Graph Models Of Social Media Network As Related To Whatsapp Groups

Tsok Samuel Hwere[1], Rwat Solomon Isa[1] & Hosea Yakubu[2]

[1]Department of Mathematics Faculty Of Natural And Applied Sciences Plateau State University Bokkos, Plateau State, Nigeria

[2]School of Applied Sciences, Federal Polytechnic of Oil, Bonny Island, Rivers State Nigeria

ABSTRACTS
Graphs are extensively used to model social structures based on different kinds of relationships between people or groups of people. WhatsApp media can conveniently be modelled using graphs, the connection between individuals in WhatsApp media can be described using graphs ranging from two individuals connected and communicating to different WhatsApp groups, this can be comfortably explained by graphs. The idea of directed graphs, undirected graphs and adjacent matrix as it's related to WhatsApp groups has been presented.
Keywords: Graph Models, Social Media Network, WhatsApp groups, Directed graphs, undirected graph, adjacency matrix,

1.0   INTRODUCTION
Graphs are discrete structures consisting of vertices and edges that connect these vertices. There are different kinds of graphs, depending on whether edges have directions, whether multiple edges have directions, whether multiple edges can connect the same pair of vertices, and whether loops are allowed. Problems in almost every conceivable discipline can be solved using graph models.

Graphs are used in a wide variety of models and are extensively used to model social structures based on different kinds of relationships between people or groups of people (Kenneth H. Rosen, 2012). This kind of graph models individuals or organizations are represented by vertices, relationships between individuals or organizations are represented by edges.

The study of social networks is an extremely active multidisciplinary area and many different types of relationships between people have been studied using them. With these, this paper decided to work on graph models of social media networks relating it to different WhatsApp groups.

Social media is frolicking an imperative role in circadian practices of communication with people all over the world. It has been extensively emerged among popular with young adults over the last decade. Growth in web-based technologies has widened the use of interactive social media that enables users to upload images and videos on the Internet. Social media networks are very much auxiliary to connect with our friends. Nowadays, whenever friends meet, they first confirm whether they use social media networks like Facebook, WhatsApp, tweeters, etc. Many find it as God's gift since they are to connect even to their childhood friends.

In previous years, there was not much communication facility. People were not able to get connected to their friends and relatives often. They felt it was a big process even communicates for a little time. The cost of communication also was very expensive.

Graph Theory

Graphs are discrete structures consisting of vertices and edges that connect these vertices. There are different kinds of graphs, depending on whether edges have directions, whether multiple edges can connect the same pair of vertices, and whether loops are allowed. Problems in almost every conceivable discipline can be solved using graph models (Kenneth H. Rosen, 2012). This paper illustrates how graphs are used as models in a variety of areas particularly in social media network as related to WhatsApp. As we all know, showing any data in pictures gives a clear understanding of the usage of words. In general, pictorial representation has been referred to as graphs. Graph Theory pays a major role in every field. In Computer Science Engineering, it has a vast application. It plays a major role in both software and hardware usage. For Example, in software, it is used in the data flow diagram, graphical design, network designing. In hardware, it is used in the data structure, image processing, web designing, etc

Social Network Analysis (SNA)

The goal of SNA is to identify "who the key actors are and what positions and actions they are likely to take", SNA has been applied to networks of individuals (Krackhardt, 1996) as well as networks of organizations (Brennan, 1999).

In SNA, interrelations and connections are represented as networks where the nodes are either individuals or organizations with arcs representing associations (Krackhardt, 1996). The arcs may be directed or undirected; undirected arcs indicate a mutual relationship

Social Media Networks

Nowadays, Technology is moving on its rising slope. We find many communication networks. Within seconds, we can share our status, photos, and messages. Besides, we are also able to have group chats.

In no time, we can communicate with many recipients at a time, with the help of groups. Not only for friendly chats. Many companies form a group with their employees and using that they can share their communication content with ease. Education also gets improved with the help of these communication networks.

There are many social media networks. Social network is the structure, which shows the relations between individuals and organizations. It indicates the ways in which they are connected through various social familiarities ranging from casual to acquaintance (Sweata Mishra, et'al, 2014). Through social networks we are able to communicate by text, voice, pictures, and videos and so on. Many discover it comfortable to use WhatsApp. Tertiary institutions have since started enjoying the full benefits of WhatsApp through different platforms such as level platform, coursemate platform, Departmental platform e.t.c. The platforms enable students to share information regarding fixed lectures, test date, examination time tables, tutorials and many more benefits numerous to mention, these enhance easy access to each other's resources, different groups as NGO's, Associations, and Business partners

In this paper, we would like to model WhatsApp groups with related ideas in graph theory.

WhatsApp

It is an application, which can be downloaded, either on mobile or on the desktop. Once we download, we can start using giving our data like the phone number. It is a user-friendly application. There are no restrictions on the number of messages or pictures shared. It also gives us privacy statements, like hiding the profile picture, hiding the status, etc. It also gives the option to check whether the recipient has viewed the message or not. We can also see whether the person whom we text is online or not. We can block the users if they are not on our interest list. It has many advantages to this type.

Advantages of WhatsApp

WhatsApp is a User-friendly, it takes less time for communication, and has good privacy service, Online calling facility, can set the lock to the application, easy to use, even a novice mobile user can use it. It instantly send message to anywhere in the world, It does not have any advertisements on display screen. WhatsApp calling made it more reliable.

2.0   Graph Theory Terminology
2.1   Graph: A graph-generally denoted G (V, E) or G= (V, E) - consists of the set of vertices V unitedly with a set of edges E. The number of vertices in a graph is normally denoted n while the number of edges is normally denoted m.
2.2   Edge: An edge is a line at which vertices are connected in the graph. Edges are denoted by E= (U, V) it is a pair of two vertices.
2.3   Null graph: A graph G= (V (G), E (G)) is a Null Graph if there are no edges in the graph, that is |E (G)|=0.
2.4   Complete graph: A simple graph G= (V, E) with n mutually adjacent vertices is called a complete graph G and it is denoted by 1 or A simple graph G= (V, E) in which every vertex in mutually adjacent to all other vertices is called a complete graph G.
2.5   The Degree of a vertex: Number of edges that are incident to the vertex is called the degree of the vertex.
2.6   Regular graph: In a graph if all vertices have the same degree (incident edges) k than it is called a regular graph.
2.7   Cycle graph: A simple graph G= (V, E) with n vertices (n≥3) n edges is called a cycle graph.
2.8   Source vertex: Is a vertex with in-degree zero. Also, a vertex that has many out-degree with no number of in-degree.
2.9   Directed graph: A directed graph in which represented by an ordered pair of two vertices, e.g. (V denotes an edge from V_i to V_j (from the first vertex to the second vertex).
2.91   Disconnected graph: A graph G is said to be disconnected if there exist two vertices in G such that no edge in G has those vertices as endpoints.

3.0   Graph Models of WhatsApp
Graphs are used in a wide variety of models. Graph theory is a robust tool for examining relationships between any set of people (objects)   (Chuck Easttom, 2017). We are going to dwell on the description of how to construct Graph models of communications in social media networks. We shall be describing some diverse graph models for some interesting applications in WhatsApp groups. The reason behind using the graphical model in social networks is to describe the network more elaborately and systematically. This graph model allows us to describe the properties of the network elaborately and distinctly. The relation between the individuals can be mapped using the graphical method and how one can access the resources of other users can be described.
Communication needs both the sender and receiver. WhatsApp uses two types of communications like single sender many receivers. Many sender single receivers, many senders many receivers and so on. In WhatsApp, first, it shows the contact of the persons who are all using WhatsApp like us. These can be compared with the set of all vertices.
3.1   Edge
In WhatsApp when two people are friends and in chat, it means they are connected. The relation between them can simply be model by a graph with an edge connecting two vertices V_1 and V_2 as shown in Figure 1. This kind of graph is known as the collaboration graph, where V_1 and V_2 are related and are working together in a particular way
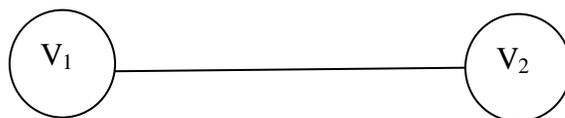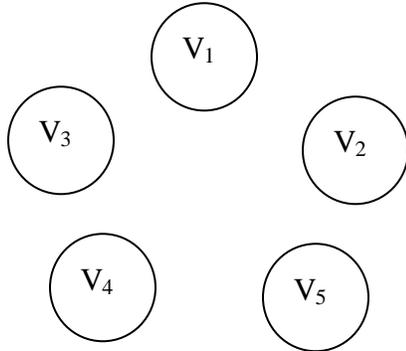

Figure 1: A model of a collaboration graph connecting two people as related to a WhatsApp chat between two persons

3.2 Null Graph

Let us consider 5 persons using WhatsApp. Then, the graph consists of 5 vertices as shown in Figure 2. When all the persons are idle, there is no communication and we say is related to a null graph, as shown in Figure 2, a WhatsApp group that is not active. In graph theory, if no edges are connecting the vertices, we say the group is idle.
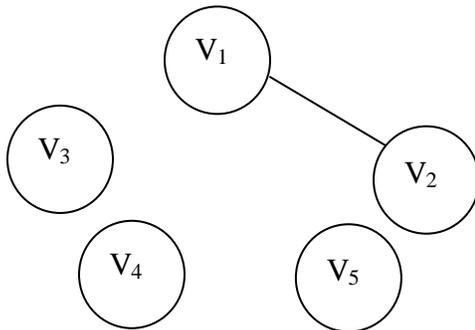
Adjacency matrix

	V_1	V_2	V_3	V_4	V_5
V_1	0	0	0	0	0
V_2	0	0	0	0	0
V_3	0	0	0	0	0
V_4	0	0	0	0	0
V_5	0	0	0	0	0

Figure 2: A model of null graph related to WhatsApp Inactive group

3.3 Incomplete Graph

In a group chat when only two persons are active in a chat while the others are inactive, it means the two are connected while all the other members of the group are inactive. In graph theory, this is described as an incomplete graph model. For example, we consider an edge between V_1 and V_2, as connected while all other vertices not connected shown in Figure 3.

Adjacency matrix

	V_1	V_2	V_3	V_4	V_5
V_1	0	1	0	0	0
V_2	1	0	0	0	0
V_3	0	0	0	0	0
V_4	0	0	0	0	0
V_5	0	0	0	0	0

Figure 3: A model of incomplete graph related to a WhatsApp group of five, when only two people are active.

3.4 Complete Graph

When all the persons needed to communicate are communicating at a time, then the WhatsApp group formed is complete and used. It can be related to a complete graph.

A WhatsApp group in which both the admin and all members of the group are allowed to send and receive messages can also be related to a complete graph as in Figure 4. Two vertices which are incident with a common edge are said to be adjacent. In a complete graph given in Figure 4, every vertex is adjacent to each other.

In WhatsApp group chat, where every person is connected to every other person, this can also be known as a complete active group. This can be referred to as a complete graph. Again referring to a group chat of 5 persons, where every person is connected to 4 other persons. In Graph Theory, this can be referred to as a regular graph, in which every vertex has the same degree. Figure 4 is

an example of such a regular graph and is also called an acquaintanceship graph. The adjacency matrix of the graph is presented as seen by the side of fig 4
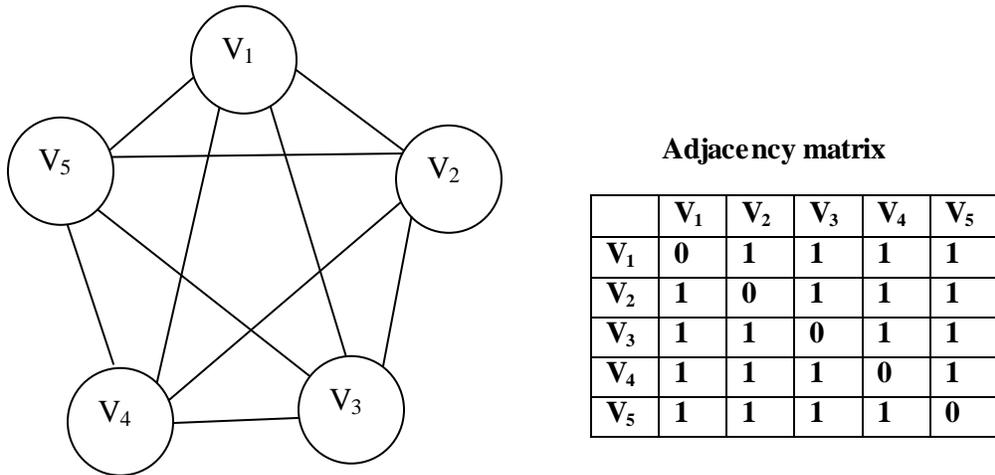
Adjacency matrix

	V_1	V_2	V_3	V_4	V_5
V_1	0	1	1	1	1
V_2	1	0	1	1	1
V_3	1	1	0	1	1
V_4	1	1	1	0	1
V_5	1	1	1	1	0

Figure 4: Model of acquaintanceship graph (regular and complete graph) related to WhatsApp group of five active members

3.5   Cycle Graph

Once again, referring to a suppose three-person are active in a group chat, while the others are inactive their communication graph model is related to Cycle graph as in fig 5, V_1, V_2, and V_3 are active while V_4 and V_5 are not active, this means that there is communication between three persons only and the other two persons are idle this can be referred to cycle graph with 3 vertices as shown in Figure 5. The adjacency matrix is presented as in fig 5
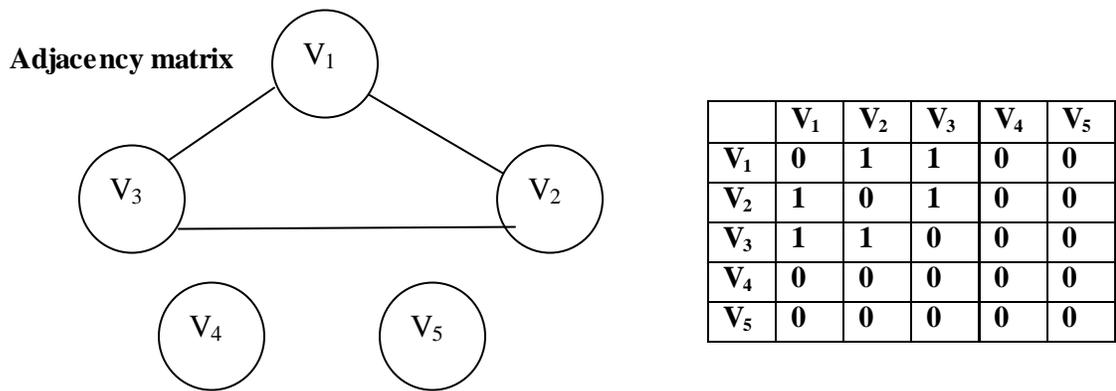
Adjacency matrix

	V_1	V_2	V_3	V_4	V_5
V_1	0	1	1	0	0
V_2	1	0	1	0	0
V_3	1	1	0	0	0
V_4	0	0	0	0	0
V_5	0	0	0	0	0

Figure 5: A model of cycle graph applicable to WhatsApp group of five but three active members and two idle.

3.6   Disconnected Graph

Once again comparing to the above said situation consider the remaining other two persons communicating among themselves, in another separate chat of two of them which disconnect them with their group. This kind of chat graph can be described as a disconnected graph, as shown in Figure 6. The adjacency matrix is presented as in fig 6

Adjacency matrix

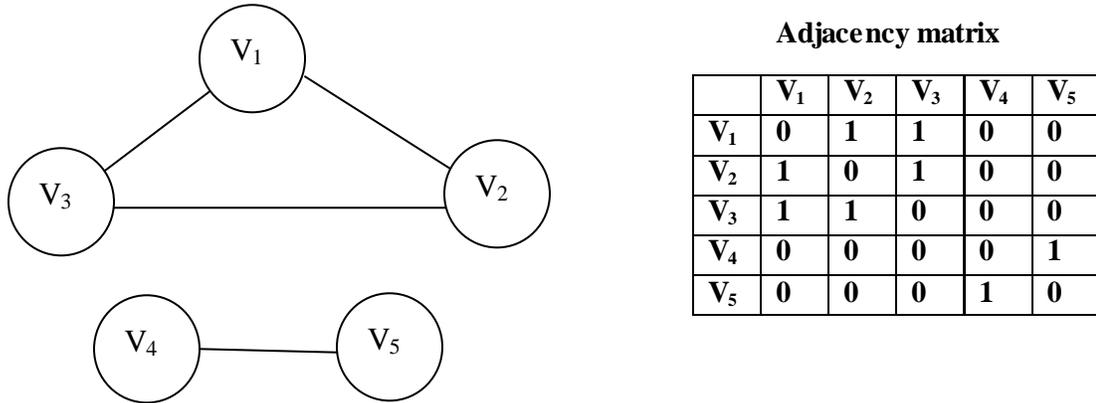|	V_1	V_2	V_3	V_4	V_5
V_1	0	1	1	0	0
V_2	1	0	1	0	0
V_3	1	1	0	0	0
V_4	0	0	0	0	1
V_5	0	0	0	1	0

Figure 6: A model of disconnected graph related to WhatsApp group with three active members while two are idle in the group chat, yet connected on a separate chat

3.7 Directed Graph

Once again referring to a WhatsApp group of five persons in which three persons are communicating between themselves and the messages are directed to a particular person amongst them. When a group chat is inactive or idle and the group members are participating in a separate chat with each other as shown below. Suppose from the graph below that V_1 sends a video message to V_2. V_2 opens the message and watches it and in turn, sends it to V_3, V_3 open the message and send the same to V_1 as shown in fig 7, this kind of connection is a typical directed graph model, this can also be called an influence graph. In studies of group behavior, it is observed that certain people can influence the thinking of others. A directed graph called an **influence graph** can be used to model this behavior. Again taking note of the situation stated above, this can be referred to as an influence graph and the adjacency matrix is presented as shown in fig.7

Adjacency matrices

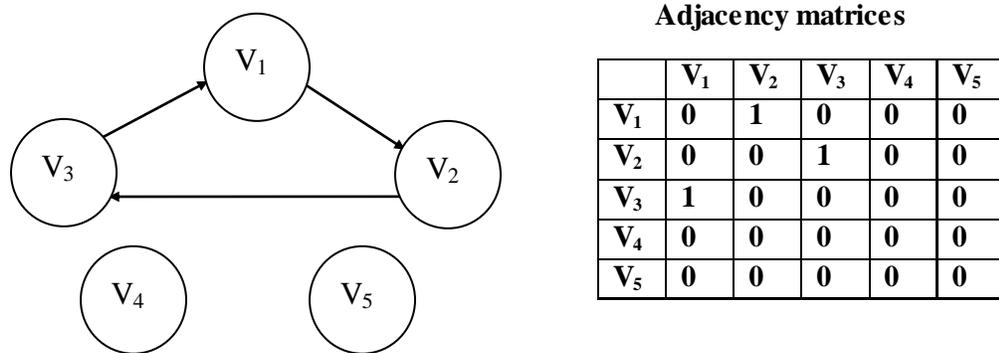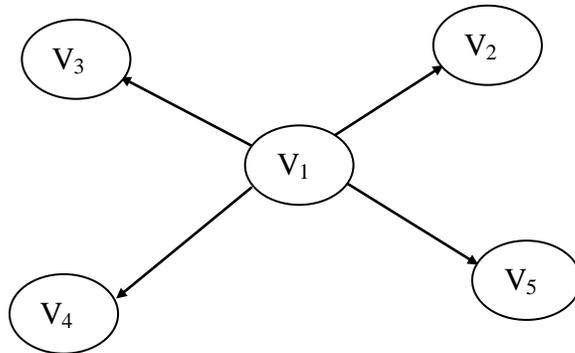|	V_1	V_2	V_3	V_4	V_5
V_1	0	1	0	0	0
V_2	0	0	1	0	0
V_3	1	0	0	0	0
V_4	0	0	0	0	0
V_5	0	0	0	0	0

Figure 7 A model of an influence graph as related to a WhatsApp group where all five persons are inactive in the group, but three are active in a separate chat with each other.

3.8   Directed Graph

A WhatsApp group can be closed or open, but for our figure 8 it is closed that is no one in the group is allowed to send messages to the group except the group admin. This is a directed graph, unlike figure 8 it is the undirected graph and is open to all group members, they can all send and receive messages from each other without any constraints. However, all messages received are from a single sender many receivers, only the group admin has the right to send messages to the group, we can describe V_1 as a source vertex because V_1 has zero in-degrees as shown in fig 8. Again this is an influence graph model. The adjacency matrix is presented as in fig 8

Adjacency matrix

	V_1	V_2	V_3	V_4	V_5
V_1	0	1	1	1	1
V_2	0	0	0	0	0
V_3	0	0	0	0	0
V_4	0	0	0	0	0
V_5	0	0	0	0	0

Figure 8: A model of influence graph with a source vertex related to the WhatsApp group with the admin as the only sender.

4.0   SUMMARY AND CONCLUSION
4.1   Summary

This treatise develops new methods for the modelling and analysis of social networks. The field of mathematics plays a vital role in the various types of fields. Many millions of people on an adjustable basis use online social networking (OSN) sites such as Facebook, Twitter, WhatsApp, and Myspace. Social media is very prevalent among youth-adult over the last decade. It has a high influence on students. The social media and custom usage of social media has an unintended effect on social communication and interpersonal relationships and self-concept among college students.

Social media networks also have become a part of our life, in current years. In this paper, our purpose is to analyze WhatsApp, considering relationships among subscribed users and relating it with some models of the graph. It also describes the model of formation and properties of the social network via a graph theoretical approach and also considers the interaction between different sets of people in a social network. We have also described the matrix representation of the social network. The purpose of this treatise is to apply graph theory with social media networking. It also explains how two persons or more are related to each other and how they can access each other's profile. A social network is a social structure made up of individuals (or organizations) called "nodes or vertices", which are tied (connected) by one or more specific types of interdependency, such as friendship, kinship, common interest, financial exchange, dislike, sexual relationships, or relationships of beliefs, knowledge or prestige.

4.2   Conclusion

In this work, we focused on extracting the relevant information about relationships on social media networks precisely WhatsApp. Thus the relationship in WhatsApp has been discussed and also, modeled with the concept of graph theory. These techniques work on any graph, including the social graph. When you have a graph as complete you're able to do a lot of interesting stuff. Imagine a marketer who wants to have a sponsored newsfeed item WhatsApp can charge a premium because they can target the influencers by using techniques like the ones above. Of course, I can't say whether WhatsApp is using some, none, or all of the techniques I described. But that doesn't mean application developers can't. By keeping track of who influences who you can use these techniques to maximize your exposure.

Thus the WhatsApp models of the graph have been discussed and also, related to the concepts of graph theory. The methodological focus of this research concentrated on relevant areas of operations research, including graph theory, network models that were shown to add insight into the analysis of social networks. The techniques developed in this paper, extend the existing operations research methods to the social network as model graphs.

REFERENCES

Brennan, N. E. (1999). *"National Networks of Corporate Power: An Irish Perspective." Journal of Management and Governance,* . Vol. 2, No. 4, 355-377.

Chuck Easttom, (2017) "Applying Graph Theory to Modeling Investigations." *IOSR Journal of Mathematics (IOSR-JM) e-ISSN: 2278-5728, p-ISSN: 2319-765X. Volume 13, Issue 2 Ver. V. PP 47-51*   HYPERLINK "http://www.iosrjournals.org" *www.iosrjournals.org*

Kenneth H. Rosen, (2012) *Discrete Mathematics and Its Applications*, published by McGraw-Hill, seventh edition pp641-644

Krackhardt, D. (1996). *"Social Networks and the Liability of Newness for Managers." Trends in Organizational Behavior,* . Vol. 3., 159-173.

Sweata Mishra, Rupam Borboruah, Bharadwaj Choudhury, Sandia Rakshit,(2014). "Modelling of Social Network using Graph Theoretical Approach" International Journals of computer Applications (0975-8887) International Conferences on Microelectronics, Circuits and Systems (MICRO-2014)