

Geospatially Enabled Serious Gaming for Decision Support in Agroforestry System: A Conceptual Study

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Abstract

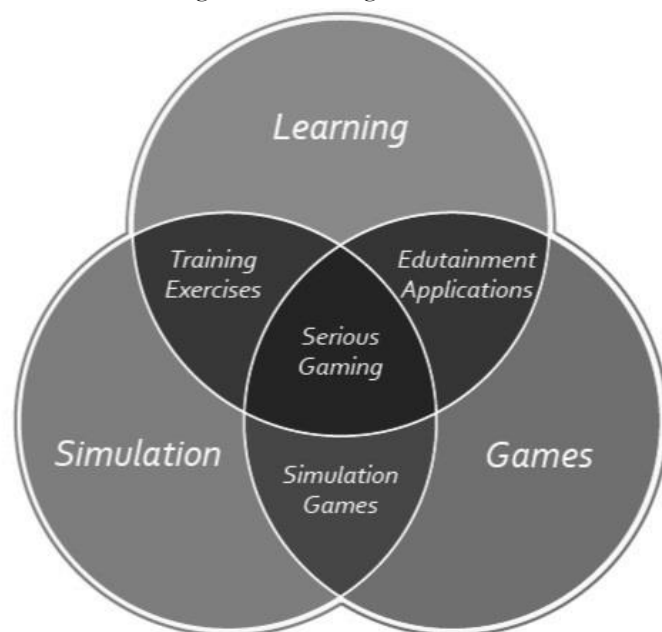
Natural resources are in a constant state of depletion. The main reason being over exploitation of these resources and not contributing to their replenishment. To deal with these challenges, ecologists, leaders and experts have recommended the adoption of an agroforestry agriculture system. Agroforestry is more sustainable agricultural method that provides a long term vision to combat food insecurity. In spite of agroforestry being very useful, still individuals can not foresee it's advantages. Serious games can motivate people in agroforestry scenarios and involve users in high interaction. GIS is a tool that can help in decision of proper location for agroforestry depending upon past data or information available. This paper defines a conceptual study for serious game to dynamically create 3D real-world agro-forestry environments. The serious games aim to provide visualization, intuitive management, and analysis of geospatial, hydrological and economic data to help participants for the decision support in agroforestry systems.

Keywords: Agroforestry, Serious games, Decision support system.

1 Introduction

In traditional agriculture only agriculture crops are grown by farmers. There are many disadvantages of traditional agriculture like uncontrolled water runoff and soil erosion, reduction in soil organic matter and soil fertility, deforestation and possibility of total crop failure. Due to population growth, financial globalization and degradation of lands, the pressure on existing forests and agricultural land continuously increasing. Therefore, it became urgent to look beyond traditional agriculture, forests and focus on agricultural lands to produce more crops, wood and non-wood forest products for meeting local and industrial needs.

Agroforestry provide the natural alternative. Agroforestry involves a variety of trees that are planted and managed agricultural lands that give two main outputs: products and services. Tree in agroforestry produce timber, organic products, gums, pitches, latex, nuts, oils, beverages, fodder for livestock, fuel wood and biomass for energy, medicines etc, thus providing



fundamental life support system to local people and communities [1]. Serious games are the computer game which is designed for a primary objective other than pure fun or entertainment. Serious games are used for improving players experience by providing the virtual interaction [2].

2 Background Literature

2.1 Advantages of Agroforestry

Besides producing tangible products, agroforestry systems also provide intangible services such as territory to wildlife, bees habitats for fertilization for crop plants, carbon capture in soil and biomass, enhancement of surrounding environment, regulation of micro-climates, nitrogen obsession, soil erosion control, soil formation, social values etc[3]. Agroforestry system can control water runoff and soil erosion, thus reducing losses of water, soil minerals, organic matter and nutrients. Solar energy can be more effectively used in agroforestry system in the comparison of monoculture systems. The fertility of soil can be increased by roots and biomass of agroforestry system.

2.2 Applications of Serious Gaming

2.2.1 Education and Training

Educational sector is one among the many sectors that has been gained extremely from Serious Gaming. Serious gaming is extremely related to tutoring and upskilling. The studying procedure of the contestants can be enhanced by the craze of serious digital games and for dependency on games. Gameboy Nintendo has been utilized for enlightening the mathematical talent in relation to several stages of complications in the “Skills Arena” [3] game. This game was analyzed; it has been verified that this has drawn in gainful refinement of statistical talent of the students. Another case of Serious game is “Making History” [4] which is used for tutoring History lectures. The research, which was made over this game has also defined that serious gaming method improved the services in learning history more than conventional methods. Another example of serious games is “Lost in the Middle Kingdom” [5], which teaches the contestant to study alternate language. Moreover, the games in Education and Teaching sectors have put forward many aims as listed but not restricted to teaching about poverty; communal awareness; to educate the players understand the troubles in agriculture; to teach about difficulties in transportation; constructive usage of electricity and water in urban areas; to teach about difficulties associated with sustainability.

2.2.2 Health and Welfare

The implementation of serious gaming in health and welfare sector is also remarkable. “Heartlands” [6] is a mobile fitness game where participants are expected to go for a walk in a region of their decision, during this time, the heart rate will be observed via a handheld computer activated with global positioning system (GPS). Another example of such serious game is “Monster and Gold” [7] that motivates the players to walk for maintaining an optimum heart rate. “Fish’n’ssteps”[8] is an exercise game that maintains a track record of wail using pedometer. This is a multi-player model serious game where participants motivate one another for better jogging. This game helps in improving healthcare practices. Different dance steps taught within the game Sensor Network for Active Play, SNAP[9]. These dance steps are effective in the active motion of entire body. Various sensors are used in this game network for the evolution of the participant’s execution. This serious game’s result has shown that different dance steps are very successful in terms of energy expenses and heart rate control.

2.2.3 Advertisement

Advergaming are the serious games that are utilized for the advertisement of any brand of product. Advergaming are mostly created for the promotional purpose of brand or goods or service to its participants. NFL, Formula One, Pepsi, 7-Up, Burger King have been successfully using Advergaming for advertisement of their products and services. These goods are usually advertised within the serious games where the brand is usually maintained within the players' memory as they descend into the game intentionally. A study [10] shows that 35% of participants are able to remember the advertising that are shown in the video game.

2.2.4 Culture

This specific area generally matches that of education because the practice of serious gaming in this domain provides cultural education. Although they bring However, they have some additional benefits of stating a specific cultural advantage and make players appreciate the artifacts as the games typically reproduce historical places and sites by an interactive display in real time or a simulation of realistic historical scenarios. The application also provides an idea of places of preservation of cultural value. Developers use technologies like telling stories or providing training to train players on culture and traditions, standards and moral duties at different periods of history.

ThIATRO[11] is a game which allows many gamers to play online where it is easy for their players to learn the history of art. The game uses Web3D technology to provide two-way interaction among museums and visitors. The game has managed to provide a virtual social experiment in 3D. Solis Curse [12] is raise the social values of his participants through a sequence of questions posed in the game play. ON the basis of point earned a worldwide ranking is also provided in this game.

2.2.5 Medicine

The applications of serious gaming in biomedical field mainly works for health checkup; detection and diagnosis; Medical education. Home Automated Remote Management System (HAT) [13] trains about symptoms associated with congestive heart failure and disease behavior. The game system helps its players monitor their symptoms, follow their body weight changes and improve their quality of life. Another similar gaming framework for the diagnosis of patients has been proposed by [14]. The game gathers information on its players very comfortably and helps a lot to monitor the health of player.

2.3 GIS

GIS is the acronym to Geographic information system. It is a system that deals with the management, collection and analysis of Geographic information data such as maps, location, elevation data etc. It makes understanding of geography or location data easy with the help of 3D view maps and other operations on map data. GIS data can be analyzed and used to take smart decisions regarding map data and planning various activities or construction projects accordingly. It helps in solving complex problems related to location data which otherwise may be a tedious job to do.

2.4 Softwares

2.4.1 Unity 2D/3D Game Development Engine

Unity is a game designing engine software that provides game creators with the necessary set of features like positioning, scaling and adding realistic objects in games quickly and efficiently. Unity is used in the creation of most of the world's known games. Unity is a very user friendly development environment which is preferred by almost all the game developers. Best part of unity is that it is an open source software whose

personal use is totally free. We may have to buy license if needed for professional use. The games created in unity are compatible with most of the gaming consoles like XBOX, windows, Mac, iOS, Android, WebGL etc.

2.4.2 Microsoft Visual Studio

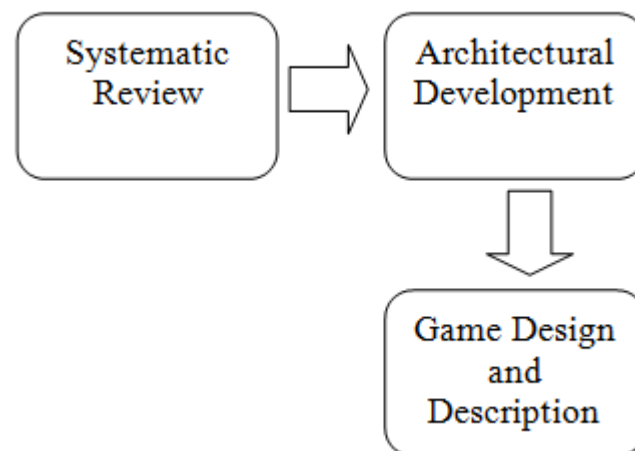
It is an Integrated development environment used for scripting of many programming languages. For Unity's support, we use it for scripting purposes in our games. All the game objects are scripted in C# programming language and for that we need visual studio. It is an open source software by microsoft.

2.4.3 QGIS

Quantum GIS is a free of cost and open source geographic information system software that is used for editing, viewing, and analysis of geospatial information. The complex geographic data is viewed in a very understandable manner by the help of QGIS. DEMs can also be easily viewed in QGIS to visualize elevation data also. Python support with QGIS makes it even more user friendly. Raster and vector data are easily viewable and we can do various operations on them to make output results in a manner that even layman can understand. Hence, QGIS makes understanding of the otherwise difficult location or map data very easy. 3D maps visualization makes understanding even more easier.

3 Methodology

The strategy of game design has been created based on a precise review of supporting methods and literature. The proposed methodology is depicted in block diagram below.



3.1 Systematic Review

Agroforestry is a land use methodology to global climate change mitigation and provide environmental, social and economical advantages. Agroforestry is promoted for it's potential for carbon capture in soil and biomass, enhancement of surrounding environment, nitrogen obsession, soil erosion control.

3.2 Proposed Architecture

The game architecture is developed using the DPE (Design, Play and experience) framework provided by Brian Winn [15]. Based on the above conceptual framework, the architecture for serious play is as follows:

3.2.1 Learning

This is the content that must be learned by the participants while playing the game. In this game, getting knowledge of different type of agroforestry systems.

3.2.2 Game Play

This is the manner in which the player interfaces with the game.

3.2.3 User Experience

Participant's emotions and attitudes while playing the game. Game rewards and punishments are expected to bring out positive changes in player behavior.

3.3 Game Description

Based on above serious gaming methodology and proposed architecture the platform for decision making should be realistic so it can use for farming purpose. The goals of game should be clear and easily understandable. The game should offer a set of straightforward instruction to be followed. The game can be played individually or with multi-participants. Rewards and badges should be given to participants for increase engagement in agroforestry system. For negative work player should be given any type of punishment. The player's performance is assessed by providing a scoring record at the end. The imposed the penalty deducting the score gained as well. There can be many level of difficulties in the serious game.

4 Discussion and Conclusion

This conceptual study on game- based approach for decision support in agroforestry can help farmers to experience the long term advantages of agroforestry without actually doing it and just by playing a game that replicates visualization, intuitive management and analysis of geospatial, hydrologic and economic data in agroforestry systems. The serious game will provide virtual environment for decision making in agroforestry system. Use of geospatial data in this serious games provides such a complex information in such an easy and understandable manner that it may motivate people in the agroforestry practices. Serious games have promoted new and creative communication techniques to inform and engage participants with logical research. This research analyses that the productivity and engagement in agroforestry practices may increase through decision-making process using serious game.

5 Future Scope

This conceptual study of proposed agroforestry game shows that combination of geospatial data and agroforestry practice through serious gaming can provide good platform for the decision making in agroforestry systems. Based on recent literature and serious games for agroforestry we recommend that virtual reality serious gaming can provide more effective decision support for agroforestry systems in future as it is even more engaging and can have a deep impact on the users' mind.

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