**COMPUTER SCIENCE**

**COM 4139-1**

**HUMAN COMPUTER INTERFACE**

**ASSIGNMENT 1**

**GROUP PRESENTATION**

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**Part 1- Research and Discussion (600 to 800 words)**

**For each factor (Discussed in class).**

**Definition: Define the Human Factor and explain its importance in HCI**

**Impact: Describe how it impacts the user experience when interacting with technology.**

**Design consideration: Discuss one example of user interface design principle or technique that can mitigate the negative effects of this factor.**

**Human Factors in Human-Computer Interaction (HCI):**

Human-Computer Interaction (HCI) refers to the study of the interaction between people and computers, focusing on the design of user interfaces that enhance user experience. Human factors in HCI consider the cognitive, physical, and emotional aspects that influence the user’s ability to interact with technology. Understanding these factors is crucial for designing systems that are intuitive, accessible, and efficient. Below is an analysis of various human factors, their impact on user experience, and design considerations to mitigate negative effects.

1. **Human Error**

Definition:

Human error refers to mistakes made by users while interacting with a system, often due to unclear instructions, complex interfaces, or distractions. It is critical in HCI because errors can lead to frustration, inefficiency, or even serious consequences in high-stakes environments like healthcare or aviation.

Impact:

Errors disrupt user flow and diminish trust in the system. If users frequently make mistakes, they may abandon the technology altogether. In safety-critical environments, human errors can have life-threatening implications.

Design Consideration:

One design technique is the use of error prevention and recovery mechanisms. For example, undo functionality in software allows users to reverse unintended actions, minimizing the consequences of mistakes. Clear labeling and feedback also help users avoid errors in the first place.

**2. Cognitive Load**

Definition:

Cognitive load refers to the mental effort required to use a system. If a task demands too much cognitive effort, users may become overwhelmed and less efficient in their tasks.

Impact:

High cognitive load leads to user fatigue, confusion, and errors. When systems present too much information at once or require users to remember complex procedures, the overall user experience deteriorates.

Design Consideration:

To reduce cognitive load, progressive disclosure can be employed. This technique presents information and features incrementally, allowing users to focus on one task at a time. Simplified navigation and clear visual hierarchy also reduce cognitive demands.

**3. Perception and Attention**

Definition:

Perception refers to how users interpret sensory information, while attention is the ability to focus on specific elements of a system. In HCI, both are essential for guiding users through tasks effectively.

Impact:

If a system fails to capture the user’s attention or if important elements are not easily perceivable, users may miss critical information, leading to errors or task failure.

Design Consideration:

Visual contrast and highlighting important elements can guide user attention. For instance, using bold colors for buttons or warnings ensures that users focus on the necessary parts of the interface.

**4. Physical Constraints**

Definition:

Physical constraints refer to limitations related to the user’s physical abilities, such as hand-eye coordination, strength, or dexterity. These factors are particularly important in designing for accessibility.

Impact:

If a system is not physically accessible, users with disabilities or older adults may struggle to interact with it. This exclusion can lead to frustration and a sense of alienation.

Design Consideration:

Designing with universal accessibility principles in mind, such as larger buttons or voice commands, ensures that systems accommodate users with varying physical abilities. This approach promotes inclusivity and broadens the potential user base.

**5. Consistency and Learnability**

Definition:

Consistency refers to using familiar patterns, elements, and behaviors across an interface, while learnability is how quickly users can master a new system.

Impact:

Inconsistent interfaces cause confusion, slow down tasks, and increase the likelihood of errors. Systems that are difficult to learn may discourage users from continuing to engage with them.

Design Consideration:

Following established design patterns and standards can enhance consistency. For example, placing navigation menus in the same location across different screens allows users to learn and predict interactions quickly.

**6. Memory Limitation**

Definition:

Users have limited short-term memory, often referred to as "cognitive bandwidth." In HCI, designs that overload memory capacity impair user performance.

Impact:

When systems require users to remember too much information—such as complex passwords, multiple steps, or long instructions—users may become frustrated or make mistakes.

Design Consideration:

Implementing recognition over recall can alleviate memory demands. For instance, using dropdown menus or autocomplete features allows users to select options instead of remembering exact inputs.

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**7. Attention Span and Fatigue**

Definition:

Users have limited attention spans, especially during prolonged interaction. Fatigue sets in after extended use, affecting decision-making and focus.

Impact:

If systems demand constant attention or involve tedious processes, users may experience fatigue, leading to errors, slower performance, and disengagement.

Design Consideration:

Incorporating breaks or natural stopping points in the interface, such as checklists or auto-save features, allows users to pause and return without losing progress. Additionally, streamlining tasks reduces unnecessary interaction steps.

**8. Diverse Abilities**

Definition:

Users come with a range of abilities, including physical, cognitive, and sensory differences. Ensuring that systems cater to this diversity is key in HCI.

Impact:

Designs that do not account for diverse abilities exclude certain users, resulting in a poor or unusable experience for them. For example, a visually impaired user may struggle with a text-heavy interface without screen reader compatibility.

Design Consideration:

Accessible design principles such as offering alternative text for images, keyboard navigation, and voice interaction help ensure that diverse user groups can interact with the system.

**9. Cultural and Language Differences**

Definition:

Culture and language influence how users interpret icons, gestures, and instructions. A design that works well in one cultural context may be confusing or even offensive in another.

Impact:

Failure to account for cultural differences can result in miscommunication, confusion, or rejection of the technology by certain user groups.

Design Consideration:

Localization is a common solution, where interfaces are adapted to different cultural contexts. This includes translating text and adjusting symbols, colors, and formats to align with local norms and expectations.

**10. Motivation and Emotions**

Definition:

User motivation and emotional state significantly influence interaction with technology. Systems that fail to engage or frustrate users can lead to abandonment or dissatisfaction.

Impact:

If a system is overly complex, users may feel frustrated and unmotivated to continue. Conversely, engaging and satisfying experiences foster loyalty and satisfaction.

Design Consideration:

Gamification techniques such as providing rewards or progress bars, can increase motivation and encourage users to engage more deeply with the system. Additionally, emotional design that considers aesthetics and user empathy can enhance positive feelings towards the interface.

**Part 2-case study analysis (300 to 500 words)**

**Choose one digital device or software application popularly used in kenya ( e.g mobile app like mpesa, a website or a gaming interface). Evaluate its design based on the human factors you reaserched in part 1 above For example consider:**

**Does the design reduce cognitive load? How?**

**What features help to prevent human error?**

**How does the interface grab and maintain the user attention?**

**Are there any physical constraints, such as small buttons or hard-to-reach elements?**

**How does it minimize reliance on memory, such as through intuitive navigation or help features?**

**Case Study Analysis:(M-Pesa) Mobile Application in Kenya**

M-Pesa, a mobile-based money transfer service, is widely used in Kenya for transactions, savings, and bill payments. Since its inception in 2007, M-Pesa has become essential in the daily lives of millions of Kenyans. In this analysis, we will evaluate M-Pesa’s design based on the human factors discussed in Part 1, including cognitive load, error prevention, attention management, physical constraints, and memory reliance.

Cognitive Load

M-Pesa effectively reduces cognitive load through a simple, step-by-step interface. The app organizes tasks into well-defined categories like sending money, withdrawing funds, and paying bills, ensuring that users do not have to juggle too much information at once. Additionally, the use of familiar terms such as “Lipa na M-Pesa” (Pay with M-Pesa) helps users quickly understand what actions are available, reducing the mental effort needed to navigate.

M-Pesa also employs progressive disclosure, displaying options only when needed. For example, when sending money, the app first asks for the recipient's phone number, then moves on to the amount. This sequential flow of tasks prevents cognitive overload by breaking down complex processes into manageable steps.

Human Error Prevention

M-Pesa incorporates several error-prevention mechanisms to safeguard users. For instance, before completing a transaction, the system displays a confirmation screen showing the recipient’s details and the amount being transferred. This allows users to verify their input and prevents accidental transfers to the wrong person.

The app also offers an option to "save" favorite contacts and bill accounts, which minimizes the risk of entering incorrect information repeatedly. Moreover, M-Pesa includes features like transaction reversal, giving users a limited window to reverse accidental payments.

Perception and Attention

M-Pesa effectively grabs and maintains user attention by utilizing contrast and clear visual hierarchies. Key functions like sending money and checking balances are prominently displayed on the home screen, while less critical functions are hidden under secondary menus.

The app uses color coding and icons to differentiate between actions. For instance, red is used for warnings or errors, such as insufficient funds, while green is used for confirmations. This color scheme helps users focus on important actions and alerts, ensuring they do not miss crucial information.

Additionally, M-Pesa employs notifications to keep users engaged. For example, upon completing a transaction, the app sends an SMS confirmation with transaction details. These notifications ensure users remain attentive and informed throughout their interactions.

Physical Constraints

Although the M-Pesa interface is largely user-friendly, there are some physical constraints, particularly for users with physical disabilities or those using older or smaller mobile devices. The app relies on relatively small buttons and input fields, which could pose challenges for users with limited dexterity or poor eyesight.

However, the app partially mitigates this issue by supporting USSD functionality, where users interact with the system via shortcodes, eliminating the need for a touchscreen. This feature allows users without smartphones, or those who struggle with touch interfaces, to still access the core services of M-Pesa.

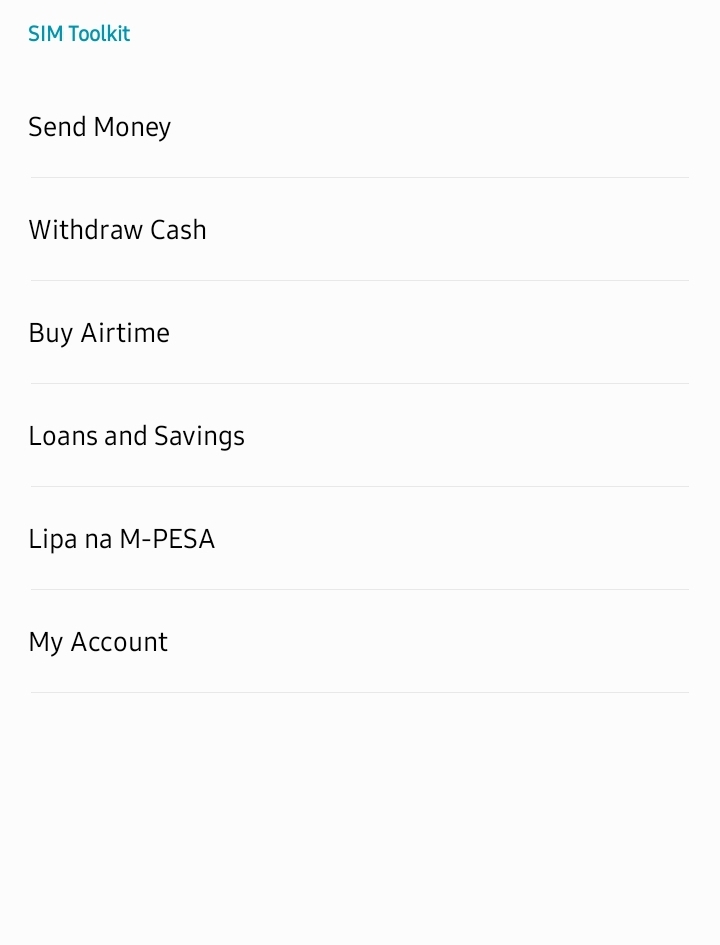
Memory Limitation

M-Pesa minimizes reliance on memory through intuitive navigation and features like stored contacts. For example, the app allows users to save frequently used numbers and accounts, reducing the need to remember details for recurring transactions. This is particularly useful for users who pay regular bills or frequently send money to the same people.

In addition, the app keeps a transaction history, allowing users to view past transfers, which reduces the need to remember past amounts or recipients. By making information easily accessible, M-Pesa limits the cognitive burden associated with remembering critical transaction details.

Attention Span and Fatigue

M-Pesa’s interface is designed for quick, goal-oriented tasks, which helps limit user fatigue. Transactions can typically be completed in a few steps, minimizing the amount of time users need to spend in the app. The app also minimizes unnecessary elements, focusing on core functionalities, which helps users complete tasks efficiently without feeling overwhelmed.



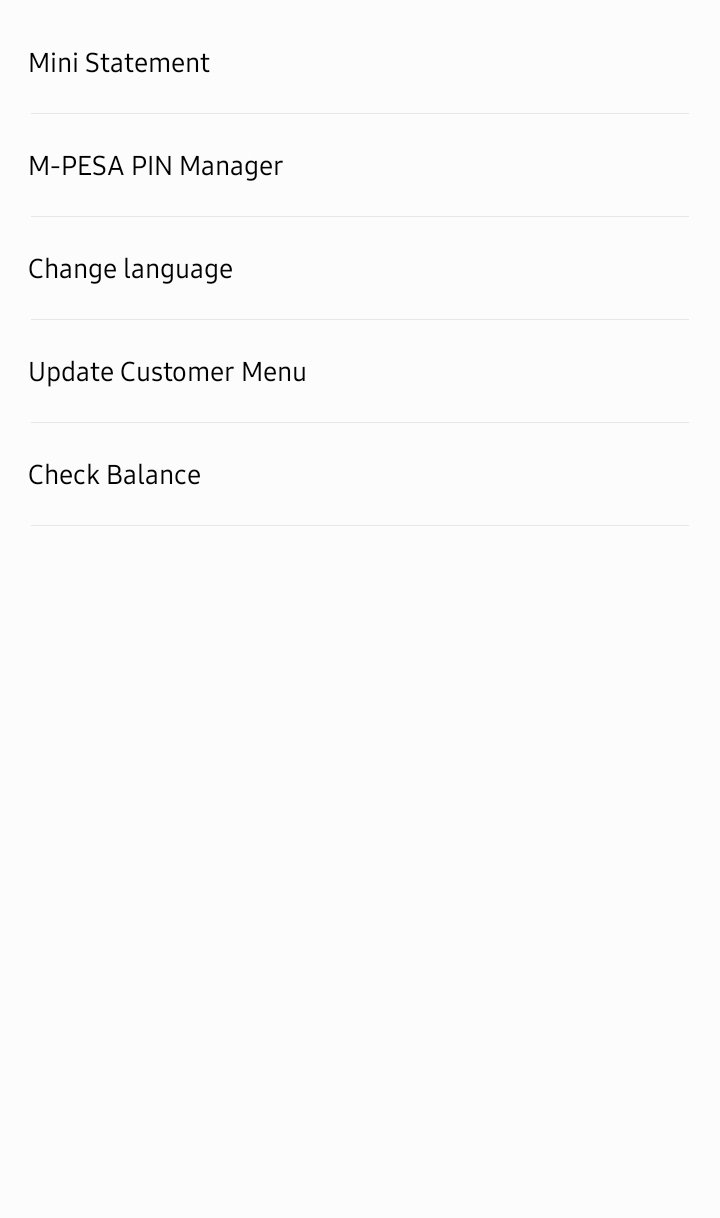
By providing immediate feedback (e.g., confirmation screens and SMS alerts), M-Pesa ensures that users remain focused and confident that their actions have been successfully completed, which reduces the likelihood of fatigue caused by uncertainty.

Diverse Abilities\*\*

M-Pesa accommodates a range of user abilities through its dual-platform approach. Users with advanced phones can access the app via a graphical interface, while those with basic phones can use the USSD menu. This ensures that the service is accessible to a broad demographic, including those who may not have access to smartphones or who are less tech-savvy.

Cultural and Language Differences

M-Pesa's interface is designed to suit the Kenyan market, using Swahili and English as you see from the below picture you can change and choose any language you wish to you use either Swahili or English, the most widely spoken languages in Kenya. It also takes into account cultural norms, such as the common practice of sending money to family members or paying for services via mobile. The app's simplicity ensures that users from different educational backgrounds can easily understand and interact with the system.



**Part 3- Design recommendations (400 to 600 words)**

**Based on your findings in Part 2, propose three improvements to the interface that would better account for human factors in HCI. Your recommendations should**

**Identify a specific problem in the current design related to human factors.**

**Propose a solution and explain how it would improve usability.**

**Consider how the proposed changes could affect other aspects of the interface (e.g., aesthetics, accessibility, efficiency).**

**Design Recommendations for the M-Pesa Mobile Application**

Based on the analysis conducted in Part 2 regarding the human factors affecting user experience in the M-Pesa mobile application, the following design recommendations are proposed. These improvements aim to enhance usability, reduce errors, and improve overall user satisfaction by addressing specific issues related to cognitive load, attention management, and memory reliance.

1. Combine Send, Withdraw Money, and Buy Airtime into a Single Section

Identified Issue:

Currently, the M-Pesa interface requires users to navigate through separate menus for sending money, withdrawing cash, and purchasing airtime. This setup can overwhelm users with multiple options, increasing cognitive load and sensory input needed to make decisions. For users who may not be familiar with the app or who are under time constraints, this fragmentation can lead to confusion and frustration.

Proposed Solution:

By consolidating these three core functions into a single section on the home screen, users will encounter fewer choices when initiating transactions. This design can be realized as a prominent "Quick Actions" button that expands to reveal options for sending money, withdrawing cash, and buying airtime.

Usability Improvement:

This change would simplify the decision-making process, allowing users to complete their transactions faster and with greater ease. Reducing the number of items displayed at once minimizes cognitive load, making it easier for users to focus on the task at hand. As a result, users are likely to experience better customer satisfaction and a more streamlined interaction with the app.

Effect on Other Aspects:

Aesthetically, this consolidated section could maintain a clean design by employing icons or visual cues to represent each action. It would allow users to quickly recognize their options without feeling overwhelmed by choices, thus enhancing the overall interface's appeal and efficiency.

2. Lengthen the Time Needed to Confirm Transactions

Identified Issue:

The current confirmation process for transactions can be rushed, often leading to errors due to hasty decisions. Users may not have sufficient time to fully understand the transaction details before confirming, increasing the risk of mistakes such as sending money to the wrong recipient or entering incorrect amounts.

Proposed Solution:

Extending the duration of the confirmation screen will allow users more time to review transaction details such as the recipient's phone number, the amount being sent, and any associated fees. Additionally, a visual countdown timer can be introduced to indicate how long the user has to confirm the transaction, helping them to manage their time effectively.

Usability Improvement:

By providing users with adequate time to review their transactions, the risk of human error will be significantly reduced. This approach addresses the human factor of attention and helps users feel more confident about their decisions. Enhanced clarity in the confirmation stage will lead to a better overall experience and fewer transaction-related issues.

Effect on Other Aspects:

While extending the confirmation time may slightly prolong the transaction process, the added security and error prevention benefits far outweigh the downside. Visually, the confirmation screen can include simple design elements like a checklist or highlighting key details, improving the overall usability without compromising aesthetics.

3. Reduce the Number of Steps Required to Complete Transactions

Identified Issue;

Currently, users navigate through multiple steps to complete a transaction, which can be cumbersome and time-consuming. Each step adds to the cognitive load, especially if users are required to enter several details, including phone numbers and amounts, before confirming their transactions.

Proposed Solution:

Streamlining the transaction process to minimize the number of steps can greatly enhance user experience. The ideal workflow could involve combining the input of transaction details and confirmation into a single step, where users enter their details and see a summary before entering their M-Pesa PIN to finalize the transaction.

Usability Improvement:

By reducing the number of interactions needed to complete a transaction, users will experience less friction, leading to quicker and more satisfying interactions. This change will minimize the reliance on memory as users will not have to remember inputs through multiple screens. The efficiency gained will allow users to complete tasks in a more timely manner, ultimately improving their overall perception of the app.

Effect on Other Aspects:

This streamlined approach can lead to a cleaner interface design, as fewer screens will be required. It may also encourage users to engage more frequently with the app, as they will appreciate the speed and efficiency of the transaction process. Ensuring that the design remains intuitive and easy to navigate will be crucial in maintaining a positive aesthetic and functional experience.

**Part 4: Reflection (200 to 300 words)Reflect on what you have learned from this assignment. How has your understanding of human factors changed? How will these concepts influence the way you evaluate or design technology in the future?**

**Reflection**

This assignment has significantly deepened my understanding of human factors in Human-Computer Interaction (HCI). Initially, I viewed user experience mainly through the lens of aesthetics and functionality. However, delving into various aspects of human factors—such as cognitive load, attention management, and error prevention—has illuminated how crucial these elements are in designing effective technology.

I learned that user interfaces must be intuitive and accessible, taking into account the diverse abilities and needs of users. The importance of minimizing cognitive load became particularly clear, as I recognized that an overwhelming number of options can lead to decision fatigue and errors. This understanding will influence my future evaluations and designs by emphasizing simplicity and clarity in user interfaces.

Moreover, the assignment highlighted the necessity of incorporating user feedback and iterative design process. Ensuring that users can easily navigate an interface and feel confident in their actions is paramount.

In future projects, I will prioritize user testing and consider the psychological and physiological aspects of user interaction. By applying these human factors principles, I aim to create technology that is not only functional but also user-friendly, enhancing overall user satisfaction and engagement across diverse user groups. This holistic approach will be instrumental in shaping effective and inclusive technology.