Secured Data with Enhanced Lifespan for Wireless Multimedia Sensor Networks

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Abstract— In wireless sensor network energy cutback is considered as a principle intensive challenge which is studied largely in the Wireless Sensor Networks (WSN) literature. On the other hand introduction of audio video streaming in wireless architecture reveals additional challenges. The image and video transmission not only demands for energy efficiency but also requires Quality of Service (QoS) assurance to ensure for the utilization of sensor resource as well as the reliability of information model. More over redundant statistics can be supplemented with streaming sequence for enhancing tracking accuracy. This paper proposes a Distributed Predictive Tracking and Verification Algorithm (DPTVA) which provides an improved to subdue existing conundrum in the streaming world. This protocol sense and categorize the level grades of sensor nodes and set nodes in a particular path to active mode and left over in sleep mode thus Predictive tracking algorithm consequences in superior energy consumption for sensing layers. Compared to classic Image Transmission Protocol and the traditional distributed predictive tracking and verification algorithm, this new algorithm has superior meeting and provides appreciably better QoS by ensuring 20% to 80% better efficiency with privileged security for manifold types of services in wireless multimedia sensor networks.

Keywords— Data security, distributed predictive tracking, energy preservation, verification algorithm, wireless multimedia sensor network.

I. INTRODUCTION

Recently due to the advancement in image sensors [8, 6], there is a growing awareness in visual wireless sensor networks for a multiplicity of applications. Target tracking active monitoring and remote surveillance also plays an essential role in wireless sensor applications. Nevertheless, wireless sensor networks sham a great dispute to image transmission. Wireless Multimedia sensor networks (WMSNs) are useful in revealing the actions in a system for the challenges of physical phenomena of the environment [1], [18]. The common which is verdict in those networks is data insecurity and data loss due to failure of components, error in transmission of wireless data, interference. Collaboration of sensor nodes is essential for consistent event recognition.

In support of event recognition by collaborative tracking with multiple sensor nodes, technique frequently used is data aggregation [17], this technique not only helps in plummeting the throughput of data transmission but also profitably saves energy.

Target tracking is a key issue for preservation of energy, this tracking technique can be achieved by using various methods [2], [5]. One of such methods is prediction based scheme. Prediction based scheme works together with selective activation of nodes. This scheme is based on event driven mechanism for tracking the target path. Subsequent to target path few nodes are waked-up. Distributed Predictive Target Tracking algorithm is also used to solve the problem of inter-sensor interference (ISI).

Data aggregation algorithm is used to gather the sensed data and aggregate it. The main objective of this algorithm is to utilize the energy in an efficient manner and to boost the network life span. Clustering in WMSN is the course of action of grouping the sensor nodes in a large-scale densely deployed sensor networks. The major issue established in clustering is that the potential node which is healthier in energy is resolute as cluster-head and the other nodes toil as Ordinary Sensor Nodes (OSN). Next to distributed predictive algorithm verification algorithm [10] is as well projected which performs data aggregate computation and in addition verifies the information. It’s a point to keep in mind that this paper aims at proving high energy efficiency and data accuracy for WMSN’s.

II. RELATED WORK

Focusing on two exposition problems, several researchers have wayward problems associated to energy efficiency, target tracking and prediction, data accuracy and data aggregation in WMSN’s.

A. Energy efficiency

Energy efficiency is a decisive aspect of WMSNs, it is viewed extensively beyond these efforts, energy efficiency is also considered as a design constraint for protocol and algorithm designing of WMSNs.
The energy consumption models to optimize grid size and diminish the energy consumption for probabilistic distance distribution network has been analyzed and evaluated in [24]. For data gathering in wireless networks the quandary of scheduling packet transmission is premeditated by author in [23]. This scheme focuses to travel around the energy latency exchanges by using modulation scaling technique in wireless communication. In [21], Sengul et al. proposed a new protocol called PBBF which is used for investigating the energy-latency-reliability transaction in broadcasting wireless information. This algorithm provides a competent study of relationship at the reliability level. PBBF says that the energy and latency is inversely proportional to a given reliability level. The input requirements from the modish can be curtailed by dynamically adjusting the parameters of PBBF algorithm.

B. Collaborative Target Tracking and target prediction

For many perspective WSN applications target tracking is an extensively used technique. In many efforts such as [3, 8] target tracking technique is viewed as a progression of continuous localization operation. Target tracking mechanism is also used to obtain optimal solution by taking into account as a dynamic state estimation problem for the trajectory and Bayesian estimation methods. Gu et al described a power saving maneuvers when the sensor nodes are in surveillance state and in tracking state [11]. To detect the moving objects, a set of novel metrics is proposed for determining the moving objects. Collaborative tracking scheme is used to wake-up and to put sensor nodes in shut down mode. The real time analysis of VigilNet is offered by He et al in [13] which classify the target node based on timely and energy efficiency manner. In this the target tracking process is detached into six phases. For each phase deadline is partitioned and theoretical derivations to certify sub-deadline, end to end delay tracking deadline is satisfied. In [22] the author presented a Prediction-based Energy Saving scheme (PES) which is an illustration of Kinematics-based prediction. In this technique the specific location of the sensor nodes is forecasted only by using simple models without considering their detailed probabilities. In [13] author predicted a scheme in which sleep schedule pattern is based on the distance of the node from the target’s instantaneous position. Thus the sleep level of the sensor nodes nearer to the target ought to be lighter.

C. Data Aggregation

Existing method of data aggregation technique mainly spotlight on the structure of aggregation and performance which involves aggregation node selection [6] and delay in aggregation [14] for aggregating multiple packets into single there are two methods available semantics-based aggregation [12] and length-based aggregation. Semantics-based aggregation technique compresses the total length of multiple packets into a single packet of original length or even less than original packet length [19]. To the converse length-based aggregation technique does not change the length of packet as an alternative it just combines the multiple packets into one, with the identical payload length.

III. DISTRIBUTED PREDICTIVE TARGET TRACKING ALGORITHM

In existing Image Transmission Protocol [4] only one node can carry out the transmission of image packet at a moment in time. Consequently on reception of intact network packets will domino effect in encumber of energy thrashing of base station. To surmount this shortcoming collaborative target tracking technique is engrossed in proposed technique. In Distributed Predictive Target Tracking (DPTT) scheme nodes in attendance to target tracking path are awakened for few time slots and lingering nodes are set aside in sleep mode. The energy consumption can be reduced by following phases.

A. Cluster Head Selection Phase

In the world of multimedia communication, to reduce the global transmission of data packets a cluster head is made to put into practice of few optimizing functions such as data aggregation, cryptogaphic analysis and identification of distant cluster heads for transmitting fused data. This seems to reduce the energy level of cluster head nodes ahead of ordinary nodes. Our DPTV algorithm picks out the higher residual energy node to pretend as a cluster head node.

The election procedure is as follows.

- The elector node nothing but a normal node broadcasts energy request message (ENE_REQ) along with its own energy level information to the remaining nodes inside cluster.
Selection of CH and next elector node

- The remaining nodes its energy level with the nearest elector nodes energy level.
- Then energy reply message (ENE_REP) is send by remaining nodes if any of its energy level is higher than elector nodes energy level, else it hold off for cluster head advertisement message (CHADV).
- If energy of elector node is greater than remaining nodes energy level then it becomes cluster head otherwise elector node selects the node with maximum residual energy as the cluster head and subsequent maximum residual energy as the next elector node. The election procedure is depicted in above figure I.

B. Cluster formation phase

Once elector node elects the cluster head, cluster head advertisement message (CHADV) is broadcasted by cluster head node along with cluster head ID. Then each ordinary sensor nodes on the basis of the signal strength of the advertisement message received selects the relevant cluster head node and joins with that cluster by transmitting the join request message (JOIN_REQ). The figure II shows the cluster formation and data transmission between the Cluster Head and Base Station.

C. Motion Prediction for Target Node

The movement of target area is under discussion to certain rules of physics. But for short duration of time period there is no momentous transformation on target’s motion rules as a result the target motion simply follows the kinematics rules. On the other hand a spiky rotate or long term behavior of targets motion is hard to predict by simply using kinematic rules. Thus probabilistic model is used to tackle any possibilities of changes in targets motion. The probability determination for target node motion prediction is shown in figure IV.

The motion prediction of target node at any instant of time $t_n$ involves the following three steps:

1. On based on previous state $S(n-1)$, determine the current speed $v_n$, acceleration $\vec{a}_n$, sense the current position $(x_n, y_n)$ and direction $\theta_n$.
2. Displacement of the target node $\vec{s}_{n+1}$.
3. Lay down the probabilistic model by embracing the deviation $\Delta_{n+1}$ and scalar displacement of target node $\vec{s}_{n+1}'$. 
4. The sleep delay $t_{n+1} = t_n + TP$

When the target is detected for first time, the preceding observations such as $S(n-1)$ are not existing so it is skipped. The following figure III shows the motion of target node at three consecutive points.

**Figure III: States of target motion**

If current location of target is assumed as $(x_n, y_n)$, then $\vec{v}_n$ and $\vec{a}_n$ is determined as,

$$\vec{v}_n = \frac{\sqrt{(y_n-y_{n-1})^2 + (x_n-x_{n-1})^2}}{t_n-t_{n-1}} \quad (1)$$

$$\theta_n = \arctan \frac{y_n-y_{n-1}}{x_n-x_{n-1}}, if \ x_n \neq x_{n-1} \quad (2)$$

$$\theta_n = 0, if \ x_n = x_{n-1} \quad (3)$$

$$\vec{a}_n = \frac{\vec{v}_n - \vec{v}_{n-1}}{t_n-t_{n-1}} \quad (4)$$

$$\vec{s}_{n+1} = \vec{v}_n \cdot TP + \frac{1}{2} \vec{a}_n \cdot TP^2 \quad (5)$$

$$\sigma_{n+1} = \| \vec{v}_n \cdot TP + \frac{1}{2} \vec{a}_n \cdot TP^2 \| \quad (6)$$

**Algorithm 1 Target Detection ( )**

1. begin
2. if (node in tracking mode) then
3. if (target is not moving away from current awaken region) then
4. return;
5. end if
6. if (node is selected as alarm node) then
7. compute $\vec{v}_n$ and $\vec{a}_n$
8. calculate $\vec{s}_{n+1}$
9. calculate $\mu_{n+1}, \sigma_{n+1}$ and $\sigma_{n+1}$
10. transmit $id_t, x_t, y_t, \vec{s}_{n+1}, \mu_{n+1}, \sigma_{n+1}$ and $\sigma_{n+1}$
11. end if
12. return;

**D. Awaken nodes reduction phase**

The transmission range of sensor nodes is $R$ which is far longer than its range of sensing $r$. In a densely deployed environment a guarantee for sensing coverage is achieved by receiving a broadcast alarm message by all the neighboring sensor nodes within the transmission range. Meanwhile there is possibility for target node to shift away from the alarm node during sleep delay. During these possible situations it is necessary for nodes within this distance to wake up. As a consequence a ring shaped awake region is fashioned. The number of awakened nodes in awake region can be reduced on the basis of target moving direction predictions. Target node can move in different probabilities in various directions. By this it seems to predict that a path with higher probability the number of awakened nodes will be high and path with lower probability the number of awakened nodes will be less. Construction of awake region is analogous to designing of cluster in network architecture [20, 7]. Only responsibility of alarm nodes is to broadcast the alarm message for the detection of target path. Awake region is an implicit notion it decides whether a node need or not to come within reach of target.

**E. Proactive wake-up with Awaken Regions phase**

This phase deals with the mechanism for managing the awake region is poles apart from cluster management. The depiction of this mechanism is as follows.

- Conception. Once a target node is selected the sensor nodes will ensure its status to agree on whether it is an awake node in existing awake region. If it guarantees it to be an awake node, it justifies if the target parting the current awake region.
If target is not parting away from current awake region then the node does nothing. On the other hand if the target is departing the current awake region or if no previously awaken region exist then the node begins to process the alarm node election procedure [16]. If this node is elected as an alarm node then it broadcast the alarm note to all the other candidate nodes.

- Firing. As the time proceeds, this protocol enhances the automatic dismissal of awaken region, since the sleep patterns of awakened nodes is automatically recovered back to the default pattern. It does not require the explicit dismissal mechanism.

**F. Election Procedure for Alarm Node**

The alarm node selection procedure is discussed in [16]. In this technique when the detection is declared each node will broadcast a DETECTION message to all the neighboring nodes with a time stamp recording. Then it checks all the DETECTION messages of the neighboring nodes within an interval and it compares the time stamps of other nodes with its time stamp value.

Nodes that detect their neighbor node’s time stamp faster than its own is kept silently. This node is considered as the alarm node for the target. There are two working models for sensor node’s default mode and tracking mode. The sensor node will be in default mode when the sleep pattern for a specific target is not programmed and then the node follows the default pattern.

The sensor node will enters into target mode when it detects a target or during rescheduling the sleep pattern on receiving an alarm message.

An alarm message includes the following information

- ID and the location of alarm node \((i_d, x, y)\);
- State vector \(State(n)\);
- The prediction results \(\mu s_{n+1}, \sigma s_{n+1}\) and \(\sigma \Delta n+1\)

**G. Selection Phase of Awaken Nodes in Awaken Region**

The target node may move by \(s_{n+1}\) during sleep delay \(TP\). For computational efficiency let us assume that the target’s position is unerringly the alarm node’s position. Let \(d\) denotes the distance of an awakened node from the alarm node.

If \(d \geq \mu s_{n+1} - \sigma s_{n+1}\), the probability is less than 16% and if \(d \leq R\) nodes are moving in range outside the alarm node’s transmission range and those are put in sleep mode. Thus the scope of awaken region is identified as \(\max \{\mu s_{n+1} - \sigma s_{n+1}, 0\} \leq d \leq R\). By considering \(\rho\) as node density, the scope for number of awaken nodes in awaken region is \(\rho \pi [R^2 - \max \{\mu s_{n+1} - \sigma s_{n+1}, 0\}^2]\).

**Algorithm 2 Awaken node detection ( )**

1. begin
2. Calculate distance \(d\) of alarm node;
3. If \((d \leq \mu s_{n+1} - \sigma s_{n+1})\) then
4. Return to awake mode; // nodes in awaken region
5. End if
6. If \((d \leq R)\) then
7. Return to sleep mode; // nodes are moving away from target lane

**H. Data transmission phase**

Once the cluster is formed transmission of data takes place. Inside the cluster only nodes located in target tracking path are in awaken state and only those nodes are involved in data transmission progress. The implementation of this technique also results in reducing the attenuation level of interfering. DPTV algorithm also facilitates for the acceptance of new node from other clusters when the current cluster is in demand for ordinary sensor nodes which is shown in figure V. The transmission of data inside each cluster is based on TDMA technique in which time is divided into periodic cycles. This further reduces the collision level of data transmitted from ordinary sensor nodes.

![Figure V: Data transmission and Migration of new node from cluster1 to cluster2](image-url)
I. Data Accuracy Detection

In this paper, verification algorithm is utilized along with Distributed Predictive Target tracking algorithm in order to get better level of security. Each cluster head inside specific cluster performs data aggregation of encrypted information being transmitted by ordinary nodes of the corresponding cluster. Each sensor nodes while data transmission, encrypt the data and transmit the cipher text to the Cluster Head. Data aggregators on the other hand does not requires the decryption of cipher text, rather it simply fuse the encrypted data and transmit to the Base station directly.

Algorithm 3 secured aggregation (R, Wx, k)

1. Begin
2. Receive \{(A'x^1, M^{x1}), (A'x^2, M^{x2}),\ldots, (A'x^n, M^{xn})\} from ordinary nodes;
3. \(A'x = W' x | A'x^1 | A'x^2 | \ldots | A'x^n\); // cipher text aggregation by cluster head;
4. \(Pq' = \text{index of qth rightmost} \ "1" \ \text{bit in} \ A'x, \text{for} \ 1 \leq q \leq k'\), where \(k'\) is largest integer but lesser than \(k\); //
5. \(A'x\) possibly will have fewer than \(k\) \ "1" \ bits where \(k' < k\). // generate a MAC bit for \(Pq'\) in \(Q'x\), for \(1 \leq q \leq k';
6. Assemble the unification of \(M\) of the received MAC’s; arbitrarily choose \(M'^x = \{M1', M2', \ldots, Mk'\} \) from \(M\); broadcast \((A'x, M'^x)\) to parent nodes;
7. End

IV. SIMULATION RESULTS

In this section, the report investigates the simulation cram that examined the network life span and accuracy of our distributed predictive target tracking and verification algorithm. The evaluation result shows the better performance metrics for the parameters such as network lifetime and data security.

A. Simulation Environment

Simulations were performed by using Network Simulator (NS2) environment which is a powerful platform for network research process and it is a discrete event simulator tool. In the environment, 100 nodes are randomly deployed in a 1000m × 1000m area. The performance of our DPTV algorithm is compared with Image Transmission Algorithm by considering the terms such as the total number of received packets at the BS, network lifetime and the security level of the received packets.

B. Results and Discussion

In the proposed technique, distributed predictive target tracking algorithm is used for the transmission and aggregation of the image packets which outcomes with condensed energy consumption and hence protracts the networks lifespan. The verification protocol works together to check the accuracy of image packets being ordained to BS from Cluster Head.

a. Network Lifespan

The lifespan of the network is the time duration of survival of the node from the instigation of the network operation to the instant that the network can no more afford the readable information.

b. Data precision

The data accuracy is defined as the ratio of summing up the collected image packets by data aggregation technique proposed and the summation of all data packets from individual sensor nodes.
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REFERENCES


V. CONCLUSION

In Wireless Multimedia Sensor Networks, battery life and the resource reticence plays a vital role. Transmission of image packets also results in more energy consumption. The paper proposes an algorithm for a mobile target tracking surveillance sensor network is supported by sleep docking technique. The main spotlight of this technique is to optimize the recital metrics such as network lifespan, energy consumption and data security. By applying sleep scheduling method and reducing the efforts of the working nodes energy efficiency can be made superior. The aggregation of data packets results in compressed data packets which further reduces the transmission burden and also provides scope for security and source coding. Thus the sensor data’s are associated and transmitted with higher-ranking efficiency which comes as a result of cryptographic and data compression techniques. Data latency is another significant issue in wireless multimedia sensor applications, in future work the research will be preceded with alternative technique in exploring the communication overhead problem.

Figure VII: Data accuracy with respect to time

From figure VII the accuracy of the proposed technique shows better performance level when compared to existing protocol which contributes fewer chances for collision and furthermore provides better chance for delivery of packets within time limit.


