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Comparative view on Phenomenon Mobility Prediction Using Virtual Force-Based Interest Driven Monitoring Scheme with FP Growth

Rakhi Narkhede[1], U. K. Thakur[2], L. H. Patil[3]

[1]MTech Student III Semester, Department of CSE, PIET, Nagpur

[2]Assistant Professor, Department of CSE, PIET, Nagpur

[3]Assistant Professor, Department of CSE, PIET, Nagpur

Abstract: ***In recent years, many new techniques have been introduced in Mobile Sensor Network. A new technique that is a monitoring scheme is developed for monitoring the moving phenomenon using virtual force called virtual force-based interest driven monitoring scheme. The scheme is evaluated in three variants: VirFID-LIB, VirFID-GHL and VirFID-IBN. All these three algorithms perform different action on the MSN to achieve the highest interest value. This monitoring scheme can be extended for prediction of the next movement of the phenomenon. It can be done by applying the User-Mobility Pattern algorithm followed by the Mobility Prediction algorithm. For the applying the UMP and MP algorithm, the required data must be extracted from the database. This will result in the prediction about the next possible move of the phenomenon.***

Keywords: Monitoring scheme, virtual force, interest value, distance, database, mobility pattern, prediction

1. Introduction

A mobile sensor network in which multiple sensor node co-operate with each other to achieve a common goal can be used in various areas such as disaster recovery, rescue missions, environmental monitoring, etc. In this paper, it is the study of use of group of mobile sensor nodes monitoring the moving phenomenon[1-2].

Mobile sensor nodes having sensing, computing, communication and locomotion capabilities can be developed for real-time hazards monitoring in a disaster area, which might not be accessible for humans. After deployment, MS nodes can autonomously localize, form an MSN, monitor the surroundings, and collect data on the phenomenon of interest without any human interaction.

As the phenomenon move, the mobile sensor relocates to follow the phenomenon. More specifically, the distribution of the mobile sensor nodes at time t_1 differs from the distribution at time t_0. Mobile sensor nodes move to new position where they can closely observe the phenomenon.

In [3] a novel monitoring scheme named Virtual Force-based Interest Driven Monitoring Scheme is proposed to monitor the moving phenomenon. In this scheme, every node decides its movement using the virtual force based on the difference among the sensed value and the distance among the mobile sensor nodes. MS nodes perform network-wise sharing of information to achieve the optimal distribution of MS nodes.

Depending on the level of information usage, three types of VirFID scheme are considered, which are VirFID-LIB (Local Information-Based), VirFID-GHL (Global Highest and Lowest), and VirFID-IBN (Interests at Boundary Nodes).

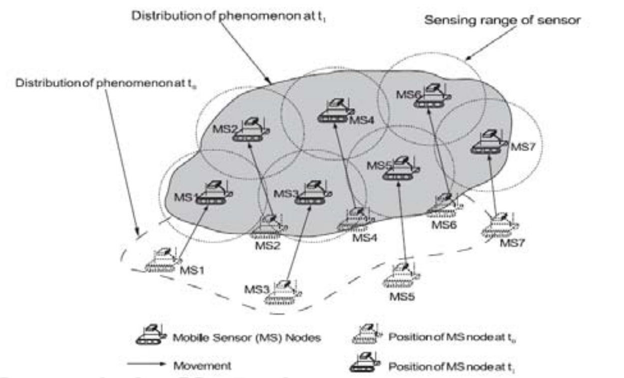

Figure 1: Moving phenomenon monitoring using MS nodes

VirFID-LIB uses only local neighborhood information to determine the movements of MS nodes, based on the distance from neighboring MS nodes and the difference in interest values with adjacent MS nodes.

On the other hand, in addition to the local neighborhood information, the other two schemes i.e. VirFID-GHL and VirFID-IBN share global information on MS node interest values.

2. Proposed System Model

The proposed system is about the use of the virtual force-based interest driven monitoring scheme to monitor the moving phenomenon and to predict their next movement. All work will be simulation. Simulation of implementation of all applied algorithms. The model is divided in to five modules. First module is the network formation. Second module is to apply the three VirFID algorithms. Third module is the creation of database. Forth module is to apply the user-mobility pattern algorithm. And last i.e. fifth module is the implementation of mobility prediction algorithm.

3. Formation of Network

- The network used here is the MANET.
- Network is divided into 4 regions.
- Each region is having its own dataset.
- Network consists of 30 nodes.

The reason behind dividing the network into 4 regions is to get the moving direction of the node i.e. North, South, East or West. Every region is having its boundary value. At first the nodes in the network are deployed within the region boundary.

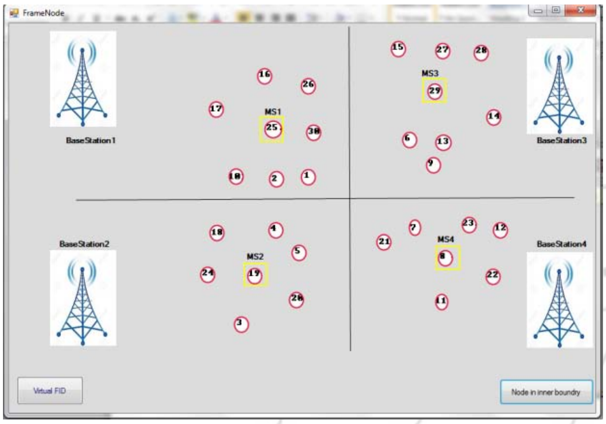

Figure 2: MSN network having 4 regions and 30 nodes

4. Implementation of Vir-FID algorithms:

There are three Vir-FID algorithms. Working of all three algorithms is based on information sharing on local and global basis.

i. Local Information Based Algorithm

In VirFID-LIB, nodes communicate with other through messages. A *Hello* message is transmitted periodically, which consist of the current position of the node and its interest value. After receiving this message each node updates its list and based on this local information, nodes calculate the virtual force acting on itself to determine its movement.

In VirFID-LIB, consist of calculating the distance of all nodes (moving phenomenon) from the mobile sensor node (of respective region). It calculates the distance of every neighboring node in its region.Euclidian distance formula is used to calculate the distance.

$$\mathrm{d}(\mathbf{p},\mathbf{q}) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2}.$$

In VirFID-LIB, to determine the movement each node uses only the local information. Due to the use of local information only, nodes in VirFID-LIB cannot adjust their position to explore uncovered region.

ii. Global Highest Lowest Algorithm:

In this algorithm, information is shared globally. This algorithm calculates the angle of the movement of the nodes.

The network is divided into 4 regions for this purpose only. With the help of the boundary of each region, it becomes easy to calculate the direction of the movement of nodes.To calculate the direction of movement of the node, angle of movement is needed.

It is also implemented to find out the nodes in the boundary range. Their distance from the boundary range is also calculated. The nodes which are near to boundary or on the boundary are forced to move inside the region.

iii. Interests at Boundary Nodes Algorithm:

In VirFID-IBN, attempts to assign the same interest values to all boundary nodes in order to achieve an optimal deployment. Interest values of boundary nodes in the network are collected first. Mean interest value of the boundary nodes is calculated and published to all nodes.

This algorithm is implemented on the nodes to get the exact position of the nodes in their respective regions. In this algorithm, the output shows the (x, y) location of nodes and boundary. Depending on this value, it is decided whether the node in within the boundary or outside the boundary.

The movements of MS nodes under VirFID are determined based on the sum of virtual forces. In VirFID-IBN, the convergence of global information is not required. It is allowed that at a specific time instance, the nodes in the network are having different information than the other nodes, depending upon their relative positions. Nodes update their movements at every time period t_m.

5. Collection of Data

Collection of data is the creation of database. For the purpose of prediction it is necessary to have more than one movement of every node. The goal of this proposed system is to get the prediction about the movement of the nodes. To get the prediction about anything on the basis of its history need to have that much data in the database

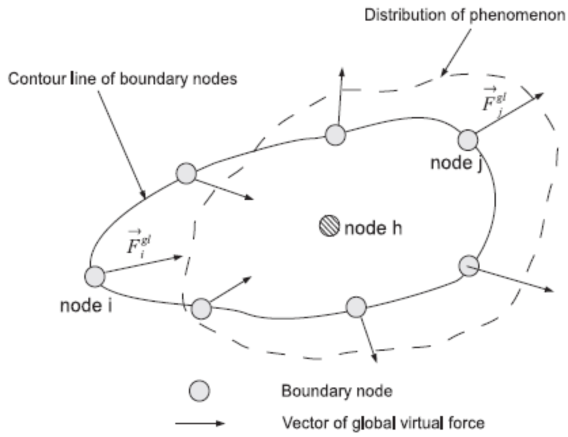

Figure 3: An example of operation of VirFID-IBN algorithm.

For this proposed system, in order to get the prediction about the nodes, two transaction of movements is been done. All three VirFID algorithms are applied twice to all the nodes in the network. After getting the desired output of all the three algorithms, it is stored in the database.

6. Implementation of UMP Mining Algorithm

UMP mining algorithm is a frequent pattern mining algorithm. This algorithm is used here because we need to find out the pattern of movement of the nodes in the WSN network. This phase of pattern mining is included because we need to predict about the movement of the nodes. In order to get the perfect or exact results, we must study its history. Thus, this mining algorithm helps us to get exact required data.

In the process of mining the required exact data a dataset is created. In this dataset pairs are formed of nodes, angle, moving directions and directions with the help of confidence value. Nodes are the numbers of nodes present in the network, angles are the angle by which the node moves. Moving direction are the 8 directions i.e. North, South, East, West, North-East, North-West, South-East and South-West and the directions are Up and Down.`

Confidence value is calculated with the help of support count value. Support count value is the frequency of the occurrence of the respective pair.

$$Supportcount = \begin{cases} 1 \\ 0 \end{cases}$$

$$Confidencevalue = \left[\frac{SupportCount\ of Pair}{SupportCountof\ 1stElement} \right] * 100$$

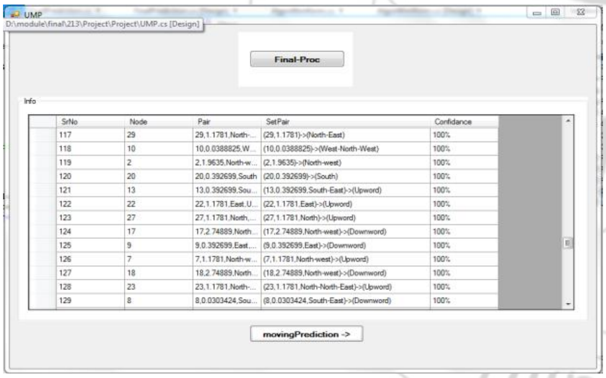

Figure 4: Result of UMP mining Algorithm showing pairs of all 4 parameters

The support count and confidence value is used to create rules for the extraction of data. Thus, UMP mining algorithm helps us to get the exact required data for the specific nodes prediction.

FPGrowth algorithm is also a data mining algorithm preferred now a day. But there are few cases where efficiency of FPGrowth does not give out the best expected result. FPGrowth is efficient because the time taken by this algorithm to mine the data is very less as compared to other mining algorithms.

FPGrowth algorithm, mines the data from database in a tree like structure. It compresses the input database creating an FP-tree instance to represent frequent items. After this, it divides the compressed database into a set of conditional databases, each one associated with one frequent pattern. Finally, each such database is mined separately. Using this strategy, the FP-Growth reduces the search costs looking for short patterns recursively and then concatenating them in the long frequent patterns, offering good selectivity.

Prediction can be done only when more amounts of data is studied. UMP algorithm, gives more number of or more data of extracted frequent patterns as compared to FPGrowth algorithm. So, here UMP algorithm is more appropriate than FPGrowth.

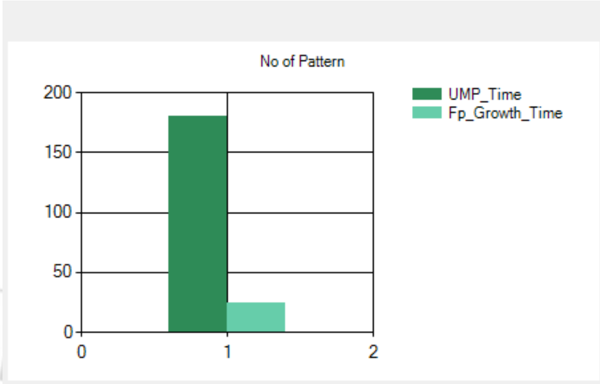

Figure 5: Number of patterns extracted using UMP algorithm and FPGrowth algorithm.

7. Prediction of Node

Prediction of the node in the WSN is calculated on the basis of the data mined from the database. The information gathered in the dataset is used for prediction calculation.

In this paper, algorithm used for prediction of the nodes is the Mobility Prediction Algorithm. Working of this algorithm is dependent of the data extracted from the dataset. On the basis of the rules and the confidence value the algorithm calculates the probable next movement of the node.

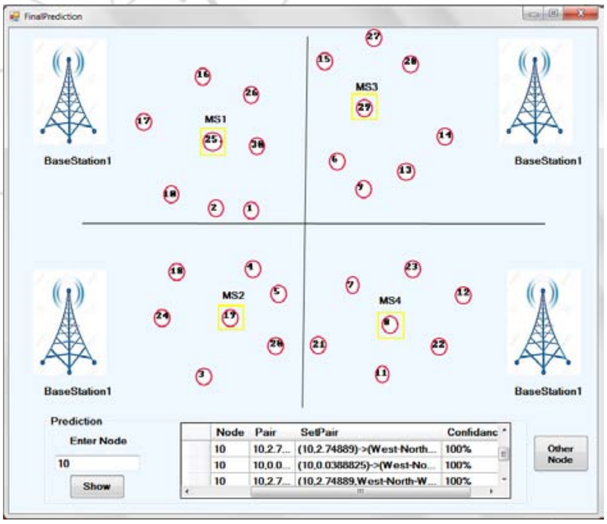

Figure 6: Prediction shown about the required node

In the above figure, it works as you enter the node number and ask for prediction it will show you the predicted result in the small box and the entire network will move. Thus, we can see the result of the prediction algorithm.

In the above figure results, it allows you to see the prediction of nodes as many number of times and as many number of nodes. Every time it will show the prediction and will move the entire network to show the movement of the node. But the prediction does not predict the region of the node if while moving it will enter the other region or will remain in the same region.

8. Conclusion

Using the Virtual Force-based Interest Driven Monitoring Scheme algorithms, it is possible to monitor the moving phenomenon. It becomes quite easy to get the position of nodes in the respective region. All this transaction of the movement of nodes can be stored in the database.

All the three algorithms show different result of distance, angle, boundary nodes, boundaryvalues respectively. All the results are stored in a database.

User Mobility Pattern algorithm is applied to this database to extract the exact required data. A dataset is created which holds the extracted data. UMP algorithm not only extracts the data from database but also creates rules and applies it to the data for better results.

Mobility Prediction algorithm, is used for the prediction of movement of nodes in the network. The result of prediction algorithm shows the angle, moving direction and direction for the respective node. All these calculations are done with the help of rules. Rules are generated on the basis of support count and the confidence value.

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