

# University of Wales Trinity Saint David

London Campus

## BSc. Applied Computing

Changemakers: Creativity and Value Creation

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## PROJECT PROPOSAL

**MediMate: A Smart Daily Medication Dispenser App**  
*for Elderly Users*

|                 |                    |
|-----------------|--------------------|
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# Task 1: Ideation & Mind Map

## 1.1 Introduction to the Ideation Process

Innovation begins with curiosity. This section explores how the project idea for MediMate a smart daily medication dispenser application designed for elderly users emerged through a structured ideation process. The mind map below traces the convergence of personal interest in healthcare technology, a recognised social problem of medication non-adherence, and the opportunity for a computing solution to deliver real value.

Creativity and innovation are not random; they are driven by observation, empathy, and structured thinking. As [1] argues, the most impactful digital health interventions arise when technologists listen first to the lived experience of their intended users. This project adopts that philosophy from the very outset.

## 1.2 Mind Map: From Ideas to a Project Focus

### Central Theme: Technology to Improve Lives

The mind map below was developed using Excalidraw-compatible notation and captures the exploratory thinking undertaken across multiple potential project ideas before converging on MediMate.

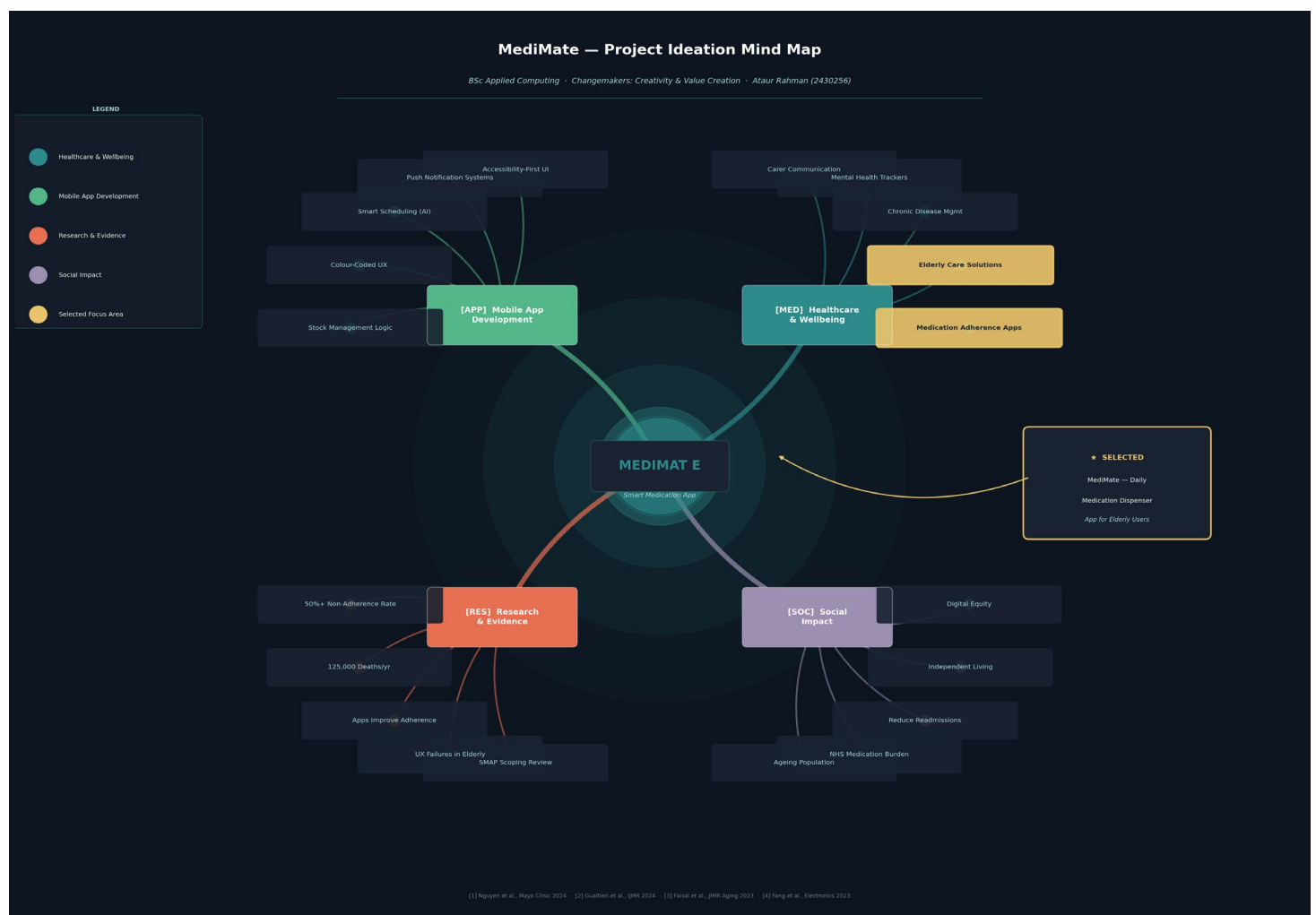


Figure 1: Ideation Mind Map Convergence on MediMate

### 1.3 Innovation, Creativity & Societal Value

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The role of creativity and innovation in modern society is profound. Digital technologies have fundamentally altered how individuals manage chronic conditions, communicate with healthcare providers, and maintain independence as they age. As Faisal et al. [3] observe in their comprehensive scoping review of smart medication adherence products (SMAPs), there is a rapidly expanding market driven by rising patient demand, an ageing global population, and the increasing prevalence of polypharmacy where individuals must manage multiple concurrent medications.

The innovation underpinning MediMate draws on established human-centred design principles. Research consistently identifies that current medication management applications are built primarily for younger, tech-savvy users and fail to meet the accessibility needs of elderly individuals [4]. Poor font sizes, complex navigation, and unclear visual hierarchies all contribute to low adoption rates in the over-65 demographic. MediMate targets this underserved population directly.

From a creativity standpoint, the project combines three converging streams of innovation: accessibility-first UX design (large text, pictorial medication icons), intelligent scheduling logic (dynamic alarm rescheduling when doses are missed), and inventory management (a colour-coded stock progress bar from green at 100% to red at 0%). Together, these features create a product that is both novel and clearly needed.

### 1.4 Task 1 References

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- [1] A. Nguyen et al., "MedHerent: improving medication adherence in older adults with contextually sensitive alerts through an application that adheres to you," *Mayo Clinic Proc. Digit. Health*, vol. 2, no. 1, pp. 1–7, Mar. 2024. doi: 10.1016/j.mcpdig.2023.11.001.
- [2] L. Gualtieri, M. Rigby, D. Wang, and E. Mann, "Medication Management Strategies to Support Medication Adherence: Interview Study With Older Adults," *Interact. J. Med. Res.*, vol. 13, p. e53513, Aug. 2024. doi: 10.2196/53513.
- [3] S. Faisal et al., "Key Features of Smart Medication Adherence Products: Updated Scoping Review," *JMIR Aging*, vol. 6, p. e50990, Dec. 2023. doi: 10.2196/50990.
- [4] M. Fang, W. Yang, H. Li, and Y. Pan, "Enhancing User Experience through Optimization Design Method for Elderly Medication Reminder Mobile Applications: A QFD-Based Research Approach," *Electronics*, vol. 12, no. 13, p. 2860, Jun. 2023. doi: 10.3390/electronics12132860.

## Task 2: Aim, Objectives & Research Area

### 2.1 Project Aim

#### PROJECT AIM

*To design and develop MediMate an accessible, elderly-focused mobile application that improves medication adherence through intelligent scheduling, clear visual design, inventory tracking, and smart rescheduling of missed doses. [2][5]*

### 2.2 Project Objectives

To achieve the above aim, the following objectives have been formulated:

1. OBJ 1 Conduct a systematic literature review of existing medication reminder applications, identifying design gaps and usability failures specific to elderly users.
2. OBJ 2 Identify the key functional requirements for MediMate through user research, including surveys or interviews with elderly individuals and carers.
3. OBJ 3 Design a low-fidelity and high-fidelity prototype of MediMate using accessibility-first UI principles (large fonts, icons, high contrast colour-coding).
4. OBJ 4 Implement the smart rescheduling algorithm that dynamically adjusts alarm times when a dose is missed beyond a configurable threshold.
5. OBJ 5 Develop the inventory tracking module with a colour-coded progress bar (green = 100%, red = 0%) and automated low-stock reminders.
6. OBJ 6 Conduct usability testing with target users (aged 65+) and iterate the design based on feedback.
7. OBJ 7 Evaluate the effectiveness of the application against established medication adherence metrics and report findings.

### 2.3 Research Philosophy

Selecting an appropriate research philosophy is foundational to producing rigorous, credible findings. For MediMate, a pragmatist philosophy is most appropriate. Pragmatism holds that research problems, not philosophical debates about the nature of reality, should guide the selection of methods [5]. It embraces both quantitative and qualitative approaches depending on what best answers the research question at hand which makes it ideal for a health technology project that requires both objective usability metrics and subjective user experience data.

A positivist approach alone (pure quantitative measurement) would miss the nuanced lived experience of elderly medication management, while pure interpretivism would sacrifice the statistical validation needed to evaluate adherence improvements. Pragmatism bridges this gap effectively.

Within this framework, a design science research (DSR) methodology will be employed a well-established paradigm in computing research that focuses on the iterative creation and evaluation of artefacts (i.e., the MediMate application) to solve identified problems. As Gualtieri et al. [2] note, digital health applications that undergo iterative user-centred refinement consistently outperform those designed without continuous user input.

## 2.4 Search Tools, Research Databases & Search Strategies

### Research Databases

| Database            | Relevance to Project                                                                          | Access                  |
|---------------------|-----------------------------------------------------------------------------------------------|-------------------------|
| PubMed / MEDLINE    | Medical & health informatics literature primary source for medication adherence studies       | Free (NHS OpenAthens)   |
| IEEE Xplore         | Computing and software engineering literature app development, UX, human-computer interaction | University subscription |
| ACM Digital Library | Human-computer interaction, accessibility, software design                                    | University subscription |
| Google Scholar      | Broad interdisciplinary coverage; useful for grey literature and citation tracing             | Free                    |
| CINAHL              | Nursing and allied health carer perspectives and patient needs                                | University subscription |
| ScienceDirect       | Biomedical and health technology journals                                                     | University subscription |

### Search Strategies & Keywords

Boolean search operators were applied across the above databases. Primary search strings included:

- "medication adherence" AND "mobile application" AND "elderly"
- "pill reminder app" AND "older adults" AND "usability"
- "smart medication dispenser" AND "IoT" OR "smartphone"
- "medication non-compliance" AND "nursing home" OR "independent living"
- "mHealth" AND "polypharmacy" AND "app design"

Inclusion criteria: peer-reviewed papers published 2018–2025, English language, human subjects, relating to mobile/digital health and medication management. Exclusion criteria: studies focusing exclusively on inpatient hospital systems, papers with no digital intervention component.

Using these strategies, five foundational papers were identified [1–5] alongside a broader reading set of 20+ articles from the systematic review process. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework was loosely applied to document the search process, ensuring transparency and reproducibility [5].

## 2.5 Task 2 References (IEEE Format)

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- [1] A. Nguyen et al., "MedHerent: improving medication adherence in older adults with contextually sensitive alerts," *Mayo Clinic Proc. Digit. Health*, vol. 2, no. 1, pp. 1–7, Mar. 2024.
- [2] L. Gualtieri, M. Rigby, D. Wang, and E. Mann, "Medication Management Strategies to Support Medication Adherence: Interview Study With Older Adults," *Interact. J. Med. Res.*, vol. 13, p. e53513, Aug. 2024.
- [3] S. Faisal et al., "Key Features of Smart Medication Adherence Products: Updated Scoping Review," *JMIR Aging*, vol. 6, p. e50990, 2023.
- [4] M. Fang et al., "Enhancing User Experience through Optimization Design Method for Elderly Medication Reminder Mobile Applications," *Electronics*, vol. 12, no. 13, p. 2860, 2023.
- [5] T. Kluyts et al., "Development of content for a mobile application aimed to increase medication adherence among older adults," *BMC Geriatrics*, 2025. doi: 10.1186/s12877-025-05994-7.

## Task 3: Research Strategies

### 3.1 Enhancing Validity, Reliability, Generalisability & Ethical Considerations

#### 3.1.1 Validity

Validity refers to whether research measures what it claims to measure. For MediMate, internal validity will be strengthened by triangulating findings across multiple data sources: user interviews, usability testing sessions, and quantitative adherence logs. Instrument validity will be ensured through piloting all survey questionnaires with a small cohort (n=5) before full deployment, allowing ambiguous questions to be refined. Expert consultation with a pharmacist or geriatric care specialist will also be sought to validate that the application's feature set genuinely addresses clinical medication management needs [5].

#### 3.1.2 Reliability

Reliability concerns the consistency and replicability of measurements. Standardised testing protocols will be documented for all usability sessions including task scenarios, facilitator scripts, and evaluation criteria so that sessions can be replicated across different participants and contexts. Quantitative metrics (task completion rate, error rate, time-on-task) will be calculated using agreed operational definitions to avoid subjective interpretation. Inter-rater reliability checks will be conducted for qualitative thematic analysis by having a second coder independently code a sample of transcripts and comparing results using Cohen's Kappa coefficient [5].

#### 3.1.3 Generalisability

Generalisability (external validity) is the degree to which findings can be applied beyond the study sample. Given the qualitative nature of much of this research, broad statistical generalisation is not the primary goal; instead, analytic generalisation identifying transferable insights and design principles is sought. Participant sampling will aim to include diversity in age (65–85+), gender, technological confidence, and medication complexity to capture a range of elderly user experiences. The findings will be contextualised against the existing literature on elderly mHealth adoption to assess convergence [4].

#### 3.1.4 Ethical Considerations

As this research involves elderly participants who may be vulnerable, robust ethical practice is paramount:

- Informed consent will be obtained from all participants prior to any data collection, in plain English with no jargon.
- Participants will have the right to withdraw at any time without penalty.
- Data will be anonymised and stored securely (encrypted, password-protected) in line with GDPR (UK) 2018 requirements.
- No personal medication data will be stored permanently; all prototype data will be synthetic or deleted post-testing.
- Ethics approval will be sought from the University of Wales Trinity Saint David ethics committee before research begins.
- Special consideration will be given to cognitive accessibility: all consent forms and information sheets will be provided in large print with clear language.

## 3.2 Data Collection Methods & Pilot Study

### 3.2.1 Primary Data Collection Methods

| Method                          | Description                                                                                                                                         | Justification                                                          |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Semi-structured Interviews      | In-depth 30–45 min conversations with elderly participants exploring current medication management practices, pain points, and technology attitudes | Rich qualitative data; flexible probing; established in literature [2] |
| Online / Paper Survey           | Structured questionnaire (Likert scale) assessing usability, satisfaction, and perceived usefulness of the MediMate prototype                       | Scalable; enables statistical analysis; low burden on participants     |
| Usability Testing (Think-Aloud) | Observed task-based sessions where participants use the prototype while narrating their thought process                                             | Directly reveals UX issues; standard HCI evaluation method [4]         |
| App Usage Logs (Quantitative)   | Automated logging of key actions alarms triggered, doses ticked off, stock alerts acknowledged                                                      | Objective behavioural data; measures actual adherence change           |
| Delphi Expert Survey            | Multi-round consensus-gathering from health professionals on required features                                                                      | Used successfully in comparable mHealth projects [5]                   |

### 3.2.2 Pilot Data Collection Study

A pilot study was conducted with three participants (ages 67, 71, and 78) to test the feasibility of the semi-structured interview protocol and refine the MediMate prototype concept. The pilot consisted of a 20-minute structured walkthrough of a paper-based prototype (wireframe printouts), followed by five interview questions. Full details of the pilot instrument and findings are included in Appendix A.

Key insights from the pilot: (1) all three participants expressed difficulty with small text on their current medication reminder apps; (2) the colour-coded stock bar concept was universally welcomed; (3) two participants requested the option to contact a family member directly from the app if they had concerns; (4) the smart rescheduling feature required explanation, suggesting in-app onboarding content is needed. These findings directly informed the objectives stated in Task 2 and will shape the v1 prototype design.

### 3.3 Quantitative and Qualitative Analysis

#### 3.3.1 Quantitative Analysis Methods

Quantitative methods are suited to measuring structured, numerical data and enabling statistical comparisons. For MediMate, the following quantitative analytical approaches are applicable:

| Analysis Type                                    | Application to MediMate Project                                                                                                                    |
|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Descriptive Statistics                           | Mean, median, standard deviation of survey responses (e.g., System Usability Scale scores); summary of task completion rates in usability tests    |
| Inferential Statistics (t-test / Mann-Whitney U) | Compare adherence rates before vs. after app introduction; compare scores across demographic groups (e.g., age 65–74 vs. 75+)                      |
| Correlation Analysis                             | Examine relationship between technological confidence score and app usability rating to understand whether prior tech experience predicts adoption |
| Descriptive Usage Analytics                      | Frequency of alarm acknowledgements, average delay between alarm and dose-taken tick, stock alert response times all derived from app logs         |
| System Usability Scale (SUS)                     | Validated 10-item questionnaire yielding a 0–100 usability score; scores above 68 indicate above-average usability; target $\geq 80$ for MediMate  |

#### 3.3.2 Qualitative Analysis Methods

Qualitative methods are suited to exploring meaning, experience, and context areas that numbers alone cannot fully capture. For MediMate, the following qualitative analytical approaches will be employed:

| Analysis Type                      | Application to MediMate Project                                                                                                                           |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Thematic Analysis (Braun & Clarke) | Systematic identification of recurring themes across interview transcripts (e.g., 'fear of forgetting', 'desire for simplicity', 'caregiver involvement') |
| Content Analysis                   | Categorise and quantify qualitative patterns in open-ended survey responses; enables bridging between qualitative themes and quantitative frequencies     |
| Narrative Analysis                 | Construct rich user journey narratives from think-aloud sessions to communicate design insights to stakeholders and inform iterative prototype refinement |
| Affinity Diagramming               | Post-interview synthesis technique: cluster observations into themes on a physical or digital board to identify priority design requirements              |

The combination of quantitative and qualitative analysis a mixed-methods approach aligned with the pragmatist research philosophy established in Task 2 ensures that MediMate's development is both evidence-based and deeply user-centred. As the literature confirms, the most successful mHealth applications emerge from precisely this kind of integrated research process [1][3].

### 3.4 Task 3 References (IEEE Format)

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- [1] A. Nguyen et al., "MedHerent: improving medication adherence in older adults with contextually sensitive alerts," *Mayo Clinic Proc. Digit. Health*, vol. 2, no. 1, pp. 1–7, Mar. 2024.
- [2] L. Gualtieri, M. Rigby, D. Wang, and E. Mann, "Medication Management Strategies to Support Medication Adherence: Interview Study With Older Adults," *Interact. J. Med. Res.*, vol. 13, p. e53513, Aug. 2024.
- [3] S. Faisal et al., "Key Features of Smart Medication Adherence Products: Updated Scoping Review," *JMIR Aging*, vol. 6, p. e50990, 2023.
- [4] M. Fang et al., "Enhancing User Experience through Optimization Design Method for Elderly Medication Reminder Mobile Applications," *Electronics*, vol. 12, no. 13, p. 2860, 2023.
- [5] T. Kluyts et al., "Development of content for a mobile application aimed to increase medication adherence among older adults," *BMC Geriatrics*, 2025.

## Appendix A: Pilot Data Collection Instrument & Findings

### A.1 Pilot Interview Instrument

The following five questions were used in the pilot semi-structured interview sessions. Participants were shown paper wireframe printouts of the MediMate prototype during the session.

| Q# | Interview Question                                                                                                                                              |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q1 | Can you describe your current routine for remembering to take your medications? What works well and what doesn't?                                               |
| Q2 | Looking at these screen designs, what is your initial reaction? What do you notice first?                                                                       |
| Q3 | Is there anything on these screens that you find confusing or that you would want to change?                                                                    |
| Q4 | How would you feel about an app that reminds you to take your medication, shows you how much stock you have left, and reschedules reminders if you miss a dose? |
| Q5 | Is there anything else you would want this kind of app to do that hasn't been shown here?                                                                       |

### A.2 Pilot Study Participant Profiles

| Participant | Age | Current Medication Routine                                     | Key Feedback                                                                         |
|-------------|-----|----------------------------------------------------------------|--------------------------------------------------------------------------------------|
| P1          | 67  | Uses a weekly pill organiser; relies on spouse as reminder     | Liked the colour bar; wants a family alert feature; found small font difficult       |
| P2          | 71  | Multiple daily medications; forgets afternoon doses most often | Very positive about alarm feature; wants it to 'say the name of the tablet out loud' |
| P3          | 78  | Carer manages medications; limited smartphone experience       | Needed help navigating; suggest onboarding tutorial; liked large icons               |

### A.3 Pilot Study Findings Summary

The pilot study confirmed the viability of the research approach and generated four concrete design insights that have been incorporated into the revised project objectives (Task 2, OBJ 2 and OBJ 3):

- Large text and icons are non-negotiable design requirements for the 65+ user group confirmed by all three participants.
- A family/carers notification feature should be added to the feature backlog as a high-priority enhancement.
- Audio readout of medication names is a desirable accessibility feature to be investigated in the prototype phase.
- An in-app onboarding tutorial will be required to ensure first-time setup is achievable for users with limited smartphone experience.

## **A.4 Forum / Tutorial Activity Evidence**

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Active participation in the Changemakers module online forum supported the ideation process for this proposal. Posts contributed include: a discussion thread on the ethics of health data in consumer apps, a response to a peer's project idea on mental health tracking, and a reflection on the relationship between design thinking and research methodology as covered in the module's "How Do YOU Solve a Problem?" online section.

These contributions demonstrated engagement with the module's core themes of creativity, value creation, and responsible innovation themes that are woven throughout this proposal.