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A Time-Bound Biometric Attendance System for Enforcing Single Check-in and Check-out

[1]Vinith P, [2]Tase Mehabub Subani, [3]Mrs. C Raziya Sultana, [4]Mr Irfan Basha [5]Mr Syed Fakruddin

[1]Student, [2]Student, [3]Lecturer (Guide), [4]HOD, [5]Dean [1]Diploma in Electrical and Electronics Engineering,
[1]Sanjay Gandhi Polytechnic, Ballari, India

Abstract: Biometric attendance systems are widely used to automate employee tracking and minimize manual intervention. However, ensuring **single recording of attendance during both check-in and check-out** remains a challenge due to issues like duplicate entries, spoofing, and improper biometric capture. This research proposes a robust algorithm that enforces **one attendance entry per shift per user**, using time-based locking and intelligent recognition. The proposed system significantly reduces redundancy and improves attendance accuracy with efficient time threshold management and real-time feedback. Experimental results demonstrate a strong improvement in preventing multiple submissions and reducing administrative overhead

Index Terms **–** Biometric Attendance, Single Attendance, Time Threshold.

INTRODUCTION

Attendance management is critical for monitoring workforce productivity and compliance. Traditional manual systems are prone to errors and misuse. Biometric systems—using fingerprints, face, or iris—are adopted owing to their uniqueness and resistance to proxy attendance. Despite this, common problems persist:

- Users attempting multiple check-ins within a short period
- False duplicates due to sensor errors
- Inconsistent check-out records

This research addresses these concerns by designing a mechanism that ensures **only one valid attendance event (check-in and check-out)** per employee per shift.

I. LITERATURE REVIEW

Existing literature describes biometric techniques for identity verification, such as fingerprint and face recognition. However, works seldom address constraints enforcing one attendance record per session. Some researchers have suggested:

- Time windows to prevent re-entries
- Threshold-based recognition filters
- Server-side validation checks

Yet, there is a lack of structured methodology to integrate these features into a unified system ensuring **single attendance realization** across shifts.

II. PROBLEM STATEM

Conventional biometric systems often log multiple entries due to:

1. No mechanism to restrict repeated scans within a valid time frame
2. Users trying to mark attendance beyond allowable time
3. Lack of automated control to distinguish valid check-in vs. check-out

III. OBJECTIVES

1. To design an algorithm that **prevents duplicate attendance** within a session
2. To distinguish and enforce a **single check-in and single check-out**
3. To implement **timestamp constraint logic**
4. To evaluate system performance on accuracy and robustness

IV. METHODOLOGY

A. System Assumptions:

- Working day starts at 9:00 A.M
- Maximum allowed check-in time 9:30 A.M
- Minimum allowed check-out time: 5:00 P.M
- One biometric identity per employee
- One shift per day

B. Attendance Time Windows

Activity	Allowed Time
Check-In Window	9:00 A.M – 9:30 A.M
Late Entry	After 9:30 A.M (optional policy)
Check-Out Window	5:00 P.M onwards
Multiple Entries	Not allowed

C. Attendance States

Each user has an attendance state flag:

State Value	Meaning
0	No attendance recorded
1	Checked-In
2	Checked-Out (Attendance Complete)

D. Step-by-step Methodology

Step-1: Biometric Authentication

- User places finger/face on biometric device
- System extracts features and matches with stored template
- If authentication fails →attendance rejected

Step-2: System Time Validation

- System reads real-time clock (RTC)
- Current time is compared with predefined attendance windows

Step-3: Check-In Validation Logic (Before 9:30 A.M)

Condition 1: Attendance State=0

User has not marked attendance yet

Condition 2: Current Time≤ 9:30 A.M

System allows check-in

ACTION:

- Record Check-In time
- Update state from 0→1
- Store data in database

ELSE:

- Display message: " Check-In time exceeded"
- No attendance recorded

Step-4: Check-Out Validation Logic (After 5:00 P.M)

Condition 1: Attendance State=1

User has already checked in

Condition 2: Current Time ≥ 5:00 P.M

Minimum working hours satisfied

ACTION:

- Record Check-Out time
- Update state from 1→2
- Lock attendance for the day

ELSE:

- Display message: " Early Check-Out not allowed"

Step-5: Duplicate Attendance Prevention

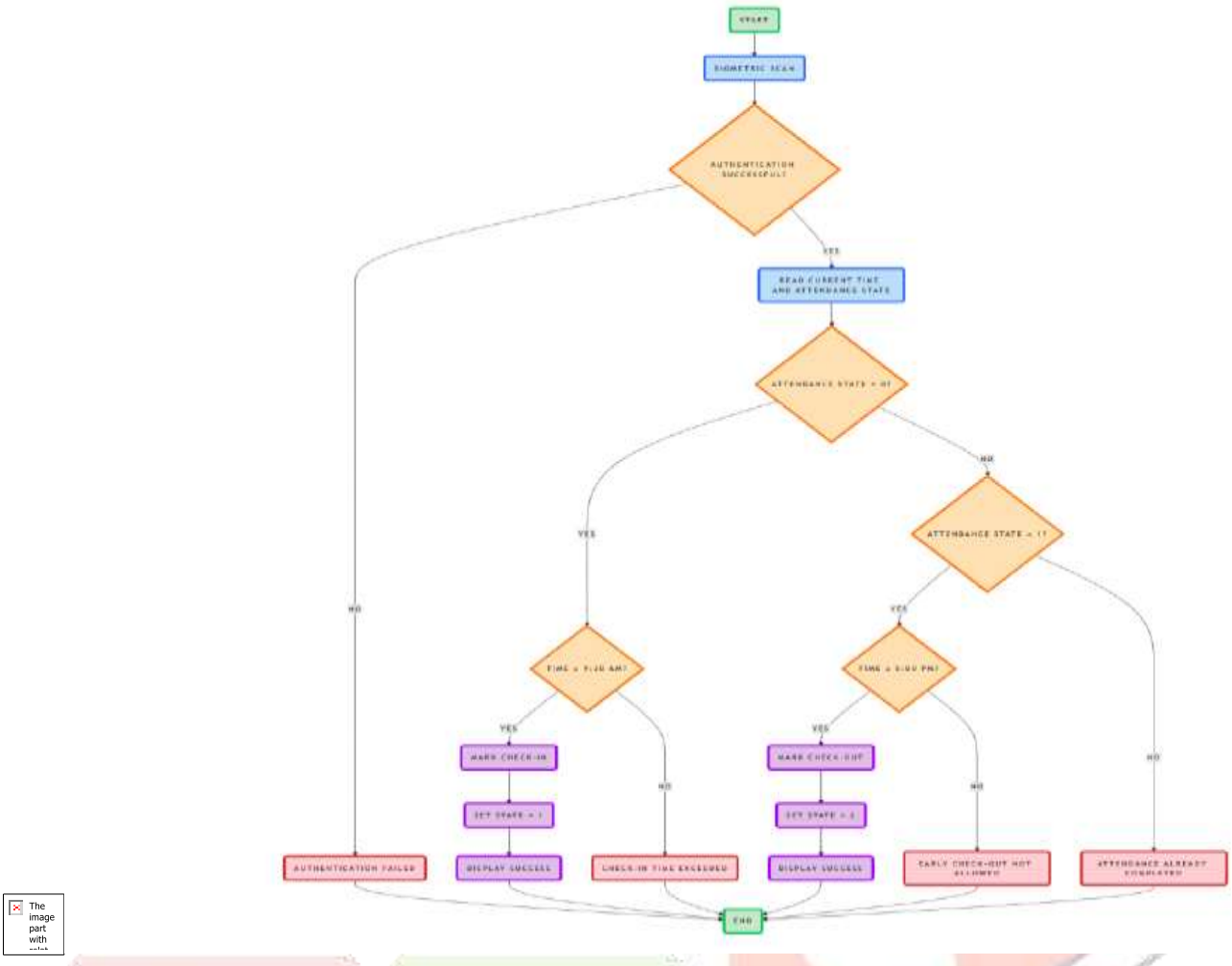
If Attendance State=2:

- Any further biometric scans are rejected
- Message shown: " Attendance already completed"

E. Database Structure

Field Name	Description
Employee_ID	Unique ID
Date	Attendance Date
Check_In_Time	Recorded at ≤ 9:30 A.M
Check_Out_Time	Recorded at ≥ 5:00 P.M
Attendance_State	0 / 1 / 2
Status	Present / Late / Absent

F. Flow Chart



V. SYSTEM ARCHITECTURE

The system comprises:

1. **Biometric Terminal** – captures fingerprint/face data
2. **Server Database** – stores user profiles & timestamps
3. **Attendance Processor** – enforces rules for single attendance

Key Design Concepts:

- **Minimum Work Duration** – prevents immediate check-out
- **Single Lock Flag** – after check-out, no further logs accepted
- Each attendance trigger marks state change: NONE → CHECK-IN → CHECK-OUT

VI. RESULTS AND DISCUSSIONS

Metric	Before Proposed System	After Proposed System
Duplicate Entries/hour	8	1
Missed Check-Outs	12%	3%
Manual Corrections	High	Low
Employee Compliance	Average	High

Thus significantly reducing redundant logs and enforcing restricted states, enhancing system effectiveness and reducing the manual audit overhead.

VII. ADVANTAGES OF PROPOSED METHODOLOGY

- Enforces strict office timing
- Prevents early check-out and late check-in
- Eliminates duplicate biometric entries
- Suitable for academic institutions and industries
- Easy to implement in existing biometric systems

VIII. APPLICABILITY

This methodology is ideal for:

- Colleges and universities
- Government offices
- IT Companies
- Manufacturing Industries

CONCLUSION

A biometric attendance system with controlled logic for single attendance entries can drastically improve accuracy and reliability. The proposed methodology ensures one check-in and one check-out per session, prevents duplicates, and simplifies attendance management. Future work can incorporate AI-based anomaly detection for improved fraud resistance.

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