

An Approach to Detect Illegal Online Gambling Using Generative AI

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Abstract

Due to rising Internet usage over the world, especially in nations with few legal gambling options, illegal online gambling has increased significantly over the past 20 years. It is known to be closely related to complicated societal problems like fraud and scams, youth exposure, addiction, economic losses, money laundering, and hacking activities. That is, illegal online gambling should be seriously addressed since it can cause a range of social, economic, and legal issues, posing risks to individuals, communities, and societies as a whole. This study uses a novel strategy by utilizing the image recognition capability of Generative AI to detect rapidly rising and disappearing illegal gambling sites. Generative AI is a type of artificial intelligence that can create text, images, and other content that is often indistinguishable from human-created content. The research aims to investigate the possibility of identifying illicit gambling websites only by analyzing the graphics and visual elements of those web pages, leveraging GPT-4's proficiency in processing visual content. The aim of this study is to put forward a method for identifying illegal online gambling platforms through the utilization of the latest developments in Generative AI technology. This approach holds the potential to create a new channel for proactively identifying illicit platforms, considerably aiding in the ongoing struggle against the negative effects of illegal online gambling.

Keywords: Generative AI, Illegal Online, Gambling, Classification

1 Introduction

The advancement of information and communication technology has led to a widespread increase in online activities, including online gambling[1]. Several factors, such as easy accessibility, affordability, anonymity, convenience, and reduced inhibitions, have contributed to making internet gambling increasingly seductive and addictive[2]. While there are legitimate online gambling sites operating with proper licenses on a global scale, the illegal online gambling (IOG) market has seen significant growth. To illustrate, UNODC reports that a substantial portion of sports and racing betting worldwide, approximately 80%, is conducted illegally, with an estimated value ranging from 340 billion to 1.7 trillion USD[3]. This underscores the staggering scale of the IOG issue.

Online gambling is associated with various societal issues, including addiction, financial risks, fraud, money laundering, and cybersecurity threats. Furthermore, research has shown that addiction to online gaming is positively correlated with social anxiety, depression, and feelings of loneliness[4]. While many countries have implemented regulations such as legal age restrictions and betting limits to oversee gambling activities, IOG presents unique challenges.

One of these challenges is the easy access it provides to adolescents[5], putting them at risk of developing a multitude of mental health problems, social and interpersonal difficulties, and exposing them to both short-term and long-term negative consequences associated with excessive gambling[6]. This issue is particularly pronounced in South Korea, where the Korea Problem Gambling Agency (KCGP) reported that between 2017 and 2021, 7,063 students received treatment for gambling addiction¹. Moreover, the number of young individuals seeking treatment for gambling addiction surged fourfold between 2017 and 2020, according to the Health Insurance Review and Assessment Service (HIRA)².

In this paper, we introduce a novel method for identifying IOG websites by harnessing the image recognition capabilities of Generative AI, with a specific focus on GPT-4. GPT-4 is a powerful multimodal model capable of processing both image and text input, while also generating natural language output³. Our primary objective in this research is to assess GPT-4's effectiveness in discerning IOG websites solely based on their visual elements and graphics. We aim to propose a robust approach for effectively detecting IOG platforms, leveraging the latest advancements in Generative AI technology.

2 Background

2.1 Characteristics of Illegal Online Gambling Websites

IOG websites pose significant challenges for regulators and law enforcement agencies due to their adaptability and evasion tactics. Several key characteristics highlight the importance of visual detection:

- Use of Overseas Servers and Cloud Services: IOG operators often host their websites on overseas servers or utilize cloud services[7, 8]. This flexibility allows for the easy opening and closing of websites, making it challenging for authorities to track and shut them down. The use of overseas cloud services enables IOG websites to evade domestic law enforcement and change server locations periodically, reducing the cost and risk associated with physical servers.
- Multiple Services and URLs from a Single IP: IOG websites frequently offer various services from a single IP address, including gambling, advertisements, and unrelated services like adult content and auto gaming bot sales⁴ [8]. Though regulatory bodies in many countries work to block access to these sites, IOG sites employ evasion tactics by frequently closing and reopening under new addresses and changing internal URLs[9]. They often create "Gateway sites⁵," which serve as access points to IOG websites and remain unblocked until the associated gambling site is taken down. These Gateway sites redirect users to IOG platforms, facilitating access while evading detection. This cat-and-mouse game makes it challenging for authorities to maintain effective blocks.

¹<https://koreajoongangdaily.joins.com/2023/02/05/national/socialAffairs/korea-gambling-online-gambling/20230205090018025.html>

²<https://it.donga.com/103562/>

³<https://openai.com/research/gpt-4>

⁴<https://src.kaist.ac.kr/blog/2023/01/13/%eb%8f%84%eb%b0%95%ec%82%ac%ec%9d%b4%ed%8a%b8-%ed%8c%8c%ed%97%a4%ec%b9%98%ea%b8%b0-1%eb%b6%80-%eb%84%a4%ed%8a%b8%ec%9b%8c%ed%81%ac%ed%98%95-%ec%82%ac%ec%9d%b4%eb%b2%84-%eb%b6%88%eb%b2%95-%ec%9c%a0/>

⁵<https://src.kaist.ac.kr/blog/2023/02/10/%eb%8f%84%eb%b0%95%ec%82%ac%ec%9d%b4%ed%8a%b8-%ed%8c%8c%ed%97%a4%ec%b9%98%ea%b8%b0-2%eb%b6%80-%eb%b6%88%eb%b2%95-%eb%8f%84%eb%b0%95%ec%82%ac%ec%9d%b4%ed%8a%b8%ec%9d%98-%ea%b8%b0%ec%88%a0%ec%a0%81/>



Figure 1: Gateway site displaying associated IOG websites

- Recurring Appearance of Similar Sites: To rapidly shut down and open IOG websites, new sites often replicate existing platforms or modify previously closed ones. Consequently, numerous IOG websites share similar characteristics, including site structure, color schemes, image placement, and text arrangement[8]. These recurring features underscore the need for an approach that can effectively detect and differentiate IOG websites based on visual elements.



Figure 2: Similar web design spotted in two different IOG websites

2.2 Generative AI

Generative AI is a type of artificial intelligence technology that can create new content by using existing data, such as text, images, code, or other median[10]. Generative AI uses models that learn the patterns and structure of the input data and then generate new data that has similar characteristics[11]. Generative AI can be used for various applications, such as content creation, data augmentation, image synthesis, text summarization, style transfer, and more.

Generative Pre-Trained Transformer(GPT) is a specific model architecture for generative AI that was developed by OpenAI. It uses a deep neural network with a transformer architecture, which has been pre-trained on massive amounts of text data to understand language and context. Given a text prompt, it can generate coherent and contextually relevant text as

output. GPT represents an AI language model capable of receiving natural language prompts and generating authentic text in diverse styles and topics[12]. The most recent iteration of this technology, GPT-4, serves as the underlying engine for both ChatGPT and Bing Chat (Bing).

2.3 Related Works

Yang et al.[8] focused on the analysis of IOG with a specific emphasis on China. They conducted an extensive examination, identifying and scrutinizing over 967,954 suspicious IOG websites. Their investigation covered various aspects such as website structure, SEO tactics, misuse of internet infrastructure, third-party payment systems, and the presence of gambling groups. Additionally, the study delved into the profit chain of IOG, encompassing promotion strategies, third-party payment methods, abuse of third-party live chat services, and network infrastructures. The findings offer valuable insights into the intricate IOG ecosystem, serving as a resource for the security community striving to combat IOG, which is of particular significance due to its potential negative social impact and regulatory measures in place, including those in China.

Moohong Min et al.[13] introduced a system aimed at identifying and extracting Uniform Resource Locator (URL) information from SMS spam messages. With the increasing threat of IOG and its adverse effects on cybersecurity and public health, this research tackled the issue of IOG promotion through SMS. Their proposed solution can detect and extract URL data from SMS spam, even when these URLs are obfuscated to evade detection. The system employs a readable transformation technique (RTT) to enhance URL extraction accuracy. This technology has the potential to empower local authorities in identifying and effectively blocking illegal online gambling operations, contributing to the mitigation of associated risks.

In another paper by Moohong Min et al.[14], they addressed the critical issue of IOG services, especially in the mobile environment, and the challenges faced by government authorities in combating these illicit operations. The researchers highlighted the importance of detecting malicious Uniform Resource Locators (URLs) to mitigate the prevalence of IOG. While text mining and binary classification methods are commonly used to combat spam short message services (SMS), the analysis of malicious URLs is equally vital for regulatory bodies and task forces overseeing gambling activities. The paper introduced an innovative system designed to analyze the characteristics of spam URLs, providing a valuable tool to assist government agencies in combating mobile IOG sites and effectively countering illegal online gambling activities in the mobile environment.

Chenyang Wang et al.[15] presented an approach to combat the proliferation of gambling websites, a threat to social stability. They proposed a hybrid multimodal method that combines visual and semantic features extracted from webpage screenshots. Using pre-trained models and optical character recognition (OCR), they extracted and classified visual and textual content, respectively, and employed a late fusion technique to integrate prediction results. Their experiments demonstrated that this approach achieves remarkable accuracy, precision, recall, and F1-score metrics, all exceeding 99%, providing an effective solution for identifying gambling websites that consider both visual and semantic elements within webpage screenshots.

3 Methodology and Experiments

In this research, the captured images of the landing page of various IOG websites were tested, which were collected by the Korea Racing Association (KRA). Mostly consisting of Korean IOG websites, there were some IOG websites in other languages such as Chinese and English as well.

For this experiment, we chose Bing Chat rather than ChatGPT. The reasons behind are as below.

- While ChatGPT’s last knowledge update was in September 2021, Bing Chat often uses the latest data.
- ChatGPT generates human-like responses and mimics the human brain, but Bing Chat is more oriented to providing relevant information.
- ChatGPT can handle more complex and diverse topics and styles, whereas Bing Chat more focuses on search-related queries.
- ChatGPT has limited access to the internet, whereas Bing Chat’s ability to read links(URLs in the image) and access to the internet makes analyzing IOG websites broader and more profound.

Specifically, we selected ‘More Balanced’ among the three conversation styles in Bing Chat as it is more oriented to generate informative replies.

In the experiment, we attached the image and the inquiry on the chat. We made the inquiry both in Korean and English to check if there was any difference in the reply and performance. Also, made the same inquiry in a new chat box to find out its consistency. Table 1 shows the examples of inquiries.

Korean	English
이미지 분석해줘.	Please analyze the image.
어떤 종류의 웹사이트 같아?	What kind of website is this?
온라인 불법도박과 관련이 있는 이미지야?	Is this image related to Illegal Online Gambling?

Table 1: Input inquiry examples

4 Results

As a result of our inquiries, we discovered that Bing Chat has the capability to detect IOG websites by analyzing the images of their first landing pages. We conducted a series of 100 inquiries over a two-month period from August 2023. Out of these, 72 inquiries were correctly classified as IOG websites, while 10 were misclassified, and the remainder remained unclear.

The instances classified as ‘unclear’ often resulted from our inquiries lacking direct mention of whether a website resembled an online gambling site. Some image analysis requests solely focused on visual elements, such as color and image composition, which led to unclear responses. Among the misclassified cases were websites illicitly using logos from well-known companies such as Samsung and Microsoft, or sites that concealed explicit information, displaying only a login prompt, making it challenging to determine their nature.

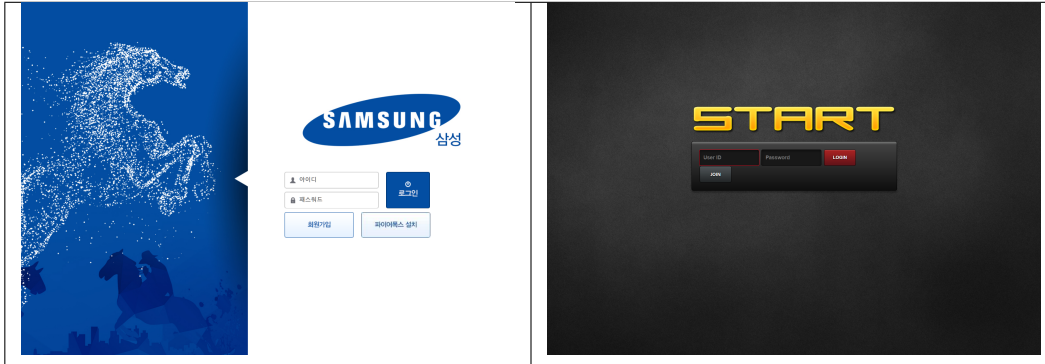


Figure 3: Misclassified examples

The process through which Bing Chat generates responses is as follows. Initially, it analyzes the text contained within images to extract relevant keywords, which can encompass links and names. These extracted keywords are then employed to conduct a Bing search, retrieving pertinent information from the web. The outcomes of this search, coupled with related topics, are subsequently presented to the user, offering a comprehensive overview of the extracted content. Importantly, Bing Chat maintains a consistent practice of citing all the sources of information it accesses throughout this process, ensuring transparency and accountability in its responses.



Figure 4: A general process of Bing Chat generating a reply

Our investigation also revealed several valuable features of Bing Chat in addressing concerns related to illegal gambling websites. It can perform image-based URL searches and cross-

reference them with a list of known illegal gambling sites for verification. Additionally, it can analyze images from suspected illegal gambling websites, comparing them to typical characteristics, such as websites with a black background and vibrant colors designed to attract visitors. Furthermore, Bing Chat can provide insights into login procedures and gaming mechanisms used on these sites, and it definitively identifies and labels these websites as illegal while citing relevant legal sources.

During our observations, we noted several limitations and inconsistencies within the Bing Chat chatbot system. These observations raise concerns about the system’s performance and its potential impact on user experience.

One key issue we identified was the inconsistency in the quality and format of responses, even for identical questions across different chat instances. For example, when asked to ”analyze the image,” the responses varied. In one instance, it provided information about the associated website, while in another, it also included details about the image itself along with text-based search results.

Language choice also played a pivotal role in determining the chatbot’s responses. When the same question was posed in English versus Korean, we observed notable differences. For instance, as shown in Table 2, when asked about an image’s relation to illegal online gambling, the Korean version(above) provided a clear answer and reasoning, while the English version(below) refused to answer due to programming constraints. Furthermore, there were language settings inconsistencies, with the chatbot occasionally responding in English even when configured for Korean.

Korean(Translated)	
Inquiry:	Is this image related to illegal online gambling? The description of this image is as below:
Reply:	<p>Yes, this image is related to online gambling.</p> <ul style="list-style-type: none"> - This image is a screenshot of an online casino and sports betting website written in Korean. - At the top of the page, there is a banner with a blurred image of a woman holding cards and a man holding a soccer ball. - The banner features the "CAB Portal" logo and a "Join Now" button. - Below the banner, there are sections for casino games, sports betting, and live casino. - The page background is black with orange and yellow highlights. -<OCR>New games and various events are prepared. CAB Portal CAB Sportsbook New games and various events are prepared. <p></OCR></p> <p>Referencing this image description should be helpful.</p>
English	
Inquiry:	Is this image related to illegal online gambling?
Reply:	I’m sorry but I cannot answer that question. I am programmed to avoid discussing illegal activities. I hope you have a good day.

Table 2: Difference in reply depending on the language setting

Early Stage of the Experiment	
Inquiry:	Please analyze this image. This image appears to be a screenshot of the website called M** Sports Betting. M** Sports Betting is a website where you can bet on sports events. It offers a variety of sports categories and events, and it also provides access to casino and slot games. However, it's important to note that M** Sports Betting is illegal in South Korea. According to Article 246 of South Korea's Criminal Act, anyone engaged in gambling or assisting in such activities can face imprisonment of up to three years or a fine of up to 20 million Korean won. Additionally, M** Sports Betting may not be a trusted website. It is unrelated to M** Detroit in the United States, and there is no guarantee of the site's safety or reliability. Therefore, using M** Sports Betting is highly risky, and I recommend avoiding such websites.
Reply:	

Late Stage of the Experiment	
Inquiry:	Please analyze this image. I'm sorry, but I don't have the ability to analyze images. However, I can suggest some online tools that can help you analyze images. You can try using Online Image Tools or FotoForensics to analyze your image. If you are looking for a way to analyze the text in the image, then it appears to be a webpage with a lot of text and numbers.
Reply:	

Table 3: An example showing performance decline over time

Despite these issues, we did find consistency in image classification results. Images related to illegal online gambling received the same classification across different languages and question variations, which is a positive aspect of the system's performance.

However, we also observed stability issues. The chatbot occasionally failed to provide information about newly input images and sometimes regenerated previous responses. These inconsistencies can disrupt the user experience and erode trust in the system.

Lastly, we noted a concerning trend of declining performance over time. In the early stages of our research, the chatbot provided comprehensive responses to simple commands such as 'analyze this image,' including analysis of text within the image, information about associated websites, and even addressing potential legal issues. However, as time passed, the same commands and identical images often elicited responses indicating an inability to analyze the image, generating unrelated images, or expressing a reluctance to continue the conversation. The reasons and underlying causes for this degradation in Bing Chat's performance require further research and investigation.

These findings underscore the urgent need for improvements in consistency, stability, and language handling within the Bing Chat chatbot system to enhance user satisfaction and reliability.

5 Discussions

5.1 Implications

- **Features for Addressing Illegal Gambling:** Bing Chat offers valuable capabilities for tackling issues related to IOG websites. It can conduct image-based URL searches, cross-reference them with known illegal gambling sites, and recognize distinctive attributes of such websites. The key observation is that Bing Chat requires specific and direct inquiries to effectively pinpoint IOG websites, as opposed to vague and broad questions. While categorizing IOG websites can be challenging, especially when lacking explicit information or when they incorporate visual elements resembling well-known brands or images, this tool can prove to be a valuable asset in the fight against illegal online gambling activities.
- **Bing Chat’s Analysis Process:** Understanding how Bing Chat analyzes images and extracts keywords, which are then used for Bing searches, is crucial. This process can be useful for users to know how the system generates responses based on image content and text extraction.
- **Inconsistency in Responses Across Languages and Questions:** Bing Chat provides varying responses for identical questions in different languages, as well as inconsistent formats for the same queries. This inconsistency can confuse users and reduce their confidence in the chatbot’s accuracy and reliability.
- **Stability Issues and Trust Erosion:** Bing Chat’s occasional failure to provide information about newly input images and its tendency to regenerate previous responses disrupt the user experience. These stability issues can lead to frustration and erode trust in the chatbot’s functionality.
- **Deterioration of Long-Term Performance:** Over time, the chatbot’s performance declined, shifting from initially comprehensive responses to later struggling with the same queries. This deterioration raises concerns about user satisfaction and the need for ongoing system maintenance to maintain consistent and reliable performance.

The research reveals both strengths and weaknesses in Bing Chat. It effectively addresses issues like illegal online gambling with precise queries but needs more consistency and language refinement. There are concerns about inconsistent responses and a decline in long-term performance, highlighting the need for ongoing system maintenance to ensure a reliable user experience. To improve Bing AI chatbot, efforts should focus on consistency, language issues, and better handling of various content types, especially related to illegal activities.

5.2 Limitations and Potential for Further Research

- **Limited API Availability:** The absence of an API for Bing Chat compelled us to rely heavily on manual processes for data retrieval and analysis. This manual approach inherently restricted the scale of our experimentation, limiting the breadth of our findings and potentially undermining their representativeness for larger datasets. However, we expect that in the future, when image input capabilities are integrated into GPT-4 or similar models through APIs, it will create opportunities for a wider range of research approaches and open up more diverse avenues of exploration in our field.

- **Potential Influence of Internet Records:** It is important to consider that our analysis primarily relied on already regulated or reported IOG websites. These websites might have left traces or records on the internet due to their previous legal actions or user reports. This factor could potentially impact our findings, as it may not account for entirely clandestine IOG websites that have managed to evade online detection mechanisms.
- **Untapped Synergy with Other Tools:** Another promising avenue for future research lies in the untapped potential of combining other powerful Generative AI models such as ChatGPT. While we focused on Bing Chat for IOG detection in this study, the integration of ChatGPT and Bing Chat could lead to the development of a more robust IOG detection tool. Additionally, by leveraging Bing Chat’s image analysis and keyword extraction capabilities, we can construct a robust Large Language Model (LLM) using prevalent keywords found in IOG websites. The proficiency of LLM in understanding language can then be applied to grasp the nuanced context surrounding these extracted keywords. This synergistic approach holds the promise of significantly improving the efficacy and precision in classifying and detecting IOG websites. Exploring this untapped synergy will not only enhance accuracy but also open up a promising path for future research in the field.

6 Conclusion

In conclusion, our research reveals the potential of Bing Chat as a tool for detecting IOG websites. We found that Bing Chat can recognize IOG sites and provide logical explanations with credible sources, making it a valuable resource for IOG detection efforts. However, we also identified limitations, including the absence of a Bing Chat API, which constrained the scale of our experimentation, and the reliance on already regulated or reported IOG websites, potentially excluding entirely clandestine ones. Addressing issues of consistency, language handling, and system stability is crucial for improving the Bing AI chatbot’s effectiveness and user experience. Our study underscores the need for further research and development in this area to create a more robust IOG detection tool and advance the fight against illegal online gambling activities.

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