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RERIMS : Robust and Efficient Railway Industry Monitoring System in Wireless Sensor Network

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ABSTRACT

The new technologies allow vast numbers of distributed sensors to be networked to constantly monitor machines, systems, and environments. Wireless sensor networks (WSNs) are wireless networks of spatially distributed and autonomous devices. In this proposed work, we used a novel framework for Railway Industry Monitoring process, the scheme called RERIMS – WSN as Robust and Efficient Railway Industry Monitoring System by using Firefly algorithm for clustering and Opportunistic Routing for reliable data sharing in Wireless Sensor Network. Here we used different sensor for monitoring systems and data communications in network. The collected information is also sending to the database. The admin will access the material which is server. This is present in the train next to the driver and also sends to the main control station. In our experimental result, we can achieve efficient data transmission, reduced delay, reduced energy consumption, improved packet delivery ratio and network lifetime and also to avoid the railway fortunes and rally security and reliability.
Keywords : Wireless Sensor Networks, Clustering, Firefly Algorithm, AODV, DSR.

I. INTRODUCTION

In sixteenth century, the rail was first utilized as a supporting and guiding structure. At that time, wooden roadways were used in England. In 1800, the first free bearing rails were applied which were supported at the ends by cast iron sockets on wooden sleepers. Railways are very large infrastructures and primary means of transportation in many countries. High risk is involved in railways in terms of human lives and cost of assets as it is used for passenger and cargo transportation. Advanced technologies and better safety methods are being constantly introduced but still accidents do occur. Risks associated with derailments and collisions are always there but can be reduced by detailed research of the root causes. A proper maintenance strategy is required to govern optimization of inspection frequency and/or improvement in skill and efficiency. The major issue is to detect and rectify the rail defects. Some of the defects include internal defects, weld problems, worn out rails, corrugations and rolling contact fatigue (RCF) initiated problems such as surface cracks, head checks, squats, spelling and shelling. These defects can cause rail breaks and derailments if not detected and/or not treated. Due to the development in wireless communications and in MEMS (Micro Electromechanically Systems) technologies, lower – power consumption and low cost wireless micro sensors have been developed that possess sensing, signal processing and wireless communication capabilities. A base station aggregates and summarizes the collected data and sends these to a user or to a Remote host. Since sensor nodes obtain power from small disposable batteries, they have limited power available for communication which limits its transmission range. A sensor node can therefore, communicate only with the sensor nodes that lie within a small distance from it. A sink has the responsibility of data collection and decision making which can be manual or automatic.

In this proposed work, The sensor nodes deployed in wireless sensor networks are extremely power constrained, and hence maximizing the lifetime of the entire networks is mainly considered in the design. An energy efficient clustering algorithm with optimum parameters is designed for reducing the energy consumption and prolonging the system lifetime. Here we introduce a novel framework,Robust and Efficient Transmission Mechanism with Firefly algorithm and also present a Cluster key Management for secure transmission in WSN. A Firefly Algorithm (FA) is a recent nature inspired optimization algorithm that simulates the flash pattern and characteristics of fireflies. Clustering is a popular data analysis technique to identify homogeneous groups of objects based on the values of their attributes.

Firefly algorithm is a swarm based algorithm used for solving optimization of wireless sensor parameters. This Research focused on approach using firefly algorithm to cluster data. The firefly algorithm can be used to find the centroid of the user specified number of clusters. We use the firefly algorithm to find initial optimal cluster centroid and then optimized centroid to refined them and improve clustering accuracy.

The protocol also supports efficient key revocation for compromised nodes and minimizes the impact of a node compromise on the security of other communication links. A security analysis of our scheme shows that our protocol is effective in data sharing.

II. DESIGN

Wireless sensor networks (WSNs) are increasingly being envisioned for collecting data, such as physical or environmental properties, from a geographical region of interest. WSNs are composed of a large number of low cost sensor nodes, which are powered by portable power sources, e.g. batteries.

The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding. In computer science and telecommunications, wireless sensor networks are an active research area with numerous workshops and conferences arranged each year, for example IPSN, SenSys, and EWSN.

We used a novel framework for Railway Industry Monitoring process, the scheme called RERIMS – WSN as Robust and Efficient Railway Industry Monitoring System by using Firefly algorithm for clustering and Opportunistic Routing for reliable data sharing in Wireless Sensor Network. Here we used different sensor for monitoring systems and data communications in network. In this work we used Acoustic Emission sensor is used detect and analyse the railway track, piezoelectric sensor is used to measure strain,pressure,vibrations and shocks and also monitor any displacement on the wheel surface to identify wheel defects,wind pressure sensor is used to monitor the brakes and temperature sensor is used to monitor the air temperature. The collected information is also sending to the database. The admin will access the material which is server. In this module used to initialize the nodes in network topology. We used network topology and topography for our network animator window (nam window). We have syntax for create nodes in network animator window. Then we can create nodes in two types like random and fixed motions.

In random motion we fixed range for X and Y, fixed particular range then the nodes are randomly generate in that range of nam window. In fixed motion we give X and Y dimension position for all nodes then all the nodes are fixed in that particular dimension. Sensor nodes are aware of their own positions. The position information may be based on a global or a local geographic coordinate system defined according to the deployment area. Determining the position of the nodes might be achieved using a Satellite based positioning system such as global positioning system (GPS) or one of the energy-efficient localization methods proposed specifically for WSNs. Every sensor node should be aware of the position of its neighbors. This information enables greedy geographic routing and can be obtained by a simple neighbor discovery protocol. The coordinates of a network center point has to be commonly known by all sensor nodes. The network center does not have to be exact and can be loaded into the sensors' memories before deployment. The ring structure encapsulates the network center at all times, which allows access to the ring by regular nodes and the sink.

III. IMPLEMENTATION

Initialization:

In this module used to initialize the nodes in network topology. We used network topology and topography for our network animator window (nam window). We have syntax for create nodes in network animator window. Then we can create nodes in two types like random and fixed motions.

Neighbours selection:

In traditional multihop routing paradigm, only one neighbor is selected to act as a next-hop forwarder. If the link to this neighbor is not performing well, a packet may be lost even though other neighbor may have overheard it. In opportunistic routing, taking advantage of the shared transmission medium, each packet is broadcast to a forwarding set composed of several neighbors. The packet will be retransmitted only if none of the neighbors in the set receive it. Opportunistic routing has advantages and disadvantages that impact on the network performance. OR reduces the number of possible retransmissions the energy cost involved in those retransmissions, and help to decrease the amount of possible collisions. However, as the neighboring nodes should wait for the time needed to the packet reaches the furthest node in the forwarding set, OR leads to a high end-to-end latency

Clustering scheme:

Firefly algorithm is based upon idealizing the flashing characteristic of fireflies. The idealized three rules are, All fireflies are considered as unisex and irrespective of the sex one firefly is attracted to other fireflies. i)Distance calculation: The distance between any two fireflies i and j at xi and xj respectively, the Cartesian distance is determined by equation where xi, k is the kth component of the spatial coordinate xi of the i th firefly and d is the number of dimensions. ii)Attractiveness: In the Firefly algorithm, there are two important issues: the variation of the light intensity and the formulation of the attractiveness. We know, the light intensity varies according to the inverse square law.

Routing and Data sharing:

After computing the forwarding set, the current forwarder node includes the address of the next-hop forwarder nodes in the packet and then broadcast it. Each, node that has correctly received the packet, verifies if it is a next-hop forwarder and then sets the timer to broadcast itaccording to its priority. The greater the priority of the node is, the shorter is its waiting time. The packet will be discarded by the nodes that are not listed as the next-hop forwarder. In opportunistic routing, the highest priority node becomes a next-hop forwarder and the rest of the lower priority nodes transmit the packet only if the highest priority node fails to do so. The lower priority nodes suppress their transmissions after listening the data packet transmission of the next-hop forwarder.

IV. PROTOCOL AND SYSTEM DESCRIPTIONS

Firefly algorithm was followed three idealize rules, 1) Fireflies are attracted toward each other regardless of gender. 2) The attractiveness of the fireflies is correlative with the brightness of the fireflies, thus the less attractive firefly will move forward to the more attractive firefly. 3) The brightness of fireflies is depends on the objective function.

Pseudo code for Firefly Algorithm

1. Objective function of f(x),
2. Generate initial population of fireflies;
3. Formulate light intensity I;
4. Define absorption coefficient γ;
5. While (t Ii), move firefly i towards j;
6. For i = 1 to n (all n fireflies);
7. For j=1 to n (all n fireflies)
8. If (Ij> Ii), move firefly i towards j;
9. end if
10. Evaluate new solutions and update light intensity;
11. End for j;
12. End for i;
13. Rank the fireflies and find the current best;
14. End while;
15. Post process results and visualization;
16. End procedure

AD HOC ON-DEMAND DISTANCE VECTOR (AODV)

AODV is essentially a combination of both DSR and DSDV. It borrows the basic on-demand mechanism of Route Discovery and Route Maintenance from DSR, plus the use of hop-by-hop routing, sequence numbers, and periodic beacons from DSDV.

Basic Mechanisms: When a node S needs a route to some destination D, it broadcasts a ROUTE REQUEST message to its neighbors, including the last known sequence number for that destination. The ROUTE

REQUEST is flooded in a controlled manner through the network until it reaches a node that has a route to the destination. Each node that forwards the ROUTE REQUEST creates a reverse route for itself back to node S. When the ROUTE REQUEST reaches a node with a route to D, that node generates a ROUTE REPL Y that contains the number of hops necessary to reach D and the sequence number for D most recently seen by the node generating the REPLY. Each node that participates in forwarding this REPLY back toward the originator of the ROUTE REQUEST (node S), creates a forward route to D. The state created in each node along the path from S to D is hop-by-hop state; that is, each node remembers only the next hop and not the entire route, as would be done in source routing.

DISTANCE SEQUENCED ROUTING PROTOCOL:

The DSR protocol is composed of two mechanisms that work together to allow the discovery and maintenance of source routes in the ad hoc network: Route Discovery is the mechanism by which a node S wishing to send a packet to a destination node D obtains a source route to D. Route Discovery is used only when S attempts to send a packet to D and does not already know a route to D. Route Maintenance is the mechanism by which node S is able to detect, while using a source route to D, if the network topology has changed such that it can no longer use its route to D because a link along the route no longer works. When Route Maintenance indicates a source route is broken, S can attempt to use any other route it happens to know to D, or can invoke Route Discovery again to find a new route. Route Maintenance is used only when S is actually sending packets to D. Route Discovery and Route Maintenance each operate entirely on demand. In particular, unlike other protocols, DSR requires no periodic packets of any kind at any level within the network.

V. RAIL DEFECT DETECTION SENSORS

Acoustic emission sensors is used to detect and analyse cracks in the railway tracks.AE sensors are high frequency, passive piezo electric transducers. AEs are transient elastic waves generated when there is a sudden release of strain energy within a material. for example the energy released by active fatigue cracks when an external force is applied. these are detect sound waves while filtering out noise. AEs are able to detect internal damage within structures where cracks are growing.

Piezoelectric sensors generate a signal when the piezoelectric material is compressed.They are used to measure strain, pressure, vibrations and shocks and it can be used to monitor any displacement on the wheels surface to identify wheel defects.

Wind pressure sensors is used to monitor the rail braks. Temperature sensors are used to monitor the temperature of the air atmosphere.

VI. RESULTS & CONCLUSION

Wireless sensor networking techniques, due to their versatility, play an important role in railway monitoring systems.There are currently only few proposals using WSN in railway monitoring, including track / tunnel monitoring systems,security monitoring systems, and secure railway operationsystems. These new technologies give a new direction to the development of railway infrastructure, and communication and signalling systems to ensure safe and secure operation of rail transport. This article presents a handy survey of wireless applications in the rail industry. Most of the solutions are adopted from the traditional single-hop wireless techniques. Application of multi-hop wireless techniques such as WSN in this industry has just emerged and our future work will explore this technology in further details.

VII. REFERENCES

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