International Journal of Advance Research in Science and Engineering
Volume No.06, Issue No. 12, December 2017
www.ijarse.com
IJARSE
ISSN: 2319-8354

Drug Encryption using Power of Graph

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ABSTRACT

Drugs are considered as one of the most essential thing in the modern world. It plays a major role in public life to maintaining their health conditions. This situation encouraged the pharmaceutical industry for further study in drug research and innovation.It is essential that there should be adequate safety for surveillance in drug researchwhile finding the chemical formula for new drugs. In this paper, I propose a method forencrypting a chemical formula of any medicine using graph operation.

Key words:Chemical formula, Drug, Encryption, Graph operation

I.INTRODUCTION

A pharmaceutical drug (also referred to as medicine, medication, or simply as drug) is a drug used to diagnose, cure, treat, or preventdisease. Drug therapy (pharmacotherapy) is an important part of the medical field and relies on the science of pharmacology for continual advancement and on pharmacy for appropriate management. Drugs are classified in various ways. One of the key divisions is by level of control, which distinguishes prescription drugs (those that a pharmacist dispenses only on the order of a physician, physician assistant, or qualified nurse) from over-the-counter drugs (those that consumers can order for themselves). Another key distinction is between traditional small-molecule drugs, usually derived from chemical synthesis, and biopharmaceuticals, which include recombinant proteins, vaccines, blood products used therapeutically (such as IVIG), gene therapy, monoclonal antibodies and cell therapy (for instance, stem-cell therapies). Other ways to classify medicines are by mode of action, route of administration, biological system affected, or therapeutic effects [1].

In cryptography, encryption is the process of encoding a message or information in such a way that only authorized parties can access it. Encryption does not itself prevent interference, but denies the intelligible content to a would-be interceptor. In an encryption scheme, the intended information or message, referred to as plaintext, is encrypted using an encryption algorithm, generating ciphertext that can only be read if decrypted. For technical reasons, an encryption scheme usually uses a pseudo-random encryption key generated by an algorithm. It is in principle possible to decrypt the message without possessing the key, but, for a well-designed encryption scheme, considerable computational resources and skills are required. An authorized recipient can easily decrypt the message with the key provided by the originator to recipients but not to unauthorized users [2].

The process of finding and developing new drugs is tremendously expensive and time consuming effort. Pharmaceutical companies have to make sure that only safe and effectual medications are released to the public.

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In [3], M. Yamuna et al. have provided a new method for encrypting any drug using binary periodic table. In 2015, M. Yamuna et al. have proposed a method for encrypting the molecular formula of any medicine [4]. In [5], B. Bazli et al. have proposed the use of chemical properties of the DNA sequences of the cipher text to encrypt data over the public channel to add key extension and complexity to the encryption algorithm.

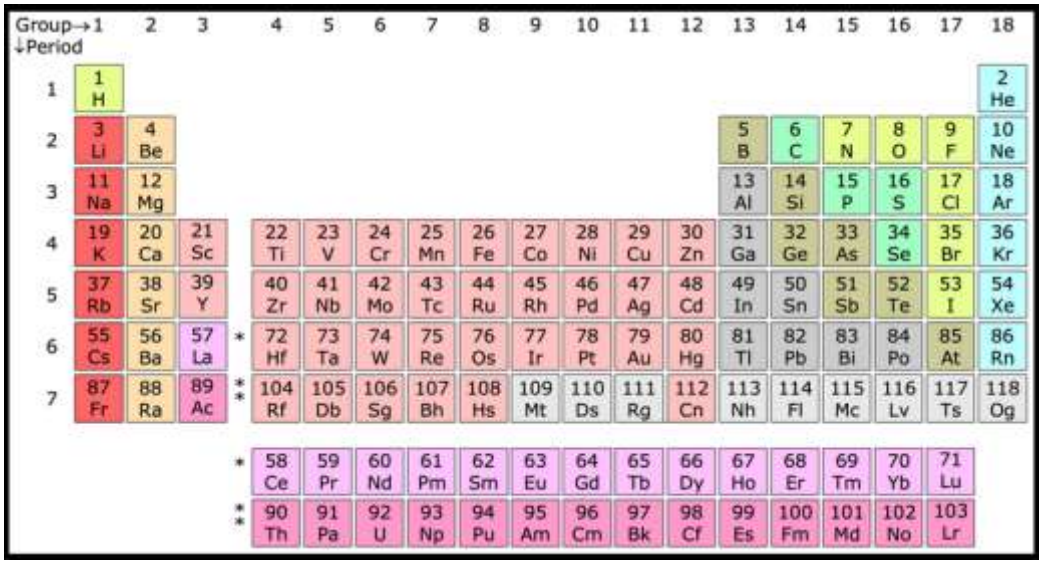
II.PRELIMINARIES

In this section, I have given some basic definitions which are required for the proposed method.

2.1 Periodic Table

The periodic table is a tabular arrangement of the chemical elements, ordered by their atomic number (number of protons), electron configurations, and recurring chemical properties. This ordering shows periodic trends, such as elements with similar behaviour in the same column. It also shows four rectangular blocks with some approximately similar chemical properties. In general, within one row (period) the elements are metals on the left, and non-metals on the right.

The rows of the table are called periods; the columns are called groups. Six groups have names as well as numbers: for example, group 17 elements are the halogens; and group 18, the noble gases. The periodic table can be used to derive relationships between the properties of the elements, and predict the properties of new elements yet to be discovered or synthesized. The periodic table provides a useful framework for analyzing chemical behaviour, and is widely used in chemistry and other sciences [6].The periodic table is as seen in Snapshot 1.



Snapshot 1

2.2 Graph

A graph G = (V, E) consists of a set of V = { v_1, v_2, … } called vertices and another set E = { e_1, e_2, … }, whose elements are called edges, such that each edge e_k is identified with an unordered pair (v_i v_j) of vertices.

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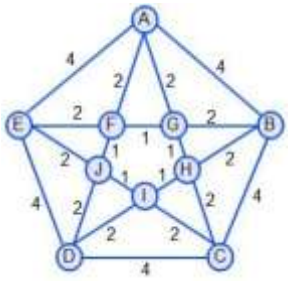
2.3 OpenNeighborhood

The open neighborhood N (v) of the vertex v consists of the set of vertices adjacent to v, that is N (v) = { u ∈ V (G) / (u v) ∈ E (G) }.

2.4 Weighted Graph

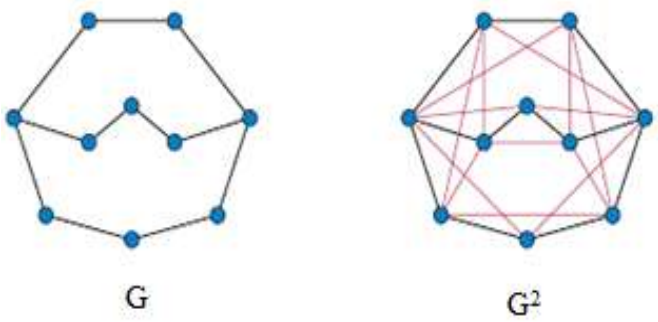
A graph G is a weighted graph if there is a real number associated with each edge of G [7].Snapshot 2 provides an example of weighted graph [8].



Snapshot 2

2.5 Power of a Graph

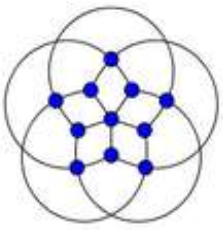
In graph theory, a branch of mathematics, the k^{th} powerG^k of an undirected graphG is another graph that has the same set of vertices, but in which two vertices are adjacent when their distance in G is at most k. Snapshot 3 provides an example of power of a graph [9].



Snapshot 3

2.6 Triangular Free Graph

A triangle free graph is an undirected graph in which no three vertices form a triangle of edges [10]. Snapshot 4 provides an example of power of a graph



Snapshot 4

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III.RESULTS AND DISCUSSIONS

In this paper, I propose the encryption scheme for transfer any medicine into a power of a graph G^2.

3.1 Graph Construction

Let G be any triangular free graph with n vertices and m edges. Let V (G) = { v_1, v_2, .., v_r } and E (G) = { e_1, e_2, …, e_s }. G^2 is another graph that has the same set of vertices, but in which two vertices are adjacent when their distance in G is at most 2.

3.2 Edge Weight

Choose a vertex v_1 from G. Assign the weights w_1, w_2, …, w_p to the edges (v_1v_i), where $v_i \in$ N (v_1) and taking care that while choosing v_i, i must be in increasing order.Similarly consider a vertex v_2 from G. Assign the weights w_{p+1}, w_{p+2}…, w_q to the edges (v_2v_j), where $v_j \in$ N (v_2), $j \neq i$ and jis in increasing order. Repeat this process for remaining vertices in G to generate a weighted graph.

3.3 Encryption Algorithm

Step 1. Consider any drug to be encoded. Let M be its chemical formula for this drug.

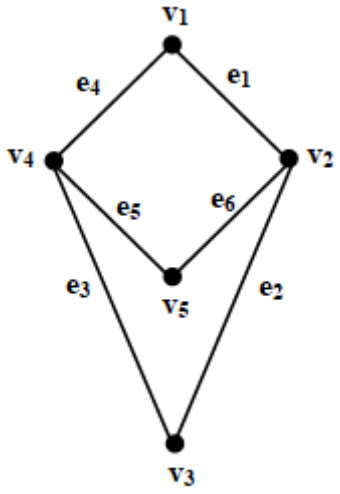
For our example, consider a chemical formula of **Aspirin** to be encrypted. Its chemical formula is **M: $C_9H_8O_4$**

Step 2. Using periodic table replace the chemical elements by its corresponding atomic number to obtain M1

For our example M1: **691884**.

Step 3. Consider any arbitrary graph with m edges (where m is number of elements in M1).

For our example, we consider a random graph with five vertices and six edges is as seen in Fig. 1.



G

Fig. 1

Step 4. Assign the weights w_1, w_2, …,$w_s$to the edges as discussed in Section 3.2.

For our example,

Vertex set = { v_1, v_2, v_3, v_4, v_5 }

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Edge set = { (v_1 v_2), (v_1 v_4), (v_2 v_3), (v_2 v_5), (v_3 v_4), (v_4 v_5) } = { e_1, e_2, e_3, e_4, e_5, e_6 }.

Edge weights W = { w_1, w_2, w_3, w_4, w_5, w_6 } = { 6, 9, 1, 8, 8, 4 }.

The graph is as seen in Fig. 2.

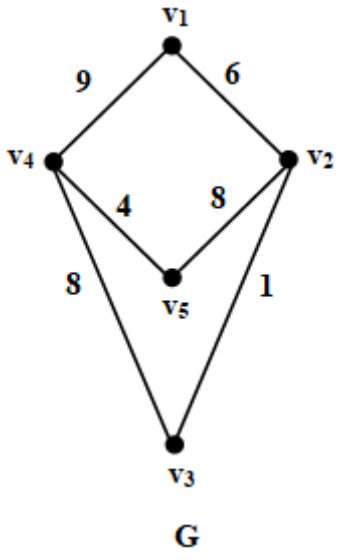

Fig. 2

Step 5. Construct the power of graph as discussed in Section 3.1to generate a graph G^2. Label the graph G^2 as H.

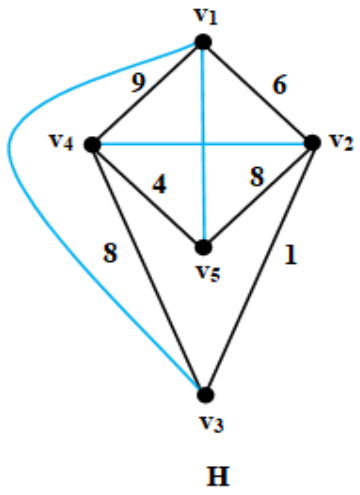

Fig. 3

Step 6. Assign arbitrary weights to the remaining edges in the graph, taking care thatthe weights should be greater thanw_k, where w_k is the largest value in W.

For our example 9 is the largest value, so assign some random numbers which are greater than 9 for remaining edges. The resulting graph is as seen in Fig. 4.

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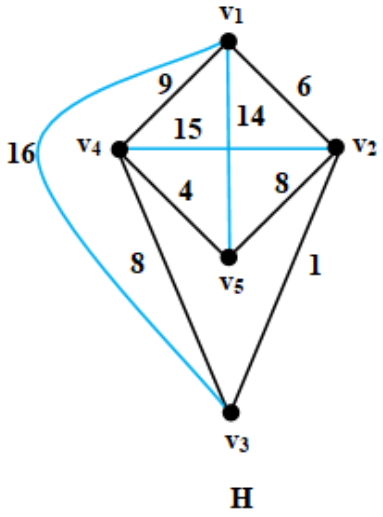


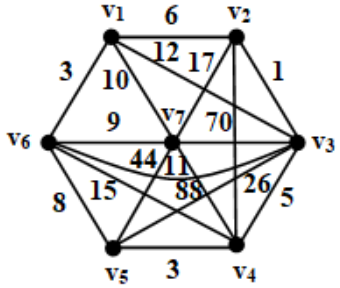
H

Fig. 4

Step 7. Send H to the receiver.

For decrypting the message we reverse the procedure.

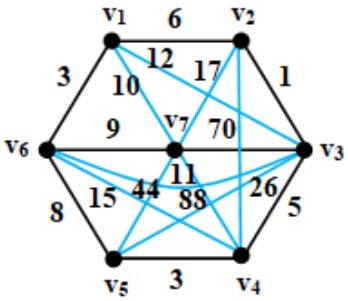
Suppose the received graph as seen in Fig. 5



H

Fig. 5

Consider any three vertices from H. If these vertices form a triangle, then remove one edge from H, whose edge weight is greater than the other two (for our example, they are highlighted in light blue colour). Repeat this process until we find a triangle free graph.



H

Fig. 6

Remove the light blue lines from H. The resulting graph is as seen in Fig. 7.

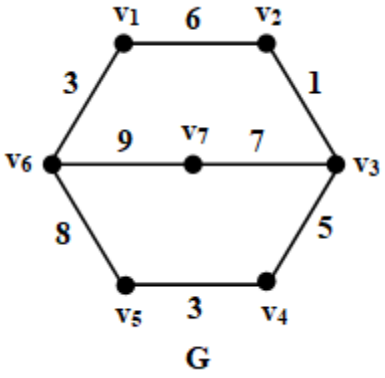


Fig. 7

Arrange the edge weights as discussed in Section 3.2.

M:6 3 1 5 7 3 8 9

Using periodic table convert the atomic numbers into its corresponding chemical element. Apply this for alternate numbers, we get the chemical formula **M:$C_3H_5N_3O_9$**.

M is the chemical formula for the medicine **Nitroglycerin**.

IV.CONCLUSION

In real life situation to promote drug revolution is most important both for enhancements in health care and for the future of organizations engaged in drug discovery research and its development. In this paper, graph operation is used for encrypting a given drug as a weighted graph. Numerous weighted graphs are available in public domain. Also it is too tedious to arrange the weights in some specific order. Unauthorized user cannot be able to decrypt the graph without knowing the secret key. The proposed method guarantees for safe transmission of drugs.

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