# Alumni Campus Tour: Capturing the Fourth Dimension in Location Based Notification Systems

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## ABSTRACT
When a person visits a place, it is almost always simple to understand the physical environment around them. Often people ignore—or don't have access to—the fourth dimension: time. Our research is an attempt to create a system that adds the aspect of time into location-based notification systems. This allows a person to not only experience their surroundings through five senses and three dimensions, but also to understand the changes the location has undergone over time, by receiving cues. This report describes our experience in designing and implementing such a system and reports on a preliminary evaluation of it.

## Categories and Subject Descriptors
H.1.2 [**Models and Principles**]: User/Machine Systems – Human Factors, Software psychology

## General Terms
Design, Experimentation, Human Factors

## Keywords
Location Based Notification System, IRC, Claims, Time, Tour Guide, Handheld

## 1. INTRODUCTION
The passage of time can be symbolized in many different ways. Common methods are to simply have a textual list of events very similar to a timeline, visual representation through the use of graphics and images, sounds, etc. A potent method to show the progression of time is recall. To have a person recollect their living memories and experiences of a particular location is vital in creating a common thread between what they have experienced in the past and what they see in front of them in the present.

Currently, to experience the progression of time one uses things such as yearbooks, university records, diaries, pictures, the internet, and other computer media as well as classmates. What do these resources have in common? All of them have some method of giving cues to recall memories. To be able to help a person recall their memories is the key.

When alumni visit their alma mater, they are very interested in the changes that have taken place since they graduated. Many would like to walk around to see the buildings in which they once had classes, recall the many memories they made in the years they spent in this university, and see how the campus has evolved from the time they remember to the present. Often, they are also interested in being able to contribute to the future growth and development of their respective departments and colleges.

Currently when alumni visit the campus, the place looks new and the people are unrecognizable—the information available to the alumni is very much centered on the present. With their five senses, they are able to see, hear, smell, feel and taste the three dimensions that surround them. There is limited opportunity to recall their memories through existing cues.

We explored adding the fourth dimension to location-based notification systems. Location-based notification systems (LBNS) provide pertinent information to users based on their current location. A common example of a LBNS is sending coupons to a customer if they are in a particular location of a store [3]. We decided to use the concept of location-based notification systems to build our system because location specific information is vital to a tour. LBNS provide users with the ability to get notifications pertaining to their location. Alumni touring the campus would benefit from such a system by the information they receive from it as they physically move throughout the campus.

SeeVT –Alumni Edition is a location-based tour guide system developed specifically for Alumni visiting Virginia Tech. The architecture of seeVT –Alumni Edition is based on the existing seeVT framework. SeeVT is a location-based notification system for mobile handheld devices [6]. To aid in the principled design and development of seeVT –Alumni Edition, we used the IRC framework—a set of design parameters and benchmarks that guide notification system design [2]. IRC stands for interruption, reaction and comprehension and is often used in designing notification systems so that they best meet the needs of users in terms of the interruption it requires, the reaction it demands, and the comprehension it causes.

## 2. RELATED WORK
There has been a significant amount of research done on location-based systems over the past few years. Our particular implementation is based upon the original seeVT system developed at Virginia Tech [6]. The seeVT system provides location specific information pertinent to a campus environment


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through mobile handheld devices. When a user enters a particular location, various points of interests around the user are displayed. The user then has the option of clicking on different points of interest and to access specific information about each. If a faculty member is shown on the list of "points of interests", the user is able to access that faculty member's webpage, view their office hours, classes they are teaching, as well as their research interests. This location-based notification system is an excellent method of displaying information about the present.

Lueg's "Smart Guiding" [4] system for tourists is similar to what we are trying to achieve with the alumni campus guide. This application provides a guide for tourists in a new city. The idea behind the system is that traditional tourist guides are very static and provide general information. These guides lack information like when the next happy hour is or if a particular music group is touring the city. To remedy this shortcoming, the "Smart Guide" provides up to date information regarding the entire city. So when a user wishes to view a particular monument, the system can show different paths, which go through different areas of the city and show different sites. Another goal of the "Smart Guiding" system is to be able to route tourists through particular paths depending on the time of day, weather, or to have them view other interesting attractions along the way.

Nexus [7], as described by Volz and Klinec, is a system that would provide a city visitor with travel information such as hotel reservations, transportation, as well as play the role of a tourist guide like the "Smart Guiding" tourist system. .

Gupta and Munson list many examples of location-based notification systems. Among the many they have mentioned, they talked about a system that sends brief multimedia descriptions of the sites in Washington D.C as a tourist enters a monument's vicinity [3].

Research done by Gupta's and Lueg's groups, like seeVT, provide information on the current state of the location. Our system differs in that it incorporates the continuity of time through the past, present, and future.

# 3. SYSTEM DESIGN

This section will explain the system architecture in terms of hardware and software, as well as the design requirements we specified in developing the system.

## 3.1 Hardware Design

The target systems are mobile handheld devices because of the mobility requirement that comes with the nature of a campus tour. Mobile handhelds, due to their size and functional capability, seem to be the most appropriate medium. Having said that, these devices have many design and usage constraints—of which the one that affects our application the most is the limited screen size.

The hardware architecture of our system is based on the original seeVT system architecture. It uses the same method of determining the location of a user based on the strength of wireless access point signals in their area. Location specific information is stored on a central database and is accessed by the seeVT application installed on the user's mobile device.

## 3.2 Software Design

To design the system, there were two main methodologies that we followed. The first was the practice of extreme programming [1]. Extreme programming (XP) is a software development methodology that focuses on tight development cycles, close collaborations with customers and the ability to respond to changes easily. This allows for a very fluid way of developing a system where testing is an integral part of code-writing. Following this methodology helped us to create an application that had fewer errors in a short time frame.

The second methodology that we followed was the concept of Scenario Based Design (SBD) [5]. SBD is the process of designing a system by writing narratives of use and deriving claims that highlight positive and negative aspects of system features. We have included an application usage scenario in this report as the usage of these scenarios has helped to design the features, like the slideshow and note tags, for the system. The scenario also helped us to view the situation from the point of view of the visiting alumni.

IRC ratings are based on a scale between 0 and 1. The closer a value is to 1, the higher the effect of that particular attribute. The IRC rating of the seeVT system was (1, 1, 1) which indicated that the system required a high level of interruption, high reaction, and high comprehension. The primary task of the user was to view and navigate around the campus. The seeVT system was a secondary device that was not the user's primary focus. However, the reason for the high levels of interruption, reaction and comprehension was that the system provided critical information regarding the user's immediate environment.

Our implementation, seeVT–Alumni Edition, has low interruption and reaction values. Like the seeVT system our application is also very much a secondary task, whereas the primary task is to view and enjoy the campus and its surroundings. However, it is not critical that the application interrupt the user to provide any information. The application should only be glanced at by the alumni at their leisure. The comprehension value is high due to the fact that one of the goals of the system is to inform the alumni about the various changes that have taken place since they graduated from the University. Having a high comprehension value enforces that goal of making sure that that user understands and can recall the information presented to them easily. The seeVT –Alumni Edition has an IRC rating of (0.25, 0.5, 1)

## 3.3 Requirements

To develop a system that would cater well to visiting alumni, we spoke with a domain expert. This person was employed by the Office of University Relations and helped us create requirements specific to the target users of this system. Below, we have listed the main requirements of the seeVT –Alumni Edition.

The first requirement is that the system should be able to recognize its location and display information relevant to the current location. This is vital in creating a LBNS. The idea behind a LBNS is to be able to give the user relevant information about their location and this is important as the system we created needed to provide information on the particular building or area that the alumni was visiting.

Next, it was important to specifically cater to our users—the alumni. Alumni are always interested in seeing the different and

growing departments on campus. The system should be able to show the different departments at the user's current location. And since alumni are often interested in meeting the Department Head, our system should also be able to give information and directions to the Department Head's office.

To help supplement the alumni tour of the campus, notifications specific to their current location such as labs, offices, and other key places should be provided. This will help the alumni learn more about the location as it is currently exists.

Finally, to incorporate the main idea of the system, evolution of a location over time, a method to present the user with information about a particular location's past, present, and future must be developed. To be able to complete this requirement is one of the main challenges of this system. It is important to develop this feature as this will be adding to the alumni's experience of the tour in a whole different dimension.

## 3.4 An Application Scenario

To further explain the use of seeVT –Alumni Edition, included below is an application scenario of how it will be used by alumni visiting the Virginia Tech campus.

Elizabeth, who graduated from Virginia Tech in 1968, with a degree in Computer Science, has returned to visit the campus and see how everything has changed since she graduated so many years ago. She visits the Alumni Center and is given a handheld with the seeVT –Alumni Edition application installed. She is then directed by the staff at the Alumni Center to take a walk around campus and to refer to the seeVT – Alumni Edition if she requires more information or to return to the Alumni Office if she needs further assistance. She starts up the seeVT application and chooses the decade she graduated as 1960-1970 (see Figure 1).

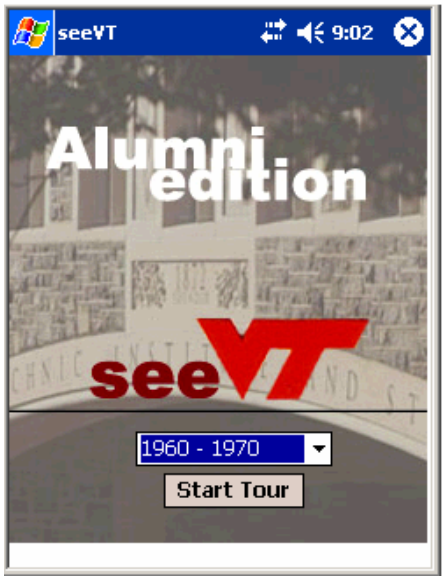


**Figure 1: seeVT Alumni Edition Start Screen**

Elizabeth then takes a walk to campus and decides to visit McBryde Hall as that is where most of her memories from her life as a student are based. As she reaches the vicinity of McBryde Hall, she is alerted by a gentle knocking sound from her PocketPC. The application informs her that she is in McBryde Hall which houses the Math Department and the Computer Science Department. It also informs her that there are a different number of interesting key points around her current location as well as notes left by other visiting Alumni (see Figure 2).

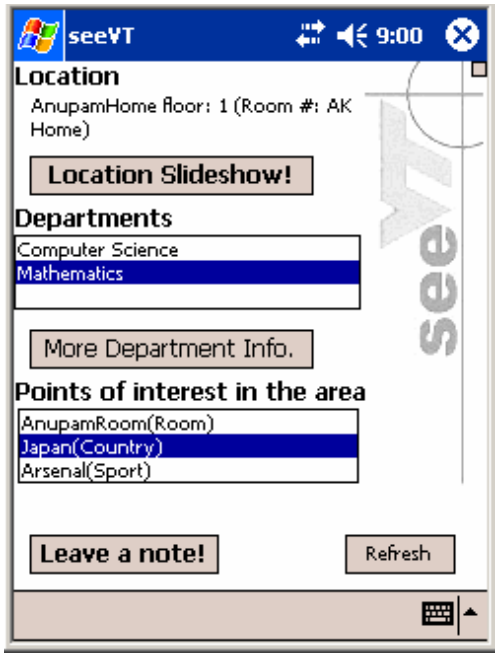


**Figure 2: Department List in McBryde Hall**

She also notices that there is a button from which she can view a slideshow history of McBryde (see Figure 3).

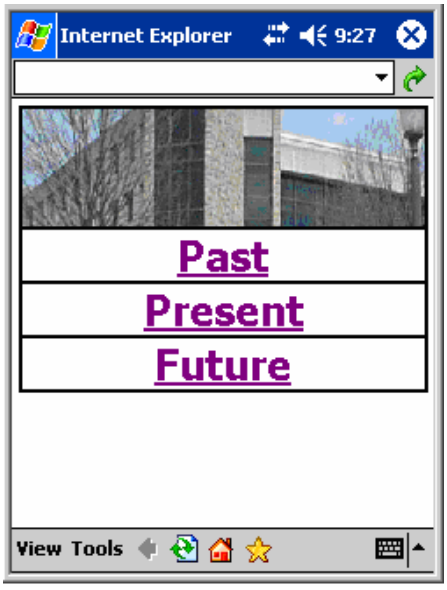


**Figure 3: McBryde Hall Slideshow**

Elizabeth walks around the building enjoying the sites, while also wondering what happened to the little cabin that used to house the Women's Center behind McBryde during the times she was in school. She looks through the slideshow present on her PocketPC and realizes that it was demolished in 2003 and the Women's

Center has now moved to Washington Street on the other side of campus.

She looks through the notes left by other alumni and sees one that was left by a close friend of hers with whom she had lost touch (see Figure 4).

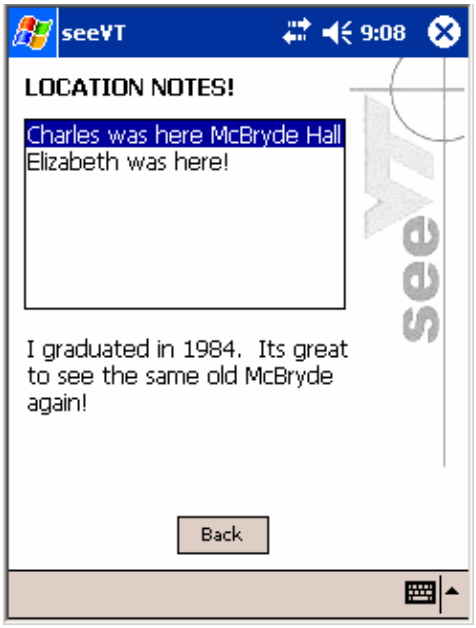


**Figure 4: Alumni Notes**

This makes her very nostalgic for the times she spent at Virginia Tech and decides she would like to do more to contribute to the growth and development of the school. Again, referring to the seeVT –Alumni Edition application, she looks for more information regarding the Computer Science Department. She finds a button that shows her more information regarding the Department Head of Computer Science. She also clicks on a link to the department website and browses through the different research topics of various students and faculty. She follows the instructions provided by the application to the Department Head's office and is able to meet with the Department Head and discuss how she can contribute to and help further develop the Computer Science Department.

# 4. EVALUATION

Evaluating the system meant we had to check if the system met the requirements stated earlier. In the evaluation, we tested the system from two different perspectives. The basic testing involved checking the usability of the system as well as the basic requirements.

To test the system, we created a varied set of tasks that would encompass testing all of the features we incorporated into the system. The tasks included finding specific information about a location's history, finding information about particular departments, writing and viewing note tags, and navigating through other key points of interests at a location. We subdivided the tasks into usability tasks and tasks that required the recognition of the essence of time.

In our analytical analysis, we chose to use our domain expert to evaluate the system. Since she dealt with alumni on a regular basis, she was the best hypothetical stakeholder to test the system's usability and feature validity.

We simulated the environment in which the visiting alumni would be in by having the expert come to a building she was not familiar with. Then we gave her a set of tasks she was to complete using only the system. As we did not provide her with any instructions or additional information regarding the use of the system, we were able to see that the application is indeed an intuitive and easy to use system.

The first set of tasks tested the usability of the system where we measured the results in a quantitative manner. These tasks included finding information about the specific location such as: the year the building was built, and the name of the department head. The domain expert rated all these tasks as being very easy to complete and thus validated our attempt to create a highly usable system.

The second set of tasks tested whether the system was able to show the essence of time to the user. This was done through more qualitative feedback questions such as; did finding a note tag left by a former classmate create a sense of nostalgia, and did the slideshow provide a way to visualize the changes that have taken place. These questions provided us with feedback on the effectiveness of the system to instill a sense of nostalgia and belonging to the location.

# 5. DISCUSSION

Here we will discuss the results of the system evaluation with regards to the different features that were brought out in the testing.

## 5.1 System Usability for Alumni

For system usability, we had to keep in mind the target user class. Therefore, one of our major goals was to cater the system to users aged 50 and over. This motivated the design to be easy to use and understand as older alumni might be less familiar with newer technology such as handheld devices. The "walk up and use" characteristic would be vital as many users will not have had prior experience using handheld devices. Some of the features we tested for the usability were: to get department information, and to read and write note tags.

To keep it simple for users to get information, such as department details, we made all the information accessible within a maximum of two button clicks. Having this feature is important because many institutions rely on their alumni for funding and research donations. To make it easy for alumni to find the department head's office is high priority. As soon as a user finds out the different departments of a location, he or she is able to get more information on the department, see the department head's picture and the directions to his or her office. Keeping this information just a click away is a major goal for the system. By having this information easily accessible and encouraging the alumni to use this feature, the alumni will be more likely to pay the department head a visit. The department head can then explain the needs and goals of the department in more detail to the alumni. The domain expert found this system to be every easy to use even for a novice user.

The feature that gives users the ability to leave note tags on specific locations was an important aspect of the system. The main concern with this system was the ability to write on a handheld device. As inputting text on a handheld device is very different from the input mediums we are normally familiar with, typing note tags was an issue that the domain expert came across. Solving this issue is a bit more involved as the use of the stylus is inherent to handhelds. We could provide a system to leave note tags for a location from a remote desktop computer.

As one of the major attributes of this system, the slideshow feature also had to meet the requirements set forth earlier. As the textual information under images was easy to read, and navigating from one image to the next was also simple, the domain expert rated this feature as being easy to use.

## 5.2 Efficacy of Time-based explorations

The next phase of our testing involved evaluating the entire system in terms of the sense of time it provided to the user. The two main features we concentrated in this section were the note tagging and the slideshow.

Note tagging is a unique way to connect alums together. When alumni visit, he or she is able to leave and read notes for a particular location. As more and more alumni use the system, a location has the potential of having a note from numerous different users whom they might have shared a lot with during their days as a student. This feature provides a tangible method of dealing with the time that has passed between their graduation and the present.

During our testing, we created a hypothetical note left by a previous visitor to campus. The domain expert felt that notes tagged to locations by alumni who had visited earlier definitely provoked a sense of nostalgia and belonging to the campus community.

In testing the slideshow feature, we had the domain expert view the slideshow for the location at which we conducted the testing. This was the main feature in promoting the sense of time through the system. The slideshow provided information about how the building had changed through the decades. This gave the user a unique understanding of the current building with respect to the past and the future. Having this embodied a time capsule type of format which let the user go through pictures where they might get visual cues about the memories and experiences they might have had. We found that a visual timeline of a particular location provided a good method of helping the user reminisce about the time they had spent at the location.. A user of the system can view a slideshow of pictures and text of how their location has changed through the years. Dividing this into a past, present, and future sections makes it more relevant and easy to navigate through the interface.

On the whole, the feedback we received was very positive. The domain expert thoroughly enjoyed using the system and was pleased with the information provided. There were a few problems with using the handheld stylus which is inherent to all mobile handheld devices. The amount of real estate available on a handheld's screen was also a downside. But through careful planning and placement of the images and text, we were able to reduce the effects of this constraint.

Our expert also suggested that we expand the amount of data the application displays to include other buildings and departments as the system she tested was only a prototype.

With respect to time, our domain expert was able to give us very valuable feedback. She stated that our system definitely would reach out to the visiting alumni and provide them a channel to connect the past that they remember, the present that they are experiencing, and the future with respect to their current location. Further, she suggested that we provide the ability to get a bird's eye view of the campus through the changes as this would help further create a feeling of nostalgia as well as allow the visiting alumni to get a broad picture on how the campus has changed as a whole.

Although we have tested our system analytically using a domain expert, empirical data will be vital to validate our research further.

# 6. CONCLUSIONS

Through testing we have seen that the system meets the requirements of both the usability factors as well as the functionality requirements.

But beyond these aspects, we were able to successfully incorporate time as a factor in location-based notification systems. Adding the aspect of the passage of time to location-based applications meant incorporating history, as well as the plans for the future to what one can experience of the location today.

Of our key findings, the most significant is the fact that through images and cues we are able to instill a sense of nostalgia in the visiting alumni, our target users. This is important as having a common thread of experience between our classmates and colleagues even decades after one last met them is invaluable. The methods available today to provide a sense of time to locations are very limited in that they present only static information. A yearbook cannot provide you information with what your former classmates are doing now or that the Mathematics Department has moved to the other side of campus. Using a system like seeVT –Alumni Edition provides a more complete picture of how a location has evolved and will continue to evolve.

# 7. FUTURE WORK

As the use of applications that leverage WiFi networks permeates further into everyday life, and spreads out from being restricted to campus buildings, we can offer the alumni guide as a replacement for campus tour guides. Currently, when alumni, as well as prospective students visit, they are taken on a guided tour through specific locations on campus. If WiFi networks covered the entire campus, campus visitors would have the additional option of taking self-directed tours around campus with the seeVT – Alumni Edition application. If a user were to be only interested in the Computer Engineering department, they could view a particular tour developed and be shown detailed information regarding the courses they can expect to take, the lab facilities and research opportunities they have, and perhaps even career paths chosen by current graduates.

Further more, we will expand the location tagging feature of our system to provide the ability for alumni to tag pictures and leave voice recordings specific to a particular location. This would help in creating a more welcoming environment for alumni and it will

help create a sense of nostalgia when they are able to see their former classmates' information and perhaps be able to contact them.

## 8. ACKNOWLEDGMENTS

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## 9. REFERENCES

[1] Beck, K., *Extreme programming explained: embrace change*., Addison Wesley Longman Publishing Co., Inc., 2001.

[2] Chewar, C.M. *User-Centered Critical Parameters for Design Specification, Evaluation, and Reuse: Modeling Goals and Effects of Notification Systems*. PhD Dissertation, Department of Computer Science, Virginia Tech, July 2005.

[3] Gupta, V. K., Munson, J. P. Location-Based Notification as a General-Purpose Service. *Proceedings of the 2nd international workshop on Mobile commerce* (Atlanta, Georgia, 2002), 40-44.

[4] Lueg, C. Smart Guiding: Using Location Awareness and Egocentric Navigation to Attract and Guide Customers. *Workshop on Location-Aware Computing at UbiComp 2004*, (Nottingham, UK, September 2004).

[5] Rosson, M., Carroll, J., *Scenario-based design, The human-computer interaction handbook: fundamentals, evolving technologies and emerging applications*, Lawrence Erlbaum Associates, Inc., Mahwah, NJ, 2002

[6] Sampat, M., Kumar, A., Prakash, A., McCrickard, S. Increasing Understanding of a New Environment using Location-Based Notification Systems. *Poster paper in Proceedings of 11th International Conference on Human-Computer Interaction* (HCII '05) , Las Vegas NV, July 2005

[7] Volz, S., Klinec, D. Nexus: The development of a platform for location aware application. *In Proceedings of the Third Turkish-German Joint Geodetic Days Towards A Digital Age*, Istanbul, Turkey, 1999.