Spread of Misinformation Online: Simulation Impact of Social Media Newsgroups.

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***Abstract*—Academic research shows increase reliance by online users on social media as a main source of news and information. Researchers found that young users are particularly inclined to believe what they read on social media without adequate verification of the information. There has been some research to study the spread of misinformation and identification of key variables in developing simulations of the process. Current literature focuses on individuals sharing of misinformation but mostly neglects social newsgroups; key players in the dissemination of information online. Using benchmark variables and values from the literature, the authors simulated the process using Biolayout; a big data-modeling tool. The results show social newsgroups have significant impact in the explosion of misinformation as well as combating misinformation. The outcome has helped better understand and visualize how misinformation travels in the spatial space of social media.**

Keywords— Misinformation; News Groups, Media Groups, Social Media; three-dimensional simulation;

I. INTRODUCTION

The spread of information online is not a new phenomenon. However, Social media provides various platforms that enables users to share information faster and easier than any time before. Misinformation is presented in variety of forms such as chain emails, spam, false news, dotted images, out of context images, out of context videos, misleading news and more. The spread of this misinformation does not only waste users' time and efforts, but could also be dangerous. This ease of sharing leaves many users as unable to verify information shared. This is further complicated when social media newsgroups share misinformation intentionally or otherwise.

The literature reviews looks at the problem of sharing misinformation online, the research into media groups and their impact, as well as the work that has been done to fight the spread of misinformation. The benchmark variables are established. The research questions are set along with the paper methodology. By developing the simulation using the data collected, the team would consider the impact of social media newsgroups in the propagation of misinformation online.

II. LITERATURE REVIEW

A. Misinformation on Social Media

Online social networks have become one of the main sources of information and news especially among younger generations [1]. There are more and more instances were journalists find themselves relaying on social media to cover their stories [2]. Online applications and social media tools have become leading methods of distributing news and user generated content, which facilitate the creation and exchange of the most up-to-date information. However, sharing inaccurate pieces of information, referred to as misinformation in [3], is found to be widespread in social media. In another publication misinformation is defined as a piece of malicious information intended to cause undesirable effects in the general public, such as panic and misunderstanding; or to supplant valuable information [4]. These definitions are consistent with other publications that have described misinformation online [5,6].

The literature contains studies that single out social media as the most popular tool in the field of misinformation propagation [7,8]. Researchers studying news on social media have reported misinformation in medical news [9,10], political news [11], breaking news [12], science news and conspiracy theories [13].

Libicki (2007) explains that prior beliefs and opinions of people influence their decision in accepting misleading information [11]. Moreover, the work of [14] discusses that people believe things that support there past judgments without questioning them. False information spreads just like accurate information, however, the role of information context is central. This links with the survey finding by [1] that shows topics on technology, finance, politics and health are the ones that interest the social media users the most and are considered as the key sources of misinformation.

Looking at social media as a tool for assisting in malicious activities and misbehaviors, it is reported that newsgroups with none professional verification methods are the driving force for sharing misinformation as well as mimicking widespread information diffusion behavior [15,16].

Several publications have called for a tool to support users and journalist in their quest to verify misinformation online [17, 18, 19, 20]. The suggestions vary is that a tool could be developed to either search for influential commentary, appearance of the image elsewhere online, or crowdsourcing beyond the limitations of the newsgroup.

B. Tools to combat misinformation online:

Researcher at Colombia University [21] have developed a real-time rumor tracker that looks into the ways in which unverified information and rumor are reported in media. The tool intends to identify pieces of news can categorize them as: True, False, and Unverified, Users are able to view the source pages as well as how many times it is being shared However, a limitation identified is that users has to visit the website and the verification is limited to text content.

In the work of [18], the researchers proposed a method for containment in the form of 'Node Protector' that would act as influencer thus disseminate correct information to fight off misinformation. The proposed approach is promising but the research does not indicate how many 'node protectors' are needed.

In the work of [22], the authors claim to have developed an algorithmic approach that could in the future help users evaluate the news or information when they see it. The model for identifying misinformation online relied on users applying that model and verification themselves. An approach, while beneficial, returns to the problem identified in other research into the general passiveness of users in taking much effort to validate information [23].

A practical approach suggested in the literature in combating misinformation online is one termed 'Right-click Authenticate' approach [24]. The approach is to design an accessible tool to authenticate and verify information online. Thus controlling misinformation propagation in social media. The approach suggests that a right-click tool, see fig 1, to be developed to allow online users to authenticate images, text and videos by means of a meta-level shared source. The information pop up to report past appearances of such item, original metadata that could help identify its source, editorial cited observations, and crowd sourced feedback; see fig.2.

Fig. 1. Conceptualizing a right-click 'Authenticate' option [24]

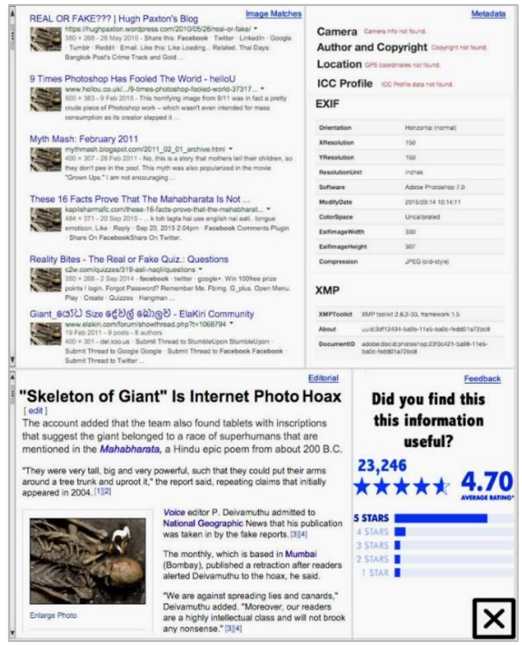

Fig. 2. Conceptualization of the 'Authenticate' outcome [24]

C. Modeling spread of misinformation:

Modeling and simulation of involved variables in such ecosystem that describes the process of misinformation propagation can provide an understanding of misinformation propagation precisely, and test the efficiency.

One essential aspect in such online environment is to provide practical methods for undertaking detailed analysis in order to prevent such activities or at least to detect and stop them from going further [25]. Online social groups however are given an excellent opportunity, having lack of accountability and verifiability, to distribute misinformation while not discouraging freedom of expression and freedom of ideas. The research by [1] presented the first tempt to model travel of information or misinformation online, see fig.3.

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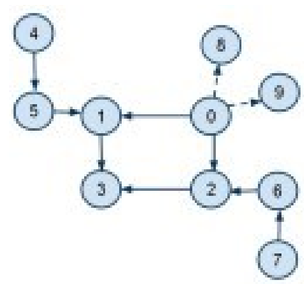

Fig. 3. Information/misinformation travel in solid lines or blocked in dotted lines [1].

The authors used a network algorithm and graph theory that could be tested in case of two competing campaigns that would test the accuracy of the information. In such scenario, suggested the need for 'influential' people to counter 'bad' campaign and limit misinformation as means to fight misinformation.

In paper [26], the authors set out to demonstrate proof-of-concept using 2D modeling and identified the variables involved in the travel of information, see fig. 4.

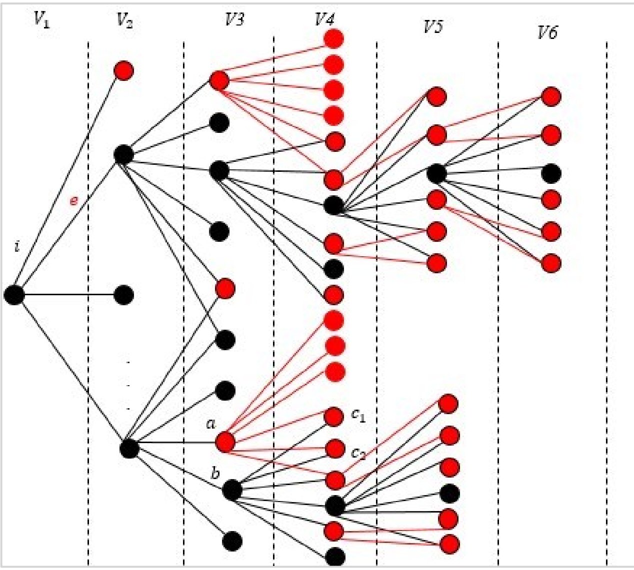

Fig. 4. The Authenticate, Passing on rate, and Cross-Wire rate simulation [26].

The paper identified eight key variables and applied theoretical values to demonstrate their applicability. These variables are: i as the first vertex and j_n is the last vertex of the given simulation. V_1 representing the first phase of spread of misinformation and l representing the maximum possible reach of information through the network. The authors conclude that combating misinformation online is also influenced by the following variables: rate of authentication A,, rate of sharing S, passing on information rate P, average cross-wire rate Cw, success rate of Same Level communication rate Sl, and Reverse Validation rate Rv.

Variable Name	Symbol	Value	Units
Maximum population	(l)	100	Nodes
Sharing/Seeing	(S)	10	Nodes
Passing on information	(P)	20	%
Authentication	(A)	30	%
Cross wire	(Cw)	20	%
Same Level Communication	(Sl)	20	%
Reverse Validation	(Rv)	50	%

Table 1.Critical Variables for propagation simulation.

By applying the following values shown in table 1, the authors demonstrated near elimination of spread of misinformation online whereby the red nodes represented individuals who do not longer believe the misinformation, see fig. 5. This demonstrated that providing easily accessible tools that would allow users to authenticate images and text, could effectively cascade the process back to the source or at least to the layer immediate to the source.

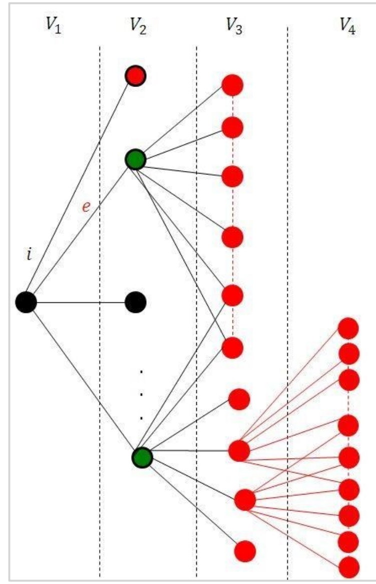

Fig. 5. Final outcome of the 2D [26].

While some headway has been achieved, the literature regarding modeling of misinformation online there is still more to be understood in order to develop a representative formula and understand the algorithms required to develop this browser tool. A research limitation identified is related to the fact that two-dimensional simulations did not reflect the method misinformation travels in a spatial space. Hence, as part of the future research direction of the last paper, the authors acknowledged the need for further three-dimensional simulation to be conducted using Biolayout [27] to better illustrate the flow of misinformation in social media and the ways in which it can be minimized and eventually prevented. Another key variable missed in earlier researchers is the impact of social media newsgroups.

III. Research Question and Methodology

This paper attempts to answer two research questions:

1. What is the impact of social newsgroups in the propagation of information on social media?
2. Can a verification/authentication tool combat misinformation after it is shared by a news or social newsgroup?

To answer these questions, the authors applied graph theory in three-dimensional computational simulations combined with reflective analysis [28] and observational research method [29]. This approach is comparable to other approaches identified in the literature [30,31,32], however it is different in being the first paper to demonstrate this progress in three-dimension spatial environment. Using the variables identified in the literature [26], the authors applied the model to social media group into the simulation. However, the earlier simulations which focused on propagation of misinformation by individuals, a population mass of 100 was sufficient to show the spread and means of combating. For this simulation, the team increased the population mass to 2200 for better view of the expansion. In lab conditions, the authors observed the different three-dimensional simulations of information as it travelled from the source to a theoretical maximum reach. These simulations intended to represent the real-world propagation of information in spatial-dimensional simulation. Biolayout [27], as a three-dimensional modelling tool, allows better visualization of how misinformation can cross-wire and be shared at same and different levels. Biolayout uses MS Excel as its database. The nodes and their relationships once set, the authors are able to use the spreadsheet's random formula and cell referencing to generate values for the random propagation of information, authentication, crosswire, same level, and reverse validation. Successively analyzing and observing simulations of scenarios, the authors subsequently evolved their model of simulation to observe the effect on misinformation and success in combating it. With the introduction of new variables the authors recorded the impact of the new variable on the simulation.

One of the main assumptions accepted at the start of all simulations in to propagation of information online is that the phenomena by which information travels can be simulated despite unpredictability generally dominating human behavior online. This assumption is consistent with other academic publishers in this area of research [1, 26, 30, 31, 33].

IV. Results of Simulation

A new variable had to be considered for the social or news group. How many of the users will see the misinformation (S) and how many will pass this misinformation on to other people (P). The team assumed that the rate of passing on (P) could be consistent with the rate defined in the benchmark at 20%. However, the number of people exposed to the sharing has to be significantly higher as would be expected from a social group or news group on social media. While a group or a news outlet on social media may have hundreds or thousands of likes, there is no studies to show the average exposure. Thus, in line with the literature review on the impact of newsgroups, the team assumed that a social media newsgroup should be at least 10 times more exposure than individual sharing. Thus, for the purpose of demonstration, that team suggests social media newsgroup would have an exposure of at least 100 nodes.

The authors outlined the steps of the experiment as follows.

1. For simulation scenario 1, the spread of misinformation will consider the following variables: Population (l) 2500, Shared and see by (S) 10 for individuals and (Sg) 100 for the newsgroup, passing on rate to be (P) 20%, no authentication in the first round (A), Cross-wire rate to be (Cw) 20%, Same Level Communication between clusters to be (Sl) 20%, and finally reverse validation to be (Rv) 50% A summary presented in table 2. The purpose of this experiment is to consider the output and its validity.

Variable Name	Symbol	Value	Units
Maximum population	(l)	2500	Nodes
Sharing/See	(S)	10	Nodes
Sharing/See (Social Groups)	(Sg)	100	Nodes
Passing on information	(P)	20	%
Authentication	(A)	0	%
Cross wire	(Cw)	20	%
Same Level (Cluster) Communication	(Sl)	20	%
Reverse Validation	(Rv)	50	%

Table 2.Critical Variables for propagation simulation Scenario 1.

Upon running the simulation, the results showed in Fig. 6.

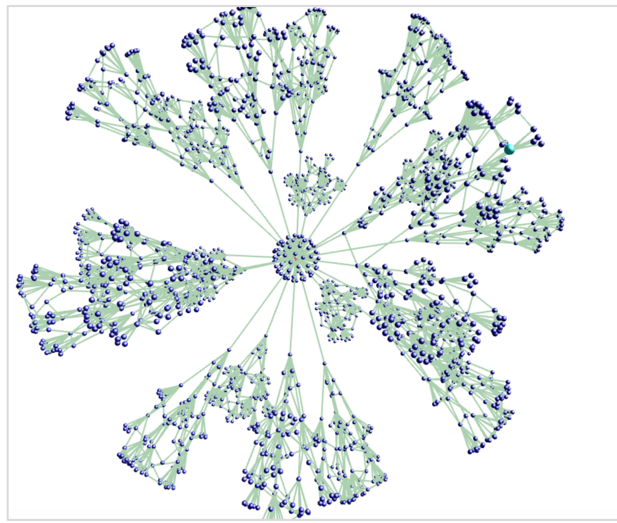

Fig. 6. Simulation using Scenario 1.

The results draws a picture with some reservations. The output shows an explosion, central ball, when the misinformation is shared by the newsgroup with the source of misinformation highlighted in a nearly hidden dimension of the diagram. The team while reviewing the diagram identified an anomaly. The simulation failed to consider cross-wire between branches, thus suggesting that once information traveled beyond the newsgroup, it never cross-wired. Therefore, it was decided that the simulation enforces at least 10% of crosswire takes places between branches.

2. For simulation scenario 2, the spread of misinformation will consider the same variables with a clear distinction that at least 10% of crosswire takes place between branches. A summary presented in table 3.

Variable Name	Symbol	Value	Units
Maximum population	(l)	2500	Nodes
Sharing/See	(S)	10	Nodes
Sharing/See (Social Groups)	(Sg)	100	Nodes
Passing on information	(P)	20	%
Authentication	(A)	0	%
Crosswire with at least 10% between branches.	(Cw)	20	%
Same Level (Cluster) Communication	(Sl)	20	%
Reverse Validation	(Rv)	50	%

Table 3.Critical Variables for propagation simulation Scenario 2.

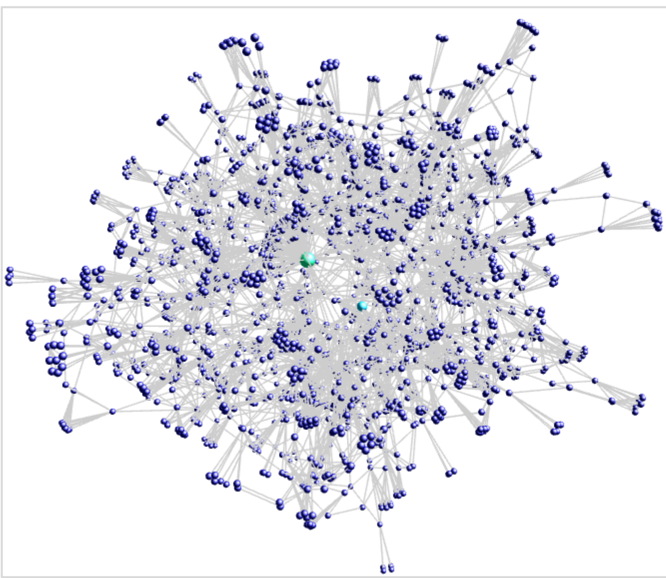

Fig. 7. Simulation using Scenario 2.

To assist with the view, the team emphasized the color and size of the newsgroup as pale green and the color of the source as light blue.

Three key observations noticed about the second simulation.

1. The main branches appearing in Fig. 7 have intermingled with other branches, suggesting more organic chaos of communication. This form may well represent the randomness of information flow in spatial space.
2. Clusters of groups appeared. These clusters are of different sizes and from different branches and at closer look, the nodes had a shared point. This suggested possible discussions and debate groups; see Fig. 8.

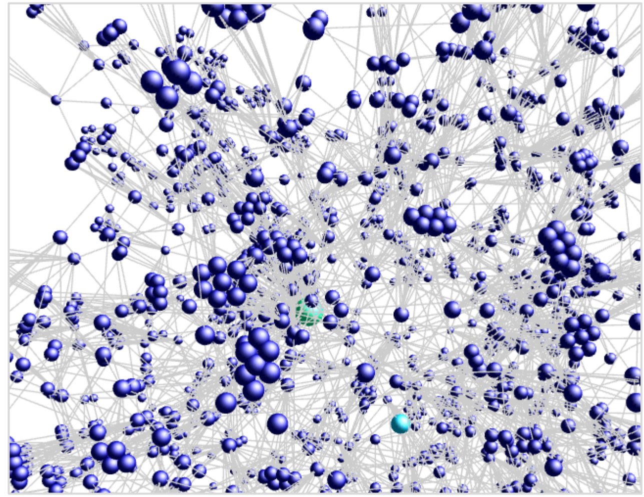

Fig. 8. Simulation using Scenario 2 showing cluster groups.

3. The source of the misinformation, a node the team called “Source”, is not easily detectable. Even in careful back tracking from the tree ‘leaves’, the links intermingled in a way that made such reverse review unreliable. Although the proximity of the node to when the newsgroup picked up the story seems close, see Fig 9. This suggest the time of the posting is a more reliable way to track the source that reverse checks.

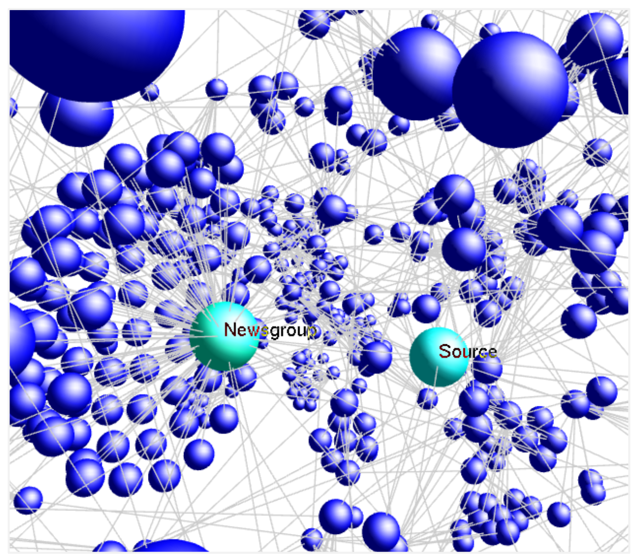

Fig. 9. Simulation using Scenario 2 proximity of the source from the newsgroup.

The team repeated the simulation three times to ensure that these findings are consistent with the output.

3- For the third simulation, the team considered the impact of 30% of the population with access to verification tools, consistent with the work the team have done with regards to right-click authentication process. While keeping all the variables, authentication (A) is set at 30% as shown in table 4.

Variable Name	Symbol	Value	Units
Maximum population	(l)	2500	Nodes
Sharing/See	(S)	10	Nodes
Sharing/See (Social Groups)	(Sg)	100	Nodes
Passing on information	(P)	20	%
Authentication	(A)	30	%
Crosswire with at least 10% between branches.	(Cw)	20	%
Same Level (Cluster) Communication	(Sl)	20	%
Reverse Validation	(Rv)	50	%

Table 4.Critical Variables for propagation simulation Scenario 3.

Identified variables have been applied in different percentage to simulate behavior of users in network exposed to misinformation spreading. The graph theory is used to model the network and to apply identified variables in this dynamic environment.

As the simulation process is being undertaken, the results showed success in stopping the propagation of misinformation significantly earlier than expected. The results of 2%, 5% and 9% authentication demonstrated in Fig. 10.

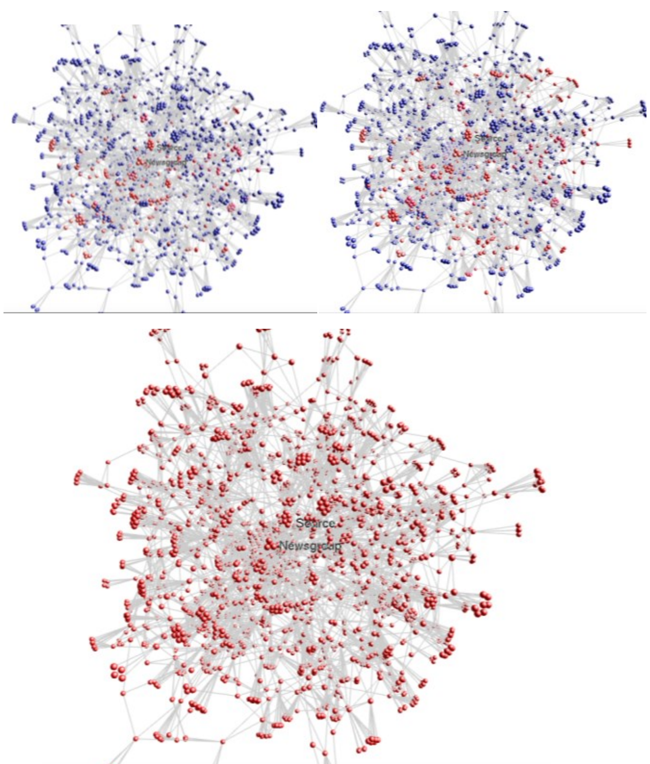

Fig. 10. Validation at 2%, 5%, and 9% respectively using Scenario 3.

In repeating the experiment, the results are found to be consistent at a rate below 10% and average elimination of misinformation propagation at 8.9%. The team did not need to perform further simulations since the population has turned red significantly earlier than expected. At closer examination, it was found that the cascade of validation reached the 'Newsgroup' or source of misinformation resulting as these sources to turn red and thus the whole diagram turned red indicating a success in fighting the propagation of misinformation. However, this simulation assumes that Newsgroups or source of misinformation would be welling to accept that the information is false. There are incidents where media outlets acknowledged sharing of misinformation and either corrected or removed such posts. However, this is likely not to be the case in many scenarios especially when the underlining reason for sharing this information is biasness. The team made the consideration to repeat the simulation as simulation 4, however with a new assumption that the newsgroup and the misinformation source would not reverse their postage despite the validation.

4- For simulation 4, the Newsgroup and Misinformation Source have been unstructured not to switch if by random they are selected to validate or information from other nodes by means of crosswire, same level, or reverse validation instructs them to validate. Repeating the experiment the team noted failure to stop the propagation at 10%, 20% or even 30%. As long as the source and the newsgroup refused to rectify the post, the validation tool would have considerable success but fails in completely eliminating it, as shown in Fig.11 and table 5.

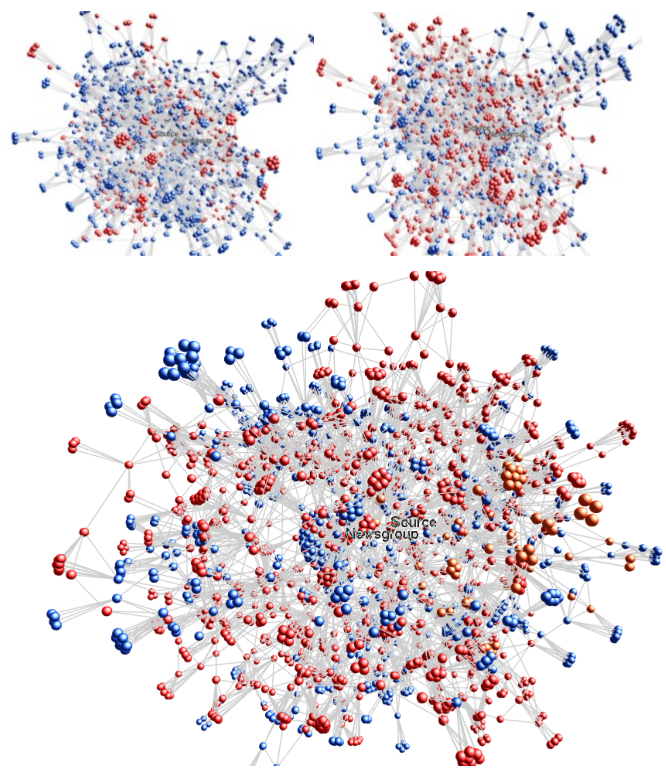

Fig. 11. Validation at 10%, 20%, and 30% respectively using Scenario 4.

Authentication rate	10% (n=220)	20% (n=440)	30% (n=660)
Halting of propagation	23.9%(n=526)	42.2% (n=930)	58.5% (n=1289)

Table 5. Data collected from simulation 4.

There is also evidence that should the population exceeding 2200; the propagation of misinformation will continue to expand. A repeat of the simulations, the results indicated the authentication rate at which misinformation can halted would be 54%, see table 6.

Authentication rate	40% (n=880)	50% (n=1100)	54% (n=1188)
Halting of propagation	76% (n=1678)	93% (n=2047)	100% (n=2200)

Table 6. Data collected from simulation further tests.

V. Results Analysis

In answering the research questions, the simulations have provided the following answers.

1. It is evident that newsgroups have immense impact in the propagation of information and misinformation. In simulation 1 and 2, it was evident that the simulation allowed faster expansion of the information and generated clusters of grouping which did not necessary social friends but clusters of individuals with interest in the subject. The impact of newsgroup is further demonstrated in combating misinformation. Newsgroups that fail to rectify misinformation in their post stood to significantly reduce the ability of authentication or validation tools. Given the benchmark variable values the team has used, the rate of authentication to achieve full combat of misinformation varied between 8.9% when Newsgroup rectified a misinformation rate to 54% if newsgroups refused to cooperate. This shows the significant power social newsgroups have.

2. The results show variations in how successful an authentication tool could have is highly dependent on information sources and newsgroups rectifying their posts. However, the need for and importance of these types of tools is further demonstrated to essential in combatting misinformation. As the simulation 3 and 4 shows, the impact is significant, even in small case applications with or without the cooperation of newsgroups or information sources.

VI. Research Limitations

The variety of variables and scenarios the overshadows three-dimensional simulation of social media will continue be subject of how realistic can the simulation be representative of the real world. The paper makes several assumptions regarding the values provided to key variables. The assumptions the authors made are mainly based on a benchmark of variables and values following a reflective analysis representing one speculative scenario. It is worth noting though that this approach is comparable to similar research on modeling the travel of misinformation. Moreover, the authors acknowledge that further research should be conducted to investigate the effect of more potential variables on the travel of information and means of combating misinformation online by applying real case studies involving the propagation of misinformation online. Thus where possible, more accurate data needs to be collected on the average values associated with the variables identified in their studies.

VII. Conclusion

In this paper, the authors have been able to show the impact of social media newsgroup in the propagation of misinformation. In addition, the simulations showed how authentication methods could greatly reduce the spread of misinformation on social media and improve the users' experience. The three-dimensional simulations combined with graph theory have further helped demonstrate the variables governing the way misinformation travels, and how this could be greatly minimized by authenticating information before it is shared. The authors believe that this study could be further extended by conducting more simulations, on different scenarios, and by including more variables that could have an effect on misinformation spread such as real case studies. Alongside this research, the authors are continuing their work on developing an algorithmic formula for predicting the spread of misinformation with the aim of programming the first fully functional browser that would be capable of running live authentication.

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