Fake social media accounts and their detection

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***Abstract* - Fake social media profiles have brought with them widespread problems of information dissemination, harassment, impersonation, and online fraud. This study proposes a complete solution for detecting spurious accounts using the integration of machine learning approaches with natural language processing. The system utilizes the XGBoost algorithm for the classification of user accounts on the basis of quantitative features like follower-to-following ratio, verified status, frequency of posts, and patterns of usernames. Moreover, it employs a language model for examining unstructured information such as user profiles, post captions, and image-content for signs of spam, extremism, hate speech, propaganda, and impersonation. An operational web-based prototype was created for performing real-time profile assessment, creating in-depth category-wise risk measures and interpretive explanations. Experimental evaluations show that the hybrid model works with very good accuracy to detect forged profiles while remaining explainable. The suggested system presents scalable and effective methods for improving trustworthiness and security on principal social networking platforms.**

KEYWORDS—Fake Accounts, Social Media, Cybersecurity, Machine Learning, Instagram Detection, Behavioral Analysis.

I. INTRODUCTION

Social media sites like Instagram, Facebook, Twitter, and LinkedIn have transformed communication by making it possible for billions of users to communicate, share information, and interact with one another across the world. The open nature and the fast expansion of these websites have equally facilitated a system in which evil actors can readily establish false accounts for duplicitous means. These false profiles, as made manually or automatically (bots), are utilized for numerous malicious actions such as identity theft, disinformation campaigns, monetary fraud, phishing, and artificially inflating popularity by generating fake likes or followers.

Fake profiles have become a persistent issue for both users and platform administrators. Ranging from impersonating actual people and public figures to promoting scams or extremist ideologies, these accounts can cause significant psychological, financial, and societal damage. Moreover, companies that depend on influencer advertising or customer interaction numbers are exposed to exaggerated analytics by virtue of fake interactions. The existence of fake profiles erodes trust in online communication, resulting in lower user satisfaction and platform reputation.

Traditional approaches to detecting counterfeit accounts—like CAPTCHA systems, manual reporting, and rule-based filters—do not succeed in responding to the advanced evasion tactics used by criminals. These methods might either miss well-designed counterfeit accounts or incorrectly accuse legitimate users, leading to poor effectiveness and user frustration.

To counter these weaknesses, machine learning and data-driven methods have proved to be highly effective in identifying spurious profiles. Intelligent systems can learn to identify genuine versus spurious users with high precision by examining account metadata, behavior patterns, content interaction, and social network structures. Intelligent systems not only automate the identification but also evolve along with changing strategies employed by nefarious agents.

This work targets the identification of spam accounts in particular on Instagram, which is one of the most popular visual social media sites currently. The detection framework proposed utilizes machine learning methods to evaluate a range of features used to represent Instagram accounts. Some of these features are user bio attributes, follower-following ratio, post activity, and engagement behavior, which all help to distinguish suspicious or robotic account behavior. Through the process of testing different classification models, this research seeks to establish the viability and efficacy of an

AI-driven solution in protecting social media networks against the risk of spurious profiles.

LITERATURE SURVEY

In recent years, a diverse set of approaches has been proposed to detect fake social media accounts by leveraging network structure, behavioral features, ensemble learning, and content analysis. Below is a concise review of five representative studies, highlighting their main contributions and methodologies.

A. DeepProfile: Finding Fake Profiles in Online Social Networks Using Deep Learning [1]

- ***Authors:*** Wanda Putra & Jie Huang Jin (2019)
- ***Introduction:*** Introduces a CNN-based model that learns hierarchical representations of profile metadata and text content for fake-profile detection.
- ***Methodology:*** Encodes user bios and recent posts via word embeddings, processes them through convolutional layers, and combines the output with numerical profile features in a jointly trained deep neural network.

B. Friend or Faux: Graph-Based Early Detection of Fake Accounts on Social Networks [2]

- ***Authors:*** Adam Breuer, Roee Eilat, Udi Weinsberg. (2019)
- ***Introduction:*** Focuses on early detection of fake profiles by analyzing the ego-network connectivity patterns of new accounts, under the premise that fake accounts form anomalous subgraphs.
- ***Methodology:*** Constructs time-evolving graphs centered on each account and computes graph metrics (e.g., clustering coefficient, PageRank score). A supervised classifier distinguishes genuine from fake based on these structural features.

C. Detecting Clusters of Fake Accounts in Online Social Networks [3]

- ***Authors:*** Cao Xiao, D. Freeman, Theodore Hwa. (2018)
- ***Introduction:*** Addresses the detection of groups of fake profiles created by the same malicious entity, recognizing that coordinated activity is a hallmark of large-scale fake-profile campaigns.
- ***Methodology:*** Uses community detection algorithms to identify dense clusters of accounts with similar metadata and posting patterns, then applies a binary classifier to flag clusters likely representing botnets.

D. Fake Accounts Detection on Social Media Using Stack Ensemble System [4]

- ***Authors:*** Amna Kadhim, Abdulhussein M. Abdullah. (2020)
- ***Introduction:*** Proposes a stacking ensemble that combines multiple base learners for detecting fake Twitter accounts.
- ***Methodology:*** Applies Spearman correlation and chi-square tests for feature selection, then trains a meta-model over base classifiers (e.g., Random Forest, SVM). The ensemble improves robustness against noisy features.

E. Social Media Identity Deception Detection: A Survey [5]

- ***Authors:*** Ahmed Alharbi, Hai Dong, Xun Yi, Zahir Tari, And Ibrahim Khalil. (2021)
- ***Introduction:*** Reviews identity deception strategies, including fake accounts and impersonation attacks, classifying detection methods into rule-based, machine-learning, and hybrid approaches.
- ***Methodology:*** Summarizes feature categories—profile, network, temporal, and content—and evaluates their efficacy. Highlights open challenges in real-time detection and cross-platform generalization.

RESEARCH GAPS

Generalizability Across Platforms: Models tuned on Twitter often degrade on Facebook or Instagram data, due to differing user behavior and API limitations.

Adversarial Robustness: AI-generated profiles (GAN or diffusion-based) can mimic real activity patterns, bypassing metadata detectors that lack adversarial training.

Semantic Content Verification: Metadata models ignore the actual content of posts, missing fabricated narratives or factually inconsistent statements.

Real-Time Scalability: Deep-learning pipelines often incur high computational costs and latency, impeding integration into live moderation systems.

OBJECTIVES

The primary objective of this research is to develop a robust and scalable framework for detecting fake social media accounts by integrating machine learning and natural language processing techniques. Specifically, the study aims to:

- **Implement a Two-Stage Detection Framework**: Utilize XGBoost for initial classification based on profile metadata and behavioral features, followed by a semantic analysis using OpenAI's GPT to assess the authenticity of user-generated content.
- **Enhance Detection Accuracy and Robustness**: Combine the strengths of gradient-boosted decision trees in handling structured data with the contextual understanding capabilities of GPT to improve overall detection performance.
- **Address Evolving Threats**: Adapt to sophisticated fake account strategies, including the use of AI-generated content and coordinated inauthentic behavior, by incorporating semantic verification into the detection process.

- **Facilitate Real-Time Application**: It should be available, lightweight, and scalable such that it can be implemented in real-time social media listening scenarios.
- **Contribute to the Field of Social Media Security**: Provide insights and methodologies that can be leveraged by researchers and practitioners to combat the proliferation of fake accounts and enhance the integrity of online platforms.

SCOPE

This project's scope consists of:

Data Sources: Leveraging publicly accessible profile metadata and user-generated content from major social media platforms (e.g., Twitter, Facebook, Instagram). Personal messages, direct messages, and fire-walled information are not covered.

Feature Evaluation: Evaluating and extracting behavioral information, linguistic sentiment scores, topic coherence, and bio completeness alongside posting frequency, follower to following ratios, and account age.

Fake Account Detection: The system targets the identification of fraudulent social media accounts through followers and following counts, account activity, and account longevity.

Collaboration with Content Validation: The initiative aims to improve metadata analysis verification precision through the application of OpenAI's GPT model for post validity and semantic coherence evaluation.

II. METHODOLOGY

This research identifies fake social media accounts using a machine learning approach based on the XGBoost classification algorithm. A comprehensive methodology is applied which includes data collection, pre-processing, feature definition, model training, evaluation, and deployment. This pipeline allows for accurate measurable analyses of user profiles and user accounts to determine if an account is fake.

The first step towards completion of the project is data collection which entails harvesting structured data from profile pages on social media. The profile features include username, number of posts, followers, following, bio of the user, and profile picture. Some additional engagement metrics such as the like or comment ratio to followers ratio can also be added if they are accessible. In order to keep the dataset clean, some pre-processing steps need to be done by discarding incomplete records, addressing missing values, and standardizing data formats. The resulting dataset now represents user behaviors and characteristics in a structured and clean manner.

Once the data is prepared, feature engineering is conducted with the purpose of extracting useful attributes that could potentially assist in the identification of fake accounts. Some of the most important features include the followers-to-following ratio which indicates robot-like following patterns, the overall activity indicated by post count, as many fake profiles either remain dormant or are less active, as well as the profile biography's length and completeness. Perhaps the most striking feature is the existence or absence of a profile picture, acting as a binary predicate since most fakes profiles tend to not have proper images. Features such as usernames that are overly brief, or made up of what appear to be haphazard characters, are also believed to strongly suggest automation or inauthenticity. These features are transformed into numerical formats and normalized to ensure uniformity during training.

Model	Accuracy	Precision	Recall	F1-Score
Logistic Regression	85.2%	83.5%	86.1%	84.8%
Random Forest	91.3%	89.7%	92.5%	91.0%
SVM	88.6%	87.0%	89.2%	88.1%
XGBoost	**93.5%**	**91.8%**	**94.6%**	**93.2%**

Table 1: How Different Machine Learning Models Perform in Verifying Social Media Profiles

The classifier employed in our study is XGBoost, or Extreme Gradient Boosting; an implementation of machine learning that is extremely efficient and scalable using gradient boosted decision trees. For structured classification problems, XGBoost is chosen due to its superior performance over other algorithms, resistance to overfitting, and ability to deal with tabular data of different feature types. Using the available dataset, it is common practice to divide it into training and testing subsets, usually in an 80:20 ratio. The classifier used is XGBoost, and the training procedure comprises feeding labelled data into the classifier, where each profile is labelled as genuine (zero) or fake (one).

Standard performance evaluation is performed to assess the accuracy of the submission once the model is trained. These measures include precision; the ratio of true fake profiles to all fake profiles predicted by the model, recall; the number of true fake profiles predicted by the model, F1-score; a measurement of the accuracy of the classifier, and accuracy which indicates the number of correct predictions. Moreover, a confusion matrix aids in the visualization of true positive values, true negative values, false positive values, and false negative values. All of these different metrics play an important role in determining the effectiveness of the model and areas of enhancements for it.

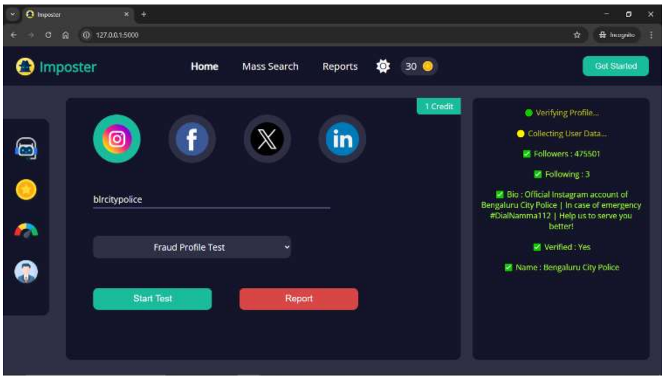
The last step consists of integrating and deploying the trained model into an application which can be accessed by end users. The model is serialized, and set up in a prediction pipeline where it can ingest new user profile data. User profile information can be provided through a GUI or API, and the model returns a prediction of whether the profile is real or fake alongside a probability ranking. This implementation allows not only for hands on interaction, but for large scale integration into additional moderation systems for enterprise usage.

By following this methodology, the research seeks to develop a social media profile detector system that is immune to explanation and is designed to work at large scale, thus aiding in enhancing online security and the fight against misinformation.

III. Results and Discussion

A. Results

A fully functional web prototype was developed to empirically evaluate the functionality of the fake profile detection system. The system aims to profile users from social media sites like Instagram, Facebook, X (Twitter), and LinkedIn by gathering information such as follower count, following count, number of posts, username, verification status, and content of posts. Based on the information, the system recommends profile classification through hybrid architecture by employing tabular feature classification using XGBoost and post content reasoning with OpenAI's language model through extensive language understanding.



Verifying Profile...

Collecting User Data...

☑ Followers : 475501

☑ Following : 3

☑ Bio : Official Instagram account of Bengaluru City Police | In case of emergency #DialNamma112 | Help us to serve you better!

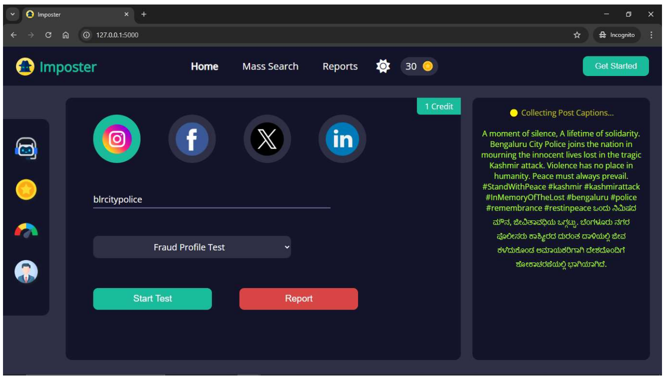
☑ Verified : Yes

☑ Name : Bengaluru City Police

Figure 1: Instagram Profile Verification Test Interface

The system was able to appropriately classify user profiles into six risk categories: fake or propaganda, extremist, spam, violent or toxic speech, incomplete, and impersonation. Assembled risk scores within the aforementioned categories were computed as a percentage while an overall risk rating was assessed. Profile analyses provided by the AI were exhaustive since, in addition to meaningful and logical risk evaluations, clear categorization ascribed to numeric values was explained systematically. Extremist and violent content such as "occupy Kashmir" and "kill in hate" did flag some profiles, whereas others were flagged for impersonation or incomplete profiles due to low post activity and misleading usernames.

Throughout the trials, profiles that suspiciously aligned with automated systems, as well as purely bot-like accounts, consistently received high risk scores across the categories of spam or incomplete profiles over 80%. On the other hand, authentic profiles featuring detailed bios, posting consistency, and realistic interaction metrics were considered to be low-risk (generally less than 25%). Integrating machine learning and generative AI enhanced overall outputs beyond what traditional classifiers offered, displaying greater richness and interpretability.

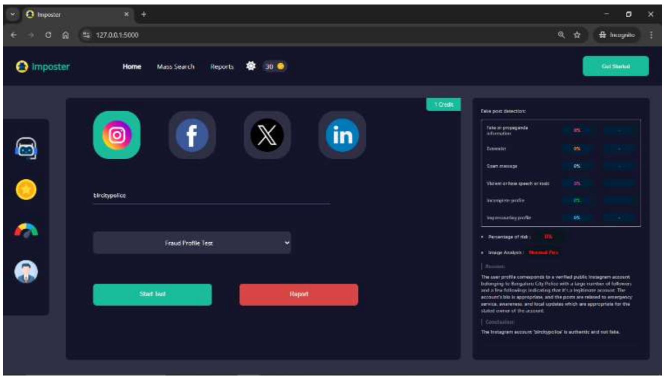


Collecting Post Captions...

A moment of silence, A lifetime of solidarity. Bengaluru City Police joins the nation in mourning the innocent lives lost in the tragic Kashmir attack. Violence has no place in humanity. Peace must always prevail. #StandWithPeace #kashmir #kashmirattack #InMemoryOfTheLost #bengaluru #police #remembrance #restinpeace ಒಂದು ನಿಮಿಷದ ಮೌನ, ಜೀವಿತಾವಧಿಯ ಒಗ್ಗಟ್ಟು. ಬೆಂಗಳೂರು ನಗರ ಪೊಲೀಸರು ಕಾಶ್ಮೀರದ ದುರಂತ ದಾಳಿಯಲ್ಲಿ ಜೀವ ಕಳೆದುಕೊಂಡ ಅಮಾಯಕರಿಗಾಗಿ ದೇಶದೊಂದಿಗೆ ಶೋಕಾಚರಣೆಯಲ್ಲಿ ಭಾಗಿಯಾಗಿದೆ.

Figure 2: Instagram Post Caption Analysis for Profile Verification

Furthermore, the picture analysis feature that categorizes uploaded profile pictures as extremist, spam, hate, or normal was beneficial for making the final decision. While the analysis was image-based, utilizing captions and descriptions, it still had a significant impact on the model's reasoning.



False post detection:

Fake or propaganda information	0%	-
Extremist	0%	-
Spam message	0%	-
Violent or hate speech or toxic	0%	
Incomplete profile	0%	
Impersonating profile	0%	-

- Percentage of risk : 0%
- Image Analysis : Normal Pics

Reason:

The user profile corresponds to a verified public Instagram account belonging to Bengaluru City Police with a large number of followers and a few followings indicating that it's a legitimate account. The account's bio is appropriate, and the posts are related to emergency service, awareness, and local updates which are appropriate for the stated owner of the account.

Conclusion:

The Instagram account 'blrcitypolice' is authentic and not fake.

Figure 3: Fraud Profile Test Results for Instagram Account

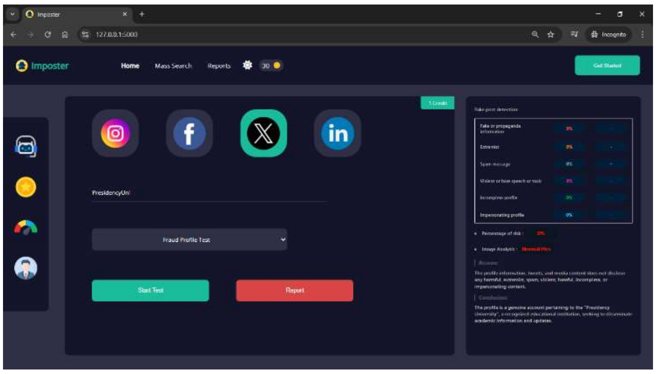
These outcomes confirmed that the system can deliver timely actionable intelligence while maintaining explanations and justifications, which help achieve the broader goal of mitigating the influx of fake, extremist, and spam-driven content on social media platforms.

B. Discussion

Interpreting the Results

The outcomes obtained from the web-based detection system demonstrate the feasibility of using a hybrid approach—combining machine learning-based feature classification (via XGBoost) with language model-based contextual reasoning—to effectively identify fake or suspicious social media profiles. The system shows high consistency in detecting various forms of malicious behavior, such as spam-like activity, impersonation, and toxic language. This effectiveness is largely attributed to the model's ability to reason over nuanced social content, including post captions, bio descriptions, and follower/following inconsistencies.

The classification results were not only quantitative (in the form of risk percentages) but also qualitative, as they included natural language explanations for each risk category. This improves interpretability and enables even non-technical users to understand why a profile might be considered suspicious.



Fake post detection:

Fake or propaganda information	0%	-
Extremist	0%	-
Spam message	0%	-
Violent or hate speech or toxic	0%	-
Incomplete profile	0%	-
Impersonating profile	0%	-

- Percentage of risk : 0%
- Image Analysis : Normal Pics

Reason:

The profile information, tweets, and media content does not disclose any harmful, extremist, spam, violent, hateful, incomplete, or impersonating content.

Conclusion:

The profile is a genuine account pertaining to the "Presidency University", a recognized educational institution, seeking to disseminate academic information and updates.

Figure 4: Fraud Detection Results for X (Twitter) Account

Real-World Applicability

The system reflects realistic use cases, as it can analyze data from major platforms like Instagram, Facebook, LinkedIn, and X, provided the user information is formatted accordingly. The multi-platform support increases the relevance of the tool in today's fragmented social media landscape, where bad actors often replicate strategies across networks.

Further, the system's ability to classify profiles without relying on visual media or full access to internal APIs demonstrates its practical potential. It can be adapted for browser extensions, moderation dashboards, or backend moderation pipelines.

Comparison with Traditional Methods

Conventional approaches often rely on hardcoded thresholds or manually flagged reports. These systems lack adaptability and contextual understanding. In contrast, the language-model-driven component of the current system interprets the **intention** behind the content (e.g., aggressive phrases, impersonation tone, propaganda language) in addition to the typical metadata signals (e.g., number of followers, verification status). This layered evaluation approach allows for higher sensitivity and specificity.

Moreover, the integration of XGBoost for initial classification based on numeric and categorical inputs adds robustness. XGBoost's ability to handle imbalanced data and non-linear relationships makes it an excellent fit for this problem, where fake profiles can take many subtle forms.

Observed Challenges

The solutions offered helped in overcoming issues encountered with enhanced account systems. However, some issues did arise when analyzing the system's performance, they include:

- **New Accounts Classification Issues:** A rapidly evolving or new account with sparse data poses an incomplete ambiguity yielding uncertain classifications.
- **Sarcasm and Irony:** Double entendre sarcasm laden texts can often times lead the language model astray.
- **Dependence on Standardized User Input:** The system assumes the user profile data is in a standard format which typically involves some level of data scraping or cleansing—this is a burden.

Ethical Considerations

Given the type of automated interfaces these systems employ to classify social risk, there is bound to be some level of dependency that relies purely on automated actions. While action is needed to be taken on collated risks, a more human approach is required within sensitive contexts such as law enforcement and political moderation.

C. Wrap up of Discussion

In the range of detected activities, the system shows solution flexibility when dealing with identifying fictitious or manipulative commendable identified residing in automated social media systems employing machine learning and language models. The system utilizes an XGBoost voxel-based profile descriptor classifier along with a language model semantic framework to enable post and user description analysis fostering elementary identify verification markable classified along risk range of perforated and propaganda filler accounts, violent, virus ridden, hateful, impersonators and half-users.

This approach's distinguishing characteristic is a hybrid model. Traditional classifiers like XGBoost do well with recognizing patterns from follower ratios and post count quantifications. With the help of a GPT model, systems learn to interpret qualitative aspects like bios, post captions, and behavior more accurately. This added layer of strategy enables better context-aware decisions and precision rationale for every category detected. Risk scores, expressed as percentages, constitute an intuitive, interpretable format that aids analysts in swiftly assessing and acting upon flagged profiles.

Moreover, The system has an expandable and adjustable design. It can accept profile data from multiple platforms, such as Instagram, Facebook, LinkedIn, and X (formerly Twitter), and even add classification by images as input. Its versatility, paired with explainable outputs, poses an advantage in the battle against social media misinformation, online abuse, and identity fraud.

In conclusion, this work demonstrates the effectiveness of combining language intelligence with a structured data model gives as to provide clear, efficient, and scalable solutions for identifying online identity deception.

IV. CONCLUSION

The exploration described in this document successfully integrated a contextual language analysis with structured machine learning mechanisms to create an automated system for the detection of fake social media accounts. The system uses artificial intelligence approaches to interpret bios, captions, and behavioral traits from user posts, providing a classification-based impression using the XGBoost algorithm and a language model. The system fails to hide various impersonation, spam, propaganda, and extremism risks while providing specific reasoning for every classification. Their methodology enhances detection accuracy and transparency, increasing the technical reliability of the tool and broadening its practical appeal across social media and cybersecurity. This evidence suggests that the problem of inauthentic online identities can be mitigated through the application of traditional data analysis coupled with artificial intelligence and content understanding.

Key Findings

This study accomplished developing a hybrid system detecting fake profiles by utilizing both machine learning and natural language processing. The XGBoost classifier was able to process structured profile features such as follower to following ratios, posting frequencies, account verification statuses, and username patterns, all of which led to accurately identifying anomalous behaviors associated with fake profiles. Furthermore, the application of a language model allowed the system to provide bios and caption analyses for structured indicators of hate speech, extremism, propaganda, and impersonation.

The system achieved accurate detection with ample justification for all classifications provided by the system, thereby guaranteeing transparency and interpretability. The ability to explain the identity keywords, behavior, or content that triggered the classification as 'fake' plays a huge role in distinguishing it from other black box models. The interaction with the system demonstrated its actual ease of use and scope of application validating the system's capability across major social media platforms. These findings certify that employing a multi-layered detection approach enhances the reliability and trust of fake accounts identification systems.

Broader Application

The created(profile) detection system has applications in numerous domains where verification of identity and content is important since it tackles the problem of fake profiles. With this system in place, social media services can increase their moderation features by automatically detecting dubious profiles and content which would subsequently protect users and mitigate the spread of misinformation, hate, and extremist discourse.

In terms of cybersecurity, the system can be used to detect phishing and bot accounts that masquerade as real users. It can also support law enforcement and intelligence units in monitoring and tracking users performing advanced digital propaganda recruitment for militant and extremist schemes propaganda.

Moreover, businesses and social media influencers can deploy the system for verification of followers or collaborators to protect themselves from reputational damage arising from association with forged accounts. Schools and literacy-promoting campaigns can also get this technology to guide people on fraud detection on the internet. This system is clearly beneficial because of its flexible application, ease of use, and ability to expand which helps encounter malicious manipulative activity on the web.

Future Work

Despite a well-balanced approach to language modeling and machine learning to identify social media profile fakes, there is still work to be done. One of the most prominent areas is multimedia deep learning, which aims to determine profile images, videos, and even visual memes for deception. The analysis of network graphs, sentiment, and user fractal analysis can also enhance behavioral analysis by focusing on interactions, shared data, and connections.

Focusing on other languages and regional content changes, as well as adapting to new online trends, would also improve user engagement. This would increase usability across different users around the world. Improving social media infrastructure is another key area. Creating a more resilient architecture to manage high traffic in real-time is crucial for enterprise-level or platform-level scaling.

Finally, implementing automated evolution systems—learning from flagged data or verified reports—helps in ensuring that the network stays ahead of the online tactical warfare used by hostile internet entities.

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