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MOVEMENT DETECTION OF A TRANSPORT SYSTEM USING FACE TRACKING

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ABSTRACT

Tracking a target in Wireless Sensor Networks has been carried out using various techniques. Some of those techniques are Angle of Arrival, Time of Arrival, Time difference of Arrival, Tree-based methods, Cluster-based methods, Prediction-based methods. Here, a new methodology, Face track is used to track a moving object. This method eliminates the disadvantages of the above mentioned conventional methods. First, the nodes are placed to form a wireless sensor field. Then, the nodes are made to form polygon-shaped cells. Each polygon is called a face. The movement of target is tracked when it moves from one face to another face. This movement towards the next face is detected by brink or edge detection algorithm. The optimal numbers of sensor nodes are selected using optimal sensor node selection method. This target tracking methodology gives high ability of tracking and the errors that occur are minimum. Using this methodology, the theft of a vehicle in a highly restricted area can be prevented by assigning pre-defined routes to the destination.

Keywords: *Edge detection, Face tracking, Target Tracking, Wireless sensor Networks.*

1. INTRODUCTION

Wireless Sensor Networks is one of the major emerging fields and it greatly helps the human by the influence of it in many real-time applications. It provides the applications in fields such as battlefield, field monitoring, Robotics, environmental monitoring, smart homes, in various other industrial purposes, commercially it has been used in many super markets, departmental stores. Sensors are to bring the interaction between human and the machine. Human-computer interaction depends wholly on sensors. The sensors consist of power supply, transceiver, transducers, microcomputer that consists of processor, memory. There are various kinds of sensors that sense different parameters and states. These different sensors play different roles. Nowadays, the behaviors of different sensors give raise to computing technologies. Autonomous computing, pervasive computing, context aware computing, are all entirely based on the input from sensors. Sensors are generally used to collect information from the environment. The inputs are received and transmitted by transceiver in sensors.

In some applications, the collected raw data is enough and made in use and some other applications need the processed data for further use. The processed data is obtained from the microprocessors inside the sensors. Besides all the basic functions, today sensors are utilized to act based on the intuition of the humans and hence the tasks are made easy. Here, we consider the application of target tracking using sensors. Tracking can be done through various techniques such as Angle of arrival, Time of Arrival, Time difference of Arrival, Tree-based methods, Cluster-based methods, Prediction-based methods. These conventional methods need measurements of the target or object at their every moves. The timely measurements and calculations from that are to be greatly concentrated. Even a small error at any point of calculation affects the entire system to a great extent. So, localization techniques possess complexity in measuring the locations of the target at every point. Tree-based, Cluster-based and Prediction-based methods have disadvantages such as grouping of nodes, operation of nodes in a timely fashion, loss of tracking, and accurate localization of target. Face Track eliminates the mentioned demerits and gives high ability of tracking and accuracy. The face track involves formation of faces i.e. polygonal shaped regions. These polygons are constructed by connecting more than three sensors together in a sensor field. The tracking operation is performed throughout the polygonal cells in the field.

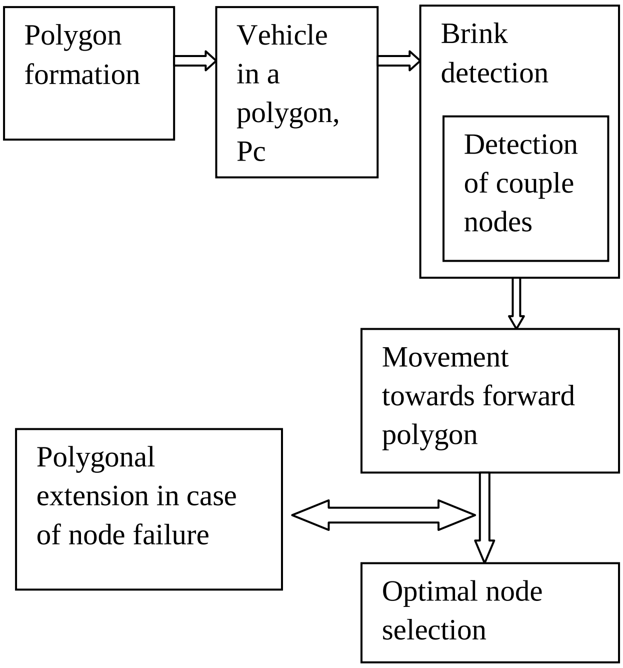

Figure 1 Architecture of face track scheme

The polygonal faces are created based on the related neighborhood graph (RNG). The target moves inside the faces and the movement of that target across the face is detected and hence the target is tracked that it's moving inside the particular polygon or face. The movement of an object or target towards the next one can be detected using the three detection phases around the edges. Not all the sensors need to be active throughout the entire time of operation. They are made to function at a specific time and hence the depletion of energy in the sensors can be avoided. They adopt a technique known as optimal node selection to make the sensors work in a timely manner. The optimal number of sensor nodes is selected to do the operation. This is activated by the exchange of messages between the couple nodes and the neighboring nodes. All nodes in the polygon should be active when the target is present at the particular face. The rest of the time i.e. when the target moves to the next face it can go to the idle state and need not to be active. The important factor in this face track is that not all the nodes send the information to the sink or user. Only the couple nodes send information to the sink or user. The couple nodes are those nothing but the nodes that are connected to the brink. The polygons have edges formed by the connection of sensor nodes. Among those edges, the edge through which the polygon crosses to move to the next face is known as Brink. This brink is detected using Brink detection algorithm. The route for the vehicle, which it should follow to reach the destination, is pre-defined. So, when the vehicle is at the face which is not pre-defined then some indications such as alarms or warnings is given to the user. Thus, the theft of the vehicle is notified and the particular area can also be known to the user.

2. LITERATURE SURVEY

Tree-based tracking functions [7],[8] based on collaborative data processing. Maintaining the tree and its hierarchical structure is difficult in tree-based tracking. In tree structure, the distance of the leaf nodes from the root gets increased as the number of sensor nodes are added more. This results in increasing the cost of energy in case of far distanced leaf nodes.

Many target tracking techniques are there, such as Received signal strength, Time of arrival, Angle of arrival, Time difference of arrival, GPS techniques [4]. Interferences and noises can easily act upon those techniques. All these techniques require the estimation of target's exact location. The accurate location of target cannot be obtained that easily.

A node selection method [1] such as Autonomous node selection and Global node selection requires the global knowledge about the network. This involves active measurement of nodes and finding the best path for routing.

Tracking is also done based on prediction [3].The prediction based techniques does not guarantee accurate tracking since, it becomes wrong if the prediction is not correct. Further, it increases the cost of energy of the nodes.

3. EXPERIMENTAL SETUP

Field Layout

An experimental setup can be considered with a vehicle as our target moving in an experimental field of sensor networks. Since, the tracking method that is to be adopted is Face Track, the layout is to be formed first. The layout is constructed by the formation of faces, the polygonal shaped cells. It is done by the use of concept, Related Neighborhood Graph. The sensor nodes are to be distributed based on the Euclidean distance. Any of the witness nodes should not be present in the network and so the problem of over-hearing can be avoided. More than three nodes are required to make a polygon. The polygon is known as active one, only if the target is present in it. The polygon can be of any shapes such as tetragon, square, pentagon, triangle, and hexagon. The nodes in the active polygon should be aware of that information such as 1) its adjacent neighbors 2) information of its own 3) about its neighboring polygons 4) about its active neighboring nodes. The amount of polygons is based on the number of edges and sensor nodes.

Detection of Brink

The vehicle or target can move to the next face through any of its edges. Not all the edges are used by the target for crossing. Only one of the edges is used by it. That particular edge which is used by the target for crossing is termed as brink. This brink can be detected using this brink detection algorithm. This consists of three tasks or phases. It starts with square, rectangle and ends with crossing phase. These structures are formed around the edge to detect the brink among the edges.

When the target enters into the square phase, any nodes present inside the square region detect but there is no guarantee for the target to use those detected nodes for crossing. As the target moves further, it enters the rectangular part. Now, it is detected by the nodes inside this rectangular region. The probability of using the nodes inside the region for crossing is more. The crossing phase is the one when the target crosses the edge, and that is the brink. Hence, the brink can be detected using three discussed phases. After the completion of last phase i.e. crossing phase, now the active polygon becomes the neighboring one and the polygon in which the target present becomes an active one. A joint message is broadcasted to the forward polygon while the moving object or target touches the second phase. This message helps highly to make the forward polygon to become vigilant. In this way, detection of brink helps also in detecting the forward polygon, so the number of nodes that to be active can be optimized.

Optimal selection of nodes

Optimality is an important factor in all processes. Here, optimization is carried out with the number of nodes and the amount of time they have been used. All sensors do not give useful information in this Face tracking technique. So, the number of sensors to be kept active can be minimized. The sensors which provide useful information in detection and which consume less energy are to be selected. An optimal mechanism is adopted to select the appropriate sensors. Once the brink is formed, nodes start to query and passes message to the neighboring nodes of the forward polygon. The estimation of the target and the information about sender are the contents of the message. The node which contains the message with the best weight is found by ranking the bid from all neighboring nodes. The comparison of the weight of all received bids is to select the best nodes to involve in detection process, and to avoid the unnecessary usage of other nodes inside the polygon. The factors that are used in this optimality process are: location of sensor node, location of target calculated by the sensor node and one of the couple nodes. The minimum number of optimal nodes should be two.

Coping of loss of tracking

The sensors in the face tracking mechanism can get failed. The failed nodes do not able to collect information and cannot able to communicate with the sink. This may result in loss of tracking. Here, this loss of tracking can be overcome by the extension of polygon. When the nodes get failed, the polygons can be merged together. The two neighboring polygons can be joined to form a single one. Using this technique, the loss of tracking can be tackled.

Identification of Theft of vehicle

In a restricted area such as area under military surveillance, all vehicles are not allowed inside the area. Only authorized vehicles can use the region. This face track concept can be used in the application of truck carrying the weapons or equipments of greater importance. Here, the routes for that vehicle carrying those important weapons to reach the destination are to be pre-fined. Since, it's an authorized vehicle, the driver is also aware of the routes that are to be used to reach the \destination. This vehicle is the target to be tracked now. The vehicle should move in the pre-defined route. Suppose, if it moves in a different route it enters into the polygon that is not pre-defined. As it crosses the brink of different polygon that it should not enter, a set-up is made like showing some alarming or indications. Through this, the user or sink can get aware about the irrelevant act of the vehicle and investigations can be done in that particular polygonal area and need not to disturb the whole area or environment.

4. RESULTS AND DISCUSSION

The Face tracking framework is simulated in a square planar field of 400×400m dimension. N (200) sensors are distributed in a field. The sensors can able to communicate using bi-directional wireless links. The sensing and communication range are declared. The distance between two sensor nodes should be less than the sensing range. Atleast three nodes are needed to form a polygon. The acceleration of a vehicle is considered as 2m/s and a velocity of 10m/s. The target moves at a speed of 2-10 m/s. The experiment is carried out with different rates of speed. Face tracking gives the best tracking ability in case of vehicle with greater speeds. The ability of tracking is greater in face track when compared with path matching, autonomous and global node selection mechanisms. Location information of the target is not needed at every step of movement of the target in case of face tracking. It computes the movement between the polygons which helps in finding the present area of the target among all the faces.

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