



Intelligent Interfaces Project

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**Distribution of Work:**

The team members mutually agreed to distribute this project’s tasks as follows.

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| --- | --- |
| **Team Member** | **Tasks Assigned** |
| Michele Terribile | * The code was worked on by both of us as we met up and worked and helped each other using 1 laptop. * Report |
| Mike Angel Galea | * The code was worked on by both of us as we met up and worked and helped each other using 1 laptop. * Video Demo * Report |

**Elderly App**

**Introduction**

The Elderly Assistance App is a comprehensive mobile application developed using .NET MAUI in Visual Studio. The app is designed to address common challenges faced by elderly individuals, such as managing their appointments, keeping track of their medications, storing important contacts, and providing a speech-to-text feature to improve accessibility. By integrating these features into a single, user-friendly platform, the application aims to enhance the quality of life for senior citizens by promoting independence and organization.

**Problem Statement and Background**

With the rise in aging populations globally, many elderly individuals encounter significant obstacles in effectively managing their healthcare schedules. A major challenge they face is remembering essential medical appointments and medication doses. These difficulties are further exacerbated by common issues such as cognitive decline, general forgetfulness, and a lack of familiarity with modern digital tools. As a result, missed medication doses or medical appointments can lead to severe health complications, an increased likelihood of hospitalization, and an overall reduction in quality of life. Given these critical concerns, the development of this application is of utmost importance to support the daily lives of elderly individuals by providing them with an intuitive, reliable, and easy-to-use reminder system for their medical needs.

Our project is centered on creating a "Smart Medication and Appointment Reminder" system, specifically tailored for elderly users. The primary objectives guiding our development include prioritizing simplicity, ensuring ease of access, and integrating caregiver support to facilitate better healthcare management. As part of our iterative design process, we have refined our approach based on preliminary feedback from potential users and stakeholders. These refinements are focused on reducing the complexity of user interactions, enhancing customization options for reminders, and streamlining integration with commonly used digital tools. Key areas of improvement in our system include:

* **Automated, Personalized Emails:** To prevent missed appointments and medication intakes, our system provides automated and customizable notifications. Medical appointment reminders are scheduled to be sent one day in advance, ensuring that patients have ample time to make necessary travel arrangements or reschedule if needed. Additionally, a second reminder is sent an hour before the appointment to ensure timely attendance. Medication reminders are configured to alert users 10 minutes before the scheduled intake time, allowing for minor adjustments if necessary. To further enhance user experience, the medication reminder interval can be customized based on individual preferences, accommodating users who may need more flexibility.
* **Accessible User Interface (UI)**: the application is designed with elderly users in mind, prioritizing accessibility and ease of navigation. The interface features large, high-contrast fonts to improve readability, a straightforward and minimalistic layout to prevent confusion, and an intuitive navigation scheme that minimizes the number of steps required for task completion. This design approach ensures that elderly users, even those with minimal digital experience, can set up and adjust reminders with minimal effort. The goal is to create a seamless experience where users can effortlessly interact with the system without feeling overwhelmed by technological complexity.
* **Exploratory Voice Activation**: Recognizing that some elderly individuals may struggle with typing or manual interactions due to conditions such as arthritis or motor impairments, we are exploring the implementation of a voice-activated system. This feature would allow users to interact with the app through simple voice commands, making it easier to set reminders, check scheduled appointments, or retrieve stored information without needing to navigate menus manually. However, this functionality is still under development, and feasibility assessments are being conducted to evaluate the technical requirements and user reception. Future iterations will focus on optimizing voice recognition accuracy and ensuring the system is adaptable to different speech patterns and accents.

**Literature Review**

The use of digital technology to support elderly individuals in managing their daily healthcare routines has been widely explored in recent research. Studies indicate that aging populations face significant challenges related to medication adherence, appointment management, and accessibility to healthcare services. These challenges have led to the development of various assistive technologies aimed at improving the quality of life for elderly individuals. This literature review examines existing research on smart reminder systems, mobile health applications, and voice-assisted technologies, highlighting their effectiveness and potential areas for improvement.

**Smart Reminder Systems for Elderly Care**

One of the primary concerns for elderly individuals is medication non-adherence, which can lead to severe health complications. Studies by Vrijens et al. (2012) indicate that nearly 50% of patients do not take their medication as prescribed, leading to increased hospitalizations and worsening health conditions. To address this issue, researchers have developed various reminder systems that employ automated notifications via mobile applications, SMS, or smart devices (Mira et al., 2015). These systems have proven effective in enhancing adherence rates, particularly when integrated with digital calendars and caregiver support (Demiris et al., 2020).

Additionally, smart reminder systems often incorporate recurring reminders, allowing users to set up daily, weekly, or custom reminders tailored to their specific medical needs. Recent studies have shown that automated reminders can significantly improve medication adherence among elderly individuals, particularly when combined with caregiver interventions (Petersen et al., 2021). However, some elderly users still struggle with understanding or dismissing notifications, highlighting the need for further simplification of reminder mechanisms.

**Mobile Health Applications and Accessibility**

Mobile health (mHealth) applications have emerged as a viable solution for elderly healthcare management. These applications provide features such as appointment scheduling, medication reminders, and emergency contact storage (Dixon et al., 2018). Studies have emphasized the importance of user-friendly interfaces that cater to the specific needs of elderly individuals. Features such as high-contrast visuals, large fonts, and minimalistic designs have been shown to improve usability (Charness & Boot, 2016). Furthermore, integrating mHealth applications with widely used platforms, such as Google Calendar, has demonstrated increased engagement and better health outcomes (Kesselheim et al., 2018).

An important aspect of mHealth applications is their ability to integrate with wearable technology. Wearable devices such as smartwatches and fitness trackers have been found to be effective in monitoring vital signs, tracking medication intake, and sending emergency alerts (Roehrs et al., 2017). These devices offer an added layer of security for elderly individuals who may need immediate medical assistance. However, usability concerns persist, as some elderly users find these technologies difficult to navigate or maintain, requiring caregiver assistance for optimal use.

**Speech-to-Text and Voice-Assisted Technologies**

Voice-assisted technologies, such as Amazon Alexa and Google Assistant, have gained attention as potential solutions for elderly individuals who struggle with manual interactions due to conditions like arthritis or cognitive impairments (Pradhan et al., 2019). Research suggests that voice-activated reminders can enhance accessibility and ease of use for elderly individuals (Wilson et al., 2020). However, challenges such as speech recognition accuracy, adaptability to different accents, and background noise interference remain areas of ongoing research (Luperfoy et al., 2021).

Additionally, voice-assisted technology has been studied in the context of companionship and emotional support for elderly individuals living alone. AI-driven conversational agents can provide cognitive stimulation and social interaction, which are crucial for mental health and well-being (Broadbent et al., 2018). Future studies should focus on refining these systems to better recognize speech variations among elderly users and improve natural language processing capabilities.

**Integration of AI and Machine Learning in Elderly Assistance Apps**

Recent advancements in artificial intelligence (AI) and machine learning have opened new possibilities for personalized healthcare applications. AI-driven reminder systems can analyse user behaviour and optimize reminder schedules based on individual habits and preferences (Wang et al., 2021). Studies have demonstrated that AI-based interventions significantly improve medication adherence rates and reduce missed appointments (Agarwal et al., 2020). Future developments in AI-driven healthcare management will likely focus on predictive analytics, enabling proactive healthcare interventions.

Another promising area of AI integration is fall detection and prevention. AI-enabled applications can analyse movement patterns and detect anomalies that indicate a risk of falling (Delahoz & Labrador, 2014). Such features could be life-saving, particularly for elderly individuals who live alone and may not have immediate access to emergency services. While AI shows great potential, ethical considerations related to data privacy and user consent must be addressed to ensure widespread adoption.

**Challenges and Future Directions**

While smart reminder systems and assistive technologies have demonstrated significant potential, several challenges remain. Studies highlight concerns regarding data privacy, security, and user adaptability to digital tools (Bennett et al., 2022). Additionally, elderly individuals with cognitive impairments, such as dementia, may require caregiver assistance to effectively utilize these applications (Smith et al., 2019). Future research should focus on refining user interfaces, improving voice recognition capabilities, and integrating alternative communication methods, such as SMS-based reminders, to enhance accessibility.

Another critical challenge is technological literacy among elderly individuals. Studies have shown that many elderly users struggle with adopting new technologies due to a lack of familiarity and confidence in using digital tools (Heart & Kalderon, 2013). Educational programs and user training initiatives may be necessary to bridge this gap and ensure that elderly individuals can fully benefit from healthcare technologies.

**Conclusion**

The literature indicates that smart reminder systems, mHealth applications, and voice-assisted technologies play a crucial role in improving healthcare management for elderly individuals. Integrating these technologies with AI-driven personalization and caregiver support can further enhance their effectiveness. While existing systems have shown promising results, continued research is needed to address challenges related to usability, security, and accessibility. As technology continues to evolve, developing comprehensive, user-friendly solutions tailored to the needs of elderly individuals will remain a key focus in digital healthcare innovation. Future directions should emphasize the need for adaptable interfaces, enhanced voice recognition, and improved integration with other healthcare tools to ensure a seamless user experience. Additionally, policymakers and developers must work together to establish guidelines that ensure data privacy and ethical considerations in the deployment of healthcare technologies for elderly populations.

**Methodology**

The development of the Smart Reminder System followed a structured methodology to ensure a user-friendly and efficient solution tailored to the needs of elderly individuals. The methodology included requirement analysis, system design, implementation, testing, and refinement, focusing on accessibility, reliability, and seamless integration with external services.

**1. Requirement Analysis**

The initial phase involved gathering requirements to understand the specific challenges faced by elderly users. Research was conducted on common issues such as forgetfulness, difficulty navigating complex interfaces, and the need for timely reminders. User feedback was collected through discussions to refine the system’s functionality, particularly emphasizing ease of use, automated notifications, and caregiver support.

**2. Implementation**

The implementation phase involved coding and integrating key functionalities using .NET MAUI within Visual Studio. The development process followed an iterative approach to ensure continuous improvements based on user feedback. Key implementation details include:

* **Reminder Scheduling Module:** Users can input their medication and appointment schedules, and the system sends reminders at predefined intervals.
* **Google Calendar API Integration:** The system leverages the Google Calendar API to enable seamless synchronization of appointments. When a user schedules an appointment, the system automatically generates a calendar event and sends an invitation to the user via their registered email address. This ensures that users can access their reminders across multiple devices and receive notifications directly within their existing Google Calendar. The API integration was implemented using OAuth authentication to securely access and manage calendar events.
* **User Interface (UI):** A user-friendly interface was developed with accessibility features such as high-contrast colors, and minimalistic design elements. The UI allows users to easily navigate through the application, input reminder details, and adjust their settings without requiring extensive technical knowledge.
* **Voice Command Integration (Exploratory):** To further enhance accessibility, an experimental voice command feature was considered, allowing users to set reminders through speech input. This feature aims to provide an alternative interaction method for users with mobility impairments.

**4. Testing and Refinement**

The system underwent multiple testing phases to ensure reliability and accuracy. Testing procedures included:

* **Unit Testing:** Individual modules were tested to verify their functionality.
* **Integration Testing:** The interaction between the reminder module and Google Calendar API was tested to ensure smooth synchronization.
* **Performance Testing:** The system was evaluated for its responsiveness and stability, ensuring minimal delays in sending reminders and syncing calendar events.

**5. Future Improvements**

Future iterations of the system will focus on:

* Enhancing voice recognition capabilities to support a broader range of accents and languages.
* Implementing AI-driven personalization features to optimize reminder schedules based on user habits.
* Expanding integration options to support additional calendar platforms beyond Google Calendar.
* Integrating reminders through SMS text message.
* Strengthening security measures to ensure data privacy and protection.

The Smart Reminder System provides an efficient and accessible solution to help elderly users manage their medication schedules and appointments with ease, ultimately improving adherence to healthcare routines and enhancing their quality of life.

A screenshot of a computer

Description automatically generated

*Figure 1: Entering email address on app.*

A screenshot of a contact form

Description automatically generated

*Figure 2: Proof of Email.*

**System Architecture**

The architecture of our Smart Reminder System is designed to provide seamless integration between various modules, ensuring that elderly users can easily manage their medication schedules and appointments without unnecessary complexity. The system architecture is structured to be both scalable and user-friendly, incorporating essential components that facilitate smooth operation and interaction. Each module has been developed with simplicity and efficiency in mind while maintaining high reliability and accessibility for elderly users. The primary components of the architecture include the following:

* Reminder Scheduling Module:
  + This module is responsible for handling all reminder notifications related to medication intake and medical appointments.
  + It provides customizable intervals for each notification, ensuring flexibility to accommodate individual user preferences.
  + Users or caregivers can input reminder details through the interface, and the system schedules notifications accordingly.
  + The module also supports recurring reminders, allowing users to set up daily, weekly, or custom reminders for long-term medication adherence.
  + Email notifications are integrated within this module to ensure that reminders reach users through multiple channels, enhancing reliability.
* Calendar Synchronization Module:
  + The system is integrated with Google Calendar’s API to facilitate automatic synchronization of scheduled appointments and medication reminders.
  + Users can manage appointment times, set up recurring reminders, and receive real-time automated updates without needing manual adjustments.
  + This module allows caregivers to modify schedules on behalf of elderly users, ensuring that updates are properly reflected in their Google Calendar.
  + The synchronization process ensures that reminders remain accessible across multiple devices, preventing scheduling conflicts and improving adherence.
* User Interface (UI) Module:
  + The UI has been developed with a strong focus on accessibility, taking into account the specific needs of elderly users.
  + It features large, high-contrast buttons for improved visibility, intuitive iconography for easy comprehension, and minimal input requirements to reduce cognitive load.
  + The navigation system has been designed to be simple and direct, allowing users to set up, modify, or remove reminders without encountering unnecessary complexity.
  + The interface is optimized to provide a smooth and frustration-free experience for users who may not be familiar with digital tools, ensuring inclusivity.
* Voice Command Integration (Exploratory):

May I note this feature was not added but is just an idea to make the app better.

* + As an advanced feature, voice command capabilities are being explored to enable hands-free interaction with the system.
  + This module would allow users to set reminders, check their schedule, and modify existing entries using voice commands, making the system more accessible for those with motor impairments or visual difficulties.
  + The feasibility of implementing this feature is being assessed based on technical constraints and user feedback.
  + Future updates will focus on refining speech recognition accuracy and ensuring compatibility with different accents and languages.

Overall, the system architecture is designed with a user-centered approach, ensuring that all modules work cohesively to enhance the experience of elderly users. The modular design allows for future expansions and improvements, enabling additional features to be seamlessly incorporated as technology advances and user needs evolve.

**Discussion**

As we continued working on the program and received feedback, it became evident that the system would likely be more beneficial for elderly carers rather than elderly individuals themselves. A similar system could also be adapted by hospitals and carers for tracking elderly appointments and medication, as these are currently recorded on paper, which can be inefficient and prone to errors. While the system could be used directly by elderly individuals, those with conditions such as dementia might find it challenging to navigate. This highlights the need for a more user-friendly interface or caregiver-assisted access to ensure its effectiveness in supporting elderly care.

**Conclusion**

The development of the Elderly Assistance App has demonstrated its potential in improving healthcare management for elderly individuals, particularly through its medication and appointment reminder system. By integrating key features such as **Google Calendar synchronization, automated notifications, and an accessible user interface**, the application provides an efficient and user-friendly solution to address common challenges faced by the elderly. Through testing and feedback, it was observed that while the system could support elderly users, it is particularly beneficial for carers and healthcare providers who assist them in managing their daily schedules. Additionally, there is scope for further enhancements, including voice command integration, AI-driven personalization, and SMS-based reminders, which could improve accessibility and usability. Future iterations should also focus on refining the interface to accommodate users with cognitive impairments, such as dementia, ensuring wider applicability and inclusivity. Ultimately, this project contributes to the broader effort of leveraging technology to enhance the quality of life and independence of elderly individuals while also supporting caregivers in their essential roles.

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