Wireless sensor network surveillance system that senses, trails and estimates the future path of a moving object

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Abstract: **This paper presents a wireless sensor network that senses and tracks the moving target. Detecting object is a challenging task due to failure of sensor nodes, high mobility of the object, processing of data acquired from object and communication between the sensors using wireless medium. This paper presents a new framework called as "Facetrack' which will help us in predicting the future path of the moving object. FaceTrack, employs the nodes of a spatial region surrounding a target, called a face. This approach estimates the target's moving probability toward another face. It uses an edge detection algorithm to generate each face further in such a way that the nodes can prepare ahead of the target's moving, which greatly helps tracking the target in a timely fashion and recovering from special cases, e.g., sensor fault, loss of tracking. This approach develops an optimal selection algorithm to select which sensors of the face to query and to forward the tracking data. The approach also focuses on predicting probable future path of a moving object based on historical data about past movements of other objects using data mining algorithm**

Index Terms: **Introduction, Literature Review, Existing System, Proposed System, System Design and Architecture, Conclusion, Acknowledgement, References.**

I.INTRODUCTION

WIRELESS sensor networks (WSNs) have gained a lot of attention in both the public and the research communities because they are expected to bring the interaction between humans, environments, and machines to a new paradigm. WSNs were originally developed for military purposes in battlefield surveillance; however, the development of such networks has encouraged their use in healthcare, environmental industries, and for monitoring or tracking targets of interest.

A Wireless Sensor Network (WSN) is a deployment of massive numbers of small, inexpensive, self-powered devices that can sense, compute, and communicate with other devices for the purpose of gathering local information to make global decisions about a physical environment.

This paper presents a framework known as Facetrack which detects the movement of target using Facetracking algorithm in Wireless Sensor networks.

II. LITERATURE REVIEW

There are different methods that are used for detecting and tracking target.

Sr. no.	Existing method	Advantages	Disadvantages
1.	DCTC	For power saving, most sensor nodes stay asleep before target arrives.	As the velocity of target increases, energy consumed by tree configuration also increases.
2.	GNS	-	The assumption that each node must know the location of all nodes can become overhead when network size grows.
3.	ANS	1) ANS is more desirable than GNS because the whole network does not need to reconfigure after addition or removal of extra nodes. 2) In the case of large network, memory requirements are not burdensome as that of GNS.	It cannot handle the scenario in which multiple targets are in detection range if the same nodes i.e. multi- target issues.

4.	1) DENA 2) ILA	Location of an event can be computed in a distributed manner without the need to gather any information on a sink node	1) ILA needs information of all neighboring nodes instead of considering subset of them. 2) DENA uses DDB that causes additional delay
5.	Distributed processing of RSSI	Minimizes power consumption, and reduces latency at the central base station.	False detection of target takes place in some cases.
6.	Maximum likelihood estimation with Kalman filtering	Improves tracking accuracy compared to commonly used extended Kalman filter approach.	-

III. EXISTING SYSTEM

In existing system of wireless sensor networks many algorithms are used for detecting and tracking the movement of target

The focus of this Paper is to effectively track moving target in Wireless Sensor Network (WSN) and predicting probable future path based on historical data about past movements of other targets.

IV. PROPOSED SYSTEM

In this paper we propose a system with following stages:

1) Initialization - Polygon Construction
2) Target Detection
3) Brink Detection Algorithm
4) Optimal Node Selection
5) Path prediction based on mining

4.1 Initialization - Polygon Construction

The system initialization includes initial polygon construction in the plane. A node has all of the corresponding polygon's information after the WSN planarization. Initially, all nodes in the WSN are in a low-power mode and wake up at a predefined period to carry out the sensing for a short time. We presume that a sensor node has three different states of operation, namely, active (when a node is in a vigilant manner and participates in tracking the target), awakening (when a node awakes for a short period of time), and inactive (when a node is in a sleeping state).

4.2 Target Detection

We use polygons to describe the target moving path. The polygon is not necessarily a convex, but it must not be self-overlapping.

4.3 Brink Detection Algorithm

An edge detection algorithm is used to detect another conceptual polygon which is called as the critical region, by generating an edge, called a brink.

1. ***Square detection phase:***

This implies that the target is preliminarily detected by any two nodes inside Pc but does not guarantee that the target may cross the brink between them.

2. ***Rectangular detection phase:***

This implies that the target may cross the brink between the nodes.

3. ***Crossing phase.:***

This implies that the target is about to cross the brink between the nodes.

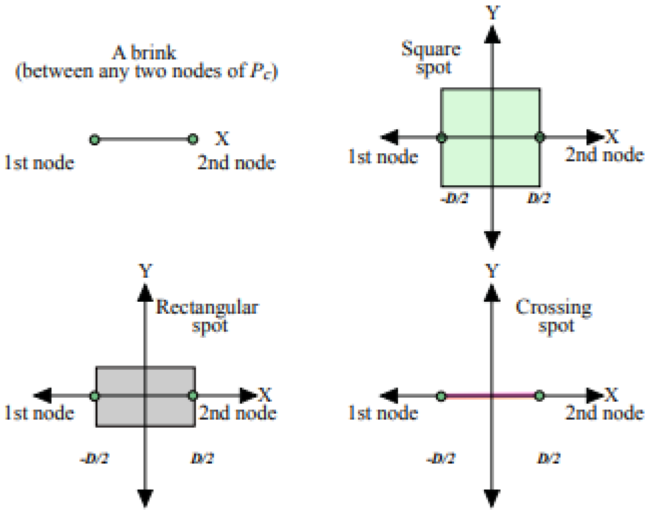


Fig no 1. Three phase detection spots,where the X-axis shows the brink crossing

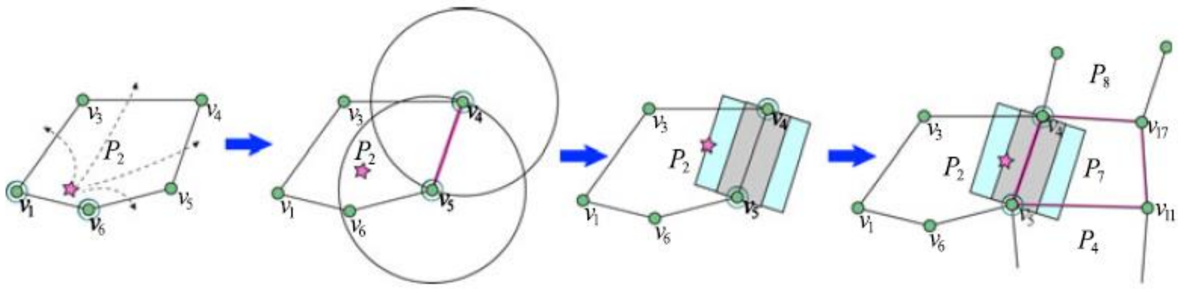


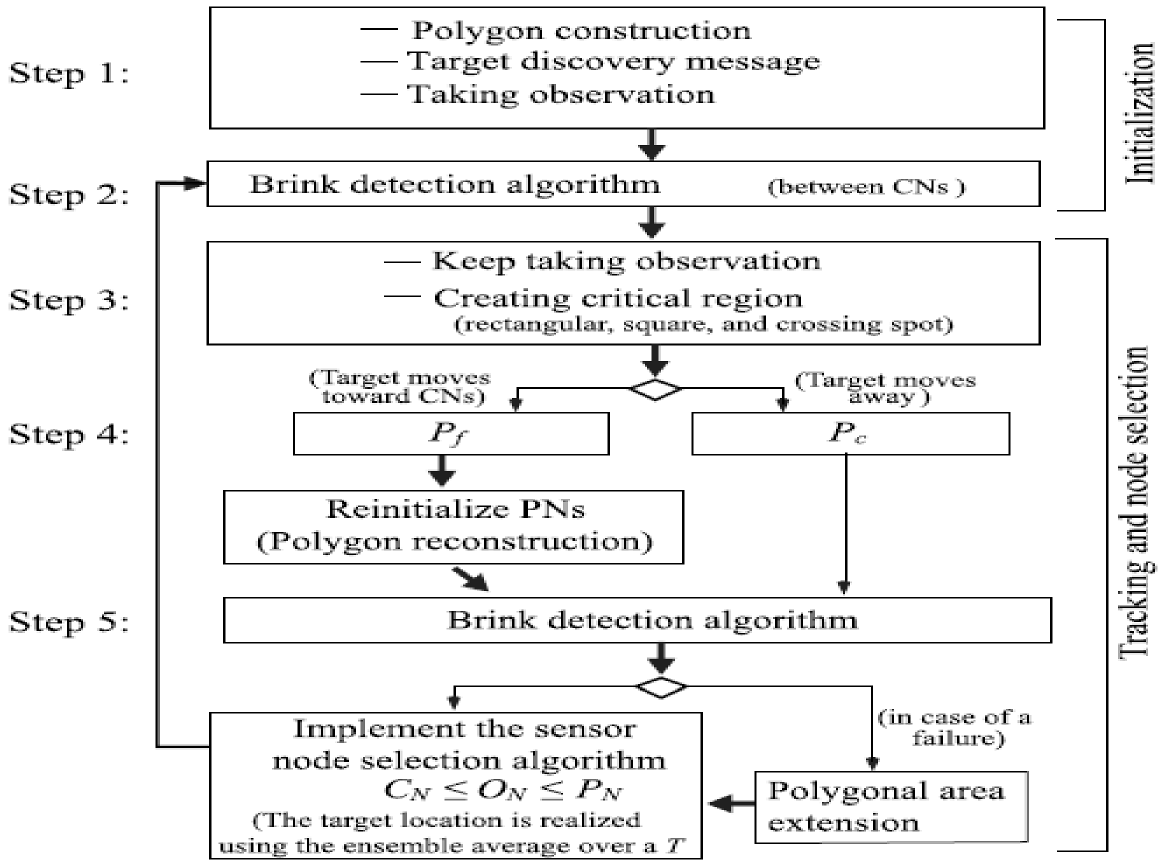
Figure 2:- A simple scenario of brink detection process

4.4 Optimal Node Selection

Tracking a target requires an optimal number of sensors in the network to aggregate data among the sensors. With FaceTrack, among the available sensors in a polygon, not all of the sensors provide useful information that improves accuracy. Particularly, if the number of sensors in a polygon is large, we need to minimize the number of active sensors. Furthermore, some information might be useful, but redundant.

We offer an optimal selection mechanism to choose the appropriate sensors, which can result in having the best detection and a low energy cost for transmitting data across the polygon; this also saves both power and bandwidth costs.

- After brink is formed CNs sends message to all NNs; NNs compute its bid
  bid= old_bid+face_members+energy+distance from CN
- NN responds to CN via bid(ID, dij, etc..)
- NN compares the weight of the bid with its own bid and ranks them.
- Selection function is a mixture of both detection information and energy cost such that $O_N \leq P_N$



4.4 Path Prediction based on mining

The objective of this project is to design FaceTrack to achieve an efficient and real-time tracking through detecting the movement of a target using face tracking and to predict the probable path for a moving object based on historical data using data mining technique. The data mining algorithm is applied to the historic data of the target's movement and useful association rules are found. These rules are used to predict the future location of the target. The target's movement information is transmitted to the sink and at the same time each sensor node also maintains its own record table containing the target's movement information table.

4.5 PR Algorithm

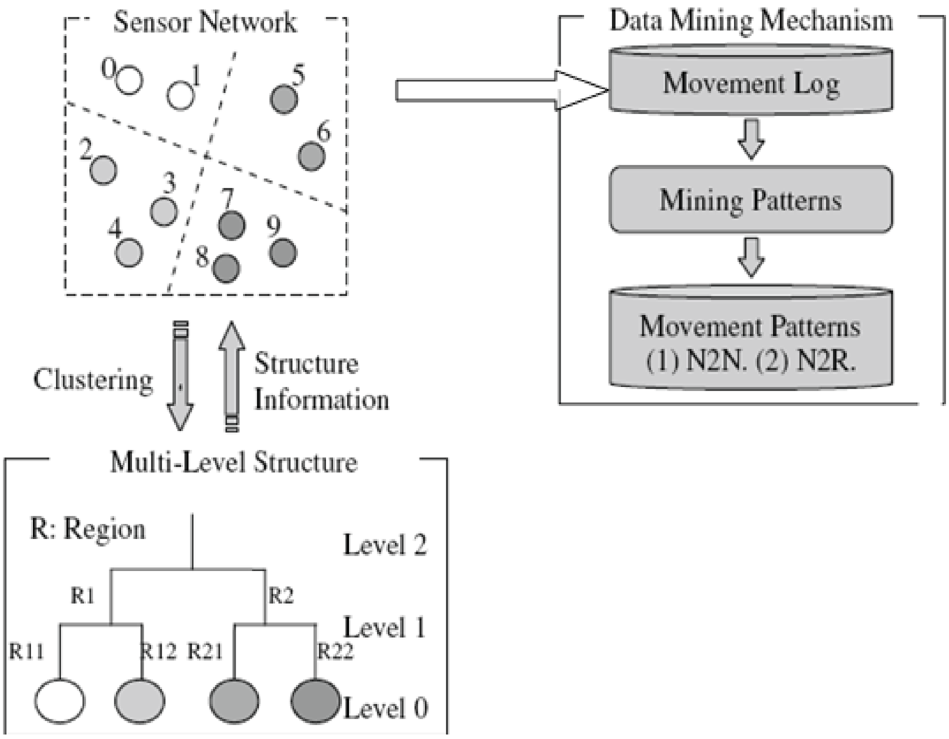
The system workflow consists of three main phases:

Clustering of sensor nodes

Discovery of movement patterns

Prediction of location of moving object.

First, we conduct the hierarchical clustering algorithm to form a hierarchical model for the sensor nodes. Then, the movement logs of the moving objects are analyzed by a data mining algorithm to obtain the movement patterns. Subsequently, the movement patterns are used to predict the next position of a moving object.



4.6 Mining of movement pattern

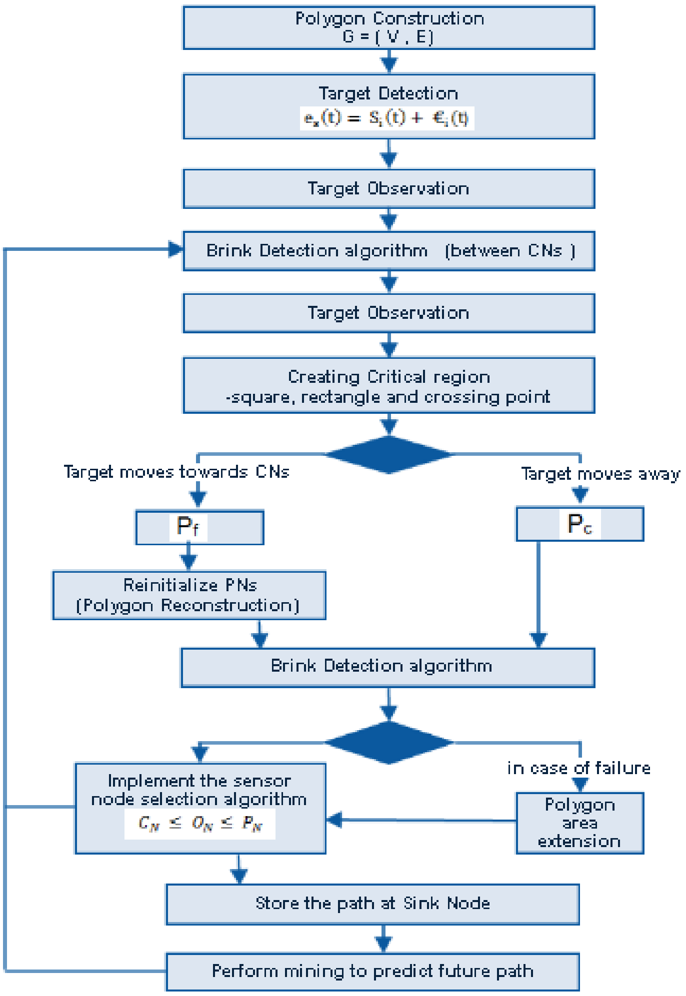
In the sensor network environment, we monitor the movement path while the object is moving. Table IX shows an example of a movement log. We propose two kinds of movement patterns: (1) node-to-node patterns, and (2) node-to-region patterns. A node-ton ode pattern, denoted a → b, indicates that an object moves from node a to node b. A node-to-region pattern, denoted a → R, indicates that an object moves from node a to region R. Furthermore, movement information is derived from changes in location and kept in the database. The frequency of the inference pattern is used to evaluate the confidence of the pattern, and that with the highest frequency serves as the basis of the prediction. Based on the above description, every sensor node has its own movement patterns including both node-to-node patterns and node-to-region patterns. In case the frequency of the different movement patterns is the same, we choose the most frequent destination sensor node in the database for our prediction. This is because it is reasonable to expect the sensor node that captures more objects to have a higher probability of being the correct next position.

Table IX. A Sample of Movement Log

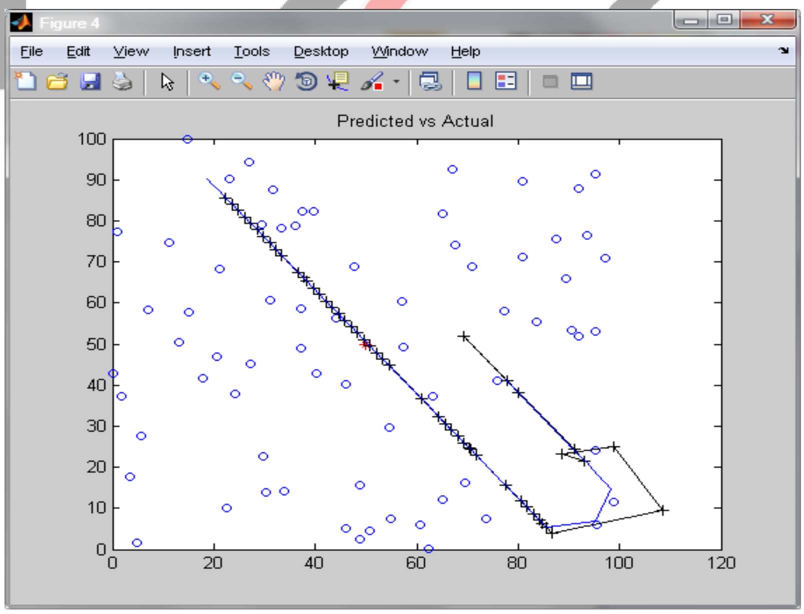
Obj_Path_Id	Movement Path
0	0, 1, 3, 7, 9
1	5, 7, 1, 3, 2, 4
2	6, 7, 9, 8, 3, 2, 0
3	1, 3, 7, 9, 8, 4, 2
4	0, 1, 3, 2, 4
5	9, 6, 5, 7, 1, 3, 2, 4

Table IX shows the Movement Pattern Generation (MPG) algorithm. For each movement path p in the movement log, the MPG algorithm is able to calculate the number of times of a moving object moves from the current node to its next location in each level. Finally, we can obtain movement patterns for most objects.

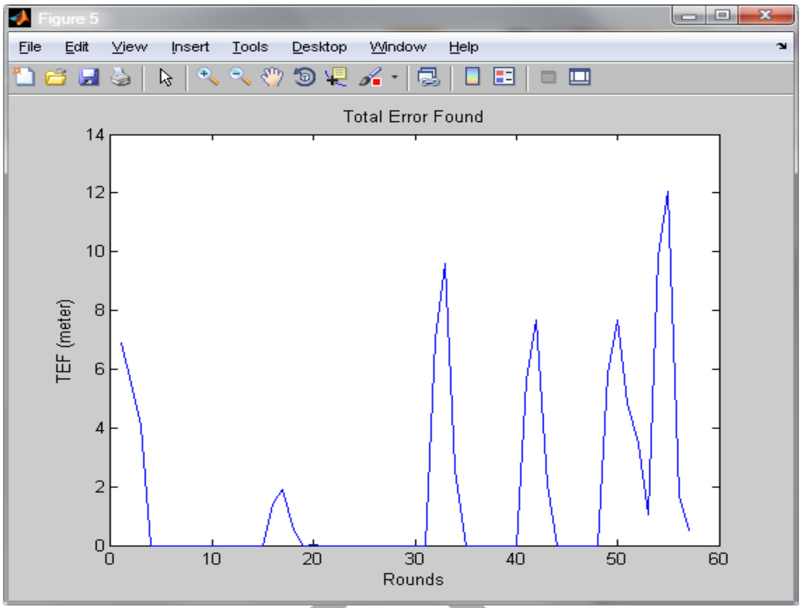
V. System Implementation



VI. Result



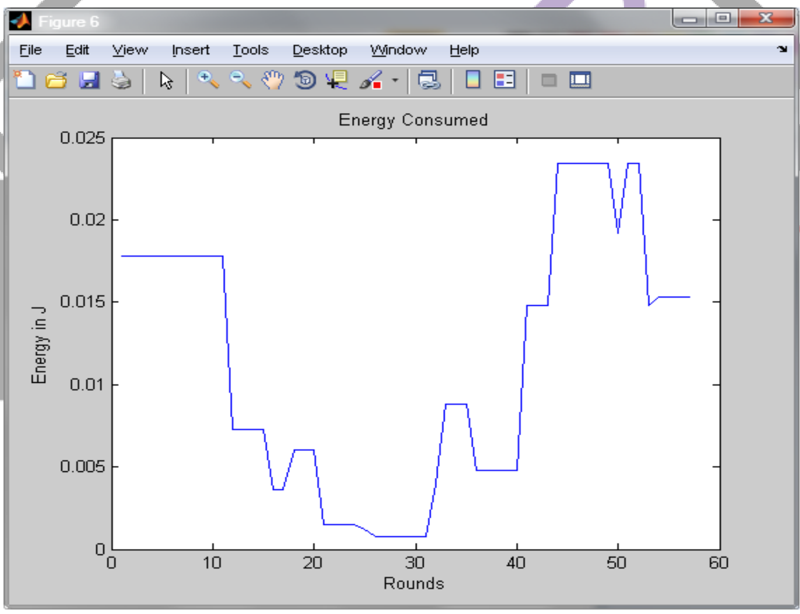
Predicted v/s Actual Graph (PR-Algorithm)



Tracking Error Found Graph (PR-Algorithm)

The energy consumed by the nodes in the network are calculated in Joules for each round and are plotted. The total energy consumed as follows:-

$$E_T(N) = \sum_{P_N \leq N} E_T(P_N)$$



Energy Consumed Graph (PR-Algorithm)

VI. CONCLUSION

To track and predict the future path of a moving object is the prime functionality of a surveillance wireless sensor network

As to future work, we would track multiple moving objects in the wireless sensor network and would predict the most probable path that each object would take using different mining

VII. ACKNOWLEDGEMENT

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