## **Research Paper: User-Centric Design of a Low-Fidelity Prototype for an Offline AI Companion and Safety Assistant for Elderly and Special Needs Individuals in Bangladesh**

### **Abstract**

This paper presents the user-centered design process leading to a low-fidelity prototype for a mobile application aimed at providing offline AI companionship and safety assistance to elderly and special needs individuals in Bangladesh. Grounded in insights from a survey involving 28 participants, this research identifies critical user needs related to loneliness, communication preferences, technology comfort, and safety concerns. The resulting low-fidelity prototype emphasizes a minimalist, voice-first interface, ensuring accessibility, Bengali language support, and robust offline functionality to address the unique challenges of the target demographic. This paper details the design rationale, key user flows, and visual elements of the prototype, outlining its potential to bridge existing gaps in social interaction and personal security.

### **1. Introduction**

The global rise in the elderly population and the specific vulnerabilities of individuals with special needs necessitate innovative technological solutions. In Bangladesh, these demographics often face particular challenges, including social isolation, limited digital literacy, and inconsistent internet access. Existing digital solutions frequently fall short by requiring constant online connectivity or complex interactions, thus excluding a significant portion of those who could benefit most. Loneliness, coupled with concerns about personal safety in emergencies, represents a critical unmet need.

This research addresses these challenges by proposing a novel, **offline-first, AI-powered mobile application**. The primary contribution of this paper is the **conceptualization and detailed description of a low-fidelity prototype** for such an application. This prototype is not an arbitrary design; it is directly informed by a rigorous user needs assessment conducted through a survey with 28 participants from Bangladesh. The paper first summarizes key findings from this user study and then extensively details the design rationale and interactive elements of the proposed low-fidelity prototype, demonstrating how user-centric insights translate into practical design solutions.

### **2. Related Work / Literature Review**

(This section would synthesize the key findings from your earlier literature review, which covered:

* **HCI Principles for Elderly and Special Needs Populations:** Emphasizing large fonts, high contrast, simple navigation, intuitive interaction methods (e.g., voice), and user-centered design.
* **Offline AI and On-Device NLP:** Discussing the feasibility of lightweight models for speech-to-text (STT) and text-to-speech (TTS) on mobile devices, and the privacy/latency benefits of offline processing for rural or low-connectivity areas.
* **Digital Health and Elderly Care Initiatives in Bangladesh:** Highlighting existing mobile health efforts, the prevalent digital divide, and the importance of accessible mobile solutions for improving well-being.
* **Bengali Language (Bangla) STT and TTS Development:** Acknowledging the availability of resources and open-source models for localized speech processing, which makes a Bengali-first AI feasible.)

### **3. Methodology**

This study followed a user-centered design approach, with an initial user needs assessment phase directly informing the low-fidelity prototype development.

#### **3.1. Research Questions Addressed by the Survey**

The survey aimed to answer the following questions to gather foundational data for the prototype design:

1. What are the daily social interaction patterns and the extent of perceived loneliness among the target users?
2. What is their current mobile technology usage, comfort level with new apps, and preferred interaction methods?
3. What are their primary safety concerns and existing methods for seeking emergency help?
4. What are their attitudes towards an AI companion, and what are their preferences regarding language and crucial features like offline functionality?

#### **3.2. Participants and Data Collection**

A total of **28 individuals** participated in the survey, primarily elderly individuals residing in Bangladesh, recruited through a university network. Data was collected using a Google Forms questionnaire, carefully designed with both English and Bengali translations and incorporating branching logic for specific follow-up questions. This ensured comprehensive data collection across demographics, daily life, technology habits, safety perceptions, and initial reactions to the app concept.

#### **3.3. Data Analysis for Design Insights**

Quantitative survey responses were analyzed using descriptive statistics (frequencies, percentages) to identify trends in user behavior and preferences. Qualitative data from multi-select options and open-ended comments were analyzed thematically to extract underlying needs, pain points, and specific feature suggestions. This synthesis directly informed the design principles and feature set of the low-fidelity prototype.

### **4. Key User Needs & Insights Driving Design**

The survey results revealed several critical insights that directly shaped the design of the low-fidelity prototype:

* **Pervasive Loneliness:** Despite many respondents living with family and reporting frequent daily interactions, a significant **57.2%** reported feeling lonely "often" or "sometimes." This highlights a qualitative gap in companionship that an AI could potentially address. Users enjoy "general chit-chat," "personal stories," and "daily news," making conversational AI a suitable avenue.
* **High Safety Concerns:** An overwhelming **96.5%** of respondents expressed worry about emergencies when alone, and nearly all (96.4%) rely solely on family for immediate help. This underscores the critical need for an accessible and reliable emergency alert system.
* **High Mobile Penetration, Moderate Comfort:** While 96.4% use mobile phones (mostly smartphones), comfort with *new* apps is moderate. This implies that the interface must be extremely simple and intuitive, leveraging existing familiarity with basic phone functions.
* **Crucial Offline Functionality:** **100%** of respondents rated offline functionality as "important" or "very important." This is a foundational requirement, validating the core technical premise of the app.
* **Overwhelming Bengali Preference & Voice Interaction:** 60.7% preferred Bengali, and 35.7% preferred both. A qualitative comment explicitly requested voice interaction instead of typing. This strongly advocates for a Bengali-first, voice-controlled interface.
* **Acceptance of Monitoring:** A high 82.2% were comfortable with movement monitoring for safety, indicating a willingness to accept such features for perceived benefit, provided trust is established.

These insights form the bedrock upon which the low-fidelity prototype is built, ensuring that every design decision directly addresses an identified user need.

### **5. Low-Fidelity Prototype: Design & Rationale**

A low-fidelity prototype, in this context, refers to paper sketches or very basic digital wireframes that visualize the core user flows and interface elements without intricate details or full interactivity. Its purpose is to quickly test fundamental concepts and gather early feedback on usability and desirability. The design prioritizes simplicity, directness, and adherence to accessibility principles for the target demographic.

#### **5.1. Design Principles for the Low-Fidelity Prototype**

Based on the survey findings and general HCI guidelines for elderly users, the following principles guided the prototype design:

* **Voice-First Interaction (Bengali):** Given the strong preference for Bengali and the desire for verbal interaction, the primary mode of communication is voice input and output.
* **Minimalist Interface:** Reduce cognitive load by showing only essential elements on screen, avoiding clutter.
* **Large, High-Contrast Elements:** Ensure readability and easy tap targets for visual and motor accessibility.
* **Direct Access to Core Features:** Critical functions (e.g., emergency call) should be immediately visible and require minimal steps to activate.
* **Offline Functionality:** The core companionship and basic safety features must operate without an internet connection.
* **Trust and Privacy (Conceptual):** While not visually represented in low-fi, the design assumes clear communication about monitoring and data use.

#### **5.2. Core User Flows & Interactions (Descriptive Walkthrough)**

Imagine the prototype as a series of large, simple paper cards or basic wireframes on a screen.

**5.2.1. Initial Setup / First Launch (Simple & Guided)**

### **Design Principles for Setup**

* **Zero Assumptions**: Assume users have never used a similar app
* **Audio-First Guidance**: Every visual element has audio counterpart
* **Family-Assisted Setup**: Designed for potential caregiver assistance
* **Cultural Sensitivity**: Appropriate greetings and explanations
* **Error Prevention**: Clear validation and helpful error messages

### **Screen 1: Welcome & Audio Introduction**

**Visual Elements:**

* **App Logo**: Simple, recognizable icon with "নীরব বন্ধু" in large, clear Bengali font (36pt)
* **Main Greeting**: "আসসালামু আলাইকুম! স্বাগতম!" (Peace be upon you! Welcome!)
* **Subtitle**: "আমি আপনার নীরব বন্ধু, সবসময় আপনার পাশে থাকব।" (I am your Nirob Bondhu, I will always be by your side.)
* **Large Start Button**: "শুরু করুন" (Start) - 80dp height, high contrast

**Audio Features:**

* **Automatic Welcome**: Plays immediately upon app launch
  + "আসসালামু আলাইকুম! আমি আপনার নীরব বন্ধু। আমি আপনাকে সাহায্য করব এবং আপনার সাথে কথা বলব। শুরু করতে নিচের বোতামে টিপুন।"
  + (Peace be upon you! I am your Nirob Bondhu. I will help you and talk with you. Tap the button below to start.)

**Accessibility Features:**

* **Audio Repeat Button**: "আবার শুনুন" (Listen Again) - small button with speaker icon
* **Volume Slider**: Clearly labeled "আওয়াজের মাত্রা" (Volume Level)
* **Large Text Toggle**: "বড় লেখা" (Large Text) option
* **Help Button**: Links to audio tutorial: "এই অ্যাপ কীভাবে ব্যবহার করবেন" (How to use this app)

**User Support Elements:**

* **Family Helper Mode**: Small button "পরিবারের সাহায্য" (Family Help) - provides setup instructions for caregivers
* **Language Confirmation**: "ভাষা: বাংলা ✓" (Language: Bengali ✓) - shows current language with option to change
* **Progress Indicator**: "ধাপ ১/৩" (Step 1/3)

### **Screen 2: Caregiver Contact Setup (Enhanced)**

**Header & Context:**

* **Title**: "নিরাপত্তার জন্য পারিবারিক যোগাযোগ" (Family Contact for Safety)
* **Explanation**: "জরুরি অবস্থায় আমি কাকে কল করব?" (Who should I call in emergencies?)
* **Reassurance**: "আপনার তথ্য সম্পূর্ণ নিরাপদ এবং শুধুমাত্র জরুরি অবস্থায় ব্যবহৃত হবে।" (Your information is completely safe and will only be used in emergencies.)

**Audio Guidance:**

* Automatic explanation: "এখন আমাকে বলুন কোন নম্বরে জরুরি অবস্থায় কল করতে হবে। এটি আপনার পরিবারের কোনো সদস্য বা বিশ্বস্ত ব্যক্তির নম্বর হওয়া উচিত।" (Now tell me which number to call in emergencies. This should be a family member or trusted person's number.)

**Input Design:**

* **Large Input Field**:
  + Label: "পারিবারিক যোগাযোগের নম্বর" (Family Contact Number)
  + Placeholder: "উদাহরণ: ০১৭১২৩৪৫৬১৮" (Example: 01712345618)
  + Helper text: "১১ সংখ্যার মোবাইল নম্বর লিখুন" (Enter 11-digit mobile number)
* **Contact Name Field**:
  + Label: "এই ব্যক্তির নাম" (This person's name)
  + Placeholder: "উদাহরণ: আমার ছেলে রহিম" (Example: My son Rahim)

**Validation & Error Handling:**

* **Real-time Validation**: Green checkmark appears when valid number entered
* **Error Messages**: Clear, helpful Bengali messages
  + "অনুগ্রহ করে সঠিক ১১ সংখ্যার নম্বর দিন" (Please enter correct 11-digit number)
  + "এই নম্বরটি সঠিক নয়" (This number is not correct)

**Additional Features:**

* **Test Call Option**: "নম্বরটি চেক করুন" (Test this number) - optional verification call
* **Multiple Contacts**: "আরেকটি নম্বর যোগ করুন" (Add another number) - for backup contact
* **Voice Input**: "কথা বলে নম্বর দিন" (Say the number aloud) - speech-to-text for number entry

**Buttons:**

* **Save**: "সংরক্ষণ করুন" (Save) - only enabled when valid input provided
* **Skip for Now**: "এখনের জন্য বাদ দিন" (Skip for now) - but shows warning about reduced emergency functionality
* **Help**: "সাহায্য" (Help) - explains why this information is needed

### **Screen 3: Permissions Setup (Enhanced & Educational)**

**Header & Trust Building:**

* **Title**: "আপনার নিরাপত্তার জন্য অনুমতি" (Permissions for Your Safety)
* **Subtitle**: "এই সুবিধাগুলো আপনাকে আরও ভাল সাহায্য করতে সাহায্য করবে" (These features will help serve you better)

**Permission 1: Microphone (Enhanced)**

* **Icon**: Large microphone symbol with sound waves
* **Title**: "কথা শোনার অনুমতি" (Permission to Listen)
* **Explanation**:
  + Primary: "আপনার কথা শুনে সাহায্য করার জন্য" (To help by listening to your words)
  + Details: "যেমন: 'সাহায্য' বললে জরুরি কল, আপনার প্রশ্নের উত্তর দেওয়া" (Like: emergency call when you say 'help', answering your questions)
* **Privacy Note**: "আপনার কোনো কথা রেকর্ড বা সংরক্ষণ করা হবে না" (None of your conversations will be recorded or stored)
* **Toggle**: Large, clear On/Off switch with "হ্যাঁ/না" (Yes/No) labels

**Permission 2: Movement Detection (Enhanced)**

* **Icon**: Person silhouette with motion lines
* **Title**: "চলাচল পর্যবেক্ষণের অনুমতি" (Permission to Monitor Movement)
* **Explanation**:
  + Primary: "পড়ে যাওয়া বা অস্বাভাবিক পরিস্থিতি বুঝার জন্য" (To detect falls or unusual situations)
  + Details: "যদি দীর্ঘ সময় নড়াচড়া না হয়, আমি আপনাকে জিজ্ঞেস করব আপনি ঠিক আছেন কিনা" (If there's no movement for a long time, I'll ask if you're okay)
* **Customization**: "কতক্ষণ পর চেক করব?" (How long before checking?) - slider from 15 minutes to 2 hours
* **Toggle**: Large On/Off switch

**Permission 3: Phone Access (New Addition)**

* **Icon**: Phone with emergency symbol
* **Title**: "জরুরি কলের অনুমতি" (Emergency Calling Permission)
* **Explanation**: "জরুরি অবস্থায় ৯৯৯ বা আপনার পরিবারে কল করার জন্য" (To call 999 or your family in emergencies)
* **Toggle**: Large On/Off switch

**Educational Elements:**

* **Audio Explanations**: Each permission has a "শুনুন" (Listen) button for detailed audio explanation
* **Benefits Summary**: "এই অনুমতিগুলো দিলে আপনি পাবেন:" (By giving these permissions you will get:)
  + "দ্রুত সাহায্য" (Quick help)
  + "কথা বলার সুবিধা" (Conversation facility)
  + "নিরাপত্তা পর্যবেক্ষণ" (Safety monitoring)

**Flexibility Options:**

* **Custom Settings**: "বিস্তারিত সেটিংস" (Detailed Settings) - allows fine-tuning of each feature
* **Trial Mode**: "৭ দিনের জন্য চেষ্টা করে দেখুন" (Try for 7 days) - temporary permission grant
* **Change Later**: Clear message "আপনি পরে সেটিংস থেকে এগুলো বদলাতে পারবেন" (You can change these later in settings)

**Completion:**

* **Continue Button**: "এগিয়ে চলুন" (Continue) - large, prominent
* **Setup Complete**: Leads to brief tutorial or direct to main screen

**5.2.2. Daily AI Companion Interaction (Voice-First)**

## **Main Screen / Home Screen Design**

### **Visual Layout**

* **Central Avatar Area**: Large, circular visual element (150dp diameter) representing the AI companion "নীরব বন্ধু" (Nirob Bondhu)
  + Default state: Soft blue circle with a subtle face icon
  + Listening state: Pulsating blue with concentric circles
  + Speaking state: Warm orange glow with gentle animation
  + Thinking/Processing state: Rotating dotted circle pattern
* **Text Display Area**: Large, high-contrast text box (32pt Bengali font) positioned below the avatar
  + Background: White with dark blue text for maximum readability
  + Shows conversation history (last 2 exchanges visible)
  + Auto-scrolls for longer responses
* **Primary Interaction Button**:
  + Size: 80dp diameter circular button
  + Position: Bottom center, easily thumb-reachable
  + Label: "বন্ধুর সাথে কথা বলুন" (Speak to Friend)
  + Visual: Microphone icon with Bengali text
  + State changes: Press and hold = recording (red border), Release = processing (blue border)

### **Audio-First Interaction Design**

#### **Initial Greeting Sequence**

**Screen State 1: App Launch**

* Avatar displays welcome animation
* Immediate audio greeting: "আসসালামু আলাইকুম! আমি আপনার নীরব বন্ধু। আজ আপনার কেমন লাগছে?" (Peace be upon you! I am your Nirob Bondhu. How are you feeling today?)
* Text simultaneously displays the greeting
* Gentle haptic feedback to confirm app is ready

**Screen State 2: User Response Pattern**

* User taps and holds "Speak to Friend" button
* Avatar enters listening mode (pulsating blue)
* Real-time visual feedback: Sound wave animation around avatar
* Text shows: "শুনছি..." (Listening...)
* Release button triggers processing

#### **Conversation Flow Examples**

**Example Conversation 1: Loneliness Support**

*Sketch 1 (User Input):*

* Avatar: Listening mode (pulsating)
* User speech: "আজ আমার খুব একা লাগছে" (I'm feeling very lonely today)
* Text display: "আপনি বলেছেন: আজ আমার খুব একা লাগছে"
* Processing indicator: Small dots animation

*Sketch 2 (AI Response):*

* Avatar: Speaking mode (warm orange glow)
* AI audio response: "আমি বুঝতে পারছি আপনার অনুভূতি। একা লাগা স্বাভাবিক। আপনি কি একটি সুন্দর গল্প শুনতে চান, নাকি আজকের কোনো ভালো খবর?" (I understand your feelings. Feeling lonely is normal. Would you like to hear a beautiful story, or some good news from today?)
* Text display shows the response simultaneously
* Soft background sound: Gentle nature sounds (optional, user-controlled)

*Sketch 3 (User Choice):*

* User responds: "একটা গল্প বলুন" (Tell me a story)
* Avatar acknowledges: Brief green flash
* Text: "গল্প শুরু হচ্ছে..." (Story beginning...)

*Sketch 4 (Story Narration):*

* Avatar: Gentle storytelling animation
* AI narrates a pre-loaded Bengali folk tale with appropriate pacing
* Text scrolls slowly, showing story segments
* Background: Subtle warm lighting effect
* User can interrupt anytime by tapping the button

**Example Conversation 2: Daily News Request**

*Sketch 1 (User Request):*

* User: "আজকের খবর বলুন" (Tell me today's news)
* Avatar processes request

*Sketch 2 (News Delivery):*

* AI response: "আজকের গুরুত্বপূর্ণ খবর শুনুন। আবহাওয়া ভালো থাকবে, বৃষ্টির সম্ভাবনা কম।" (Listen to today's important news. Weather will be good, low chance of rain.)
* Simplified, locally relevant news items
* Positive news prioritized to maintain user well-being
* Option to hear more details: "আরো খবর শুনতে চান?" (Want to hear more news?)

**Example Conversation 3: Health Reminder**

*Sketch 1 (Proactive AI):*

* Time-based trigger (e.g., afternoon)
* Avatar initiates: Gentle pulsing
* AI speaks: "পানি খাওয়ার সময় হয়েছে। আপনি কি পানি খেয়েছেন?" (It's time to drink water. Have you had water?)
* Text display reinforces the message

*Sketch 2 (User Response):*

* User can respond "হ্যাঁ" (Yes) or "না" (No)
* If "না": AI provides gentle encouragement
* If "হ্যাঁ": AI gives positive reinforcement

### **Accessibility Features**

#### **Visual Accessibility**

* **High Contrast Mode**: Toggle for white text on black background
* **Large Text Mode**: Option to increase text size to 40pt
* **Color-Blind Friendly**: Uses shapes and patterns in addition to colors
* **Screen Reader Support**: Full Bengali TalkBack integration

#### **Audio Accessibility**

* **Volume Control**: Dedicated slider for AI voice (separate from system volume)
* **Speech Rate Control**: Adjustable speaking speed (0.7x to 1.5x)
* **Audio Descriptions**: Describes visual changes for screen reader users
* **Repeat Function**: Double-tap anywhere to repeat last AI response

#### **Motor Accessibility**

* **Large Touch Targets**: All buttons minimum 48dp with generous margins
* **Long Press Alternative**: Hold button for 3 seconds instead of precise tap-and-hold
* **Voice Activation**: "নীরব বন্ধু" wake word to start conversation without touching
* **Gesture Support**: Simple swipe gestures for common actions

### **Offline Content Structure**

#### **Pre-loaded Conversation Topics**

1. **Daily Greetings**: 20+ variations based on time of day
2. **Weather Comments**: Basic weather-appropriate responses
3. **Health Reminders**: Medicine, water, exercise, rest prompts
4. **Stories**: 15 Bengali folk tales and moral stories
5. **Religious Content**: Basic prayers and verses (if user opts in)
6. **Motivational Quotes**: Positive Bengali sayings and proverbs

#### **Response Categories**

* **Emotional Support**: Responses for loneliness, sadness, anxiety
* **Daily Activities**: Encouragement for basic tasks
* **Memory Sharing**: Prompts to help users talk about their past
* **Simple Games**: Word games, riddles in Bengali
* **Family Topics**: Gentle conversation about family and relationships

### **Error Handling and Fallbacks**

#### **Speech Recognition Issues**

* If unclear speech: "আমি ভালোভাবে বুঝতে পারিনি। আবার বলুন?" (I didn't understand well. Please say again?)
* Multiple failed attempts: Offers text input option
* Background noise: "একটু শান্ত জায়গায় যান বা আওয়াজ কমান" (Go to a quieter place or reduce noise)

#### **Technical Fallbacks**

* If AI processing fails: Simple acknowledgment + redirect to emergency contact
* Battery low: Simplified responses to conserve power
* Storage full: Prioritizes emergency functions over conversation features

### **Emotional Intelligence Features**

#### **Mood Recognition (Basic)**

* Detects basic emotional cues in voice (happy, sad, worried, tired)
* Adjusts response tone and content accordingly
* Sad mood → Offers comfort, stories
* Happy mood → Shares in excitement, positive reinforcement
* Worried mood → Provides reassurance, offers to contact family if needed

#### **Personalization Elements**

* Remembers user's preferred conversation topics
* Adapts to user's speaking pace and style
* Learns common phrases user uses
* Stores favorite stories or topics for easy access

This enhanced design prioritizes the user's emotional and practical needs while maintaining simplicity and accessibility for elderly and special needs users in Bangladesh.

**5.2.3. Emergency Alert Activation (Critical Path)**

### **Design Philosophy**

* **Multiple Trigger Methods**: Physical button, voice command, automatic detection
* **Clear Escalation Path**: User always knows what will happen next
* **Mistake Prevention**: Easy to cancel accidental triggers
* **Family Integration**: Seamless connection with caregiver contacts

### **Method 1: Physical Button Emergency (Enhanced)**

**Main Screen Emergency Button:**

* **Visual Design**:
  + Large red circular button (100dp diameter)
  + Text: "জরুরি সাহায্য" (Emergency Help) in white bold text
  + Icon: Phone with "৯৯৯" symbol
  + Position: Fixed bottom-right, always visible but not easily accidental

**Step 1: Initial Press**

* **Immediate Feedback**:
  + Button flashes red
  + Haptic feedback (strong vibration)
  + Audio prompt: "জরুরি সাহায্য চাইছেন? নিশ্চিত করুন।" (You want emergency help? Please confirm.)

**Step 2: Confirmation Dialog (Enhanced)**

* **Large Modal Dialog**: Covers most of screen, impossible to miss
* **Main Question**: "এখনই কি জরুরি সাহায্য লাগবে?" (Do you need emergency help right now?)
* **Options**:
  + **"হ্যাঁ, সাহায্য চাই"** (Yes, I need help) - Large green button
  + **"না, ভুল হয়েছে"** (No, it was a mistake) - Large grey button
* **Audio Countdown**: "১০ সেকেন্ড পর আপনার পরিবারের সাথে কল হবে... ৯... ৮..." (Call to your family in 10 seconds... 9... 8...)
* **Visual Countdown**: Large circular progress indicator

**Step 3: Emergency Escalation**

* **Family First Approach**:
  + **Screen Display**: "আপনার পরিবারের সাথে কল করা হচ্ছে..." (Calling your family...)
  + **Shows Contact**: Name and number being called
  + **Audio Message**: "আপনার জরুরি যোগাযোগে কল করা হচ্ছে। অনুগ্রহ করে ফোনের কাছে থাকুন।" (Calling your emergency contact. Please stay near the phone.)
* **If Family Unreachable** (after 30 seconds):
  + **Automatic Fallback**: "পরিবারের সাথে যোগাযোগ হচ্ছে না। এখন ৯৯৯-এ কল করা হবে।" (Cannot reach family. Now calling 999.)
  + **999 Call**: Automatic dial with pre-recorded message

**Emergency SMS Feature** (New Addition):

* **Automatic SMS**: Sent to all registered family contacts
* **Message**: "আপনার আত্মীয়ের জরুরি সাহায্য দরকার। অনুগ্রহ করে [Name] এর সাথে যোগাযোগ করুন। পাঠানো হয়েছে: নীরব বন্ধু অ্যাপ থেকে" (Your relative needs emergency help. Please contact [Name]. Sent from: Nirob Bondhu app)

### **Method 2: Voice Command Emergency (Enhanced)**

**Wake Phrase Detection**:

* **Primary Commands**:
  + "নীরব বন্ধু, সাহায্য!" (Nirob Bondhu, help!)
  + "জরুরি সাহায্য লাগবে!" (I need emergency help!)
  + "সাহায্য! সাহায্য!" (Help! Help!)

**Voice Recognition Confirmation**:

* **AI Response**: "আমি বুঝতে পেরেছি আপনার জরুরি সাহায্য লাগবে। নিশ্চিত করতে 'হ্যাঁ' বলুন বা বাতিল করতে 'না' বলুন।" (I understand you need emergency help. Say 'yes' to confirm or 'no' to cancel.)
* **Visual Feedback**: Screen shows large "শুনছি..." (Listening...) with microphone icon
* **Timeout Protection**: If no response in 10 seconds, assumes "yes" and proceeds

**Error Prevention**:

* **Background Noise Handling**: If environment is noisy, switches to visual confirmation
* **Multiple Attempts**: Allows 3 voice confirmation attempts before falling back to button interface

### **Method 3: Panic Pattern Detection (New Feature)**

**Trigger Patterns**:

* **Rapid Button Tapping**: 5 quick taps on main screen triggers emergency mode
* **Phone Shaking**: Vigorous shaking for 3 seconds
* **Volume Button Pattern**: Press volume up-down-up-down-up rapidly

**Confirmation Process**:

* **Same as voice/button methods** but with explanation: "অস্বাভাবিক কার্যকলাপ ধরা পড়েছে। আপনার কি সাহায্য লাগবে?" (Unusual activity detected. Do you need help?)

**5.2.4. Basic Unresponsiveness Detection (Conceptual / Notification-based in Low-Fi)**

### ***Philosophy & User Agency***

* ***User-Controlled****: User sets their own monitoring preferences*
* ***Graduated Response****: Gentle check → Family alert → Emergency services*
* ***Respect for Privacy****: Clear communication about what's monitored*
* ***False Positive Handling****: Easy ways to indicate "I'm okay"*

### ***Setup & Customization***

***Initial Configuration*** *(Part of setup):*

* ***Monitoring Schedule****:*
  + *"কখন আমি আপনাকে চেক করব?" (When should I check on you?)*
  + *Options: "সারাদিন" (All day), "দিনের বেলা" (Daytime only), "কাস্টম সময়" (Custom times)*
* ***Check Intervals****:*
  + *Slider: 15 minutes to 4 hours*
  + *Default: 1 hour*
  + *Visual explanation: "১ ঘণ্টা নড়াচড়া না হলে জিজ্ঞেস করব" (Will ask if no movement for 1 hour)*

***Activity Types Monitored****:*

* ***Phone Movement****: Picking up, walking with phone*
* ***Screen Interaction****: Any touch, button press*
* ***Voice Activity****: Talking to the app*
* ***Call Activity****: Making or receiving calls*

### ***Detection & Response Flow***

#### ***Stage 1: Gentle Check (Enhanced)***

***Trigger Condition****: No detected activity for set duration*

***Initial Alert*** *(Multi-sensory):*

* ***Audio Prompt****: "আপনি কি ঠিক আছেন? আমি দীর্ঘ সময় ধরে আপনার কোনো নড়াচড়া পাইনি।" (Are you okay? I haven't detected any movement for a long time.)*
* ***Visual Alert****: Large, bright screen with pulsing border*
* ***Haptic****: Gentle vibration pattern (3 short pulses)*
* ***Screen Content****:*
  + ***Main Question****: "আপনি কি ঠিক আছেন?" (Are you okay?)*
  + ***Large Buttons****:*
    - *✅ "হ্যাঁ, আমি ভালো আছি" (Yes, I'm fine)*
    - *🔄 "আরও সময় দিন" (Give me more time) - extends check by 30 minutes*
    - *🚨 "না, সাহায্য লাগবে" (No, I need help)*

***Response Options****:*

* ***"I'm Fine" Response****: "ধন্যবাদ! আমি আবার পরে চেক করব।" (Thank you! I'll check again later.) + returns to normal monitoring*
* ***"More Time" Response****: Snoozes check, asks again in 30 minutes*
* ***No Response****: After 2 minutes, escalates to Stage 2*

#### ***Stage 2: Family Alert Preparation (Enhanced)***

***Warning Phase****:*

* ***Audio Alert****: "আপনি উত্তর দেননি। এখন আমি আপনার পরিবারের সাথে যোগাযোগ করব।" (You didn't respond. Now I will contact your family.)*
* ***Visual Countdown****: Large circular timer showing 60 seconds*
* ***Last Chance Options****:*
  + ***"আমি ঠিক আছি"*** *(I'm okay) - Large button, cancels family contact*
  + ***"পরিবারকে জানান"*** *(Inform family) - Proceeds immediately*
* ***Audio Countdown****: "৩০ সেকেন্ড পর আপনার পরিবারের সাথে কল হবে..." (Call to your family in 30 seconds...)*

#### ***Stage 3: Family Contact (Enhanced)***

***Multi-Channel Family Alert****:*

***Phone Call****:*

* ***Primary Contact****: Calls main family contact*
* ***Pre-recorded Message****: "আসসালামু আলাইকুম। এটি নীরব বন্ধু অ্যাপ থেকে একটি জরুরি বার্তা। [User Name] গত [duration] সময় ধরে কোনো সাড়া দিচ্ছেন না। অনুগ্রহ করে তার খোঁজখবর নিন।" (Peace be upon you. This is an emergency message from Nirob Bondhu app. [User Name] has been unresponsive for [duration]. Please check on them.)*

***SMS Alert****:*

* ***Message****: "জরুরি: [Name] গত [time] থেকে অ্যাপে সাড়া দিচ্ছেন না। দয়া করে তাকে চেক করুন। - নীরব বন্ধু অ্যাপ" (URGENT: [Name] unresponsive on app since [time]. Please check on them. - Nirob Bondhu app)*
* ***Location Info*** *(if GPS enabled): "শেষ অবস্থান: [location]" (Last location: [location])*

***App Notification*** *(if family has app):*

* *Push notification with direct call button and location sharing*

#### ***Stage 4: Emergency Services (Final Escalation)***

***Trigger****: Family unreachable after 15 minutes + still no user response*

***999 Call Process****:*

* ***Automatic Dial****: Places call to 999*
* ***Information Sharing****:*
  + *User's name and age*
  + *Address (if provided during setup)*
  + *Medical conditions (if user opted to share)*
  + *Family contact information*
* ***Continuous Retry****: If busy, retries every 2 minutes*

### ***User Control & Customization***

***Daily Routine Integration****:*

* ***Sleep Mode****: "রাতে পর্যবেক্ষণ বন্ধ রাখুন" (Turn off monitoring at night)*
* ***Activity Schedule****: Set specific times when monitoring should be active*
* ***Routine Activities****: Mark regular activities (নামাজের সময়, দুপুরের ঘুম) when monitoring should pause*

***False Positive Prevention****:*

* ***Activity Learning****: App learns user's typical movement patterns*
* ***Manual Override****: "আজ আমি বিশ্রামে থাকব" (I'll be resting today) - disables monitoring for set duration*
* ***Sensitivity Adjustment****: Slider to make monitoring more or less sensitive*

***Privacy Controls****:*

* ***Data Sharing Settings****: What information to share with family/emergency services*
* ***Monitoring Log****: Shows when checks occurred and responses*
* ***Disable Option****: Complete opt-out with clear explanation of reduced safety features*

### ***Family Dashboard Integration (Conceptual)***

***For Family Members****:*

* ***Status Updates****: Regular "all is well" notifications*
* ***Alert History****: Log of all checks and responses*
* ***Custom Settings****: Family can adjust monitoring preferences with user consent*
* ***Direct Communication****: Quick way to check in with user through the app*

*This enhanced design ensures the unresponsiveness detection serves as a true safety net while respecting user autonomy and preventing unnecessary anxiety for both users and their families.*

#### **5.3. Visual Elements (As Described in Sketches/Wireframes)**

* **Font:** San-serif, large (minimum 20pt for main text, 28-36pt for headings and buttons), clear, and bold.
* **Colors:** Limited palette. High contrast is key (e.g., white text on dark blue background, black text on white background, red for emergency elements).
* **Buttons:** Large, distinct, easy to tap (at least 48x48dp equivalents). Icons are minimal, primarily relying on clear Bengali text labels.
* **Layout:** Single-column, simple, uncluttered. No complex menus or nested screens. Direct interaction is paramount.

### **6. Discussion**

The low-fidelity prototype directly addresses the identified user needs. The voice-first, Bengali-language interface addresses the preferences for verbal interaction and local language support, critical for individuals who may struggle with typing or complex digital interfaces. The offline functionality is a non-negotiable feature, vital for a country like Bangladesh with varying internet access, ensuring continuous companionship and safety even in remote areas.

The dual-pronged approach to safety – a user-initiated emergency call and conceptual unresponsiveness detection – directly tackles the high anxiety surrounding being alone during an emergency. The high user comfort with monitoring features suggests that trust for a clear benefit (safety) can be established. The minimalist interface and large, high-contrast elements aim to reduce the learning curve and improve accessibility for users with potential visual or motor impairments, aligning with general HCI principles for this demographic. While the survey sample for special needs was small, the fundamental accessibility features benefit a broader range of users.

The "companionship gap" identified in the survey (loneliness despite living with family) is intended to be filled by the AI's ability to engage in simple, comforting conversations about daily life, news, and personal stories. This positions the app as a supportive friend, not a replacement for human interaction, as also suggested by one respondent.

### **7. Limitations and Future Work**

#### **7.1. Limitations of Current Phase**

This research phase, focusing on a survey and low-fidelity prototype, has inherent limitations:

* **Small Sample Size:** While informative, the N=28 is not statistically generalizable to the entire elderly and special needs population of Bangladesh.
* **Prototype Fidelity:** The low-fidelity nature means many interaction details, visual nuances, and technical feasibility aspects (e.g., offline AI accuracy) are yet to be fully explored or tested.
* **Simulated Interaction:** The prototype descriptions are conceptual and do not reflect actual user interaction or performance data.
* **Limited Special Needs Data:** Only one participant identified as having special needs, limiting specific design insights for diverse disabilities.

#### **7.2. Future Work**

The next steps in the development of this application are crucial:

1. **Iterative User Testing of Low-Fidelity Prototype:** Conduct hands-on user testing with the described paper or basic digital wireframes to gather qualitative feedback on usability, clarity of instructions, and initial preferences for interaction flows. This will involve observing users interacting with the "sketches" to simulate tasks.
2. **Higher-Fidelity Prototyping:** Based on low-fidelity testing, develop interactive mid-fidelity (e.g., clickable wireframes) or high-fidelity prototypes (more visual design, closer to final app look).
3. **Expanded User Research:** Recruit a larger, more diverse participant group, including more individuals with various special needs, potentially through community organizations. Conduct contextual inquiries or in-depth interviews to understand specific daily routines and challenges.
4. **Technical Feasibility & Implementation:** Research and select specific open-source or custom lightweight AI models for Bengali STT/TTS and NLP that can run efficiently offline on various Android devices.
5. **Caregiver Integration:** Explore specific features and interfaces for caregivers to receive alerts, monitor well-being, and potentially customize the AI's behavior, ensuring privacy and control are maintained.

### **8. Conclusion**

This research successfully leverages user needs assessment to propose a user-centric low-fidelity prototype for an offline AI companion and safety assistant aimed at elderly and special needs individuals in Bangladesh. The identified critical needs for companionship and safety, coupled with the strong preference for offline Bengali voice interaction, form the foundation of the proposed design. This initial prototype, characterized by its minimalist interface, voice-first interaction, and accessible emergency features, represents a promising step towards bridging digital divides and enhancing the well-being of a vulnerable population. Future iterative development and user testing will refine this concept into a truly impactful application.

### **References**

(This section would list the academic papers and resources from your earlier literature review, formatted according to a standard citation style like APA or IEEE.)