

Project ID:

24-25J-296

1. Topic (12 words max)

AI system personalizes software interfaces in real time using user behavior and feedback.

2. Research group the project belongs to

Software Systems & Technologies (SST)

3. Research area the project belongs to

Software Engineering (SE)

4. If a continuation of a previous project:

Project ID	-
Year	-

5. Brief description of the research problem including references (200 – 500 words max) – references not included in word count.

Firstly, recommendation systems often struggle with providing accurate suggestions for new users or new gadgets due to limited interaction history. This "cold start" problem can lead to less personalized and less relevant recommendations, which can negatively impact user experience and engagement. As new users have minimal historical data, the system's ability to predict their preferences accurately is hindered, necessitating advanced algorithms capable of making reliable inferences with sparse data [1].

Secondly, there is a limited application of adaptation, context awareness, and self-learning in current systems. Effective utilization of these personalization concepts can significantly enhance user experience by making the system more responsive and tailored to individual needs. However, many existing systems fail to integrate these aspects adequately, resulting in less effective personalization [2][4]. For instance, the lack of context-aware personalization has been highlighted as a significant limitation in telemonitoring systems for chronic patients [5].

Another critical issue is the transparency of the system. Users may find it challenging to understand and anticipate automatic adaptations due to the statistical processing of sensor events. These adaptations do not occur immediately but after a certain threshold, which can create a disconnect between user actions and system responses. Ensuring transparency in how and why the system adapts is vital for maintaining user trust and satisfaction [3]. Studies on context-aware applications have shown that transparency in system operations can significantly improve user experiences [6].

Lastly, balancing user control with automated adaptations poses a significant challenge. While automation can enhance user experience by providing personalized suggestions and adjustments, it is equally important to ensure that users feel in control. Users should have the ability to understand, override, or refine automated decisions to align with their preferences and needs. This balance is critical to prevent users from feeling alienated or frustrated by the system's actions [1][2].

Addressing these challenges requires innovative solutions that combine advanced AI algorithms, user-centered design, and robust feedback mechanisms to create truly personalized software user interfaces and experiences in real-time based on user behavior, preferences, and feedback.

References:

- [1] M. Silli, M. Garschall, M. Morandell, S. Hanke, and C. Mayer, "Personalization in the User Interaction Design," in HCI 2016, Part I, LNCS 9731, Springer, 2016, pp. 198–207. DOI: 10.1007/978-3-319-39510-4_19
- [2] M. C. Schraefel, "Building Dynamic Systems for Universal Usability: The Value of User Experience Design," in Universal Access in Human-Computer Interaction. Design and Development Methods for Universal Access, Springer, 2015, pp. 47–56. DOI: 10.1007/978-3-319-18374-9_5
- [3] T. Jokela and K. H. Tammi, "User Experiences in Context-Aware Mobile Applications," in Human-Computer Interaction – INTERACT 2015, Springer, 2015, pp. 36–44. DOI: 10.1007/978-3-319-18374-9_5
- [4] M. Monteiro-Guerra, et al., "Personalization in Real-Time Physical Activity Coaching," IEEE Journal of Biomedical and Health Informatics, vol. 23, no. 1, pp. 1-12, 2019
- [5] F. Villaçã, et al., "Analyzing the Usability and User Experience of Telemonitoring Systems for Chronic Patients," Journal of Biomedical and Health Informatics, vol. 21, no. 1, pp. 1-12, 2017
- [6] T. Nieminen, et al., "Designing a Context-Aware Mobile Application for Real-Time Physical Activity Coaching," IEEE Journal of Biomedical and Health Informatics, vol. 20, no. 1, pp. 1-12, 2016

6. Brief description of the nature of the solution including a conceptual diagram (250 words max)

The proposed solution involves developing an AI-based system (plugin for web applications) designed to enhance user experiences by personalizing software interfaces and interactions in real time. This system will leverage advanced algorithms and AI techniques to address common issues such as the "cold start" problem, limited adaptation, and lack of transparency in current recommendation systems.

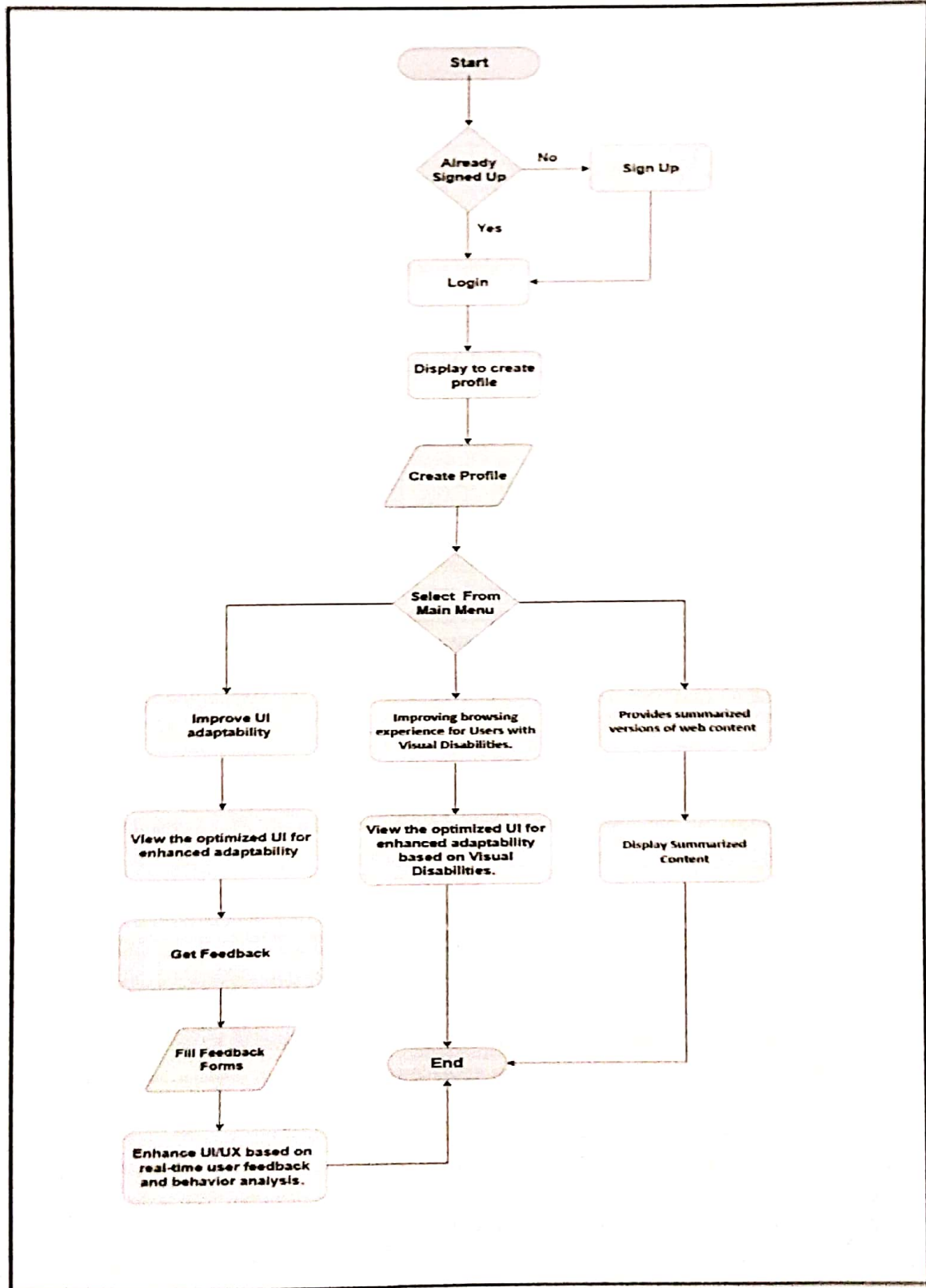
The AI system will utilize a combination of probabilistic models and reinforcement learning to analyze user behavior and preferences continuously. By processing real-time data, the system will adapt software interfaces dynamically, offering personalized content and suggestions that align with individual user needs. This approach aims to overcome the cold start problem by using sophisticated inference methods to generate relevant recommendations even with limited initial data.

Additionally, the system will incorporate context-aware features to enhance adaptability. It will employ self-learning mechanisms to improve over time, making the interface increasingly responsive to user needs and preferences. For users with visual disabilities, the system will offer enhanced browsing experiences through accessible design and customization options.

To address transparency concerns, the solution will include clear explanations of how recommendations and adaptations are made based on the user behaviors and feedback. This transparency will help users understand and trust the system's adaptations, thereby improving overall satisfaction and engagement.

Overall, the AI system will strive to create a more intuitive and personalized software environment, ultimately leading to a more satisfying and engaging user experience.

Conceptual Diagram:



7. Brief description of specialized domain expertise, knowledge, and data requirements (300 words max)

Designing an AI system to personalize software user interfaces and experiences in real time requires specialized expertise across several domains, a deep understanding of user behavior, and access to comprehensive datasets.

Domain Expertise:

- Expertise in machine learning algorithms, particularly those related to real-time data processing, recommendation systems, and reinforcement learning, is crucial. Knowledge of neural networks, decision trees, clustering, and collaborative filtering methods will be essential.
- Understanding HCI principles is vital to create interfaces that are intuitive and user-friendly. This includes expertise in usability testing, user experience (UX) design, and cognitive psychology.
- Proficiency in software development, particularly in real-time systems, data processing pipelines, and scalable architectures, is necessary. Knowledge of programming languages such as Python, Java, or C++ and experience with development frameworks is also important.
- Skills in data analytics, statistical analysis, and data visualization are needed to interpret user data accurately. Expertise in creating data models, feature extraction, and validation techniques is required.

Knowledge Requirements:

- In-depth knowledge of how users interact with software interfaces, including common pain points and preferences, is crucial. This includes understanding different user personas and scenarios.
- Understanding techniques for processing and analyzing data in real time, including stream processing and event-driven architectures, is important for timely personalization (Real-time Data Processing).

Data Requirements:

- We are utilizing existing datasets from **Kaggle**: Examine user interaction data to gain insights into preferences and behaviors, aiding in the enhancement of web personalization and recommendation systems.
- We are leveraging datasets from **Data World**: Collect detailed user profiles and historical behavior to customize web experiences according to individual preferences and requirements.
- We are accessing datasets from **Open Data Portal**: Analyze user engagement and browsing patterns on websites to enhance personalization and optimize web content for typical user behaviors. Mechanism for collecting explicit feedback from users, such as surveys, ratings, and comments, to refine and improve the personalization algorithms continuously.

- We are gathering datasets from various sources to enhance web personalization for users with visual disabilities. From **Kaggle**, we will utilize the **Personalized Web Search Challenge dataset**. Furthermore, we will collect detailed user profiles and historical behavior from Data World to customize web experiences according to individual needs, considering factors such as color blindness and short-sightedness. Datasets like the **Color Vision Deficiency Datasets** and **Color Identification Dataset** will be particularly useful for developing personalization strategies that cater to users with specific visual

S. Objectives and Novelty

Main Objective			
The main objective of this project is to design and develop an AI system that can personalize software user interfaces and experiences in real time based on user behavior, preferences, and feedback. This system aims to enhance user satisfaction, engagement, and overall user experience by dynamically adapting the software environment to meet individual user needs and preferences.			
Member Name	Sub Objective	Tasks	Novelty
Silva H.S.N	Continuously improve software user interfaces and experiences based on real-time user feedback and behavior analysis.	<ul style="list-style-type: none"> • Implement mechanisms to collect real-time user feedback and behavior data. (In-App Surveys and Pop-Up Forms: Use front-end technologies, Backend Data Integration: Use APIs (RESTful APIs) to securely transmit and store data in databases (MongoDB). 	↓ Real-Time Feedback Integration incorporating real-time user feedback directly into the system's personalization process allows for immediate UI adjustments, ensuring the interface evolves

		<ul style="list-style-type: none"> Develop natural language processing (NLP) models to analyze qualitative feedback. (Utilize Python libraries like NLTK (Natural Language Toolkit) or spaCy for text preprocessing, sentiment analysis, and keyword extraction, Use frameworks like TensorFlow or PyTorch for training and deploying machine learning models for feedback classification) Design a flexible UI framework that adjusts based on feedback and behavior analysis (For Front-end frameworks use React.js or Angular for building responsive and dynamic user interfaces that can adapt to real-time data changes, implement state management tools like Redux or 	with user needs and preferences.
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		handle UI state changes based on user feedback) <ul style="list-style-type: none"> Establish a feedback loop where user input drives system improvements (Utilize Apache Kafka or RabbitMQ for handling real-time data streams and processing user feedback as it arrives) 	
Rosa M.D	Enhance the personalization and adaptability of user interfaces in adaptive systems by utilizing probabilistic models, reinforcement learning, and AI-based mechanisms.	<ul style="list-style-type: none"> Identify and Implement Probabilistic Models: Research and implement probabilistic models like Bayesian networks and Hidden Markov Models to predict user behavior and manage uncertainty in adaptive systems. Test these models and refine them to improve their accuracy and reliability. Integrate Reinforcement Learning: Explore reinforcement learning techniques 	Integration of probabilistic models, reinforcement learning, and AI-based mechanisms to create a highly adaptive and personalized user interface, leveraging advanced machine learning techniques to manage uncertainty, predict user behavior, and continuously adapt the UI to meet evolving user preferences, thereby enhancing the overall user experience.

		<p>such as Q-learning to personalize user interactions based on feedback. Develop and test a reinforcement learning algorithm, refining it through iterative evaluations in controlled environments.</p> <ul style="list-style-type: none"> • Develop AI-Based Mechanisms for UI Adaptation: Investigate and implement AI mechanisms like neural networks to dynamically adjust UI variants based on user preferences. Continuously monitor the system's adaptability and adjust enhance user experience. 	
H.L. Sandun Geemal	Improving browsing experience for Users with Visual Disabilities.	<ul style="list-style-type: none"> • Develop Interactive Tests: Create interactive tests using JavaScript and WebAssembly to identify visual 	<ul style="list-style-type: none"> • Dynamically adjusts browser settings and content presentation based on real-time user data. By providing interactive



		<p>impairments such as color blindness, short-sightedness, Use libraries like D3.js for visual tests and data visualization.</p> <ul style="list-style-type: none">• Data Collection and Analysis: Gather test results and interaction data using MongoDB for storage and Python for data analysis. Apply machine learning models with scikit-learn to analyze the collected data and identify specific accessibility needs.• Dynamic Adjustment of Browser Settings: Implement features to adjust text sizes, contrast settings, and color schemes dynamically based on user test results using CSS variables and	<p>tests to identify visual impairments and automatically optimizes the browsing experience. By enabling real-time adaptation and customization</p>
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		<p>custom properties. Use the Web Accessibility Initiative (WAI-ARIA) to enhance semantic content accessibility.</p> <ul style="list-style-type: none"> Customizable User Interface: Allow users to customize their browser interface through the plugin settings. Develop a user-friendly interface using React and Material-UI for managing accessibility preferences. Real-Time Adaptation: Use WebSockets and Firebase for real-time data synchronization and updates to browser settings. Ensure that changes are applied immediately to enhance the browsing 	
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		experience without requiring page reloads. <ul style="list-style-type: none"> User Feedback and Improvement: Integrate feedback forms and surveys using React and Node.js to gather user input on the effectiveness of accessibility enhancements. Implement analytics with tools like Matomo to monitor user satisfaction and identify areas for improvement. 	
M.M.Tharindu Pradeepa	Provides summarized versions of web content based on user preferences	<ul style="list-style-type: none"> Model Integration: Use TensorFlow.js to load the converted summarization model into the React application and Write functions to preprocess text input into tensors and postprocess output tensors back into text. Real-Time Summarization: 	The adaptive content summarization component leverages TensorFlow.js to enable real-time, browser-based text summarization tailored to user preferences. By integrating advanced natural language processing techniques directly within the browser

		<p>Use JavaScript and React to provide instant feedback and summaries as users interact with content.</p> <ul style="list-style-type: none">• Accessibility and Testing: Make sure the summarization component is accessible to screen readers and other assistive technologies.	
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9. Supervisor checklist

a) Does the chosen research topic possess a comprehensive scope suitable for a final-year project?

Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
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b) Does the proposed topic exhibit novelty?

Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
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c) Do you believe they have the capability to successfully execute the proposed project?

Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
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d) Do the proposed sub-objectives reflect the students' areas of specialization?

Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
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e) Supervisor's Evaluation and Recommendation for the Research topic:

Approved

10. Supervisor details

	Title	First Name	Last Name	Signature
Supervisor	Mr.	Thushanjan	Thilakaratna	
Co-Supervisor	Ms.	Rivani	De Zoysa	
External Supervisor				
Summary of external supervisor's (if any) experience and expertise				

This part is to be filled by the Topic Screening Panel members.

Acceptable: Mark/Select as necessary

Topic Assessment Accepted	
Topic Assessment Accepted with minor changes (should be followed up by the supervisor)*	
Topic Assessment to be Resubmitted with major changes*	
Topic Assessment Rejected. Topic must be changed	

* Detailed comments given below

Comments

The Review Panel Details

Member's Name	Signature

***Important:**

1. According to the comments given by the panel, make the necessary modifications and get the approval by the **Supervisor** or the **Same Panel**.
2. If the project topic is rejected, identify a new topic, and follow the same procedure until the topic is approved by the assessment panel.