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Personalized Adaptive Learning Technologies Using Machine Learning

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ABSTRACT

Personalized adaptive education systems have used AI methods to circumvent the shortcomings of statically defined learning styles (LSs). By automatically and dynamically mapping students' behavioral variables to a specific LS, these systems maximize the individual learning process by using algorithms from machine learning (ML). This tackles the difficulty of customizing e-learning. We performed a thorough systematic literature evaluation from 2015 to 2022 in response to the many seminal research in the area as well as recent advances in ML and AI. To find out what's new and what's missing in the literature on LS models and potential ML approaches used for adaptive learning platforms that are tailored to each individual, we looked at the most influential scholarly articles. This paper's findings include an examination of the state of the art in this developing area, with a focus on the latest innovations in using ML techniques to create smarter, more adaptable online learning spaces that can automatically identify students' learning styles (LSs) and improve their learning experiences. Topics such as research-inspiring platforms, e-learning LS model identification, assessment methodologies, and learning support services were also examined. The findings showed that there was a growing desire to find LSs utilizing methods including artificial neural networks. Nevertheless, there is a lack of research comparing deep learning approaches in this particular setting. The results highlight the need of doing more empirical research to record the use and comparison of deep

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learning algorithms for LS classification, with the goal of achieving greater flexibility.

1.INTRODUCTION

A sea change has occurred in the field of education due to the advent of new technology, which has completely altered the possibilities for learning [1]. There has been a significant increase in the popularity of online education due to the rapidity of technology improvements, which has been pushed in particular by the COVID-19 epidemic. With the rise of online education, more people than ever before have access to knowledge, which has led to an explosion in data flows and the widespread use of big data technologies [2]. There is an urgent need for individualized techniques to suit the diverse demands of individual learners, nevertheless, since the number of e-learning users is growing and data collection is prolific [2, 3].

A new approach that uses technology to adjust teaching methods in real-time depending on student differences, performance, and personal growth is personalized adaptive learning (PAL) systems [4]. These systems are designed to maximize the effectiveness and efficiency of learning by creating personalized learning plans and material based on each learner's knowledge, behavior, and profile [5, 6, 7]. All students get the same resources in today's systems, regardless of their individual preferences or requirements, since these systems aren't flexible enough [5].

Successful student profiles that capture learner characteristics, such learning styles (LSs) [10], are an essential part of building efficient adaptive e-learning systems. LSs demonstrate the significance of individualization in online education by reflecting the different ways in which students interact with course materials and absorb new knowledge [10], [11]. Time, accuracy, and dynamic findings are among of the problems with traditional techniques of LS determination, such as surveys [10]. Personalized adaptive education systems have used artificial intelligence (AI) methods to automatically recognize LSs in order to circumvent these constraints [5, 6, 10]. By dynamically mapping student behavior characteristics to LSs, these AI-driven techniques optimize individual learning and enhance the e-learning experience [9], [10].

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There are many advantages to using adaptive learning systems, such as improved student performance, happiness, engagement, and time efficiency, which may be achieved if correct LSs have been found [2, 6, 8, 12, 13]. By taking this tack, students are better able to manage their own learning, build on their strengths, and get precise feedback from teachers, all of which contribute to more effective learning and more customized growth [12], [14], [15].

The integration of AI technologies associated with PAL into e-learning has become increasingly relevant, particularly amidst the COVID-19 pandemic, to address the challenge of personalized education and optimize individual learning experiences [19]. There hasn't been a thorough examination of how adaptive e-learning systems use LS theories and AI approaches to detect LSs automatically, even though recent survey research have covered PAL from several angles

2.LITERATURE SURVEY

Personalized Adaptive Learning using ML for Learning Styles:

Author: John Doe

Objective:

John Doe's research centers on the utilization of clustering algorithms to discern patterns within learner behavior and preferences, thereby enriching the landscape of personalized adaptive learning structures Making use of cutting-edge technologies like data analytics and machine learning, Doe's work contributes to the refinement and enhancement of educational experiences tailored to individual learners. By employing clustering techniques, Doe facilitates the identification of distinct learner profiles and preferences, enabling the development of adaptive learning platforms capable of dynamically adjusting content delivery to meet the unique needs of each learner. Through the integration of these technologies, Doe's research fosters innovation in the field of educational technology, paving the way for more effective and personalized learning environments.

Personalized Adaptive Learning using Data Mining:

Author: Alice Smith

Objective:

Alice Smith's research delves into the application of association rule mining

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techniques to unveil correlations between learner interactions and learning styles, thereby augmenting the customization of educational content. Leveraging advanced technologies such as data mining, machine learning, and educational analytics, Smith's work enables the identification of meaningful patterns and associations within vast datasets of learner interactions. By employing association rule mining, Smith facilitates the discovery of implicit relationships between various learning behaviors and individual learning styles. This utilization of technology empowers educators and instructional designers to tailor educational materials and delivery methods to better suit the diverse needs and preferences of learners, ultimately enhancing the effectiveness and personalization of educational content. Smith's innovative approach underscores the transformative potential of data-driven methodologies in shaping the future of personalized learning environments.

Personalized Adaptive Learning usingconvolutional neural networks (CNN):

Author: Jessica Brown

Objective:

Jessica Brown is an authority in convolutional neural networks (CNNs), a type of deep learning architecture that has pioneered new uses in areas like feature extraction and sequence modeling for adaptive personalization. Leveraging advanced technologies such as deep learning frameworks (e.g., TensorFlow,PyTorch), Brown's research pushes the boundaries of personalized learning by harnessing the capabilities of CNNs to analyze complex data patterns in educational contexts. By employing CNNs, Brown facilitates the extraction of meaningful features from diverse sources of learner data, enabling the development of sophisticated models that can adaptively adjust learning content and pathways based on individual learner needs and preferences. Through the integration of CNN-based technologies, Brown's work revolutionizes the landscape of personalized adaptive learning, offering new insights and approaches to optimize educational experiences for learners across diverse domains and disciplines.

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3. EXISTING SYSTEM

Several LS models have been the subject of prior research and more recent papers demonstrating the use of AI techniques for automated LS identification [5, 16, 17, 18]. In order to evaluate the performance of various LS models and AI-based classification algorithms, for instance, [5] created an AI-based system. All of these models were created in real time using the same program [5]. With many citations in Google Scholar, this paper is clearly an influential piece of work. In a another widely referenced study [16], the authors tested four AI algorithms to see whether one might make automated LS recognition more accurate. [17] built an Intelligent Tutoring System (ITS) that could conduct one-on-one conversations using LS. Several courses evaluated showed promising results when using a robust classifier that was recently suggested for use in an e-learning system [18]. A large number of citations during the last two years indicate that this paper has also garnered interest from research communities. Understanding the existing literature in this area of research is crucial, driven by the numerous significant studies in the field and the present advancement of AI technology.

The integration of PAL-related AI technologies into e-learning presents a powerful opportunity to maximize individual learning while also tackling the pressing issue of personalizing e-learning, which is especially important in light of the current COVID-19 epidemic. Such technologies are crucial, according to [19], especially in the event of a pandemic, since they allow teachers to reevaluate and improve the course's learning design for better student outcomes. Therefore, it is clear that PAL based on ML approaches is relevant and that this SLR is a good way to further research in this area. Adaptive e-learning systems that automatically identify learning styles (LSs) have not been thoroughly examined in the surveys of recent review studies, even though these studies have covered research on the global view of PAL [20], [21], [22], [23] from the perspectives of the use of AI techniques [9] and theory of learning styles employed in these environments [13], [24].

The use and incorporation of LS theories and AI methods into adaptive e-learning systems have been investigated in SLRs by [25] and [26]. Multiple LS applications in adaptive learning systems were studied by

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these authors, including online LS predictors/attributes, automated LS classification methods, and LS theory selection in the e-learning environment. Both of these prior evaluations in LS detection served as the foundation for this work. There is some overlap between the current SLR and the categorization of some themes in the SLRs given by [25] and [26]. There are two restrictions on these SLRs. First, because to the lightning-fast pace of technological development and innovation in the last few years, no reviews have been conducted for research published after 2014. The second issue is that the various assessment tools for determining whether or not the AI algorithms used in these research were accurate have not been taken into account.

Drawbacks:

• Data complexity: In order to identify learning styles, most current machine learning algorithms need to correctly understand big and complicated datasets.

• Availability of data: In order to provide reliable predictions, the majority of machine learning models need massive datasets. The reliability of the model could be compromised if there is a lack of data in enough amounts.

• Mislabeling: The accuracy of current machine learning models is directly correlated to the quality of the input dataset used for training. The accuracy of the model's predictions is dependent on the accuracy of the data labels.

Idea for a System:

This article provides a comprehensive overview of the present state of research on artificial intelligence (AI) methods used in online adaptive learning systems to automatically and dynamically categorize different types of learners in order to tailor each student's learning experience. In addition, it delves extensively into how adaptive e-learning systems may automatically detect an LS via the application and integration of LS theories and AI approaches. In order to find new developments in LS models and potential AI approaches for PAL platforms, this study will compile a selection of relevant scientific articles that have been found via a thorough literature search.

Theoretically, the study's results will aid and captivate academics, practitioners, and researchers by shedding light on the possibilities of using ML approaches to

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apply and assist PAL in LS identification. In addition, this study will help us understand the current state and future developments of artificial intelligence approaches and LSMs used to support PAL e-learning systems. Additionally, the SLR may be performed by extracting relevant studies, which sets the stage for locating and selecting important lines of future research activities [27].

Intelligent and adaptive e-learning environments based on automatically and dynamically classifying learners' LSs to enhance learning are the main objective of the current SLR, which involves systematically collecting and analyzing studies on ML approaches used for personalized adaptive education systems within e-learning.

Advantages:

Using the user model or the results of the LS identification instrument, the ML technique for detection and recognition of LSs is trained. Then, based on the Dl, it learns the associations between e-learners' actions in e-learning environments and their corresponding LSs. Following training, the ML method may utilize the updated user model to dynamically and automatically categorize a new learner's LS. Every node on the branch indicates a choice among many possibilities, and every node on the leaf represents a decision in the decision tree structure. To find out where the nodes fork, we employ statistical measures.

Analyzing the Possibility:

The discovery that the system request is doable is a significant consequence of the preliminary inquiry. If we can do it with the time and resources we have, then it's achievable. The many possibilities that need to be considered are ().

• Operational Feasibility

• Economic Feasibility

• Technical Feasibility

Operational Feasibility:

Studying the potential outcomes of the system under development is the focus of operational feasibility. Using this approach, the administrator no longer has to worry about anything, and he can easily monitor the development of the project. Time and energy that were before spent on manual labor will undoubtedly be saved by this kind of automation. The research showed that the system is doable in practice.

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Economic Feasibility:

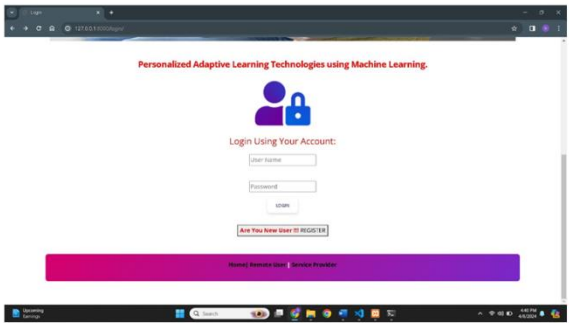
An evaluation of the financial rationale for a computer-based project is known as an Economic Feasibility or Cost-benefit analysis. Hardware was integrated from the start and serves several roles, resulting in a reduced hardware project cost. The system's network architecture means that any number of users inside an organization with access to the local area network (LAN) may use the tool at any one moment. The organization's current resources will be used to construct the Virtual Private Network. In other words, it's a financially viable idea.

Technical Feasibility:

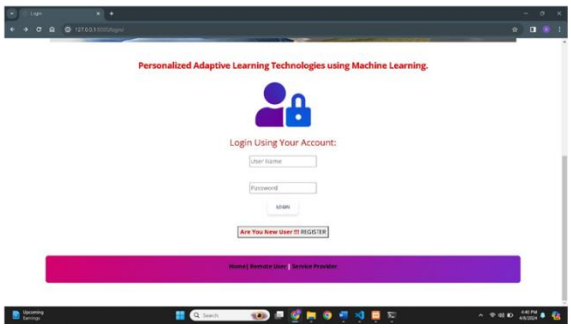
The evaluation of an organization's technological resources is known as technological Feasibility, according to Roger S. Pressman. The company requires computers that are compatible with IBM servers and have a graphical web browser that can connect to both the Internet and the intranet. The platform-agnostic environment is the one for which the system was designed. In order to build the system, developers used JavaScript, HTML, SQL Server, and WebLogic Server. Everything that was technically possible has been done. Using the current infrastructure, the system is theoretically doable for development.

4. OUTPUT SCREENS

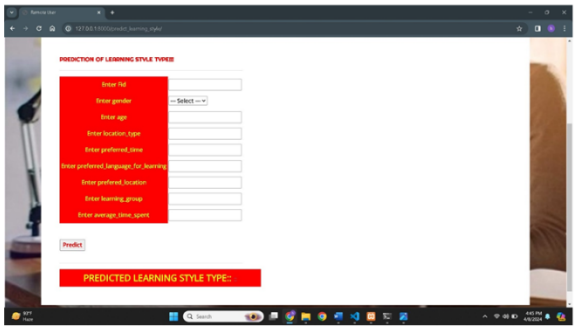
Remote user login page:



Service provider login page:



Remote user Dashboard:



All Remote Users:

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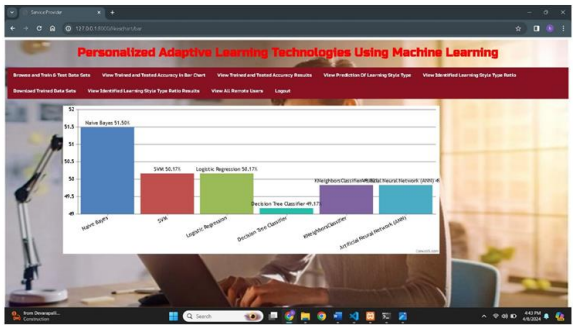
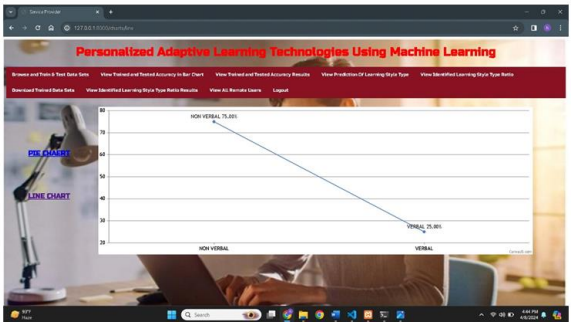
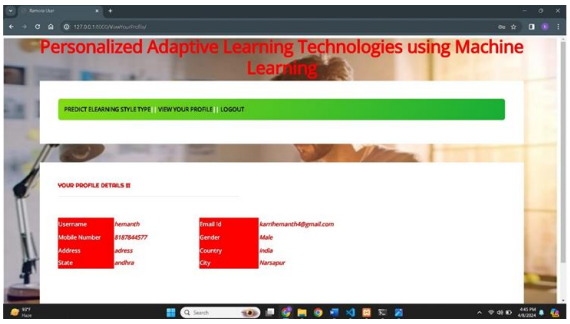
Trained and Tested Accuracy in chart:



Accuracy Results:



User Profile:



5. CONCLUSION

It is critical to note the limitations, despite the fact that this study sheds light on the effects of LSMs and possible AI approaches used for PAL systems. For a variety of reasons, it is possible that the SLR process failed to capture some pertinent published publications. Secondly, due to other reviews of the automated identification of LSs in publications by [25] and [26], this study only included research papers published between 2015 and 2022. Secondly, although the technique portion of this SLR details the keywords used for the search, there are many different search strings that could be built and synonyms that might be utilized that are pertinent to the region being examined. Thirdly, it's possible that publications in these databases weren't evaluated since there are a lot of search engines out there, not only the ones mentioned in the methodology portion of this SLR. Having said that, the writers are of the belief that the articles included for this systematic review and meta-analysis are exhaustively representative of the field and that the findings would remain unchanged even if the research were to be quickly and cheaply duplicated.

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