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Research Paper

EECLA: Clustering and Localization Techniques to Improve Energy Efficient Routing in Vehicle Tracking using Wireless Sensor Networks

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Abstract

Abstract: The applications of wireless sensor networks became more usable in daily life. In spite of many proposed techniques and methods, energy efficient routing in WSN is still an open issue. In this paper we made an attempt to give one of the solution for this problem in vehicle tracking system based on the vehicle sensor nodes. We studied many existing works, were failed in handling location and energy efficient routing of vehicle tracking properly. We proposed an algorithm which handles clustering and location at time and improves the performance of the system. This algorithm uses the fundamentals of LEACH, CLAEER and mean shifted algorithm. We conducted a sequence of experiments and our algorithm EECLA (Clustering and Localization Techniques to Improve Energy Efficient Routing in Wireless Sensor Networks) has given better results than the existed one with more accuracy.

Keywords: EECLA, MSDU, MSA,AVT

1. Introduction

Handling and monitoring of sensor nodes in a vehicle tracking system is a major challenge. These nodes provide services to the driver as well passengers. We used services of GPS (Global Positing System) for efficient and quality performance for current location identification [4]. We observed that uniform movements of the vehicle performance efficient than the random and speed movement of the vehicles hence tracking and energy consumption can be an issue now. For this purpose, we used anchor base and anchor free methods. Anchor based nodes tells about the location of the vehicle by acquired data with the help of GPS[4] and artificial arrangements whereas anchor free nodes tells complete the location of the system with the monitor nodes. Comparatively anchor free can perform well and is affordable than the anchor node where maintenance of monitoring node is [6] cost effective.

We have gone through the few the studies related target tracking and the common problem identified was building mathematical probability model with the existed data. To have a better performance we introduced clustering technique to avoid the confusion with over loaded tracking data. This clustering EECLA algorithm is proved better than the existed one. EECLA [8] is incorporated the feature of few exited clustering algorithms.

2. Literature Survey

The existed works given some clarity and base of our work i.e as Yoon et al. (2006) explained about how to get efficient current performance by getting absolute present position, history of positions, paths of sources, target location irrespective of nodes information and coarse grained and original maps with concepts of markove models.

As per, Kotz et al. proposed a method by considering behaviour nodes. The description of this method is to get current location with the help of user position by using normal distribution with respect to the time (Kim et al., 2006). This method could not explained target under moving mode but can location on the road. He did not explained about relation among the nodes.

Whereas Tuduce and Gross (2005) given a solution to this problem based tracing data of WLAN. In this model required are obtained by dividing into series of square then probability model was traversing adjacent nodes. Hou (2006) presented a model with respect to the visiting time and Markov process. Finally this method was capable of explained location in different time phases.

3. Related Work

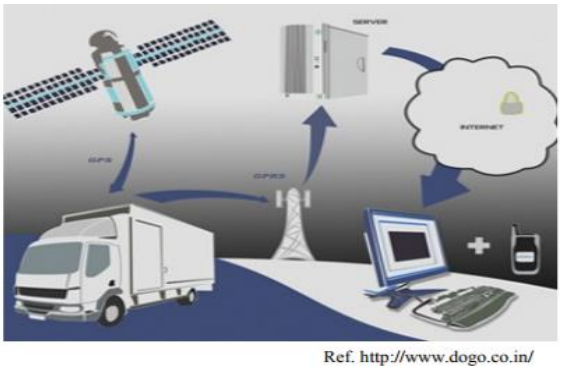
Even though tracking system performing well still we identified problems in prediction precision can be solved by mean shifted and *maximum likelihood estimation[1]*(MLE) methods. Development and deployment of monitor nodes with respect to the vehicle velocities. EECLA has given solutions to all these issues. As per our results we conclude that our work can give better, efficient vehicle location with using more nodes.

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The rest of the sections describes as, section 4 explains the working procedure and other ingredients of EECLA, Section 5 given models used and need the of the work. Section 6 briefs about models used for vehicle tracking. Section 7 incorporated node selection methods and results of EECLA. Section 8 ended paper with proper conclusion.



Fig. 1: sample WSN topology



Ref. http://www.dogo.co.in/

Fig. 2: WSN system architecture

The importance of vehicles is getting more in daily industry hence security also an important issue can be given by live tracking of the vehicle by developing précised tracking methods will give better services. As per the Jialue Fan and Xiaohui Shen [1] category of target locations identified easily. To get better performance they used two models, high level offline model and low level online model collectively. They also concentrated view of the target location with many challenges for the movingobjects. Finally we concluded with few limitations as when number of tracking objects increases with respect to the categories hence ambiguity. We get error when incorrect location tracking of the object. Existing work is not suitable for all datasets related tracking due to inconsistency in the data types.

3.1. EECLA

EECLA[8] (Clustering and Localization techniques to improve energy efficient routing in WSN) can be applied on Vehicle tracking system. The Vn represents vehicle nodes and Mn represents monitor nodes. Vn send information of vehicle positions and Mn handles the monitoring of location and sends the data to the nearest base station from where the process can be initiated.

Vn sending the data can contain null packets which disturb the process more, the problem here is how to identify such type of inactive data is big issues. Here we used clustering technique to segregate the information while coming from Vn. EECLA saves energy consumption by ignoring the inactive data node or sleeping nodes. It reduces data traffic in the network and provides multipath for routing.

The distance of the signal can be calculated by using the following formula and be locate the position of the vehicle, finally provides the required services to the customers.

$$Rd=R0-10\eta\log(d/d0)+\text{Ɛ} \quad (1)$$

$$P_d=P_o-10\eta\log(d/d_0)+\varepsilon \quad (2)$$

Where Rd and Ro are the strength of the signals to be received with respective to the distance d and d0, pathloss exponent is η, from 2 and 4; Ɛ error in measurement. Eq.(1) tells about basic tolerances bands with respect to the layout. The measurement error e is influenced by several factors, such as manufacturing tolerances, antenna inadequacies, and more importantly multipath.

But still getting proper location of the vehicle is not up to the hence we used a localization algorithm which describes about finding the correct direction of movement. obtaining the distance moved, and integrating the prior results and GPS location information. The main issue is energy consumption here.

4. Energy Consumption Model

Clustering is one of the technique for balanced energy consumption, actually clustering is the process of gathering nodes to perform a task efficiently using algorithm and can also used for division of topology.

4.1. Mean Shift Algorithm

Mean shift target tracking (MS)[3] gives estimation of the position based on probability density and sampling mean. In MSDU, mean shift theory is used to move the target candidate to the location most similar to that of the target model which is new location. To find this location, the Bhattacharyya coefficient [7], written as ρˆ(y), is chosen as the comparison measure of target candidate and target model. ρˆ(y) increases as the comparison difference increases and the location where ρˆ(y) attained maximum is the absolute target location.

Target location, ρˆ(y) relating ρˆ(y) and ρˆ(y^*) q can be given as:

$$\hat{\rho}(y)\equiv p[\hat{p}(y),\hat{q}(y^*)]=\sum_{u=1}^{m}\sqrt{\hat{p}u(y)\hat{q}u(y*)} \text{ ...Eq…3}$$

Apart from this, new target candidate location can be calculated by using the (y^l) mean shift vector as:

$$y'=\frac{\sum_{i=1}^{s} x_i\,\omega_i\, g(\|\frac{y-xi}{h}\|^2)}{\sum_{i=1}^{s}\omega_i g(\|\frac{y-xi}{h}\|^2)} \quad (4)$$

where g(x)= -k^l(x), and {ωi}i=1,…s represents the weight coefficient can be calculated as:

$$\omega_i=\sum_{u=1}^{m}\sqrt{\frac{\hat{q}u(y*)}{\hat{p}u(y)}}\,\delta[b(X_i)-U] \quad (5)$$

5. Detection of Target Model

While tracking process, existed algorithms considered target model is invariable. Hence the tracking will be pretentious due to modifications in background of the target in process. This damage was controlled by the real-time target information. For the collection of real-time target information, *Target Tracking Based on Detection Update*s (MSDU)[3] draws lessons from *Tracking Learning Detection* (TLD)[3] and uses the real-time target detection results as a priori knowledge. To be specific, the detection results give real-time information about the target, and consequently, if there is an obvious difference between the detection results and the tracking

results, the tracking results are probably not believable. By using MSDU, the out is matched with the their nearest-neighbour to have the effective tracking. If the effectiveness of the tracking is slow the target model has to updated by using the detection results for absolute tracking results, Updation can be done using target model with given constrains. Effective tracking evolution criterion: This criteria was evaluated by taking similarity in the spatial domain, δ, as measure. The δ between the detection result and its nearest-neighbour matched tracking prediction is expressed as the Euclidean distance[3] between their centers:

$$\delta = \frac{\sqrt{(xdtc - xtrk)^2 + (ydtc - ytrk)^2}}{\text{dtrk}} \quad (6)$$

where (X_{dtc}, Y_{dtc}) is the detection central point, $(X_{trk}, Y_{tkr})$is the tracking central point,d_{trk} is the tracking diameter.

6. Vehicle Tracking Methods

The monitor nodes collect data for tracking of vehicle location. Sensor data gives samples for continuity in tracing process by using a D-dimensional random variable or vector [1]. Gaussian mixture models [1] performs excellent performance for vehicle tracking process based on the sensory data by correlating covariance. It also describes signals in unsupervised data flexibly.

$$p\,(d_i(t)|\,\mu_j(t),\sum_j(t)) = \sum_{j=1}^{k} \propto_j(t)\phi(d_i(t)|\mu_j(t),\sum_j(t) \quad (7)$$

We use di(t) is gives sensory data of monitor node i, is a variant of D dimension. The generated sensory data was represented by with respect tot the components of individual dimension. The mean value and covariance matrix is can be represented by the sensor respective to the time slots t. E & M steps are given by EM by estimating the free and posterior parameters.

rij(t) evaluates M-step parameters

$$\alpha j(t) = \frac{\sum_{i=1}^{m} rij(t)}{\sum_{j=1}^{k}\sum_{i=1}^{m} rij(t)}$$

$$\mu j(t) = \frac{\sum_{i=1}^{m} rij(t)di(t)}{\sum_{i=1}^{m} rij(t)}$$

$$\sum j(t) = \frac{\sum_{i=1}^{m} rij(t)(di(t)-\mu j(t)(di(t)-\mu j(t))'}{\sum_{i=1}^{m} rij(t)} \quad (8)$$

$$L(t) = \frac{\sum si\varepsilon\, A(t)(p\left(di(t)\middle|\mu j(t), \sum j(t)\right)Li(t)}{\sum si\varepsilon A(nt)P(di(t)|\mu j(t),\sum j(t))} \quad (9)$$

In respective to the time t the vehicle positions can be changes hence few monitors nodes will be activated surroundings of the vehicle to get it position. We denote the set of monitor nodes as A(t), then given the computational predictions procedure of vehicle position at t time can be calculated by mean-shift algorithm repeatedly. Here vehicle position is $L_i(t)$ can be given by monitor node S_i at time t, for absolute position of the vehicle can be used MLE to give the L_i. MLE[1] only needs each monitor node give its distance strength received from the vehicle sensor. We denote the position of monitor nodes $S_i \in A(t)$ as(x_i, y_i)

$$(X_i - X_t)^2 + (Y_i - Y_t)^2 = (L_i)^2 \quad (10)$$

X_t, Y_t of $L_i(t)$ can be calculated from Eq..(11) substituting it in to Eq,.(10) more accurate results can be obtained.

7. Simulation and Results

As in entire work conducted sequence of well-organized experiments. In this process we explained accurate tracking model with by considering various parameters. Then importance of monitor nodes while tracking the position of the vehicle and efficient energy consumption and life time of the network can be explained by using EECLA algorithm.

I f we are unable to target the location of the vehicle, the position can be given by the vehicle sensor nodes. Identification difficulty tracking system could not perform well in this regard amount of target losing can be calculated for getting accurate location. We have demonstrated with different speeds of vehicle as 15 km/h, 35 km/h and 55 km/h. We observed that speed of the vehicle is more it gives more errors in accurate position of the vehicle since nodes are not come up with the speed needed relocation. It can be seen from Fig. 4, if losing target is less than 2 to 4 at any interval of speed verifies the accuracy of tracking model adopted in this paper and also vehicle speed is more and is proportion to the losing targets.

7.1. Model for Energy Consumption and Network Lifetime

The performance of EECLA is evaluating for to increase efficient energy consumption as well as network lifetime based record of monitor nodes exhausted with respect to the vehicle speeds. Figure 5 shows energy consumption changing of VSNs by adopting EECLA and EECLA-circle algorithm. It can be observed that when vehicle is speed energy consumption increased and reaches saturated when energy of all monitor nodes is exhausted.

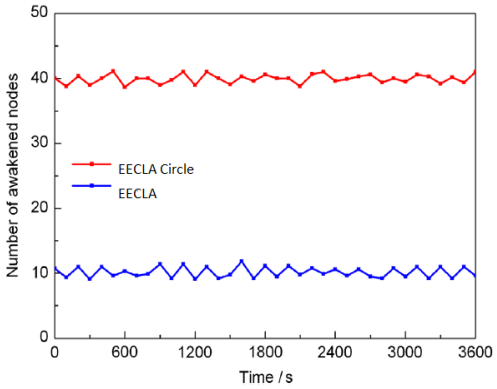


Fig. 3. Status of awakened monitor nodes as per time

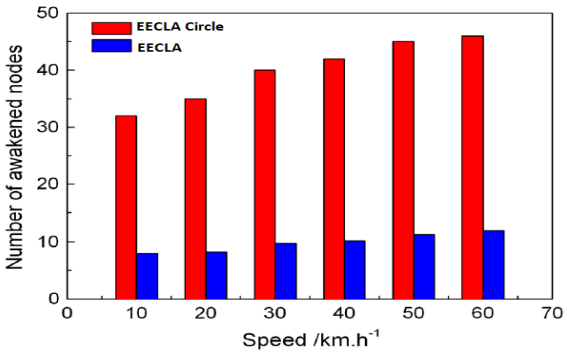


Fig. 4. Awakened monitor nodes at different speed

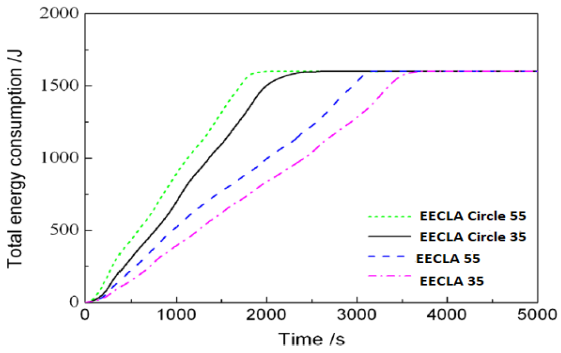


Fig. 5. Consumption of energy model at time t.

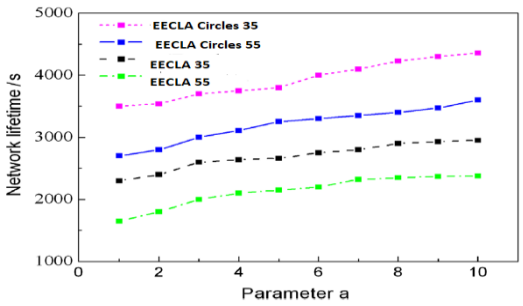


Fig. 6. Life time of Network based on parameters

8. Conclusion

The objective of this paper is to perform energy efficient routing in WSN for by reducing unnecessary energy consumption while tracking a vehicle with respective to their positions using multiple nodes monitoring. The prediction of vehicle position is done by adapting the concepts of MSDU and MLE for accuracy. We also optimized monitor nodes by using sector area instead of circle area. Moreover, the sigmoid function is adopted to further filter the monitor nodes in active area. Sequence of experiments proved that our model can perform better than the existed one and energy saving in VSNs.

We almost given solutions for the existing systems but we still feel that where the process can start after sending the data to a base station can give best performance. Effective identification inactive data is a big issue and to be improved more.

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