



On-screen Activity Tracking Using Federated Learning

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Abstract. In this rapid technology of remote and online learning, the ability to monitor and assess students' engagement and productivity has become increasingly vital. This paper presents a pioneering approach to addressing this challenge by combining privacy-preserving on-screen activity tracking with federated learning. Our revolutionary technology combines the benefits of real-time user monitoring with strong privacy protection, trying to discern whether students are productively using their time for knowledge development or unhappily wasting it. E-learning platforms have grown in popularity, especially in light of global events necessitating remote instruction; nonetheless, ensuring that students are actively engaged and focused throughout online sessions remains a key challenge. Our technique employs federated learning, a decentralized machine learning model, to guarantee user privacy while properly identifying on-screen actions.

Keywords: decision tree, convolutional neural networks, linear

discriminate analysis.

1 Introduction

In today's world in dynamic landscape of education the demand for education has grown exponentially concerns about user privacy have become increasingly prominent traditional on-screen activity tracking methods often compromise user privacy raising ethical and legal issues this project introduces a groundbreaking solution privacy-preserving on-screen activity tracking using federated the primary goal of project s to develop a robust system that seamlessly integrates on-screen activity tracking using federated Learning.

implementation using fl and fl is a decentralized ml that enables model training across multiple devices or servers without exchanging raw data by adopting this paradigm our system ensures that sensitive user information remains localized and secure on individual devices.

The suggested architecture offers a novel strategy for improving the adaptability of e-learning content while resolving important data privacy issues. The project protects each learner's privacy by using federated learning techniques to train these algorithms collectively without jeopardizing individual data privacy and machine learning algorithms to analyze on-screen activities such as mouse movements and keyboard inputs. This creative method finds a balance between maximizing the benefits of individual learning and protecting user privacy, in addition to supporting ethical technology integration in education. This study project has the potential to help e-learning become a more private and

secure space as education develops, which will ultimately provide a safer and more productive learning environment for everyone.

2 Literature Review

Xu, J. M. David et al. [1] The article by M. Xu, J. M. David, S. H. Kim explores opportunities and challenges associated with the fourth industrial revolution (4IR). Published in the *International Journal of Financial Research* in 2018, the authors delve into the transformative impact of emerging technologies on various industries. They discuss the potential advantages of the 4IR, such as increased efficiency and innovation, while also acknowledging the challenges, including concerns related to job displacement and ethical considerations. The literature survey highlights the complex landscape of the 4IR, offering insights into the multifaceted implications of technological advancements on the financial domain and beyond.

J. Goet et al. [2] "The Impact of Social Media on Academic Performance of Students" explores the complex connection between academic success and social media use. The project intends to determine the effects of social media involvement on many aspects of students' academic performance, such as grades, study habits, and overall learning outcomes, using empirical research and analysis. It explores things like how often and for how long people use social media, what kinds of platforms they utilize, and what kinds of interactions people have online. The study may also investigate how students' capacity for focus, memory retention, and academic success is impacted by social media distractions, information overload, and online sociability. By revealing these patterns, the study helps stakeholders, educators, and legislators make informed decisions and directs the creation of successful student assistance plans.

S.I. U. Rehman et al. [3] "Digital Learning Compass: Distance Education Enrollment Report" provides a thorough examination of the state of enrollment in distance learning in postsecondary education institutions. The research provides insightful information about the increasing popularity and significance of online learning through a thorough analysis of enrollment statistics, demographics, and institutional policies. Through the display of information on enrollment rates, course offerings, student demographics, and institutional tactics, the report offers comprehensive comprehension of the changing landscape of online learning. In light of the growing influence of technology and online platforms in broadening access to educational possibilities, this resource is crucial for educators, policymakers, and other stakeholders who wish to comprehend and adjust to the evolving environment of higher education.

F. Lalani et al. [4] The association between students' use of social media platforms and their academic success is examined in the study on social media use and academic performance. It looks at how students' impressions of these platforms, the kinds of activities they engage in, and the amount of time they spend on social media may affect their overall academic performance. Researchers hope to find trends and connections between social media use and academic results through surveys, data analysis, and maybe qualitative interviews. By being aware of these dynamics, educators and legislators may create plans to assist students in time management, reduce distractions, and even use social media for learning. In the end, this will improve students' performance and well being in the classroom.

A. Aristovnik et al. [5] "The Influence of Social Media on Students' Academic Performance" explores the nuanced connection between students' use of social media and their academic achievement. The study aims to clarify the effects of social media involvement on several facets of students' academic performance, such as grades, study habits, and overall learning

outcomes, through empirical research and analysis. The goal of the study is to identify any possible connections and causal linkages by looking at variables including the amount of time spent on social media, the kinds of platforms used, and the frequency of usage. It might also look at how information overload, social media diversions, and online interactions affect students' capacity to concentrate, remember knowledge, and achieve academic objectives.

3 Methodology

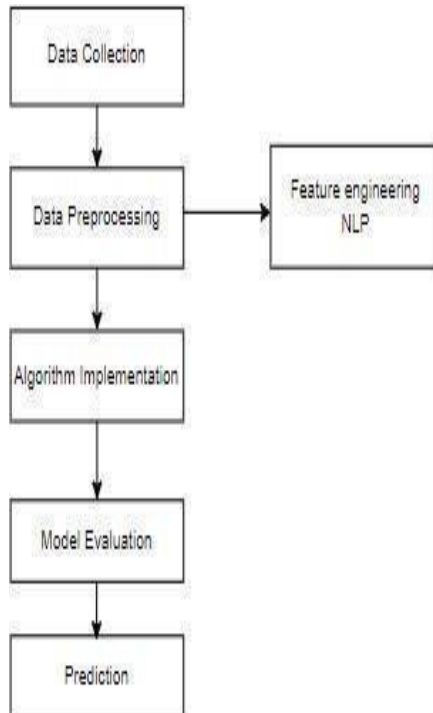


Fig1:Proposed System architecture

User:

1. **Data upload module:** this module enables users to securely upload their e-learning activity data for analysis and classification by implementing measures such as encryption and data anonymization techniques users can trust that their personal information remains confidential throughout the process
2. **Data preprocessing module:** prior to analysis the data preprocessing module ensures that users data is cleaned anonymized and features are extracted this protects users personal information while also enhancing the accuracy of classification algorithms by

providing high- quality standardized input data.

3. **Algorithm implementation module:** users benefit from the systems utilization of advanced machine learning algorithms including convolutional neural networks cnn decision trees and linear discriminant analysis lda these algorithms accurately classify users activities and offer valuable insights into their learning habits aiding in personalized learning experiences.
4. **Model evaluation:** module this module empowers users to assess the performance and accuracy of the classification models by providing comprehensive evaluation metrics and visualization tools users gain a deeper understanding of the systems effectiveness and can make informed decisions about its utilization.
5. **Prediction module:** users can access predictions regarding their levels of engagement in e-learning activities through this module by leveraging machine learning models users can determine whether they are effectively utilizing their time or potentially underutilizing it this feature ultimately enhances the overall e-learning experience by enabling users to optimize their learning strategies and maximize productivity without compromising privacy.

For System:

1. **Data Upload Module:** This module securely gathers user-generated data from diverse e-learning platforms and stores it within the system for subsequent processing. It employs robust encryption and authentication protocols to ensure the confidentiality and integrity of the transferred data.
2. **Data Preprocessing Module:** Data preprocessing is a crucial step to refine the collected information. This module focuses on cleansing the data, anonymizing personally identifiable details, and extracting pertinent features. By standardizing and organizing the data effectively, it sets the stage for accurate analysis and classification.
3. **Algorithm Implementation Module:** Advanced machine learning algorithms, including Convolutional Neural Networks (CNN), Decision Trees, and Linear Discriminant Analysis (LDA), are deployed in this module to classify user activities based on the preprocessed data. These algorithms are fine-tuned to optimize performance and ensure precise categorization of e-learning behaviors.
4. **Model Evaluation Module:** Rigorous evaluation techniques are employed in this module to assess the effectiveness and reliability of the classification models. Comprehensive metrics and cross-validation methods are utilized to gauge the models' accuracy and generalization capabilities, providing insights into their real-world performance.
5. **Prediction Module:** Utilizing the classified activities, this module generates predictions regarding user engagement levels within the e-learning platform. These predictions serve as valuable insights for educational institutions and administrators, enabling them to tailor interventions, optimize resource allocation, and enhance the overall e-learning experience for users.

Home: This Is "Detecting activity in E-Learning: Federated Learning for On-Screen Activity Tracking using Federated Learning" Home Page.

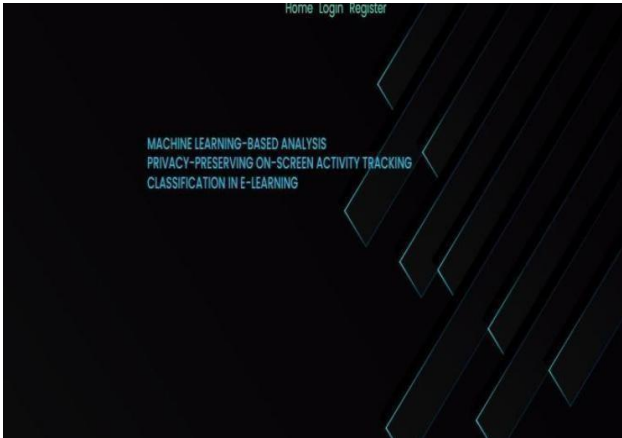


FIG 2:Home Page For On-Screen Activity

Login page: "Secure your learning journey with On-Screen Activity Tracking. Log in securely for personalized e-learning experiences. Load and preprocess the image dataset, ensuring compatibility with the input format expected by the Transformer network."

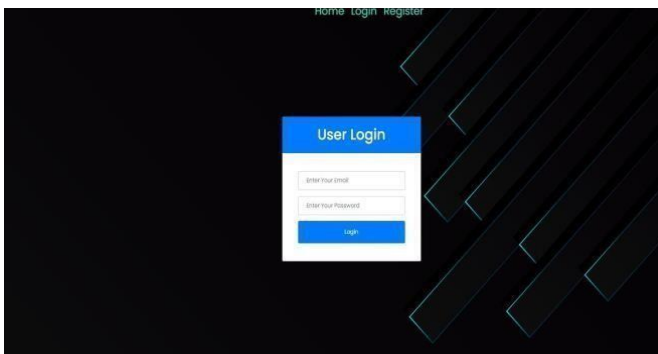


FIG 3:Login page for on screen activity

Register Page: "Register to safeguard your privacy while learning online. Join our federated Learning platform for personalized e-learning experiences."

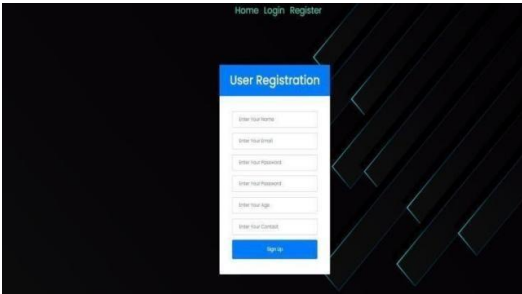


FIG 4: Register page for onscreen activity

View data: View data securely with Federated Learning tech for privacy in e-learning

Activity	Category	Value 1	Value 2
Reviewing course lecture slides	Utilizing Time for Knowledge Development	52	54
Playing a video game	Utilizing Time for Knowledge Development	73	61
Playing a video game	Utilizing Time for Knowledge Development	69	65
Watching Khan Academy math tutorial	Utilizing Time for Knowledge Development	45	61
Watching TV shows	Wasting Time	12	60
Watching reddit forum or lecture video	Utilizing Time for Knowledge Development	13	62
Checking email	Wasting Time	39	28
Playing online crossword puzzles	Utilizing Time for Knowledge Development	60	71
Watching cool videos on YouTube	Wasting Time	62	62
Playing online crossword puzzles	Wasting Time	41	65
Checking email	Utilizing Time for Knowledge Development	76	64
Solving programming exercises	Utilizing Time for Knowledge Development	66	63
Participating in an online quiz	Wasting Time	88	27
Watching an episode for a class assignment	Wasting Time	70	70
Scrolling through social media feeds	Utilizing Time for Knowledge Development	65	70
Scrolling through social media feeds	Utilizing Time for Knowledge Development	65	23
Reading or scientific research paper	Utilizing Time for Knowledge Development	36	70
Playing a video game	Utilizing Time for Knowledge Development	26	66
Online shopping	Utilizing Time for Knowledge Development	12	52
Checking email	Utilizing Time for Knowledge Development	37	60
Watching an episode for a class assignment	Utilizing Time for Knowledge Development	54	69
Playing online crossword puzzles	Utilizing Time for Knowledge Development	18	36
Online shopping	Utilizing Time for Knowledge Development	19	65

FIG 5: Viewing Dataset For On-Screen Activity

Model Selection: Utilizing Federated Learning for On-Screen Activity Tracking using Federated Learning."

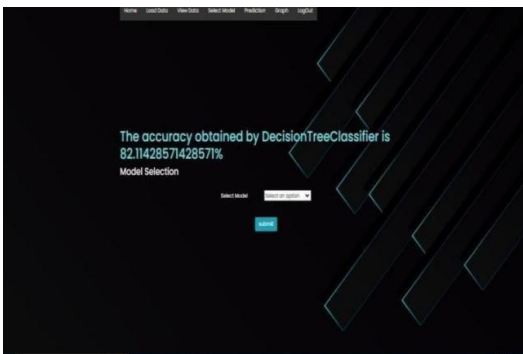


FIG 6: Selecting Model For On-Screen Activity

Prediction: "Predicted user actions based on on-screen activity in e-learning platforms."

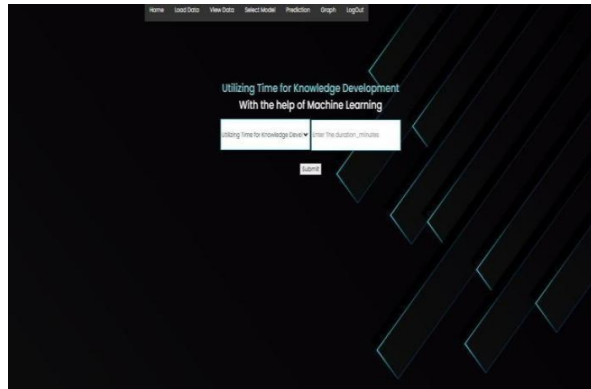


FIG 7: Prediction For On-Screen Activity

Result of Activity Description Duration:How students are effectively spending on their work activity graph can be displayed using this bar graph shown below:

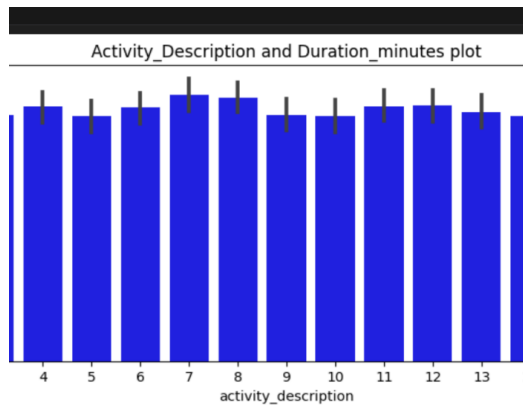


FIG 8 :Activity Description For On-Screen Activity

4 CONCLUSION

In summary the integration of on-screen activity tracking using federated learning marks a significant milestone in reconciling data analytics with user privacy concerns this innovative strategy not only safeguards users sensitive information but also cultivates a secure and reliable e-learning environment through the utilization of federated learning the model continually refines its performance without compromising the privacy of individual users data thereby effectively addressing the privacy challenges often associated with conventional centralized tracking systems this approach contributes to the evolution of personalized learning experiences while maintaining a steadfast commitment to user privacy fostering a more ethical and sustainable incorporation of technology in education as the role of technology continues to evolve in the realm of e-learning this privacy-centric framework serves as a promising cornerstone for

responsible and impactful educational analytics by optimizing data analysis processes while upholding stringent privacy standards educational institutions can harness the transformative potential of data-driven insights without sacrificing the confidentiality or trust of their users in essence the adoption of On-Screen Activity Tracking Using Federated Learning represents a positive advancement in e-learning analytic offering a secure ethical and forward- thinking approach to leveraging technology for educational.

5 FUTUREWORK

Future enhancements for privacy-preserving on-screen activity tracking and classification in e-learning using federated learning could include refining model accuracy through advanced machine learning algorithms. Integrate differential privacy techniques to ensure individual user data remains confidential while still contributing to the overall model's improvement. Implement adaptive learning mechanisms to tailor the tracking and classification models to individual user preferences, enhancing personalized learning experiences without compromising privacy. Explore the integration of multi- modal data sources, such as incorporating eye-tracking or sentiment analysis, to provide a more comprehensive understanding of user engagement. Additionally, research on optimizing federated learning protocols to reduce communication overhead and enhance scalability for large-scale e- learning platforms, ensuring efficient and secure collaboration across diverse user environments

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