SMART ATTENDANCE MANAGEMENT SYSTEM WITH TIME-WEIGHTED ATTENDANCE SCORING (TWAS) ALGORITHM

Yash Chaudhari*, Ashutosh Patil, Kalash Laddha***, Om Ahir****, Gauresh Gadhe*****, Prof. Amarnath Chadchankar******

*(Department of Computer Science, DY Patil School of Technology and Research, Pune, India. Email:chaudhariyash3006@gmail.com)
**(Department of Computer Science, DY Patil School of Technology and Research, Pune, India. Email: ashutosh.patil9750@gmail.com)
***(Department of Computer Science, DY Patil School of Technology and Research, Pune, India. Email: laddhakalash2006@gmail.com)
****(Department of Computer Science, DY Patil School of Technology and Research, Pune, India. Email: omahir112007@gmail.com)
*****(Department of Computer Science, DY Patil School of Technology and Research, Pune, India. Email: gadherugved@gmail.com)
******(Department of Computer Science, DY Patil School of Technology and Research, Pune, India. Email: amarnathchadchankar@gmail.com)

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Abstract:

Keeping track of student attendance is one of those tasks that every college deals with daily, yet most institutions still rely on the same old manual methods that eat into lecture time and leave room for errors. We ran into this problem ourselves and started thinking — why should a teacher have to call out 60 names when only 4 or 5 students are actually absent? That simple question led us to build SAMS, the Smart Attendance Management System. Instead of marking who is present, SAMS marks everyone as present by default and only requires the faculty to mark those who are absent. Beyond that, we noticed another issue: a student who missed half the semester early on but has been attending every class recently gets treated the same as one with the opposite pattern. That does not seem fair. So we developed the Time-Weighted Attendance Scoring (TWAS) Algorithm, which gives more importance to recent lectures than older ones. The result is an attendance score that actually reflects how engaged a student is right now, not just historically. The system also generates downloadable reports for each student, all through a web interface that needs no special hardware to run.

Keywords *— Attendance Management, TWAS Algorithm, Time-Weighted Scoring, Web Application, Educational Technology, Default Present Mechanism.*

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I. INTRODUCTION

Walk into any engineering college in India and you will likely see the same scene — a teacher calling out names from a register while students half-listen, waiting for class to actually start. It is a routine that has barely changed in decades, despite everything else around it changing completely. AICTE requires a minimum of 75% attendance for engineering students, so tracking it is not optional. But the way it is done has not kept up with the times [1].

For a batch of 60 to 120 students, manual attendance can take anywhere from 5 to 10 minutes per lecture. Multiply that across a full semester and it adds up to hours of teaching time lost to roll calls. The problem does not stop there. Once that data is collected, the percentage calculated at the end of the semester treats every single lecture as equally important — a class attended in week one counts the same as one attended last week. That makes it hard to see whether a student has genuinely improved their habits or whether their good early attendance is masking recent absences.

There are digital systems out there — biometric scanners, RFID readers, facial recognition setups — but most of them require hardware that many institutions simply cannot afford or maintain [2][3]. Software-only options tend to be basic, offering little more than a digital version of the same old percentage calculation [4]. We wanted to build something different: a system that saves time, scores attendance fairly, and works on any device with a browser. That is what SAMS is.

II. MOTIVATION AND OBJECTIVE

A. Motivation

The idea for SAMS came from a frustration most students and teachers share but rarely do anything about. Watching a teacher spend the first ten minutes of every class doing roll call, or seeing a classmate get penalized despite genuinely trying to improve their attendance — these are problems that feel small individually but add up to real inefficiency and unfairness at scale.

We looked at existing solutions and found that almost all of them either required expensive hardware or stuck with the same percentage-based scoring that has been around forever. Nobody had asked the obvious question: what if we weighted recent attendance more than older attendance? A student who struggled in September but has not missed a class since November deserves a different score than one who coasted early and then stopped showing up. That gap in existing systems motivated us to build something that actually reflects student behavior as it stands today, not just as an average of everything that happened since day one [2][3][7][8].

B. Objectives

The goal of SAMS is to build something practical — a system that a real college can actually use without buying new hardware or training their staff on complex software. Here is what we set out to do:

1. Build a web-based attendance system where marking absent students is the only action required from faculty, rather than marking everyone individually.

2. Develop the TWAS Algorithm so that attendance scores reflect how engaged a student is right now, giving more weight to recent lectures.

3. Cut down faculty interaction per session from N actions (one per student) to A actions (one per absentee), where A is almost always much smaller than N.

4. Give administrators the ability to download attendance reports per student, per subject, without any extra steps.

5. Make the whole thing run on a standard web setup with no specialized devices needed.

III. RELATED WORK

A lot of research has gone into automating attendance, and the work is genuinely impressive in places — but it keeps running into the same walls. Oluyemi et al. [5] built a facial recognition system that accurately identifies students without them doing anything at all. It works well, but it needs good cameras and enough processing power to handle real-time recognition, which rules it out for most regular classrooms. There was also no attempt to score attendance based on when classes were attended, just whether they were.

QR code systems, like the one explored by Zerach and Nasien [6], took a lighter approach — students scan a code displayed in class to mark themselves present. No hardware beyond a smartphone is needed, which is great. But the system is easy to beat: someone can share the QR code with a friend who is not in the room. And again, the scoring is just a straight percentage.

On the hardware side, Tripathi et al. [7] combined fingerprint readers with blockchain to make records both secure and tamper-proof. The blockchain element is clever — it means no one can quietly edit attendance data after the fact. But fingerprint scanners at every classroom door is a significant investment, and the paper acknowledged this as a real barrier to adoption.

Shoewu et al. [8] took a similar direction with IoT-connected biometrics, managing to verify a fingerprint in about four seconds with minimal power draw. Technically solid, but still tied to hardware at every location. Mohan and Singh [9] went the blockchain route for a different reason — to ensure that attendance records cannot be tampered with, using a distributed ledger rather than central storage. The trade-off was latency; blockchain consensus takes time, and real-time updates suffered for it.

Balasubramaniam et al. [10] tried to get the best of both worlds by combining facial detection using OpenCV with blockchain for security. It is an interesting combination but brings together the hardware requirements of computer vision and the overhead of blockchain in one system. Ahmed et al. [11] shifted focus away from the attendance process itself and looked at how attendance data, once collected, can predict academic outcomes. Their work confirmed that attendance is one of the strongest indicators of student performance — which reinforces why getting the scoring right matters so much.

Gupta et al. [12] built a web-based system that automates the timetable-based marking process and even deployed it on the cloud. They noted that percentage-based scoring was a limitation and called for smarter scoring in future work. Zhao et al. [13] integrated IoT with smart classroom infrastructure to track attendance dynamically, but the scoring remained conventional. Kuvshinov et al. [14] explored blockchain-based DAO governance for attendance management — an innovative governance model, but one that adds significant complexity for what should be a straightforward administrative task. A broader review by Psyridou et al. [15] confirmed that recency-sensitive metrics consistently outperform flat averages in predicting current student engagement, which directly supports the motivation behind TWAS.

TABLE I

COMPARISON OF EXISTING ATTENDANCE SYSTEMS WITH PROPOSED SAMS

Student Attendance Pattern	Total Attended	Conventional %	TWAS Score %
Irregular early, regular recently	7/10	70%	81.3%
Regular early, irregular recently	7/10	70%	58.7%
Consistently regular	10/10	100%	100%
Consistently irregular	5/10	50%	50%

B. Overlaps and Differences

Looking across the existing work, a pattern emerges: systems either go deep on accuracy through complex models and hardware, or they stay lightweight but offer no improvement on how attendance is scored. SAMS sits in a different space. It is lightweight like the web-based and QR approaches, but it introduces something none of them have — a scoring algorithm that actually changes based on when attendance happened, not just whether it happened. That is the gap SAMS fills.

IV. RESEARCH GAP

A. What is Missing in Existing Work

The gap that stands out most clearly after reviewing existing systems is not about accuracy — many of them get that right. The gap is about fairness and practicality. Every system reviewed calculates attendance as a flat percentage: total lectures attended divided by total lectures held. This means a student who attended every class in the first half of the semester and then stopped showing up looks identical to a student who missed the first half and has attended every class since. These are very different situations, and a flat percentage cannot tell them apart.

Equally, most systems that achieve good results rely on hardware — cameras, fingerprint scanners, RFID readers — that many institutions cannot afford. The lightweight alternatives that skip the hardware offer no scoring innovation. No existing lightweight system applies time-based weighting to attendance scoring. That is the specific gap SAMS addresses.

B. Challenges Not Addressed by Prior Studies

Beyond the scoring issue, prior systems have left several practical challenges unresolved. Real-time lightweight operation is one — systems that depend on model inference or blockchain consensus cannot always deliver instant results. Integrated report generation is another; most open-source options require separate tools to produce downloadable reports. And hardware-free deployment remains a challenge for almost every system that achieves meaningful accuracy improvements.

C. Why This Work is Needed

Colleges need a system they can actually deploy — one that runs on existing infrastructure, requires no new devices, saves time for faculty, and gives students a fairer assessment of their attendance behavior. SAMS was built to meet all of those requirements, and the TWAS Algorithm was developed specifically to address the scoring fairness gap that no prior lightweight system has tackled [12][15].

V. PROPOSED SYSTEM

A. System Components and Workflow

SAMS has four main parts working together. The frontend is a web interface that faculty access through any standard browser — no installation needed. The backend handles the logic: receiving session submissions, running the TWAS calculation, and serving data to the frontend. A database stores student records and attendance history. And the TWAS engine sits at the centre of it all, recalculating weighted scores every time a session is submitted.

The flow is straightforward. Faculty log in, select their subject, and start a session. The system immediately loads the full class roster with every student marked as present. Faculty scroll through and tap on anyone who is absent — that is the only action required. Once submitted, the TWAS engine runs in the background, and updated records are immediately available. Reports can be downloaded at any point.

B. Default Present Mechanism

The default-present mechanism flips the traditional approach. Instead of marking who showed up, faculty mark who did not. For a class of 60 students where 5 are absent, this cuts the number of actions from 60 to 5 — a 91.7% reduction. Over a full semester of lectures, this adds up to a significant amount of time returned to actual teaching. The idea is simple, but its impact on daily workflow is real [1][12].

C. TWAS Algorithm

The TWAS Algorithm works on a straightforward principle: the more recent a lecture, the more it should count. For a subject with N total lectures, we assign each lecture i a weight equal to i divided by N. So the very first lecture gets a weight of 1/N, and the most recent lecture gets a weight of N/N, which equals 1. The weighted score is then:

$$S = [\, \Sigma\, (W(i) \times A(i)) \;/\; \Sigma\, W(i) \,] \times 100$$

Here A(i) is 1 if the student attended lecture i and 0 if they did not. The result is a score that rises faster for students who have been consistently attending recently, and falls for those whose attendance has dropped off. Table I shows what this looks like in practice — two students with exactly the same number of absences can have TWAS scores that are over 20 percentage points apart, depending on when those absences happened.

D. Diagrams

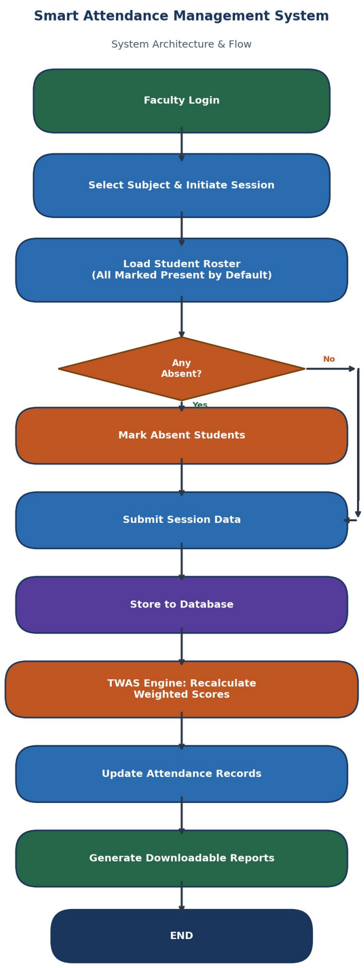

Fig. 1 System Architecture of SAMS

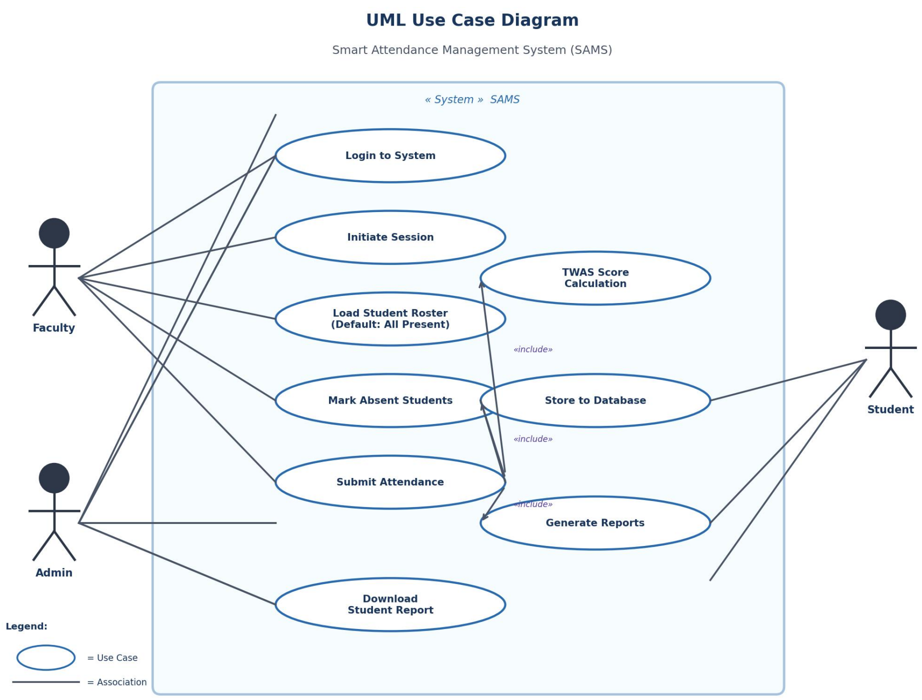

Fig. 2 UML Use Case Diagram of SAMS

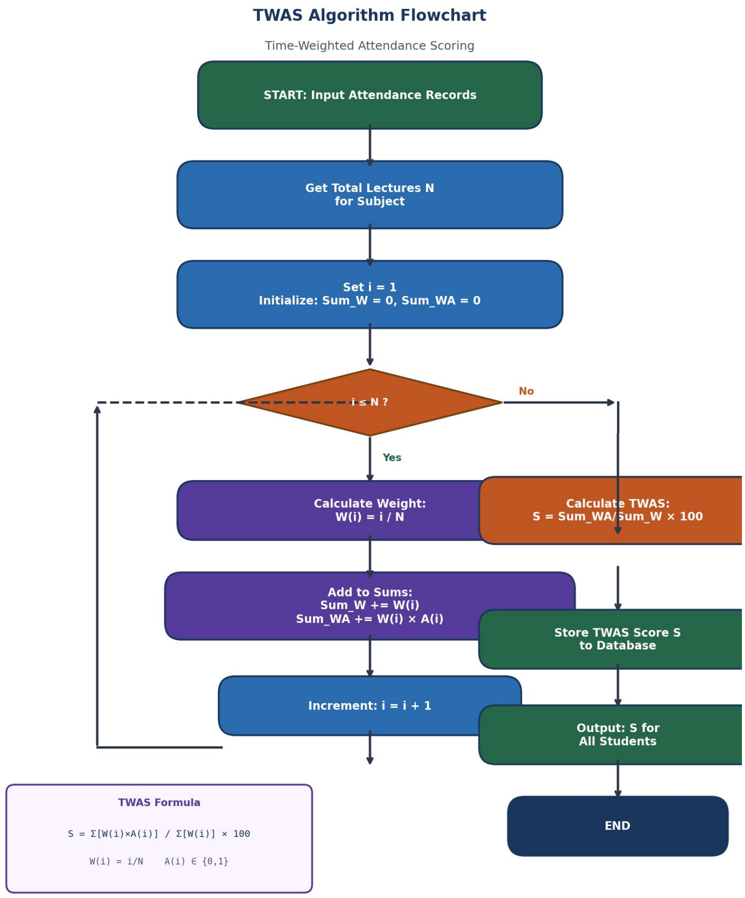

Fig. 3 TWAS Algorithm Flowchart

VI. ADVANTAGES

The most immediate benefit of SAMS is the time it saves. Faculty no longer have to work through an entire class list — they only interact with the students who are absent, which in most sessions is a small fraction of the total. The TWAS Algorithm brings a fairness improvement that no other lightweight system currently offers: students are scored on their current behavior, not just their historical average. Because the system is entirely web-based, it works on any device with a browser and does not require a single piece of additional hardware. Downloadable reports mean administrators get the data they need without chasing faculty for spreadsheets. And because both a conventional percentage and a TWAS score are available, institutions can compare them and make more informed decisions about student support.

VII. APPLICATIONS

Engineering colleges with large batch sizes stand to benefit the most from the default-present mechanism, since the time savings scale with class size. Schools managing multiple sections with different teachers can use SAMS across all classrooms through a single web deployment. Corporate training teams running mandatory sessions can track participation without setting up any new infrastructure. Online and hybrid learning platforms could integrate SAMS to monitor synchronous session attendance. Coaching institutes juggling multiple batches and subjects can manage everything in one place.

VIII. CONCLUSION AND FUTURE SCOPE

A. Conclusion

We built SAMS because we saw a genuine problem that existing solutions were not solving. Manual attendance wastes teaching time, and flat percentage scoring does not capture whether a student has improved or declined over the course of a semester. The default-present mechanism addresses the first problem by reducing faculty actions per session to just the number of absentees. The TWAS Algorithm addresses the second by giving recent lectures more influence over the final score than older ones. Table I shows clearly that two students with the same total absences can have very different TWAS scores depending on when those absences occurred — which is exactly what a fair attendance metric should reflect. SAMS does all of this without requiring any hardware beyond what a college already has.

B. Future Scope

There is a lot more SAMS could do with more development time. The most useful next step would be adding facial recognition through the device camera, which would prevent proxy attendance without requiring any dedicated hardware — just the phone or laptop already in the classroom. A mobile app would make the faculty experience even smoother. We would also like to train a model to automatically tune TWAS weights based on institutional data, rather than using the linear formula we have now. Connecting SAMS to existing LMS platforms would let colleges pull attendance data into the same system they use for grades and assignments. And with enough historical TWAS data, there is a real opportunity to flag at-risk students early — before their attendance drops to a point where intervention is too late.

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