Lab 1 – Thought Locker Product Description

Olivia Gee
Old Dominion University
CS411W
Professor James Brunelle
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1 Introduction

According to Alzheimer's Disease International (2020), approximately one in ten Americans aged 70 and older experiences some form of dementia, with Alzheimer's disease being the most common type, accounting for 60-80% of cases. As people age, their risk of developing dementia increases, making it a growing concern for healthcare providers, families, and communities. The National Institute on Aging reports that half of Alzheimer's disease cases may be mild (Fact sheet: U.S. dementia trends, n.d.), while the Alzheimer's Society describes the three stages of dementia: early, middle, and later (The early stage of dementia | Alzheimer's Society, n.d.; The middle stage of dementia | Alzheimer's Society, n.d.; The later stage of dementia | Alzheimer's Society, n.d.). It is important to understand the progression of dementia and its symptoms to better manage the condition.

According to the National Institute on Aging, the majority of dementia cases are mild or moderate, with 50.4% being mild, 30.3% being moderate, and 19.3% being severe. (Half of Alzheimer’s disease cases may be mild, n.d.) Individuals with mild dementia may experience mood changes, memory problems, and difficulty effectively planning and thinking through. However, they generally require very little assistance in daily living activities. (The early stage of dementia | Alzheimer’s Society, n.d.)

Individuals with moderate dementia may need frequent reminders and some assistance with washing and dressing. They may also experience symptoms of anxiety, depression, and paranoia, with their memory problems worsening over time. In severe cases of dementia, individuals may become completely dependent on others for care.

As dementia symptoms worsen, assistance becomes necessary from either a family member or outside source. However, individuals with mild or moderate dementia often prefer to
maintain some of their independence. Caregiving for dementia patients can become stressful for family members due to the constant attention required. Caregivers may struggle with managing their own emotions, balancing their caregiving responsibilities with other commitments, and coping with the changes in their loved one's behavior and cognition.

There has been a steady increase in the number of individuals diagnosed with dementia over the years. This highlights the need for innovative solutions to support these patients and help them maintain their independence. (Fact sheet: U.S. dementia trends, n.d.). In recent years, there has been a growing interest in developing technology-based solutions for dementia care. One such solution is Thought Locker, a mobile assistant designed to help dementia patients and their caregivers.

Thought Locker provides reminders, item location assistance, monitoring, and analytics to the present caregiver, allowing dementia patients to maintain their independence while still receiving the necessary assistance. For example, the application can send reminders to take medication or complete certain tasks, such as turning off the stove. It can also help caregivers keep track of their loved one's location and monitor changes in their behavior.

In addition to assisting with day-to-day activities, technology-based solutions like Thought Locker can also provide valuable insights into the progression of dementia. By collecting data on a patient's activity levels, the application can help caregivers and healthcare providers track changes in cognition and behavior over time. This information can be used to adjust treatment plans and provide personalized care.

In conclusion, dementia is a complex condition that affects many older Americans and their families. As the number of diagnoses continues to rise, it's becoming increasingly important to find innovative solutions to help patients maintain their independence and improve their
quality of life. Technology-based solutions like Thought Locker have the potential to revolutionize dementia care by providing support and insights to patients and their caregivers.

2 Product Description

Thought Locker is a mobile assistant designed to help individuals with mild to moderate dementia maintain their independence while still receiving the necessary assistance. Thought Locker provides a range of features to help individuals with dementia and their caregivers manage daily living activities. The application sends reminders to take medication or complete certain tasks, such as turning off the stove, helping individuals stay on track with their daily routine. Additionally, Thought Locker assists with item location, making it easier to find misplaced items like keys or wallets.

2.1 Key Product Features and Capabilities

Thought Locker is a mobile assistant that is compatible with smartphones, tablets, and other devices running on both Android and iOS operating systems, making it accessible to a wide range of users. To use Thought Locker, users will need to sign up for an account using their email address, ensuring secure and personalized access.

Users can schedule reminders and appointments using the application's calendar feature to keep track of important tasks and events. The application's settings can be customized for each individual user, allowing family members or caregivers to tailor the application to the patient's specific needs. Patients can also control some settings, giving them a sense of independence and control over their care.

Thought Locker helps users locate commonly misplaced items such as keys or wallets, which can be particularly useful for individuals with mild to moderate dementia. The application
can also integrate with sensors to track item location, making it easier to find lost items. With motion sensors added by the caregiver, the application will have the ability to monitor motion sensors that can detect activity in the home, providing caregivers with valuable information on the patient's daily routine and activity levels.

The application provides a task scheduler which assists in daily reminders and notifications to help users stay on track with their daily routine, such as taking medication or completing household tasks. This feature is particularly helpful for individuals with memory problems, ensuring that important tasks are not forgotten. Family members or caregivers can use Thought Locker to monitor patient activities, providing peace of mind and allowing for timely intervention if necessary. The application's monitoring capabilities also provide valuable insights into changes in cognition and behavior over time, helping healthcare providers adjust treatment plans and provide personalized care.

One of the standout features of Thought Locker is the contact center that allows users to call their emergency contacts in order if the first contact is unavailable. The application's monitoring and analytics capabilities provide caregivers and healthcare providers with valuable insights into changes in cognition and behavior over time. The Progress page allows users to view collected data and use it to adjust treatment plans and provide personalized care.

Thought Locker is customizable to the user's needs, making it an excellent option for individuals with mild to moderate dementia who prefer to maintain some of their independence. The application is available on both iOS and Android devices, making it accessible to a wide range of users.

In summary, Thought Locker is a mobile assistant designed to help individuals with dementia maintain their independence while still receiving the necessary assistance. With its
customizable settings, item finders, sensors, and monitoring capabilities, the application provides valuable support to patients and caregivers alike.

2.2 Major Components (Hardware/Software)

The Thought Locker application is compatible with both Android and Apple mobile devices that have internet access. To ensure seamless functionality, a reliable internet connection is necessary. The architecture of the application accommodates two user roles: the caregiver and the patient.

In addition to the user roles, the application requires two servers to operate effectively: an application server and a database server. These servers can either be on-premises or cloud-based. For a better understanding of the application's architecture, please refer to figure 1.
The backend server for Thought Locker is built on Amazon Web Services (AWS), providing reliable and scalable performance. The application uses two databases: PostgreSQL and MongoDB. PostgreSQL is used for storing structured data such as user information, while MongoDB is used for unstructured data such as sensor data. The programming language used for the application is Javascript, specifically the React/Node.js frameworks. Jest is the testing framework used to ensure the application's quality and reliability. The application's codebase is stored on GitHub for easy version control and collaboration among developers. GitHub is also used for issue tracking, allowing developers to quickly address any bugs or issues that arise. GitLab is used for continuous integration and deployment (CI/CD) to ensure a seamless deployment process. The application is containerized using Docker to ensure easy portability and scalability.
3 Identification of Case Study

Thought Locker is a mobile assistant designed to support individuals with mild to moderate dementia, as well as their caregivers and family members. It offers a range of features, such as locating lost items, reminding patients to take their medication or attend appointments, monitoring patient habits, and providing a direct line of communication to a caregiver in case of emergencies. This initial release of the real-world product will be tested by a small group to gather information and insight into its functionality.

The use case for this initial release is to provide a valuable resource for those who may not have the financial means to hire a full-time caregiver, as it offers a more cost-effective option. The product's ability to track patient habits and provide analytics could also be useful for medical facilities, insurance companies, and Alzheimer's research groups.

The real-world product will be tested by a small group of users, including individuals with mild and moderate dementia and their caregivers or family members. The focus will be on demonstrating the product's use cases, such as item finding, scheduling, and contacting caregivers. In addition, the product will provide assistance with monitoring patient habits and analyzing trends.

4 Product Prototype Description

Thought Locker is designed to alleviate the concerns of families, friends, and caregivers about the well-being of individuals with dementia. By fostering a sense of independence for the dementia patient, the platform aims to reduce stress for all involved. While the prototype of Thought Locker may not include all features and may have limited versions of certain functions found in the complete product, it effectively demonstrates its potential to solve targeted
challenges. This is accomplished by providing an overview of its core features and simulating the capabilities planned for the full version.

4.1 Prototype Architecture (Hardware/Software)

Thought Locker's prototype architecture, as seen in Figure 2, encompasses a range of hardware, from mobile devices operating on Android to desktops running Linux, MacOS, or Windows. The software will be implemented using JavaScript, React, and Node.js, with data management entrusted to MySQL. AWS serves as the backbone, Jest guarantees code reliability, and APIs like Reactive Native and Google Maps Geolocation enrich user experiences. The efficient CI/CD pipelines and version control via Git and Github ensure a seamless development process.

Figure 2

Thought Locker Prototype Major Functional Components Diagram
In the domain of hardware, the tools encompass a range of devices, including mobile phones and tablets that operate on the Android operating system, along with desktops and laptops equipped with Linux, MacOS, or Windows. Complementing this hardware setup, the software arsenal is powered by a versatile array of technologies. Programming languages such as JavaScript, React, and Node.js are employed to craft dynamic and responsive applications. Data management relies on the MySQL database, while Amazon Web Services (AWS) serves as the backbone for the back-end server infrastructure. Rigorous testing is facilitated through the use of Jest, ensuring the reliability and functionality of the code. To enhance user experiences and functionality, APIs like Reactive Native and the Google Maps Geolocation API are harnessed. Additionally, the development process benefits from the efficiency of CI/CD pipelines and version control, managed seamlessly through Git and Github.

4.2 Prototype Features and Capabilities

Thought Locker's prototype architecture, as seen in Table 1, shows the various features and capabilities, each with its own degree of implementation. This approach allows for prioritizing core functionalities while providing a comprehensive overview of the intended prototype.
Table 1

Thought Locker RWP vs. Prototype Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Patient</th>
<th>Caregiver</th>
<th>RWP</th>
<th>Prototype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Account Creation</td>
<td>✔</td>
<td>✔</td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Account Deletion Verification</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Login / Authentication</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>User Profile Management</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>User Location Information</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Partial: Location data will be simulated</td>
</tr>
<tr>
<td>Task Scheduling</td>
<td>✔</td>
<td>✔</td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Task Completion</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Task Deletion Verification</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Item Locator</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Partial: Location data will be simulated</td>
</tr>
<tr>
<td>Item Registration</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Item Deletion Verification</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Event Viewer</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Calendar</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Sensor Monitoring</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Partial: Sensor data will be simulated</td>
</tr>
<tr>
<td>Contact Center</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Partial: Contact data will be simulated</td>
</tr>
<tr>
<td>Emergency Contacts</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Partial: Contact data will be simulated</td>
</tr>
<tr>
<td>Notifications</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Remote Access</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Not implemented in the prototype</td>
</tr>
<tr>
<td>User Analytics</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Partial: Analytics will be based on simulated data</td>
</tr>
<tr>
<td>Reports</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Item Tagging</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Partial: Geotag data will be simulated</td>
</tr>
<tr>
<td>Images</td>
<td>✔</td>
<td></td>
<td>Full</td>
<td>Full</td>
</tr>
</tbody>
</table>

The intended plan is to fully implement user account management, encompassing essential aspects such as account creation, deletion, profile management, and login capabilities. This robust framework will serve as the foundation for a seamless user experience.

The prototype will feature fully implemented user interface features, including task management, calendar functionality for adding appointments and tasks throughout the day, and the ability to add and delete items often lost by the patient. In-application notifications will enhance user engagement, ensuring a user-friendly interface.

While some features require external data sources, partial implementation is chosen for this phase. This decision stems from the prototype's focus on showcasing in-application functionalities, rather than relying on real-world data. The item locator, for instance, will simulate item location data by generating random item locations on a map for demonstration.
purposes. Similarly, contact data will use simulated information, with parameters for adding and deleting contacts fully integrated. Emergency contact features, however, will be fully implemented, ensuring a seamless process for calling and notifying emergency contacts when needed.

Remote access functionality is eliminated from the current prototype iteration, aligning with the emphasis on directly addressing the unique challenges faced by individuals with dementia. While remote access may be an embellishment for future development, the current focus is on essential core functionalities.

Data management features within the prototype will vary in their implementation status. User reports and item tag data will be simulated to allow for further testing and refinement, ensuring accuracy in generating reports tailored to the target market's needs. On the other hand, formatted reports and images used to track items will be fully implemented, serving as valuable tools for caregivers to better understand patient activity and tailor their care plans accordingly.

This strategic approach to implementation ensures that the prototype aligns with the core goals of addressing the needs of individuals with dementia while offering a glimpse into the full potential of the solution.

### 4.3 Prototype Development Challenges

Ensuring the technical feasibility of Thought Locker's development involves addressing potential challenges in various areas. Compatibility issues, both in terms of hardware and software configurations, may pose hurdles, demanding seamless functionality across diverse systems. Scalability is imperative to handle real-world scenarios and a growing user base while maintaining performance and reliability. The choice of prototyping tools and platforms is critical to realizing the prototype's goals effectively.
On the security front, safeguarding sensitive user data, especially in healthcare applications, is complex, requiring robust encryption, access controls, and compliance with regulations like HIPAA. Integrating external data sources or systems can be intricate, necessitating the resolution of compatibility issues, API limitations, and data format disparities. Realistic simulation of dementia-related experiences and creating an accessible, user-friendly interface for individuals with varying cognitive abilities adds an additional layer of complexity, demanding careful consideration and empathy in design.
5 Glossary

**Amazon Web Services (AWS)**: A cloud computing platform that provides a variety of services including compute, storage, databases, analytics, machine learning, networking, mobile, developer tools, security, and enterprise applications.

**Android**: An open-source mobile operating system based on the Linux kernel and developed by Google.

**Application Programming Interface (API)**: A set of protocols, routines, and tools for building software applications that specify how software components should interact with each other.

**Application Server**: A software framework that provides an environment for running applications.

**Authentication**: The process of verifying the identity of a user.

**Biometric**: unique physical or behavioral characteristics of an individual to identify them.

**Bluetooth Low Energy (BLE)**: a wireless communication technology used for short-range communication between devices.

**Caregiver/Family Member**: Any person that is able to provide assistance with managing a dementia patient’s symptoms. Their duties consist of transporting patients to and from their commitments, maintaining a patient’s daily routine, and reminding them to take their medications at regular intervals.
**Continuous Integration (CI):** A software development practice that involves frequently integrating code changes from multiple developers into a shared repository, verifying that the changes do not break the build and that the software continues to function correctly.

**Containerization:** A method of packaging and deploying software applications with all their dependencies into a single unit, called a container, which can run reliably and consistently across different computing environments.

**Database Server:** A computer program or software application that provides database services to other computer programs or clients.

**Docker:** A software platform that allows its users to build, test, and deploy applications in standardized executables resembling containers.

**GeoTag:** A physical tag that emits a Bluetooth signal to assist devices in determining their location.

**GitHub:** An open-source repository service that allows its users to work on a single project simultaneously.

**Google Maps Geolocation API:** A service provided by Google that allows developers to determine the location of a device using Wi-Fi or mobile network signals.

**iOS:** A mobile operating system developed by Apple Inc based on the Unix operating system.

**Issue Tracking:** The process of managing and resolving software issues, bugs, and feature requests.

**JavaScript:** Scripting programming language that creates dynamic web page content and mobile
applications.

**JavaScript Object Notation (JSON):** A lightweight data interchange format that is easy for humans to read and write and easy for machines to parse and generate.

**Jest:** Test-runner for JavaScript applications that supports a JavaScript library for creating, running, and structuring tests.

**MongoDB:** Non-relational document database that provides support for non-relational querying.

**Node.js:** An open-source, cross-platform JavaScript runtime environment that enables the execution of server-side JavaScript code.

**Non-relational Database:** A type of database that doesn't rely on the traditional structure of tables, columns, and rows found in relational databases. Instead, they are designed to handle large and complex sets of unstructured, semi-structured, or structured data.

**Patient:** Any individual suffering from mild to moderate dementia. Their symptoms typically comprise of occasional disorientation, difficulties with making decisions, and short-term memory loss.

**PostgreSQL:** Free and open-source database management system that supports relational (SQL) and non-relational (JSON) querying.

**Programming Language:** A formal language used to communicate instructions to a computer or other machine.

**React:** An open-source JavaScript library that is used to build user interfaces for web and mobile applications.
Relational Database: A type of database that stores data in a structured format, using rows and columns to represent data entities and attributes.

Relational Database Management System (RDBMS): A software system that enables users to create, maintain, and manipulate relational databases.

Repository: A central location where digital files, usually in the form of software source code, are stored and managed.

Structured Query Language (SQL): A programming language used to manage and manipulate data in a relational database management system (RDBMS).

Testing Framework: A set of guidelines, standards, and tools that software developers use to create and run automated tests for their code.

Version Control: A system that tracks and manages changes to software code, documentation, and other files over time.
6 References


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harvard.edu/blog/whats-the-best-way-to-manage-agitation-related-to-dementia-20200214

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