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ITC 130 – Applications Development in Emerging Technologies

PROJECT X: Automated Attendance Tracking System Research Document

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The development of a reliable, secure, and efficient Automated Attendance Tracking System (AATS) requires careful integration of various emerging technologies and tools. From cloud computing and data encryption to version control and software testing strategies, each component contributes to building a system that is scalable, maintainable, and user-centric.

Barcode scanning is widely used in tracking systems for its speed and reliability. In academic settings, it automates the attendance-taking process by scanning student ID barcodes, thereby minimizing human error and manual record-keeping. Wu et al. (2019) emphasized that barcode-based attendance solutions reduce classroom time spent on roll calls and enable real-time data collection and validation.

Cloud computing supports educational institutions by offering scalable, cost-efficient, and reliable infrastructure for storing and processing large datasets. A cloud-based architecture allows the system to remain accessible from any location while ensuring real-time synchronization. As Sultan (2010) notes, cloud solutions eliminate the need for in-house hardware and simplify maintenance through third-party platforms like AWS, Azure, or Firebase.

RBAC ensures that users only access the parts of the system relevant to their roles such as admin, instructor, or student. Sandhu et al. (1996) proposed RBAC as a standard model for managing permissions efficiently, reducing the risk of internal breaches and ensuring data integrity. In systems handling sensitive student records, RBAC becomes essential for organizational security.

To reinforce login security, MFA is implemented for instructors, requiring more than one method of verification. MFA protects against unauthorized access even if a user's password is compromised. Alotaibi (2019) demonstrated that incorporating MFA reduces account hijacking incidents and enhances overall trust in web-based platforms.

HTTPS ensures secure communication over the internet by encrypting transmitted data using Secure Sockets Layer (SSL) or Transport Layer Security (TLS). Rescorla (2000) explains that SSL prevents eavesdropping, data tampering, and forgery essential features for protecting student information in educational systems.

For analysis and record-keeping, data export in CSV format is simple, lightweight, and universally compatible. It enables educational administrators to review attendance data in tools such as Microsoft Excel or Google Sheets. Padhy et al. (2012) noted that CSV formats are ideal for handling tabular data in low-resource environments due to their minimal processing requirements.

GitHub is a collaborative development platform that hosts source code and tracks project changes using Git version control. It provides branch management, issue tracking, and pull requests essential for team-based development. According to Loeliger and McCullough (2012), using GitHub in software projects ensures code integrity, facilitates peer reviews, and simplifies the process of reverting changes or resolving conflicts.

TDD is a software development practice where test cases are written before the actual code is implemented. It promotes better design, reduces bugs, and results in more reliable software. Beck (2003), the originator of TDD, described it as a cyclic process of writing a test, coding just enough to pass the test, and refactoring the result. For critical systems like attendance trackers, TDD ensures that functionalities such as barcode scanning or report generation work consistently.

The successful implementation of an Automated Attendance Tracking System requires the careful orchestration of multiple technologies. Barcode scanning facilitates real-time attendance, cloud computing ensures scalability and accessibility, and security technologies like MFA, RBAC, and HTTPS protect sensitive data. Tools like GitHub support collaborative development, while

TDD enforces systematic testing for software reliability. By grounding the system design in proven technologies, this project offers a comprehensive, secure, and scalable solution to enhance attendance monitoring in educational institutions.

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