GRAPH THEORETIC TERMINOLOGIES IN COMMUNICATION NETWORK

Maghy S J[1] & Robinson Chelladurai [2]
[1] Research Scholar, Department of Mathematics, Scott Christian College (Autonomous), Nagercoil-629 003, Tamil Nadu, INDIA.
[2] Associate Professor, Department of Mathematics, Scott Christian College (Autonomous), Nagercoil-629 003,Tamil Nadu, INDIA.
Affiliated to Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli - 627 012, Tamil Nadu, INDIA.

Received: February 01, 2019 Accepted: March 14, 2019

ABSTRACT: *One of the significant domains in mathematics is graph theory which is used in structural models. Through this study author aimed to depict the role of different graph theoretic concepts which can be used in communication network problems This paper mainly concentrates on applications that uses graph coloring and graph labeling concept. This paper explains the applications of graph theory in various fields to some extent but primarily focused on the computer science applications. Since computer science is not a concrete centralized subject graph terminologies can be applied in many areas.*

Key Words: : *Graph Coloring, vertex cover algorithm, radio labeling.*

1. INTRODUCTION

The official birthday of graph theory is considered to be August 26, 1736 — the day Euler presented his historic paper proving the infeasibility of traversing Konigsberg's seven bridges, each exactly once. Network topologies can be modeled using graph concepts and several graph theoretic concepts can be utilized by computer science applications[1]. Particularly in research areas of computer science and electronic data transfer with help of digital network with advance computing concept such as data mining, image segmentation, clustering, image capturing, calculation of shortest path in networking etc., For example a data structure can be considered as in the form of hierarchical structure called tree which in turn utilized vertices and edges.In similar manner the most significant concept of graph coloring is utilized in resource scheduling and allocation. Also, circuits, paths, and walks in graph theory are used in remarkable applications like resource networking, traveling salesman problem, and database design concepts. This research paper demonstrates how graph theory can be utilized in different real world problems in communication network.

1.1 APPLICATION OF MAP COLORING IN GSM MOBILE PHONE NETWORKS

Groups Special Mobile (GSM) is a mobile phone network in which the geographical region of this network is separated into hexagonal regions or cells. Each and every cell has its own communication tower which connects with mobile phones within the cell. Every mobile phone connects to the GSM network by searching for cells in its neighbors. Since GSM works only in four different frequency ranges, and it is clear by the concept of graph theory that only four colors are capable to color the cellular regions. These four identical colors are used for proper coloring of the cellular regions. Therefore, the vertex coloring algorithm of graph theory may be used to assign at most four different frequencies for any GSM mobile phone network. The cells of a GSM mobile phone network is shown in figure 1.

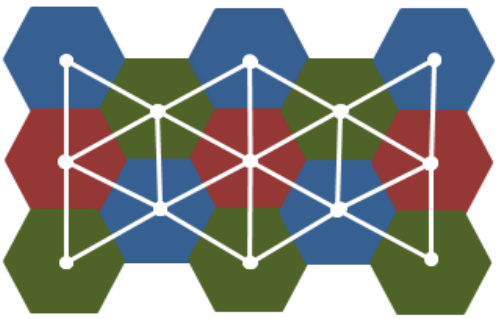

Fig : 1 The cells of a GSM mobile phone network

In Mobile phone network like Groups Special Mobile(GSM) the geographical area of the network is divided into hexagonal regions called cells. Mobile phones within the cell will be connected to communication tower that exist in that cell.

Now solve a real world problem by assigning GSM frequencies in India such that frequencies could not be overlapped. How can we assign the frequencies such that least number of frequencies can be used. Is this applicable to all the countries.

Construct a dual graph by putting vertices in the regions that shared boundaries. Use a single color for a state and never use the same color for two adjacent states. The dual graph is constructed by placing vertex inside each region of a map. The vertex inside two regions will be connected by an edge if those two regions have a common edge forming the boundary. The chromatic number of the dual graph gives the chromatic number of the original map. The vertex coloring of dual graph is same as the region coloring of the map. So the four color theory can be used in GSM network where four colors are the four frequency ranges in which the network operates. Map drawn on the plane uses a four color theorem to color the regions of a map properly using at most four distinct colors. The proper coloring should be such that no two adjacent regions are assigned the same color. The vertex coloring is used for the dual graph.

Figure 2 shows the dual graph constructed for the map and Figure 3 shows the map of India colored using four colors

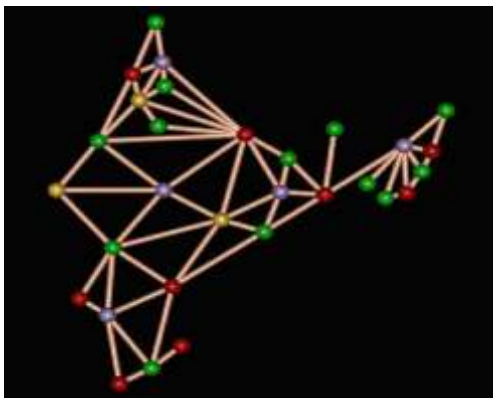

Fig 2. Dual graph of India Fig3.Mapof India

1.2 APPLICATION OF VERTEX COVER ALGORITHM IN COMPUTER NETWORK SECURITY

The main aim is to find a minimum vertex cover by considering the vertices as routing servers and edges as connection between routing servers. Thereby optimal solution can be found for worm propagation. The vertex cover algorithm for a graph G with n vertices labeled 1, 2, …, n, search for a vertex cover of size at most k. At each stage, if the vertex cover obtained has size at most k, then stop. Vertex cover algorithm is used to simulate the propagation of stealth worms on huge computer networks and drawing best strategies to protect the network in opposition to virus attacks in real time. Simulation was approved out in large internet like virtual network and showed that the topology routing has large impact on worm propagation. The significance of finding the worm propagation is to avoid them in real time. In a graph G, a set of edges g is said to cover G if every vertex in G is occurrence on at least one edge in g. The set of edges that covers a graph G is said to be an edge covering or a covering sub graph or simply a covering of G. Eg. A spanning tree of a connected graph is a covering. A Hamiltonian circuit is also a covering [5]. Figure 4 shows a simple computer network and a corresponding minimum vertex cover {2, 4, 5}.

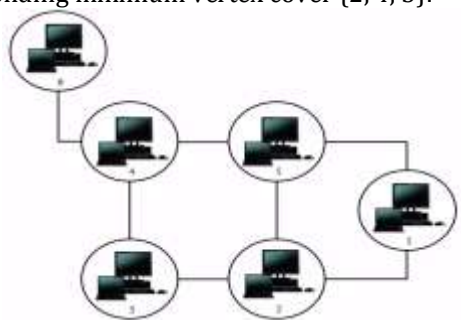

Fig 4. The vertex Set g ={2,4,5} covers all vertices in G.

1.3 INTERFERENCE REDUCTION AND FAST COMMUNICATION IN SENSOR NETWORKS USING RADIO LABELING.

Radio labeling is a labeling in which a channel is assigned to each station such that interference can be avoided. If the distance between the stations are smaller the the interference will be stronger.In radio labeling each node represent a transmitter. An edge is used connected two nodes if the two transmitters are adjacent. Radio labeling is connected graph defined as G (V, E). d(a,b) represents the distance between two vertices a and b in G. Diam(G) is the diameter of G is the maximum distance between any pair of vertices in G. A radio labeling or multilevel distance labeling for G is an injective function f: V (G) →N union {0} such that for any vertices u and v, |f (u) - f(v)| >= diam (G) -d (u, v) +1.To determine the time of communication in sensor networks Radio labeling is an effective tool.

Transmitting nodes influence the ability of other nodes to receive data. A node is not able to receive data from its neighbor if it was interfered by receiving a transmission not intended for it. This mutual disturbance of communication is called interference. Reducing interference in the network leads to fewer collisions and packet retransmissions, which indirectly reduces the power consumption and extends the lifetime of the network. Therefore, reducing the interference is an important goal for wireless networks. A potential negative impact on the performance of a wireless network is termed as interference.

In MANETs, each device can selectively decide which device to communicate with either by adjusting its transmission power or its antenna direction. Relatively limited direct neighbors is helpful to speed up the routing protocols in addition to possibly alleviating the interference among simultaneous transmissions, and also possibly save the energy consumption. So, we can conclude that the interference is a major drawback of wireless networks. The aim of reducing interference is to prevent adjacent or connected nodes, which are linked by radio signals, from receiving and transmitting signals which conflict or blend together. Whenever conflicting transmissions over one radio frequency are received by one or more nodes in a wireless network. the ability of the receiver to decipher incoming signals will inhibits. This concept is illustrated in Figure 5.

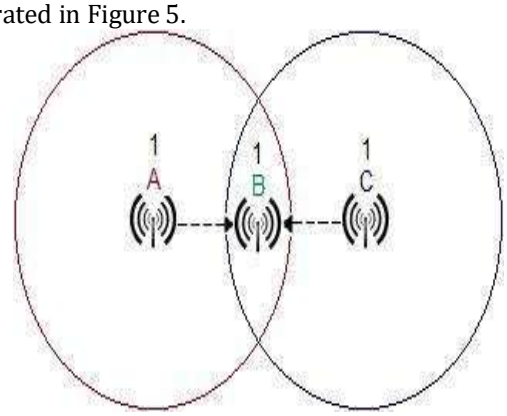

Fig : 5

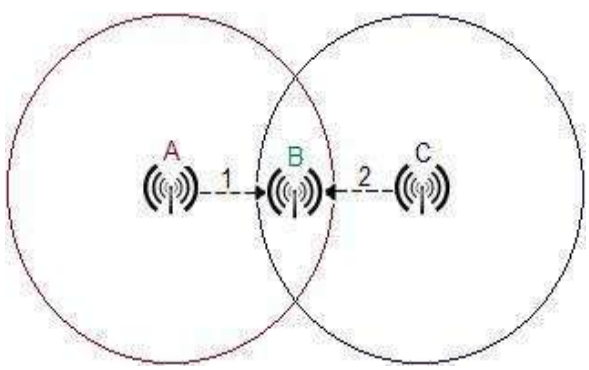

Fig : 6

Fig 5 shows a typical situation in which the broadcast areas of nodes A and C overlap in the vicinity of node B, causing B to receive a garbled signal composed of the signals from A and C. In such situations, it is difficult for B not only to decipher simultaneous signals, but also to reliably determine the source of the signal.

The problem of reducing interference in arbitrary networks turns out to be very difficult, and for this reason, simpler network layouts such as, multi-hop wireless mesh network layouts triangular lattice topologies unit disk graphs , hexagonal topologies and other more general topologies have been investigated . Other key facets of the interference problem in wireless networks specify whether a proposed solution is contrived in a distributed or centralized setting, whether nodes in a given solution are self-aware of their location or whether this assumption is not necessary, and whether or not minimum separation distance between nodes needs to be factored into algorithmic solutions. To avoid interference ,assign channels of different frequencies to interfering nodes or edges. In Figure5 ,simultaneous transmissions of A and C result in interference at B. This problem is resolved in Figure 6 by having nodes A and C transmit over frequencies 1 and 2 respectively, equipping node B with two radios that can transmit and receive over frequencies 1 and 2.

Signals from A and C can be demultiplexed or extracted from one signal at node B because of differing frequencies, and node B can clearly determine if node A transmits across frequency 1 or if node C transmits across frequency 2. Therefore the intersection node A and node C's broadcast areas no longer results in

interference. Thus we can conclude that Interference can be greatly reduced by careful assignment of communication channels to nodes in a network .

CONCLUSIONS

The important aim of this paper is to present the significance of graph theoretical ideas in a range of areas of compute applications for researches that they can implement theoretical concepts of graph in various research domains. An overview is presented particularly to project the multidisciplinary application of graph theory.

REFERENCES

1. Adam Schenker, Mark Last, horst Banke, Abraham andel," Clustering of Web documents using a graph model",Springer werlog, Septermber 2007.
2. M.Vasuki, Dinesh Kumar and R.Prabhakaran, A Study On GSM Mobile Phone Network in Graph Theory, International Journal of Current Research and Modern Education, 1(1), 772-783 (2016).
3. Perri Mehonen, Janne Riihijarvi, Marina Petrova, "Automatic Channel allocation for small wireless area networks using graph coloring algorithm approach", IEEE 2004
4. Daniel Marx, "Graph Coloring problems and their applications in scheduling",
5. Narasingh Deo, "Graph theory with applications to engineering and computer science", Prentice Hall of India, 1990.