

Illegal Hoarding Detection and Alert Raising

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Abstract - Illegal hoardings and unauthorized advertisements have become a serious concern in modern cities, leading to visual pollution, safety hazards, and violations of government regulations. Traditional manual methods of identifying and removing such hoardings are inefficient and prone to errors. To address this challenge, this project introduces a Blockchain- and Database-based system for detecting, verifying, and managing illegal hoardings automatically. The proposed system integrates Artificial Intelligence (AI) for hoarding detection and uses Blockchain technology to securely store and verify data about legal and illegal advertisements. IoT-enabled cameras capture real-time images from public locations, which are analyzed by AI models to identify the presence of hoardings. The results are recorded in a blockchain ledger to ensure data immutability and transparency. A centralized database maintains records of authorized hoardings, allowing the system to cross-verify and detect any unauthorized installations. Once detected, alerts are automatically generated and sent to the municipal authorities through a secure web or mobile dashboard. This system ensures data integrity, security, and reliability while enabling real-time monitoring and rapid decision-making. By combining AI, blockchain, and database management, the solution supports smart city initiatives, reduces human intervention, and improves the overall efficiency of urban governance.

Key Words: Blockchain, Database Management, Artificial Intelligence, Illegal Hoarding Detection, IoT, Smart City, Alert Generation

1.INTRODUCTION

In modern urban areas, outdoor advertisements are a common form of marketing and public communication. Hoardings, banners, and billboards are placed at prominent city locations to attract attention and promote various brands or public messages. However, the rapid increase in illegal hoardings—those erected without official approval—has become a serious issue in

many cities. These unauthorized structures not only violate municipal laws but also contribute to visual clutter, obstruct traffic visibility, and sometimes even cause accidents or structural collapses, posing a direct threat to public safety.

Traditional monitoring systems rely heavily on manual inspection by municipal authorities, which involves physically visiting multiple locations to check for unauthorized advertisements. This process is inefficient, labor-intensive, and time-consuming, especially in large metropolitan areas. Moreover, the lack of a centralized digital record often leads to inconsistencies, data manipulation, and corruption in the verification process. The need for a technologically advanced and transparent solution has therefore become crucial to address these challenges effectively.

Recent advancements in Artificial Intelligence (AI) and Internet of Things (IoT) have opened new possibilities for automating urban management tasks. AI-based image recognition models can be trained to detect hoardings from real-time camera feeds, enabling continuous monitoring of city areas. IoT-enabled cameras or drones can capture visual data from roads, buildings, and public spaces, sending it to a central server for automated analysis. Despite this automation, the issue of data security, authenticity, and transparency remains unresolved when using conventional storage systems.

This is where Blockchain technology plays a key role. Blockchain provides a decentralized and tamper-proof ledger that records every transaction or detection event in a secure and verifiable manner. Once a hoarding detection record is stored on the blockchain, it cannot be altered or deleted, ensuring transparency and trust between municipal departments and external stakeholders. It also prevents data manipulation, which is often a major issue in manual and paper-based systems.

Alongside blockchain, a centralized database is used to manage large volumes of image data, permit information, and location records efficiently. The blockchain stores verification and validation data, while the database handles bulk information storage, enabling

faster data retrieval and analytics. The integration of these two technologies creates a hybrid architecture that balances performance, security, and scalability.

The proposed system aims to automatically detect, verify, and record hoardings in real time. Once a hoarding is identified, the system cross-checks it with the authorized list stored in the database. If the structure is not registered, it is flagged as illegal, and an alert is sent to municipal authorities through a web or mobile interface. This automation not only saves time and effort but also ensures fair and transparent enforcement.

[1] Liang Wang et al. proposed and study a problem of targeted outdoor advertising recommendations. Given a set of billboards and a predefined budget, it strives to response to an ad query and return a subset of billboards maximizing the total targeted advertising influence within budget constraint. By utilizing users' mobility patterns and advertising repetition effects, we build a tailored targeted ad influence model and formalize our problem with a constrained combinatorial optimization problem. To effectively solve it, based on a divide-and-conquer strategy, we develop two approaches, namely the TOAR-MSS and TOAR-CC algorithms. Using two real-world datasets, we conduct extensive experiments to verify the solution effectiveness and search efficiency of our proposed approaches

[2] Sayali Avinash Chavan et al. proposed paper addresses the need for accurate billboard detection in advertising analytics. We have made notable contributions in several areas. Firstly, we developed a robust billboard detection system using advanced models like YOLOv8, YOLOv5, Faster-RCNN, and CenterNet. Challenges involved in this endeavor included finding optimal hyperparameters, mitigating over-fitting, and efficiently managing computational resources during the training process, all of which we adeptly addressed and resolved during the development of these networks. Hence, these models demonstrate high accuracy in detecting billboards in real-world scenarios. Furthermore, we introduced an innovative approach by applying a Gaussian weighting technique to determine the most central billboards. This significantly improved the overall accuracy of the detection process, particularly in the case of YOLOv8, which achieved an impressive accuracy of 82.71% after the application of the Gaussian weighting. The combination of accurate detection models and the novel Gaussian weighting approach proves to be a promising direction for improving billboard detection in various domains. This advancement holds significant potential for applications such as urban planning,

advertisement analysis, and traffic monitoring. Future work could explore further refinements to optimise the proposed approach and extend it to real-time billboard detection systems, encompassing the task of verifying the relevance of displayed information. This would involve ensuring that billboards continuously present accurate and up-to-date content, addressing scenarios where some billboards may no longer convey valid information. Furthermore, exploring the billboard visibility based on environmental conditions, as well as the unique perspectives offered by different viewing angles, resulting in more effective outdoor advertising.

[3] Dr. Santosh M. Shinde et al. studied show that consumers of both genders react to outdoor hoardings with regards to purchase intention and purchasing behaviours at retail stores in the same way. Moreover, there is a slight difference in brand perceptions between males and females but it is not statistically significant. Thus, advertisers should be aware that they can target all genders when creating their advertising campaigns, as they will respond in similar ways. This research further highlights how important it is for marketers to understand their target audience when designing effective marketing strategies that meet consumer needs and create desired outcomes. Overall, this research has highlighted the similarities between male and female responses towards outdoor hoardings at retail stores. It provides valuable insights into how consumers perceive these ads and how marketers can best utilize them for effective advertising campaigns. The findings of this research suggest that outdoor hoardings are an important tool for marketers to target both genders and create effective advertising campaigns as consumers of both genders react similarly when exposed to such advertisements. This research can be used by marketers to understand the impact of their advertisements on different demographics and make informed decisions about the design, placement and messaging strategies used in the campaign. Furthermore, further studies should be conducted in order to understand the differences between male and female responses towards outdoor hoardings further. This will help us better understand how we can use these ads effectively to reach our target audience and maximize their potential.

An examination of earlier research that was deemed a Literature Survey is presented in the second part of this publication. Section 3, labeled "Proposed methodology," provides a comprehensive description of the proposed approach. Section 4 delves into the experimental evaluation, Section 5 examines possible

modifications, and Section 6 concludes the essay with a conclusion on the present plan.

2. LITERATURE SURVEY

[4] Sayali Avinash Chavan et al. addressed the need for accurate billboard detection in advertising analytics. We have made notable contributions in several areas. Firstly, we developed a robust billboard detection system using advanced models like YOLOv8, YOLOv5, Faster-RCNN, and CenterNet. Challenges involved in this endeavor included finding optimal hyperparameters, mitigating over-fitting, and efficiently managing computational resources during the training process, all of which we adeptly addressed and resolved during the development of these networks. Hence, these models demonstrate high accuracy in detecting billboards in real-world scenarios. Furthermore, we introduced an innovative approach by applying a Gaussian weighting technique to determine the most central billboards. This significantly improved the overall accuracy of the detection process, particularly in the case of YOLOv8, which achieved an impressive accuracy of 82.71% after the application of the Gaussian weighting. The combination of accurate detection models and the novel Gaussian weighting approach proves to be a promising direction for improving billboard detection in various domains.

[5] Haiyan Zhang et al. addressed the challenge of identifying novel and diverse illegal outdoor advertisements by proposing a method that combines CLIP fine-tuning and OCR technology. By leveraging both image data and text data, this approach enables the detection of a wide range of outdoor advertisements. To handle image content, the model introduces an illegal outdoor advertising caching mechanism and fine-tunes the CLIP model using tip-adaptor technology. This approach allows for the identification of novel illegal outdoor advertisements using the zero-shot classification capability of the fine-tuned CLIP model. The experimental evaluation of illegal outdoor advertising image recognition demonstrates significant progress in the model's performance. The continuous decrease in the model's loss function, coupled with the increasing accuracy of both the training set and test set, highlights the advancements of the model during the training process. Through optimization of the loss function, the model effectively minimizes the disparity between the predicted results and the actual labels, resulting in continuous improvement in training effectiveness.

[6] Sukriti Dhang et al. introduced AdSegNet, a novel deep neural network for identifying the location of

billboard in outdoor scenes. Our proposed method surpassed the performance of all four techniques using the ALOS dataset, demonstrating that our network has a high accuracy in detecting the location of billboard. The AdSegNet model provides significant benefits for advertising and marketing companies by enabling them to create targeted video content based on the identified billboard locations. We evaluated AdSegNet's performance using the RMSE metric and found that it accurately detects the four corners of the billboard with a low RMSE score. We computed the RMSE score by determining the four corners of the predicted map. In the future, the AdSegNet model can be further developed for localizing multiple billboards in video frames, providing more precise locations for integrating advertisements. This technology has the potential to revolutionize the advertising industry, making it more efficient, effective, and targeted than ever before. Overall, AdSegNet is a significant step forward in the field of computer vision, and its potential applications are vast and exciting.

[7] Maciej Szankin et al. studied compared traditional CNN-based OCR with modern VLMs for billboard text recognition in realistic outdoor conditions. Results show that OCR accuracy consistently degrades under increasing weather severity, highlighting the need for robust models in real-world deployment. Among the VLMs, models with explicit or partial OCR supervision - such as InternVL3 and Qwen 2.5 VL 3B - were the most resilient to visual noise, with Qwen 2.5 VL 3B emerging as the strongest overall performer for fullscene recognition.

[8] Victor Olutope Ige et al. studied has provided an analysis of the valuation of outdoor advertising billboards in Lagos, Nigeria, within the context of prevailing economic challenges and the increasing need for diversified revenue sources. Given the pivotal role of billboards in business advertising and urban aesthetics, their valuation remains a crucial determinant for investment decisions, taxation policies, and regulatory frameworks. However, inconsistencies in valuation methodologies and the absence of standardized regulatory guidelines have led to significant discrepancies in assessed values, raising concerns among stakeholders, including estate surveyors, advertisers, and urban planners. Employing a quantitative research approach, this study gathered empirical data from 81 estate surveying and valuation firms in Lagos through structured questionnaires. The findings revealed the dominant valuation methodologies adopted by practitioners, with the cost approach and

market demand analysis emerging as the most widely preferred techniques. Logistic regression analysis further identified key factors influencing billboard valuation, including location, visibility, traffic volume, demographic profile, zoning regulations, maintenance costs, technological advancements, and competitive market forces.

[9] Xingye Chen et al. presented an innovative CTR-Driven Advertising Image Generation (CAIG) method, leveraging the powerful capabilities of Multimodal Large Language Models (MLLMs) to successfully address the limitations in optimizing online performance metrics. Our comprehensive framework, comprising targeted pre-training tasks, an MLLM-based two-branch reward model, and a productcentric preference optimization strategy, enables the generation of visually appealing and product-relevant advertising images. Extensive experiments demonstrate that CAIG achieves state-of-the-art performance in both online and offline metrics, significantly improving CTR in real-world e-commerce scenarios. This work not only advances the field of advertising image generation but also opens up new possibilities for applying MLLMs to complex multimodal tasks in e-commerce and digital advertising, laying a solid foundation for future research in this domain.

[10] Angelica Adinda Maharani et al. studied regarding billboard tax at the Manado City Regional Revenue Agency states that while the calculations and procedures generally align with regional regulations, several obstacles prevent the full realization of revenue targets. The study found that billboard tax calculations are appropriately based on contract values using a fixed rate of 25%, and the collection process correctly follows the official assessment system as mandated by Manado City Regional Regulations. Despite these proper administrative steps, the realization of billboard tax revenue often falls short of designated targets due to recurring issues such as late payments by taxpayers, a general lack of tax compliance, and the prevalence of illegal billboards installed without official permits. Nevertheless, the study emphasizes that billboard tax remains a vital and significant contributor to the city's Regional Original Revenue (PAD).

[11] Dr. Midya Rafiq Majeed et al. proposed cognitive analysis of the four randomly selected American election billboards reveals that their overall design aligns with the conveyed content and message. The primary objective of these billboards is to persuade voters to support the designated candidate and to evoke people's feelings that choosing such a candidate is the

best decision for a better future. Additionally; billboards play a crucial role in political campaign elections. Examining them reveals that the interpretation of linguistic expressions, including both visual and verbal modes, is not solely reliant on the dictionary meanings of the words involved, but rather, depends in part on how the interlocutors view the situation and how they conceptualize it. Thus, it can be concluded that the application of the construal operation of specificity proves to be good tool for investigating and examining electoral billboards, as it helps to raise ones awareness about the purposes, meaning and the way electoral billboards are designed.

[12] Nze U. Nze et al. Introduced idea that change in challenges prompts reinforcement has led to the shift from conventional billboard advertising to the adoption of electronic billboard as a means of aiding better understanding of advert messages. This is to help explain the benefit of the twisco brand to the audience through the special feature of animation just like the television. This quest to bring the concept of television that is motion of picture into the public domain has given the advertising industry a boost by fostering influence of consumers patronage to the product advertised on the medium.

[13] Melati Theresia et al. proposed Linguistic landscapes serve to connect language use with space, time, and social aspects of society, while also reflecting the power, status, and ideology of language in a region. In the billboard, it has three modes, they are: writing mode, image mode, and color mode. Written mode refers to the use of language in written form in public spaces. It is not only functions as a means of informational communication, but also has a strong semiotic role in representing the visual aspects of the social, cultural, and political complexities that shape a community. Next, image mode is not merely a visual complement, but a highly strategic element in the linguistic landscape that helps shape meaning together with written mode. This mode provides information and conveys symbolic messages, reflecting the social dynamics and identity of a community in the public sphere. In addition, color mode functions as a non-linguistic semiotic source that conveys meaning. Unlike the literal meaning of writing mode, it acts as a visual code that influences how linguistic messages are read and understood.

3. METHODOLOGY

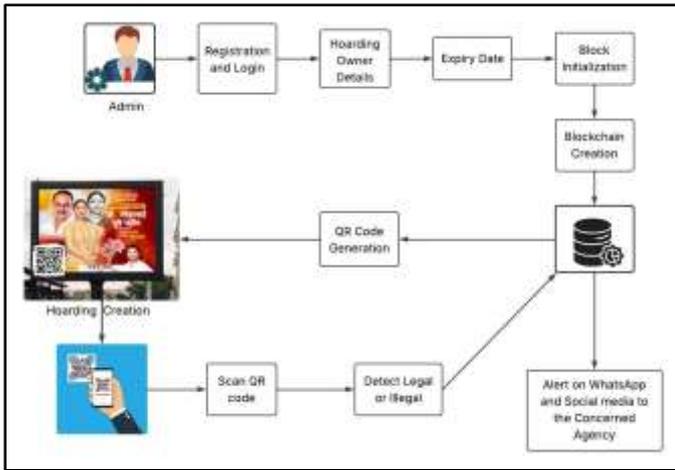


Fig 1: Overview Diagram

The proposed system follows a structured process to monitor and verify hoardings using QR codes and blockchain technology. The step-by-step methodology is as follows:

Step 1: Data Collection and Entry

This phase begins with the admin registering and logging into the system to ensure secure access. After authentication, the admin enters hoarding-related details such as owner name, location, advertisement content, and necessary permissions. Additionally, an expiry date is assigned to each hoarding to define its legal validity period. The collected data is then organized into a structured format, which serves as the input for further secure processing in the system.

Step 2: Security through Blockchain

This phase makes use of the stored hoarding data achieved linearly through the previous step. Each of these hoarding records is processed individually for the purpose of secure storage.

Before the data is stored, it is used for implementing the blockchain framework by generating a unique hash key using hashing techniques such as MD5. This hash acts as a digital fingerprint of the hoarding data. The generated hash key may be optimized to maintain a reasonable length while preserving uniqueness.

Eventually, the blockchain's block head and block body are formed, where the header contains metadata and the hash, and the body contains the actual hoarding details. This process is repeated for all hoarding records, resulting in a chain of blocks. The

final head key (terminal key) is stored securely and is used in the next step for integrity evaluation.

Step 3: QR Code Generation and Embedding

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After securely storing the hoarding data in the blockchain, a unique QR code is generated for each hoarding using the corresponding blockchain data. This QR code serves as a digital identifier linking the physical hoarding to its secure digital record.

The generated QR code is then embedded onto the hoarding image using an image processing algorithm. In this process, both the hoarding image and QR code image are loaded into the system, and the QR code is resized appropriately to fit onto the hoarding without distortion. The position for embedding is calculated, typically at the bottom-right corner of the hoarding image to ensure visibility and consistency.

The working of the QR code embedding algorithm is illustrated below in figure 2.. The algorithm iterates through each pixel of the QR code image and retrieves its RGB value, which is then mapped onto the corresponding pixel location of the hoarding image using the calculated coordinates. This process continues until all pixels of the QR code are successfully overlaid onto the hoarding image



Fig 2: Algorithm of Embedding

Once the embedding process is complete, the final hoarding image with the integrated QR code is generated and deployed. This enables easy access to

hoarding information during scanning and ensures seamless integration between physical and digital systems.

Step 4: QR Code Scanning and Data Retrieval

In this phase, authorities or users scan the QR code using a mobile device. Upon scanning, the system retrieves the hoarding information from the blockchain using the encoded data in the QR code. This ensures that the retrieved information is secure, authentic, and tamper-proof.

Additionally, the scanning activity is recorded in a separate system database (such as SQL or cloud storage) for monitoring, tracking, and maintaining a history of inspections.

Step 5: Integrity Evaluation and Verification

The blockchain for the hoarding data is created in the previous steps through hash key calculation. The terminal key generated earlier is stored securely and is utilized for integrity evaluation through the detection of an Avalanche effect.

The process of blockchain generation is repeated in the first layer of the integrity examination. The newly generated terminal key is compared with the previously stored terminal key. If both keys are identical, the data is considered secure; otherwise, the integrity evaluation proceeds further.

The first layer of the integrity assessment is depicted in equation 1.

$$f(BI) = \int_0^n (PT! = CT) \Rightarrow f(NTE) _ (1)$$

Where,

f(BI) = Block Integrity

N = Number of hoardings

PT = Previous Terminal Key

CT = Current Terminal Key

f(NTE) = Next Tier Evaluation

In the next level of verification, each hoarding’s terminal key is matched with its previously stored key. If all keys match, the hoarding is considered valid and legal. If any mismatch is detected, the hoarding is marked as compromised or illegal. Any modification in the data results in a significant change in the hash value due to the Avalanche effect, ensuring accurate detection of tampering.

Step 6: Alert Generation and Reporting

Based on the verification results, the system classifies the hoarding as legal or illegal. If the hoarding is found to be expired or unauthorized, alerts are automatically generated and sent to the concerned authorities via WhatsApp and social media platforms.

Furthermore, a verification report is generated and displayed in an interactive user interface. All scanning results and verification logs are stored in the system database for future reference, monitoring, and decision-making.

4. Result and Discussion

This research study presents the implementation of the proposed methodology for detecting the legality of hoardings using QR code and blockchain technology. The system has been developed using the Java programming language with the NetBeans IDE. The experimental setup consists of an Intel Core i5 processor, 4 GB RAM, and 600 GB storage. The MySQL database server is used for managing and storing all hoarding-related data, including owner details, blockchain records, and scanning logs.

The performance of the proposed system is evaluated through various experiments focusing on blockchain creation and key generation time. As the number of hoarding records increases, the system analyzes the time required to generate blockchain blocks and corresponding hash keys. This evaluation helps in understanding the efficiency and scalability of the system in real-time applications.

The results obtained from the experiment are shown in Table 1.

No. of Hoardings	Blockchain Creation Time	Key Generation Time
10	3	2
20	8	6
30	15	12
40	23	18
50	32	25
60	42	33
70	53	42
80	65	52
90	78	63
100	92	75

Table 1: Blockchain creation and key generation time

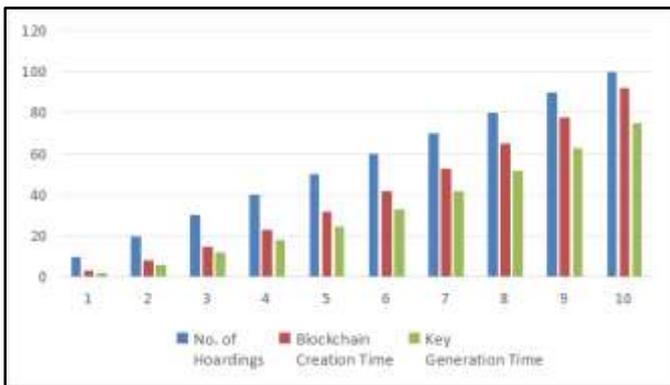


Figure 2: Blockchain & key generation Time

An effective graph is shown in Figure 2 using the values obtained from the experimental results. The graph illustrates the relationship between the number of hoardings and the time required for blockchain creation and key generation.

From the graph, it can be observed that both blockchain creation time and key generation time increase as the number of hoardings increases. However, the increase is gradual and not strictly linear. This variation occurs due to processing overhead and the complexity of hashing operations involved in blockchain implementation.

The results indicate that the proposed system performs efficiently even with an increase in data size. The controlled growth pattern demonstrates that the model is well-optimized and capable of handling scalability without significant performance degradation.

3. CONCLUSIONS

The proposed system provides an efficient, automated solution for detecting and managing illegal hoardings using Blockchain. By utilizing image recognition for detection and Blockchain for real-time alerting, the system ensures timely reporting and minimizes human intervention. It helps municipal authorities to act quickly, thus improving the efficiency of city management. The integration of such systems will not only reduce visual clutter and safety risks but also promote the vision of smart, sustainable, and technology-driven urban development.

In the future, the proposed system can be enhanced by integrating real-time video surveillance and advanced deep learning models to improve detection accuracy under varying environmental conditions. The Blockchain framework can be extended to support smart contracts for automated penalty generation and

compliance tracking. Integration with GIS and cloud platforms can enable city-wide scalability and centralized monitoring for municipal authorities. Additionally, the system can be expanded to include citizen reporting modules and predictive analytics to identify high-risk zones, further supporting smart and sustainable urban governance.

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