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Achieving 2 Pie Radian Angle Coverage with Minimum Transmission Cost in wireless Visual Sensor Networks

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Abstract— **Detecting and tracking of intrusion over an area covered by wireless visual sensor network is a part of the surveillance problem. The visual sensor nodes that are deployed need to be efficiently managed to conserve energy while providing the optimum coverage. We consider the angle problem in this paper. We have a surveillance system which is responsible for capturing images of the intruder in the area it is monitoring. We aim at maintaining all angles of the intruder object with minimum transmission cost. The proposed model is implemented using MATLAB to evaluate the performance of the system, with the results showing that our model is more efficient than the existing system and it was found that it can save up to 10 to 15 % of transmission cost and prolong network lifetime.**

Keywords: Visual sensor Networks, Energy saving, Tracking, Surveillance, Distributed algorithm.

I. INTRODUCTION

Wireless visual sensor networks is an upcoming domain where a number of quality research can be conducted. There are many challenging problems which have intrigued the research community [1], [2]. A visual sensor network consists of sensor which are distributed randomly or deterministically over a large area which it has to monitor. This domain area supports a lot of new work. The visual sensor is responsible for tracking an intruder and capture it, due to many sensors, the client gets more information of the intruder. As a result, the transmission load of the wireless visual sensor networks should be reduced in order to extend network lifetime. Additionally, traditional wireless sensor networks are often static with no rotating capabilities [3]. *Coverage problem* is our main concern in wireless sensor networks [4], [5]. It shows how an area is monitored by sensors. In this paper, we analyze the *angle coverage* problem. In a surveillance system when an object enters the network the sensors capture their images .Due to the random deployment of sensors we get many angles of the object which is useless for processing .A traditional way to go about this problem is collect all the data and process it on by one which is an unconventional method and consumes a lot of energy .Since nodes are next to each other there is correlation between the data captured by the nodes .Using this we can eliminate certain useless data and only the important data can be sent to the sink while maintaining high coverage shortest path problem [6], which can in turn be transformed using dijiktra's algorithm .we develop a new optimized algorithm which is more efficient compared to existing techniques

The rest of this paper is organized as follows: Section II presents the related work. Section III presents the Network model and the simulation results are shown in Section IV. We finally conclude our paper in Section V.

II. RELATED WORK

Coverage problem is one of the main problems in wireless visual. There are many organizations researching on this domain [5], [7], [8]. Ref [9] Visual sensor networks are different compared to other sensors because they have a capture range. In this paper we can see that the sensors are deployed on a random plane and due to how the visual sensor networks capture data the existing techniques cannot be used and we don't get satisfying results from them and coverage cannot properly be maintained. Due to randomness of nodes distribution and each image has to travel different amount of distance to reach the sink we develop an algorithm to find minimal cover [10] to maintain all angles of the intruder object with minimum transmission cost.

III. NETWORK MODEL

let us consider a network model where nodes are randomly distributed. The main job of sensors is to capture an intruder which enters the sensors field of view and transmit them to the sink. we set some parameters to the model where the field of view and radius and focal length etc. of all the sensors are the same. The sensors know their position using image-based localization algorithms such as [11], [12] . if two sensors have an intersecting range then they are considered neighbors and can communicate with each other

A. Capture Range

In the below figure **aov** is angle of view, **fov** is field of view. Each sensors knows where it is physically located so p is given. Ao, aov ,fov can be found .

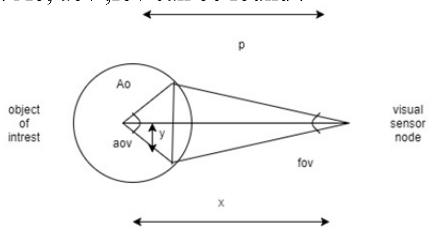

Fig. 1. Relationship between intuder object and sensor

The image sent to the sink by a visual sensor node has the resolution 512X512, see the above Figure 1. The full view of the captured image is 2y. So based on this we get an image resolution of 512/2y. As the sensors is more far from the intruder object y increases, there are certain advantages and disadvantages we can capture more visual information but resolution decreases. This shows there is a tradeoff between distance and captured image.

B. Transmission Cost

The below equations contains equations which can be summarized as follows |Is| is the image size hpc(s) is hop count and E is the energy required.

$$T(s) = |Is| \times hpc(s) \times E \qquad (1)$$

By considering fig 2 it can be seen that sometimes the shortest path will not be the most efficient path. The two sided arrow indicates a capture range and the circle with a number in it is the hop count.

$$T_{total\_energy} = (3 + 3 + 4 + 4 + 4) \times |I| \times E \qquad (2)$$

{1, 2, 3, 4, 7, 8} is another cover and its transmission cost is:

$$T_{total\_energy} = (3 + 2 + 3 + 3 + 3 + 3) \times |I| \times E \qquad (3)$$

It can be seen {1, 2, 3, 4, 7, 8} utilizes lesser power than {1, 3, 5, 6, 9}.

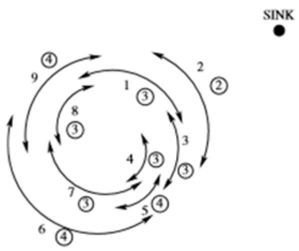

Fig. 2. Illustraton of new network model

C. Distributed Algorithm

The dijikstra's algorithm doesn't work in every situation. So based on this we consider an Distance Vector protocol which has a large message complexity an overhead .So due to uniqueness of graphs i.e. no deadlocks we can solve this by shortest path. So we develop an an optimized distributed algorithm.

Default Node s
1: Price[s]=hpc[s]
2: Old[s]=⊥
3: total price=∞
4: After finding price[s], send s to all the neighbors ahead
5:
6: After receiving price[w], w from all the backward neighbors w
7: {
8: If total price > price [w]
9: {
10: Total price = price[w]
11: Old(i)=w
12:}
13: Save w
14: If all backward neighbors are saved
15: {send ELECTED to old[s]}
16:}
Non-default Node v
17: Pricet[v]=∞
18: Old(v)=⊥
19: After receiving price[w], w from all the backward neighbors w
20: {
21: if price[v] > cost [w]+hpc[v]
22: {
23: price[v]=price[w]+hpc(v)
24: old[v]=w
25:}
26: Save w
27: if all backward neighbors are saved
28: {send price[v], v to all forward neighbors}
29:}
30: Upon receiving ELECTED
31: {send ELECTED to old[v] }

A sensor starts its process of identifying the paths. whenever a non-default node is approached by default node we can say that a new path is found. If all the backward neighbors have sent their cost, then a path is fully identified. Then based on the paths identified and costs are broadcasted we can choose a shortest path.

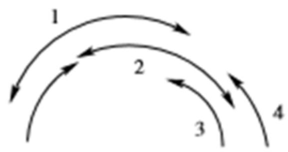

Fig. 3. Without default member

The above model is at its peak efficiency if there are a lot of default sensor nodes. if there are not many sensor nodes then each node may try to start its own procedure .so we need to restrict only one sensor node to start, which can be solved by changing the following lines in the algorithm 14 and 27: if (all backward neighbors are marked) or (timeout).

IV. SIMULATION

The analytical mode which we developed is executed on matlab. The network which we are considering is a 50X50 area. We use various test case, which is based on FOV (field of view). Fig4 shows when a certain image resolution is specified how many nodes which satisfies the specified resolution fig 5 and 6 is show how minimal cover is always lesser than minimal cost cover but substantially there is a reduction in sum of hop count. The hop count only increases when an image of higher resolution is requested. Fig 7 and fig 8 show the same attributes with a different test case i.e. FOV (field of view) =30.

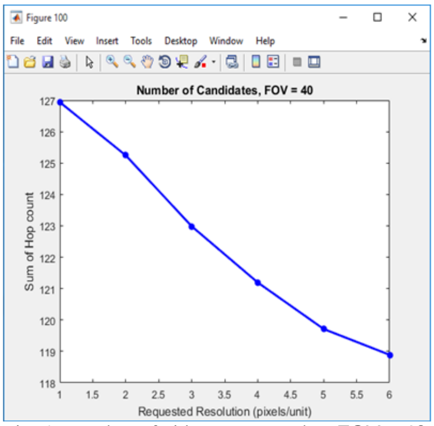

Fig. 4. Number of video sensor nodes, *FOV* = 40°

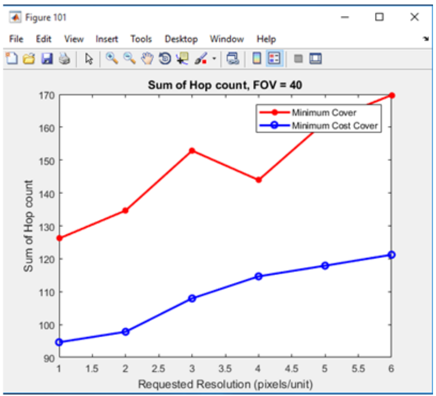

Fig. 5. Summation of hop count, *FOV* = 40°

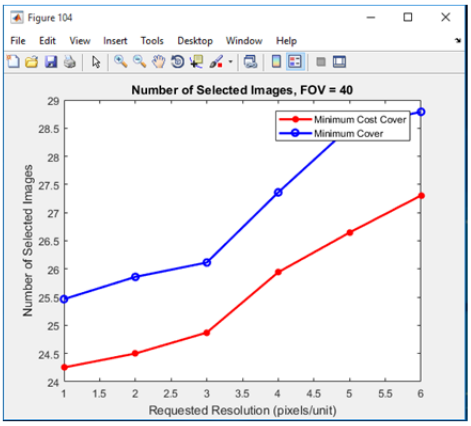

Fig. 6. Selected images when, field of view = 40°

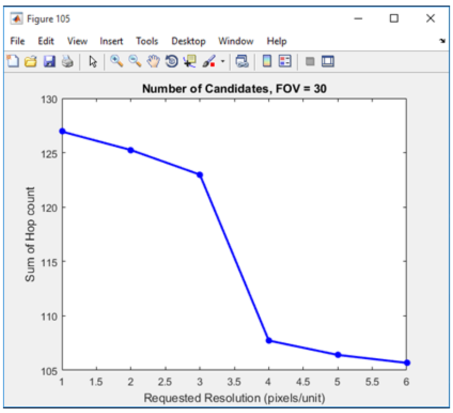

Fig. 7. Number of video sensor nodes, *FOV* = 30°

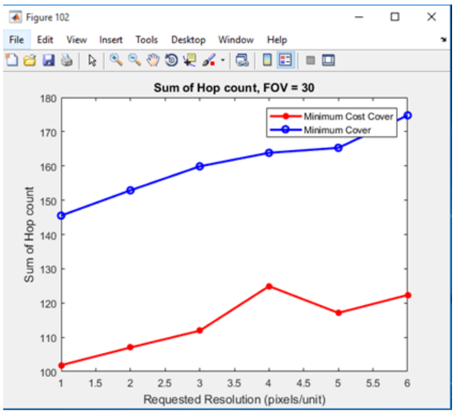

Fig. 8. Summation of hop count, *FOV* = 30°

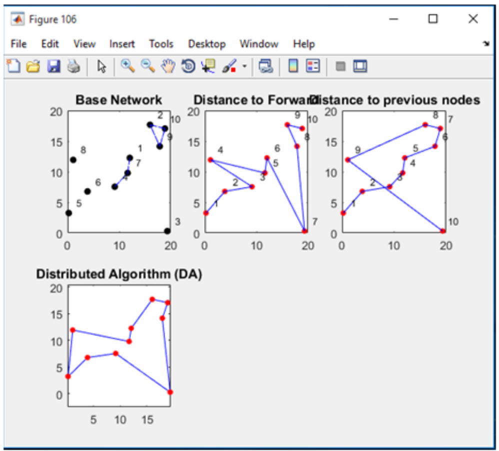

Fig. 9. Network Details (DA Algorithm)

V. Conclusion

In this paper our main focus is on the angle coverage problem in wireless visual sensor networks. we can see that minimal cost cover can in turn be converted into shortest path problem and solved by dijikstra's algorithm. Our developed algorithm is more efficient compared to the existing techniques. The above results show that it can conserve 10 to 15% of energy and add more life to the network. The model that was used in this project is just one of the simple models that can be applied to the network for reducing the transmission cost. Next step of the project would be in the direction of analyzing the trade-offs between hop count and requested image resolution. Various analytical models can be used for the same. The project mainly contributes to providing an algorithm for designing a prototype that achieves 2 pie radian angle coverage with minimum transmission cost.

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