

Personal sensing for mental health and wellbeing



Report

CSE 4451/CSE 451 (A): Human Computer Interaction

Group F

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1 | Introduction

In the hustle and bustle of today's life, where stress and worries can mess with our well-being, personal sensing steps in like a helpful guide, showing us the way to feel mentally chill. This cool method uses technology to help us get what's going on inside us, so we can steer toward feeling emotionally balanced. Think of personal sensing like teaming up tech with being mindful. It lets us pay close attention to how we're doing mentally. By keeping tabs on our sleep, activity, and heart rate, we get some useful clues about how we're feeling. It's like having a guide to help us through the tough times, pointing us toward a calmer state. In a time when we're all super connected, personal sensing is like a light in the dark, guiding us toward a future where feeling good in our minds isn't just a wish, but a big part of who we are. It gives us the tools to take charge of our emotions, turning us into experts at keeping calm. Embracing this cool tech, we start a journey of self-discovery, facing life's challenges with new strength and poise.

1.1 | Problem Statement

Addressing mental health and well-being is essential as it directly impacts the quality of life for individuals and their communities. Many people, regardless of their backgrounds, struggle with managing their mental health due to factors such as stress and limited access to timely support. This issue spans across physical and digital spaces, affecting individuals in their daily lives and online interactions. Developing solutions to enhance mental health in the digital environment (i.e. Mobile application, web application, etc.) and well-being is critical because it can provide real-time insights and personalized interventions, empowering users to take control of their mental health and ultimately contributing to healthier communities and improved overall well-being.

1.2 | Team's specific user

Adults aged 18-45 who experienced stress and limited access to mental health support.

2 | Tech and Mental Wellness: A Dive into Secondary Research Findings

2.1 | Unveiling the Factors Behind Target User Group Selection

According to the research paper "Personal Sensing: Understanding Mental Health Using Ubiquitous Sensors and Machine Learning" [4], the target user group for personal sensing technologies for mental health is broad and includes individuals who:

- Experience stress or anxiety
- Have difficulty managing their emotions
- Are at risk for or have a mental health disorder
- Have limited access to traditional mental health care

The paper also notes that personal sensing technologies can be particularly helpful for individuals who:

- Are not comfortable seeking traditional mental health care
- Live in rural or underserved areas
- Have difficulty communicating their mental health concerns
- Are seeking a more personalized approach to mental health care

The research paper "Systematic review of smartphone-based passive sensing for health and wellbeing" [2] identifies adults aged 18-45 as a key target user group for smartphone-based passive sensing applications for mental health and wellbeing. This is because this age group is more likely to own a smartphone and use it regularly, making them more likely to adopt and use passive sensing applications. Additionally, this age group is also more likely to experience stress and mental health problems, making them a group that could benefit from the use of passive sensing applications

- Individuals with mental health conditions
- Individuals with chronic physical conditions
- Older adults
- Individuals in low- and middle-income countries

The research paper identifies a target user group of "adults (age range: 18-65 years)" [1]. This age group is particularly vulnerable to mental health problems due to factors such as stress, work-related pressure, and social challenges. The paper also notes that this group is more likely to have smartphones and be comfortable using technology, making them a good target for smartphone-based interventions

2.2 | Identify problems that Target Audience Face

Insights from the research paper Personal Sensing: Understanding Mental Health Using Ubiquitous Sensors and Machine Learning:

1. **Privacy:** The paper highlights privacy concerns in the section titled "Privacy, Ethics and the Naked Truth" [4]. It discusses the importance of obtaining informed consent from users and implementing robust data security measures.
2. **Limited access to traditional mental health care:** According to the paper, "access to traditional mental health care is often limited due to factors such as cost, availability, and stigma" [4]. This can leave many individuals without the support they need to manage their mental health.
3. **Difficulty managing emotions:** Individuals with mental health conditions may have difficulty regulating their emotions, which can lead to stress, anxiety, and other problems. Personal sensing technologies can help individuals track their emotions and identify patterns that may be triggering their symptoms.
4. **Lack of awareness of triggers:** Many individuals with mental health conditions are not aware of what triggers their symptoms. Personal sensing technologies can help individuals identify their triggers so that they can take steps to avoid them.
5. **Limited personalized support:** Traditional mental health care often provides a one-size-fits-all approach to treatment. Personal sensing technologies can provide personalized support that is tailored to the individual's needs.

The research paper "Next-generation psychiatric assessment: Using smartphone sensors to monitor behavior and mental health" highlights several problems faced by the target user group, including:

1. **Stress:** The paper finds that sensor-derived Geospatial Activity, Sleep Duration, and variability in Geospatial Activity were associated with changes in self-reported daily stress levels [1]. This suggests that smartphone sensors can be used to track changes in stress levels over time.
2. **Symptoms of Depression:** The paper also finds that Speech Duration, Geospatial Activity, and Sleep Duration were associated with changes in participants' symptoms of depression [1]. This suggests that smartphone sensors can be used to monitor changes in depression severity.
3. **Loneliness:** The paper finds that changes in loneliness were associated with sensor-derived kinesthetic activity [1]. This suggests that smartphone sensors can be used to track changes in loneliness levels.

2.3 | The Challenges for Target Audience

The research paper "Personal Sensing: Understanding Mental Health Using Ubiquitous Sensors and Machine Learning" [4] identifies several challenges that the target user group may face when using personal sensing technologies for mental health, including:

1. **Privacy concerns:** Individuals may be concerned about sharing their personal data with third parties. It is important to ensure that personal sensing technologies are designed with privacy in mind and that individuals have control over their data.

2. **Data accuracy:** The accuracy of personal sensing data can be affected by a variety of factors, such as sensor placement and environmental conditions. It is important to develop algorithms that can account for these factors and provide accurate interpretations of the data.
3. **User engagement:** Individuals may not be motivated to use personal sensing technologies on a regular basis. It is important to develop technologies that are easy to use and that provide users with valuable feedback.
4. **Necessary Background:**
 - Understanding of mental health conditions
 - Familiarity with personal sensing technologies

The challenges target audience face "Next-generation psychiatric assessment: Using smartphone sensors to monitor behavior and mental health"[1] :

1. **Limited access to care:** There is a shortage of mental health professionals worldwide, and many people do not have access to timely and affordable care [1].
2. **Stigma:** Mental health problems are often stigmatized, which can prevent people from seeking help [1].
3. **Cost:** Mental health care can be expensive, and many people cannot afford the out-of-pocket costs [1].
4. **Limited awareness of available resources:** Many people are not aware of the mental health resources that are available to them [1].
5. **Difficulty accessing resources:** Even if people are aware of available resources, they may find it difficult to access them due to transportation barriers, scheduling conflicts, or other logistical challenges.
6. **Lack of motivation or self-efficacy:** People with mental health problems may lack the motivation or self-efficacy to seek help, even if they are aware of available resources.

2.4 | Justification of the Problem Statement

The problem statement highlights the crucial need to tackle mental health and well-being, underscoring their significant influence on both individuals and communities. It stresses that mental health challenges are widespread and impact people from various backgrounds. Additionally, it justifies the necessity to prioritize mental health and well-being, presenting it as a intricate and prevalent issue that requires comprehensive, technology-driven solutions to enhance the welfare of individuals and communities. Here's a justification of the problem statement based on secondary research:

1. **Mobile Sensing at the Service of Mental Well-being: a Large-scale Longitudinal Study** [5]: The research paper justifies its problem statement by highlighting the widespread use of smartphones and their potential for gathering mental well-being data. It critiques past studies for their small scale, controlled settings, and lack of longitudinal perspectives. The paper suggests a fresh approach: a large-scale, long-term, and real-world study using smartphones to better understand mental well-being. This method aims to overcome the limitations of previous research, offering a more accurate and widely applicable insight into how smartphones influence mental well-being. Ethical concerns are also addressed, emphasizing the need for informed consent, privacy protection, and clear usage guidelines for collected data. Overall, the paper establishes a well-grounded case for the proposed research, identifying gaps in existing literature and presenting a novel approach to address them, while conscientiously addressing ethical considerations.
2. **ATHENA: A Personalized Platform to Promote an Active Lifestyle and Wellbeing Based on Physical, Mental and Social Health Primitives**[3]:The research paper supports its problem statement by addressing obstacles related to the use of personal sensing technologies for mental health, such as high expenses, limited accessibility, insufficient awareness, and the necessity for further research in the field. It notes that these technologies can identify early signs of mental

health issues, deliver tailored interventions, offer immediate feedback, boost self-efficacy in managing mental health, and enhance overall quality of life. The paper identifies a noticeable gap in current literature and suggests an innovative approach to fill this gap, underscoring both the potential advantages and challenges associated with employing personal sensing technologies for mental well-being.

- 3. Systematic review of smartphone-based passive sensing for health and wellbeing[2]:** The document highlights the potential of using smartphones for passive sensing to transform mental healthcare by collecting continuous and personalized data. However, challenges must be addressed, including the need for rigorous research on the effectiveness of these interventions, the development of user-friendly and privacy-protective technologies, and better integration of passive sensing data into clinical care. The well-justified problem statement emphasizes specific goals, such as evaluating the impact of smartphone interventions on mental health outcomes, creating user-friendly interfaces, ensuring data privacy, and integrating passive sensing data effectively into clinical practice. Successfully addressing these challenges could revolutionize mental healthcare, enabling early identification of issues and improving treatment outcomes.

3 | Data Collection Process

The research data analysis process involves systematically examining and interpreting gathered data to extract meaningful insights and make conclusions. It typically starts by organizing and cleansing the data to ensure accuracy and completeness. Then gradually step by step analysing the data through finding patterns. The aim is to convert raw data into practical information, forming a foundation for informed decision-making and contributing to the research's overarching goals.

3.1 | Implemented Research Methods

Our research employs a dual methodology involving interviews and surveys. Interviews afford us the opportunity for in-depth, open-ended discussions, yielding rich qualitative insights into individuals' experiences and perspectives. This method proves invaluable for unraveling subtle details. Conversely, surveys serve as an effective means for collecting quantitative data on a larger scale, providing standardized responses and offering statistical insights into discernible patterns and trends. The amalgamation of these methodologies establishes a comprehensive approach, encompassing diverse perspectives while facilitating the exploration of commonalities across various demographic groups. The use of surveys, particularly when conducted anonymously, fosters an environment that encourages participants to share sensitive information that they might be hesitant to disclose in person. Additionally, this combination of methodologies facilitates longitudinal studies, enabling the tracking of changes over time. Ethical considerations, including prioritizing informed consent and ensuring participant confidentiality, remain paramount throughout the entire data collection process.

3.2 | Demographics of Our Target Users

The participants in our study primarily consist of individuals within the 18-35 age range, reflecting the demographic profile of our friends and university students. This targeted group allows us to explore the subject matter within a specific life stage, ensuring relevance and relatability among participants. The study focuses on capturing insights from this age cohort, providing valuable perspectives from individuals who share similar backgrounds and experiences within our immediate social and academic circles.

3.3 | Target Demographic Engagement Strategy

To engage our target demographic, primarily individuals aged 18-35, we conducted direct, in-person interactions on campus and participated in relevant Facebook groups associated with our university. Utilizing these platforms facilitated a seamless connection with our immediate community, allowing students within our age bracket to stay informed about and actively participate in our study. Additionally, we sought insights from our family and friends within the same age group. The combination of face-to-face engagements and an online presence within university-associated platforms demonstrated effectiveness in reaching our specific demographic.

3.4 | Data Generated from the Data Collection Process

Our data collection process gathers a wide range of information, including both descriptive and numerical data. Descriptive data, obtained from interview transcripts and detailed notes, provides in-depth insights into participants' experiences, emotions, and perspectives related to the research topic. This rich, qualitative data allows us to gain a deeper understanding of how participants perceive and interact with the subject matter. On the numerical side, survey responses contribute structured data that is amenable to statistical analysis. By analyzing this quantitative data, we can identify patterns, trends, and correlations within the larger dataset, providing a more objective and generalizable view of the research topic. Audio recordings further enhance the qualitative aspect of our data collection process, preserving the tone, context, and nonverbal cues of participants' narratives. This combination of qualitative and quantitative data ensures a comprehensive and multifaceted understanding of the topic under investigation, facilitating a more robust analysis and interpretation of our research findings.

3.5 | Data Recording Process

In our data collection process, we adopt a comprehensive approach to record collected information. This involves the systematic use of notes and audio recordings. During interviews, detailed notes are taken to capture key insights, participant responses, and contextual observations. Simultaneously, audio recordings provide a valuable resource for later reference, ensuring the accuracy of transcriptions and preserving the richness of participants' narratives. This dual method, combining meticulous note-taking with audio documentation, enhances the reliability and depth of our recorded data. These records, whether in the form of notes or audio, serve as essential references for analysis and interpretation, contributing to the overall rigor and validity of our research findings.

3.6 | Data Collection Challenges

During the data collection phase, we encountered various challenges related to participant confidentiality and openness. To address privacy concerns, we ensured transparent communication regarding data security measures and the anonymization of responses. Encouraging participants to share their experiences openly, especially on sensitive topics, presented another hurdle. To overcome this, we fostered a supportive and non-judgmental environment, establishing rapport before delving into more personal aspects. Technical glitches, including recording malfunctions, were addressed by having backup recording devices and conducting regular checks. Biased responses surfaced when addressing questions with specific examples, and to rectify this, we meticulously filtered such answers. Additionally, the diverse backgrounds of participants necessitated adaptability in our approach, tailoring communication styles and methods to accommodate individual preferences. By proactively tackling these challenges, our aim was to elevate the quality and reliability of our collected data while prioritizing participant comfort and maintaining data integrity.

4 | Data Analysis Process

We conducted a series of interviews to gather insights into the use of personal sensing devices for mental health and well-being. The interviews yielded a rich and diverse dataset, reflecting the varied experiences of individuals navigating the complexities of mental health care. To make sense of this data, we employed a systematic data analysis process, culminating in the creation of an affinity diagram. In the data analysis process, we carefully examine the interview transcripts, identifying prominent themes and concepts. Subsequently, we categorize these key themes and concepts into distinct clusters, assigning each cluster a descriptive label. This culminates in the creation of a visual representation in the form of an affinity diagram.

4.1 | Insights from Affinity Diagram

Personal sensing holds the potential to transform our approach to mental health, yet there are notable barriers hindering its widespread adoption. The digital environment offers a variety of resources and support for individuals struggling with their mental health. Numerous patterns have been identified within the clustered data, which are elaborated below.

Key Themes and Patterns:

1. **Self-Care Practices:** Participants illuminated the innumerable ways they engage in self-care for mental well-being, ranging from traditional practices like prayer and exercise to the exploration of mental well-being.
2. **Privacy Concerns:** A notable thread running through the conversations was the varying comfort levels participants exhibited concerning the sharing of personal mental health information through digital platforms. Privacy emerged as a pivotal consideration shaping their perspectives.
3. **Mixed Perceptions of Digital Support:** Participants offered subtle perspectives on the efficacy of the digital environment in providing resources and support for mental health. The landscape appeared complex, with both positive and skeptical views.
4. **Barriers to Personal Sensing Technologies:** Challenges such as cost, lack of awareness, and concerns about trust and data security surfaced as barriers preventing participants from embracing personal sensing technologies for mental health.
5. **Potential for Stigma Reduction:** Despite varying opinions, there was a shared belief among participants in the potential of personal sensing technologies to contribute to the reduction of societal stigma surrounding mental health.
6. **Cost-Effectiveness and Support for Traditional Visits:** Views on the cost-effectiveness of personal sensing technologies were explored, with participants considering them as potential complements rather than substitutes for traditional mental health visits.

4.2 | Discoveries Beyond Our Prior Knowledge

In our thorough examination, we're exploring how people go about improving their mental well-being through personal practices—like making new connections, engaging in prayer, or exercising, to name a few. We're also looking into how comfortable individuals feel about sharing personal mental health information online. Additionally, we're investigating the specific hurdles people face when trying to use personal sensing technologies for mental health. This investigation dives deep into the intricacies of personal habits, online disclosure comfort, and challenges tied to adopting mental health technologies. This in-depth exploration aims to provide a greater understanding of mental well-being practices, shedding light on the ease of online sharing and the obstacles encountered in leveraging technology for mental health management.

4.3 | Confirmation of Suspicions: Unveiling that We Expected

Utilizing personal sensing as a tool to enhance mental health is promising, yet several challenges must be tackled for widespread adoption. The digital environment offers a valuable resource for those grappling with mental health concerns, but our suspicion suggests a lack of awareness about such technology. Additionally, uncertainty surrounds whether individuals perceive this technology as a complement to professional mental health support. Furthermore, accessibility may be hindered by cost concerns, concluding our final set of suspicions. Addressing these challenges is crucial for the effective integration of personal sensing in mental health support.

4.4 | Miro-Board link for Affinity Diagram

Click to Jump into Affinity Diagram: [Team F: Affinity Diagram](#).

5 | Personas

Two personas in the context of our subject are provided below:

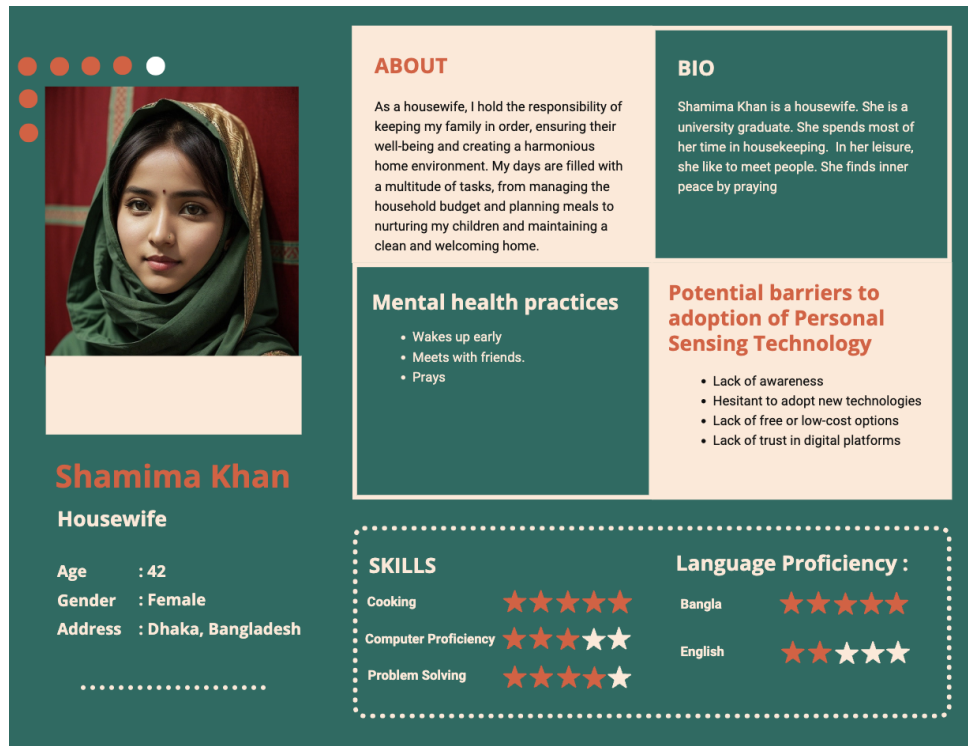


Figure 5.1: Persona 01

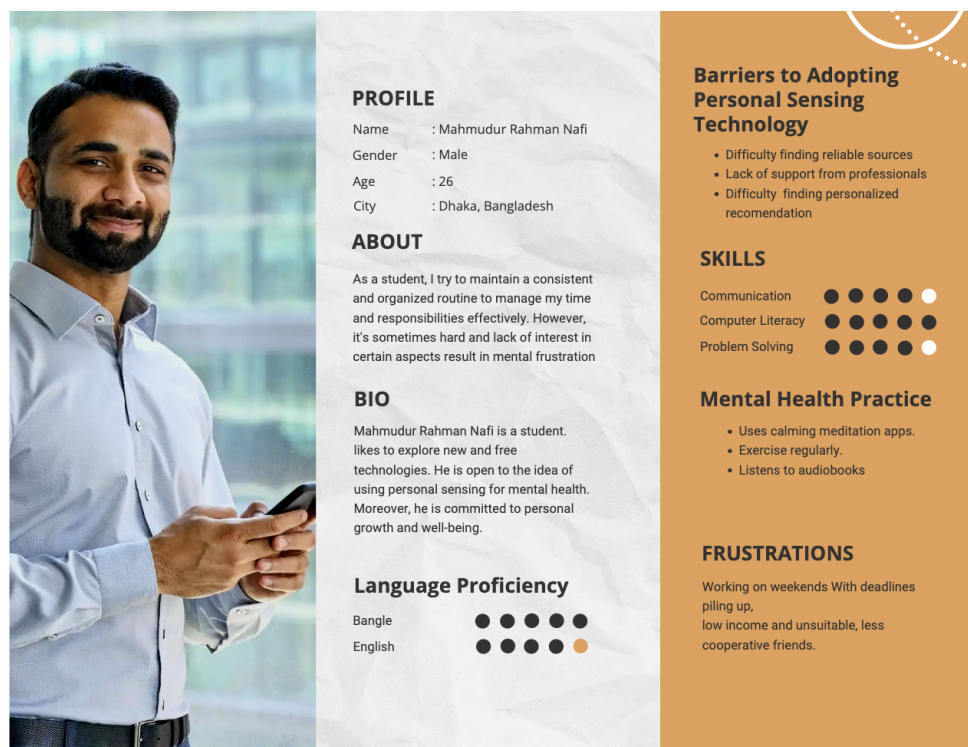


Figure 5.2: Persona 02

6 | Scenario

Nafi is a 26-year-old graduate student, but he's been feeling overwhelmed lately. He is struggling to keep up with the demands of his studies and his personal life. Nafi is a bright student. But nowadays he's



constantly juggling classes, assignments, extracurricular activities, and a part-time job(tutoring high school students). He's also been trying to maintain a healthy social life, but he's finding it difficult to make time for everything.

As a result of this constant pressure, Nafi has been experiencing symptoms of stress and anxiety. He's having trouble sleeping, his concentration is slipping, and he's been feeling more irritable than usual. He started isolating and disconnecting himself from his friends and family.

One day, Nafi was scrolling through his Facebook newsfeed and an app popped for personal sensing to help manage his stress. Nafi is skeptical at first, but he's willing to give it a try.

Nafi downloads the personal sensing app and starts tracking his data. He is surprised to see his sleep patterns are very irregular, and his heart rate variability is high, indicating stress. He also notices that his activity levels are low, as he's been spending most of his time studying or working.

Nafi has suggested some changes along with some personalized breathing exercises in times of stress. He starts to implement those changes to his lifestyle. He sets a goal to get 7-8 hours of sleep each night, and he starts taking breaks throughout the day to jog or exercise. He also started using mindfulness techniques to manage his stress.

After a few weeks, Nafi starts to see a difference. He's sleeping better, his anxiety is decreasing, and he's feeling more energized. He's also more productive at University, as he's able to focus better and make better decisions. Now, He encourages his friends and classmates to try personal sensing, and he even writes a blog about his journey. He believes that personal sensing is a powerful tool that can help students like him take charge of their mental health. Nafi's journey is far from over, but he's feeling more hopeful about the future than ever before. However, he's learned that it's okay to ask for help, and he's found a valuable tool in personal sensing that can help him navigate the challenges of student life.

7 | Storyboard



(a) Stress individuals from different circumstances



(b) Use Personalised Mental Well-being Monitor in Smart-Device



(c) Practicing mental well-being activity



(d) Relieving Stress and Getting Mentally Sound



(e) All activity of the individuals in proper discipline

Figure 7.1: Storyboard of Personal sensing for mental health and wellbeing

8 | References

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