GRAPH MODELING FOR THE SUSTAINABILITY OF DA'WA COMMUNICATION PLATFORMS IN THE DIGITAL INFORMATION SOCIETY

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Abstract: The role of information technology is very important in building communication relations between users in cyberspace. The relationship of digital communication with platforms through social media is very complicated. The most important thing is the pattern of communication in the spread of da'wa in cyberspace. Currently, the form of cyber media is only used for the use and evaluation of how da'wa can adopt internet media. In this paper, our motivation is to make data modeling on communication patterns with digital platforms through social media in the dissemination and development of da'wa media. The research method is starting with the collection, extraction, understanding of data, the formation of a graph model and the evaluation stage. The modeling is in the form of a graph using network-based analysis techniques through the identification of entities and also relationships with other entities. The final result of this discussion is that the graph model is measured by the centrality method to ensure the validity of the model. Based on the results of tests and evaluations with centrality that graph modeling is considered very good for modeling communication by building a classification of media forms used.

Keywords: Digital Communication Platform, Graph Modeling, Graph Analytic, Information Society, Sustainability Da'wa

Abstrak: *Peranan teknologi informasi sangat penting dalam membangun relasi komunikasi antar pengguna dalam ruang siber. Relasi komunikasi secara digital dengan platform melalui media sosial itu sangat rumit. Hal yang terpenting adalah pola komunikasi dalam penyebaran dakwah dalam ruang siber. Saat ini bentuk media siber hanya digunakan sebatas penggunaan dan evaluasi bagaimana dakwah bisa mengadopsi media internet. Dalam makalah ini, motivasi kami adalah membuat pemodelan data pada pola komunikasi dengan platform digital melalui media sosial dalam penyebaran dan pengembangan media dakwah. Metode penelitian yang dilakukan adalah dimulai dengan pengumpulan, estraksi, pemahaman data, pembentukan model graf dan sampai pada tahap evaluasi. Pemodelan berbentuk graf menggunakan teknik analisis berbasis jaringan mlalui identifikasi entitas dan juga relasi dengan entitas lain. Hasil akhir dari pembahasan ini adalah, model graf diukur dengan metode centrality untuk memastikan keabsahan model. Berdasarkan hasil uji dan evaluasi dengan centrality bahwa pemodelan graf dianggap sangat baik untuk memodelkan komunikasi dengan membangun klasifikasi bentuk media yang digunakan.*

Kata Kunci: *Platform Komunikasi Digital, Pemodelan Grafik, Analisis Grafik, Masyarakat Informasi, Dakwah Keberlanjutan.*

A. Introduction

The presence of information technology seems to raise the concept of an information society. The information society is seen as a community condition in terms of quality of life, changing patterns of society, and economic growth depending on technology. In almost the last

two decades, technological improvement and growth have been not only in infrastructure but also in technology users.[1] Every day there will be opportunities for new users of information technology. Thus, starting from here, we will see how the communication pattern between users reaches the scope of the community.

The role of information and communication technology has opened opportunities and challenges in the development and processing of spreading da'wa messages. Both information and communication technology are motivated by the development of the Internet to provide freedom for each individual to explore all information.[2] In the context of da'wa communication, the Internet as part of technology is considered a virtual space to distribute information, for the da'wa messages has effectively, efficiently, and easily accessible in terms of time and place [3].

Another essential implementation of da'wa communication through platforms or media is extensive if using information technology devices. The growth in digital da'wa communication platforms has begun to increase since the covid-19 pandemic hit the country, so it becomes an opportunity and a hand on how da'wa can still be carried out [4]. The concept of a digital da'wa communication platform that is partly carried out still revolves around qualitative methods, which means exploring information on the individual side [5]. Discussion of the da'wa communication platform is also done utilizing a literature review focusing on qualitative methods. Social media is part of the da'wa media dissemination platform with descriptive delivery of media characteristics[6]. The cluster of targets for the spread of da'wa also occurs in the millennial generation who use internet media[7]. The use of social media is carried out on YouTube with audio, video and animation content through the concept of learning with da'wa content [8]. The use of podcasts is also an option in addition to opportunities as a medium of da'wa communication with a technology platform [9]. According to the literature review results, there is little or no concept of modeling da'wa communication, even with a digital platform. Another weakness is that digitizing da'wa communication only focuses on using various online-connected media and has not mentioned effectiveness measurements.

In this paper, our primary motivation is to explore and build a mapping of the da'wa communication platform in the digital information society. As for mapping communication patterns, modeling is needed to describe how forms of communication occur based on digital platforms in the information society. Thus, at the end of the discussion, a visualization of the modeling results will be presented using graphs.

This paper will be organized into an introduction that contains the background of how the development of da'wa communication occurs and the pattern of da'wa communication that has not used information and communication technology. The following section is a theoretical review that explains the extent of the development of da'wa communication platforms and what media have been adopted. The next section is the method that describes the collection of data and

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[1] Ridwan Rustandi, "Cyberdakwah: Internet Sebagai Media Baru Dalam Sistem Komunikasi Dakwah Islam," *NALAR: Jurnal Peradaban dan Pemikiran Islam* 3, no. 2 (2020): 84–95.

[2] Puput Puji Lestari, "Dakwah Digital Untuk Generasi Milenial," *Jurnal Dakwah* 21, no. 1 (2020): 41–58.

[3] Sunardi Iman, "Sistem Komunikasi Dakwah Di Era Digital," *Al Amin : Jurnal Kajian Ilmu dan Budaya Islam* 5, no. 1 (2022): 1–10.

[4] Ahmad Fauzi, "Problematika Dakwah Di Tengah Pandemi Covid 19 Mewabah," *Jurnal Al-Hikmah* 18, no. 1 (2020): 27–36.

[5] Lestari, "Dakwah Digital Untuk Generasi Milenial."

[6] Muhammad Helmy and Risa Dwi Ayuni, "Komunikasi Dakwah Digital : Menyampaikan Konten Islami Lewat Media Sosial Line (Studi Deskriptif Pada Akun Line 3Safa)," *Jurnal Ilmu Komunikasi* Vol. 2, no. 1 (2019): 23–29.

[7] Taufik Rahman, "Komunikasi Dakwah Untuk Kaum Milenial Melalui Media Sosial," *At-Tadabbur : Jurnal Penelitian Sosial Keagamaan* 15, no. 2 (2016): 1–23.

[8] Guntur Cahyono and Nibros Hassani, "Youtube Seni Komunikasi Dakwah Dan Media Pembelajaran," *Al-Hikmah* 13, no. 1 (2019): 23.

[9] Athik Hidayatul Ummah, M. Khairul Khatoni, and M. Khairurromadhan, "Podcast Sebagai Strategi Dakwah Di Era Digital: Analisis Peluang Dan Tantangan," *Komunike* 12, no. 2 (2020): 210–234.

information. The next section is a discussion that presents the visualization of modeling results with tools such as Graphs. Finally, conclude at the end of the paper [10].

B.   Theoretical Review

Da'wa communication platforms have various forms. First, through social media, it could be social media such as Twitter, Facebook, YouTube, and Instagram. Adopting technology in da'wa communication gave rise to the idea of cyber da'wa, for the people are the most important participants. Almost the activity was conducted related to da'wa communication in the implementing technology. Various kinds of previous research have been carried out with a qualitative approach, namely, how media opportunities can disseminate da'wa information. Communication media with various platforms are only intended for use. In terms of methods, the da'wa communication media platform only describes the use descriptively.

The other most important thing is related to how to model the use of digital communication platforms. Modeling is defined as forming a flow or pattern of communication. Apart from all that, the form of communication has been recorded in database technology. The utilization of digital media platforms indirectly records all submitted data. Thus, the collected data is from an extensive database (big data).

Furthermore, the data recorded in the system perform relationships between data regarding entities. Thus, based on the literature review results, the communication pattern modelled is too little, while it's interesting how to describe. Thus, in this paper, state-of-the-art is found, namely modeling on a digital da'wa communication media platform using a modeling language such as graphs.

Graph modeling provides an overview of how connecting entities form data. The underlying theory is the formation of vertices and segments. The segment shows the relationship between the vertices. The node can be intended as an entity of people, objects, or an institution. Graph modeling must also be criticized by looking at the differences in how graph modeling can be applied according to the case raised. For example, graph modeling is applied to model transportation modes [11]. Although a graph is a database, it has other advantages over a relational database. The exciting thing is that graph modeling is intended to draw relationships between vertices, so transportation modeling is very suitable. The rest of the discussion of graph modeling is also carried out to determine the modeling of the MSME sales information system database [12]. The modeling of the database system uses the NoSQL concept with the intention of not making relation tables in general to make graph modelling. One of the reasons for using the graph model is that it has been confirmed that it supports the speed of data transmission. One reason is that the relational database system model does not support high-speed services even with large amounts of data. The following analysis of graph modeling is how to capture research on health in Indonesia [13]. This research is almost the same, namely using graph modelling. The modeling shows building knowledge about health research networks in Indonesia through implementing CQL (Cypher Query Language). Therefore, from the results of identification and tracing, it is found that the graph model has not been able to apply communication patterns with digital platforms.

According to the research results described previously, this paper proposes to model the form of communication patterns with digital platforms regarding the delivery of da'wa. The paper analyses the tools for determining the trend in da'wa and communication platforms. The results of this study show the distinction from the results of previous studies, namely focusing on the

[10] Fauzi, "Problematika Dakwah Di Tengah Pandemi Covid 19 Mewabah."

[11] Panji Wisnu Wirawan and Djalal Er Riyanto, "Kajian Implementasi Graph Database Pada Rute Bus Rapid Transit," *Jurnal Nasional Teknologi dan Sistem Informasi* 3, no. 3 (2017): 313–319.

[12] Muhammad Sholeh, RR. Yuliana Rachmawati, and Erma Susanti, "Pemodelan Basis Data Graph Dengan Neo4j (Studi Kasus : Basis Data Sistem Informasi Penjualan Pada UMKM)," *Jurnal Teknologi Informasi dan Terapan* 7, no. 1 (2020): 25–32.

[13] Yoga Yoga Sahria and Dhomas Hatta Fudholi, "Pemodelan Pengetahuan Graph Database Untuk Jejaring Penelitian Kesehatan Di Indonesia," *Jurnal Media Informatika Budidarma* 4, no. 3 (2020): 604.

domain of digital communication platforms. Graph modeling can provide an alternative solution for storing and visualizing network data of da'wa communication platforms in the context of cyberspace. Graph modeling will connect the vertices that are related to each other. The graph is the most to explain about data and information, and the digital platform was proposed in the graph database or knowledge based. The adoption in graph have opportunity to draw the pattern of communication platform. The consideration about the graph is to understand how the information or data should be described when the communication has present. Therefore, currently the graph that is meaning as graphical interaction more in the circle of data.

C. Methods

Modeling communication patterns with various digital platforms occurs in cyberspace, involving many people as users. This type of communication platform provides access and features that can directly connect with users or entities. Furthermore, in this method, there are several very important things in graph-based modelling, namely starting the research stage and conceptual design of graph databases.

1. Research Stages

The concept of graph-based modeling on digital platform communication patterns is arranged systematically. Figure 1 illustrates steps in the sequence of development or modeling of digital platforms in da'wa communication. Overall, there are five phases which this figure begins with a literature study of Da'wa and the Graphic communication platform, and the end is model analysis and evaluation.
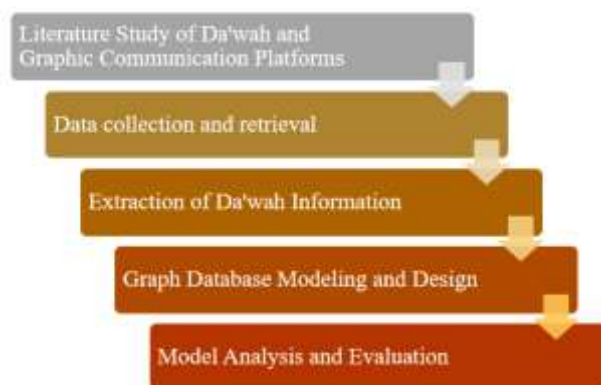

Figure 1 Stages of Modeling the Digital Da'wa Communication Platform

The first stage refers to Figure 1, which is carrying out a literature study. This stage can explain the technique or method used to explore and obtain various data and information or sources related to the topic in modelling. Website-based literature databases that the list group was presented, such as Springer, Elsevier, Wiley, and Google Scholar, are examples of literature studies. The next addition is books, magazines, and other documents. Thus, the theory and discussion will refer to the results of the literature study.

In the second stage, the data collection was implemented through web scraping techniques where data searches were specifically related to the digital da'wa communication platform in Indonesia. For example, the stages in the data collection process are obtained by social media such as Twitter, Facebook, YouTube, and so on, which are considered media for cyber propaganda communication. Moreover, the retrieve to the number of datasets related to da'wa and communication.

Next, carry out the extraction of various information in this graph-based modelling, namely to extract the data that has been collected by converting unstructured data into information data in a structured form. The type of information on the Internet that contains da'wa content is

generally represented in an informal form through websites or social media sites. Therefore, we need technology to analyze texts and find relevant knowledge in the form of structured information [14].

At the modeling stage, the concept of a digital platform adopts network-based analysis using graph database tools. Network analysis with graph database technology is a science that studies the relationship between one entity unit and other entity units supported by graph theory. Network modeling analysis carried out in this study will result in knowing actors as senders, recipients, messages and message groups on digital platforms. The modeling image is shown in Figure 2.
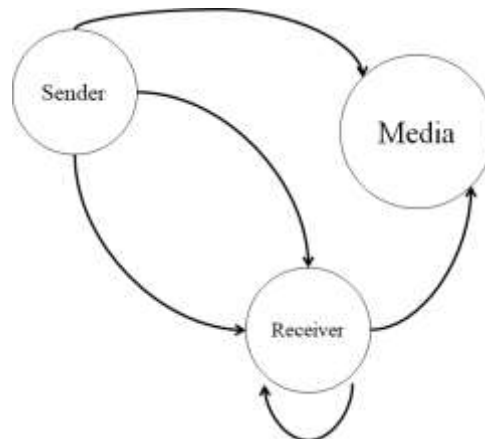

Figure 2 Network Analysis Modeling of Cyber Propaganda Communication Platforms

The last stage is an evaluation to generate knowledge from data modeling generated by network analysis through a graph database [15]. The given illustrated network analysis modeling in figure 2 show three nodes generally. A node such as sender, media an receiver have communicated. Furthermore, to find out useful information on the domain of the communication platform by applying queries derived from the recipient, sender, message, message type and message group. Queries that can be done in this modeling can find out what types of information are related to da'wa. The results of the query are then extracted to find out the types of da'wa messages through cyberspace [16].

2. Conceptual Design of Graph Database

In the database graph design, each data is made in the form of a circle that represents a node. Each node is connected to other nodes through a line that has a direction called an edge. Both vertices and edges have properties. In contrast to relational databases, the property values on nodes are node or edge values. Figure 2, Conceptual design of graph database [17].

D. Results and Discussion

1. Running the Modeling Tool

Platform modeling through virtual concepts is applied with network analysis tools. Neo4j is one of the tools to support communication modeling with various platforms. In Neo4J applications, there are several pre-processing sequences before modeling is carried out starting

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[14] Claudio Gutierrez and Juan F. Sequeda, *Knowledge Graphs*, 2020.

[15] William McKnight, *Graph Databases*, *Information Management*, 2014.

[16] Ali Ameer Jabora' and Ahmed Abd Ali Omran, "Topological Domination in Graph Theory," *AIP Conference Proceedings* 2334, no. March (2021): 5–8.

[17] Yuanfei Dai et al., "A Survey on Knowledge Graph Embedding: Approaches, Applications and Benchmarks," *Electronics (Switzerland)* 9, no. 5 (2020): 1–29.

from checking system requirements, checking runtime environment, looking for Neo4J, preparing applications and preparing graph apps. Figure 3 is the use of the Neo4J application. There are two ways to access the Neo4J application, namely using a browser or desktop-based tools. In addition, it can be applied via the terminal [18].

Figure 3 Areas where graph databases are created and their modeling

2. Formation of Nodes and Relations

In figure 4, how to formulation the nodes which completed attributes and the name of edge. As the mention about figure 4, Formulation and formation of models based on network analysis through identification of nodes and edges. Digital platform modeling on the concept of communication using graph network analysis. This modeling is also a concept of graph-based database modelling. Graph-based database modeling is different from relational database systems in general. The database graph does not recognize records or tables. Thus, every existing data is made a node and the relationship between nodes can be made a link between nodes.

Figure 4 Formation of nodes and segments and their relationships

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[18] Wei Jin et al., "Graph Representation Learning: Foundations, Methods, Applications and Systems," in *Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, vol. 1 (Association for Computing Machinery, 2021), 4044–4045.

In simple terms, it can identify correlations between data modeling terminology, namely entities and attributes with graph elements (vertices and edges). However, in the concept of modeling with graphs, the edge is a form of relationship connecting two vertices. Figure 4 below is the form of a node-to-node relationship with a segment [19].

3. Testing the Relationship between Vertices in the Form of a Graph

There are several parts of modeling using graph concepts. First, the node section consists of several or more users of social media or communication media on digital platforms. Second, namely, the relationship section, which explains the relationship between nodes such as users and media platforms.
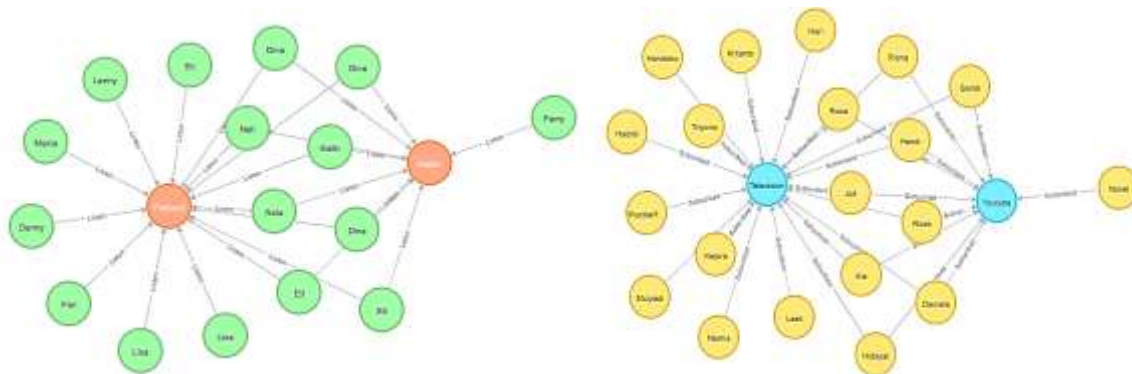

Figure 5 The relationship between vertices is in the form of a graph

The pattern of relations between nodes is very diverse and complex. The increasing number of nodes allows an increase in the complexity of the communication relationship. Thus, communication patterns in complex digital forms can be simplified through network analysis modelling. Furthermore, to support network analysis, tools such as neo4j are applied to analyze, and classify data based on observations through social media digital platforms about da'wa.

4. Testing the Node Relationship in the Form of a Table

The trial of making connections between nodes was carried out with the help of neo4j software. Figure 6 below is a representation of the output in the form of a table relation (left) and summary code (right). The table relation was produced by a tool, or the script in an application was executed by several type. This table could represent that the collecting of the name as participant that is combined to form a group in communication with digital platform. The summary code in an application (Neo4j) has implemented to show the status of creating table relation, and this script explain the information server version in the local machine, query was built, summary and response with limited feature.

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[19] Harsha R. Vyawahare, Pravin P. Karde, and Vilas M. Thakare, "An Efficient Graph Database Model," *International Journal of Innovative Technology and Exploring Engineering* 8, no. 10 (2019): 1292–1295.
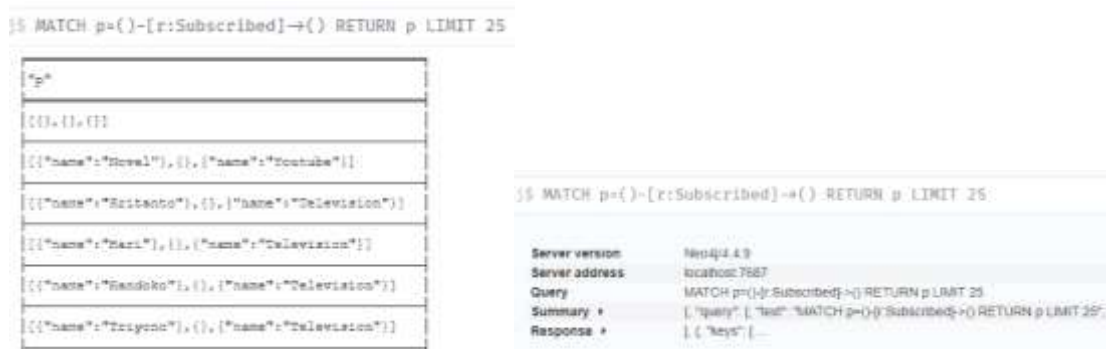
Figure 6 Table Representation on Node Relationship

Figure 6 on the left describes the form of the subscribed relationship pattern notation on social media accounts. The general form of the relation is Match P=()-[r:subscribed]→() Return p. Entity P is related to entity Q (p→ q) with the relation name is subscribed. Entities are provided with attributes that make up the characteristics of the entity. One form of attribute on the account or user entity is username, age, email and so on. While the right side of Figure 6 is a form of representation in the form of program code through a query [20]. Query is a form of programming language that gives orders to certain data [21].

5. Visualization Results and Knowledge

This study succeeded in implementing a graph database through Neo4J to analyze the pattern of da'wa communication through digital platforms. In Figure 7 below the social media other media could be represented by circle that it's a node. Thus, figure show that 6 node which is identified, or majority in entity relationship with graph visualization. For example, TV, Twitter, Facebook, YouTube, podcast and Radio are available in the central among other nodes. It seems each deep node in the prime node could illustrate as participant in platform. In figure 7 show that relationship among prime node in the real-time mode communication. Because the nodes are complex in the many situations, the tools (e.g. Neo4J) might classified the big group in circle around communication in social media and another platform. Although, the several nodes that ordered circle in the community of node, the edge as well as considered to describe workflow that contains a message. The edge, is one of important in the graph analysis to determine the delivery of a message, but it really depends on conceptuality in the case. In addition, the creating in the graph design through the tools have too much spent time when to identify sample or participant.

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[20] Joshua Levy et al., "Topological Feature Extraction and Visualization of Whole Slide Images Using Graph Neural Networks," *Pacific Symposium on Biocomputing. Pacific Symposium on Biocomputing* 26 (2021): 285–296.

[21] Shefali Patil, Gaurav Vaswani, and Anuradha Bhatia, "Graph Databases- An Overview," *International Journal of Computer Science and Information Technologies* 5, no. 1 (2014): 657–660.
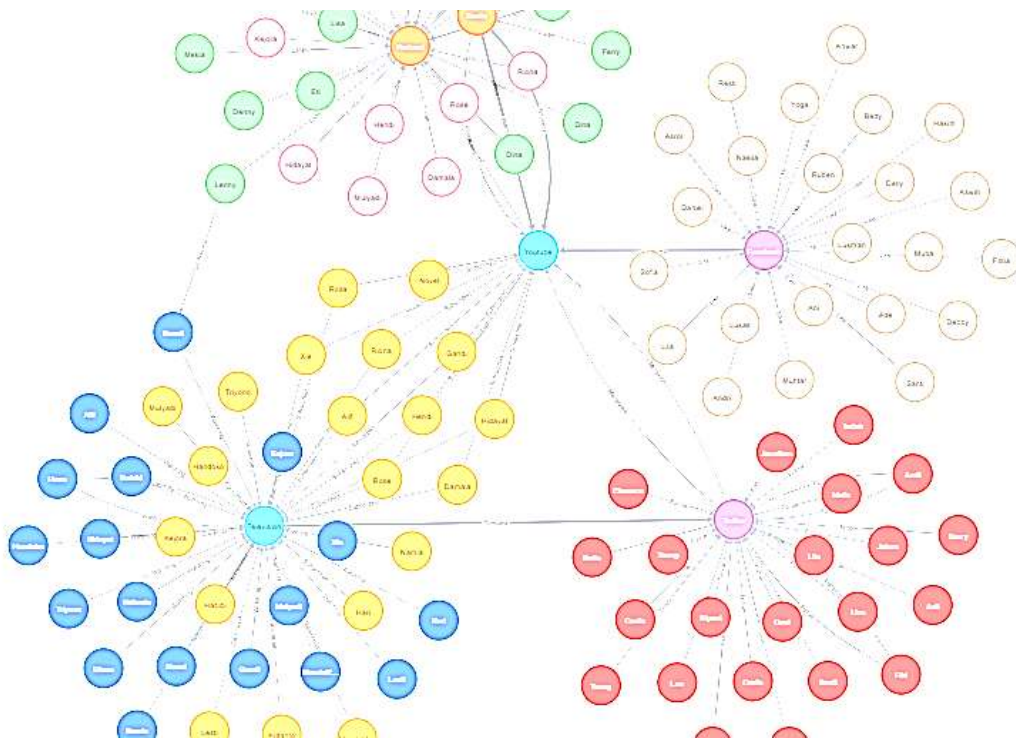
Figure 7 Visualization of Graph Modeling on the Da'wa Communication Platform

Modeling is the process of translating or interpreting real-world entities into equivalent software representations. Entity refers to people, institutions or concepts connected to the cyber world. Each user is equipped with an account to connect to the communication platform application is considered a real-world reality. Since data modeling is an interpretation of real-world problems, we begin by defining some generic or general data terminology. This step is a consideration for discussing problems in the context of communication using digital platforms. The initial understanding of data modeling in this case is divided into four parts. First, entities are usually represented as objects, where entities describe objects or types of objects in a domain. An example, in this case, is users, and social media. At the same time, the types of social media that are explored include Facebook, Twitter, YouTube, Instagram, and so on. Second, relationships are often represented by verbs. Relationships describe how entities can interact with other entities. An example is supposed on Facebook. Someone has friends with other people. Third, attributes are like entities using nouns. Attributes describe the quality of the entity and characteristics of an entity. Fourth, the access pattern describes the question or method of interaction in a domain. For example, Ali has a friend from which country.

Graphs as a way to make data modeling refer to Euler's theory in mathematical studies. In the concept of a graph, a composition consists of vertices denoted by a circle containing nouns as well as entities. While the other is edge as a relationship between two vertices. Twitter nodes have more than 20 users from the sample size in Figure 7. Furthermore, the largest number is followed by YouTube and podcasts, which have more than 30 connected nodes from the sample size. According to Figure 7, it can be learned that almost all nodes are connected to other nodes through edges. By using the graph in the modeling above, it can reduce the complexity so that it can be presented in a simplified form of data systems on the communication platform.

The last step is how to evaluate data modeling with graphs. In this concept, graph analytics is a data analysis technique in the form of a network. The form of development is to use the help of algorithms how to detect one data with other data. One form of data analysis is centrality. Our motivation for using centrality when analyzing is to identify the important edges in the graph. So far, based on our observations, this method is often used to analyze social media between users. The use of centrality in analyzing communication patterns on digital platforms includes

identifying critical components in the communication network between users in the media, identifying people in the organization, and estimating optimal timing and routing for communication packets.

Table 1 Digital Platform Graph Modeling Centrality Identification Sample

Name	Degree Centrality	Betweenness Centrality	Closeness Centrality	Eigenvector Centrality	Page Rank
Budi	4	48	1.26	1	0.0235
Hendi	3	23	3.06	2	0.0512
Mukhsan	4	15	2.36	5	0.0531
Arif	1	35	1.39	3	0.0402
Riyadi	3	40	3.78	1	0.0512
Melia	2	41	2.69	4	0.0106
Sujadi	1	35	0.89	2	0.0206

As in table 1, it can be described that there are five attributes to evaluate graph modeling. Degree centrality shows how many segments connect the nodes. For example, Budi has four forms of interaction with social media such as YouTube, Instagram, Facebook, and Twitter. Betweenness centrality describes the segment closest to the adjacent vertices. Budi is the user who has the highest number of adjacent segments. Closeness Centrality shows the average of what is the shortest distance in the segment connecting the nodes. Eigenvector Centrality shows how many segments are not connected to the node. Finally, page rank is the relative centrality of connecting between segments.

The provided table 1 as mentioned above show contrast the difference betweenness centrality in digital platform graph modeling with seven samples beside degree centrality were represented. It is crystal clear that the largest and the lowest proportion digital platform graph modeling centrality in each sample went on degree centrality, between centrality, closeness centrality and the page rank. At the first glance, graph modeling centrality become not significantly if the pattern in table was represented. In first sample made up 4 with the continued the amount saw decrease slightly underwent increase fairly with accounted for 4. The second block sample, modeling centrality decrease gradually which this case initially at fifth sample account. Moreover, this table describe modeling centrality fell rapidly that the moving a sample accounted for 1 in the fourth respondent.

E. Conclusion

In this final section, modeling with network analysis on the database graph has modeled the form of communication through a digital platform. The use of digital platforms is then classified according to the application domain through social networks. Seven nodes have been identified, namely Twitter, Instagram, Facebook, YouTube, radio, tv, and podcasts. These seven applications are platforms that are often and most widely applied when broadcasting in the delivery of da'wa in cyberspace. Thus, based on media search results, podcasts and YouTube have the highest rankings. Therefore, the use of social media as a means of delivering da'wa in cyberspace is an opportunity to reach people who need information related to religion.

Graph modeling has explained how da'wa communication patterns in cyberspace are interconnected. Every user equipped with an account on the application will always be connected with other users through the communication platform as a medium. Based on this study, it can be described how the sustainability of da'wa in the cyber context can develop to date. In addition, in the future, there will be waves not in the user aspect but in the variant of da'wa media.

References

Cahyono, Guntur, and Nibros Hassani. "Youtube Seni Komunikasi Dakwah dan Media Pembelajaran." *Al-Hikmah* 13, no. 1 (2019): 23.

Dai, Yuanfei, Shiping Wang, Neal N. Xiong, and Wenzhong Guo. "A Survey on Knowledge Graph Embedding: Approaches, Applications, and Benchmarks." *Electronics (Switzerland)* 9, no. 5 (2020): 1–29.

Fauzi, Ahmad. "Problematika Dakwah di Tengah Pandemi Covid 19 Mewabah." *Jurnal Al-Hikmah* 18, no. 1 (2020): 27–36.

Gutierrez, Claudio, and Juan F. Sequeda. *Knowledge Graphs*, 2020.

Helmy, Muhammad, and Risa Dwi Ayuni. "Komunikasi Dakwah Digital : Menyampaikan Konten Islami Lewat Media Sosial Line (Studi Deskriptif Pada Akun Line 3Safa)." *Jurnal Ilmu Komunikasi* Vol. 2, no. 1 (2019): 23–29.

Iman, Sunardi. "Sistem Komunikasi Dakwah Di Era Digital." *Al Amin : Jurnal Kajian Ilmu dan Budaya Islam* 5, no. 1 (2022): 1–10.

Jabora', Ali Ameer, and Ahmed Abd Ali Omran. "Topological Domination in Graph Theory." *AIP Conference Proceedings* 2334, no. March (2021): 5–8.

Jin, Wei, Yao Ma, Yiqi Wang, Xiaorui Liu, Jiliang Tang, Yukuo Cen, Jiezhong Qiu, et al. "Graph Representation Learning: Foundations, Methods, Applications and Systems." In *Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, 1:4044–4045. Association for Computing Machinery, 2021.

Lestari, Puput Puji. "Dakwah Digital Untuk Generasi Milenial." *Jurnal Dakwah* 21, no. 1 (2020): 41–58.

Levy, Joshua, Christian Haudenschild, Clark Barwick, Brock Christensen, and Louis Vaickus. "Topological Feature Extraction and Visualization of Whole Slide Images Using Graph Neural Networks." *Pacific Symposium on Biocomputing. Pacific Symposium on Biocomputing* 26 (2021): 285–296.

McKnight, William. *Graph Databases. Information Management*, 2014.

Patil, Shefali, Gaurav Vaswani, and Anuradha Bhatia. "Graph Databases- An Overview." *International Journal of Computer Science and Information Technologies* 5, no. 1 (2014): 657–660.

Rahman, Taufik. "Komunikasi Dakwah untuk Kaum Milenial melalui Media Sosial." *At-Tadabbur : Jurnal Penelitian Sosial Keagamaan* 15, no. 2 (2016): 1–23.

Rustandi, Ridwan. "Cyberdakwah: Internet sebagai Media Baru dalam Sistem Komunikasi Dakwah Islam." *NALAR: Jurnal Peradaban dan Pemikiran Islam* 3, no. 2 (2020): 84–95.

Sahria, Yoga Yoga, and Dhomas Hatta Fudholi. "Pemodelan Pengetahuan Graph Database untuk Jejaring Penelitian Kesehatan Di Indonesia." *Jurnal Media Informatika Budidarma* 4, no. 3 (2020): 604.

Sholeh, Muhammad, RR. Yuliana Rachmawati, and Erma Susanti. "Pemodelan Basis Data Graph Dengan Neo4j (Studi Kasus : Basis Data Sistem Informasi Penjualan pada UMKM)." *Jurnal Teknologi Informasi dan Terapan* 7, no. 1 (2020): 25–32.

Ummah, Athik Hidayatul, M. Khairul Khatoni, and M. Khairurromadhan. "Podcast Sebagai Strategi Dakwah Di Era Digital: Analisis Peluang Dan Tantangan." *Komunike* 12, no. 2 (2020): 210–234.

Vyawahare, Harsha R., Pravin P. Karde, and Vilas M. Thakare. "An Efficient Graph Database Model." *International Journal of Innovative Technology and Exploring Engineering* 8, no. 10 (2019): 1292–1295.

Wirawan, Panji Wisnu, and Djalal Er Riyanto. "Kajian Implementasi Graph Database pada Rute Bus Rapid Transit." *Jurnal Nasional Teknologi dan Sistem Informasi* 3, no. 3 (2017): 313–319.