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MYDAY MEDICATION REMINDERS

Phillip Garriss

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Approved by

Advisory Committee

Dr. Ron Vetter

Dr. Julian Keith

Dr. Doug Kline

Dr. Devon Simmonds,
Chair

Abstract

The purpose of this paper is to research the potential of the Myday Medication application. This program was designed and developed to remind patients with memory problems (i.e. Alzheimer's patients) and their caregivers to take their medications and treatments at their specified times. Alzheimer's disease causes dementia that leads to short-term memory loss and cognitive impairment. Patients in advanced stages forget how to perform bodily functions such as swallowing ultimately leading to death. It is essential for patients such as these to keep up with their medications. The importance of the research project lies in its ability to hold hands with both caregivers and many kinds of patients as they strive to remember the treatments which need to be administered correctly and consistently. The MyDay application provides an interface that allows users to create and maintain a personalized medication treatment file. The program prompts caregivers and patients to administer and or take daily medications and treatments as specified in the file. All users are able to run response reports based on dates to see how a patient responded to the prompts for a given day. The program includes an accompanying tutorial and easy to use instructions and it can send a cell phone text message to the caregiver if patients do not respond positively for a final prompt. Thirty nursing students were trained on the application and performed a thorough walk through examining it's features. Afterwards they filled out a survey answering questions such as how did the program perform overall. The program achieved better than expected results, and provided valuable feedback for how to improve upon the current features. The paper shows that the MyDay application has the possibility of becoming a useful tool for the medical community.

Table Of Contents

Chapter 1: Introduction	5
1.1 Current Tool Support for Alzheimer’s Disease	5
1.2 General Research Approach	7
1.3 Proposed Solution	7
1.4 Research Contribution	9
1.5 Roadmap	9
Chapter 2: Background and Related Work	12
2.1 Holistic Treatment and Ethical Considerations	12
2.2 Computer Treatment Devices and Applications	13
2.3 Software, Hardware, and Internet Considerations	15
2.4 MyLifeBits and MyDay	16
2.5 Summary	17
Chapter 3: The MyDay Design and Research Method	18
3.1 MyDay Characteristics and Design	19
3.2 Software Architecture	20
3.3 Association Files	25
3.4 The MyDay Administration Application	25
3.5 The MyDay Medication and Treatment Reminders Screen	27
3.6 MyDay Encryption and The Administration Screen	27
3.7 HCI Techniques	27
3.8 Evaluation Criteria	29
Chapter 4: Research Results	30
4.1 Unit Testing and System Test Results	34
4.2 Evaluator Feedback	39
4.3 Results Summary:	40
Chapter 5: Discussion & Lessons Learned	44
Chapter 6: Conclusion and Future Work	50
References:	51

Appendices

A: Evaluation Instrument MyDay System Evaluation	55
B: Use Cases	56
C: Additional UI Diagrams	62
D: Various Diagrams	63
E: Suggested Enhancement for Future Consideration:	64

List of Figures

Figure 1: MyDay Actor Diagram	8
Figure 2: A Physical Blueprint for a Piece of the MyDay Screen	19
Figure 3: The MyDay Architectural Diagram	21
Figure 4. The MyDay Class Diagram	23
Figure 5. Finite State Machine	23
Figure 6. Activity Diagram	24
Figure 7: The MyDay Administration Login Screen	30
Figure 8: The MyDay Administration Caregiver Dashboard	30
Figure 9: MyDay Administration Patient Dashboard	31
Figure 10: The MyDay Reminder screen	31
Figure 11: MyDay Administration Maintain User Activities Screen	32
Figure 12: MyDay Administrator Administer User Screen	33
Figure 13: The MyDay Reporting screen	33
Figure 14: A Graph of the Evaluation Results	41
Figure 15: Evaluation Statistics	42
Figure 16: An earlier alternative view of the MyDay Patient Activity screen.	62
Figure 17: Architectural Design Diagram	63

List of Tables

Table 1: Sample Test Cases for the MyDay Application	35
Table 2: The Medication Reminding Use Case	56
Table 3: The Reporting Use Case	57
Table 4: The Alerting Use Case	58
Table 5: The Patient Management Use Case	59
Table 6: The Administration Use Case	61

Chapter 1: Introduction

Alzheimer's disease presents increasingly difficult challenges for society. There are more than 5 million diagnosed cases in the United States, and this group is expected to triple in the next 20 years [1, 2]. Prediction tables show estimates of approximately 8 million patients with Alzheimer's disease in 2030 and almost 14 million by 2060 [3]. This disease causes dementia primarily within the elderly community [3, 4]. A distinguishing factor for Alzheimer victims is that they forget how to perform basic body functions such as swallowing which leads to death in the later stages of the disease. While there are questions about how Alzheimer's disease affects the brain and how it leads to the loss of mental functionality, it is important to remember that Alzheimer's is the “causatory” disease while dementia and memory loss is the reciprocating disorder [1, 2, 3, 4].

Dementia is a mental disorder that manifests itself in patients diagnosed with Alzheimer's disease. A common symptom is that patients can recall long-term memories but have difficulty remembering short-term events and performing cognitive tasks such as communicating and using a pencil. Psychological problems like depression and schizophrenia share similar dementia-like symptoms [5,6,7].

1.1 Current Tool Support for Alzheimer's Disease

Medical professionals need improved diagnostic methods and treatment tools in order to provide better care for Alzheimer patients. Drugs, bio-marker research, computer games, and memory-storage systems are currently being used. Research and development is ongoing in the quest to provide appropriate care for these patients.

Pharmaceutical drugs are used to help relieve symptoms. Razadyn, Exelon, and Aricept are used to treat moderate symptoms. Nemenda allows patients to continue to perform body functions such as swallowing for several months after losing the ability to remember [1]. Diagnostic tools are in the developmental stage that will potentially enable medical practitioners to improve the quality-of-life for their patients. For example, one research group has discovered that new synthetic materials can locate bio markers associated with Alzheimer's much faster than the antigen bio markers previously used [8].

Computer research concludes that playing game systems such as the Wii can protect patients against the effects of dementia while increasing daily physical activity. Israeli game developers have been working on an adaptive computer-game system named Savion. It works to rebuild lost cognitive abilities and entertain the patient during therapy sessions [9, 10].

Computer applications are being designed to enable users to organize and locate information related to historical events and conversational pieces. For instance, the Universities of Dundee and Saint Andrews are developing communication support systems that allow patients to view general memories from certain time periods. One of these applications includes a tool that intersperses personal information to enhance the user's experience [11, 12]. MyLifeBits is a computer memory-storage system in the developmental stages at Microsoft Corporation. It allows patients to store important memories starting at an early stage of life.

1.2 General Research Approach

This research initiative provides a memory-aid tool called MyDay that is designed to remind patients to take prescribed medications. It works with cognitive reserve to reinforce these daily activities. Cognitive reserve models define the ability of the brain to actively cope with damage. There are two levels of cognitive reserve: active and passive. Passive reserve refers to the size of the brain and the portion that allows it to withstand an amount of damage before beginning to show clinical symptoms of memory loss such as that caused by Alzheimer's disease. Active reserve refers to the amount of cognitive reserve a person has accumulated. Several studies suggest that higher levels of education can build a degree of resistance to the effects of Alzheimer's disease. Active reserve provides an explanation for this conclusion. Both models provide an explanation for what occurs in patients who are affected by Alzheimer's [13].

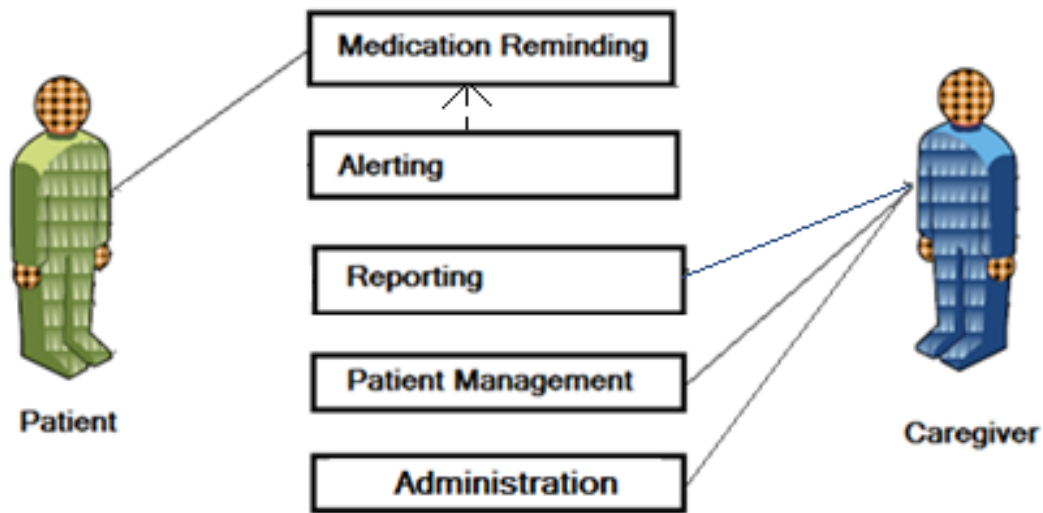
The MyDay project provides a user-friendly and affordable design. It focuses on creating a tool to enhance the active cognitive reserve of individuals who may be diagnosed with Alzheimer's or have memory loss caused by other factors. MyDay stores daily medication treatments for patients and uses pictorial and sound prompts to remind them of these activities. Additionally, if a patient does not respond or responds negatively to prompts, a text message may be sent to the caregiver. Caregivers and patients are able to run daily response reports to analyze the effectiveness of the reminders.

1.3 Proposed Solution

The MyDay Project reminds patients to take medications and treatments at prescribed times during the day. The software can prompt patients for input to determine whether they have taken

treatments and allows users to provide verbal responses. The application also allows for the display of scheduled medical treatments and provides caregivers with the ability to enter patient data as well as alert them as to the status of a patient’s medication treatment compliance.

Figure 1: MyDay Actor Diagram



The actor diagram in Figure 1 shows participants, use cases, and the dependencies that the use cases have as they relate one to another. Medication Reminding is where the program reminds patients and caregivers to take or administer their treatments. Alerting is the test case that sends alerts to the caregiver via the cell phone if a response is not positive. Reporting is where the caregiver may run reports to determine what responses were provided at various times. Patient Management is where caregivers create patients and assign them a password and path for storing patient data. The Administration screen describes the tool used by caregivers when they create treatment activities. A list of use cases may be found in Appendix B.

Memory loss of any kind can be difficult to deal with. Alzheimer's is a debilitating disease that affects large groups of people worldwide by taking away many of their most important memories. Other factors such as drinking and drug abuse cause similar memory related problems. MyDay was designed to be an effective and secure application that can be used by individuals to augment some of those memories.

1.4 Research Contribution

MyDay makes the following contribution to the collection of devices and software used to augment human memory:

1. It incorporates the use of migratable XML files.
2. It displays medications and treatments prompting patients and caregivers to respond.
3. It allows users to report on patient's daily responses.
4. It allows caregivers to create and modify user account access to MyDay Administration.

Memory augmentation is needed to offset the effects of diseases like Alzheimer's. Patients and caregivers have access to a variety of tools to use including computerized applications. The MyDay Project has been developed to remind patients to take prescribed medications at specified times using a personal computer. This tool has features that may enhance the effectiveness of existing applications.

1.5 Roadmap

The next chapter describes the history behind the MyDay application and projects that have come before. It also begins to define the way MyDay can work with these modern day tools to assist patients with memory related issues. Chapter three discusses the goals and procedures

accomplished in order to finish the project. It describes the design and the research method used to create the application. It also presents different ways to represent the MyDay architecture and functionality pictorially. Chapter four focuses on testing and evaluating the results for the MyDay application. Chapter five outlines some of the lessons learned during this project and chapter six concludes the paper and discusses future work.

Chapter 2: Background and Related Work

Approximately 5 million people have been diagnosed with Alzheimer's disease which has created social and medical issues for patients and caretakers [2]. Much time and effort has been devoted to creating a set of tools to assist with the effects of this destructive disorder. Reviewing results of these efforts can provide beneficial information for research and development teams who are working to improve diagnostic tools and treatment for patients. The Alzheimer's Organization (www.alzh.org) provides background information, treatment and coping suggestions, and up-to-date prescriptions for how to remedy debilitating effects.

There is no cure for Alzheimer's, but ongoing research is focused on developing tools to support victims of this debilitating disease. These developments include pharmaceutical, diagnostic, and cognitive enhancement tools as well as computerized cognitive prosthesis. Research shows that switching colors regularly with Stroop testing appears to confuse people who are predisposed to developing the disease [6]. Some Stroop testing techniques as well as task switching have been used to further support this finding. This research shows that attention deficiencies play an important role in the early stages of the disease [7]. The MyDay tool can keep caregivers and their patients focused on medications and treatments while working with the larger medical community to further accomplish this task.

Multiple catalysts lead to memory loss. These include drug and/or alcohol use, head injuries, and depression [2]. Researchers in Santa Cruz have identified tau filaments that are proteins located inside the brain. They believe these filaments may lead to tangles in the brain that are associated with Alzheimer's Disease [2, 14, 15]. Another possible underlying causal agent is the

aging process. When a person experiences unusual lapses of memory with negative effects on social activities, this person may be experiencing early effects of the disease [2]. The traditional 10/66 diagnostic program and the new DSM-IV computerized diagnostic tool check to see if the patient can recall names, animals, and numbers. These tools employ a test known as the Geriatric Mental State Test to determine if the patient has dementia or a similar mental disorder [6]. Diagnostic tools and treatment methods including synthetic biomarkers are in the developmental stage. These will enable medical practitioners to diagnose this disease much faster thereby giving patients, friends, and family additional time to treat and cope with this disease [8].

2.1 Holistic Treatment and Ethical Considerations

The following are focus areas for memory-augmentation software development:

1. Treating other diseases that add to the effects of dementia.
2. Reviewing medications and dosages.
3. Slowing the deterioration of the disease.
4. Managing abnormal behavior.

These focus areas raise critical ethical concerns that could be tracked and analyzed with a software program such as MyDay. For instance when a patient is diagnosed with the disease, he or she may wish to be kept alive as long as possible. However, when the patient reaches the more severe stages, he or she may not want to be kept on life support. Life-support systems can cause bloating, discomfort and death. Death is the natural way of allowing the body to experience relief. At what point does the power of attorney representative make decisions for the

patient? Another area of concern is the inclusion of spirituality that may provide hope for patients. Medical professionals must be cognizant of this area of need and be prepared to acknowledge it at individual levels. Other ethical considerations include how to prepare patients for the road ahead, address genetic implications for the family, and deal with societal issues created by this disease [4, 16].

2.2 Computer Treatment Devices and Applications

There are a variety of computer applications and technological devices currently in the developmental stage. Some store general information about the era when patients grew up while others test and entertain patients as they attempt to improve cognitive skills and memory. Devices are also being designed to help older acquaintances locate each other using a GPS or remind patients when to take medicine. Developers are inventing devices such as coffee makers that will keep track of the number of times a user makes a mistake while brewing coffee and prescription glasses that will use facial recognition techniques to help patients recognize individuals [9, 10, 11, 12, 17].

CNN recently interviewed author Gordon Bell. They asked if storing memories in a computer would make the brain less keen or capable of remembering things. He replied that technology allows him to hewn in on a topic that he remembers. The important reason for using the technology is not to replace memory but to ensure that all details are in place without losing information. By using memory-augmentation software, he acts like the librarian for his family and friends to ensure that no memories are forgotten. He always carries an electronic camera with him to capture memorable events [18].

Gordon Bell addresses the memory privacy issue by acknowledging that it is not good policy to share personal information online. This applies to people who tweet or publish personal information on web-based communities like Facebook. He believes that some memories should be kept private and any application that stores memories should have the capability of doing so [18]. A windows-based tool using windows-based files could remedy some of these security concerns.

Future memory-augmentation software will benefit the research community by providing extensive files with dates and locations that will be searchable and portable. For instance, research shows that it is possible for certain catalysts to negatively affect human genetics when introduced at key points in gene development [19]. Memory-augmentation XML files could be searched to find these catalysts or other targeted pieces of information relevant to this line of research.

Memory-augmentation applications will offer features that benefit sociological research projects. Treatment centers rely on volunteers to work with dementia patients due to lack of funds to pay trained caregivers. A recent sociological project conducted in Hong Kong paired elderly and young volunteers in order to study the effects, if any, on dementia symptoms. Findings showed that the elderly patients enjoyed being cared for. It appeared that the social interactions helped maintain their current state of mental health. The young volunteers gained experience and empathy for elderly people struggling with Alzheimer's disease. The project encouraged volunteers to help patients develop an autobiography. [20].

2.3 Software, Hardware, and Internet Considerations

Alzheimer's disease mainly affects the elderly population who have special needs that must be taken into consideration when designing a memory-augmentation system. User interface has to be developed so that patients with vision and hand and eye coordination problems can use it [21, 22, 23, 24]. Blind and deaf patients and those who are not able to perform computer tasks easily will require system modifications [19, 21]. Loss of the ability to perform structured tasks is symptomatic of Alzheimer's disease. For instance, one research study required patients over 65 to seal an envelope, wait 10 minutes, and put their initials on it. Many participants could not perform this task [21, 24]. Disabilities like these require a program to be adaptive and have as few performance functions as possible. Improved technologies will offer improved treatment for patients and medical practitioners. Easy-to-use software updates should be made accessible as quickly as possible [21, 25, 26, 27],

The design of Personal Digital Assistants (PDAs) and mobile phones pose another set of challenges for victims of Alzheimer's disease. These devices have to be sturdy. They must provide special features for patients with physical and mental disabilities, problems with dexterity, and other limited use of bodily functions. For instance, small buttons and screens may improve proximity for users but make it difficult to access the information. Software and hardware improvements should eliminate these obstacles [21, 28].

2.4 MyLifeBits and MyDay

Total Recall, by Gordon Bell and Jim Gemmell with a forward by Bill Gates, was inspired by Microsoft research. It discusses and explores the e-memory phenomenon made possible by recent advances in computer storage, metadata, tagging, and processing capabilities. The developers are designing MyLifeBits which is a system they claim will be able to provide the “Total Recall” commodity. They have collaborated with universities via a workshop known as CARPE “Continuous Archival and Retrieval of Personal Experiences” asking them to contribute to the research effort. This system will rely heavily upon cloud computing, internet technology, and database capabilities like table indexing. The book recognizes modern discoveries that have moved us closer to the “Total Recall” reality using technologies like Google Search, Desktop Search, oneNote, ReQall, and Evernote. The vision of MyLifeBits is to offer a highly-developed functional tool that provides unlimited storage and searching capabilities. However, issues like how to secure user privacy while sharing memories and how to store this information must be resolved before the product becomes marketable [29].

Bill Gates predicts that cloud computing will be the primary tool used for memory-augmentation software but that the functionality of the PC will probably not vanish completely. This is due to the fact that programs like MyLifeBits can safely store most information (some of which can be shared) but developers and designers recognizes that there is still information that needs to remain personal [29]. A program like MyDay could be used to store highly-sensitive medical response information while supporting a centralized cloud-based database as the general storage program. This system could support communities and individuals who wish to protect information from becoming transparent to DBAs, developers, and anyone with access to the

system. Users could be able to store non-sensitive or non-classified information in the cloud database where files could be updated to or downloaded from its database with GUIDs defining relationships between the two programs. This is one approach MyDay could take.

Concurrent functions within MyDay include providing memory and communication pieces that will enhance social interaction and understanding between patients and caregivers. Implementation of a treatment system that will rely on this type of memory-augmentation software will require a paradigm shift. It will require caregivers to begin to rely more on a “memory data warehouse”. The expectation is that the program will help patients with daily activities, and analysis of related-cumulative-data will be used to determine life catalysts that may lead to better resistance against Alzheimer’s disease advanced stages [21, 22, 23, 24, 25, 26, 27, 28, 30].

2.5 Summary

A review of existing tools and treatment methods shows that research and development teams envision the computer to be an integral part of treatment for patients with memory related problems. Patients with Alzheimer’s disease and other patients with memory deficiencies have special needs that must be addressed before functional applications can be offered to the medical profession for use. The MyDay project design is based on these findings.

Chapter 3: The MyDay Design and Research Method

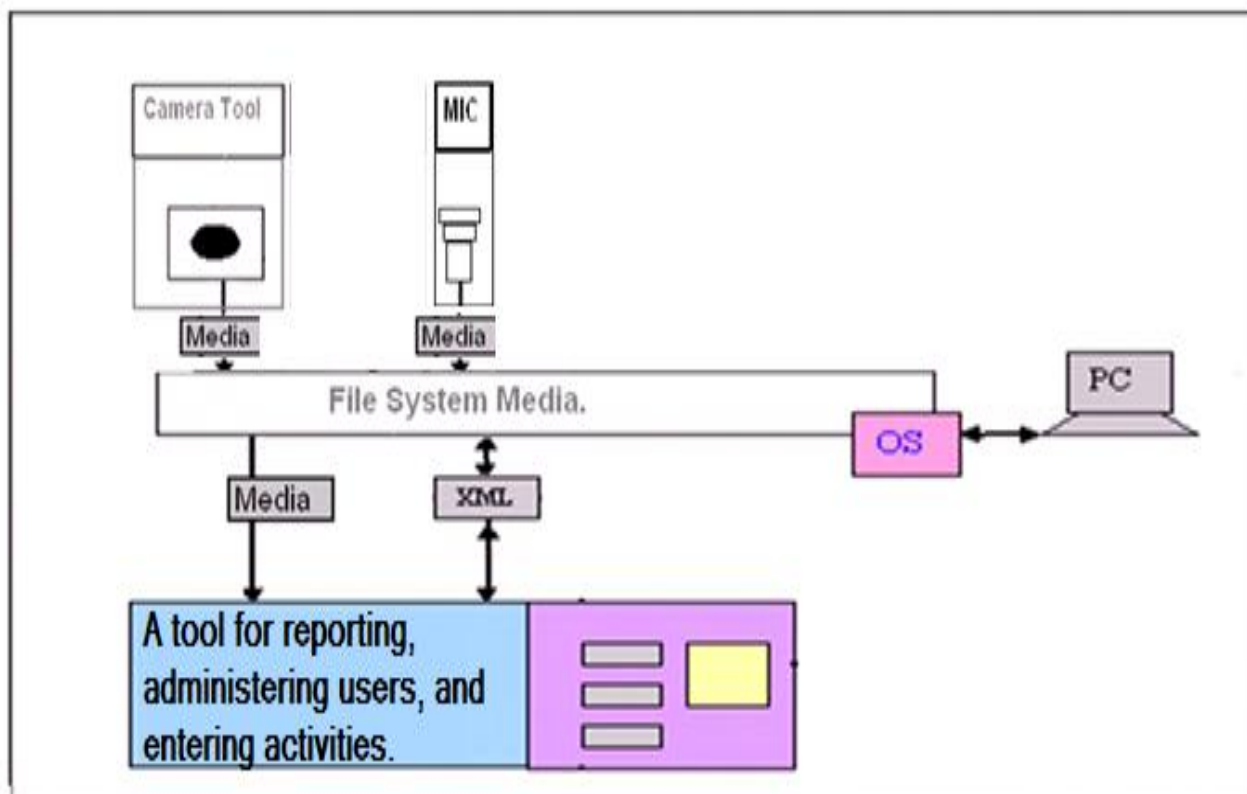
The MyDay Project allows patients, especially those with Alzheimer's disease, to use a personal computer to remind them to take medications and/or treatments at specified times. It includes a monitoring system that allows caregivers to track patient progress. The MyDay system was created using the following process steps:

1. Design the overall architecture for the software.
2. Develop the requirements for MyDay.
3. Create the MyDay application.
4. White-box test the application.
5. Develop *representation* screens to be used by in-group presentations.
6. Develop the evaluation criteria for MyDay.
7. Unit Test the application using pre-defined test procedures.
8. Recruit evaluators and administer surveys.
9. Analyze data and apply suggestions as needed.

White-box testing refers to testing performed when the tester has seen and understood what the code is doing inside. Some white-box unit testing was performed against the MyDay application. The developer performed a system test against the application to verify that screens performed as defined in the Use Cases in Appendix B. The user community usually performs this test, but that was not needed because of the extensive evaluation discussed in sections 4.2 and 4.3

Representation refers to the way developers present a project to a group of non-developers. This is an essential piece of system architectural design because it connects users with the developmental phase of the application. One representation of this is provided as a physical blueprint. Figure 2 shows an example of a physical blueprint for the MyDay application prototype. This particular blueprint represents what happens in the process of using this screen from the collection of media and data records to the storage of the application files.

Figure 2: A Physical Blueprint for a Piece of the MyDay Screen



3.1 MyDay Characteristics and Design

MyDay incorporates a flexible and easy-to-use design. The “migratable” platform for this memory-storage system has the capability of interfacing with other memory systems in order to

enhance capabilities. It is a cost-effective, user-friendly system [21, 22, 23, 24, 25, 26, 27, 28,30]. Modifications have been applied in order to accommodate the special needs of these patients. The program has been field tested to check for reliability and appropriateness of design. This treatment tool enhances the quality of patient care for Alzheimer patients and other patients dealing with memory related disorders.

3.2 Software Architecture

XML user files and media are stored on the Operating System (OS) on the backend. The XML files are created by File Input Output functions within the VB.net program, and the media is created by recording equipment such as a camera. The OS is a Windows-based system – preferably Windows 2000, XP, or Vista. The frontend of the user application provides screens that interact with the user’s XML files and media. These screens include the Administration, Reporting, and MyDay screens, and the main MyDay Medications and Treatments Reminders screen. Figure 3 shows the holistic Architectural diagram of the program and its system host. Figure 4, the MyDay Class Diagram, is used to define the MyDay system with the associated object classes.

Figure 3. The MyDay Architectural Diagram

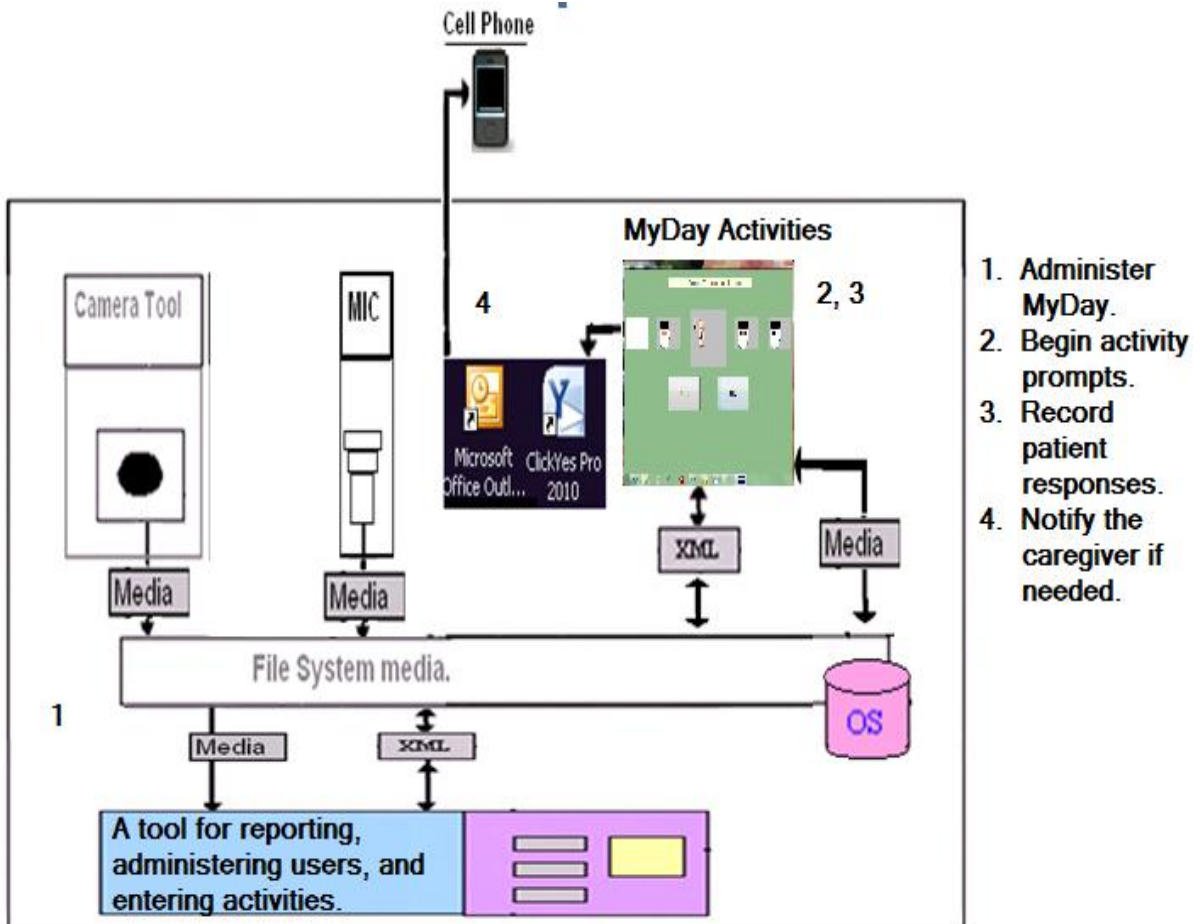
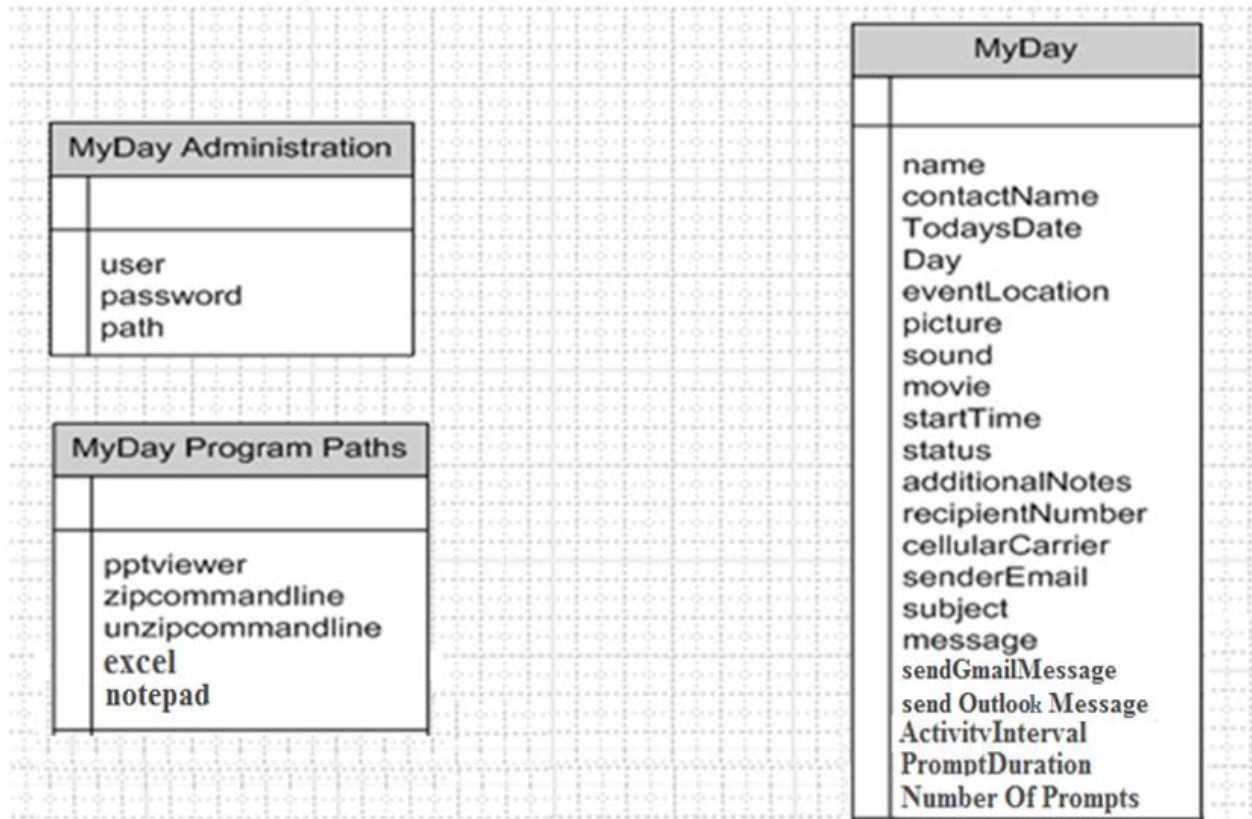


Figure 4. The MyDay Class Diagram



Once a user responds negatively on a properly configured screen, the MyDay application uses MS Outlook or Gmail and the Click Yes Express 2010 application (when Outlook is being used) to send a non-compliance text message . Gmail may be used if the OS network allows for sending messages via SMTP using a script. If not, users can send messages through MS Outlook. Click Yes Express forces MS Outlook to send a message even if the system security prompts the user to confirm that it is alright to send the message through the scripted process. Free Express-Click software can be downloaded from <http://www.contextmagic.com/express-clickyes/>.

Figure 5: Finite State Machine

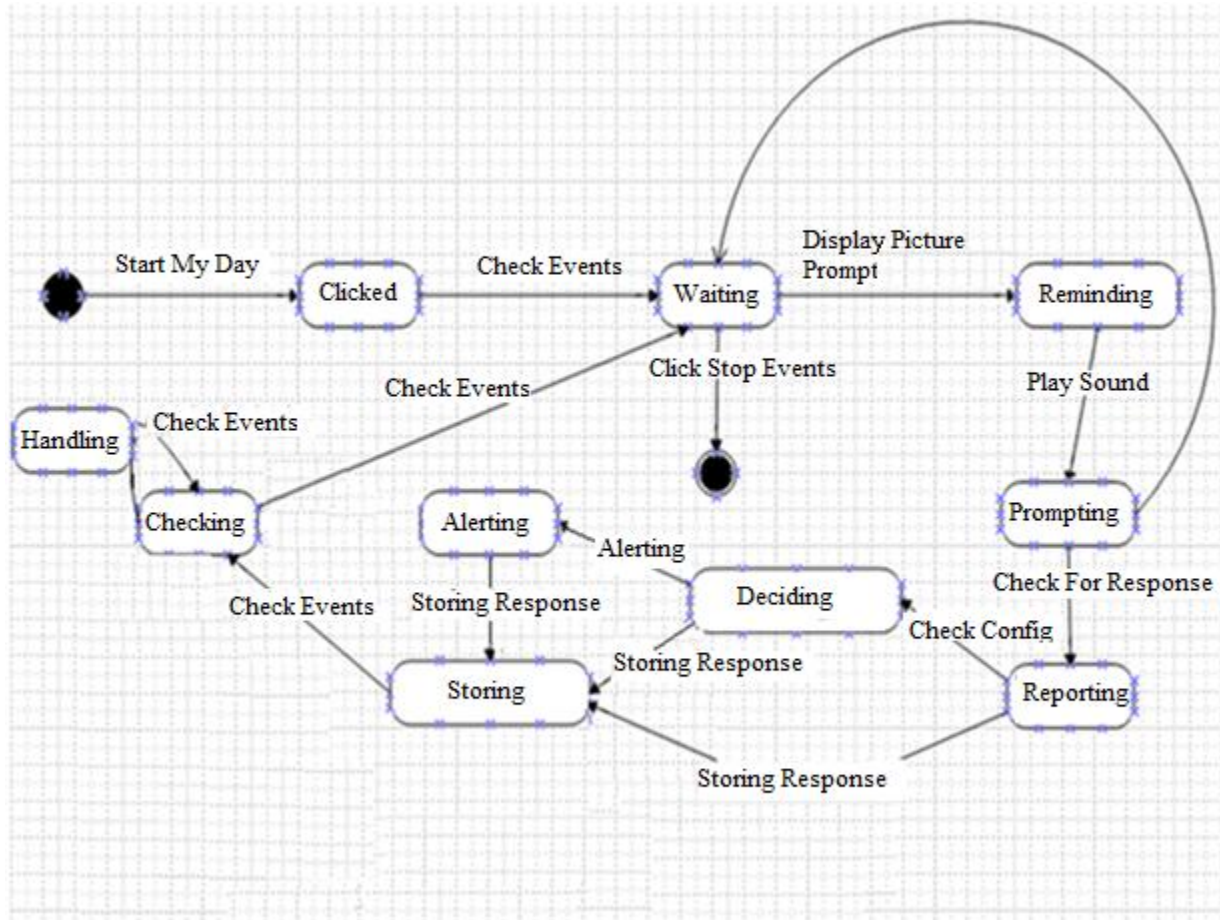
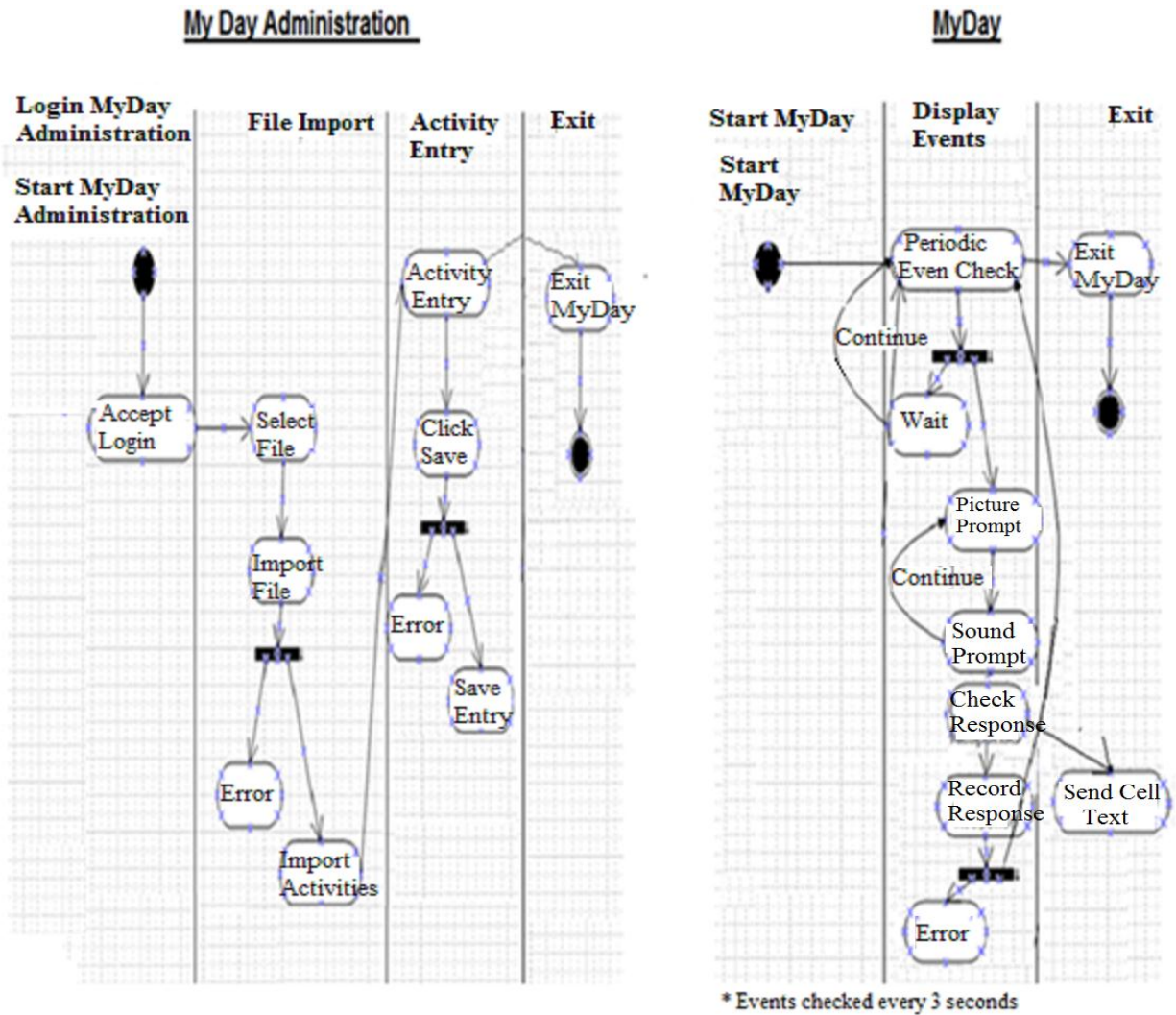


Figure 5 shows the MyDay Finite State Machine. This diagram walks through the various states of the application. First the user clicks to start the application. The program waits for a response, reminding and prompting the user for a response. The program enters reporting mode deciding if the program should alter the caregiver or not before storing the information. Then the program checks for errors and starts the cycle of reminding and prompting again.

Figure 6: Activity Diagram (Note: Only caregivers can enter activities.)



The Activity Diagram in Figure 6 shows how the caregiver logs into the MyDay Administration screen, selects the activity file and saves the information. At this point the program will either respond with an error or save the record. Once the administrative activities have been setup the patient (or caregiver) will login to the MyDay application and wait for a prompt. Once a prompt comes up he or she will respond. If the response is positive it will be recorded. If it is negative an alert will be sent to the caregiver. At that point the cycle will start again or wait for the user to exit the application.

3.3 Association Files

A variety of factors influence the mind's ability to remember. Software users can remember information by making associations. If someone has limited recall ability, he or she may be able to improve that function by thinking about a piece of related information. For instance, remembering people or events from a specific period of time can trigger associated memories from the same time period. Other factors that allow us to remember things are emotional experiences, logical patterns, and rewards for recollection. Regardless of the catalyst for activating memories, the brain organizes materials into numerous small categories [31]. MyDay incorporates features that utilize many of these techniques in order to remind users about daily medical activities. The brain associates occurrences from one day with those from another. A single Activities file tracks all MyDay medical activities. If an activity reoccurs, the Start Time is entered in such a way that the program recognizes the reoccurrence: IE. if users enter 1/1/2000 for the month, the program knows this is a reoccurring activity. If the activity only occurs once, then the actual date (i.e. 09/25/2011) is entered and that activity only displays on that day.

3.4 The MyDay Administration Application

MyDay Administration allows caregivers to create user account access, run reports, and set up medical activities for the patient. The Administrator login and password is required in order to set up users and create activities, but all users are able to run response reports. Response reports are based on a specified day and show all responses for that day. Generation of a report requires the user to select the patient response file and click "run report". The report opens in Excel showing the patient name, activity name, date and time, and if the treatment was taken.

The caregiver can select Administration in order to administer accounts by clicking "New" to create a new account or navigating to previous or subsequent records to modify them. InformationD.xml is the name of the encrypted file that stores the user account information. The file is decrypted when the administrator opens the MyDay Administration page and encrypted when he or she exits. User Name and Password is the name and password of the User Account. Path is the directory where the patient's media and activity files are stored. All pictures and sounds must be stored in this location in order to properly display in the MyDay Medications and Treatment Reminders screen.

The My Day screen is where patient medical activities and information are entered. Examples of these attributes are as follows: personal information, name of the medical treatment, the responsible contact person, treatment location, occurrence or reoccurrence start time, times to display activities, and picture/sound prompts. Caregivers can create personal media in the C:\MyDay\Files directory or select from pre-existing media. The Overall Prompt Interval is the overall amount of time required to prompt the user with sounds for an activity. The Prompt Duration tells how long the sound prompts will play, and the number of prompts is the number of sound prompts. The caregiver can click the Send Outlook Text Messages or the Send Gmail Text Messages button to activate an alert for no response or a negative patient response. If these buttons are pressed, he or she must enter the Recipient Number, Cellular Carrier (i.e. Vtext.com will email to a Verizon phone number), the sender's email address, and the subject and message.

3.5 The MyDay Medication and Treatment Reminders Screen

The MyDay “reminder” screen shows the most current medication and treatment requirements. Prompts remind patients to perform appropriate tasks and respond manually or orally with a *Yes* or *No*. The last response is recorded at the completion of the last prompt. If a response exists in the response file for an activity that has already occurred, the application will reference it to see how to display the picture. If the patient responded *Yes* to a prompt, the picture displays with a green border and a green check mark. A *No* response displays a picture with a red border and a red X. See Table 1 in Appendix B for additional information.

3.6 MyDay Encryption and The Administration Screen

The MyDay Administration screen decrypts and encrypts the MyDay XML user account file. This ensures the security of personal information.

Identity theft is a societal issue that is associated with computer applications--including memory-augmentation software [32]. A computer containing stored XML files could be stolen. This presents a security concern comparable to fishing techniques used by identity thieves who search for personal information on the web through programs like Facebook. Patients will be encouraged to use strong passwords to secure computers and to logout of the local MyDay program when it is not being used .

3.7 HCI Techniques

HCI (Human Computer Interaction) techniques are used to enhance interactions between humans and computers. The following have been incorporated to improve screen appearance [33]:

- Contrast, repetition, alignment, and proximity of application objects have been checked for consistency.
- Simple, legible, and audible displays have been included.
- Alternative feedback mechanisms such as the use of buttons and speech recognition are available.
- Pictorial realism has been applied as needed.

Familiar memory tags, such as the use of a stop sign versus using an alternative-unrecognizable image or word, are being used. The program has been designed to support patients as they perform daily medical tasks. A variety of colors, sounds, and images inform users whether they are in compliance with prescribed medication/treatment schedules. Medications and treatments will be highlighted with gray before an activity has been displayed and green after a patient has responded positively to taking their dosage. A green check will display with the image. If the patient is not in compliance, medications and treatments will be highlighted in red with an accompanying red X.

Research shows that green has a calming effect on psychiatric patients; therefore, the background color for the Patient Activities screen is green [34]. Figure 8, the final design of choice, displays medications horizontally across the screen. Figure 16 in Appendix C shows an older alternative view with the treatments cycled from the bottom to the top of the screen.

3.8 Evaluation Criteria

The evaluation process began by creating an evaluation instrument that would be used to test the overall effectiveness of the application. Reference Appendix A for the Evaluation Instrument.

The first few questions were used to determine if the patients would be able to use the application. The next few questions were used to see how evaluators thought the alerts and other caregiver tools worked. Two additional questions asked if there was anything confusing about the program and if anything could be done to improve the program.

Once the committee approved the evaluation instrument an Internal Review Board had to approve the research and the survey administrators had to take official IRB testing. Once that was complete 30 random students were surveyed. They all filled out an informed consent form before evaluating the MyDay application. Once the survey was over the evaluation results were written down in an Excel spreadsheet and the data was analyzed to see how the community responded. See chapter 4 for addition information.

Chapter 4: Research Results

The MyDay application reminds patients of daily medications and treatments and allows caregivers to verify the appropriateness of the responses. This chapter describes the research results.

Figure 7: The MyDay Administration Login Screen

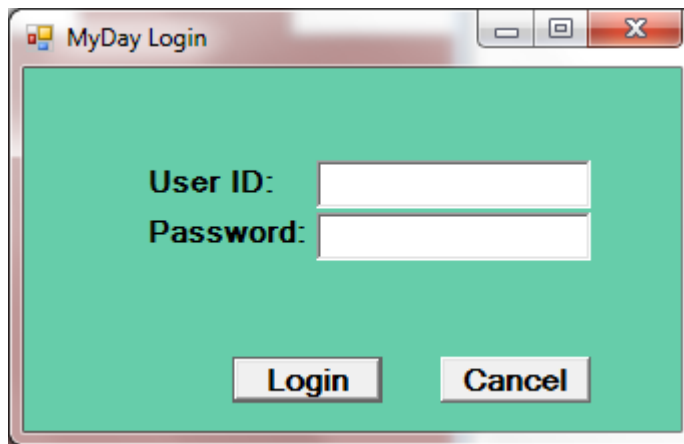


Figure 8: The MyDay Administration Caregiver Dashboard

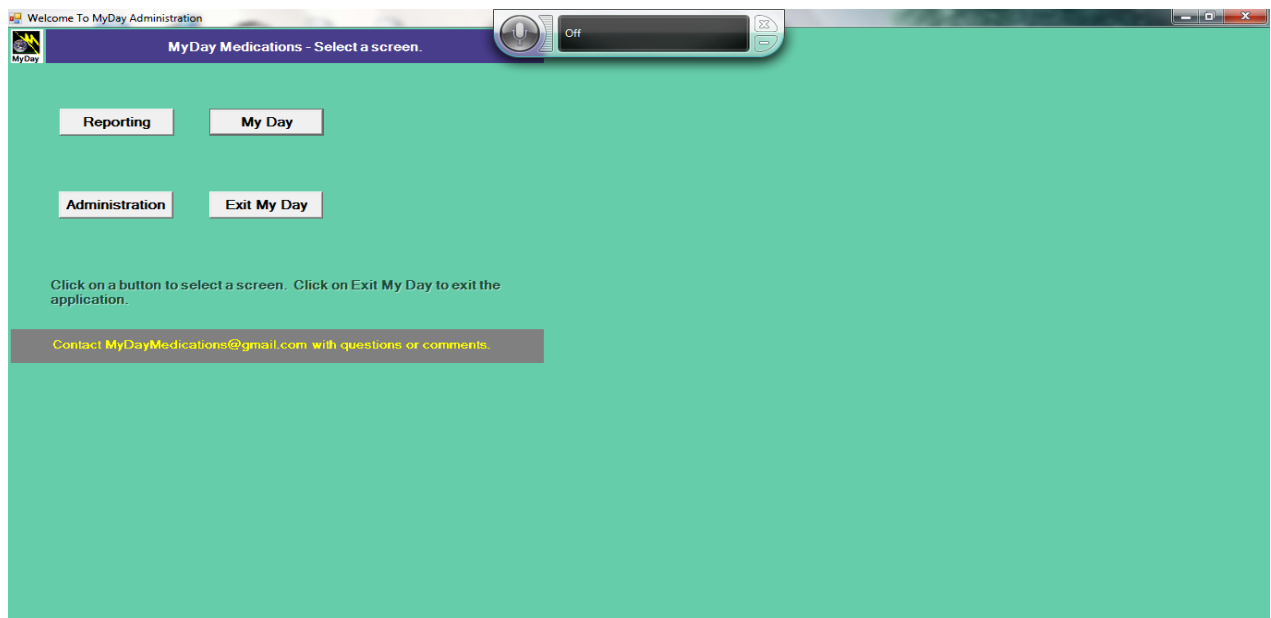


Figure 9: MyDay Administration Patient Dashboard

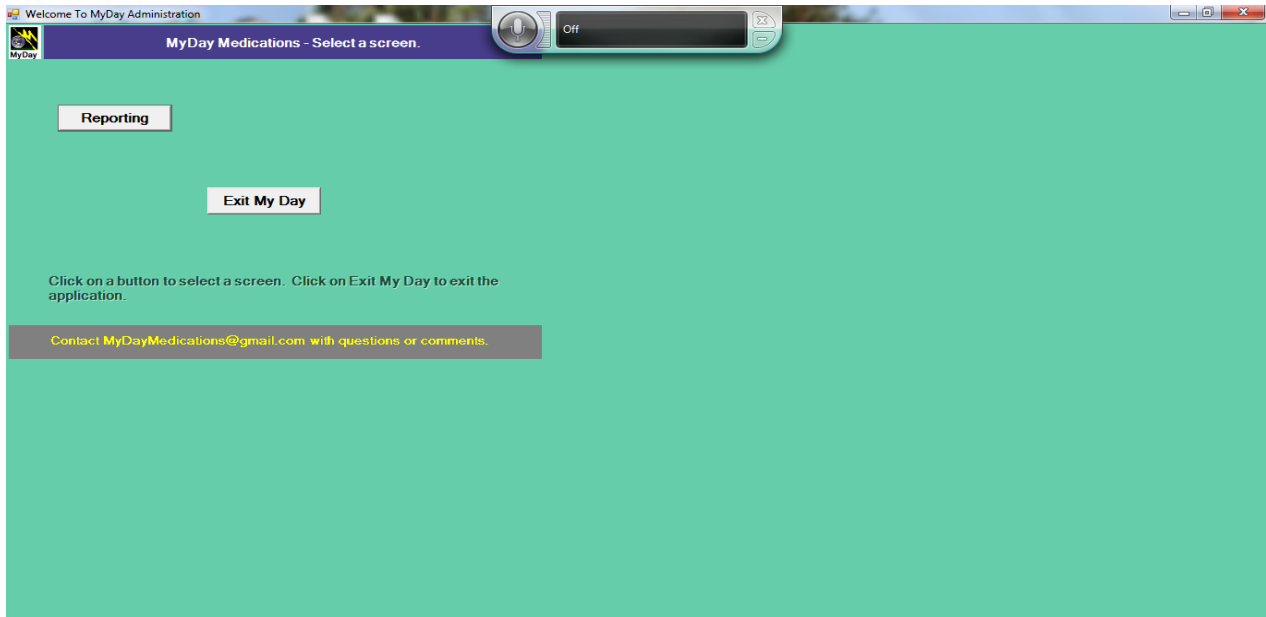


Figure 10: The MyDay Reminder screen



Figure 5 shows the MyDay Login screen. Figure 6 displays the initial screen used by application administrators to navigate the MyDay Administration application. Administrators

are able to create new treatment activities. Figure 7 shows the initial screen used by the patient to navigate the MyDay Administration application. Patients are not permitted to use the Activities screen to enter patient scheduled medications and treatments. Figure 8 show the treatment reminders as the users would see them. The middle of the MyDay Reminder Screen displays medications and treatments that are assigned for the patient to take corresponding to the closest Operating System date and time. Medication/Treatments to the right of the center indicate those that need to be taken in the future. Medications/Treatments to the left reflect those that have been or should have been taken already. Responses will be stored in an XML file. If the patient does not take a medication or treatment as specified, a text message may be sent to the caregiver.

Figure 11: MyDay Administration Maintain User Activities Screen

MyDay Medications - Patient Data Entry	
Patient Name	Display Days: Sunday.Monday.Tuesday.Wedne
Patient Address	Overall Prompt Duration (In Seconds): 120
Patient Phone #	Prompt Duration (In Seconds): 60
Patient Treatment	Number Of Prompts: 2
Contact Info	Caregiver Contact Information
Event Location	Recipient Number
Picture To Show	Cellular Carrier
Sound To Play	Sender Email
Start Time	Subject
Type	Message
Medical Directions	Send MS Outlook Message: <input type="checkbox"/> IMS Outlook must be running.
	Send Gmail Message (Alternative): <input type="checkbox"/> SMTP must not be blocked.

1 Of 9 Record(s) <> [Instructions](#) [Go To](#) [Test Message\(s\)](#) [Search](#) [Insert Record](#) [Save Entry](#) [Dashboard](#)

Contact MyDayMedications@gmail.com with questions or comments.

Figure 12: MyDay Administrator Administer User Screen

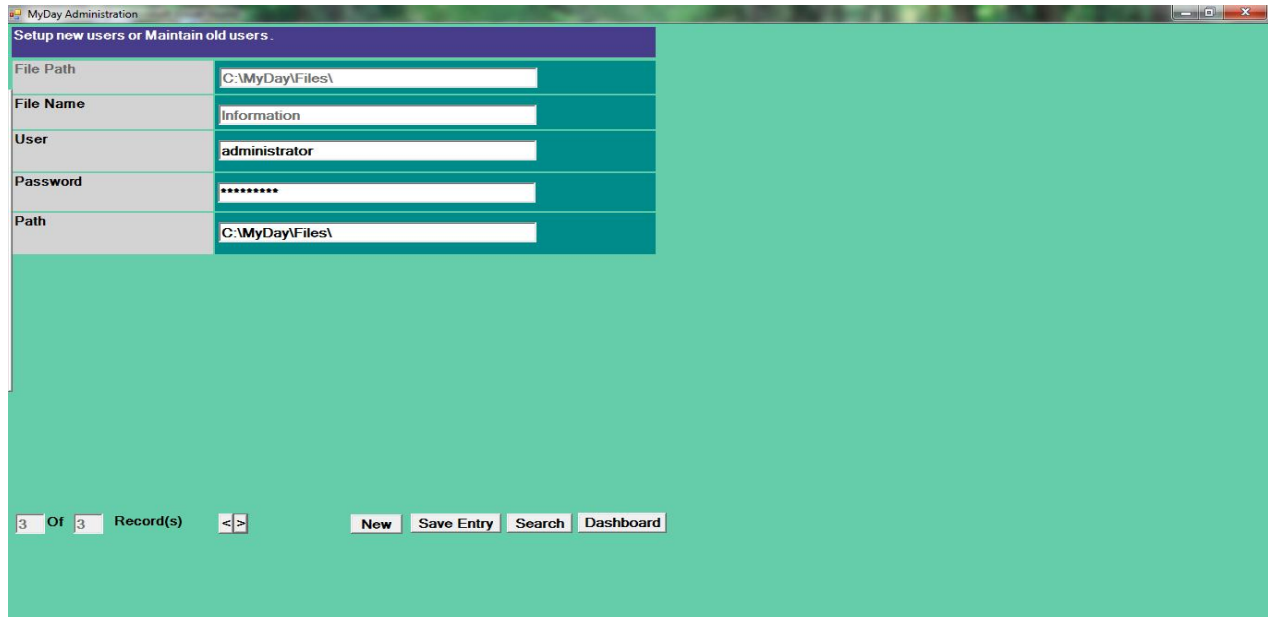
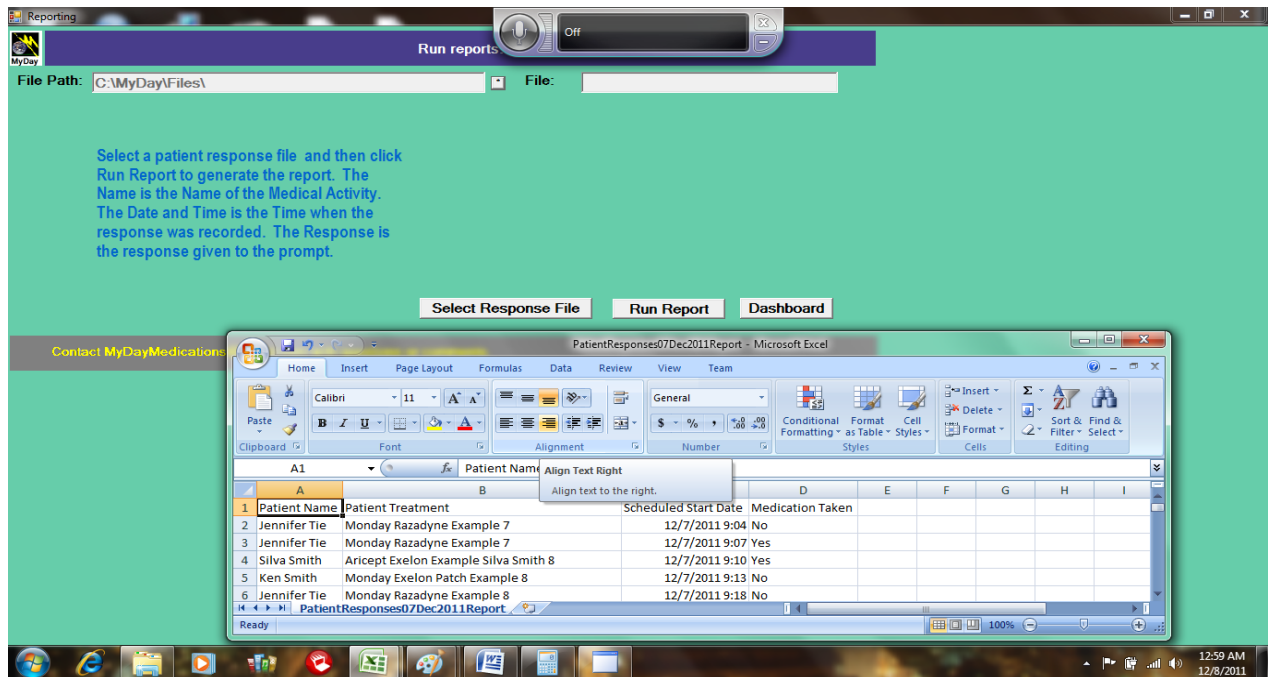


Figure 13: The MyDay Reporting screen



Figures 9 and 10 show the main MyDay Activity Entry form and the Administer User screen. Figure 11 shows the MyDay Reporting screen used to print out a spreadsheet with the patient responses. See Appendix D for an alternative screen shot of the MyDay Activity Entry form. All screens were created using VB.Net and XML technology. Users will need a Windows-based Operating System such as Windows XP with the .Net Framework 4.0 to run the program. If users choose to send text messages to caregivers using MS Outlook they will also need to be running Microsoft Outlook with a ClickYes plug-in installed beforehand.

An Additional screen shot of the MyDay application user interface can be seen in Appendix C. The developer tested the application with actual test cases. These cases verified things like making sure that the administrator can create users, users can run MyDay reports, and that users can respond successfully to the MyDay prompts. See the Unit Test section below for additional details.

4.1 Unit Testing and System Testing Results

Some white box unit testing was performed on the application prior to the user evaluation. For instance the VB sub below shows code that was used to verify that Outlook and or Gmail messages could be sent successfully.

```
Private Sub ButtonTxtMsg_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles ButtonTxtMsg.Click
    If CheckBoxSendOutlookText.Checked = True Then
        SendOutlookMsg()
    End If
    If CheckBoxSendGmailText.Checked = True Then
        SendGmailMsg()
    End If
End Sub
```

White box testing performs tests against code and it is usually performed by someone with working knowledge of underlying code. System testing checks all of the use case requirements as shown in Appendix B. This is usually performed by the tester or user community. System testing by the user community is not necessary with this project because of the extensive evaluation that performed and described in sections 4.2 and 4.3. In this case the developer performed the system testing. Table 1 below describes the system test steps that were carried out by the developer to test the software. The last column shows if the test result was successful or not.

Table 1: Sample Test Cases for the MyDay Application

Test	Expected Result	Success (Yes Or No)
1. Login to the MyDay Administration application as any regular user.	The MyDay Dashboard should display and the only buttons you will see are Reporting and Exit MyDay.	Yes
2. Log back into the MyDay Administration application as the administrator.	The MyDay Administration application will open and you will see the Reporting, Administration, MyDay, and Exit MyDay buttons.	Yes
3. Click on MyDay Reporting and click on Select a Response File.	The MyDay Reporting screen opens and the desired response file is selected.	Yes
4. Click the Run Report button.	An Excel spreadsheet will open showing the correct Patient Name, Patient Treatment, Scheduled Start Date, and Treatment Taken values.	Yes
5. Click on Dashboard.	The Dashboard will appear.	Yes
6. Click on Administration.	The Administration screen will appear.	Yes
7. Click New and create a new	The record saves.	Yes

user by typing in the User Name, Password, Confirm Password, and clicking Save.		
8. Click on Dashboard and then click on Administration and use the < > buttons to find the record you created in the previous step.	The record is there.	Yes
9. Change the password and click Save.	The record saves.	Yes
10. Change the User Name to deleteme and click Save.	The record saves.	Yes
11. Test the GoTo button to navigate to a specified record.	The screen should navigate to the specified record.	Yes
12. Click on Dashboard and then click on Administration and use the < > buttons and the Search to try to locate the deleteme User Name.	The new deleteme User is no longer in the MyDay system.	Yes
13. Click on Dashboard and then click on MyDay.	The MyDay screen displays.	Yes
14. Click on the > button two times to navigate to the last initially blank record. Click on New to insert a new record.	The screen is ready for insertion.	Yes
15. Click on Instructions to view the Instructions.txt file. Exit the file when ready.	The Instructions file will open as close as expected.	Yes
16. Enter a patient Name and Address.	The Patient Name and Address values have been entered.	Yes
17. Change the Patient Treatment to Blank and click Save. A message will say that this file value must be unique. Change the Patient Treatment to a unique value.	The value is entered successfully.	Yes
18. Choose a Type from the drop down and enter Medical Directions.	The Type and Medical Directions are entered successfully.	Yes
19. Enter character values in the Overall Prompt Duration, Individual Prompt Duration, and Number Of Prompt fields	A message will display saying that these fields must be numeric.	Yes

and click Save.		
20. Change the fields from the step above to the following numbers (Overall Prompt Duration: 120, Individual Prompt Duration: 60, Number Of Prompts: 2). Do this one at a time and click Save to confirm that a message displays for each fields saying it must be numeric.	A message will display saying that these fields must be numeric.	Yes
21. Change the Number of Prompts to 10 and click Save.	A message will display saying that the Number Of Prompts times the Individual Prompt Duration must not be greater than the Overall Prompt Duration.	Yes
22. Change the Number of Prompts back to 2. Click Save.	The record saves.	Yes
23. Change the Overall Prompt Duration to 12000. Click Save.	A message will display saying that the records cannot overlap with other prompts.	Yes
24. Change the Overall Prompt Duration back to 120. Click Save.	The record saves.	Yes
25. Enter valid information for the following fields: <ul style="list-style-type: none"> • Recipient Number • Cellular Carrier • Sender Email • Subject • Message • Send Outlook Message • Send Gmail Message 	The values are saved.	Yes
26. If the system requirements are in place for sending messages as specified in the MyDay Instructions file click Test Message(s) to test the cell phone message.	A message should be sent to the cell phone.	Yes
27. Change the Start Time to 01/01/2000 12:01:00 AM and click Save.	A message will display saying that the Start Time does must not overlap with	Yes

	another record (IE. The first and second blank records).	
28. Change the Start Time setting the time from 12:01:00 AM to a time 5 minutes in the future. Click Save. Note that 5 minutes is the amount of time you will have to exit the Administration application and enter the MyDay application to see the prompt in action.	The time is successfully changed.	Yes
29. Click New and enter a new Treatment with a Start Time that is 3 minutes past the time you entered in the last step.	A new treatment is entered.	Yes
30. Click Search and search for "Blank".	The first record with the word Blank will appear after clicking through the prompts.	Yes
31. Click GoTo and type in a record you want to navigate to and click OK.	The screen will navigate to the specified record.	Yes
32. Click Dashboard.	The user will successfully return to the Dashboard.	Yes
33. Click Exit MyDay.	The application will exit.	Yes
34. Open the MyDay application.	The 1 st or 2 nd picture prompt and sound you see and hear should be the one you entered in step 28 above.	Yes
35. Click Yes and No to verify that the frame changes to green and red and that the check and the X display as required.	The responses are displayed successfully.	Yes
36. Use voice recognition to verify that the Yes and No is recognized as the user says it.	The responses are displayed successfully.	Yes
37. Wait until the treatment you entered in step 29 above is displayed. After that exit the MyDay application.	The next treatment should be displayed and the screen should exit without a problem.	Yes
38. Login to the MyDay Administration screen as any	The Reporting screen opens.	Yes

user. Go to reporting.		
39. Run the report for today's file.	Verify that the response(s) you entered while in the MyDay screen were successfully recorded here.	Yes
40. Exit the application.	The application exits.	Yes

4.2 Evaluator Feedback

The MyDay Evaluation was run successfully. 30 people from various backgrounds including caregivers and some patients tested the program and supplied valuable feedback. The evaluators who were mostly students at UNCW gave overall usage and average ratings for the program. The results were used to evaluate the effectiveness of the program. See Appendix A for the survey responses. The next few sections summarize their responses and their overall reaction to the initial MyDay application:

Here is some of the feedback and the comments provided by the evaluators. The rest of the feedback is presented in Chapter 6 - Conclusion And Future Work.

Feedback that has been implemented:

- Enlarging the pictures for older patients and improving sound prompt clarity.
- Using better colors and clarity with the treatment pictures displayed.
- Applauding the users after positive responses.
- Creating a better, easy to use tutorial.

Other Comments:

- A great potential of the program is the way it can alert caregivers about patient responses.
- Medication adherence is a primary reason for patient readmission within 30 days of an initial hospital visit.

- The program is similar to medication visuals.
- Elderly people may have issues with insecurities using this kind of technology.
- The ease of use depends on the age of the patients using the tool.
- Patients in late stages of dementia could not use this, but it works great for caregivers.

4.3 Results Summary:

Thirty surveys were taken. Twenty five of the evaluators were caregivers and 5 were patients. There is no way to know if the patients would qualify as potential users so all caregiver and patient results are summarized as one unit within this section. Out of the evaluators, 21 were female, and 9 were male. Twenty three were Caucasian, 1 was Asian, 2 were African American, 1 answered other, and 2 did not respond. Eighteen were ages 16-25. Six were 26-35. One was 36-45. Three were age 51-60, and two were 61-80.

Figure 14: A Graph of the Evaluation Results

Caregivers and Patients						
	Poor	Below Average	Average	Above Average	Good	NR
Question 1		1	4	11	14	
Question 2		2	9	12	7	
Question 3			1	8	21	
Question 4			4	8	17	1
Question 5			7	11	11	1

	Yes	No	Maybe
Question 6	7	20	3
Question 7	15	7	8

Sex	Males:	9
	Females:	21

Age	16-25:	18
	26-35:	6
	36-50:	1
	51-60:	3
	61-80:	2

Race	Caucasian:	23
	Asian:	1
	African American:	2
	Native American:	1
	Other:	1
	No Response	2

The reader may reference Figure 12 when reviewing the MyDay application statistics that follow. This figure gives an overall breakdown of the results. One evaluator gave the program a below average score for being able to remind patients to take their medications. Two gave the program a below average score for being easy to use. The remaining evaluators gave the first five survey questions an average to good response.

All evaluators said that the MyDay application alerts caregivers within the average to good range. All evaluators felt that the program effectively allows caregivers to manage patient data and generate reports, and all evaluators felt that the program works effectively over all.

Seven out of the 30 evaluators felt that the program was confusing and 15 of the evaluators thought that they could offer suggestions for improving the program. Their suggestions were noted in section 4.4. Some of the suggestions such as providing positive reinforcement and improving the media quality of the program have been implemented at this point.

Figure 15: Evaluation Statistics

	Mean	Median	Max
How well does the MyDay app. Remind patients to take their scheduled meds? 1=Poor and 5=Good	4.3	4	0.8
How easy will it be for patients to use this program? 1=Poor and 5=Good.	3.8	4	0.09
How well does the MyDay application alert caregivers? 1=Poor and 5=Good.	4.7	5	0.5
How easy will it be for caregivers to use this program to manage patient data and generate reports? 0=? 1=Poor and 5=Good.	4.3	5	1.1
Overall, how do you rate the MyDay Application? 0=? 1=Poor and 5=Good.	4	4	1.1

Evaluation Statistics Continued:

	Was there anything confusing about using this program? 1=Yes 2=Maybe 3=No	Is there anything that can be done to make MyDay easier to use? 1=Yes 2=Maybe 3=No
Yes	23%	50%
No	67%	23%
Maybe	30%	27%

Figure 13 shows the statistics behind the MyDay survey evaluations. The mean and median values were all above average for the first 5 questions. On average the first five questions yield very positive results. The lowest mean value was 3.8 in response to how easy it is for patients to use the program. This seems fair considering the responsibility of the program and the user group. All of the mean values were well above average for questions 1, 3, 4, and 5. In Question 6 a mean of 2.4 and median of 3 suggests that some people thought the program was confusing, but the majority felt that it was not. The mean of 1.5 for question 7 shows that there were a large amount of people offering suggesting for how to improve the program. As mentioned, these suggestions have been noted, and some suggestions have been implemented. The lowest standard deviation was .5 and the highest was 1.1. This shows that most of the evaluation responses given were consistent within the survey population.

Chapter 5: Discussion & Lessons Learned

The research project suggests that the MyDay application has great potential for reminding patients to take their medicines. The overall results of the survey were very promising especially considering that some evaluators were aware of the difficulties associated with creating a tool to be used by memory challenged patients. Many lessons were learned while designing and developing the program, writing this paper, and following through with the evaluation results. These lessons include the following:

- Strategic pre-planning with important questions addressed up front is key for a good design.
- Good note taking with close attention paid to feedback is important.
- Simple-concise instructions and prompts are necessary.
- Instructional venues such as the WITX conference provide valuable up-to-date feedback.
- The design process must focus on the user and relevant community at all stages.

Even though there were only 5 potential patients evaluating the application, each of these evaluations were highly encouraging because they gave better than average survey results. Caregivers evaluating the program appear to have believed in the potential of the program. Some said that the pictures and sounds were very helpful and others were very happy with the cell phone integration. The negative feedback from the users was that patients, some of which cannot distinguish between left and right, may not be able to use this program no matter how user friendly it is. Many evaluators gave ideas for how to improve the program. Refer to

Appendix for a list of these suggestions. This may imply that people are generally interested in this project.

Many tools were used developing this project including Microsoft vb.Net, ExpressClickYes, XML, Winzip, Speech Recognition technology, and media tools like Microsoft Paint and Sound Recorder. Some of the necessary key software development techniques showcased the power of threaded processes, using IO functionality, and invoking exception handling in order to make the software run smoothly and responsively.

The hardest part of the MyDay Medications project was threading the various pieces together using the VB.Net System.Threading library. Threading is a coding technique that allows a program to transfer control from one working process to another. For instance an initial thread can wait to accept input from the user and then a secondary thread can be used to redraw the screen based on that input. The code below shows a fragment of the code used to thread the class used to display prompts and wait for a response from the user.

```
oWaitingEvents = New WaitingEventsClass()  
Dim t = New Thread(AddressOf oWaitingEvents.ThreadWaitingEvents)
```

The MyDay Activities screen used three threaded classes. The first class accepted input from the user using the Speech Recognition library. The second class was used to display activities, wait for a sign that input had been given by the user, and record responses. The third class was used to redraw the screen after the user responded to the prompts. This was the most challenging piece of the project because threading was not familiar to the developer and all of the threaded

pieces had to work well as a whole in order to provide for and meet the requirements of the MyDay Medications user community.

The Speech Recognition Toolkit is a very powerful tool and it was essential to the success of this project. The toolkit allows various users (IE. Caregivers and patients) to create profiles with their voices that can be used by the computer to recognize human commands and requests. This was key in providing an alternative feedback mechanism for the patients. In recent years the government has put a lot of emphasis on providing alternative input possibilities for disabled users so that people with hearing and sight impediments are able to use the system with similar ease. The chunk of code below shows a function used to start the speech recognition functionality.

```
'This function will start the speech recognition feature.
'NOTE: This must be turned on before you can start to use speech recognition
Public Sub SpeechLibrary_StartSpeechRecognition()
    'First check to see if reco has been loaded before. If not lets load it.
    If (RecoContext Is Nothing) Then
        RecoContext = New SpSharedRecoContext 'Create a new RecoContextClass 'Removed
        Sp...Class to allow embedding. PG 2.15.12
        Grammar = RecoContext.CreateGrammar(1) 'Setup the Grammar
        Grammar.DictationLoad() 'Load the Grammar
    End If

    Beep() 'Make the computer beep so the user knows speech recognition has started
    Grammar.DictationSetState(SpeechRuleState.SGDSActive) 'Turns on the Recognition
End Sub
```

Allowing the user to speak his or her responses into a microphone or to click a button using a keyboard or mouse really provided functionality that went over and beyond what was required for the project and it would not have been possible without the toolkit. The major limitation that speech recognition needs to overcome is the time consuming task of learning a voice and it's

somewhat limited ability to switch between profiles. These advancements are only a matter of time. Speech recognition is a powerful tool and will be used more and more in the future.

In retrospect the number two main things that could have been done differently to make this project more of a success would have been to have more up front design work as well as requirement discussions with the committee. The project initially began as an idea to remind patients about every possible life occurrence and to give users the ability to display or report on these life occurrences after they occurred. The committee felt the project requirements needed to be filtered down some because of the arduous and time consuming task of completing such a project.

The developer had already designed a good part of the VB.net application before the committee met for the first time. If this had not been the case the committee may have selected a different set of tools with which to build the program. They may have been able to pinpoint a smaller set of requirements up front and made the task a little less stressful. It was nice to have a point of reference, but a mockup screen would have probably been sufficient in place of the very time consuming .Net prototype. The results may have turned out differently as well. For instance, we may have ended up with a cell phone that would remind users about their medications as opposed to the more localized windows application.

Some of the key features of the system include alternative mechanisms for input and user prompts, the caregiver alerting feature, and the MyDay reporting capabilities. Allowing for alternative feedback mechanisms and prompting them with pictures and sounds opens up new

possibilities for the physically challenged community. The ability to contact a caregiver via cell phone if there is a problem is key with a system like this because it allows the caregiver to remain connected to the needs of his or her patient. The reporting capabilities are also important because they allow the caregiver a bird's eye view of how the patient is responding to the medications and treatments and what needs to be done differently to help with these tasks.

Some of the less key features of the application include the display of subsequent and previous activities in the patient activities window and the ability of the patient user to login to the MyDay Administration screen. The patient may or may not need to see what treatments were before and or behind because their focus needs to be on the task at hand. The patient will probably not need to log into the administrative side of MyDay either. Running reports and creating activities and patients is more of a caregiver's task. While it may be nice to see the treatment responses the patient need not be as concerned with this information as he or she is with the treatment activities.

System analysis is a key component in designing a system such as this. Some of the analysis tools used in this project included the unit test and system test, the use case scenarios, the various diagrams, and the evaluation instrument. The developer performed the unit testing and system testing. Unit testing involved creating procedures to test the underlying code providing the requirements essential to the MyDay Medications functionality. System testing basically runs through every requirement manually ensuring that each requirement was met successfully and thoroughly. This was helpful because it showed that all of the major application features had been checked. The various use cases were also key because the system test looked at these use

cases to determine all of the major software requirements for the MyDay Medications application. The various design diagrams included the Actor Diagram, the Finite State Diagram, the Architectural Diagram, and the Activity Diagram. These diagrams played an important role in describing the MyDay application to the committee members and reminding the developer of key features that needed to be tested and developed further. The evaluation instrument was very valuable as well for determining how the user community felt about the application.

Our method for analyzing the project began with mockup screens and a prototype. Once the users were happy with the proposed requirements some unit testing was carried out on the initial MyDay Medications application. Several procedures were coded and executed to test the functionality of the underlying code. Diagrams such as the Architectural and the State Chart Diagram were then developed to make for easier discussions with the committee and for easier use case analysis. Use cases were created to outline all of the actors, parts, and their functionality within the system. This was used to develop the system test. After the system test was carried out, the system was ready for a more thorough evaluation by the user community.

Having the diagrams was useful for explaining the application to interested people and groups. The most useful diagrams were the activity diagram and the actor diagram. Both of these helped to define the use cases used in testing the functionality and requirements of the application. The unit testing, system testing, and user evaluation showed that the system was stable and that users were happy with the way it worked in general. Everything worked together to prove the usefulness and the general acceptance of the MyDay application by potential users and the medical community.

Chapter 6: Conclusion and Future Work

There was a positive response to the initial software version. Evaluators believed that the software would work well with one or two patients in a home setting. They indicated that the users need to be competent patients or caregivers and that some media modifications could improve the program. They noted that many generic medications look different from one refill to the next and suggested that users need the capability to create new pictures and sound prompts on an as needed basis for medication changes. Some other suggestions for future changes include:

- Using a Checkbox to assign activity days.
- Entering repeating times for activities instead of creating a new record for subsequent activities.
- Adding a snooze to the treatment reminders.
- Having the computer call the patient to remind them to take the medication.
- Considering how to fund the use of this tool for patients using it in their homes.

See Appendix F for a list of suggested enhancements for future consideration. Most interviewees indicated that the software is useful and beneficial for the community. Some interviewees indicated that the software would be best suited for 1 patient working with a caregiver in a home setting.

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Appendix A: Evaluation Instrument MyDay System Evaluation

MyDay System Evaluation

The MyDay application is being developed to help Alzheimer and Dementia patients remember to take their medications on time. The information requested will be used to evaluate and improve the application. Your input is greatly appreciated. Thanks in advance.

Demographic Information

Please fill in the required data or circle the item that best matches your profile.

Patient: Yes No Qualification/Profession(If not a patient):_____

Sex: Male Female Prefer Not To Answer

Age: 1-15 16-25 26-35 36-50 51-60 61-80 81-100 100+ Prefer Not To Answer

Race: Caucasian Asian Native American African American Other _____
Prefer Not To Answer

MyDay Software Evaluation

Please evaluate the MyDay application using the questions below. Circle your choice use the scale:

1=Poor 2=Below Average 3=Average 4=Above Average 5=Good

1. How well does the MyDay application remind patients to take their medication at the scheduled times? 1 2 3 4 5

2. How easy will it be for patients to use this program? 1 2 3 4 5

3. How well does the MyDay application alert caregivers? 1 2 3 4 5

4. How easy will it be for caregivers to use this program to manage patient data and generate reports?
1 2 3 4 5

5. Overall, how do you rate the MyDay application? 1 2 3 4 5

6. Was there anything confusing about using this program?

7. Is there anything that can be done to make My Day easier to use? _____

Additional Comments _____

Appendix B: Use Cases

Table 2: The Medication Reminding Use Case

Use Case Name:	Medication Reminding
Scope:	MyDay Application
Level:	Patient goal
Primary Actor:	Patient
Preconditions:	The MyDay activity information must have been entered prior to use of the application.
Success Guarantee:	Responses are stored correctly in the response files and the activities are displayed as specified by the activity file.
*+Flow:	<ol style="list-style-type: none"> 1. The patient opens the application. 2. Activities are displayed sequentially from left to right. <ol style="list-style-type: none"> 1. The first three and last three activities of the day display as blank prompts. 2. Activities that have a positive response show with a green frame and have a green check mark on top. 3. Activities that have a negative response or require a response have a red frame and a red X on top. 4. Activities that have no responses yet display with a gray frame without an X or a check mark. 5. The latest daily activities will be displayed. 3. A configured amount of prompts will be displayed within a specified duration of time prior to and after an event. See Patient Management. 4. Prompts will be displayed at a configured duration during the configured activity interval. See Patient Management. 5. Patients will be able to respond to the prompts by saying Yes or No or by pressing the Yes or No buttons. 6. When the configured activity interval comes to a close, the last patient response will be recorded in the daily response file. <ol style="list-style-type: none"> 1. Patient responses will be stored in a response file. 2. If the response is negative or no response is given an alert may be sent to the caregiver and the activity will show with a red border and a red X on top as it moves to the right of the central activity. 3. If the response is positive the activity will show with a green border and a green check on top as it moves to the right of the central activity. 7. The MyDay application will exit when the user clicks the

	X button at the top right hand side of the application.
Extensions:	See the Alerting Use Case. If any problem occurs a message will display. After the patient clicks OK the application will continue to work as specified.
Special Requirements:	Voice recognition software. This will require that the user has a computer with this technology and it will require that the patient go through voice recognition training under the control panel-Speech configuration tool.
Technology and Data Variations Lists:	Speech recognition programming as mentioned under special requirements will be required separately by all patients.
Frequency of Occurrence:	Continuous until the program is turned off.

Table 3: The Reporting Use Case

Use Case Name:	Reporting
Scope:	MyDay Administration Application
Level:	Patient and Caregiver Goal
Primary Actor:	Patient and Caregiver
Preconditions:	At least one patient response must have been provided for the daily file to appear for the targeted date.
Success Guarantee:	The Patient Response file must open and display patient responses as specified in the MyDay Reminding Use Case.
Flow:	<ol style="list-style-type: none"> 1. The patient or caregiver opens the application. 2. The user will request the report. 3. The system will display the report.
Extensions:	If the file is not there the user will not be able to select it. If the file does not exist, the application will notify the user. If a problem occurs the system will provide a message. When the patient clicks OK, the application will continue to work as specified.
Special Requirements:	The application will read the XML response file in the C:\MyDay\Files directory and output to a text file report so a text editor should exist on the computer.
Technology and Data Variations Lists:	N/A
Frequency of Occurrence:	This will occur whenever the user wants to run a report.

Table 4: The Alerting Use Case

Use Case Name:	Alerting
Scope:	MyDay Application
Level:	Patient Goal
Primary Actor:	Patient
Preconditions:	<p>The patient has not responded as expected to a MyDay activity.</p> <p>The caregiver should have a cell phone and a carrier that will work with this Use Case scenario.</p> <p>The correct caregiver cell phone information should be specified for the Activity record.</p> <p>MS Outlook must be installed on the computer.</p>
Success Guarantee:	The caregiver should receive a cell phone text alerting them if a patient does not respond correctly to a MyDay Activity prompt if the configuration specifies that this should occur.
Flow:	<ol style="list-style-type: none"> 1. The system prompts for patient input. 2. The patient responds <i>no</i> or does not respond at all to the prompts. 3. The system will notify the caregiver.
Extensions:	<p>If MS Outlook is not setup on the system, or if the cell phone text message does not go through, or if any other issue occurs, a general message will be displayed. The patient will click Ok to acknowledge that this has happened and the application will continue to work as specified.</p> <p>Note that caregivers will be allowed to test this functionality from the MyDay Administration Patient Management screen.</p>
Special Requirements:	<p>MS Outlook must be installed on the computer.</p> <p>MS Outlook does not always allow users to send emails programmatically and asks the user if it is alright to send the message. A program named Express Click Yes may need to be installed on the machine to automatically handle this situation.</p>
Technology and Data Variations Lists:	N/A
Frequency of Occurrence:	This may occur at any time during the medication reminding use case as specified above.

Table 5: The Patient Management Use Case

Use Case Name:	Patient Management Use Case
Scope:	MyDay Administration Application
Level:	Caregiver Goal
Primary Actor:	Caregiver
Preconditions:	Supporting files, such as pictures and sounds must exist in the MyDay/Files directory before the caregiver can select them from the drop down. The Activities file must exist in proper format.
Success Guarantee:	The activities are displayed, inserted, and saved correctly in the application and in the activity file as conveyed through the user interface. Other features, such as the Search feature, will work correctly when invoked.
Flow:	<ol style="list-style-type: none"> 1. The caregiver will login to MyDay and open the Maintain User Activities screen. 2. If the caregiver clicks Insert Record, all field values will be blanked out. Then the user will insert the medical activity and click Save Record. The date must be in the correct format and it must sequentially fall in between record X-1 and X+1. <ol style="list-style-type: none"> 1. The user will not be allowed to insert records within the first three records or the last three records as these records are reserved for showing blank records as the first and the last records promptings during the day. 2. The Start Time must display in the following format: MM/DD/YYYY HH:MM:SS XM. If it is not in that format a message must be acknowledged by clicking OK and the record will not be savable until it has been fixed. 3. Activity Names must be unique and cannot be NULL. 4. The caregiver will be required to enter an activity interval time for the record. This will specify how long the application will continue to prompt the user about an activity. 5. The caregiver will be required to enter a prompt duration time. This will specify how often each prompt should display for an activity. 6. The caregiver will be required to enter the number of prompts displayed. If this number times the prompt duration is greater than the activity interval time the user will be required to

	<p>change one of the numbers.</p> <p>7. The activity interval time will not be allowed to overlap with the X-1 or X+1 record. If medication records need to overlap they will display as a single activity.</p> <p>8. If all criteria are met, the user will be able to save the record.</p> <p>3. The caregiver will be able to click GoTo to navigate to a particular record. The Current Record of Record Count values will display correctly as the user navigates through the records.</p> <p>4. The caregiver will be able to click < to go to a previously existing record. The caregiver will be able to click > to go to the next record if the record exists. The caregiver may type deleteme for the activity name and click Save. The next time the screen opens the record will be removed.</p>
Extensions:	<p>If there is an unhandled error performing a task the caregiver will receive a general error message. If he or she clicks OK the program will continue to work as specified. When the caregiver enters the picture they will select the grayed out picture named Activity.bmp. Once the patient responds, depending on the response the application will know whether or not to select the ActivityNo.bmp or ActivityYes.bmp picture and a similar technique will be used for the sounds.</p>
Special Requirements:	<p>The caregiver will be allowed to send a text message to themselves via a cell phone if they have a cell phone supporting the technology.</p>
Technology and Data Variations Lists:	<p>MS Outlook must be installed to test the message to caregiver functionality.</p>
Frequency of Occurrence:	<p>Will display while the caregiver is maintaining patient activities.</p>

Table 6: The Administration Use Case

Use Case Name:	Administration
Scope:	MyDay Administration Application
Level:	Caregiver Goal
Primary Actor:	Caregiver
Preconditions:	The InformationE.xml file must exist in the C:\MyDay\Files directory.
Success Guarantee:	After creating MyDay users they can use the MyDay Administration and MyDay applications successfully.
Flow:	<ol style="list-style-type: none"> 1. The caregiver will enter the Administration form. 2. The caregiver will click New to create a new user. 3. The caregiver will click Save to save the new user. 4. The caregiver can use the < > or GoTo to navigate to a preexisting record. 5. The caregiver can use Search to search for a particular record. 6. The user can click Save to save modifications to a pre-existing record. 7. The user can click Dashboard to return to the Dashboard.
Extensions:	A decryption and an encryption function will unprotect and protect the file as the administrator enters and exits the form. If there is an error with this process the application will alert the user. A backup file will be maintained in order to provide redundancy for the user informationD.xml file.
Special Requirements:	N/A
Technology and Data Variations Lists:	<p>The file will exist in a decrypted mode when the administrator opens the form.</p> <p>The file will exist in an encrypted mode when the administrator exits the form.</p>
Frequency of Occurrence:	Whenever the administrator needs to administer MyDay user accounts.

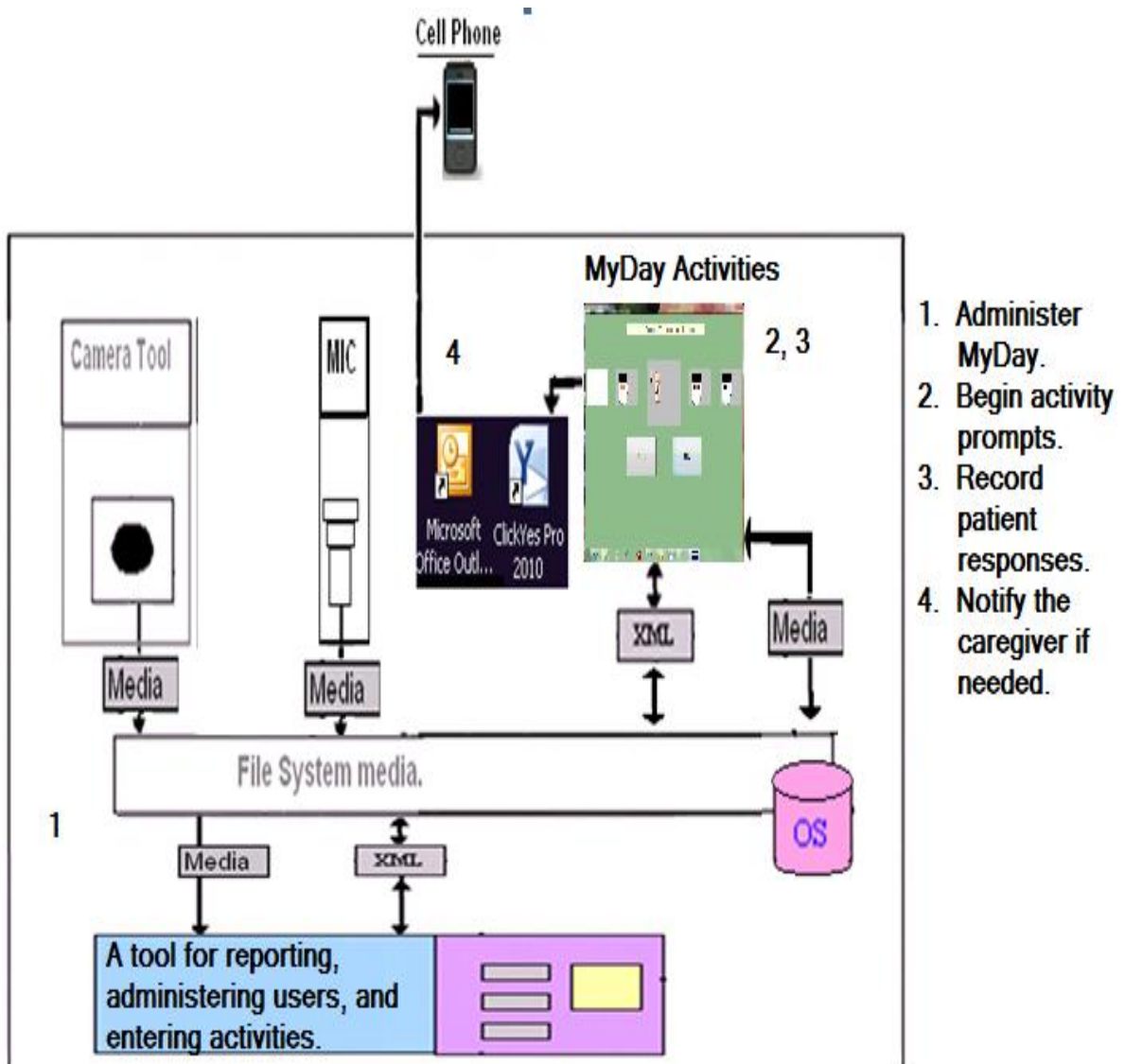
Appendix C: Additional UI Diagrams

Figure 16: An earlier alternative view of the MyDay Patient Activity screen.



APPENDIX D: Various Diagrams

Figure 15: Architectural Design Diagram



Appendix E: Suggested Enhancements for Future Consideration

- Incorporate sufficient training for elderly users.
- Make it so that users see pictures and hear sounds as they select images and wav files.
- Check web domains to see if MyDay.com is being used.
- Make this a web-based application.
- Show statistics on the dashboard and allow for various report formats.
- Track dosage and prescriptions.
- Test the program with larger letter-size resolution.
- Enlarge medication pictures as the user navigates over them.
- Create and improve a medication list for doctor visits.
- Make the MyDay Instructions clear, readable, and to the point.
- Track medications at the time of refill.
- Store lists of allergies, instructions, med tech license number, information related to power of attorney, and the caregiver company/family contact information.
- Ensure that everything is simple for the various patients. One person said that they didn't feel patients with dementia could use this.
- Put the name of the pictures above the pictures.
- Address what to do if a medication picture displays when the patient is away. Patients need to remember to check for reminders.
- Only use pictures of the medications themselves and not the medication containers.
- Display notes about how other foods and medications can affect the central medication.
- Address what to do in an out-patient setting with real time caregiver tracking.
- Consider what to do for user who do not have a "cell" phone.

- Improve microphone speech recognition capabilities to ensure all responses are saved.
- Continue to remind patients with treatment pop-ups if the program shuts down.
- Improve the timing of the program.
- Consider a non computer/laptop click button device instead of a computer application.
- Consider how to link the speakers (and microphone) throughout the house for the patient.
- If the users responds “no” then tell the patient to take the treatment with additional details on how to do that. Tell the patient why it is important to take the treatment.