Leveraging Edge AI for Smart Betting Terminals: A Literature-based Analysis of Current Trends and Future Opportunities

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ABSTRACT
Smart betting terminals operate as regulated high-volume transactional systems that serve lotteries and sports wagering markets. The systems need to respond right away while fully protecting data. They also must continue running without interruption. The current terminal systems use cloud processing to validate tickets and detect anomalies and analyze devices, which causes delayed operations and unstable network connections. Edge Artificial Intelligence solves this problem by enabling local inference operations that process data directly on-devices. The research presents a complete review of embedded inference systems, edge computing, hybrid systems, predictive maintenance, and systems engineering for regulated environments. The research methodology uses a structured approach to locate relevant studies. These sources are screened and combined into a single analysis. The research evaluates operational problems in smart betting terminals through Edge Artificial Intelligence solutions, which enhance system reliability, security, and response times. The research proposes an Edge Artificial Intelligence framework, which organizes findings to direct future system development. The research study reveals current knowledge deficiencies while showing potential directions for academic and industrial advancement.

Keywords
Edge Artificial Intelligence, Smart Betting Terminals, Embedded Inference, Edge Computing, Anomaly Detection, Predictive Maintenance.

1. INTRODUCTION
Smart betting terminals operate under strict regulations because they need to verify all transactions and store complete audit records [1]. The devices manage several functions, including ticket scanning operations, payout requests, identity verification, cash deposit processing, account management, and risk-based system interactions [2]. The systems need to respond quickly while maintaining high operational reliability and protecting sensitive data to fulfill all regulatory standards [3]. The performance of smart betting terminals depends on three main factors, which include latency, network stability, and backend system performance [4].

The current betting systems perform validation, analytics, and fraud detection through cloud-based servers. The cloud-based system design makes terminals dependent on external networks while creating performance bottlenecks when many users access the system [5]. The retail network experiences delayed ticket verification and payment processing because its connection system remains unstable [6]. Researchers and engineers have explored new approaches because current system limitations force them to reduce the difference between computational operations and devices.

Edge computing allows processing operations to take place directly on-device hardware. Edge Artificial Intelligence enables edge computing because it allows machine learning models to run directly on embedded processors [7]. Research studies show that running time-sensitive decision logic on-devices produces superior latency results and better privacy protection and operational stability [8]. The implementation of embedded models for anomaly detection and predictive maintenance and real-time analytics shows promising results in other regulated device sectors [9], [10].

The existing body of research about Edge Artificial Intelligence applications in betting terminals remains insufficient, despite significant progress in related fields. The current research focuses on designing interfaces and developing backend systems and creating new innovations for gambling platforms [11]. The research investigates existing studies to extract valuable knowledge that applies to controlled betting systems.

2. BACKGROUND AND RELATED WORK
Smart betting terminals are equipped with embedded processors, bill validators, printers, ticket scanners, card readers, network modules, and secure cryptographic components [12]. The transaction process operates under strict regulatory rules that need both complete prediction capabilities and full audit trail functionality [13]. The devices function in various environments, which include retail stores, sports facilities, and automated payment machines that experience different levels of network reliability.

Industry reports show that betting terminals experience three main operational problems, which include slow network speeds, delayed cloud validation, and insufficient hardware failure detection [6]. Research on point-of-sale systems suggests that local processing enhances system reliability and decreases network dependency for sustained operations [14]. The research results provide value to the gaming industry.

Edge computing has become popular for low-latency applications because it processes information at the source location [7], [15]. Research on embedded inference shows that neural networks function well on small hardware platforms because of optimization methods, which include quantization, pruning, and architecture design [16]. The research shows that ARM processors and microcontrollers allow small model execution, which produces accurate results during interactive operations [17], [18].

Terminal environments need anomaly detection to operate as their main security protection system. AI-based methods use operational data from sensors and logs and user interactions to identify irregular system behavior [19]. Research studies about

kiosks and vending systems and other transactional devices demonstrate that operational reliability improves when anomaly detection systems are integrated into them because they detect system faults before they develop into major problems [9]. Research on predictive maintenance shows that detecting equipment problems at an early stage leads to better system uptime and lower maintenance expenses [20].

All terminal operations under regulatory oversight have security and privacy protection as their fundamental requirements. The local processing method protects data by minimizing the amount of information that needs to travel through external networks [21]. Organizations can meet their regulatory requirements through the combination of embedded rule enforcement with local access control systems [22], [1].

Research studies demonstrate that hybrid systems, which run inference operations on-devices and analytics operations in cloud environments, produce the best results for large distributed systems [23]. The system design enables terminals to perform vital operations independently while the cloud system handles model updates and performs storage operations and fleet analytics [24]. Research shows that this method reduces network bandwidth consumption while enhancing system reliability [25].

The existing body of research about Edge Artificial Intelligence applications in betting terminals remains insufficient, despite significant progress in related fields. The current research focuses on interface design and backend platforms and general gambling system innovations [11]. The research investigates existing studies to extract valuable knowledge that applies to controlled betting systems.

3. METHODOLOGY

The research uses a systematic literature review to find studies about Edge Artificial Intelligence and embedded inference and regulated device systems. The review methodology aims to present current edge computing research findings, which will help evaluate its suitability for smart betting terminals.

The review process began by searching for peer-reviewed articles and industry reports that were published during the previous few years. The research focused on studies that investigated embedded artificial intelligence systems and edge computing frameworks and anomaly detection methods and predictive maintenance approaches and security protocols for distributed systems. The review process focused on studies that provided valuable insights about real-time systems and regulated devices.

The analysis process started by evaluating titles and abstracts to discard irrelevant studies before performing full-text assessments on relevant papers to verify their methodological quality and relevance. The selection process focused on research that used empirical evidence to show its application to embedded systems and resource-limited environments and presented architectural components for transactional devices.

The selected literature received thematic organization based on recurring research patterns that emerged from the analysis. The research investigated four critical areas, which studied latency reduction methods and compact model creation and privacy protection analytics and edge-cloud system management and system operational stability improvement. The thematic organization enabled researchers to evaluate different studies against each other while discovering commonalities between them that apply to betting terminals.

The study methodology faces challenges because it does not have available datasets, and there is a lack of empirical studies about betting terminals. The review depends on transferable knowledge from financial kiosks and IoT devices and interactive real-time systems because no specific betting terminal data exists. The review methodology uses a structured method to assess Edge Artificial Intelligence in terminal environments, although it has limited application.

This paper follows a structured literature review process to examine how Edge AI has been applied to smart betting and other transactional terminal systems. Relevant studies were identified by searching established digital libraries such as IEEE Xplore, ACM Digital Library, SpringerLink, and ScienceDirect. The review primarily considers work published over the last six to seven years to reflect recent advances in edge computing and embedded intelligence. Search queries combined terms related to Edge AI, on-device inference, smart terminals, regulated environments, system latency, and operational reliability. Papers were selected based on their relevance to terminal class hardware, deployment in real world operational settings, and discussion of performance, security, or compliance considerations. Rather than reproducing experimental results, the analysis synthesizes findings reported in prior studies to highlight common architectural patterns, observed benefits, recurring challenges, and areas where further research is needed. For synthesis, the selected studies were grouped by their primary focus areas, including performance characteristics, security and compliance considerations, and deployment and operational patterns.

4. ANALYSIS AND DISCUSSION

The existing literature contains multiple vital components that will direct the creation of enhanced betting terminal systems. The main advantage of executing real-time decision logic directly on-device hardware has been established through research. Findings in the literature indicate that edge-based processing reduces response times, which results in faster ticket validation and payout confirmation and transaction logging operations. The system performance improves significantly when terminals function in networks that experience unstable connections and when cloud systems face congestion. Research on gaming systems and IoT systems demonstrates that user interface applications improve system reliability and overall performance, which often increases user satisfaction when latency falls below one millisecond [26].

All terminal operations that fall under regulatory oversight need security and privacy protection as their core requirements. Research shows that processing data at local locations reduces the chance of data interception and unauthorized access and manipulation because it decreases the amount of data that needs to be transmitted. Research on distributed Internet-of-Things systems demonstrates that edge data processing methods deliver superior privacy protection for systems that process confidential financial and personal data. By using a betting terminal inference model, organizations can meet regulatory requirements because it reduces network exposure and allows for full system monitoring.

Device-level constraints represent an essential theme that needs to be considered. The embedded processors inside smart betting terminals do not have enough processing power to run complicated or extensive models. Research on embedded artificial intelligence shows that neural networks can achieve efficient operation on low-power hardware through optimization techniques, which include quantization, pruning, and model architecture development. The research shows that

terminal functions at an advanced level can perform anomaly detection and fraud scoring and component health prediction without needing additional hardware or power consumption. To provide a consolidated view of these observations, Table 1 summarizes key findings reported across prior studies on Edge AI for smart terminal systems.

Table 1. Summary of key findings reported in prior work on Edge AI for smart terminals

Focus area	Reported benefit of Edge AI	Representative references
Latency and real time response	On-device inference reduces round trip dependence, supports faster decision making, and improves responsiveness in high volume transactional environments.	[4], [6], [7], [15], [26]
Reliability and operational resilience	Local processing enables continued operation during network instability, minimizes service disruption, and improves system availability in field deployments.	[6], [7], [23], [24], [25]
Security and regulatory compliance	Edge level controls limit data exposure, support localized enforcement of policies, and strengthen auditability in regulated terminal systems.	[1], [21], [22]
Deployment and lifecycle management	Hybrid edge cloud architectures balance real time decision making with centralized analytics, enabling scalable monitoring and controlled update workflows.	[23], [24], [25]

The reviewed studies evaluate Edge AI systems under a range of operational contexts rather than a single uniform dataset. Prior work examines transactional event streams, device telemetry, system logs, and fault or stress simulations to assess performance and robustness at the edge. While the specific datasets and evaluation setups vary across studies, together they cover diverse scenarios such as normal operation, peak transaction loads, intermittent connectivity, and degraded network conditions. This diversity of evaluation contexts allows literature to collectively reflect how Edge AI behaves across multiple deployment scenarios relevant to smart terminal environments, even when individual studies focus on a specific use case or dataset. As a result, the literature collectively provides broad coverage of operational conditions relevant to real world smart betting terminal deployments.

Big terminals need advanced software distribution systems and standardized configuration management and security maintenance to solve operational challenges that occur during deployment. Research on hybrid edge-cloud models demonstrates that distributed systems achieve better performance through edge-based real-time decision-making and cloud-based extended analytics and global model updates and fleet management. The system design allows terminals to run their own time-critical operations while they receive scheduled updates and essential parameter synchronization and extended analytics reporting. The proposed system design matches the requirements of betting terminal operations because it enables thousands of terminals to operate independently while maintaining network connectivity.

5. PROPOSED APPROACH

This study proposes a basic Edge AI framework for betting terminals, derived from patterns and practices reported in existing literature. Rather than introducing a new system design, the framework reflects how prior work commonly organizes on-device intelligence in regulated terminal environments. Six functional components work together to support real time decision making, system reliability, and compliance requirements.

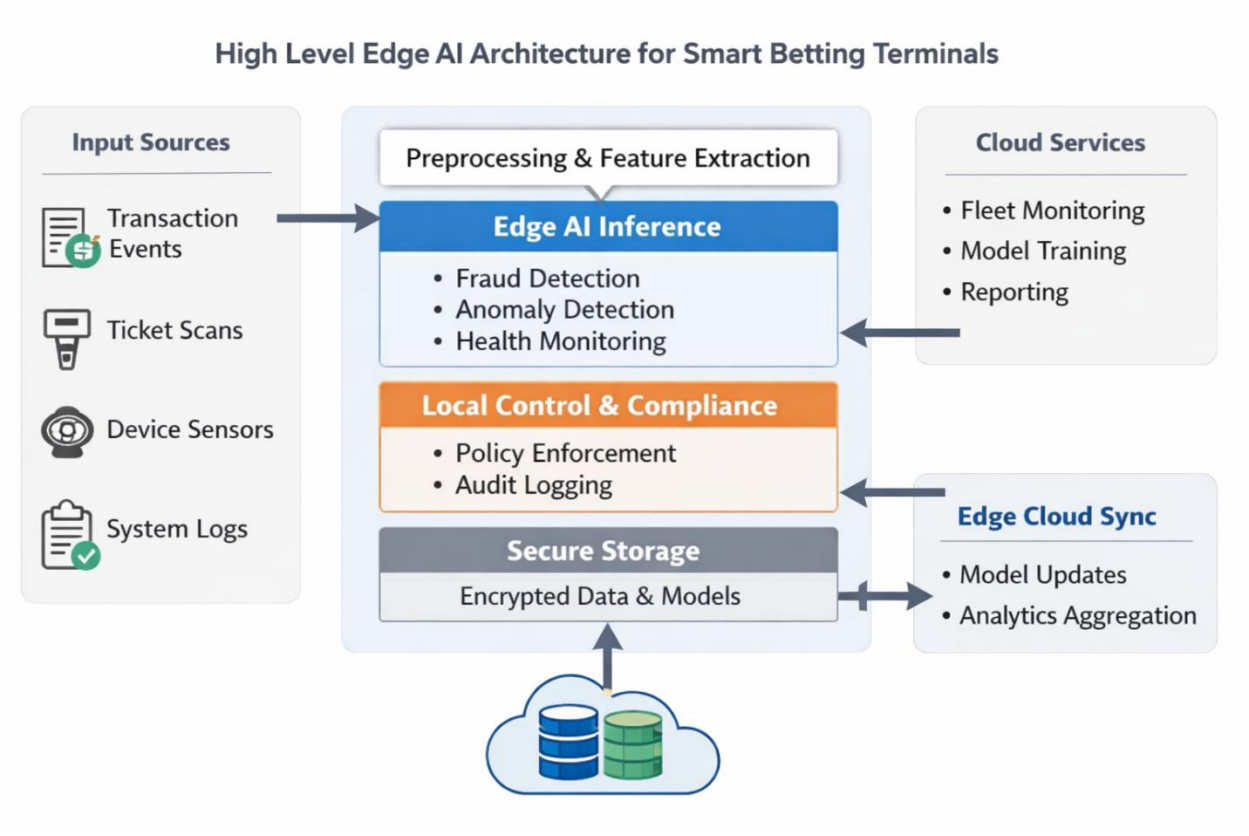

Fig 1: Conceptual Edge AI architecture for smart betting terminals derived from patterns reported in prior literature.

At the foundation, the framework includes a data collection component that gathers operational logs, sensor readings, device status information, and user interaction events generated during terminal operation. Incoming data is handled by a preprocessing component that performs noise reduction, normalizes inputs, and prepares features in a form suitable for embedded inference.

An embedded inference engine is responsible for real time analysis at the terminal. This component supports anomaly detection, score validation, and pattern recognition using optimized models designed to operate within the computational limits of terminal hardware. To protect sensitive information, a dedicated security component applies encryption, secure storage, access control, and rule-based enforcement aligned with regulatory expectations.

Communication with centralized services is handled through a synchronization component that supports model updates, configuration changes, and periodic aggregation of operational analytics. In addition, an operator interface exposes performance indicators and diagnostic information that can be accessed by management systems for monitoring and maintenance activities. Figure 1 presents this framework as a high-level conceptual architecture, synthesizing common components and data flows identified across the reviewed literature on Edge AI enabled smart betting terminals.

6. EXTENDED DISCUSSION

Edge AI technology brings multiple advantages to smart betting terminals, which extend beyond performance improvements to create long-term benefits for operational efficiency, regulatory compliance, and economic stability. The main advantage of Edge Artificial Intelligence implementation in terminals leads to better system reliability. The terminals perform embedded inference to monitor their internal components in real time for detecting first signs of wear and system anomalies through trained behavioral models. Industrial IoT settings use predictive maintenance systems, which show that anomaly detection before occurrence leads to better system reliability and lower maintenance expenses [9], [20]. The implementation of predictive maintenance algorithms for printers and bill validators and scanners and network modules in betting terminals will lead to better system availability.

The main advantage of Edge Artificial Intelligence implementation in terminals is its ability to enhance regulatory compliance. Betting terminals must operate with absolute predictability because regulatory bodies require them to meet auditing and logging and data retention standards. Research on secure embedded analytics demonstrates that local inference logic can embed rules for data access and processing and retention to ensure traceable and consistent device operations [1], [21], [22]. Terminal firmware systems achieve better regulatory compliance through compliance-oriented inference models which reduce their need for centralized rule enforcement systems.

The system requires solutions to address scalability problems that occur when operating with large terminal networks. Betting operators maintain large numbers of terminals across different locations, which creates expensive and complicated management challenges. Research on hybrid edge-cloud orchestration demonstrates that distributed systems achieve better performance through edge node real-time decision-making and cloud node management of extended processing tasks and global model updates and fleet management. The system design decreases bandwidth usage while creating a more dependable system architecture. The hybrid system design enables operators to handle terminal network expansion

efficiently while providing improved system reliability during peak usage periods.

The current research lacks sufficient studies about Edge Artificial Intelligence applications for betting terminals. The absence of publicly available betting terminal data makes it impossible for researchers to test their models while studying particular actions in this market. The development of synthetic datasets and simulation platforms for this industry sector has been proposed as an effective solution. There needs to be more research on secure firmware update systems that follow the rules for controlled software distribution for devices. Research needs to establish how fast validation operations affect customer satisfaction and operator performance to evaluate the user experience advantages of local inference processing.

7. CONCLUSION

The review suggests that Edge Artificial Intelligence can bring major benefits to smart betting terminals because it decreases latency while making operations more autonomous and secure and stable. The embedded inference system allows terminals to operate at high speed while keeping their operational capacity during network disruptions. The analytical framework indicates that edge-based analytics systems align well with regulatory requirements and risk management standards for controlled environments. The research demonstrates that embedded model optimization methods from IoT and embedded systems can be applied to the hardware constraints found in betting terminals.

The field provides various research opportunities despite major progress in IoT security and embedded model compression and distributed analytics. The development of synthetic datasets that mimic betting terminal operations should be a future research priority. The evaluation of embedded inference performance needs to continue across different hardware platforms and operational workloads and hybrid system maintenance requirements for extensive networks. The evaluation of edge-based solutions in real-world environments through pilot tests will demonstrate their potential to boost system reliability and fulfill regulatory standards.

8. REFERENCES

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