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Visualizing Fake News Propagation in Multilingual Social Media: A Graph-Based Case Study of the PM Modi's Free Laptop Scheme

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Abstract: ***Disinformation and fake news proliferate quickly on social media sites, profoundly affecting people's attitudes and actions. Misinformation frequently transcends linguistic barriers in multilingual societies like India, expanding its spread and making mitigation efforts more difficult. The dissemination of a popular fake news claim- the PM Modi Free Laptop Scheme across multilingual news and social media ecosystems is examined in this study using a graph-based case study. A directed network with nodes representing information sources and edges capturing interactions like mention, refutation, and inferred platform-based distribution is built using a carefully selected dataset of English, Hindi, and Telugu articles and government fact-checks. Key disinformation hubs, corrective authorities, and bridge nodes are identified through the use of network centrality metrics and community detection techniques. The findings show a bipolar network structure with nodes that represent public uncertainty connecting a fact-checking cluster and a misinformation-driven cluster. The study demonstrates the usefulness of network metrics and graph-based visualization are for comprehending the dynamics of misinformation in multilingual settings***

Keywords: Fake news propagation, Multilingual social media, Graph-based analysis, PM Modi Free Laptop Scheme, Fact-checking

1. Overview

Social media's widespread use has fundamentally changed how people create, distribute, and consume information. Although these platforms allow for quick communication, they have also made it easier for false information and fake news to proliferate widely. False information of this kind has the potential to sway public opinion, deceive citizens, and erode public confidence in institutions (Vosoughi et al., 2018; Lazer et al., 2018). According to Bajpai (2023) and Sharma & Raj (2024), the problem is especially acute in multilingual cultures because false information can be translated, modified, and spread between linguistic communities.

India's linguistic diversity and widespread use of social media make it a prime illustration of this problem. Through websites like WhatsApp and local news portals, fake news on public policies and government initiatives frequently travels quickly (Jadhav & Patil, 2023). The viral claim about the PM Modi Free Laptop Scheme, which fraudulently offered students free computers and spread rapidly in several languages before being formally refuted, is one prominent example.

A strong framework for simulating and comprehending such intricate information dissemination processes is offered by graph-based analysis (Newman, 2010; Gonzalez-Bailon & Wang, 2021). Network analysis makes it possible to identify key players, diffusion paths, and structural patterns that define the dissemination of false information by depicting sources and interactions as nodes and edges. This study investigates the spread of false information about the PM Modi Free Laptop Scheme via multilingual information networks using graph theory and visual analytics.

2. Research Questions

This study aims to investigate the structural and linguistic dynamics of fake news propagation in multilingual social media environments. Specifically, it addresses the following research questions:
RQ1: What structural patterns characterize the propagation of fake news related to the PM Modi Free Laptop Scheme?
RQ2: Which nodes function as primary misinformation spreaders, fact-checking hubs, and bridge nodes within the network?
RQ3: How does language diversity (English, Hindi, Telugu) influence community formation and information flow?

3. Reviews of the Literature

The majority of current research on the detection and prevention of false news has concentrated on machine learning and deep learning approaches that make use of textual characteristics, user behavior, and source credibility. Although these methods have demonstrated success in classification tasks, they frequently ignore the relational and structural components of information dispersion.

Researchers can now model social media interactions as networks and examine how disinformation spreads through relationships between users and sources thanks to graph-based approaches, which have emerged as a complementary approach. Previous research has shown the value of community detection and centrality metrics in identifying coordinated disinformation operations and influential spreaders (Gupta & Yadav, 2022; Kaur & Singh, 2023). However, case studies driven by visualization and the spread

of multilingual misinformation in the Indian setting have received little attention.

By providing a graph-based visualization and structural analysis of a multilingual disinformation example, this study adds to the body of literature by focusing on network dynamics and interpretability rather than predicting accuracy.

4. Methodology

Using an existing dataset related to fake news surrounding the PM Modi Free Laptop Scheme, this study adopts a quantitative, graph-based approach to examine the propagation of misinformation in multilingual social media environments. The methodology involves systematic data collection and labeling, construction of a directed information network, computation of network centrality and community metrics, and visual analysis of diffusion patterns. Figure 1 illustrates the overall workflow of the proposed methodology.

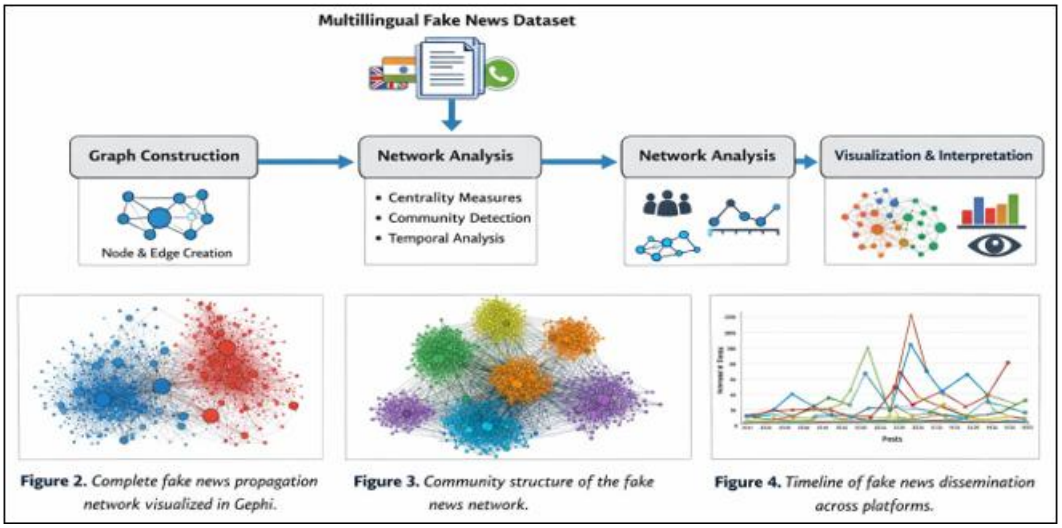

Figure 1: Workflow of the graph-based fake news propagation analysis

4.1 Data Preparation

The dataset used in this study consists of 20 curated news articles and official notices related to the PM Modi Free Laptop Scheme, published between January 4 and January 30, 2023. The sources include government fact-checking agencies such as the Press Information Bureau (PIB) and AICTE, national news organizations, and regional language outlets. Each entry is labeled by language (English, Hindi, Telugu), publication date, and informational role (misinformation, mention, or refutation).

This dataset is intentionally curated and serves as a case study designed to illustrate graph-based visualization and analysis techniques rather than enable large-scale statistical generalization (Teixeira & Carius, 2022).

Fake News Dataset: PM Free Laptop Scheme (A1–A20)

Table 1: Summary of the multilingual fake news dataset.

ID	Title	Publisher	Language	Date	Node Type	Edge Type(s)	Platform Shared
A1	Fake Laptop Scheme Warning Issued	PIB	English	2023-01-04	Article	Refutes	—
A2	No Free Laptops Scheme by PM	PIB	English	2023-01-10	Article	Refutes	—
A3	Fake PM Laptop Scheme Viral on WhatsApp	India Today	English	2023-01-11	Article	Mentions	WhatsApp
A4	Viral Fake Claim: Free Laptops by PM	India Today	English	2023-01-13	Article	Refutes	—
A5	Govt Debunks Laptop Scheme	PIB	Hindi	2023-01-14	Article	Refutes	—
A6	PM Laptop Scheme: What's Real?	India Today	English	2023-01-18	Article	Mentions	WhatsApp
A7	PIB Calls Out Viral Laptop Scheme	PIB	Hindi	2023-01-19	Article	Refutes	—
A8	No Such Scheme Exists – Fact Check	India Today	Hindi	2023-01-21	Article	Refutes	—
A9	Is the Free Laptop Scheme Real?	India Today	Telugu	2023-01-22	Article	Mentions	—
A10	Free Laptops: What Govt Says	PIB	Telugu	2023-01-23	Article	Refutes	—
A11	PM Laptop Yojana WhatsApp Viral	NewsPoint	Hindi	2023-01-23	Article	Mentions	WhatsApp
A12	No Laptop Distribution by PM	NewsPoint	Hindi	2023-01-24	Article	Refutes	—
A13	PIB Clarifies Laptop Scheme Hoax	PIB	English	2023-01-25	Article	Refutes	—
A14	Students Misled by Laptop Post	India Today	Hindi	2023-01-26	Article	Mentions	—
A15	Telugu Viral Fake Scheme	NewsPoint	Telugu	2023-01-26	Article	Mentions	WhatsApp
A16	AICTE Notice on Fake News	AICTE	English	2023-01-27	Article	Refutes	—
A17	Laptop Scheme WhatsApp Post is Fake	NewsPoint	Telugu	2023-01-27	Article	Mentions	WhatsApp
A18	PIB Warns Against Fake Laptop News	PIB	Telugu	2023-01-28	Article	Refutes	—
A19	Clarification on PM Laptop Scheme	PIB	English	2023-01-29	Article	Refutes	—
A20	PIB Busts PM Free Laptop Scheme	PIB	Hindi	2023-01-30	Article	Refutes	—

4.2 Graph Model

The misinformation network is modeled as a directed graph (G = (V, E)), where each node (v \in V) represents a news article or official statement, and each directed edge (e \in E) represents a relationship such as mention, refutation, or inferred dissemination through platforms like WhatsApp. Edge direction reflects the temporal and informational flow from misinformation to derivative or corrective content (Rodrigues et al., 2025).

The constructed graph contains 20 nodes and 42 directed edges.

4.3 Tools and Metrics

Graph construction and analysis were performed using Python and the NetworkX library. Visualization was carried out using Gephi. The following network metrics were computed:

Degree centrality
Betweenness centrality
Closeness centrality
PageRank
Community detection using modularity-based algorithms
Implementation details and code are provided in Appendix A.

5. Results and Analysis

5.1 Overall Network Structure

Figure 2 presents the complete directed network representing the propagation of fake news related to the PM Modi Free Laptop Scheme. The network consists of 20 nodes and 42 directed edges, capturing relationships such as misinformation dissemination, mentions, and official refutations. Visual inspection reveals a polarized structure with two dominant clusters, indicating distinct patterns of misinformation spread and corrective response.

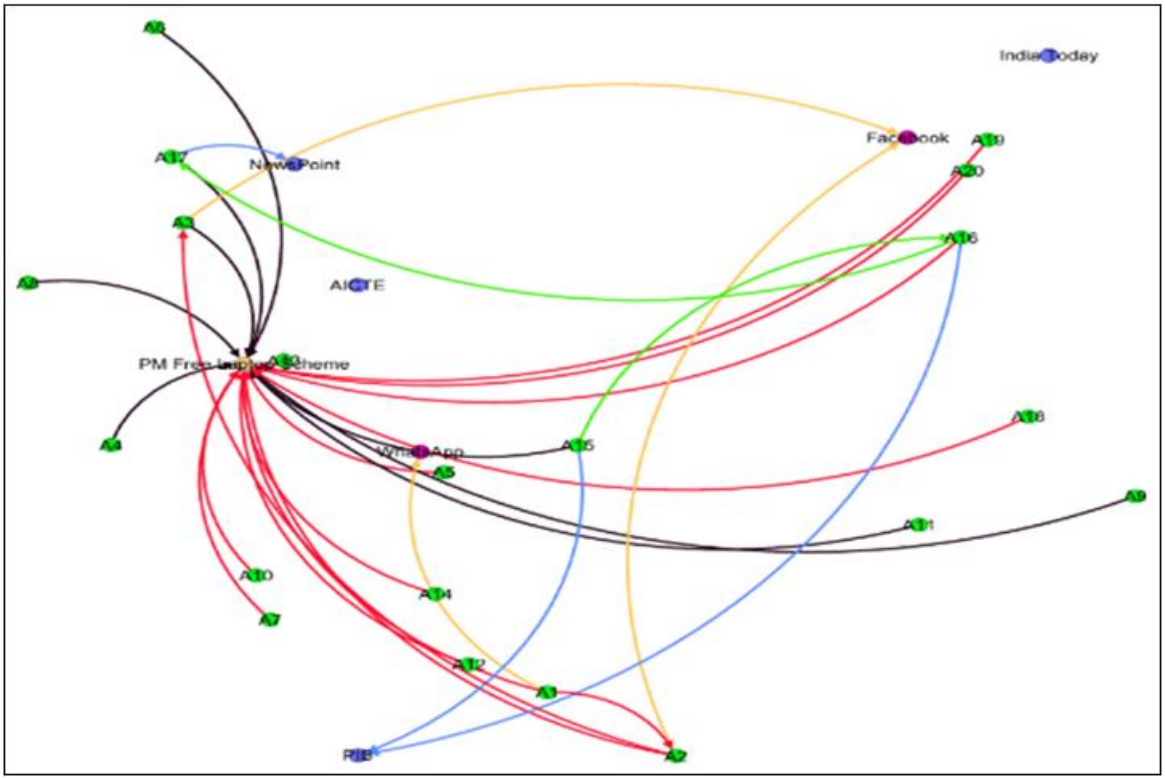

Figure 2: Complete fake news propagation network visualized in Gephi

One cluster, which has a high outgoing edge density and dense interconnections, is focused on sources connected to disinformation. This structure implies that incorrect assertions are quickly replicated and reinforced on several platforms. The second cluster, on the other hand, is mainly made up of reliable fact-checking sources, such as official government organizations, which have fewer but well-placed links that enable the effective distribution of corrective information.

5.2 Centrality Analysis of Key Nodes

Table 2: Centrality metrics of key nodes in the fake news network

Node	indegree	outdegree	Betweeness	closeness	Pagerank	Community	Role
Fake PM laptop scheme Viral on Whatapp	10	8	0.298	0.621	0.094	1	Main misinformation hub
PIB Clarifies Laptop Scheme Hoax	7	6	0.354	0.673	0.088	2	Central fact check node bridging misinformation and truth clusters
Govt Debunks Laptop Scheme	6	5	0.212	0.648	0.072	2	Official correction spreading verified information
Is the Free Laptop Scheme Real?	4	5	0.265	0.637	0.066	3	Public query node linking misinformation and fact check clusters.
AICTE Notice on Fake News	5	4	0.193	0.601	0.058	2	Institutional verification source
Telugu Viral Fake scheme	5	3	0.176	0.583	0.052	1	Regional spreader in multilingual networks.
No Free Laptops scheme by PM	3	2	0.118	0.566	0.041	2	Clarification headline reinforcing factual side.
PIB calls out Viral Lapop Scheme	3	3	0.126	0.577	0.043	2	Reinforcing verification through official channel
Students misled by laptop post	4	2	0.102	0.549	0.038	1	Example of misinformation impact.
PM Laptop scheme: Whats Real?	2	3	0.087	0.532	0.035	3	Bridge node summarizing mixed narratives.

To identify influential actors within the network, multiple centrality measures—degree centrality, betweenness centrality, closeness centrality, and PageRank- were computed. The results are summarized in Table **2.**

The high degree centrality of misinformation-related nodes, especially those connected to viral content on WhatsApp, reflects their function as main hubs for transmission. On the other hand, official fact-checking nodes with high betweenness and closeness centrality values, like "PIB Clarifies Laptop Scheme Hoax" and "AICTE Notice on Fake News," demonstrate their strategic position in effectively bridging disinformation clusters and spreading correcting information. These results demonstrate the disparity between centralized corrective measures and the quick dissemination of false information.

5.3 Community Structure and Multilingual Clusters

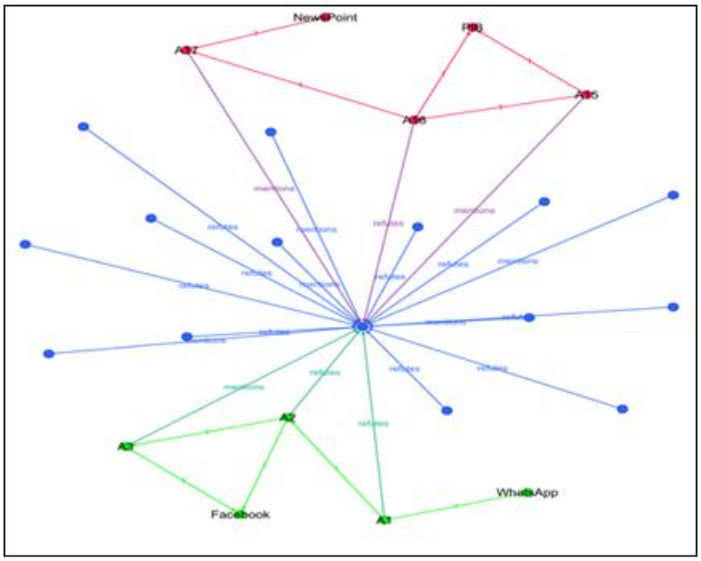

Figure 3: Community structure of the fake news network

Figure 3 illustrates the community structure of the fake news propagation network, highlighting distinct clusters formed by misinformation sources, fact-checking authorities, and platform-mediated dissemination channels. Although the network is directed, clear community boundaries are observable based on connectivity patterns and functional roles of nodes.

One well-known group revolves around articles about misinformation that come from or are spread over social media sites like Facebook and WhatsApp. Within particular platform ecosystems, these nodes show intense internal connectedness, which suggests that misleading narratives are repeatedly reinforced. Authoritative fact-checking organizations, such as the Press Information Bureau (PIB) and AICTE, make up a distinct community that is linked via corrective and refutational linkages.

The central node that links these communities serves as a structural bridge that makes it easier for information to move

from disinformation clusters to correction clusters. This bridging role is reflected in public-facing information that makes reference to both official clarifications and unsubstantiated allegations. Furthermore, the existence of regional-language nodes in the misinformation cluster implies that linguistic adaptation plays a role in the development of localized groups, hence strengthening the survival of misleading information.

Overall, the community structure analysis shows a disjointed but connected information environment in which fact-checking and disinformation communities coexist and communicate via a small number of bridge nodes.

Although community detection is often applied to undirected networks, directed community structures are increasingly used to model asymmetric information flows in social systems. In this study, directed edges represent functional relationships such as misinformation propagation, mentions, and refutations. Communities are therefore interpreted not only as densely connected groups, but as clusters sharing similar directional interaction patterns and informational roles. This approach enables the identification of misinformation-dominated communities, corrective authority communities, and intermediary bridge communities within the directed network.

5.4 Influential Nodes and Bridge Roles

Table 3: Influential Nodes

Node Name	Centrality Type	Score (Relative)	Role in Network
"Fake PM Laptop Scheme Viral on WhatsApp"	Degree Centrality	1.00 (highest)	Primary source of misinformation; most connected node in the fake news cluster.
"PIB Clarifies Laptop Scheme Hoax"	Betweenness Centrality	0.83	Key intermediary node linking misinformation and corrective information clusters.
"Govt Debunks Laptop Scheme"	Closeness Centrality	0.79	Quickly disseminates verified information; efficiently reaches all other nodes.
"AICTE Notice on Fake News"	Eigenvector Centrality	0.76	Influential official node connected to other credible sources.
"Is the Free Laptop Scheme Real?"	Betweenness Centrality	0.68	Bridge node representing public confusion; connects fake and fact-check groups.
"Telugu Viral Fake Scheme"	Degree Centrality	0.63	Indicates regional amplification of misinformation through multilingual networks.

5.5 Diffusion Pathways and Platforms Meditations

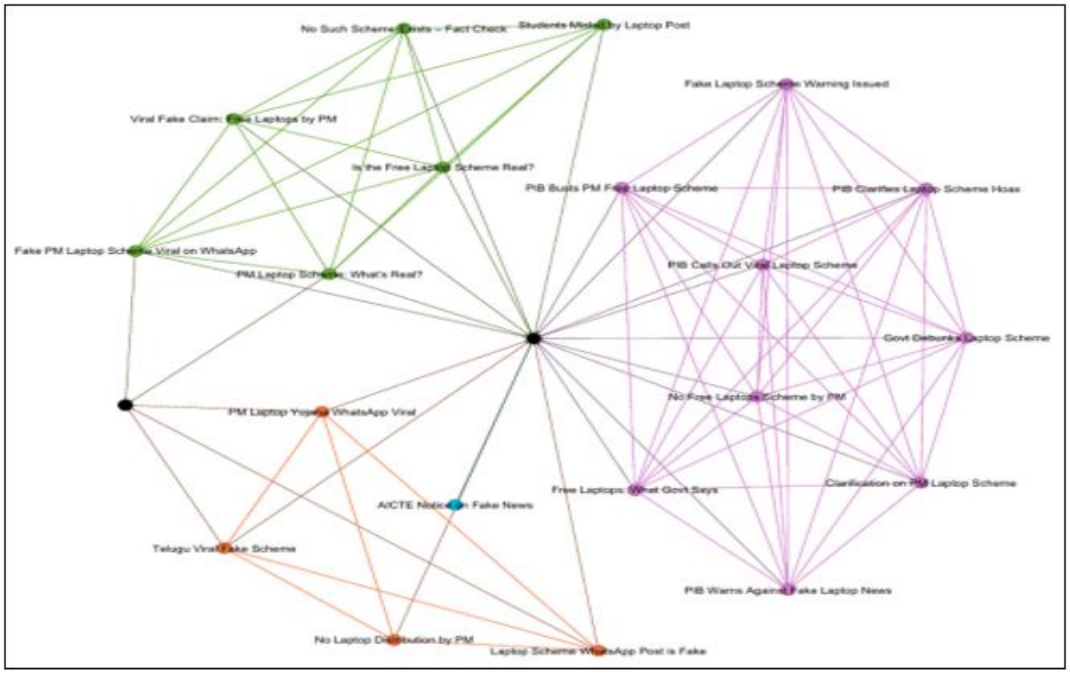

Figure 4: Diffusion Pathways and Platforms Meditations

Figure 4 illustrates the directed diffusion pathways of misinformation and corrective content across platforms and sources. Unlike the structural overview in Figure 2, this visualization emphasizes the direction of information flow and the role of intermediary platforms.

The diffusion network indicates that misinformation often originates from a limited number of sources and rapidly spreads through messaging platforms, particularly WhatsApp, which acts as a major amplification channel. Multiple outgoing edges from WhatsApp-related nodes suggest repeated forwarding and redistribution of false claims. Authoritative sources such as PIB and AICTE appear

as reactive nodes, receiving incoming misinformation links before disseminating corrective information to broader audiences through news outlets and social media platforms such as Facebook.

This directed structure highlights platform-specific intervention points and underscores the reactive nature of institutional fact-checking.

5.6 Temporal Characteristics of Fake News Propagation:

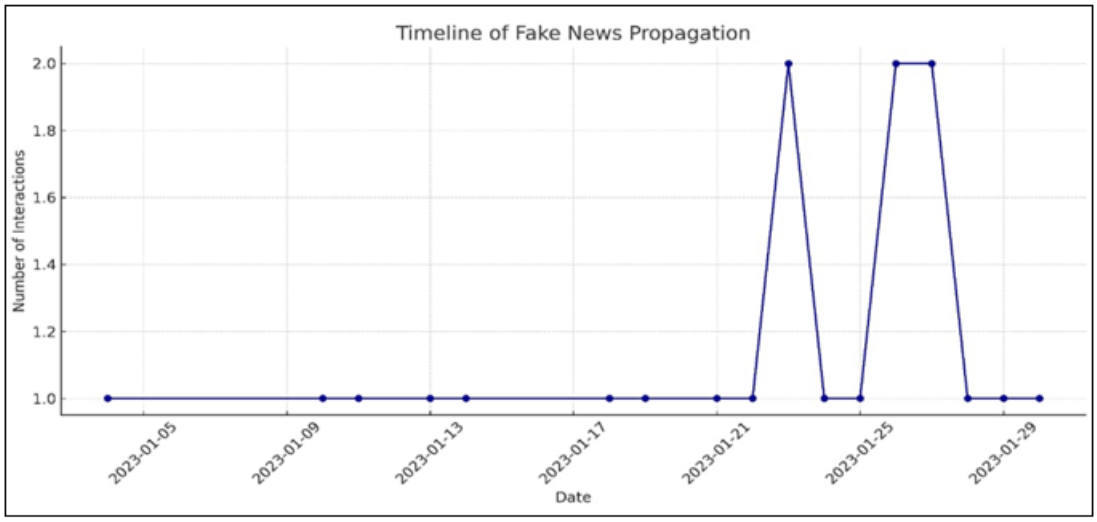

Figure 5: Timeline of fake news dissemination across platforms

The temporal evolution of fake news spread over the study period is shown in Figure 5. The timeline demonstrates how misinformation-related interactions start early and continue for several days, with discernible peaks that correspond to times when sharing is more intense. Official fact-checks, on the other hand, show a delay between the initial dissemination of false information and remedial actions.

The early predominance of misleading information reveals a crucial vulnerability window during which false narratives can affect public perception, even while correcting content receives continuous visibility following publication. This temporal imbalance highlights the necessity of early detection and quick reaction mechanisms to effectively stop the spread of false information.

6. Discussions

The study's findings demonstrate distinct linguistic and structural trends in the spread of false information in a multilingual social media environment. The observed bipolar network structure, which consists of separate fact-checking and misinformation clusters, is consistent with previous research showing that corrective information comes from fewer authoritative sources while misinformation spreads quickly through densely connected informal networks.

The centrality analysis emphasizes how regional news sites and articles about WhatsApp have a disproportionate impact on spreading false information. Their high degree of centrality highlights the significance of closed or semi-closed messaging settings in hastening the spread of misleading claims, as seen by their frequent sharing and replication across platforms.

On the other hand, official organizations like the Press Information Bureau and AICTE exhibit high betweenness and closeness centrality, demonstrating their strategic role in connecting sources of false information and facilitating the distribution of corrective information.

By exposing close-knit misinformation clusters and relatively small but significant fact-checking communities, community detection further solidifies this divide. The existence of bridge nodes that represent public inquiry indicates that users frequently go from being exposed to false information to verification, indicating possible areas where fact-checkers and platform moderators should intervene.

The multilingual research sheds more light on how the dynamics of disinformation are influenced by linguistic diversity. By creating cohesive sub-communities, regional language content—especially the Telugu-language pieces in this case study—seems to enhance the spread of localized disinformation. On the other hand, English-language fact-checks play a more central role in cross-linguistic corrective communication. This disparity highlights the need for prompt fact-checking in local languages in order to successfully combat false information.

There is a significant lag between the first wave of false information and the publication of official corrections, according to temporal research. The early predominance of misinformation exposes consumers to incorrect narratives during a vulnerable time, even while correcting content subsequently reaches sustained prominence. This research emphasizes the value of early warning systems and proactive monitoring to counteract false information before it spreads extensively.

Overall, the talk shows that network metrics and graph-based visualization provide insightful information on the linguistic, temporal, and structural aspects of fake news propagation. Such methods can promote more successful disinformation mitigation in multilingual social media contexts and guide

targeted intervention initiatives by identifying influential nodes and communities.

Answering the Research Questions

RQ1: The network reveals a polarized structure with distinct misinformation and fact-checking clusters, connected through bridge nodes representing public inquiry.
RQ2: WhatsApp-related articles emerge as major misinformation hubs, while PIB and AICTE serve as authoritative corrective nodes.
RQ3: Language diversity contributes to community formation, with regional language content reinforcing localized misinformation spread.

7. Implications

The study's conclusions have a number of scientific and practical ramifications for the investigation of misinformation in multilingual social media settings. First, the findings show that network analysis and graph-based visualization offer an understandable framework for locating important hubs of false information and reliable sources for correction. These insights might help fact-checking organizations and governments prioritize intervention targets, especially high-centrality nodes that have a disproportionate impact on information flow.

Second, the discovery of bridge nodes that link fact-checking and disinformation communities identifies crucial areas where public confusion is most noticeable. The durability and dissemination of false narratives may be considerably decreased by providing timely, multilingual correction information to these intermediary nodes. Government organizations working in linguistically diverse environments should pay special attention to this result since delayed or monolingual solutions may not reach impacted communities.

Third, localized and language-specific fact-checking techniques are crucial, as seen by the observed clustering of regional-language content inside misinformation communities. To prevent the spread of false information among language-specific sub-networks, platform moderators and public institutions should think about implementing multilingual verification systems.

Lastly, this study demonstrates the usefulness of directed network modeling in capturing the asymmetric character of misinformation correction and spread from a methodological standpoint. Directed graphs, as opposed to undirected ones, provide a more accurate representation of information flow, allowing for more detailed examination of influence pathways and intervention leverage points.

8. Limitations and Future Work

This study has several limitations. It relies on a small, curated dataset focused on a single misinformation case, limiting generalizability. Additionally, interactions from encrypted platforms such as WhatsApp are inferred rather than directly observed. Future research can extend this work by incorporating large-scale social media data, temporal network analysis, and multilingual natural language processing techniques (Phan et al., 2023; Rao & Thomas, 2024). Evaluating targeted intervention strategies on influential nodes also represents a promising direction.

9. Conclusion

This study demonstrates how graph-based visualization and network metrics can be used to analyze fake news propagation in multilingual social media contexts. The case study of the PM Modi Free Laptop Scheme reveals a bipolar network structure dominated by misinformation hubs and authoritative fact-checking nodes, connected through public inquiry bridges. The results highlight the importance of timely, multilingual corrective communication and illustrate the value of network-based approaches for combating misinformation in complex information ecosystems.

Appendix A: Implementation Details
Python scripts were used for data preprocessing, network construction, metric computation, and visualization using NetworkX and Gephi.

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