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HUNT: Scavenger Hunt with Augmented Reality

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Abstract

This project shows a creative approach to the familiar scavenger hunt game. It involved the implementation of an iPhone application, HUNT, with Augmented Reality (AR) capability for the users to play the game as well as an administrative website that game organizers can use to create and make available games for users to play. Using the HUNT mobile app, users will first make a selection from a list of games, and they will then be shown a list of objects that they must seek. Once the user finds a correct object and scans it with the built-in camera on the smartphone, the application will attempt to verify if it is the correct object and then display associated multi-media AR content that may include images and videos overlaid on top of real world views. HUNT not only provides entertaining activities within an environment that players can explore, but the AR contents can serve as an educational tool. The project is designed to increase user involvement by using a familiar and enjoyable game as a basis and adding an educational dimension by incorporating AR technology and engaging and interactive multimedia to provide users with facts about the objects that they have located.

Keywords: Software Engineering, Augmented Reality, iOS Application, Scavenger Hunt.

Introduction

A scavenger hunt is a popular game in which the organizers define a list of objects or tasks for players to find or perform, often within a set time limit. When the individual or team participants find objects and perform tasks, they collect the found objects and/or take photos/videos to prove they have satisfied the tasks on the list. While scavenger hunts are fun to play, game organizers often design games to encourage players to explore specific geographic areas or to familiarize them with certain topics of interest.

A university setting can be an ideal place to hold scavenger hunt games. Every year new students arrive, and before starting their academic life they are often required to attend various orientations to familiarize them with university life and policies. Gamification, the application of game elements to non-game problems, can be used to enhance student experiences in orientations and can provide memorable learning experiences in various programs and services. Similarly, libraries and museums could also benefit from this popular game to showcase their facilities.

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This project explores an innovative approach to the scavenger hunt game by developing an iPhone application, HUNT, with Augmented Reality (AR) capability for the users to play the game. There is also an administrative website that can be used by game organizers to create games for users. The authors were asked to develop an app for their university library, whose staff recognized a need to find a better approach to introducing library facilities and services to their visitors in a fun and attractive way, while also enhancing the effectiveness of their visits.

With rapidly developing new technologies, scavenger hunt games have seen a resurgence. One well known example is reported by Talton, Peterson, Kamin, Israel, & Al-Muhtadi (2006) in which the University of Illinois at Urbana-Champaign used handheld computers to run scavenger hunt games with incoming freshmen in the Department of Computer Science for the purposes of orientation and retention. They found a significant correlation between student participation in the scavenger hunt and retention rates in the department. They also found that playing the game improved the attitude of new students toward computer science.

Augmented reality is a technology that refers to the use of computational displays to add virtual information to a user's sensory perceptions (Feiner, 2002). It allows users to see more, hear more, or even touch more. People can perceive entirely computational components and objects within the real world experience (Van Krevelen & Poelman, 2010). For example, people could read the reviews of the restaurants that they pass by as they walk down a street, visitors could see additional information in multimedia form of special exhibits in a museum, machinists repairing a broken piece of equipment could receive instructions highlighting in real time what to do next, firefighters could see the structure of a burning building to avoid invisible hazards on the scene, and soldiers could see the position of enemy snipers who had been spotted by unmanned reconnaissance aircraft (Feiner, 2002).

According to a survey of augmented reality conducted by Azuma and others (Azuma, 1997; Azuma et al., 2001), an AR system has the following properties:

- combines real and virtual objects in a real environment;
- runs interactively, and in real time; and
- registers (aligns) real and virtual objects with each other.

In this project, a mobile platform, specifically Apple's iOS, was chosen for the game due to its popularity and portability. The objective of this project is to introduce an innovative and fun way for anyone who wants to organize a scavenger hunt game. The HUNT mobile app is accompanied by the HUNT administration web, which includes an administration panel that can be used by the game organizer to design games, create a list of available games, and upload games to HUNT mobile app dynamically. Game organizers can use the HUNT admin web to define objects for the game and also load and associate AR content with each object so it can be displayed as each object is found by a player.

As each object is located by a player, the HUNT mobile app will track the success rate and allow the player to move on to the next object in the game.

The goal of this project is to increase user involvement by using a familiar and enjoyable game as a basis, and adding an educational dimension by incorporating AR technology and engaging and interactive multimedia to provide users with facts about the objects that they have located.

Literature Review on AR Applications

The first AR prototype was developed by Sutherland (1968) and involved a head-mounted three dimensional display upon which 3D graphics were projected such that they overlay the user's view of the world. The term "Augmented Reality" was first used in 1990 by Caudell and Mizell

(1992), who were developing an AR system to help workers assemble wiring harnesses. Throughout the years, computing and tracking systems and devices have become powerful and portable enough to build graphical overlay in mobile configurations. Feiner, MacIntyre, Höllerer, and Webster (1997) created a prototype system that involves wearable computer systems and combines a three dimensional graphics tour guide overlaying real world buildings.

AR display for viewing the merged virtual element and real world objects can be classified into three categories: head-worn displays (HWD), by which users mount some type of display on their heads to display virtual views in front of their eyes; handheld displays such as mobile phones that use a built-in camera to provide see-through augmented content; and projection displays, by which the virtual elements are projected on the physical objects to be augmented (Azuma et al., 2001).

The advances of smartphone capabilities, such as built-in GPS, sensors, and high resolution cameras, make AR technologies even more feasible. These capabilities, combined with the ubiquity of mobile devices, has simplified the development of AR and had made AR available and more easily accessible for users (Butchart, 2011). There are mainly two types of augmented reality currently seen in mobile technology: markerless and marked AR. Markerless AR uses the location determined by a mobile cell phone to serve as a basis for adding local information to the camera view. Shklovski and de Souza e Silva (2013) conducted a study of an urban game named Encounter that is popular in the former Soviet Union area. This location-aware mobile game combined local engagement and the global gamers' communication, showing that the interaction among the local-based communication, distant connections, and the local attachment as part of the gaming experience. Marked AR uses a two-dimensional barcode such as QR (Quick Respond) code to connect a cell phone or personal computer to information, usually on a web site (Pence, 2011).

There are numerous AR applications available on the market in various fields including entertainment, education, art, translation, military and law enforcement, vehicles, medical, trial rooms, tourism, architecture, assembly lines, cinema/performance, weather forecasting, television, astronomy and many other fields (Sood, 2012).

AR applications are changing the way educational content is offered, helping to improve classroom learning through interaction. Klopfer (2011) explored the case studies of mobile educational games that use augmented reality. The real world context and social dynamics of these augmented reality applications have the potential to develop needed skills in today's students. Research conducted by Nickels et al. (2012) indicated the problems facing high school students in understanding the spatial relations of protein structure. ProteinScanAR is an AR application for a biomolecular educational purpose that allows students to perceive 3D molecular structures in the real world by scanning a marker. The visualization of 3D molecular structures helps students to improve their spatial imagination while learning molecular mechanism in living cells.

In classrooms, student successes are often impeded by lack of motivation and engagement (Huang & Soman, 2013). Research conducted by Shelton and Hedley (2002) revealed that incorporating games in learning activities not only makes the learning fun, but also raises students' motivation and engagement in a given task. Different AR games have been developed for learning purposes in education. Woll, Damerau, Wrasse, and Stark (2011) presented Skillmaster, a fun AR game that guides the user in assembling a car generator. The Skillmaster scenario requires a player under alien attack to assemble a broken generator in order to power a laser cannon. The Skillmaster game helps players gain knowledge of car generators as well as how to assemble a generator while enjoying game play. The AR technology helps the player visualize the partially assembled generator in 3D and identifies the location of the next missing component after a marker is scanned. Another outdoor/indoor mobile AR game, ARQuake, was created by Henderson and Feiner (Thomas et al., 2000). ARQuake is an extension of the desktop game Quake that

includes a physical environment in which the player sees monsters, weapons, and objects of interest augmented on the real world.

Mobile AR, which integrates AR technologies with mobile devices, is an evolving field that is advancing rapidly and is full of opportunities. Additional examples are noted in Chao, Du, Wagenheim, and Rippey (2014).

The Project Design

In this study a mobile game prototype was designed to explore learning opportunities through an orientation activity in a university environment. The research design involved the development of the general architecture and implementation of a prototype built upon the game scenario. Features of the prototyped game such as "map-navigation" and "hunting and hiding" were selected to be fun and engaging for users. The prototype features were designed to allow players to experience a mixed reality that augmented both physical and social space (Schwabe & Göth, 2005).

This AR scavenger hunt project was designed to create technically augmented scavenger hunt games that could be used by individuals, departments, or organizations to provide an innovative approach to playing the scavenger hunt game with an educational purpose. Consisting of both the web admin interface and the mobile application, HUNT is intended to be used by both game developers (administrators) and game players, and therefore provides a variety of features for each group. The HUNT admin web is used by administrators to create new scavenger hunt games and edit existing games and then upload those games to the HUNT mobile app dynamically. The HUNT mobile app allows players to play those games, receive augmented content once the correct object is found, and score points.

The scavenger hunt proceeds by the HUNT mobile app displaying a list of objects for which players will search. Each object is assigned different point values. When an object is located by the player, augmented content such as video clips or images will pop up on the mobile screen. The app will record the successful search and then the player can proceed to the next object to be found. At the end of game, the app provides a summary page displaying the game results including time elapsed, the number of objects found, and the total points earned.

It was decided that user stories would be the most appropriate tool for capturing the range of features required by both administrators and players. A user story is an agile software development approach that expresses project requirements written in human language to describe what the user wants to do. Table 1 and Table 2 below show the list of features established as user stories for administrators and players.

This project was developed using an agile development methodology based on eXtreme Programming (Beck, 2000) and Scrum (Schwaber, 2009). That means the development process was both incremental and iterative with thorough testing and frequent delivery of working software. The project was broken into five two-week iterations. The first iteration focused on basic player functionalities of selecting a game from a list to play. The second iteration created an administration website that allows an administrator to create a list of games for the player to select and play. The third iteration then added the augmented reality functions for the player to verify a found object and reveal the augmented multimedia contents. The fourth iteration added more administrative functions to the website such as allowing modification and deletion of games as well as setting points and time limits for games. Finally, the fifth iteration implemented the timer and game summary on the mobile app. At the end of each iteration, working software, both an iOS app and the admin website, was delivered to the client (a group of intended users from the university library) for testing and feedback. This agile development approach has been adopted successfully by the authors and has been recommended by several other educators (Alfonso & Botia, 2005; Chao & Brown, 2009; Davey & Parker, 2010).

Table 1. User Stories for Administrator

AS AN ADMINISTRATOR	
1	As an administrator, I want to be able to create multiple games so that games can be more custom designed and a player can select a game based on his/her interests.
2	As an administrator, I want to be able to add objects to a gallery of objects so that I can reuse them later.
3	As an administrator, I want to be able to add augmented content so that the players can see them once the right image is scanned.
4	As an administrator, I want to be able to set time limits for a given game.
5	As an administrator, I want to be able to assign points for each item being sought after.
6	As an administrator, I want to be able to upload a created game to HUNT mobile app.
7	As an administrator, I want to be able to update/delete an existing game.
8	As an administrator, I want to be able to edit hints for each item.
9	As an administrator, I want to be able to edit the game's instructions

Table 2. User Stories for Players

AS A PLAYER	
1	As a player, I want to select a game to play from a list of available games according to my interests.
2	As a player, I want to see a list of objects to find after starting a game
3	As a player, I want to be able to use the camera on my mobile device to verify the object found so that the system has a record of my findings at the end of the game.
4	As a player, I want to see augmented content associated with an object once I have scanned the correct object.
7	As a player, I want to have an instruction screen so that I can learn how to play the game.
8	As a player, I want to get hints for each item on how and where to find the objects selected.
9	As a player, I want to know the points I will earn for each object.
10	As a player, I want to see a timer on the game page so that I can monitor the time left while playing a game.
11	As a player, I want to see a summary of my game status including objects found and total points I have earned at the end of game.

The Technologies

One feature of this app is that it provides users with the ability to see augmented multi-media content when scanning objects with a mobile device. The implementation requires two major technologies: mobile application development and augmented reality. In addition, it also requires a database and an application server for information storage and retrieval.

The Metaio software development kit (SDK) was the tool selected to incorporate Augmented Reality into the app. There are several AR SDKs available in the market that could have been used for this AR scavenger hunt project. Considering some criteria such as mobile platform compatibility, required AR features, responsible financial cost, and availability of support, Chao, et al. (2014) found that Metaio SDK and Vuforia are relatively more suitable for mobile AR related projects. Both AR development kits are compatible with the major platforms and could be used to provide all the required features for this project. Metaio SDK was selected is because of its reliable tracking technology and availability of support such as documentation, tutorials, and helpdesk.

The Metaio SDK is a modular framework that includes the capturing component, the sensor interface component, the rendering component, the tracking component, and the Metaio SDK interface. The Metaio SDK interacts between the application and other four components. Because of this configuration, the detail implementation of those four components is encapsulated and the major functionalities are implemented through the SDK API, which provides an easy realization of AR applications. The Metaio SDK is compatible with all major software development platforms such as Android, iOS, and Windows. The Metaio Mobile SDK offers several different tracking strategies, each of which can be stored in an XML file called the tracking configuration file. These tracking configuration files define the tracking setup of the application and can be easily modified.

In conjunction with selecting an SDK, a mobile platform had to be selected for the app. Today's most popular mobile platforms are Android and iOS. Android is an open-source platform that provides a significantly flexible and customizable development environment. However, since Android mobile operation system can be run on so many different models of smartphones with various versions, compatibility could present a problem. iOS was selected for this project due to its consistency. The iOS system runs on Apple mobile devices including iPhone, iPod, and iPad. Xcode is an integrated development environment from Apple and includes the iOS Software Development Kit that was used in developing this project. The app was developed for iOS version 6 and higher, making it accessible to a wide range of users. An Apple developer's license was needed in order to use certain features required for an iOS device.

MySQL was selected to address the database needs. Languages such as HTML, CSS, and JavaScript/jQuery were employed to adjust the administrative interface. PHP was used to connect to the database and retrieve information, as well as to insert information. The HUNT admin web used HTML5, CSS and JavaScript/jQuery for presenting, styling, and validating web pages. Since the design is based on three-tier architecture, a PHP script running on the server was used for storing and retrieving data to and from the web server while SQL was used to communicate with the database. To ensure the scalability of HUNT, all data was stored in a MySQL database.

Implementation of the Admin Web

HUNT includes two modules, the HUNT mobile app and the HUNT admin web. The admin web provides the features listed in Table 1. Once the administrator has successfully logged in to the web panel the administrator sees the display shown in Figure 1 and can access different functionalities including create new game, edit existing game, and browse the object gallery.

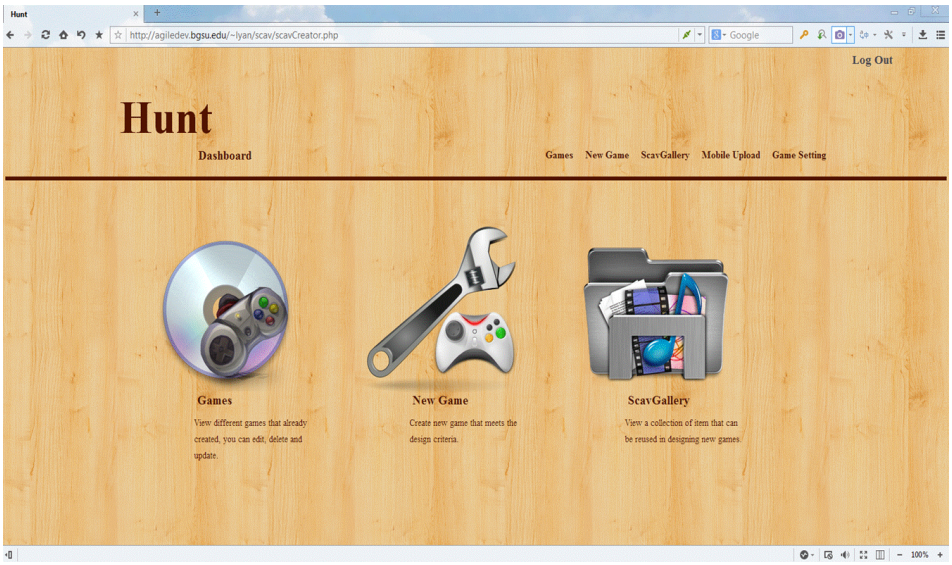

Figure 1: HUNT Admin Web Interface

The administrator is able to create a new game by clicking the New Game icon. The design of a game will be based on different criteria such as player area of interest, the purpose of the visit, player occupation, and the duration of the orientation or other activity. The administrator is able to specify game name, game description, and game duration via the interface shown in Figure 2.

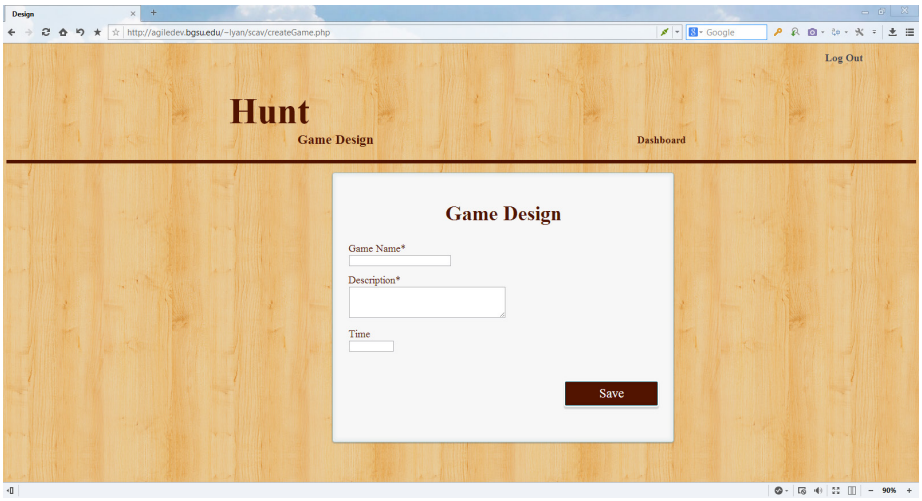

Figure 2: Creating New Game Interface

The administrator has an option of adding objects to the game, either new objects from local storage or existing objects from the object gallery. To add new objects the administrator must specify several fields, such as the object to find, hints to assist in finding the object, and AR content to be displayed once the correct object is found. The AR content will be displayed on top of a view of the physical object and can be a video clip, particular image, or a default image specified by the administrator in a game setting.

The games option will bring up a list of existing games that is populated from the database. In this area the administrator will be able to delete a game, update existing games, or upload any number of games to the HUNT mobile application. Deleting a game also deletes related game information from the database. Updating a game allows the administrator to change a game's

name or duration, or add one or more new objects or delete objects via the interface shown in Figure 3.

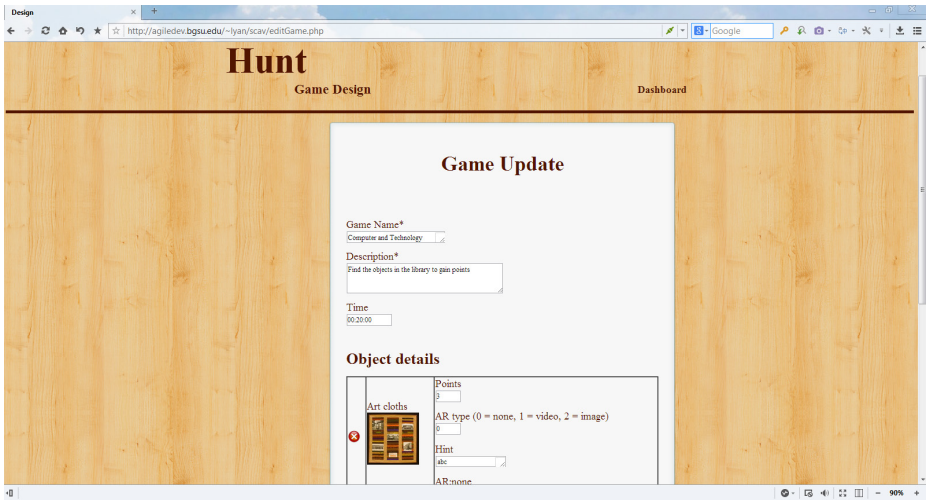

Figure 3: Editing Game Interface

The Mobile Upload option can also be accessed from the navigation bar on the home page. The administrator can choose which games to upload to the mobile application based on the orientation/activity purpose and target player.

The ScavGallery, or Scavenger Hunt Gallery, option lists all the uploaded objects in the database as well as their corresponding AR multimedia content, such as video clips, defined image, or default image, as shown in Figure 4. By clicking each small object icon, a full size image of that object will be displayed so that the administrator can have a clear view of the objects.

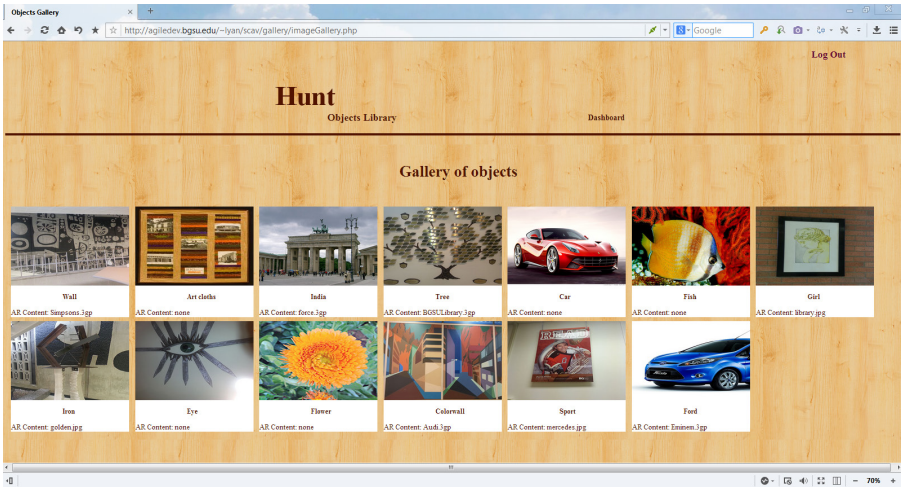

Figure 4: ScavGallery Interface

Implementation of the Mobile App

Once games have been uploaded to the HUNT mobile app, players can choose different games from the game list. HUNT is scalable since all data are retrieved from the database.

When a player starts the scavenger hunt game a welcome page will be displayed. When the user clicks "Start Hunting" the player is able to select a game from a list of games that have been uploaded by the administrator. The player can select a game based on personal interest or one specified by the orientation or activity organizer that serves a special purpose. Once the player has selected a game, a game detail page will show Game Name, Number of Objects, Play Time, and Game Description. The player can begin the game by clicking Start Game button. The app will then display a list of objects to be found, including the object name and an image, as seen in Figure 5.

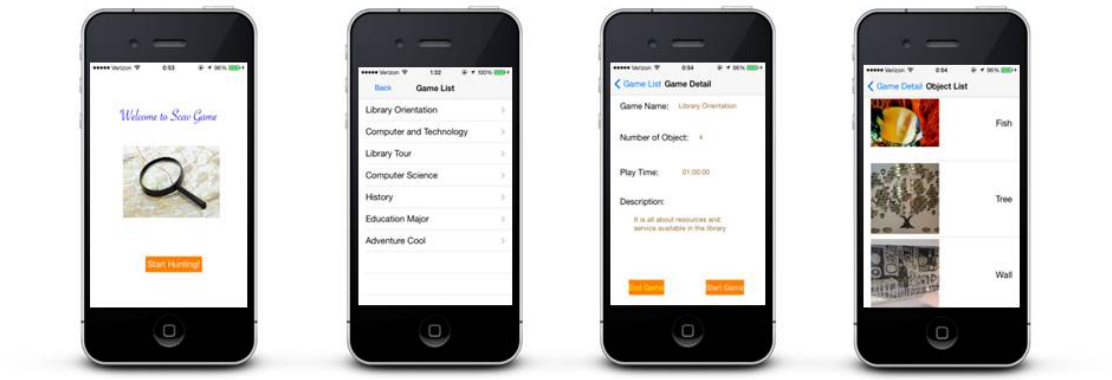

Figure 5: HUNT Mobile App Interface (part 1)

Information about all objects associated with the selected game are downloaded and stored in device cache to help improve performance of the mobile app. The player can select an object from the list that will lead the player to an object detail page, as shown in the leftmost image in Figure 6. The object detail page also includes hints on where to find the object as well as the associated point value. As in the traditional scavenger hunt rules, the player is required seek each object. In order to confirm that the correct object has been found, the player must scan the object. Touching the Scan button on the object detail page opens a scanning tool supported by Metaio SDK technology. The scanning tool initializes the device's built-in camera and compares the search object to the object the player found. If a match is detected, a button to show augmented content is superimposed upon the displayed object. If the AR button is a video play button, the player can click the button to watch a video clip that provides more information about the object. If the button is an information button, a click will bring up a related image with additional detail. Only by clicking the AR buttons can the player see the additional information associated with the object. This design motivates the player to view the associated AR content, rather than simply finding and scanning the object. This adds an educational aspect to the scavenger hunt game.

To reveal the next object to be located, the player returns to the object list page and selects another object. The player has the option to end the current game by clicking the End Game button in either the game detail page or the object detail page. Upon either successfully completing the quest or giving up, the player receives a game summary that includes the current game name, total number of objects, objects found, points earned, and time used, as shown in the rightmost image of Figure 6.

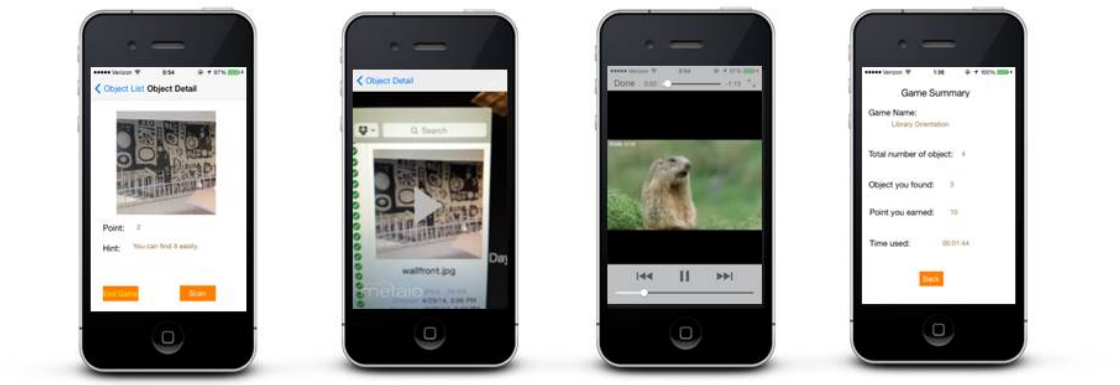

Figure 6: HUNT mobile app Interface (part 2)

The overall data flow for the AR scavenger hunt game can be seen in Figure 7. First, The HUNT admin web interface is used to upload the tracking files and augmented contents to the database. The HUNT admin web and the HUNT mobile app use the application server to interact with the MySQL database. Once the player uses the HUNT app to select the scavenger hunt game to play, the app downloads the tracking files from the database and stores them in the mobile device cache. When the game has reached its conclusion and the user has received the results of the game, the tracking files are deleted from the cache automatically to save the storage space and facilitate the application performance.

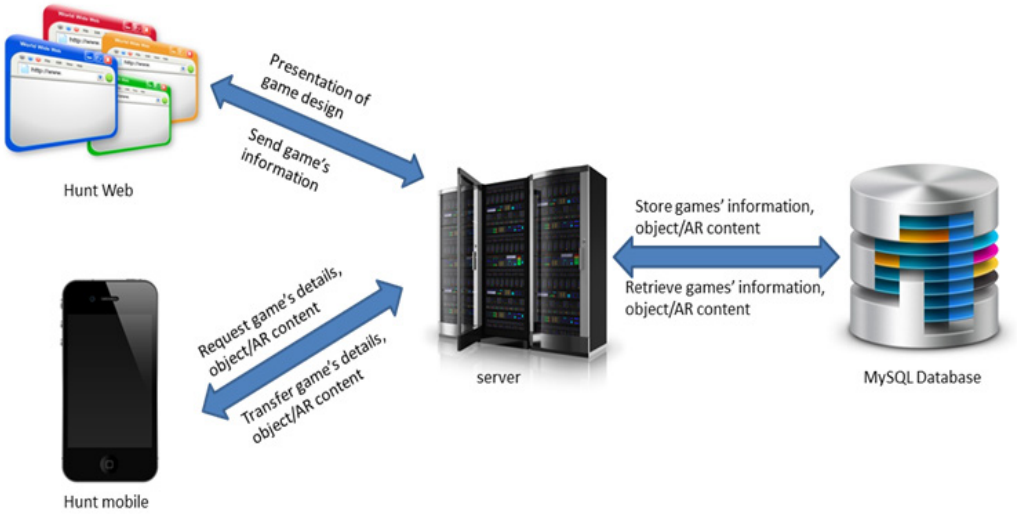

Figure 7: HUNT Application Data Flow

Future Work

Both a functional HUNT admin web and HUNT mobile app were implemented for this project, although some originally planned features were postponed for future enhancement. One such feature is to include an option for the administrator that allows new games to be either time-based or point-based.

The AR scavenger hunt game can also be enhanced by adding a larger variety of AR content, such as text and/or 3D objects. Other possible enhancements include the introduction of group games in which a registered group of players will play the same game in a competitive setting. Another enhancement is to expand the current project so that it can be used by different organiza-

tions or departments, with separate accounts for each. This requires implementing account grouping and authorization for the administration web panel, but would have no effect on the mobile app since it is designed to be scalable.

Contributions to Research, Learning, and Education

This study contributes to the information technology literature on a variety of fronts, including bringing advances in AR to the attention of the educational community (information), extending the literature regarding the use of AR in teaching and learning (knowledge), exploring the use of gamification to enhance teaching and learning (information and management), serving as a source of project ideas to other educators (knowledge), and looking at approaches to address the lack of motivation and engagement that often plague students and employees (information and management).

The study not only informs the educational community about the nature and advancements in augmented reality, but also verifies and extends the literature regarding the use of AR in teaching and learning. Talton et al. (2006) augmented the scavenger hunt concept by incorporating handheld computers to run scavenger hunt games with incoming freshmen for the purposes of orientation and retention. They also found that playing the game improved the attitude of new students. The Mobile Technologies Group (2004) at Georgia Institute of Technology developed a cell-phone based scavenger hunt for student orientation in which students had to interact with local merchants, scour the library, and discover the hidden relics and monuments on campus. This project incorporates even more current technology, including augmented reality and mobile game iOS applications, to previous approaches to further increase student engagement and to enhance the learning component. The AR scavenger hunt game project serves as an example of how AR technology can be used to add an educational component to even common games, increasing their educational value and making them more engaging for users.

The study also provides an example of gamification to enhance teaching and learning. Gamification takes the essence of games – attributes such as fun, play, transparency, design and competition – and applies these to a range of real-world processes inside an organization, including learning and development (Meister, 2013). Gamification has become a popular approach to encourage specific learning behaviors and increase student motivation and engagement (Huang & Soman, 2013). Gamification helps educators find a compromise between achieving their learning objectives and accommodating evolving student needs by increasing student motivation and engagement during the learning process. (Huang & Soman, 2013). Gamification is an area of information technology of great importance in both education and business. Gartner, Inc., the information technology research and advisory company, predicts that gamification will be used in 25 percent of redesigned business processes by 2015 and will grow to more than a $2.8 billion business by 2016. They also predict that 70 percent of Global 2000 businesses will be managing at least one "gamified" application or system by 2014 (Meister, 2013).

The HUNT project also provides an example to other educators of incorporating software development projects into the curriculum. The student developed a practical system that has potential to be applied in multiple areas. In addition, the software methodology used in developing the system is described.

In addition, we propose an approach to address the lack of motivation and engagement that often characterizes today's learners, regardless of whether the scenario is a university environment or employee training programs. The application that this study addressed was university-related, but using gamification to add a fun element to employee training programs can improve both attendance and outcomes (Cognizant, 2013).

This is how these facets all come together. In a traditional learning environment, a student's motivation to learn can be hindered due to a multiple reasons (Huang & Soman, 2013). The successful application of suitable gamification techniques can transform the delivery of the information into an addictive learning process for the students (Huang & Soman, 2013). The gamification of library orientation seemed a good application of the scavenger hunt game. Scavenger hunts have become one of the most popular tools for teaching students how to use available resources and information (Starr, 1999). Hunts can be tailored to virtually any curriculum area, simultaneously providing students with technological and subject matter knowledge, and they can be as simple or involved as circumstances dictate (Starr, 1999).

Library orientation is clearly not the only application of scavenger hunts. A quick Internet search of the phrase "educational uses of scavenger hunt" turns up a variety of applications, such as teaching students how to use Google, insuring that students are more engaged on a tour of an aquarium, archaeological education, familiarity with Blackboard, mineral recognition, and digital library navigation and use.

The use of AR interfaces provides not only a more interactive delivery mechanism for instructional content, but they also fundamentally change the way that content is understood through a unique combination of visual and sensory information that results in a powerful cognitive and learning experience (Shelton & Hedley, 2002).

HUNT addresses a relevant and persistent need in an innovative and effective way; it deals with the lack of student engagement through the application of gamification combined with AR. Our vehicle for gamification was a commonly used teaching tool, the scavenger hunt game. We extended prior research in technologically enhanced scavenger hunts to further increase student involvement by developing an iPhone application that incorporates AR technology to provide a more interactive delivery mechanism for instructional content and to enhance student learning.

Conclusion

In this study a mobile game prototype was developed to explore learning opportunities through an orientation activity in a university environment. The research design involved the development of the general architecture and implementation of a prototype built upon the game scenario. Features were selected to be fun and engaging for users and were designed to allow players to experience a mixed reality that augments both physical and social space (Schwabe & Göth, 2005).

The HUNT project was developed to introduce the campus library facilities and services to visitors more effectively than traditional orientations. There was a perceived need to make the library orientation more engaging and memorable. Traditional orientations seemed to be doing little to convince students of the usefulness of the library. As Ly and Carr (2010) point out "[w]ithout experiencing the physical library, students often lack the understanding of the organization of information, may not use library resources, and possess poor research skills." Improving the quality of library orientation can alleviate library anxiety and improve student learning (Ly & Carr, 2010).

It was determined that our library tour needed to be more interactive to engage today's youth, because they have different expectations and interaction approaches than prior students. The students of today are digital natives, having grown up with ubiquitous technology, and "[t]oday's teachers have to learn to communicate in the language and style of their students" (Prensky, 2001, p.4).

The AR scavenger hunt game project serves to show how AR technology can be used to add an educational component to even common games, increasing their educational value and making them more engaging for users. This example of educational innovation improves student experi-

ences in a common aspect of their university environment and increases both their enjoyment and their retention by making learning more memorable. The HUNT project uses a multipronged approach that includes AR to enhance teaching and learning, gamification to engage students, and delivery via technology that seems pervasive with today's students. These features come together to overcome the lack of motivation and engagement that often impede students and employees.

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