EXTRACTION OF BEHAVIORAL PATTERNS IN WIRELESS SENSOR NETWORK

[1]P. Tejaswi, [2]Dr. Uma N Dulhare, [3]Maniza Hijab
[1]Student, [2]Professor, [3]Associate Professor
Email: [1]tejupuligilla@gmail.com, [2]uma.dulhare@mjcollege.ac.in, [3]hijabmaniza@gmail.com

Abstract— Wireless Sensor Networks produce large scale of data in the form of streams. By using Association Rule Mining, the sensor data provides useful information for different applications. The main goal of this approach is to determine behavioral patterns which are generate rules to improve the WASN's quality of service, energy conservation, resource management. In this paper, we propose a mechanism in such a way that sensor sends only frequent sensor pattern to the sink.

Index Terms—Association Rule, Behavioral Pattern, Wireless sensor network

I. INTRODUCTION

A wireless sensor network is a collection of nodes organized into a cooperative network. It consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location predefined as central node called sink in multi-hop mode of transmission[2][3]. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance, today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on. They have the capability of sensing, processing and transmitting. The technology promises to revolutionize the way we live, work and interact with physical environment.

Problems in WSN: Not only the unreliable wireless communication, the node of WSN have to work with limited resources such as limited energy, limited processing capacity, limited storage, limited memory, limited communication capacity, etc. So, WSN suffers from lot of problems such as lost messages, delay in data delivery, loss of data, data redundancy, etc., resulting in poor quality of service[7].

Recently , the knowledge discovery process, which is a well known process in traditional database systems used to extract patterns from data, has shown to be a promising tool to improve WSN performance and its QoS. Knowledge discovery in WSN (KDW) has been used to extract the following two types of information (knowledge): first is, patterns about the surrounding environment, which are extracted from the data reported by sensor nodes, and the second is, behavioral patterns about sensor nodes, which are extracted from meta-data describing sensor‟s behaviors[5]. And also due to generation of large amount of data, data mining techniques used to reduce the amount of computation required to preserve energy to enhance the life of sensors[6].

Rest of the paper is organized as follows : Section II presents preliminaries. Section III presents Methodology for association rule mining algorithm in WSN. This paper is concluded in Section IV.

II. PRELIMINARIES

Notations for Sensor association rules can be derived based upon the definition of association rules proposed in the domain of transactional databases. It can be represented as follow:

Let S= (s1, s2. . . sn) be a set of sensors in a particular sensor network. Let assume that the time is divided into equal-sized slots (t1, t2 . . . tn) such that ti+1 – ti =ɽ for all 1 < i < n, where ɽ is the size of each time slot, and T = tn - t1

Represents the historical period of the behavioral data defined during the data extraction process.

Sensor association rules find the temporal relationship between the sensor nodes. eg: (s1, s2) -> (s3, s4), 75%,λ. This rule states that if events are received from the sensor nodes s1, s2, then there is a 75 % chance of receiving the events from the sensor nodes s3, s4 in the λ units of time. We use Apriori algorithm for finding the frequent patterns in the sensor data.

A set P = (s1, s2 . . . sk) S as a pattern of sensors is referred. Given a database DS of epochs

TS	EPOCH
1	S1,s2,s4
2	S1,s3,s4
3	S2,s3

Table I : Database of Epochs Ts :Time, S:Sensors

III .METHODOLOGY

1) First we have to collect the data from different sensor nodes. Here every sensor node has its own sensed data.

2) After collecting the data we need to make sensor association rules by using association rule mining mechanism in which we can find the temporal relationships between the sensor nodes.

3) After that we have to do the classification of data by using those rules .

4) Then we have to compare them with other sensor nodes so that we can find the frequent sensor patterns.

Algorithm for Sink Node

- Broadcast parameters (T_his,l, min_ sup);
- Upon receiving all messages;
- For Slot Number = 1 to (T_his/l);
- P=the set of the sensors' identifiers within; the same time slot;
- E = (slot Number;P);
- Insert (E, DS);
- End {for}

Algorithm for sensor node:

- Upon receiving mining parameters;
- Slot Number = 1;
- Time=current time;
- Reported = False;
- If (current time £ Time + (Slot Number *l)
- If ((there is a detected event)
- Set buffer [slot number];
- End [if]
- Else
- Slot Number ++;
- End {if}
- End {while}
- If (number of set bits = min sup)
- List = list of time slots that have set bits;
- M= (Sensor ID, List);
- Send M to the Sink;

The total nodes are going to be created in the network…(N1,N2,N3,N4,N5,…N10).Once the network created then the Current team leaders are changing randomly and every node is sending the buffer with the size, like it shows in the Generated Buffer(1,0,0,0,0,0,0) and(0,1,1,1,1,0,1)etc….After every node generated the buffer then each and every node check for the frequent sensor patterns here for N9&N4 nodes.After successfully finding frequent sensor patterns then the sensor patterns are sent to Sink Node. At the Sink Node side the sensor patterns are received from some of the sensor nodes only like shown in the below .

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Sink Node Activated

Total Active Sensors Are 10

Query received from frequent sensor patterns

N9 : 0,1,1,1,1,1,1 : 16 : 2014-05-20 13:40:42.984
N4 : 0,0,1,1,1,1,1 : 2 : 2014-05-20 13:40:43.984
N2 : 0,0,1,1,1,1,0 : 11 : 2014-05-20 13:40:45.984
N6 : 0,1,1,0,0,1,1 : 14 : 2014-05-20 13:40:46.984
N10 : 1,0,1,0,0,1,0 : 3 : 2014-05-20 13:40:48.984
Total Active Sensors Are 10

Query received from frequent sensor patterns

N2 : 1,1,1,1,1,1,1 : 15 : 2014-05-20 13:46:36.125
N5 : 0,1,0,1,1,1,1 : 18 : 2014-05-20 13:46:37.125
N6 : 1,1,1,1,1,0,0 : 11 : 2014-05-20 13:46:38.125
N4 : 1,0,1,1,0,1,0 : 2 : 2014-05-20 13:46:39.125
N10 : 1,1,1,0,0,0,1 : 3 : 2014-05-20 13:46:40.125
N8 : 0,1,1,0,0,0,1 : 5 : 2014-05-20 13:46:42.125
N9 : 0,0,0,1,1,1,0 : 6 : 2014-05-20 13:46:43.125
Total Active Sensors Are 10

Query received from frequent sensor patterns

N6 : 1,1,1,1,1,1,1 : 4 : 2014-05-20 14:25:57.343
N3 : 1,1,1,1,1,0,1 : 7 : 2014-05-20 14:25:58.343
N10 : 1,1,1,1,1,0,1 : 18 : 2014-05-20 14:25:59.343
N2 : 1,1,1,0,1,0,0 : 14 : 2014-05-20 14:26:00.343
N4 : 0,1,1,0,0,1,1 : 2 : 2014-05-20 14:26:01.343
N7 : 0,1,1,0,0,1,0 : 10 : 2014-05-20 14:26:03.343
N8 : 1,1,1,0,0,0,0 : 8 : 2014-05-20 14:26:04.343
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IV. CONCLUSION

In this work , the sensors send only the frequent sensor patterns to the sink, not the sensor‟s complete activity sets. Due to find frequent sensor patterns in the sensors themselves. Although this work reduces redundancies in the messages to be sent to the sink, it put extra load on the
Individual sensor node and it requires extra memory in each sensor node to store the information to calculate the
frequent sensor

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