Project Implementation

Smart Advertising: Integrating Analytics in Outdoor Billboard Campaigns

Submitted To

Fariza Rahman Prodhan

Lecturer

Department of Innovation & Entrepreneurship

Daffodil International University

Submitted By

Md. Maniruzzaman Hredoy

ID: 212-45-009

Department of Innovation & Entrepreneurship

Daffodil International University

Letter of Transmittal

Fariza Rahman Prodhan

Lecturer

Department of Innovation & Entrepreneurship

Daffodil International University

Subject: Smart Advertising: Integrating Analytics in Outdoor Billboard Campaigns

Dear Sir,

It is my great pleasure to submit the report named “Smart Advertising: Integrating Analytics in Outdoor Billboard Campaigns” as a part of Project Implementation of the Department of Innovation & Entrepreneurship for your kind consideration. I made sincere efforts to “Smart Advertising: Integrating Analytics in Outdoor Billboard Campaigns” and examined relevant records for the preparation of the report.

Within a limited time, I have worked to make this report as comprehensive as possible. But there may be some incompleteness due to various restrictions. For this reason, I beg your kind consideration in this regard.

Sincerely yours,

Md. Maniruzzaman Hredoy

212-45-009

Department of Innovation & Entrepreneurship

Daffodil International University

Declaration

We hereby declare that this project has been done by us under the supervision of Fariza Rahman Prodhan, Lecturer, Department of Innovation and Entrepreneurship, Daffodil International University .We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

Supervised by

Fariza Rahman Prodhan
Lecturer
Department of Innovation and Entrepreneurship
Daffodil International University

Submitted by

Md. Maniruzzaman Hredoy

212-45-009

Department of Innovation and Entrepreneurship Daffodil International University

Certificate of Approval

This is certifying that **Md. Maniruzzaman Hredoy** bearing ID No.212-45-009 is a regular student of the Department of Innovation & Entrepreneurship, Faculty of Business and Entrepreneurship, Daffodil International University. He has completed his Project Implementation on Smart Advertising: Integrating Analytics in Outdoor Billboard Campaigns,

I have gone through the project and found the business idea feasible.

I wish him every success in life.

Fariza Rahman Prodhan

Lecturer

Department of Innovation & Entrepreneurship

Daffodil International University

Acknowledgment

By the kind help of almighty Allah, I have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them.

I am highly indebted to my supervisor Fariza Rahman Prodhan, Lecturer, Department of Innovation & Entrepreneurship, Daffodil International University for his guidance and constant supervision as well as for providing necessary information regarding the report & also for his support in completing the project.

I would like to express my special gratefulness and thanks to Md. Maniruzzaman Hredoy for giving me such attention and time.

A**bstract**

Billboard advertising has long been a cornerstone of outdoor marketing, valued for its ability to reach diverse audiences and create impactful brand impressions. However, traditional billboard campaigns often lack measurable data, leaving advertisers unable to accurately assess effectiveness or return on investment (ROI). In an era dominated by data-driven decision-making, this limitation threatens to undermine billboard advertising's relevance compared to digital platforms. The integration of advanced technologies such as artificial intelligence (AI), computer vision, and mobile analytics offers a transformative solution to this challenge.

This study explores how modern technologies can revolutionize billboard advertising by enabling precise measurement of audience engagement, traffic patterns, and demographic segmentation. It develops a comprehensive framework that leverages computer vision to collect real-time data on traffic and audience demographics, and mobile analytics to track post-exposure behaviors such as app downloads or website visits. The proposed framework also incorporates dynamic content optimization, allowing advertisers to adjust billboard content based on real-time insights, audience profiles, and external conditions such as weather or traffic density. Focusing on the context of Bangladesh, where outdoor advertising remains a vital medium for brand visibility, this research examines challenges such as infrastructure limitations and data privacy concerns, proposing practical solutions to overcome them. The study employs a mixed-methods approach, combining quantitative analysis of traffic and demographic data with qualitative insights from case studies. Findings demonstrate how integrating AI and analytics can enhance the measurability, adaptability, and ROI of billboard campaigns. The technology in traditional advertising while offering actionable strategies for advertisers to remain competitive in the evolving marketing landscape. By bridging the gap between physical and digital media, the study positions billboard advertising as a dynamic and data-driven medium, ensuring its continued relevance in the modern advertising ecosystem.

Table of Content

List of Figures

Chapter-1

1. Introduction

1.1 Overview of Billboard Advertising in Bangladesh

Billboard advertising has long been a staple of outdoor marketing in Bangladesh, particularly in urban areas such as Dhaka, Chattogram, and Sylhet. The power of billboard advertising in Bangladesh is a significant aspect of the country's advertising industry, with Billboard Advertising BD being a leading agency in providing innovative outdoor promotion solutions. The agency offers a range of services, including highway billboards, LED display screens, and promotional advertising services, to help businesses connect with their audience effectively. With the evolution of traditional billboards into diverse and creative forms, billboard advertising has become a timeless and impactful medium for businesses to reach a wide audience in Bangladesh. .With a rapidly growing urban population and increasing vehicle ownership, billboards provide high visibility and access to diverse audiences. Positioned along busy roads, highways, and commercial hubs, they are a powerful medium for brand promotion. However, billboard advertising in Bangladesh primarily relies on static formats and traditional methods of measuring effectiveness, such as traffic volume estimates, which fail to provide actionable insights for advertisers.

1.2 Challenges in Measuring Effectiveness

Despite its widespread use, billboard advertising in Bangladesh faces significant challenges in competing with digital advertising. Platforms like Facebook and YouTube dominate the advertising market by providing precise data on reach, engagement, and conversion. In contrast, billboard campaigns struggle with a lack of measurable data, leaving advertisers uncertain about audience demographics, engagement levels, or return on investment (ROI). The reliance on a one-way communication model further limits its effectiveness, as advertisers cannot gauge real-time audience responses or adapt campaigns accordingly.

1.3 Opportunities for Technological Integration

With the rapid advancement of artificial intelligence (AI), computer vision, and mobile analytics, there is an opportunity to modernize billboard advertising in Bangladesh.

Technologies like AI can analyze traffic patterns and viewer engagement, while mobile analytics can provide location-based insights into audience behavior. These innovations can transform billboards into interactive, data-driven platforms, bridging the gap between traditional and digital advertising.

1.4 Research Gap

In Bangladesh, there is limited research or application of modern technologies in the outdoor advertising sector. While some global markets have adopted AI-driven tools to measure billboard performance, the local industry still relies on manual estimations and traditional practices. This research aims to address this gap by exploring how AI and analytics can enhance the effectiveness and measurability of billboard campaigns, making them more competitive in the digital era. Billboard advertising in Bangladesh has evolved into a vital component of the marketing landscape, providing businesses with a unique opportunity to reach vast audiences in urban and semi-urban areas. Unlike other forms of advertising, billboards offer a high level of visibility, ensuring that messages are seen by motorists, pedestrians, and commuters consistently. This level of exposure can significantly bolster brand recognition, making it easier for potential customers to recall a brand when making purchasing decisions. In a country like Bangladesh, where economic growth is fostering the rise of new businesses, billboard advertising provides an accessible entry point for companies looking to differentiate themselves in the market. Local entrepreneurs, in particular, can leverage the power of billboards to establish a presence, gain customer loyalty, and ultimately influence purchasing behavior. So here is a chance to get more outcomes using modern technology.

1.5 Objectives and Scope

This study focuses on integrating advanced technologies into billboard advertising in Bangladesh, aiming to:

1. Investigate the potential of AI, computer vision, and mobile analytics in measuring billboard campaign performance.
2. Develop a framework to analyze viewer engagement, traffic patterns, and conversion rates.
3. Provide actionable recommendations for advertisers to optimize campaigns using data-driven strategies.

1.6 Significance of the Study

This research is of significant importance to various stakeholders, particularly advertisers and the academic community in Bangladesh. As the advertising landscape continues to evolve, the integration of artificial intelligence (AI) and analytics into billboard campaigns presents a crucial opportunity for advertisers to enhance their strategies. For advertisers, leveraging AI enables a more data-driven approach to campaign management. By analyzing consumer behavior and preferences, advertisers can more accurately identify specific target audiences. This targeted strategy not only ensures that advertising messages reach the appropriate individuals but also increases engagement rates, thereby maximizing the effectiveness of billboard advertisements. Moreover, the use of analytics allows for real-time monitoring and adjustments to campaigns, empowering advertisers to continually optimize their messaging and placement strategies. Consequently, there is considerable potential for a significant improvement in return on investment (ROI), as advertisers can allocate resources more efficiently, focusing on avenues that deliver the best results.

This research acts as a bridge between technology and marketing, offering valuable implications for advertising strategies while simultaneously enriching academic knowledge. Its findings are poised to inspire a new wave of thinking regarding how traditional advertising mediums can be enhanced through technological integration, fostering greater efficiency and effectiveness in campaigns.

Chapter-2

2. Literature Review

2.1 Traditional Billboard Advertising in Bangladesh

Billboard advertising has been a prominent medium in Bangladesh for decades, especially in urban areas like Dhaka, Chattogram, and Khulna. Studies have highlighted the importance of billboards for increasing brand visibility and reaching large audiences in high-traffic areas. However, the effectiveness of these campaigns often relies on estimations of traffic volume and general impressions rather than precise metrics Dhaka city features numerous billboards and hoardings leased by various companies through advertising agencies that secure government tenders for rentable advertising spaces. The advent of LED billboards has further increased the popularity of outdoor advertising. LED or digital billboards display computer-controlled images that change automatically every few seconds. The cost of conventional billboards typically correlates with their dimensions. In Dhaka city, billboard rental rates range from approximately 1200-1400 BDT per square foot annually, with the maximum permitted billboard size in Bangladesh being 600 square feet.

LED Billboards

Recently, DSCC has installed small-scale LED billboards on poles, offering high visibility to a large audience. This area sees daily foot traffic of about 5.7 million people, with each advertisement visible for 120 seconds per traffic signal cycle. According to information from slideshare.net, these mini pole displays are available for rent at prices ranging from roughly 90 BDT to nearly 600 BDT per day. A total of 500 mini pole LED screens are available for advertising, with peak advertising hours occurring between 4 pm and 11 pm. The location with the highest projected audience reach is the Gulistan to English Road circle, estimated at 50 lakh people annually, priced at 14 BDT per minute for 270 minutes daily. The New Market Police Box location follows closely, reaching 45 lakhs at a higher rate of 30 BDT per minute for 270 minutes daily. These police box smart screens measure 6 feet by 4 feet. Similar screens can be found at various locations including Sheraton, Kadam Fuara, Kakrail, Matsha Bhaban, Doinik Bangla, Mogbazar, Lab Aid, Shikkha Bhaban, Mintu Road, Bango Bazar, Zero Point (gulistan), Bata Signal, Malibagh Railgate, Mouchak Crossing, Fakirapool, Shahjahanpur, Sadarghat, Rai

Saheb Bazar, Fulbaria and Golap Shah Mazar. Billboard advertising in Bangladesh is a powerful tool for businesses to increase brand awareness and drive traffic. The cost of billboard advertising in Bangladesh varies widely, ranging from BDT 1.5 to 20 lakh, depending on factors such as the size and type of billboard, location, and duration of the campaign. To maximize investment, businesses should choose the right location, use a simple and clear message, and consider running long-term campaigns. With the right strategy, billboard advertising can be a worthwhile investment for businesses looking to reach large audiences and increase sales.

2.2 Advances in Advertising Analytics

The global advertising landscape has witnessed significant transformations with the adoption of AI and analytics. Tools such as computer vision, mobile analytics, and geo-location tracking have been utilized to enhance the performance measurement of outdoor advertising.

Computer Vision: Technologies like automated traffic counting and facial recognition enable the identification of audience demographics, such as age and gender, in real-time. Computer vision is revolutionizing traffic management by analyzing video data from cameras to improve traffic flow, enhance safety, and reduce congestion. This technology offers significant benefits such as vehicle detection and tracking, leading to improved traffic flow analysis and smarter traffic signals that adapt to real-time conditions. Despite challenges related to lighting, weather, and computational resources, successful implementations in cities like Hangzhou and Pittsburgh demonstrate substantial returns on investment through reduced congestion, accidents, and improved emergency response times.

Mobile Analytics: By utilizing smartphone location data, advertisers can track foot traffic near billboards and correlate these movements with in-store visits or online activity

Dynamic Content Delivery: AI-powered billboards can adjust content based on the time of day, weather conditions, or audience demographics, enhancing relevance and engagement

However, while these technologies are prevalent in developed countries, their implementation in emerging markets like Bangladesh remains limited due to infrastructure challenges and a lack of awareness among advertisers.

2.3 Challenges in the Bangladeshi Context

Despite its potential, the adoption of AI and analytics in billboard advertising faces several challenges in Bangladesh:

Technological Barriers: Bangladesh has limited infrastructure for implementing AI-driven advertising systems. The absence of advanced traffic monitoring systems or high-quality sensors hinders real-time data collection.

Cost Constraints: Many advertisers in Bangladesh operate with limited budgets and are hesitant to invest in new technologies without guaranteed ROI.

Privacy Concerns: The use of mobile analytics and AI tools raises ethical and legal concerns regarding data privacy, as regulations around data protection are still evolving in Bangladesh.

2.4 Bridging the Gap Between Traditional and Digital Advertising

Research suggests that integrating AI and analytics into billboard advertising can help bridge the gap between traditional and digital advertising by providing advertisers with measurable and actionable insights. Digital advertising platforms such as YouTube and Facebook dominate the Bangladeshi market due to their ability to provide detailed metrics like click-through rates, engagement, and conversions. Billboards, by comparison, can achieve similar levels of measurability with the right tools, positioning them as a competitive alternative.

Case studies from other emerging markets reveal the effectiveness of AI-powered advertising in improving ROI. For example, in India, AI-powered billboards have successfully measured audience engagement and adjusted content dynamically based on viewer demographics.

Chapter-3

3.3: Problem Statement

3.1 Overview

Billboard advertising is a critical component of outdoor advertising in Bangladesh, particularly in densely populated cities like Dhaka, Chattogram, and Sylhet. It offers unparalleled visibility in high-traffic areas, making it a preferred choice for brands seeking mass outreach. However, with the advent of digital advertising platforms that provide precise data and insights, billboard advertising is increasingly seen as an outdated medium.

Despite its visibility, traditional billboard advertising faces challenges in quantifying its impact and proving its return on investment (ROI). This issue is compounded by a lack of technological integration, limiting advertisers' ability to optimize campaigns and remain competitive in the evolving market landscape of Bangladesh.

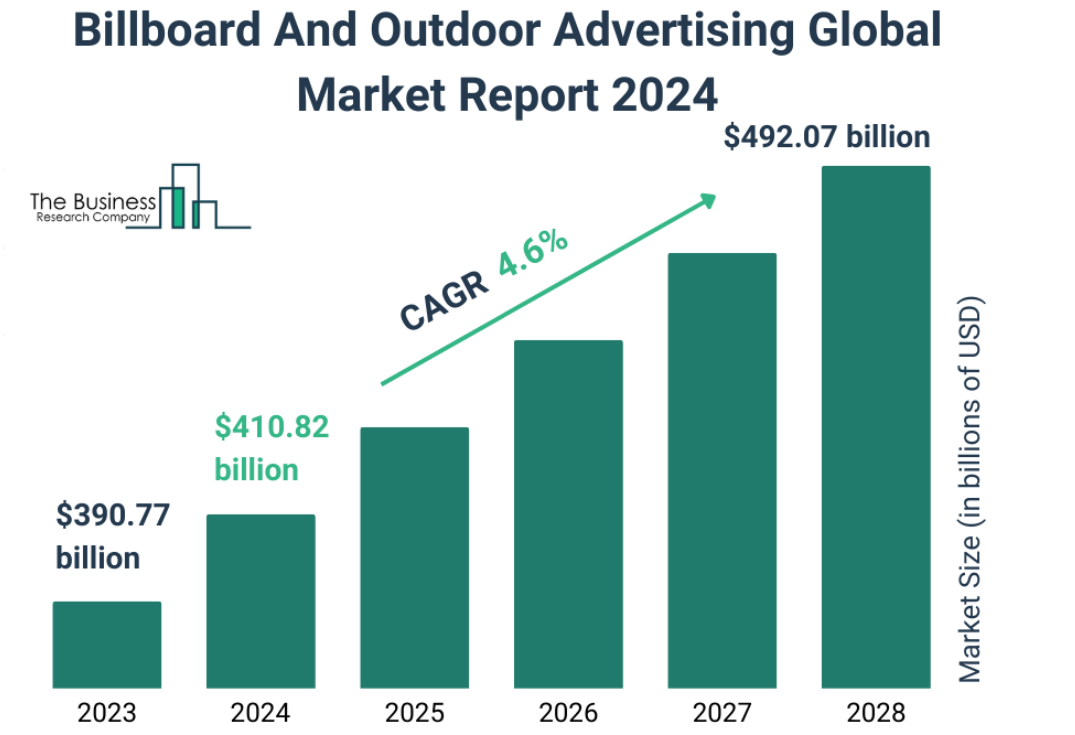

Figure 1: Billboard And Outdoor Advertising Global

The billboard and outdoor advertising industry has experienced robust growth in recent years. The market is projected to expand from $390.77 billion in 2023 to $410.82 billion in 2024, with a compound annual growth rate (CAGR) of 5.1%. Factors contributing to this historical growth include shifts in mobility and transportation, environmental considerations, cultural and social trends, industry competition and expansion, as well as advancements in design and creativity.

Looking ahead, the billboard and outdoor advertising sector is anticipated to maintain steady growth. The market is expected to reach $492.07 billion by 2028, with a CAGR of 4.6%. This future growth is likely to be driven by digital transformation, targeted advertising solutions, mobile integration, augmented reality (AR) and virtual reality (VR) technologies, and environmental sustainability initiatives. Key trends forecasted for the industry include cross-channel campaigns, interactive advertising, mobile integration, data-driven targeting, and programmatic buying.

3.2 Key Challenges

Traditional billboard advertising in Bangladesh relies on outdated methods for estimating audience impressions, such as:

Lack of Ad Insights for Advertisers

One of the most significant drawbacks of traditional billboard advertising in Bangladesh is the absence of actionable insights for advertisers. Unlike digital platforms, which provide detailed reports on campaign performance, billboard advertising offers little to no feedback on the following key metrics:

Audience Interaction and Engagement

Advertisers have no way to determine:

- How many people actively noticed their billboard.
- The duration of time spent viewing the ad.
- Whether the ad resonated with the intended audience.

This lack of engagement data makes it difficult to assess the effectiveness of creative design or messaging in capturing audience attention.

Audience Demographics and Behavior

Advertisers are unable to access granular data on the demographics or behaviors of individuals exposed to their billboards. For example, a billboard in Gulshan might attract different demographics compared to one in Mirpur, but there is no system to analyze such variations. This data gap prevents advertisers from tailoring campaigns to specific audiences.

Geographical Performance Variations

Billboards are often installed at multiple locations, but there is no mechanism to determine which locations perform better in terms of audience reach or impact. As a result, advertisers cannot make informed decisions about optimal placement or future investments.

Conversion Tracking

One of the biggest challenges is the inability to track whether billboard exposure leads to desired outcomes, such as:

- Increased foot traffic to stores.
- Online searches or website visits.
- Actual purchases or inquiries.

This limitation leaves advertisers in the dark about the ROI of their billboard campaigns, making it hard to justify the cost of outdoor advertising compared to digital alternatives.

3.2 Consequences of the Lack of Ad Insights

The absence of ad insights has several negative implications:

Inefficient Resource Allocation

Advertisers invest significant amounts in billboard campaigns without understanding their impact, leading to potential wastage of resources. For example, a high-cost billboard in a prime

area like Mohakhali may not yield better results than a lower-cost one in a suburban location, but advertisers lack the data to make such comparisons.

Reduced Campaign Optimization

Without insights into performance, advertisers cannot refine or optimize their billboard campaigns. This is in stark contrast to digital platforms, where real-time analytics allow for iterative improvements based on audience responses.

Declining Trust in Billboard Advertising

As advertisers prioritize data-driven decisions, the lack of insights makes billboard advertising appear less reliable and less effective compared to digital advertising platforms. This perception further reduces investment in traditional outdoor media.

Missed Opportunities for Innovation

Modern tools such as AI and analytics could provide advertisers with valuable insights, but their absence means billboard campaigns fail to leverage technological advancements, leaving the medium stagnant and outdated.

3.3 Limited Campaign Flexibility and Optimization

Unlike digital advertising, billboard campaigns in Bangladesh often lack adaptability due to their static nature. Key limitations include:

Static Content Delivery: The same advertisement is displayed for weeks or months without adjusting for:

Time of Day: Morning commuters may prefer different messaging compared to evening travelers.

Seasonal Relevance: Advertisements for products like air conditioners or umbrellas may not resonate during certain times of the year.

One-Way Communication: Traditional billboards cannot capture feedback or audience interaction, reducing their effectiveness compared to interactive digital platforms.

For instance, during festivals like Eid or Pohela Boishakh, advertisers may miss opportunities to display contextually relevant content, which could significantly enhance audience engagement.

3.4 Competition from Digital Advertising

In Bangladesh, digital platforms such as Facebook, YouTube, and Google Ads have gained significant market share due to their ability to:

- Provide precise audience targeting based on demographics, interests, and behaviors.
- Measure performance through metrics such as impressions, engagement rates, and conversion rates.
- Offer cost-effective solutions for advertisers with limited budgets.

By contrast, billboard advertising struggles to justify its costs due to a lack of comparable measurement tools. Small and medium-sized enterprises (SMEs), which form a significant portion of Bangladesh's advertising market, increasingly favor digital platforms, leaving traditional billboard advertising underutilized and less competitive.

3.5 Technological and Infrastructure Barriers

The integration of AI, computer vision, and mobile analytics into billboard advertising has been successfully implemented in developed countries. However, in Bangladesh, the adoption of these technologies faces several obstacles:

1. **Infrastructure Gaps**: High-quality sensors, cameras, and AI tools necessary for real-time data collection are not widely available or deployed.
2. **High Implementation Costs**: Many advertisers, especially SMEs, perceive AI-driven solutions as expensive and are hesitant to adopt them without proven ROI.
3. **Regulatory Challenges**: The absence of clear data protection and privacy laws in Bangladesh raises concerns about the ethical use of AI tools, such as facial recognition and mobile analytics.

4. **Knowledge and Awareness Deficit**: Many advertisers and agencies lack the technical expertise or awareness to integrate advanced technologies into their billboard campaigns.

For example, while digital tools like geofencing are commonplace globally, their implementation in Bangladesh remains rare due to the above constraints.

3.6 Broader Implications

The inability to measure and optimize billboard advertising impacts the broader advertising industry in Bangladesh:

- **Low ROI for Advertisers**: Without data to support decision-making, campaigns risk underperforming, leading to wasted resources.
- **Reduced Trust in Traditional Advertising**: Advertisers increasingly perceive billboard advertising as less reliable and less efficient than digital alternatives.
- **Missed Opportunities for Innovation**: The lack of integration with modern technologies prevents billboard advertising from evolving into a data-driven medium, limiting its future potential.

3.7 The Research Gap

While global research highlights the transformative potential of AI and analytics in outdoor advertising, there is minimal localized research in Bangladesh addressing:

- The unique challenges faced by advertisers in implementing such technologies.
- The economic feasibility of integrating AI-driven tools into billboard campaigns.
- The potential for bridging the performance gap between traditional billboards and digital platforms.

The current body of knowledge fails to provide advertisers in Bangladesh with actionable frameworks or best practices for modernizing billboard advertising through technology.

Chapter-4

4. Proposed Solutions

To address the limitations of traditional billboard advertising and leverage modern technologies effectively, several innovative solutions are proposed. These solutions incorporate AI, computer vision, mobile analytics, and dynamic content delivery systems that can help transform outdoor advertising into a more data-driven and measurable medium. Below are the key proposed solutions tailored to the context of Bangladesh:

4.1 Computer Vision Analytics

Computer vision is a subset of artificial intelligence that equips machines to interpret and understand visual information from the world, leveraging machine learning and neural networks. Despite its recent advances, computer vision technology surpasses human capabilities in speed and precision, achieving significant impacts across various industries including automotive and manufacturing. The field has evolved over several decades, driven by data-intensive methods and innovative algorithms like deep learning and convolutional neural networks, leading to sophisticated applications that are transforming industries and enhancing everyday experiences. With AI-powered tools, advertisers can obtain real-time, actionable insights that allow them to measure and optimize the performance of their campaigns. The following technologies can be integrated.

Working Process

Traffic Detection: The combination of AI and machine vision can achieve results that surpass what machine vision alone can offer. For example, engineers at Teledyne developed a license plate reading system that achieved a 75% accuracy rate using only machine vision during real-world tests involving various plate designs, weather conditions, and lighting scenarios. By incorporating AI and segmenting the problem, they optimized the use of both traditional

machine vision tools and machine learning technology, ultimately developing a system that achieved 95% accuracy.

With the help of vision systems and AI analytics, traffic planners can gather more valuable data about current conditions, leading to more accurate insights into future traffic scenarios. In this case, developers trained an AI engine using a collection of images with and without vehicles and license plates. This allowed the system to detect cars, trucks, and motorcycles, as well as locate their license plates. Traditional machine vision was then used to perform optical character recognition (OCR) to read the information on the license plates. The capability to count and classify vehicles aids in maintaining smooth traffic flow and ensures more accurate planning for future transportation needs. Furthermore, technology can enhance safety by, for example, ensuring that an intersection is clear of pedestrians before allowing traffic to proceed. However, ongoing advancements in traffic monitoring technology may necessitate improved AI models and training. Additional innovations may be required, such as utilizing new imaging spectra and modalities. Experts emphasize that various applications within traffic monitoring require different imaging resolutions; for instance, detecting and accurately reading a license plate requires approximately 100 pixels per 1-foot-wide plate, with many users opting for about double that resolution.

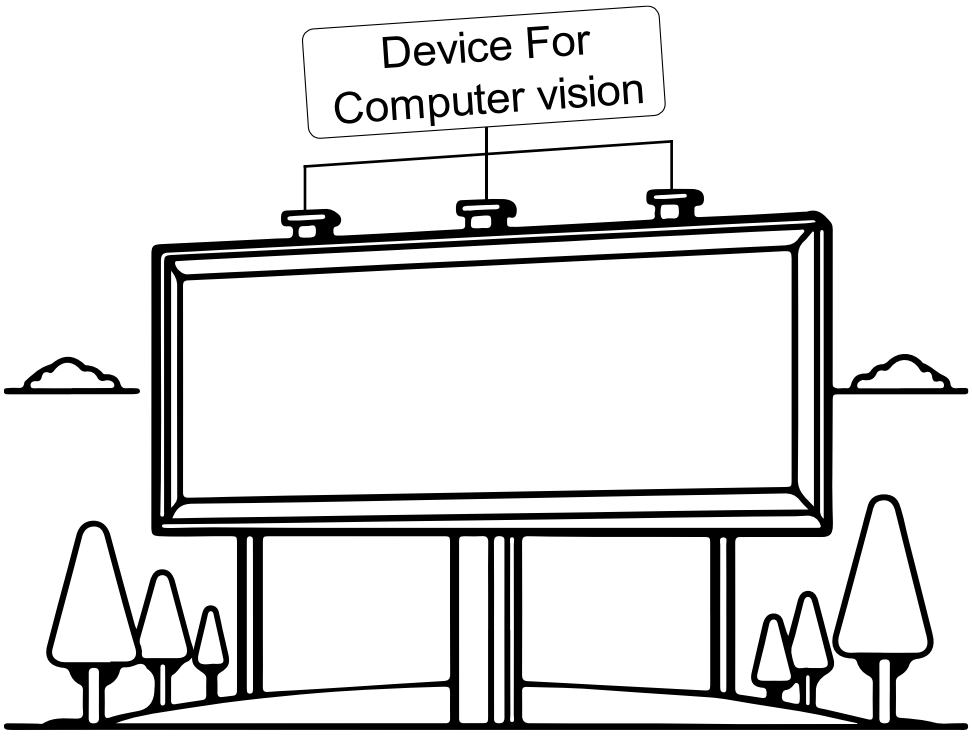

Figure 2 Device for Computer vision

Impression Analysis

The state-of-the-art device showcased on the billboard is a powerful tool designed to revolutionize audience engagement. With its advanced sensors and high-definition cameras, it effortlessly monitors and analyzes pedestrian activity around it. This innovative system accurately counts the number of individuals who pass by, providing real-time insights into foot traffic that are crucial for effective advertising strategies.

Moreover, the device measures how long each person lingers in front of the billboard, delivering valuable data on viewer engagement. Its cutting-edge facial recognition technology takes this a step further by assessing how many people are actively gazing at the advertisement, along with insights into the audience's demographics and attention levels. All data is processed through sophisticated algorithms that leverage the video footage captured, allowing for precise analytics that drive impactful marketing decisions. This intelligent billboard technology stands as a significant advancement in targeted advertising, enabling brands to connect with their audiences like never before. Embrace the future of advertising with confidence!

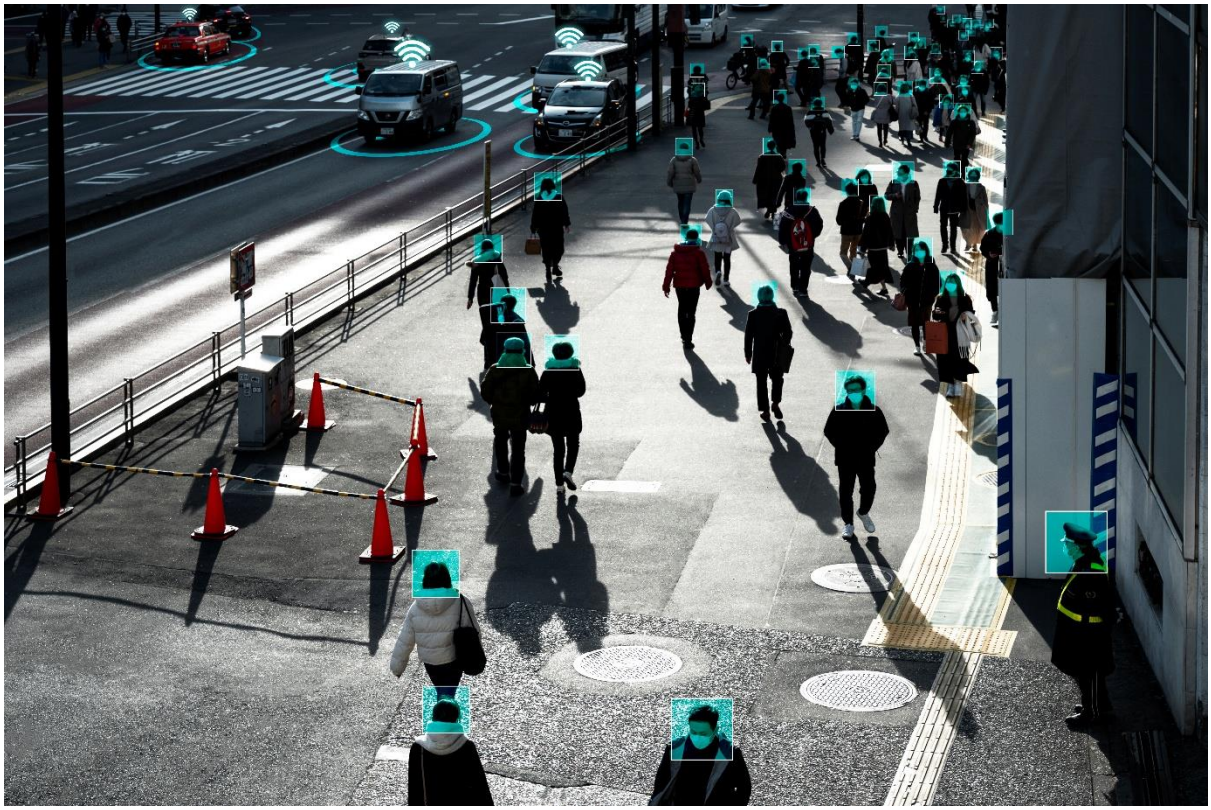

Figure 3 Traffic Detection

Demographic Profiling

AI tools can process visual data to detect demographic features such as age, gender, and even emotional responses from people interacting with the billboard. This is done using advanced computer vision algorithms.

Example: In areas like Dhaka's Banani or Gulshan, AI tools can estimate that 60% of passersby are within the age group of 18-30 years. Ads can be tailored to this demographic, promoting products such as clothing, gadgets, or food delivery services.

Benefit: It enables hyper-targeted advertising, making campaigns more relevant and impactful to the viewers.

Engagement Analysis

AI-based systems have the capability to monitor and analyze the duration of engagement that individuals have with a digital billboard. By utilizing advanced technologies such as cameras equipped with facial recognition and eye-tracking capabilities, these systems can accurately gauge the amount of time viewers spend looking at the advertisement. This data can provide valuable insights into the effectiveness of the ad design, helping to determine whether it successfully captures and retains the attention of the audience. Furthermore, such technologies can also assess viewer demographics and emotional responses, allowing for a more comprehensive understanding of how different audience segments interact with the advertisement over time.

Example: If an advertisement on a billboard near Dhaka University gets significantly more engagement from students during break times, it can indicate that the creative content or timing is effective.

Benefit: Increased engagement tracking allows for real-time content optimization to increase viewer interaction and improve ROI.

4.2 Dynamic Content Delivery

Traditional billboards display static advertisements, which are not adaptable to external factors like time of day, weather, or audience demographics. Dynamic content delivery leverages digital technology to display advertisements based on real-time data.

Time-Based Ads

Dynamic billboards can change their content based on the time of day, optimizing visibility during peak traffic hours. For example, morning commuters may see ads for coffee shops, while evening commuters might see promotions for dinner offers or entertainment events.

Example: A billboard near a university could show ads for coffee or breakfast items in the morning, and then switch to ads for study materials or cafes during the afternoon.

Benefit: The content is tailored to the time of day, making it more relevant to the audience's needs at that specific moment.

Weather-Responsive Content

Using weather APIs or on-site sensors, billboards can display different content based on current weather conditions, such as promoting cold beverages during hot weather or jackets during cold seasons.

Example: In Dhaka, if the weather is rainy, a billboard for umbrellas or raincoats can be displayed. On hot, sunny days, it might promote cold drinks or air conditioning services.

Benefit: Advertisements feel more relevant to the audience's immediate surroundings, increasing engagement.

Audience-Specific Ads

By using geofencing technology, billboards can display content tailored to the demographics of people near the billboard. For example, if a geofence identifies a large presence of students in the area, the billboard may show ads for budget-friendly products or services.

Example: Billboards near Dhaka's major universities or tech hubs could display ads for student-related services or tech gadgets, while those in residential areas may show ads for family-oriented products.

Benefit: Ads are targeted not only by location but also by the specific demographic profile of the audience in that location, improving relevance and increasing potential conversion rates.

4.3 Real-Time Campaign Monitoring and Optimization

The ability to monitor and optimize advertising campaigns in real-time is absolutely essential for maximizing the impact of billboard advertising. By integrating artificial intelligence (AI) and mobile analytics, advertisers can precisely evaluate their campaigns' performance and seamlessly make adjustments on the fly, ensuring their advertising efforts yield optimal results.

Impression Counts and Engagement Metrics

With the implementation of AI-powered cameras and cutting-edge sensors, advertisers can accurately track the number of viewers exposed to the billboard and measure the duration of their engagement. This wealth of data is readily accessible in real-time via a sophisticated campaign dashboard, allowing advertisers to make informed decisions swiftly and effectively. Take, for instance, a digital billboard situated at a high-traffic intersection in Dhaka that registers an impressive 10,000 impressions per day. A closer analysis of engagement reveals that only 30% of those passersby are interacting with the advertisement for more than just a glance. This critical information empowers advertisers to assess the efficacy of their ad designs. If the majority of viewers are only briefly looking at the billboard, they can decisively implement strategic changes to enhance engagement levels—whether it involves refining visuals, tweaking messaging, or strengthening call-to-action components.

Real-Time Content Adjustments

Thanks to the actionable insights derived from the monitoring system, advertisers can confidently and instantly alter the content displayed on billboards. This agility allows for proactive management and ensures that the most appealing advertisements reach the audience effectively. Imagine a digital billboard in the Mirpur area promoting an e-commerce sale that isn't driving traffic as expected. With real-time data at their fingertips, advertisers can swiftly pivot the content to showcase a time-sensitive offer or a flash sale, both known to captivate audiences more effectively. This capacity for real-time content optimization not only amplifies the effectiveness of campaigns but also guarantees a maximum return on advertising investment. By consistently showcasing only high-performing content, advertisers can confidently reach and engage their target audience, driving superior results and reinforcing their brand's presence in the market.

4.4 Mobile Analytics Integration

Integrating mobile analytics with billboard campaigns creates a direct link between offline exposure and online consumer behavior. This enables advertisers to track the effectiveness of their campaigns beyond the billboard itself.

Geofencing and Location Data

Geofencing is a powerful tool in location-based marketing and advertising. It utilizes advanced technologies such as the Global Positioning System (GPS), radio frequency identification (RFID), Wi-Fi, and cellular data to establish a virtual geographical boundary known as a geofence. This boundary allows businesses to trigger targeted marketing actions as soon as a device enters or exits it. Consider this compelling example: when a student and a working professional are near a computer store, they quickly receive a text message that states, "Today only! Buy a laptop and get an e-reader free!" This immediate response occurs because the store has effectively set up a geofence that activates this strategic marketing action.

Businesses can leverage geofencing not only through text messages but also via in-app notifications, social media ads, push notifications, and emails. These strategies ensure they reach potential customers at the right moment. Geofences can be categorized into active and passive types. Active geofences necessitate that users opt in to location services and keep a

mobile app open, while passive geofences operate seamlessly in the background, relying on Wi-Fi and cellular data to remain constantly active.

A billboard advertising a retail store in a bustling shopping district in Dhaka can track the number of people who visited the store after seeing the billboard. This provides valuable data on conversions. Advertisers can directly link billboard exposure to consumer actions, enhancing the measurement of return on investment (ROI).

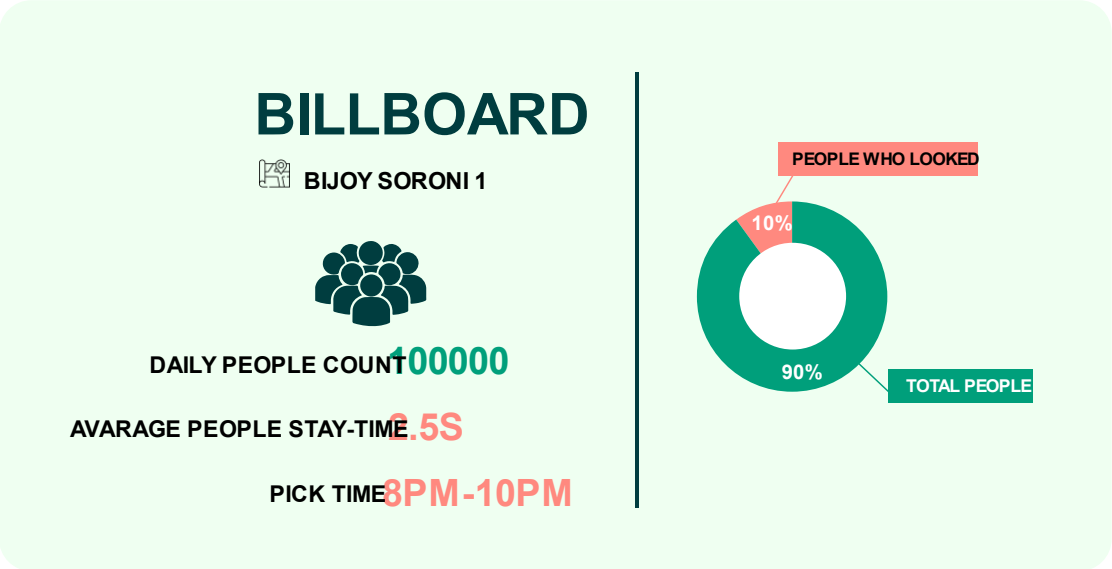

Figure 4 Real-Time Campaign Monitoring

.

4.5 Cost-Effective Implementation for Bangladesh

Considering the budgetary and infrastructural constraints in Bangladesh, cost-effective methods are essential to ensure the feasibility of these solutions. Several strategies are proposed to achieve this:

Cloud-Based Solutions

Using cloud technology for data storage and analytics reduces the need for extensive hardware and maintenance costs. A cloud-based solution provides businesses with access to storage, applications, and services over the internet, offering greater operational efficiency and cost-effectiveness. This approach allows companies to avoid upfront infrastructure costs and instead pay a monthly fee for the services they need. Cloud-based solutions are highly flexible,

scalable, and can be customized to meet specific business needs, enabling employees to work remotely and collaborate in real-time. By leveraging the power of the cloud, businesses can improve productivity, reduce costs, and increase their overall competitiveness

Collaborative Funding Models

Collaborating with multiple stakeholders such as tech companies, telecom providers, and local government bodies can reduce individual investment burdens. Partnering with a local telecom provider for location data or a tech company for AI analytics can help split costs and enhance the deployment of new technologies. Shared financial responsibility makes it easier for smaller advertisers to access advanced technologies.

Chapter-5

5. Framework

The proposed framework combines computer vision and mobile analytics to revolutionize billboard advertising, enabling data-driven insights and dynamic optimization. Below is a detailed narrative of the process, with fewer bullet points and a focus on explanation.

5.1 Goal Identification and Planning

For successful advertising implementation, the foundation lies in setting clear and ambitious objectives. Advertisers must define specific targets, such as significantly enhancing brand awareness, driving app downloads, or maximizing sales conversions. Take, for example, a billboard campaign for an e-commerce platform in Dhaka that confidently sets the goal of increasing app downloads by 20%.

Location selection is a key factor in achieving these objectives. Using demographic and market data, advertisers can strategically position their campaigns for optimal visibility among their target audience. High-traffic urban areas like Banani or Gulshan are perfect for reaching affluent professionals, while billboards near universities like Dhaka University are ideal for engaging younger demographics. By aligning objectives with strategic placements, advertisers can ensure impactful results.

5.2 Deploying Computer Vision Technology

Computer vision is the backbone of this framework, enabling real-time analysis of traffic patterns and audience engagement. High-resolution cameras equipped with AI are mounted on or near billboards to capture pedestrian and vehicular traffic. These cameras analyze data to determine audience demographics, including age and gender, and track engagement metrics like gaze duration.

For example, a billboard near Dhaka's Farmgate might analyze traffic flow during peak hours, identifying the optimal times for displaying specific advertisements. AI-powered systems

process this data locally through edge computing, ensuring real-time feedback and reducing dependence on high-speed internet.

Behavioral analysis adds depth to these insights. By observing facial expressions and movement patterns, advertisers can gauge reactions to the content, helping them refine messaging. For instance, a billboard promoting a new beverage might assess whether passersby exhibit curiosity or indifference.

5.3 Utilizing Mobile Analytics

Mobile analytics complements computer vision by linking physical billboard exposure to digital engagement. Geofencing technology creates virtual perimeters around billboards, tracking mobile devices within the area. This allows advertisers to send personalized notifications or promotions to users nearby.

In an instance, a billboard advertising a restaurant in Chittagong could use geofencing to deliver discount coupons to pedestrians within a one-kilometer radius. QR codes and URLs displayed on the billboard offer another layer of engagement, enabling advertisers to track how many users interact with the ad and proceed to digital platforms.

Mobile analytics also captures post-exposure behavior. Advertisers can analyze whether viewers who interacted with the billboard visited associated websites or made purchases. For instance, after seeing a clothing ad on a billboard, users might browse the brand's website, providing measurable insights into the ad's effectiveness.

5.4 Data Collection and Integration

The integration of data from computer vision and mobile analytics creates a holistic view of campaign performance. Traffic volume, demographic profiles, and engagement metrics are compiled into actionable insights.

For example, data from a billboard near Shahbagh could reveal that it attracts a high concentration of young professionals during the evening rush hour. Advertisers can use this insight to tailor their content to resonate more with this audience.

Audience mobility patterns further enhance this analysis. Combining camera data with GPS information, advertisers can track where viewers go after seeing the ad. This can help identify potential secondary advertising locations, such as nearby shopping malls or entertainment centers.

5.5 Real-Time Optimization

One of the most powerful aspects of this framework is its ability to optimize billboard content dynamically. Real-time data enables ads to adapt to audience profiles, weather conditions, and time of day. For example, a billboard near Dhaka's airport might display coffee ads during the morning rush and dining options in the evening.

Dynamic content adjustments ensure ads remain relevant and engaging. For instance, during heavy rain in Sylhet, the billboard might switch to promoting umbrellas or raincoats. Similarly, ads can change based on traffic density, with bold, high-impact messages during peak hours and more detailed ads during quieter periods.

5.6 Post-Campaign Analysis

At the end of the campaign, the collected data is analyzed to assess performance and return on investment (ROI). Metrics such as impressions, engagement rates, and conversions provide a clear picture of the campaign's success. For instance, a campaign for a tech product might measure how many app downloads originated from viewers within the geofenced area. Post-campaign analysis also involves calculating ROI by comparing ad spend to measurable outcomes. If a billboard in Dhaka promoted an online store and led to a 30% increase in sales, this data would validate the campaign's effectiveness. Insights gathered during analysis feed into a feedback loop for future campaigns. Advertisers can refine targeting, improve content strategies, and enhance their approach based on what worked and what didn't.

5.6 The Framework of Smart Advertising

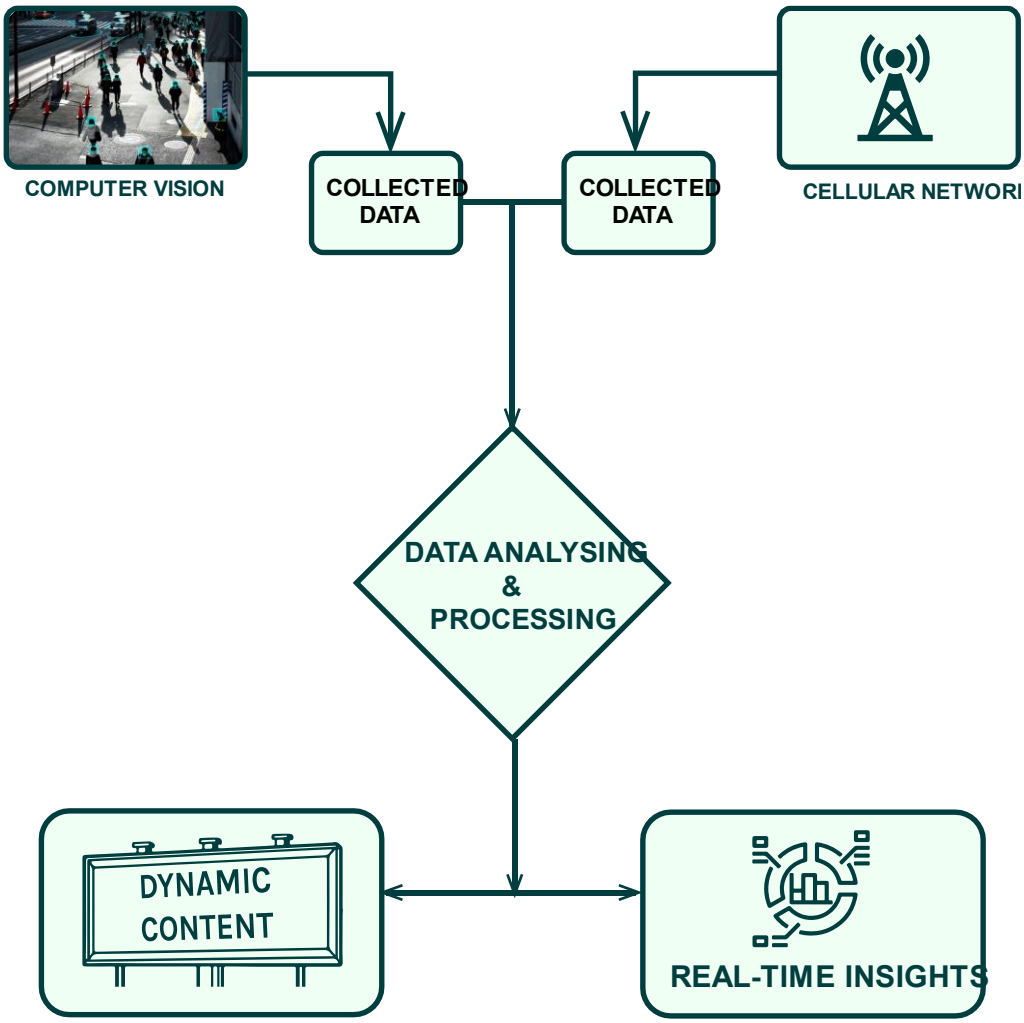

Figure 5 Framework Smart Advertising: Integrating Analytics in Outdoor Billboard Campaigns

Chapter-6

6. Conclusion

The traditional approach to billboard advertising, while effective in creating broad brand awareness, has struggled to keep pace with the data-driven demands of modern marketing. This limitation has placed billboard campaigns at a disadvantage compared to digital advertising, which provides detailed analytics and precise audience targeting. However, the integration of advanced technologies such as artificial intelligence (AI), computer vision, and mobile analytics offers a transformative pathway to bridge this gap. This research has demonstrated that by employing computer vision, advertisers can collect real-time data on traffic patterns, audience demographics, and engagement levels. Mobile analytics further extends these capabilities by tracking post-exposure behaviors, such as app downloads or website visits, creating a link between physical and digital engagement. The proposed framework also introduces dynamic content optimization, enabling advertisers to adapt billboard content based on real-time insights and external factors like weather, traffic density, and audience composition. In the context of Bangladesh, where outdoor advertising remains a prominent medium, this framework addresses critical challenges such as infrastructure limitations and the need for cost-effective solutions. By implementing AI-powered edge computing, geofencing, and localized data processing, advertisers can overcome these barriers while maintaining compliance with data privacy regulations. For advertisers, this represents an opportunity to leverage traditional outdoor media with the precision and adaptability of digital platforms. The necessity of embracing innovation to ensure the continued relevance and effectiveness of billboard advertising. By adopting the proposed solutions, advertisers can transform static, one-way campaigns into dynamic, data-driven experiences that resonate with modern audiences. This integration of technology and analytics ensures that billboard advertising remains a vital component of the marketing ecosystem in Bangladesh and beyond.

Chapter-7

Reference

Awati, R. (2022, Dec). *What is geofencing and how is it used?* . Retrieved from TechTarget: https://www.techtarget.com/whatis/definition/geofencing

Billboard And Outdoor Advertising Global Market Report 2024. (2024, October). Retrieved from TBRC The Business Research Private Ltd.: https://www.thebusinessresearchcompany.com/report/billboard-and-outdoor-advertising-global-market-report

Computer vision. (2021, July 27). Retrieved from IBM: https://www.ibm.com/think/topics/computer-vision

Digital billboard advertising cost in Bangladesh. (2024, Sep 23). Retrieved from ADPRO: https://adpro.com.bd/index.php/2024/09/23/billboard-advertising-cost-in-bangladesh/

Drozdov, A. (2024, Oct 29). *Computer Vision for Traffic Management and Analysi*. Retrieved from Yellow: https://yellow.systems/blog/computer-vision-for-traffic-management

Machine Vision with AI Assists Traffic Monitoring. (2024, Jul). Retrieved from PHOTONICS: https://www.photonics.com/Articles/Machine_Vision_with_AI_Assists_Traffic_Monitoring/a70106

Sami, A. (2024, Sep 24). *Why Billboards in Bangladesh Are Your Secret Weapon for Business Success*. Retrieved from Medium: https://ahmedsamii.medium.com/why-billboards-in-bangladesh-are-your-secret-weapon-for-business-success-db6c7de1dc54

The Power of Billboard Advertising in Bangladesh. (n.d.). Retrieved from Billboard Advertising BD: https://billboardadvertisingbd.com/the-power-of-billboard-advertising-in-bangladesh/

What Is A Cloud-Based Solution? (n.d.). Retrieved from Mitel: https://www.mitel.com/articles/what-is-a-cloud-based-solution

Md. Maniruzzaman Hredoy ID: 212-45-009

by Md. Maniruzzaman Hredoy

Submission date: 04-Jan-2025 03:22PM (UTC+0600)
Submission ID: 2559700185
File name: Final_Project.pdf (718.1K)
Word count: 7253
Character count: 49043

Md. Maniruzzaman Hredoy ID: 212-45-009

ORIGINALITY REPORT

14%	14%	1%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.coursehero.com Internet Source	4%
2	www.photonics.com Internet Source	3%
3	www.thebusinessresearchcompany.com Internet Source	2%
4	Submitted to Daffodil International University Student Paper	1%
5	stickerdriver.com Internet Source	1%
6	www.techtarget.com Internet Source	1%
7	Submitted to Southern New Hampshire University - Continuing Education Student Paper	<1%
8	seacastle.online Internet Source	<1%
9	www.marketresearch.com Internet Source	<1%

10	ijisrt.com Internet Source	<1%
11	thebusinessresearchcompany.com Internet Source	<1%
12	Submitted to George Bush High School Student Paper	<1%
13	Submitted to Manipal University Jaipur Online Student Paper	<1%
14	fastercapital.com Internet Source	<1%
15	www.statista.com Internet Source	<1%
16	www.mediasearchgroup.com Internet Source	<1%
17	docplayer.net Internet Source	<1%
18	callej.org Internet Source	<1%
19	ir.uitm.edu.my Internet Source	<1%
20	princeofpiesblogs.blogspot.com Internet Source	<1%
21	www.360quadrants.com Internet Source	<1%

22	eprints.utm.my Internet Source	<1%
23	knowledgecommons.lakeheadu.ca Internet Source	<1%
24	whatis.techtarget.com Internet Source	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	Off		