripples and dunes, while the three levels of honeycomb bedforms are circular (Zimbleman, 2009; Bridges, 2010). The second type of feature, Gullies and River Meanders, relates to places on Mars where there could have been water in the past and thus could have been caused by water erosion (Berman, 2010; McEwen, 2006; NWT, 2010). The third type, Layers, relates to vertically ordered ground. Layers are often created by sediments that have been laid down by water, dust storms, volcanic eruptions or crater impacts (Grant, 2010; Beyer, 2009). The fourth category, Anomalies, is different from the other three because it is not specifically defined, but caters for the case when a player recognises something strange that does not fit into any particular category, but which could still be interesting, such as, for example, strangely coloured mountains, strange shapes or even Mars landers like the Phoenix lander (Bridges, 2006).

The photos annotated by the players covered all four types of feature and were carefully preselected. Eight photos were extracted from the HiRISE database and a ninth photo was created manually which functioned as a training map. This photo was a synthesis of all the other photos welded together using photo editing software. Each photo had a resolution of 25 $cm^2$ per pixel, covering a surface of 300 $m^2$. Each was downloaded in colour (better for context) and infrared (better for detail). The players could shift between these two views using a slider.

| | Poor gaming experience | Rich gaming experience |
|---|---|---|
| Implicit knowledge transfer | −−/−−/−− (condition 1) | ++/+/+ (condition 3) |
| Explicit knowledge transfer | −−/++/+ (condition 2) | ++/++/++ (condition 4) |
| Notation: Hypothesis: Motivation/Precision/Validity (condition#) | | |

*Table 1. Factor table for testing the hypotheses.*

Figure 2. Game interface.

Each photo was divided into 144 squares which the players had to annotate with the features they had discovered. Figure 2 demonstrates the interface containing the annotation tools (bottom). Each tool is arranged by type and represented by its own icon. The tools are from left to right: ripples, dunes, draas honeycomb levels 3, 2 and 1, river meanders, layers and anomalies.

When a player annotates a feature he gains a point and this point is added to the total number of annotations previously made by others for that feature on that square. This new total is then the amount credited to the player's individual score. So for example, if a player marks a dune and eight other players had previously marked the dune then the player is rewarded with nine points, and the next player to mark the dune would get ten points, and so on. Thus the game rewards good behaviour and encourages players to do their best.

Figure 3 shows the player's view with some annotated features. In these example grid squares the player can see the points assigned to the ripple (RI) and dune (DU) annotations he has made. Note the only negative feedback is the low score received when an error is made, while a high score represents positive feedback. Each of the features to be marked in the game was represented by one or more tools that the player could select. Each new annotation was transmitted to a database and the set of accumulated annotations formed the dataset used in this research.

### B. The main game

The dataset, the annotation module used to mark features and the basic scoring system were identical for all four game conditions. Also each condition started with a training phase so players could become familiar with the interface and with Mars. This phase differed in the way it was built up for the poor and the rich game conditions. The poor game conditions only required players to score a total of 3380 points before proceeding to the main game, while the rich game conditions included short missions that had to be completed and a total score of 3380 points as prerequisites. The training photo was pre-annotated using information from the scientific literature, so players experienced the game as if other players had previously annotated the photo. In this way new players were rewarded for making correct annotations as they would be in the game. Completion of the training unlocked the real Mars photos so that players could begin annotating in earnest.

### C. Explicit versus implicit

The explicit and implicit game conditions had different help functions. The implicit game condition only had a first level "mouse-over" help function which very roughly described what each tool did. It did not give any examples nor did it supply the knowledge needed for players to know where to look. The explicit game condition added two additional levels of help. The second level help function was shown when a player clicked on a tool and displayed a brief description of what to look at and was always in scope. The third level was the most detailed help level and was accessible by clicking on the question marks. This level showed what to do and what to look for in great detail. The help texts used information from the scientific literature, but were written specifically for the game.


Figure 3. Annotated ripples and dunes.

### D. Poor game experience versus a rich experience

Section 2 described several motivational functions in existing games, including counting scores, rewards for certain achievements, a share in any scientific glory and an active social network (NASA & Microsoft, 2009; Hoffmann, 2009; Charles, 2009; Dartnell, 2009). The conditions with a poor game experience only had a simple scoring system to provide the player with minimal feedback. The rich game experience had an additional extra palette of game-stimulating functions inspired by existing games, including the selection of a personal avatar, promotion in a fictitious operational hierarchy on Mars, rewards for certain actions such as using the infrared tool, and the missions used in training.

### E. The test group

Each player was randomly assigned to a game condition during registration to generate a uniform distribution of players in age, gender and pre-knowledge about Mars over the four conditions. Players were recruited via direct mailing and by starting community topics in internet forums related to games, science and Mars.

## Results

The game, called Cerberus, after the mythological dog, was launched on 17 July

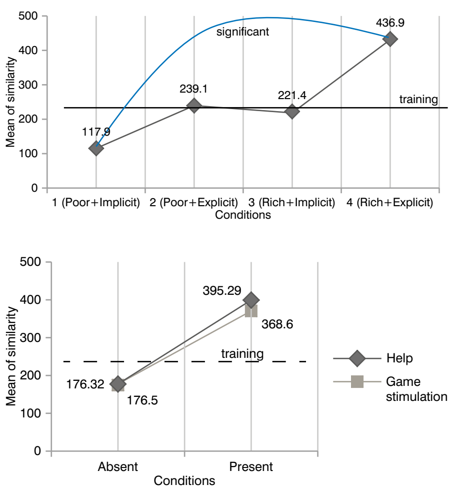


Figure 4. Mean of motivation.

| Condition | N | Prop. | Passed Training (n and prop) | | Age (mean) | Age (sDev) | Male | Female | Male (prop) | Female (prop) | Motivation (mean) | Motivation (sDev) | Precision (mean) | Precision (sDev) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 27 | 20.8 % | 4 | 17.8 % | 26.89 | 13.08 | 19 | 8 | 70.4 % | 29.6 % | 117.9 | 131 | 0.483 | 0.432 |
| 2 | 26 | 20.0 % | 6 | 23.1 % | 29.81 | 14.36 | 21 | 5 | 80.8 % | 19.2 % | 239.1 | 471 | 0.407 | 0.359 |
| 3 | 35 | 26.9 % | 9 | 25.7 % | 27.79 | 6.24 | 31 | 4 | 88.6 % | 11.4 % | 221.4 | 336.4 | 0.39 | 0.293 |
| 4 | 42 | 32.3 % | 22 | 52.3 % | 33.21 | 16.28 | 35 | 7 | 83.4 % | 16.6 % | 436.9 | 513.7 | 0.626 | 0.176 |

*Table 2. Numerical breakdown by condition.*

2010. On 18 August 2010 the database containing data from 151 players was extracted. After removing test accounts, spam and people who never logged in, the group was reduced to 130. The composition and some results of the research groups and its corresponding conditions are shown in Table 2. In this section the results measuring the motivation, precision and the validity, which indicates whether the data could be used for scientific research, will be discussed.

**A. Motivation**

Motivation is about the eagerness of the players to play Cerberus. It is measured by the total number of annotations, or clicks, made by the players. The more annotations a player makes the more time and effort they have spent playing. A one-way ANOVA was conducted to test whether the mean motivation differed among the conditions. In this measurement each annotation per photo per player was counted, including the training photo. The motivation (m) for each individual player is calculated as follows (f = feature):

$$m = \Sigma\, (\text{photo}\ (\Sigma\ \text{tile}\ (\Sigma\ f)))$$

## Motivation results

Figure 4 shows all the motivation results. The horizontal line marks the training threshold, which is the minimum required sum of 194 annotations to pass the training mission. There was a significant difference between condition 1 and condition 4 (see Table 1), i.e. players were more eager to participate in crowdsourcing using a serious game with extended help in combination with rich game elements. The two intermediate game conditions in between (2 and 3) showed no significant differences with either condition 1 or condition 4. So adding either a rich game experience or explicit help does not add enough to be significantly different from condition 1.

## Precision

Precision is measured by comparing each individual annotation with the expert annotation. The expert annotation is based on descriptions in the literature about Mars's geological features. Each photograph is pre-annotated by the experts to test the players' precision. Table 2 in the column Precision shows the results from each condition. A mean score of 1.0 implies maximum precision (no errors) while a score of 0.0 implies the player is wrong. To test which condition performed better a One-Way ANOVA is conducted. No training photographs were included in this calculation. Precision (pr) is calculated by testing each player-annotated feature ($f_{pl}$) per square (sqr) with the expert annotated feature ($f_{exp}$). Note each square can have a maximum of eight different annotated features. Each feature is marked as 1 or 0 (annotated or not annotated) in the database. The formula is as follows:

$$pr_{sqr} = \frac{\Sigma\, f_{pl} + f_{exp}^{-1}}{\Sigma\, f_{pl}}$$

The results show that for this data, there is no significant difference in precision between the implicit and the explicit gaming conditions.

## Validity for science

Until now motivation and precision were discussed as measurements based on an individual basis. However, this approach does not give any insight into the performance of Cerberus as a crowdsourcing initiative, and thus into how players performed as a collective.

To check for validity, all the player results for each condition are now taken together and their similarity (sl) is calculated. Similarity is a measurement comparing the collective data with the expert annotation. Because the number of annotations per feature per player varies from 0 to 15 (15 meaning that 15 players made the same annotation independently) with a mean of 0.789 for the entire data collection, all marked expert features are assigned a target of ten annotations. This means that ten players need to make an identical annotation agreeing with the expert to gain a similarity of 1.0, and for 15 player annotations the similarity would be 1.5. Similarities greater than one indicate that the collective (crowd) has outperformed the expert (Hoffmann, 2009). If neither the collective nor the expert made any annotations for a particular feature the similarity was also 1.0 as the collective was not in error. For this reason all eventual calculated similarity means for each condition will be rather high because the largest portion of all possible annotations is no annotations at all. This is different from the precision calculation where each individual click was tested for right or wrong.

Summarising the similarity calculation for each square, ($sl_{sqr}$) is calculated by testing each collective annotation ($f_{col}$) with the expert annotation ($f_{exp}$) and can be any posi-

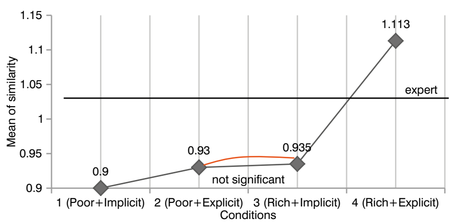


*Figure 5. Similarity.*

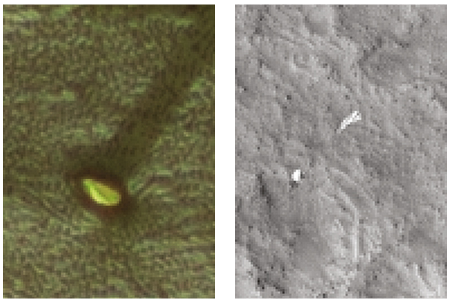

*Figure 6. The possible tower and the Phoenix.*

tive value when there is similarity, and is 0 when there is no similarity. Before applying this formula to the dataset, each feature where there was neither an expert nor a collective annotation was upgraded to 10 manually. This ensured that the formula calculated a similarity of 1.0 for all the unmarked features. The formula is:

$$sl_{sqr} = \frac{\sum \frac{f_{col} \cdot f_{exp}}{100}}{8}$$

### Qualitative results

The anomaly tool was available in all game conditions and it was used for a total of 67 annotations. Most of these annotations were for craters, strange spots, sediments and rocks, but some rarer objects were found, and which were "marked" objects by the expert. The first object is the strange yellow rock, of which some unknown expert annotated as an outgassing tufa tower. The other object is the Pathfinder lander (Bridges, 2006). People have described it as a white spot, a pod or a balloon. Figure 6 shows the possible tufa tower (left) and the Pathfinder lander's pod and its balloon (right).

## Discussion

Motivation was significantly higher in condition 4 where there was explicit help and a rich game experience. Precision did not show any significant differences between any of the conditions although there was a noticeable increase in conditions with explicit help, perhaps because in the conditions where players were not motivated enough most gave up long before completion of the training phase due to boredom or the lack of clear goals, and so did not contribute to the final dataset. This meant there were very few players whose results could be used to calculate the precision in the poor game conditions, and so the results in these cases might be biased. It is remarkable that the precision standard deviation tended to narrow in the explicit help and rich game conditions, implying a higher consensus among players in making annotations. Condition 4 showed the highest mean of precision and had the lowest standard deviation. When investigating the similarity results of the collective, condition 4 also demonstrated a significantly higher similarity than any other condition.

## Conclusion

While it cannot be proven that the level of instruction had any effect on precision, and thus on the acquired knowledge of the players, it did show a significant effect on the players' motivation. The collective results did show a significantly better similarity with the expert data for the explicit game conditions, so for overall success, explicit instruction is essential. The rich game conditions scored significantly better for motivation than the poor game conditions. Yet the rich game condition without explicit help did not motivate the players significantly better or worse than any other condition. The rich game with explicit help does score significantly better than the condition with implicit help and a poor game experience. Therefore we conclude that a rich game condition is indeed essential, but it must be combined with explicit help to be effective. The annotations made under condition 4, explicit help and a rich game experience showed a high similarity to the expert annotations. Moreover the players generated more results collectively because the expert missed some features. Some players did actually re-discover the Phoenix lander — somewhat of a needle in a haystack task. In conclusion, we can say that the annotations performed by the players are indeed of use for science.

The answer to the main question, whether crowdsourcing in the form of a serious game used for annotation in a semantically-rich research domain is possible, is positive. While there still can be discussion about the implicit or explicit learning conditions and the effects on individual precision, the players did manage to generate an accurate map of the Mars photographs as a collective and thus were able to apply deeper semantic knowledge.

Cerberus has not come to an end with this study. Cerberus as a game has a lot of functions per game condition, but it is not yet clear what the effects of each separately are. For example the explicit help function adds a second and a third help level, so claims can only be made about these functions combined, but not separately. The same applies to the rich game conditions. Cerberus has avatars, rewards, rankings and more enriching game elements, but it is not yet clear what the effects are of avatars or any other of these functions in isolation. Cerberus as a platform is being developed further and meanwhile is participating in the European Space Agency (ESA) business incubator programme. With technological aid directly coming from ESA, Cerberus is now being professionally developed and directly targeted at crowdsourcing, e-learning, gaming and outreach. Other applications where Cerberus could be used are being explored, such as assisting climate-change research or in any field where satellite photographs could be translated into Geographical Information System data. More about Cerberus's current progress, along with the most recent playable version can be found at www.cerberusgame.com.

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## Biography

**Hans van 't Woud** (1983) was born in Leiden, the Netherlands, and studied Human Centred Multimedia at the University of Amsterdam where he was awarded his MSc degree for this research. Before this he graduated with a Bachelor's degree from Rotterdam University, and in part also, the Willem de Kooning Academy of Arts, in Communication and Multimedia Design. After this he worked a period as product manager for a company involving healthcare software. During his Master's study at the University of Amsterdam he participated in a project regarding learning with mobile devices, where he was responsible for the general interface design. Nowadays he is a fulltime entrepreneur for his company, BlackShore — creative, where he is taking Cerberus to the next level. For this he is collaborating closely with and participating in the ESA business incubation centre in the Netherlands.

Reviews

# Carbon Based Lifeforms @ Cosmonova: A Concert in Sight and Sound for IYA2009

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## Summary

Replacing its conventional analogue planetarium with a digital fulldome system, the Cosmonova theatre at the Swedish Museum of Natural History sought to come up with a variety of public offerings for the International Year of Astronomy 2009. Besides several fulldome shows it was decided that a concert of live music would both celebrate the year as well as attempt to attract a new audience.

Originally planned as a conventional planetarium, Cosmonova opened in mid-October 1992 as a combined ImaxDome 15/70 large-format film theatre and an Evans & Sutherland Digistar I video planetarium, both operating within the same 23-metre dome. With a 30-degree tilt the dome covers a large part of the audience's peripheral vision, making for a very immersive experience. Besides showing "off-the-peg" large-format IMAX films, a number of original planetarium shows were created that involved both Digistar and analogue media, such as 35 mm slides, videos, custom-built all-sky projectors that cover the dome and offered spectacular special effects, and even astronomy-themed IMAX film clips. While Cosmonova was one of the most technically advanced facilities in the world when it opened, by 2006 it was obvious that an upgrade was needed to bring the theatre into the 21st century.

After the renovation, Cosmonova planned to show a selection of astronomy-related fulldome video shows during the International Year of Astronomy 2009, as well as featuring a small mini-exhibit with some historical telescopes outside the theatre's entrance. It was also thought that a