ADHAN TIME: PRAYER POSITION DETECTION AND DEVICE UNLOCKING SYSTEM

FULL PATENT SPECIFICATION

FIELD OF THE INVENTION

[0001] The present invention relates to systems and methods for biometric authentication and access control for computing devices. More particularly, the invention relates to a computer vision-based system named "Adhan Time" for detecting and verifying Islamic prayer positions and sequences, and using successful prayer completion as an authentication mechanism for device unlocking.

BACKGROUND OF THE INVENTION

[0002] Islamic prayer (Salah) constitutes a fundamental religious obligation performed five times daily by Muslims worldwide. Each prayer session comprises a specific sequence of physical positions—standing (Qiyam), bowing (Ruku), prostration (Sujud), and sitting (Julus)—organized into units called "Rakaat," with different prayers requiring different numbers of Rakaat.

[0003] The proliferation of mobile devices among younger demographics has created significant challenges for parents and educators seeking to balance technology access with religious observance. Conventional access control mechanisms—including password protection, biometric authentication, and time-based restrictions—fail to address the specific need for verifying physical religious practices completion before granting device access.

[0004] Recent advancements in computer vision and pose estimation technologies, particularly frameworks such as MediaPipe developed by Google LLC, have enabled real-time detection and tracking of human body positions with high accuracy even on resource-constrained mobile devices. These technologies utilize machine learning models to identify key skeletal landmarks and track their spatial relationships over time.

[0005] Prior attempts to monitor prayer activities using technology have primarily focused on prayer time reminders or simple motion detection via accelerometers. However, these approaches cannot reliably distinguish specific prayer positions or verify proper prayer sequence completion, thereby presenting an unmet technological need addressed by the present invention, Adhan Time.

SUMMARY OF THE INVENTION

[0006] The present invention, Adhan Time, provides a novel system and method for detecting, classifying, and verifying Islamic prayer positions and sequences using computer vision techniques, and controlling device access based on verified prayer completion. The invention utilizes a mobile device's built-in camera in conjunction with pose estimation technology to capture, analyze, and authenticate user prayer activities.

[0007] In one aspect, Adhan Time comprises a specialized lockscreen implementation that can only be bypassed through properly completing Islamic prayer, as detected, verified, and authenticated by the device's integrated systems.

[0008] In another aspect, the invention implements sophisticated angle-based algorithms for accurately classifying prayer positions based on geometric relationships between skeletal landmarks, compensating for variations in user physiology, camera position, and lighting conditions.

[0009] In yet another aspect, Adhan Time provides a rakaat tracking system that monitors position transitions, enforces position duration requirements, validates proper sequence completion, and maintains count of completed prayer units.

[0010] The invention further includes security measures to prevent unauthorized bypass attempts, privacy protections during camera operation, and alternative authentication methods when needed.

DETAILED DESCRIPTION OF THE INVENTION

[0011] Fig. 1 illustrates the overall architecture of the Adhan Time prayer position detection and device unlocking system.

System Architecture

[0012] Adhan Time comprises several integrated subsystems working in concert:

[0013] A. Camera Management Subsystem:

- Initializes and configures device camera with appropriate resolution and frame rate

- Implements privacy safeguards including visual indicators during camera operation

- Manages camera lifecycle to minimize power consumption

- Handles camera permission acquisition and verification

[0014] B. MediaPipe Integration Layer:

- Configures the MediaPipe Pose Landmarker with optimal detection parameters

- Processes video frames to extract 33 skeletal landmark points

- Provides normalized coordinates with visibility confidence metrics

- Implements frame buffering for smooth processing

[0015] C. Prayer Position Classification Engine:

- Analyzes geometric relationships between landmark points

- Calculates critical angles including:

\* Spine angle (relationship between shoulders and hips)

\* Knee angles (for standing, bowing and prostration detection)

\* Elbow and wrist positions (for hand folding detection during standing)

- Applies temporal smoothing to filter detection noise

- Classifies positions with confidence scores

[0016] D. Rakaat Tracking Subsystem:

- Maintains state machine representing prayer progress

- Enforces minimum duration thresholds for each position:

\* Standing: 3000ms minimum

\* Bowing: 1000ms minimum

\* Prostration: 2000ms minimum

\* Sitting: 2000ms minimum

- Validates position sequence correctness

- Counts completed Rakaat units

- Manages prayer completion states

[0017] E. Secure Lockscreen Manager:

- Integrates with Android device administration APIs

- Prevents unauthorized bypass attempts

- Implements PIN-based override with security limitations

- Applies cooldown periods after failed unlock attempts

- Ensures secure screen state maintenance

Position Classification Algorithm

[0018] The Adhan Time prayer position classification algorithm operates by analyzing specific angular relationships between key body landmarks. The following details the technical implementation:

[0019] For Standing (Qiyam) Position Detection:

- Calculate spine angle between mid-shoulder point and mid-hip point

- Verify spine angle falls within STANDING\_SPINE\_ANGLE\_RANGE (180.0° to 270.0°)

- Calculate both left and right knee angles

- Verify knee angles fall within STANDING\_KNEE\_ANGLE\_RANGE (160.0° to 200.0°)

- Calculate distance between wrists and chest center point

- Verify wrists are in proximity to chest (distance < HANDS\_FOLDED\_THRESHOLD)

- Apply temporal smoothing using exponential weighted average with SMOOTHING\_FACTOR

- Classify as Standing when all conditions are satisfied with required confidence threshold

[0020] For Bowing (Ruku) Position Detection:

- Calculate spine angle between mid-shoulder point and mid-hip point

- Verify spine angle falls within BOWING\_SPINE\_ANGLE\_RANGE (210.0° to 320.0°)

- Calculate both left and right knee angles

- Verify knee angles fall within BOWING\_KNEE\_ANGLE\_RANGE (140.0° to 220.0°)

- Calculate relative shoulder and hip heights

- Verify shoulders are below initial standing height but above hip level

- Apply temporal smoothing with SMOOTHING\_FACTOR

- Classify as Bowing when all conditions are satisfied with required confidence threshold

[0021] For Prostration (Sujud) Position Detection:

- Calculate height relationship between nose landmark and mid-hip point

- Verify nose position is below hip position (nose.y > midHipHeight)

- Calculate both left and right knee angles

- Verify knee angles fall within PROSTRATION\_KNEE\_ANGLE\_RANGE (70.0° to 160.0°)

- Apply temporal smoothing with SMOOTHING\_FACTOR

- Classify as Prostration when all conditions are satisfied with required confidence threshold

[0022] For Sitting (Julus) Position Detection:

- Calculate spine angle between mid-shoulder point and mid-hip point

- Verify spine angle falls within SITTING\_SPINE\_ANGLE\_RANGE (140.0° to 220.0°)

- Calculate both left and right knee angles

- Verify knee angles fall within SITTING\_KNEE\_ANGLE\_RANGE (40.0° to 140.0°)

- Calculate height relationships between landmarks

- Verify hip position is lowered relative to standing position

- Apply temporal smoothing with SMOOTHING\_FACTOR

- Classify as Sitting when all conditions are satisfied with required confidence threshold

Rakaat Tracking Implementation

[0023] The Adhan Time Rakaat tracking system utilizes a state machine approach to monitor prayer progress:

- Initialize expected position to Standing

- For each detected stable position:

\* If position matches expected position:

- Record position start time

- If position duration exceeds required threshold:

> Mark current position as completed

> Update expected position to next position in sequence

\* When Sitting position is completed after both Standing and Bowing:

- If not final Rakaat:

> Increment Rakaat counter

> Reset position completion flags

> Set expected position to Standing

- If final Rakaat:

> Start unlock timer

> Upon timer completion, trigger device unlock

[0024] The system enforces the following position duration requirements:

- Standing: Minimum 3 seconds

- Bowing: Minimum 1 second

- Prostration: Minimum 2 seconds

- Sitting: Minimum 2 seconds

[0025] For the final Rakaat, the system implements a FINAL\_UNLOCK\_DELAY of 25 seconds before triggering device unlock, allowing for the completion of final prayer elements.

Security Implementation

[0026] Adhan Time implements several security measures to prevent bypass attempts:

[0027] PIN Override Security:

- Limited to 3 attempts within a defined window

- Implements exponential backoff for failed attempts

- Stores PIN securely using EncryptedSharedPreferences

- Implements secure PIN input UI with visual masking

[0028] Anti-Spoofing Measures:

- Verifies continuity of landmark detection

- Monitors confidence scores across all required landmarks

- Requires minimum visibility thresholds for key landmarks

- Analyzes movement naturalness through jitter detection

[0029] Device Administration Integration:

- Registers as device administrator to prevent force-closure

- Monitors and responds to HOME and RECENT buttons

- Prevents task switching during locked state

- Implements screen-off detection and state restoration