APPLYING SERIOUS GAMES TO INTELLIGENCE ANALYSIS

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ABSTRACT

Knowledge from game design appears to offer new methods for software instruction and use that would traditionally require long, expensive, and not always effective training. In this paper, we explore the possibility of applying such knowledge to the field of intelligence analysis.

KEYWORDS

serious games; intelligence analysis; intelligence analysts

1. Introduction

The most popular use of games is for entertainment. However, knowledge from game design is now being recognized as useful for more then entertainment purposes. Games are being applied successfully to such widely diverse tasks as military training, environmental impact decision making, pain management, and language acquisition.

> *Serious Games*: Products that are not specifically entertainment but which use entertainment or the techniques and processes of the entertainment business to achieve a purpose.

There is no one key to a successful serious game (SG) - it is not necessarily an immersive environment, nor is it using physical controllers such as a joystick. Yet, we find that the elements of a successful game can work just as well in a setting where the goal is not entertainment but to achieve a valuable purpose in the outside world.

We are interested in discovering and applying the possibility of such ideas - serious games - to augmenting traditional training of intelligence analysts. In addition, there is the possibility of using these ideas in the post-training phase of intelligence analysts such as their daily work actually performing analysis. How and to what extent there is such supplement and replacement is a difficult but potentially rewarding area of study.

There is a tremendous amount of work occurring on serious games. Industry is coalescing with the help of numerous support groups, periodicals, conferences and a growing body of literature. [1], [2], [3], [4][1] The use of serious games is not a passing fancy. However, like many new thrusts, it remains to be seen which benefits will be truly useful and which will prove to be insufficient to the challenges ahead.

1. Any mention of commercial products or companies is for information only and does not imply recommendation or endorsement by the authors and their institutions.

1.1 Intelligence Analysis and Intelligence Analysts

The type of intelligence analysis, which we address in this paper refers to the work of analyzing information by analysts in the intelligence community (FBI, CIA, DIA, et al.). Raw data (human intelligence, signal intelligence, and other data) are gathered, analyzed, and used to answer questions, predict outcomes, or stored and fed back into reports and databases for subsequent analysis. The intelligence community is investigating the use of SG technology in a variety of roles.

2. Serious Games Characteristics & Examples

2.1 Characteristics

Serious games are characterized by a variety of attributes. This list is not complete but provides us some of the more obvious and notable attributes.

- Highly realistic visuals
- Immersive environments
- Realistic user interfaces
- Implicit knowledge acquisition
- Real-world models
- Complex simulations
- Frequent interaction
- Collaboration and competition

Not all games have such attributes. Even one may be sufficient. Correspondingly, some games succeed despite a lack of some attributes that might intuitively seem necessary. Indeed, virtually all games show a certain brittleness outside their relatively focused area of interest. We will return to this topic later.

3. Intelligence Analyst Attribute Challenges

Unlike many other fields in which SG is used, intelligence analysis has unusual attributes that present unique demands. These demands may make it particularly challenging to apply SG technology to intelligence analysis.

3.1 Disparate Backgrounds

> There is no common background for intelligence analysts. Analysts come from a wide variety of fields. For example, many have scientific degrees in different areas; others have liberal arts backgrounds. Some have military experience; others do not.

Analysts are also trained to different levels of expertise. Veteran analysts deal with raw intelligence differently than beginning analysts.

3.2 Depth and Breadth

An intelligence analyst frequently has specific tasks (e.g., "Summarize nuclear capabilities in Iran."). This not only requires the obvious knowledge (Iran, nuclear capabilities, languages and dialects) but also requires knowledge of intelligence-related issues. For example, an analyst must be able to identify vulnerabilities, threats, and opportunities.

Analysts must have an extraordinary range of knowledge – deep in their specialty (e.g., Middle-East affairs) ranging from countries to individuals. Knowledge must be wide as well. For example, an analyst must have context for politics, economies, industries, and so on.

3.3 Other Points of View

Analysts must recognize other points of view. This includes viewpoints such as political, religious, cultural, and age.

3.4 Political Uses and Exigencies

Analysts must bear in mind the users and uses of the intelligence product. Unlike traditional SG users, the analyst is rarely the consumer of the final product.

4. Intelligence Analysis Attribute Challenges

Unlike the challenges presented by intelligence analysts discussed earlier, attributes of intelligence analysis are more similar to SG although some significant differences are evident. Consider the following examples:

4.1 Vague, Unknown, and Uncertain

Intelligence data is frequently vague. Even when clear, the validity of the data may be uncertain. Consequently, while games generally present the user with problems that are completely solvable, the world often presents the analyst with problems that are only partially solvable or have no solutions whatsoever. And almost always, conclusions produced by analysts carry uncertainty. It is a challenge to recognize what one does not (and sometimes cannot) know.

4.2 Misinformation and Meaningless Information

Intelligence analysis frequently involves misinformation or irrelevant information. Sometimes misinformation is deliberate and yet appears as solid as any other piece of information. This area is very similar to scenarios encountered in SG. Meaningless information is common to misinformation in the sense that in SG, meaningless information is also deliberate, even if provided by automatic noise algorithms.

4.3 Compartmentalized

Intelligence is frequently compartmentalized. An intelligence analyst might spend time trying to derive such missing information while a traditional SG approach

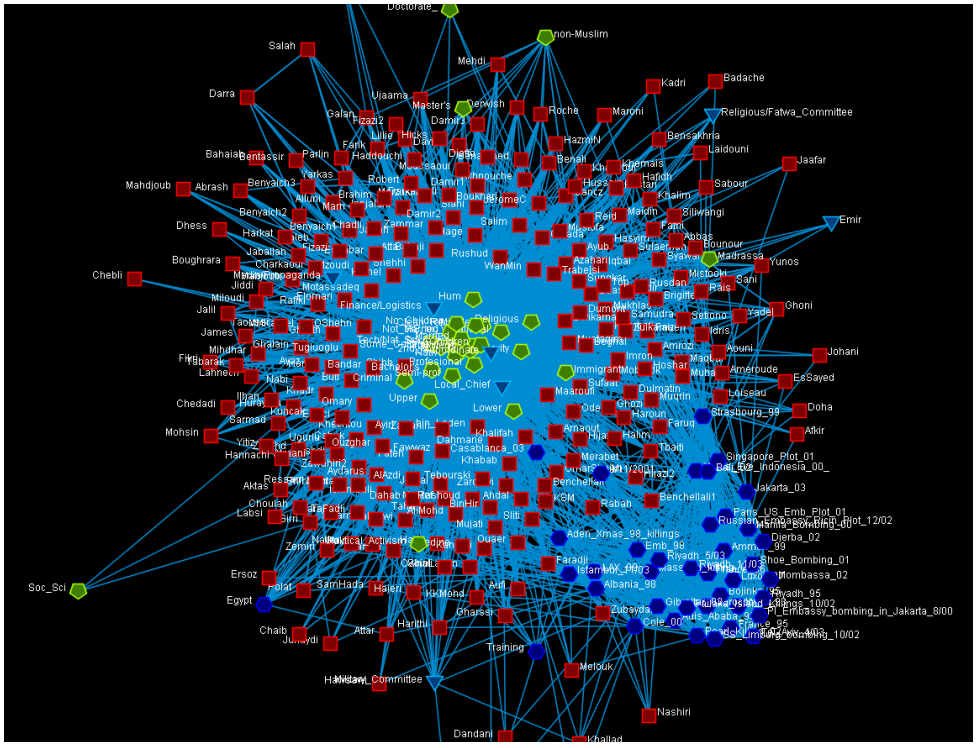

Figure 1: Making sense of a complex web is similar to being in a game with few instructions -- where strategies must be developed and knowledge acquired with no help. This example is so complex that it is not at all obvious where to start.

would be to outwit the classification or otherwise subvert the access protection.

4.4 Obsolete Information

Dated knowledge is common in intelligence analysis. Not so in SG where information is readily updated.

5. Discussion & Examples

Despite large differences, the task of intelligence analysis has large commonalities with application areas of SG. In addition, we do not want to look at SG as simply a replacement for what we have always done but as a source of new ideas. As an example, particularly effective SG allows the user to do almost anything. To paraphrase Douglas Whatley, "*We want to allow the user to try and explode anything.*" [5]

To take a step back, we may view the larger problem as the most obvious commonality to the overall task – to take a scenario of utter ignorance and disorder and from that to extract knowledge and bring to it a structure that is firm enough that useful conclusions can be drawn.

Consider figure 1 which shows a web of varied relationships that might be found in a semantic knowledgebase. The web is so complex that it is not at all obvious where to begin looking. At the edges where things are simpler? At the center where the most connections are? Or should we search for something we already know? [6]

In many ways, the task of understanding such a web is exactly like that of a very challenging game. Like many games, knowledge is hidden; otherwise the game has little point. Trial and error must be used; strategies must be developed as dead-ends are encountered. Rules may be unstated. These are hallmarks of both SG and the problems faced by intelligence analysts.

Another aspect of gaming and analysis commonality is the problem of integration of different sources. This problem of "sensor fusion" refers to the overwhelming amount of data, number of sources, and reliability (or lack thereof) of each. Games such as Netstrike provide a good example of how people can increase their skills at this fusion by playing a game. Initially overwhelmed, one spends time learning what to ignore and gradually develops a feel for relevancy and how to apply it adeptly.

While arguably not SG in a strict sense, Civilization shows some of the benefits because it begins to approach the complexity of real life and provide an interesting source of possibilities. "What if" scenarios can be played out to see results, strategies modified and the game rerun, both to see outcomes and to attempt to match given events. We can expect the sophistication of Civilization-style games to continue to improve to the point that analysts may actually find them useful to model the very events and relationships that concern them.

The Food Force game is another example of this concept. [7] For example, one Food Force scenario provides the player with a disaster-hit community (Sheylan, see figure 2). The player must identify problems and balance issues such as drought and civil conflict.

Slate is a software agent capable of assisting intelligence analysts with tasks such as hypothesis tracking and generation. [8] Slate provides analysts with the ability to construct arguments that "battle" each other to see which is the stronger argument. One way for the analyst to effectively define these battles and understand their outcomes, is to cast them in the form of a game. (See figure 3.)

This view of intelligence problems as games encourages the idea of what-if simulations. The user may explore how known facts may be affected. For example:

What if a particular official threatened to defect?

What if a rogue country had nuclear weaponry?

What if a militant group gained access to key secrets?

Figure 2: Food Force requires the user to identify problems in a disaster-hit community, such as identifying conditions, locating food, and solving logistics.

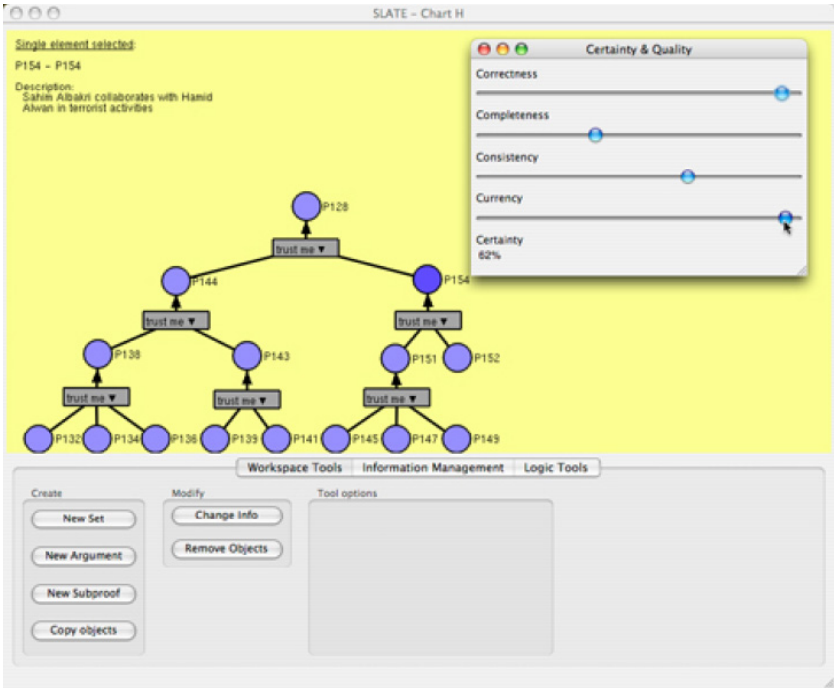

Figure 3: Slate allows construction of arguments that battle each other.

Proposing such alternatives, examining how they change the world in a simulated environment, and deciding which to pursue further, treats the problems as a game. This view changes the focus from analysis of a static situation to a much more open-ended problem – again with game-like strategies, comparisons of different outcomes, and so on.

Multiplayer game technology also opens up the idea of analysts playing against each other. Faced with an active "opponent," problems become more realistic. For example, a real-world situation may require months to develop a meaningful change in response to a new strategy. But additional analysts can adopt roles or strategies and move arbitrarily fast, perhaps forcing analysts to make decisions that they might otherwise be unwilling to do for any number of reasons (e.g., normally accepting that there is more time).

Multiple analysts could even battle over strategies while allied. For example, analysts representing "friendly" countries could experiment with different strategies that dynamically change from cooperative to independent behavior and back again as they see fit to achieve their own goals.

Another aspect of SG technology is the application of rich visualization. Successful visualization projects have frequently stressed the simplification of data presentation to remove distractions. However, experience with virtual gaming worlds suggests the opposite potential – that fuller, richer, overlapping meanings can not only be communicated successfully but that they also provide a synergy that would more effectively communicate complex information.

EPIC (figure 4) is an example of a SG system that deals with rich visualizations. It leverages the human visualization system, which is naturally used to dealing with complex scenes. [9]

6. Other Issues Of Application

We can speculate that intelligence analysts will benefit from two types of SG application. First, there will be SG that was never intended for intelligence analysts. Secondly, there will be SG intended specifically for analysts. This is a significant difference because it is likely to impact the effectiveness of SG products by intelligence analysts.

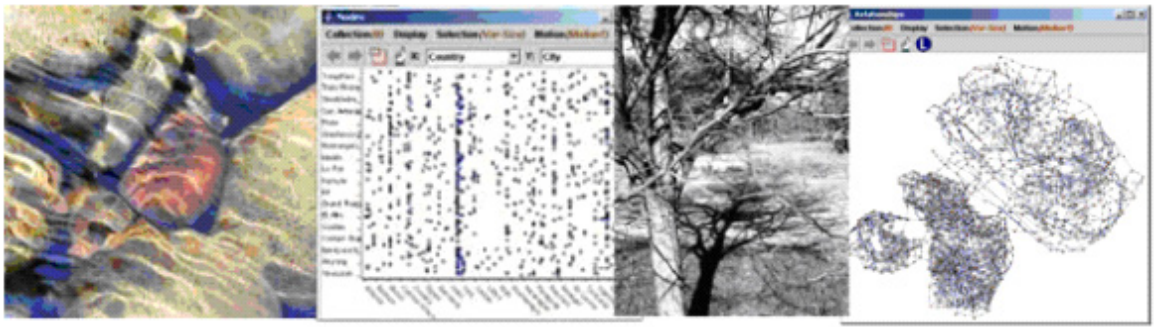

Figure 4: Several snapshots of EPIC showing intentionally overlapped visualizations to leverage human comprehension.

In the first type, we can already find SG that focuses on the ability to collect and structure knowledge. In essence, to think like an analyst is a natural outcome of some strategic and semantic game play. We can expect such games to be repurposed to better suit the needs of analysts.

It is sometimes useful for analysts to have a better understanding of the situations in which raw information has been collected. Participating in the SG exercises used by field agents is likely a natural desire for some analysts and, with little cost, may provide context that they could use to gain a greater understanding of the information. Similarly, the converse of this idea may be true. Specifically, if analysts could experiment using the SG technology to better understand policy modeling, war gaming, and what-if analysis used by intelligence consumers, they could improve intelligence analysis.

More and more, intelligence field agents are providing information directly in machine-readable form. We expect that it will be possible to feed increasing proportions of raw data directly to SG implementations. This integration will help to reconstruct the situation in which the data was collected and lead to a better understanding by the analysis of its meaning, reliability, and so on. In the future, it may likely be possible for the analyst to change the playback to experiment with different outcomes in an SG setting.

Of course, the most obvious application to the second type – SG specifically designed for intelligence analysts – is to build a simulated environment that truly models the analyst's tasks. One could imagine a scenario generator with a virtual task manager that provides human-like feedback and successively generates ever more challenging tasks. This would require an 'analyst analyst' but has significant potential. For example, during gameplay the analyst analyst could identify strengths and weakness of the analyst-in-training and either modify the training or find more appropriate taskings for the analyst that better fit the types of tasks needed.

That last example represents a larger effort that is pervasive throughout SG including customization and adaption of scenarios, of player modeling, and of tracking effectiveness of gameplay. At the same time, to support such lofty goals, the difficulties in creating SG are corresponding higher.

7. Risks & Concerns

There are many factors that could make SG infeasible for intelligence analysts, in whole or in part. In addition, there are several concerns that should be considered.

7.1 Cost of Science

First and foremost, effective SG is hard to create – much harder than traditional gaming. Semantic models, realistic environments, immersive user interfaces, real-time response, etc., are all difficult challenges. Some of them are being addressed. For instance, ever-faster computing and larger displays suggest that it is only a matter of time before achieving whatever degree of realism is needed.

But counterintuitively, games require hard science. The more science can be provided, the more realistic and effective the result. Just as the laws of physics provide a better learning experience with piloting a spacecraft, so do analytic 'laws.' For example, the 'laws' of information propaganda, weaponry life cycles, and history of warfare all have to be described formally and encoded in a way that makes them amenable to machine computation. This can be a daunting task.

7.2 Inaccuracy

The previous section described the difficultly of encoding laws. How, this presupposes such laws even exist. Even if such laws do exist, they may be impossible to find.

The risk is that an SG implementation may not reflect reality but in such a subtle way that analysts do not realize the mismatch and nonetheless go on to create analytic products that have a higher confidence level than they deserve.

7.3 Cost of Infrastructure

SG deployment is associated with fast-computation infrastructure that enables real-time response. Multi-computational units with high-speed network access are much more expensive than traditional analyst access. Immersive-user interfaces require headsets with 3D interfaces; and multiple or oversize displays are also an expected attribute of the technology.

7.4 Time for Training

Traditionally, analysts have had limited time for training, particularly with specialized tools and unproven methodologies. The idea of letting analysts 'play games' sounds, at least superficially, like something that would have very little support without a strong guarantee of immediate benefit. However, there is significant support for research into the value of SG technology in the intelligence community. [10], [11] While it is not clear that such a guarantee of benefits could ever be offered, training is likely to raise the likelihood of positive results.

7.5 Age and Experience

According to studies, the willingness to work with games is correlated closely to the age of the player. The average age of an SG player is 30. [12] Not only does this mean a more difficult sell to policy makers (who are generally much older) but it raises the question of whether older analysts will readily accept the technology. This has yet to be addressed.

Another study showed a related result – that more sophisticated gaming experience was correlated with higher scores in training, satisfaction with user interfaces, team cohesion, and hours played. [13]

7.6 Public Support

Public support can play surprising roles in the deployment of SG by intelligence analysts. For example, Policy Analysis Market project (PAM) was an intelligence project structured as a game that used the idea of a futures exchange – in this case allowing trading in such events as the assassination of heads of state and acts of terrorism. [14] Soundly based on economic theory (the Efficient Market Theory), PAM appeared to hold the promise of predicting future events better than individual experts.

However, critics branded PAM "immoral" and "ghoulish" and that it appeared to be government-sanctioned betting

Top 10 Claims by Transaction Volume in the Last 7 Days

Rank	Volume	%	Symbol	Bid/Ask/Last	Short Description
1	1136	25.1%	WarmSU	51/ 74/ 52	Pres Mentions Global Warming
2	520	11.5%	T2007	98/ 99/ 99	True on Jan 1 2007
3	477	10.6%	Arnold	7/ 9/ 9	Arnold Schwarzenegger Pres.USA
4	276	6.1%	AtTS06	49/ 50/ 50	Atlantic Tropical storms 2006
5	257	5.7%	G3.0	2/ 4/ 3	US Gasoline $3 again in 2006
6	253	5.6%	G3.5	1/ 2/ 1	US Gasoline $3.50 in 2006
7	225	5.0%	YEN100	27/ 48/ 40	Dollar-Yen Exch Rate below 100
8	161	3.6%	Canc	17/ 18/ 17	Cancer Cured by 2010
9	133	2.9%	Blair	2/ 3/ 3	Blair PM longer than Thatcher
10	121	2.7%	PFol	18/ 30/ 29	Protein folding solved by 2010

Figure 5: The Foresight Exchange is a commercial futures market for current events.

with the possibility that it could encourage terrorist acts to subvert the market (and make a profit). Not long after it became public knowledge, PAM was quickly shut down. [15]

In the same timeframe, commercial enterprises (see example in figure 5) recognized the interest and replicated the effort. [16], [17] Ostensibly for profit (i.e., not for intelligence-analysis purposes), these gaming sites continued to support issues of international current events such as terrorist and government activities. Ironically, one even offered customers the opportunity to bet on whether PAM would be terminated.

In 2006, the US made it illegal for banks and credit card companies to handle payments for such online gaming sites. [18] While unlikely to prevent access by intelligences agencies, it seems reasonable to assume that such legislation may have a detrimental impact on the accuracy of the markets by limiting U.S. participation.

7.7 Tacit Knowledge and Other Analyst Differences

Analysts typically have a large amount of unwritten or tacit knowledge. Such knowledge is not necessarily common from one analyst to another. Current analyst tools do not incorporate such knowledge and the search for ways to incorporate tacit knowledge has been a long-standing issue.

As mentioned earlier, analysts have widely disparate backgrounds. This is another form of tacit information. SG must address these various types of tacit information.

7.8 Hype and Overpromising

A final concern is that of hype which can lead to overpromising on what SG can deliver. Our experience at this time is limited and yet it is tempting to make substantial claims that exceed our current practices, particularly given that whether for-profit or non-profit, a return on investment is a must. Else why do SG? However, we must temper such claims so that early failures do not lead to early abandonment that is premature.

There is a lack of statistics correlating the use of SG and training and improvement except in very specialized instances. For example, the US Department of Education recently published a major study of the effectiveness of education technology including SG. Among their findings was that "*Test scores were not significantly higher in classrooms using the reading and mathematics software products than those in control classrooms…. found no significant differences in student achievement between the classrooms that used the technology products and classrooms that did not*." [19]

Will this carry over to SG for intelligence analysts? The answer is not at all obvious but it would be rash to assume a particular answer. In short, the question that must be answered: Is the development and deployment of SG more effective and less costly than training that could be accomplished without SG? Given the lack of thorough data on alternative training costs versus effectiveness, this question is impossible to answer at the present time.

8. Summary / Conclusion

To date, SG has seen limited exposure to intelligence analysts for the purpose of intelligence analysis. Yet it seems clear that there is potential for significant synergy in analyst training and in the analysis process as a whole. We should expect continuing improvements in SG technology itself. It is worth further exploration and experimentation with SG and intelligence analysts, both using intelligence analysis-specific SG and non-intelligence analysis-specific SG.

However, we must recognize that the effectiveness of SG may fall short of the hype just as many other technologies that have appeared with big promises and funding. Technologies such as artificial intelligence and expert systems ultimately required significant experimentation to learn their limits and where deployment made sense. Like those technologies, SG along with its potential benefits is also certain to have limitations and costs, many of which are not as yet clear.

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