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QoS Routing Solution

Angular Position Discovery Methods

Highlights

Wireless Sensor Networks

Evaluation of Target Trajectory

Discovering Thoughts, Inventing Future

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Performance Evaluation of Target Trajectory and Angular Position Discovery Methods in Wireless Sensor Networks

By Rashmi Ranjan Sahu & Dr. Jitendranath Mungara
RVCE, India

Abstract- In sensor networks Target Tracking defines how accurate a targets position can be measured. We consider both stationary target and mobile target. Since the mobile target is unknown, the mobile sensor controller utilizes the measurement collected by a wireless sensor network in terms of the mobile target signal's time of arrival (TOA).We proposed time of arrival2 (TOA2) algorithms which consider time to live (TTL). We investigate the correlations and sensitivity from a set of system parameters. We derive the minimum number of mobile sensors that are required to maintain the resolution for target tracking in a mobile sensor network (MSN).The simulation results demonstrate the tracking performance can be improved by an order of magnitude with the same number of sensors when compared with that of the static sensor environment.

Keywords: *time of arrival (TOA), time to live (TTL), mobile sensor network (MSN).*

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Performance Evaluation of Target Trajectory and Angular Position Discovery Methods in Wireless Sensor Networks

Rashmi Ranjan Sahu [α] & Dr. Jitendranath Mungara [σ]

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Keywords: time of arrival (TOA), time to live (TTL), mobile sensor network (MSN).

I. Introduction

Wireless Sensor Networks (WSNs) consist of many no of small nodes .It can be an effective for collecting data from various environments. Each sensor sends its data to Base Station (BS) [4], and finally BS sends these data to end user. Clustering is considered as an effective approach to provide better data gathering and scalability for large sensor networks.

Sensor networks are the combination of distributed sensing, communication and computing. They lend themselves to various applications such as Military applications, environmental monitoring, and support for logistics, human-centric applications and robotics applications.

Since a large number of sensor nodes are closely deployed, neighbor nodes may be having very short distance among them. Hence, multi-hop communication [2] in wireless sensor networks consumes less power than the single hop communication which is a traditional approach. However, the multi-hop routing of WSNs often has to perform target detection not only with respect to the distance between the transmitting base station but also spatial separation with respect to each sensor is also required in order to accurately estimate the target in a sensor field.

II. Literature Survey

A wireless sensor network is an autonomous system of numerous tiny sensor nodes equipped with integrated sensing and data processing capabilities. These sensor networks are distinguished from other wireless networks by the fundamental constraints under which they operate, i.e., sensors have limited and un-replenish able power resources making energy management a critical issue in wireless sensor networks. So these sensors must utilize their energy as efficiently as possible.

Many no of sensors are randomly placed and the target does not follow a single uniform path. So the main challenge is to track the moving target .So it requires an efficient navigation control method. Enyang and Soura [1] studied a set of different algorithm for node deployment like TOA algorithm. Generally a target is signal emitter whose transmission is received by a number of sensors that is placed distributedly. Distributed inference methods [8] developed for graphical models comprise a principled approach for data fusion in sensor networks. The application of these methods, are distributed nature of computation and deployment coupled with communications bandwidth and energy constraints typical of many sensor networks. Traditional measures [1] of distortion are not sufficient to characterize the quality of approximation as they do not address in an explicit manner the resulting impact on inference .While both graphical models and a distributed sensor network [8] have network structures associated with them.

III. New Contributions

We are interested in target tracking by considering both moving targets and mobile sensors. The spatial resolution refers to how accurate a target's position can be measured by sensors, and the actual paths in wireless sensor networks. Here we used Time To Live (TTL) for route discovery and also we considered Min Hop for finding the path .We define the spatial resolution as the deviation between the estimated and the actual target trajectory path, which

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can be explained as the distance that a target is not covered by any mobile sensors. It includes a more general TOA [8] measurement model that accounts for the measurement noise due to multipath propagation and sensing error.

IV. Problem Statement

The problem of tracking signal-emitting mobile targets using navigated mobile sensors based on signal reception. The Mobile Sensor Collection node will initiate communication with other sensor nodes in the network and finds multiple measurements with respect to the target location and then the time of arrival of each signal from the sensor nodes is computed with respect to target by the mobile sensor collector node. The path which has the lowest TOA is said to be trajectory of the mobile node in the network. But this project not only computes the TOA [8] but only measures the spatial separation with respect to degrees so that the TDD [5] of the mobile target is also captured. The node deployment algorithm, which is responsible for deploying the nodes in a sensor area consider TTL and mean hop. It also checks which nodes are within the coverage range and which are not. The target is tracked by angular position discovery algorithm.

V. Mathematical Modeling

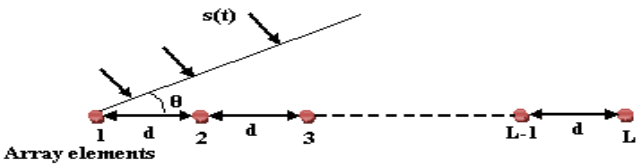

Figure 1 : Uniform Linear Array

Consider a uniform linear array geometry with L elements numbered 0, 1,…, L- 1 with a spacing of have half wavelength spacing ( ) between them. Let be the baseband signal that is received by each array element, but at a different time instant. If the phase of baseband signal received at element 0 is zero. By examining the geometry from figure 1, using basic trigonometry and facts from wave propagation, the time delay of arrival can be computed as

$$\Delta t_k = \frac{k\,D\sin\theta}{c} \qquad (1)$$

Where, is the speed of light, is an integer and is the direction from which plane wave is impinging on Sensor array

Suppose is a narrowband digitally modulated signal with low pass equivalent, carrier frequency , and symbol period . Narrow band signal can be written as

$$b(t) = \mathrm{Re}\left\{ b_l(t)\, e^{j2\pi f_c t} \right\} \qquad (2)$$

The signal received by the k[th] element is given by

$$x_k(t) = \mathrm{Re}\big(b_l(t-\Delta t_k)\big)e^{j2\pi f_c (t-\Delta t_k)} \qquad (3)$$

Now suppose that the received signal at the k[th] element is down converted to the baseband. In that case, the baseband received signal is defined as

$$x_k(t) = b_l(t-\Delta t_k)\, e^{-j2\pi f_c \Delta t_k} \qquad (4)$$

VI. Methodology

1. Node Deployment
   This is responsible for placing the nodes in a given area
2. Coverage Area Determination
   This module is used to determine the nodes which are reachable or to which a given sensor node can communicate directly
3. Picking the Next Sensor
   The next sensor is picked randomly and target location is determined with respect to given sensor area.
4. Measuring the TOA
   The TOA is measured with respect to the distance of the node and time of arrival of the detection packets.
5. Measuring the TDD
   The Target Direction Detection of the signals with respect to the target is measured using MEV and CRLB approach

VII. Tracking Algorithms

a) Node deployment algorithm

Algorithm I

1.Input no of nodes ,node id,I,xmin,xmax,ymin,ymax.
2.if I<=no of nodes
3.Then x-coordinate position between Xmin to Xmax
4.Then y-coordinate position between Ymin to Ymax
5.Generate Node Id
6.Then I=I+1
7.End

The Node Deployment algorithm is used to randomly disperse the nodes across the network. It will place the node randomly in a network.

b) Path Discovery Algorithm

Algorithm 2(Path Discovery)

1. Input Source Node and Target Node
2. Fetch Routing Table
3. Fetch Neighbors
4. If neighbors contain Target
5. Route Discovered
6. Else Pick neighbor randomly
7. Then TTL=TTL-1

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8. If TTL !=0
9. Then Go to Step 1
10. Else Min-Hop

The Individual Route Discovery Module is implemented by Time of Arrival 2 algorithm. . When a source node wants to send data to the sink, it includes a TTL of initial value N. It then randomly selects a neighbor for each share, and uni-casts the share to that neighbor. After getting the share, the neighbor first decrements the TTL. If the new TTL is greater than 0, then compares the neighbor list obtained from routing table with the list of nodes present in Node in Route (NIR Field). After getting the set of nodes not present in NIR. The neighbor is randomly picked from the neighboring nodes .When the TTL becomes 0, the last node receiving that share stops the random propagation of this share, and starts mooving it toward the sink using normal min-hop routing. The Min-Hop Routing algorithm picks the farthest node of its transmission range.

The minimum Hop Routing Algorithm used in the algorithm when TTL becomes zero works as below Min Hop routing algorithm picks the neighbor which is closest to the destination node. i.e. farthest node which is reachable.

c) Target Direction Detection Algorithm

Target Direction Detection of a mobile node with respect to spatial separation using different Filters approach are as follow.

We can get from (4)

The received baseband signal after sampling with a sampling period of T seconds is given by

$$x_k(nT) = b_l(nT - \Delta t_K)e^{-j2\pi f_c \Delta t_K} \quad (5)$$

In a wireless digital communication system, the symbol period will be much greater than each of the propagation delays across the array given by

$$T \succ\succ \Delta t_K, \; k = 0,1,.....,L-1 \quad (6)$$

This allows the following approximation to be made

$$x_k(nT) \approx b_l(nT)e^{-j2\pi f_c \Delta t_K} \quad (7)$$

The constants c and f_c can be related through the basic equation

$$c = f_c \lambda \quad (8)$$

Where, λ is the wavelength of the propagating wave and f_c is the carrier frequency. The element spacing can be computed in wavelengths by using

$$d = \frac{D}{\lambda} \quad (9)$$

Using the equations (1) and (8) in equation (7) we can arrive at equation

$$x_k(nT) \approx b_l(nT)e^{-j2\pi f_c \Delta t_K} = b_l(nT)e^{-j2\pi \frac{c}{\lambda}\frac{kD\sin(\theta)}{c}} \quad (10)$$

Substituting the value of 'D' from equation (9) in equation (10) gives

$$x_k(nT) \approx b_l(nT)e^{-j2\pi \frac{c}{\lambda}\frac{k\,d\,\lambda\sin(\theta)}{c}} \quad (11)$$

After simplifying, we get

$$x_k(nT) \approx b_l(nT)e^{-j2\pi\, k\, d\sin(\theta)} \quad (12)$$

When discrete time notation is used with time index n, equation (12) can be written as

$$x_k(n) \approx b(n)e^{-j2\pi\, k\, d\sin(\theta)} \approx b(n)a_K(\theta) \quad (13)$$

Where, $a_K(\theta) = e^{-j2\pi\, k\, d\sin(\theta)}$ and k is an integer in the range $0 \le k \le L-1$

Let the n[th] sample of the baseband signal at the k[th] element be denoted as $x_k(n)$ .When there are M signals present, the n[th] symbol of the i[th] signal will be denoted by $b_i(n)$ for $i = 0,1,2,....,M-1$. The baseband sampled signal at the k[th] element can be expressed as

$$x_k(n) \approx \sum_{i=0}^{M-1} b_i(n)\,a(\theta_i) \quad (14)$$

i. *Formulation of Array Data Matrix*

By considering all the array elements, i.e $k = 0,1,2,....L-1$, equation (2.14) can be written in a matrix form as

$$\begin{bmatrix} x_0[n] \\ x_1[n] \\ . \\ . \\ . \\ x_{L-1} \end{bmatrix} = \begin{bmatrix} a_0(\theta_0) & a_0(\theta_1) & .....a_0(\theta_{M-1}) \\ a_1(\theta_0) & a_1(\theta_1) & .....a_1(\theta_{M-1}) \\ . & . & . \\ . & . & . \\ . & . & . \\ a_{M-1}(\theta_0) & a_{M-1}(\theta_1) & .....a_{M-1}(\theta_{M-1}) \end{bmatrix} \begin{bmatrix} b_0[n] \\ b_1[n] \\ . \\ . \\ . \\ b_{M-1}[n] \end{bmatrix} + \begin{bmatrix} n_0[n] \\ n_1[n] \\ . \\ . \\ . \\ n_{L-1} \end{bmatrix} \quad (15)$$

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Where , $n_k[n]$ is additive white Gaussian noise considered at each element, $x_K[n]$ is the induced signal, b_n is the amplitude of n[th] source, M is the number of sources, L is the number of Sensor elements and n_n is the amplitude of n[th] noise sample. Equation (2.15) can be written in compact form as

$$x_n = [a(\theta_0)\ a(\theta_1).....a(\theta_{L-1})]b_n + n_n = Ab_n + n_n \quad (16)$$

Where, $a(\theta_i) = [a_0(\theta_i)\ a_1(\theta_i).....a_{L-1}(\theta_i)]$ is called the steering vector for the angle θ_i .These form a linearly independent set assuming the Target Direction Detection of each of the M signals is different. The vector n_n represents the uncorrelated noise present at each Sensor element. Because the steering vectors are a function of the angles of arrival of the signals, the angles can be computed if the steering vectors are known or if a basis for the subspace spanned by these vectors A is known. The set of all possible steering vectors is known as the array manifold given by

$$A = \begin{bmatrix} a_0(\theta_0) & a_0(\theta_1) & \ldots & a_0(\theta_{M-1}) \\ a_1(\theta_0) & a_1(\theta_1) & \ldots & a_1(\theta_{M-1}) \\ . & . & & . \\ . & . & & . \\ . & . & & . \\ a_{M-1}(\theta_0) & a_{M-1}(\theta_1) & \ldots & a_{M-1}(\theta_{M-1}) \end{bmatrix} \quad (17)$$

ii. *Formation of Array Correlation Matrix or Spatial Covariance Matrix*

The spatial covariance matrix of the Sensor array can be computed as follows. Assume that b_n (signal) and n_n (noise) are uncorrelated, n_n is a vector of Gaussian white noise samples with zero mean. The spatial covariance matrix R is given by

$$R = E[x_n\ x_n^H] \quad (18)$$

Substituting x_n from equation (16) in equation (18), we can obtain

$$R_{xx} = E[(Ab_n + n_n)(Ab_n + n_n)^H] \quad (19)$$

Applying expectation operator (E) to signal b_n and noise n_n in equation (19) results in

$$R = AE[b_n\ b_n^H]A^H + E[n_n n_n^H] \quad (20)$$

Defining $R_{ss} = E[b_n\ b_n^H]$ and $E[n_n n_n^H] = \sigma^2 I$ one can obtain array correlation matrix given by

$$R = A\ R_{ss}\ A^H + \sigma^2 I \quad (21)$$

Where, R is LxL Array Correlation Matrix or Spatial Correlation matrix, A is LxM Array Manifold Vector, A^H is hermitian transpose of A, σ^2 is noise variance, I is LxL identity matrix and R_{ss} is MxM source amplitude matrix given by

$$R_{ss} = E[b_n\ b_n^H] = \begin{bmatrix} b_1 \\ b_2 \\ . \\ . \\ b_M \end{bmatrix} * [b_1^*\ \ b_2^*\ .....b_M^*] = \quad (22)$$

$$\begin{bmatrix} b_1 b_1^* & 0 & \ldots & \ldots & 0 \\ 0 & b_2 b_2^* & \ldots & \ldots & 0 \\ \vdots & \vdots & \vdots & & \vdots \\ \vdots & \vdots & \vdots & & \vdots \\ 0 & 0 & \ldots & \ldots & b_M b_M^* \end{bmatrix}$$

Where $b_1, b_2, ...b_M$ are amplitudes of M signals (sources).

iii. *Finding Eigen value and Eigen Vectors of Array Correlation Matrix*

Eigen values and eigenvectors [4] provide useful and important information about a matrix. It is possible to determine whether a matrix is positive definite, invertible, indicate how sensitive determination of inverse will be to numerical errors. Eigen values and eigenvectors are useful in spectrum estimation and adaptive filtering problems.

The Eigen values of LxL Array Correlation matrix R is found by solving the characteristic equation given by

$$|R - \lambda I| = 0 \quad (23)$$

The solution to equation (23) gives L Eigen values $\{\lambda_1, \lambda_2, ..., \lambda_L\}$.

The Eigen Vector for specific Eigen value λ_a is found by solving the equation given by

$$R\ V_n = \lambda_a V_n \quad (24)$$

Where V_n is Lx1 matrix comprising of unknown variables. Expanding equation (24) in matrix notation,

$$\begin{bmatrix} R_{0,0} & R_{0,1} & \ldots & R_{0,L} \\ R_{1,0} & R_{1,1} & \ldots & R_{1,L} \\ \vdots & \vdots & \vdots & \vdots \\ R_{L,0} & R_{L,1} & \ldots & R_{L,L} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ \vdots \\ V_L \end{bmatrix} = \lambda_a \begin{bmatrix} V_1 \\ V_2 \\ \vdots \\ V_L \end{bmatrix} \quad (25)$$

Multiplying the matrices, a set of simultaneous equations as defined in (26) are obtained

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$$\begin{aligned} R_{0,0}V_1 + R_{0,1}V_2 + \ldots\ldots\ldots\ldots + R_{0,L}V_L &= \lambda_a V_1 \\ R_{1,0}V_1 + R_{1,1}V_2 + \ldots\ldots\ldots\ldots + R_{1,L}V_L &= \lambda_a V_2 \\ \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots & \\ R_{L,0}V_1 + R_{L,1}V_2 + \ldots\ldots\ldots\ldots + R_{L,L}V_L &= \lambda_a V_L \end{aligned} \quad (26)$$

Since there are L Unknowns we have L simultaneous equations which can be solved to obtain $V_1, V_2, \ldots\ldots, V_L$. These L values form Eigen vector matrix.

a. *Kalman Filter*

This method finds a power spectrum such that its Fourier transform equals the measured correlation subjected to the constraint that its entropy is maximized. For estimating TDD from the measurements using an array of sensors, the Kalman method finds a continuous function $P_{MEv}(\theta) > 0$ such that it maximizes the entropy function.

The Kalman power spectrum is given by

$$P_{KALMAN} = \frac{1}{a^H(\theta) E_S E_s{}^H a(\theta)} \quad (27)$$

Where,

E_s = Maximum eigen vectors

$a^H(\theta)$ = Hermitian transpose of steering vector

b. *MMA Filter*

The Maximum Margin Analyzer is known as a MMA. It is also alternatively a maximum likelihood estimate of the power arriving from one direction while all other sources are considered as interference. Thus the goal is to maximize the Signal to Interference Ratio (SIR) while passing the signal of interest undistorted in phase and amplitude. The source correlation matrix R_{ss} is assumed to be diagonal. This maximized SIR is accomplished with a set of array weights given by

$$w_{mma} = \frac{R_{xx}^{-1} a(\theta)}{a^H(\theta) R_{xx}^{-1} a(\theta)} \quad (28)$$

Where, R_{xx}^{-1} is the inverse of un-weighted array correlation matrix R_{xx} and $a(\theta)$ is the steering vector for an angle θ. The MMA pseudo spectrum is given by

$$P_{MMA} = \frac{1}{a^H(\theta) R_{inv} a(\theta)} \quad (29)$$

Where, $a^H(\theta)$ is the hermitian transpose of $a(\theta)$ and R_{inv} is the inverse of autocorrelation matrix.

c. *WMMA Filter*

In this method [10] a rectangular window of uniform weighting is applied to the time series data to be analyzed. For bearing estimation problems using an array, this is equivalent to applying equal weighting on each element. WMMA Filter method is also called Ordinary Beam forming Method (OBM). This method estimates the mean power $P_B(\theta)$ by steering the array in θ direction.

The power spectrum in WMMA Filter method is given by

$$P_{WMA}(\theta) = \frac{S_\theta^H R S_\theta}{L^2} \quad (30)$$

Where, 'S_θ' denotes the steering vector associated θ,

'R' is the array correlation matrix.

'L' is the number of elements in the array

In DOA estimation, a set of steering vectors {Sθ} associated with various direction θ is often referred to as the array manifold. From the array manifold ,the array correlation matrix, PB(θ) is computed. Peaks in $P_B(\theta)$ are then taken as the directions of the radiating sources.

d. *CRLB Filter*

CRLB is an acronym which stands for Carmer Roa Bound. CRLB provide correct estimates of the number of signals, angles of arrival and the strengths of the signal. CRLB makes the assumption that the noise in each channel is uncorrelated making the noise correlation matrix diagonal. However, under high Signal correlation the traditional CRLB algorithm breaks down and other methods must be implemented to correct this weakness.

The Eigen values and eigenvectors for correlation matrix R is found. M eigenvectors associated with the signals and L−M eigenvectors associated with the noise are separated. For uncorrelated signals, the smallest Eigen values are equal to the variance of the noise. The L× (L − M) dimensional subspace spanned by the noise eigenvectors is given by

$$E_N = [e_1\, e_2\, e_3 \ldots\ldots\ldots\ldots\ldots\ e_{L-M}] \quad (31)$$

Where, e_i is the i^{th} Eigen Value.

The noise subspace Eigen vectors [4] are orthogonal to the array steering vectors at the angles of arrival $\theta_1, \theta_2, \ldots\ldots\ldots\theta_M$. Because of this orthogonality condition, the Euclidean distance $d^2 = a(\theta)^H E_N E_N^H a(\theta) = 0$ for each and every angle of arrival $\theta_1, \theta_2, \ldots\ldots\ldots\theta_M$ .Placing this distance

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$d^2 = a(\theta)^H E_N E_N^H a(\theta) = 0$ for each and every angle of arrival $\theta_1, \theta_2, \ldots\ldots\ldots \theta_M$ .Placing this distance expression in the denominator creates sharp peaks at the angles of arrival. The CRLB pseudo spectrum is given by

$$P_{CRLB} = \frac{1}{a(\theta)^H E_N E_N^H a(\theta)} \qquad (32)$$

Where, $a(\theta)$ is steering vector for an angle θ and E_N is L x L-M matrix comprising of noise Eigen vectors.

VIII. Simulation

In this section we will provide the examples to explain different result .After that we will compare between TOA1 and TOA2, CRLB with other three algorithms.

Algorithm	Number of Nodes	Source Node	Target Node	Coverage Area	TTL
TOA1	30	8	23	15	-
TOA2	30	8	23	15	2

a) Route Discovery using TOA1 Algorithm

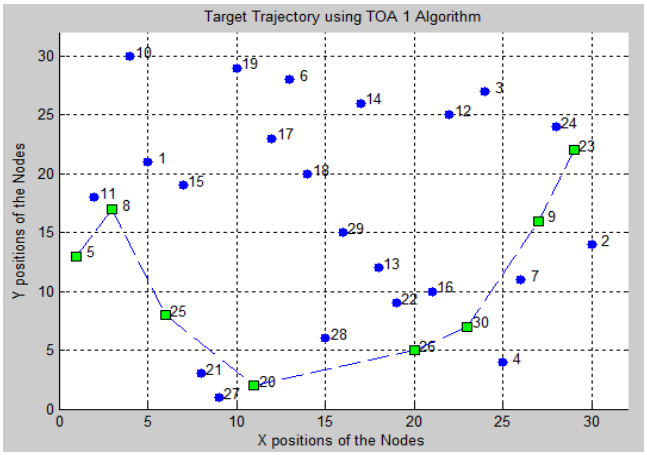

Figure 2 : Route Discovery Using TOA1

Figure 2 shows route discovery algorithm using TOA, which contains 30 nodes that are randomly placed. The source node is 8 and the target node is 23.

b) Route Discovery using TOA2 Algorithm

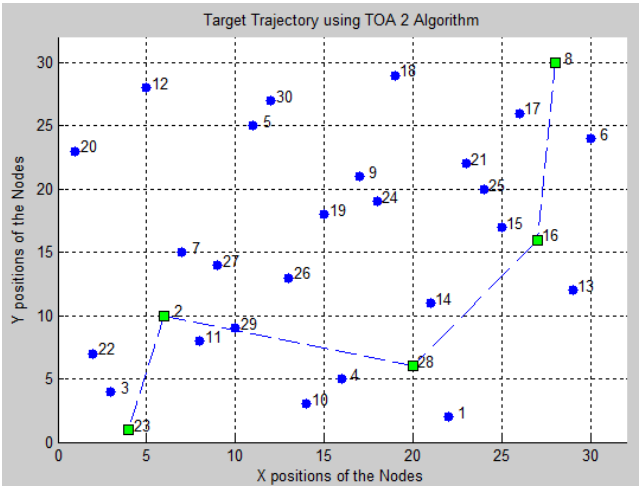

Figure 3 : Route Discovery Using TOA2

Figure 3 shows route discovery algorithm using TOA2, which contains 30 nodes that are randomly placed. TOA2 algorithm selects 3 intermediate nodes from source to destination whereas TOA1 algorithm selects 7 intermediate nodes.

c) Comparison between TOA1 and TOA2

We consider factors like Power consumption, Energy consumption, No of hops, Time for comparing the TOA algorithm and TOA2 algorithm.

No of Sensor	Source Node	Target Node	Power (mw)	Env. factor	Energy (mj)	Energy for Amp
50	23	9	1	0.5	1	0.5

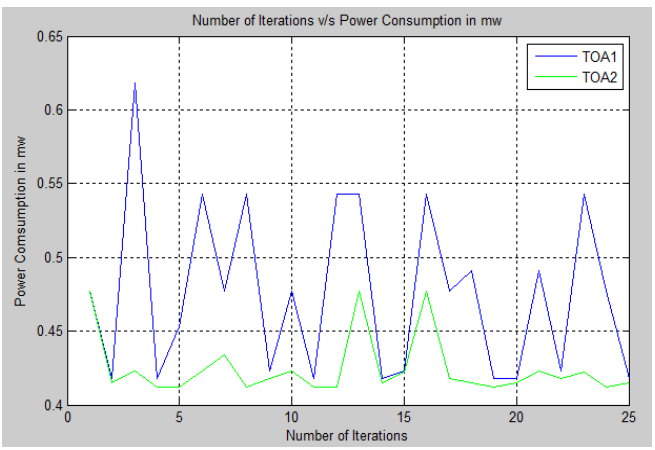

Figure 4 : No of Iteration v/s Power Consumption in mW

Figure 4 represents the graph between no. of iteration and power consumption in mw. From figure it is clear that TOA2 is having low power consumption as compared to TOA1.

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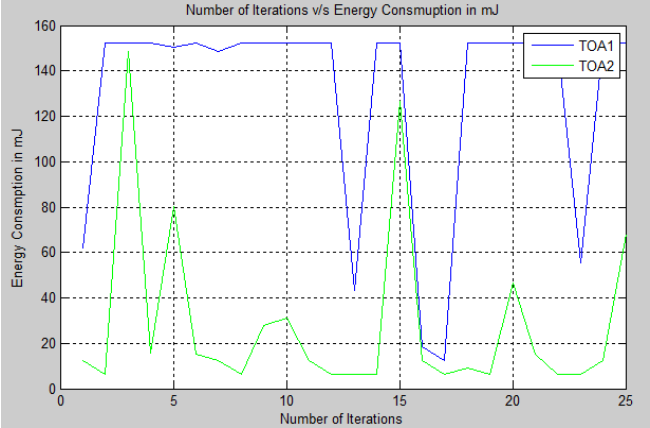

Figure 5 : No of Iteration v/s Energy Consumption in mJ

Figure 5 represents the graph between no. of iteration and energy consumption in mJ. From figure it is clear that TOA2 is having low energy consumption as compared to TOA1.

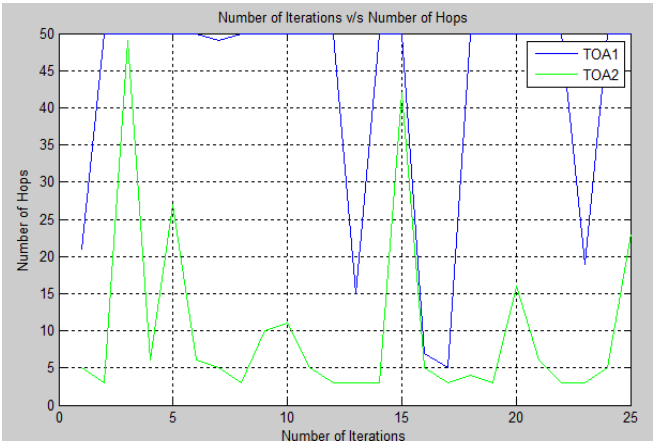

Figure 6 : No of Iteration v/s No. of Hops

Figure 6 represents the graph between no. of iteration and no of hops. No of hops is the no of links between a source node to destination node. The no of hops decreases when coverage area increases. Here the coverage area is fixed for both the algorithms. From figure 6 it is clear that TOA2 is having less no of hops as compared to TOA1.

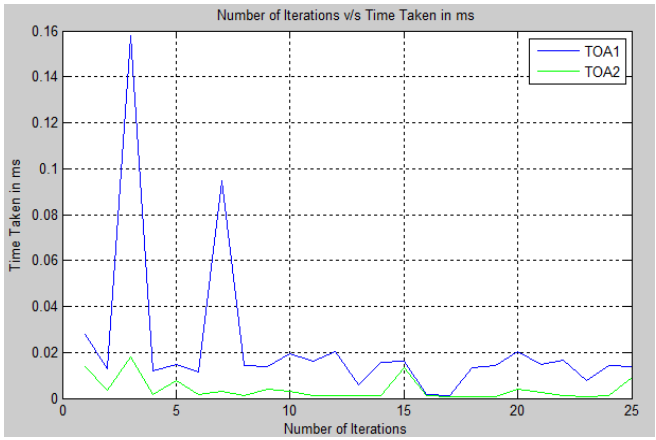

Figure 7 : No of Iteration v/s Time taken in ms

Figure 7 represents the graph between no. of iteration and time taken in ms. From figure it is clear that TOA2 takes less time as compared to TOA1.

No of Iteration/ Factor	5		10		25	
	TOA1	TOA2	TOA1	TOA2	TOA1	TOA2
Power(mw)	0.45	0.42	0.47	0.43	0.423	0.422
Energy(mj)	150	80	150	30	50	70
No of Hops	50	28	60	12	80	20
Time in Ms	.01	.005	0.02	.015	.019	.015

From the above table it is clear that the power and energy required for TOA2 algorithm is less than TOA1 algorithm. The second algorithm takes less time as compared to first one and also it takes less no hopes.

d) Comparison Filter Target Detection for Less Sensor Elements and Widely Spaced Sources

Algorithm	Number of Sensors	Target Direction	Amplitude
Kalman	20	[25 40 60]	[1 2 3]
WMA1	20	[25 40 60]	[1 2 3]
WMA2	20	[25 40 60]	[1 2 3]
CRLB	20	[25 40 60]	[1 2 3]

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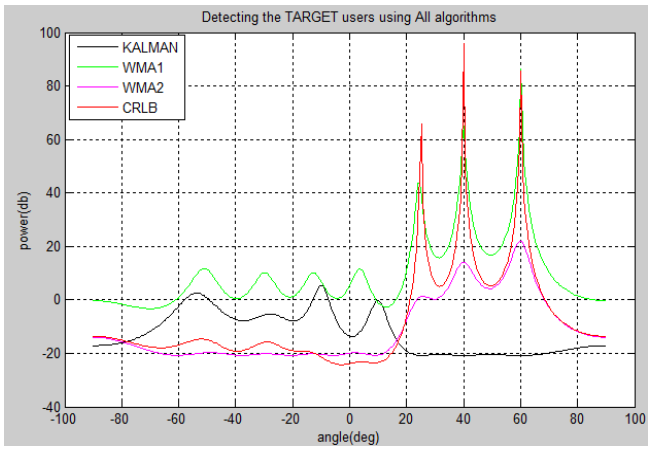

Figure 8 : Comparison of Filters for Less Sensor Elements and Widely Spaced Targets

From the plot it is evident that the Kalman filter is not able to detect target. The WMA1 and CRLB detect the target at 25, 40 and 60 degree as shown in the figure 8 .WMA2 detects two targets at 40 and 60 degree.

e) *Comparison Filter Target Detection for Large Sensor Elements and Widely Spaced Sources.*

Algorithm	Number of Sensors	Target Direction	Amplitude
Kalman	100	[25 40 60]	[1 2 3]
WMA1	100	[25 40 60]	[1 2 3]
WMA2	100	[25 40 60]	[1 2 3]
CRLB	100	[25 40 60]	[1 2 3]

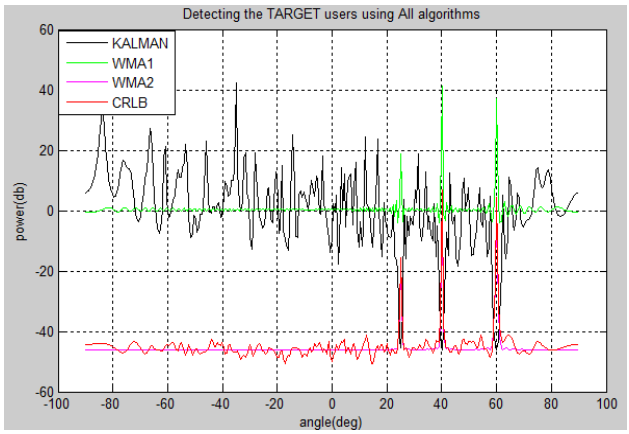

Figure 9 : Comparison of Filters for Large Sensor Elements and Widely Spaced Targets

From the plot it is evident that the WMA1 and CRLB detect the target at 25, 40 and 60 degree as shown in the figure 9. WMA2 detects the target and Kalman filter is not able to detect all the targets.

f) *Comparison Filter Target Detection for Less Sensor Elements and Closely Spaced Sources*

Algorithm	Number of Sensors	Target Direction	Amplitude
Kalman	20	[35 40 45]	[1 2 3]
WMA1	20	[35 40 45]	[1 2 3]
WMA2	20	[35 40 45]	[1 2 3]
CRLB	20	[35 40 45]	[1 2 3]

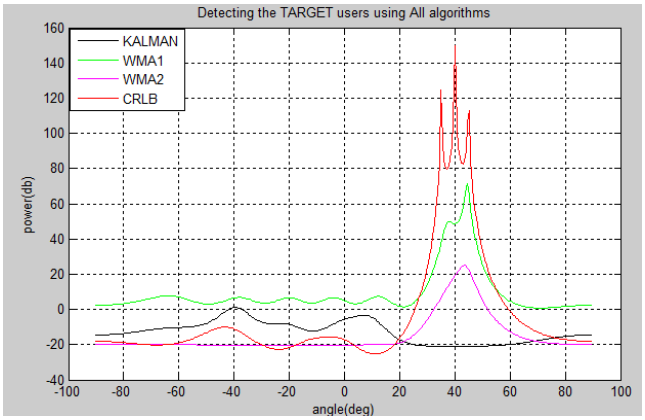

Figure 10 : Comparison of Filters for Less Sensor Elements and closely Spaced Targets

From the plot it is evident that the CRLB detect all the three targets where WMA1 detect two targets at 40 and 45 degree as shown in the figure 10. WMA2 detects one target whereas and Kalman filter is not able to detect all the targets.

g) *Comparison Filter Target Detection for Large Sensor Elements and Closely Spaced Sources.*

Algorithm	Number of Sensors	Target Direction	Amplitude
Kalman	100	[35 40 45]	[1 2 3]
WMA1	100	[35 40 45]	[1 2 3]
WMA2	100	[35 40 45]	[1 2 3]
CRLB	100	[35 40 45]	[1 2 3]

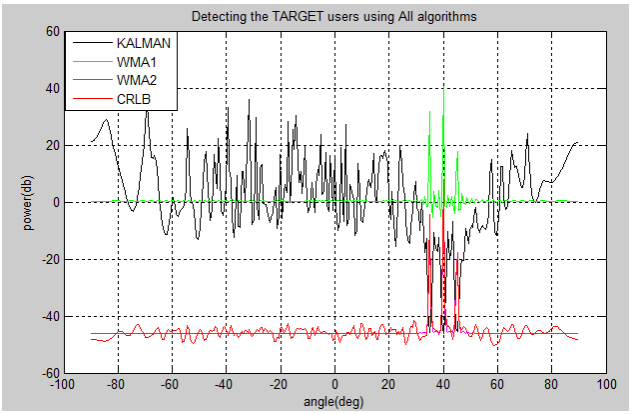

Figure 11 : Comparison of Filters for Large Sensor Elements and closely Spaced Targets

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From the plot it is evident that the CRLB and WMA1 detects all the three targets as shown in the figure 11 where WMA2 also detects targets whereas and Kalman filter is not able to detect all the targets.

IX. Conclusion

From the various simulations we can find out that CRLB works best as compared to all other algorithms for various cases like Low Sensors and Widely spaced targets, Low Sensors and Closely Spaced targets, Large Sensors and Widely Spaced targets and finally large sensor and closely spaced sources. From the various simulations one can prove that the TOA2 algorithm works better as compared to TOA1 algorithm with respect to energy, time, power and no of hops.

Algorithms can be future improved by maintaining the route trace list thereby reducing the energy, time, power and number of hops.

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Cognitive Location based Mobile AD HOC Networks Implementation with an Android Operating Systems

By Rajaram & Dr. V. Sumathy
PCET, India

Abstract- Cognitive radio (CR) technology is envisaged to solve the problems in wireless networks resulting from the limited available spectrum and the inefficiency in the spectrum usage by exploiting the existing wireless spectrum opportunistically. CR networks, equipped with the intrinsic capacities of the cognitive radio, will provide an ultimate spectrumaware communication paradigm in wireless communications. Specifically, in cognitive radio ad hoc networks (CRAHNs), the distributed multi-hop architecture, the dynamic network topology, and the time and location varying spectrum availability are some of the key distinguishing factors. In this paper, intrinsic properties and current research challenges of the CRAHNs are presented. A particular emphasis is given to distributed coordination between CR users through the establishment of a common control channel. Lastly, a new commission called the park model is explained, where CRAHN users may independently determine their own performance based on pre-decided spectrum. The performance is comparable to MANET routing protocols In this system implementation through real time systems with Specialized ANDROID BASED OPERATING SYSTEMS.

Keywords: *cognitive radio, Ad hoc networks, routing protocol, android OS.*

GJCST-E Classification : *D.4*

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Rajaram [α] & Dr. V. Sumathy [σ]

Abstract- Cognitive radio (CR) technology is envisaged to solve the problems in wireless networks resulting from the limited available spectrum and the inefficiency in the spectrum usage by exploiting the existing wireless spectrum opportunistically. CR networks, equipped with the intrinsic capacities of the cognitive radio, will provide an ultimate spectrumaware communication paradigm in wireless communications. Specifically, in cognitive radio ad hoc networks (CRAHNs), the distributed multi-hop architecture, the dynamic network topology, and the time and location varying spectrum availability are some of the key distinguishing factors. In this paper, intrinsic properties and current research challenges of the CRAHNs are presented. A particular emphasis is given to distributed coordination between CR users through the establishment of a common control channel. Lastly, a new commission called the park model is explained, where CRAHN users may independently determine their own performance based on pre-decided spectrum. The performance is comparable to MANET routing protocols In this system implementation through real time systems with Specialized ANDROID BASED OPERATING SYSTEMS.

Keywords: cognitive radio, Ad hoc networks, routing protocol, android OS.

I. Introduction

Recent technical improvements have resulted in the evolution of wireless ad hoc networks composed of twists that are self-organizing and can be deployed without infrastructure support. These devices generally take in small form factors, and have embedded storage, processing and An ability to communicate effectively. While ad hoc networks may support different wireless standards, the current state of the art has been mostly confined to their operations in the 900 MHz and the 2.4 GHz industrial, scientific and medical (ISM) bands. With the rising proliferation of wireless devices, these rings are increasingly getting congested. At the same time, in that respect are several frequency bands licensed to operators, such as in the 400–700 MHz range, that are used sporadically or under-employed for transmission The licensing of the wireless spectrum is currently undertaken on a long-term basis over vast geographical areas. In parliamentary law to direct the vital problem of spectrum scarcity, the FCC has recently sanctioned the usage of unlicensed devices in licensed bands. Therefore, dynamic spectrum access (DSA) techniques are offered to work out these current spectrum inefficiency problems. This new field of research foresees the growth of cognitive radio (CR) networks to further improve spectrum efficiency.

On the infrastructure-based CR networks, the observations and analysis performed by each CR user feeds the central CR base-station, so that it can reach determinations on how to avoid interfering with primary networks. Agreeing to this decision, each CR user reconfigures its communication parameters, as indicated in Fig. 1. Since the CR user cannot predict the influence of its activities on the entire network with its local observation, cooperation schemes are essential, where the noted data can be exchanged between devices.

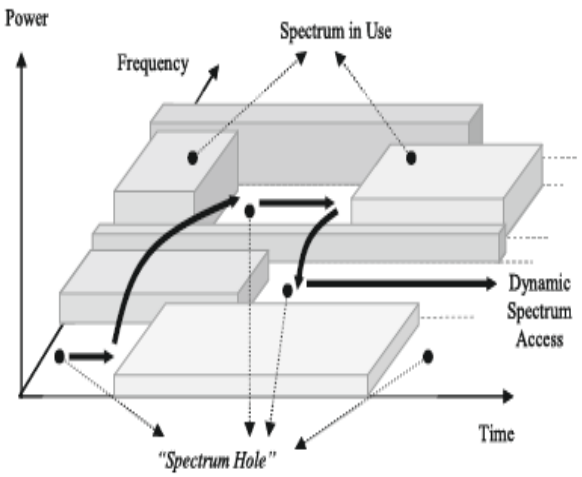

Figure 1 : CR use

a) Spectrum Sensing

A CR user can be allocated to only an unused part of the spectrum. Consequently, a CR user should monitor the available spectrum bands, and then detects spectrum holes. Spectrum sensing is a basic functionality in CR networks, and thence it is closely linked to other spectrum management functions as well as layering protocols to offer data on spectrum availability.

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b) Spectrum Decision

Once the available spectrums are identified, it is indispensable that the CR users select the most appropriate band according to their QoS requirements.

c) Spectrum Sharing

Since there may be multiple CR users trying to access the spectrum, their transmissions should be organized to prevent collisions in overlapping portions of the spectrum. Spectrum sharing provides the capacity to share the spectrum resource opportunistically with multiple CR users, which includes resource allocation to avoid interference caused to the main network.

1.4 spectrum mobility if a pu is detected in the specific part of the spectrum in use, cr users should vacate the spectrum immediately and stay on their communications in another vacant portion of the spectrum.

II. Sensing Control

The main objective of spectrum sensing is to find more spectrum access opportunities without interfering with primary networks. To this end, the sensing operations of CR users are controlled and coordinated by a sensing controller, which considers two main issues on (1) how long and frequently CR users should sense the spectrum to achieve sufficient sensing accuracy in in-band sensing, and (2) how quickly CR user can find the available spectrum band in out-of-band sensing.

a) In-Band Sensing Control

The first issue is related to the maximum spectrum opportunity as well as interference avoidance. The in-band sensing generally adopts the periodic sensing structure where CR users are allowed to access the spectrum only during the transmission period followed by sensing (observation) period. In the periodic sensing, longer sensing time leads to higher sensing accuracy, and hence to less interference. But as the sensing time becomes longer, the transmission time of CR users will be decreased. Conversely, while longer transmission time increases the access opportunities, it causes higher interference due to the lack of sensing information. Thus, how to select the proper sensing and transmission times is an important issue in spectrum sensing.

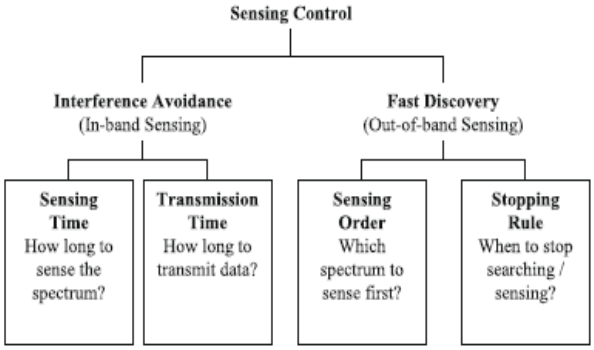

Figure 2 : Configuration Parameters

A theoretical framework is developed to optimize both sensing and transmission times simultaneously in such a way as to maximize the transmission efficiency subject to interference avoidance constraints where both parameters are determined adaptively depending on the time-varying cooperative gain and Spectrum characterization.

III. Radio Environment

Since the available spectrum holes show different characteristics, which vary over time, each spectrum hole should be characterized by considering both the timevarying radio environment and the spectrum parameters such as operating frequency and bandwidth. Hence, it is essential to define parameters that can represent a particular spectrum band as follows: ! Interference: From the amount of the interference at the primary receiver, the permissible power of a CR user can be derived, which is used for the estimation of the channel capacity. ! Path loss: The path loss is closely related to the distance and frequency. As the operating frequency increases, the path loss increases, which results in a decrease in the transmission range. If transmission power is increased to compensate for the increased path loss, interference at other users may increase.

a) Primary User Activity

In order to describe the dynamic nature of CR networks, we need a new metric to capture the statistical behavior of primary networks, called primary user (PU) activity. Since there is no guarantee that a spectrum band will be available during the entire communication of a CR user, the estimation of PU activity is a very crucial issue in spectrum decision. Most of CR research assumes that PU activity is modeled by exponentially distributed inter-arrivals.

IV. Spectrum Sharing for Cognitive Radio ad hoc Networks

The shared nature of the wireless channel necessitates coordination of transmission attempts

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between CR users. In this respect, spectrum sharing provides the capability to maintain the QoS of CR users without causing interference to the PUs by coordinating the multiple access of CR users as well as allocating communication resources adaptively to the changes of radio environment. Thus, spectrum sharing is performed in the middle of a communication session and within the spectrum band, and includes many functionalities of a medium access control (MAC) protocol and resource allocation in classical ad hoc networks. However, the unique characteristics of cognitive radios such as the coexistence of CR users with PUs and the wide range of available spectrum incur substantially different challenges for spectrum sharing in CRAHNs.

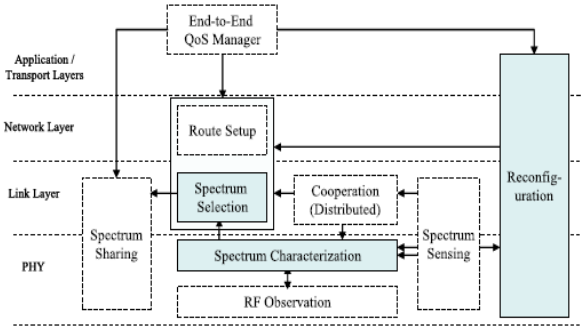

Figure 3 : Spectrum Design with Ad-hoc networks

V. Spectrum Mobility for Cognitive Radio ad hoc Networks

CR users are generally regarded as 'visitors' to the spectrum. Hence, if the specific portion of the spectrum in use is required by a PU, the communication needs to be continued in another vacant portion of the spectrum. This notion is called spectrum mobility. Spectrum mobility gives rise to a new type of handoff in CR networks, the so-called spectrum handoff, in which, the users transfer their connections to an unused spectrum band. In CRAHNs, spectrum handoff occurs: (1) when PU is detected, (2) the CR user loses its connection due to the mobility of users involved in an on-going communication, or (3) with a current spectrum band cannot provide the QoS requirements.

VI. Common Control Channel

The common control channel (CCC) is used for supporting the transmission coordination and spectrum related information exchange between the CR users. It facilitates neighbor discovery, helps in spectrum sensing coordination, control signaling and exchange of local measurements between the CR users. The operation of the CCC is different from the data transmission over the licensed band in the following aspects: ! CR users may optimize their channel use over a number of constraints, such as channel quality, access time, observed PU activity, network load, among others during CR data transmission. However, these parameters are not known to the CR users in advance at the start of the network operation, and thus, it is a challenge to choose the CCC with the minimum or no exchange of network information.

VII. Network Layer for Cognitive Radio ad hoc Networks

At the network layer, the selection of the transmission bands and the routing path must be undertaken jointly, This is a key challenge as nodes only have limited local information. The sudden appearance of a PU may render certain channels unusable in the vicinity of CR nodes, necessitating a local change in the existing routes. In such situations, the routing layer is presented with two options. The first of these involves circumventing the affected region.

VIII. Transport Layer for Cognitive Radio ad hoc Networks

As the transport protocol usually runs at the end nodes (source and destination), it has limited knowledge of the conditions of the intermediate nodes. Typically, routes in an ad hoc network may involve multiple hops, and hence the end-to-end reliability becomes important. By regulating the transmission rate of the source, the transport layer adapts to the congestion in the route and maintains a buffer of unacknowledged packets for error recovery. The main problem in classical ad hoc networks is incorrectly attributing packet losses to network congestion, when they are actually caused by mobility of the nodes or bad channel 1.Route disruptions due to spectrum sensing 2.Large bandwidth variations.

IX. CR ad hoc Networks based on Commons Model

Spectrum can be shared among multiple users under pre-decided regulatory models. There are two

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general models for assigning spectrum usage rights in CR networks as follows ! Exclusive use model: In this model, the spectrum is licensed to users within a given geographical region with well established rules for their protection from external interference.

a) Determination of Channel Structure

Under the commons model, the spectrum is made available as a contiguous frequency block, that must be separated into channels for use by the CR users. The number of channels should be such that the CR users have sufficient choice is choosing distinct and non-overlapping channels whenever possible, and at the same time be able to sustain a minimum desired channel throughput. In the absence of a central entity, balancing this tradeoff by creating an optimal number of channel divisions is a challenge

X. Implementation with Android os

The Android open-source software stack consists of Java applications running on a Java-based, object-oriented application framework on top of Java core libraries running on a Dalvik virtual machine featuring JIT compilation. Libraries written in C include the surface manager, OpenCore media framework, SQLite relational database management system, OpenGL ES 2.0 3D graphics API, WebKit layout engine, SGL graphics engine, SSL, and Bionic libc. In this part we implement cognitive based manets implement with android os. At Google, the team led by Rubin developed a mobile device platform powered by the Linux kernel. Google marketed the platform to handset makers and carriers on the premise of providing a flexible, upgradable system. Google had lined up a series of hardware component and software partners and signaled to carriers that it was open to various degrees of cooperation on their part.

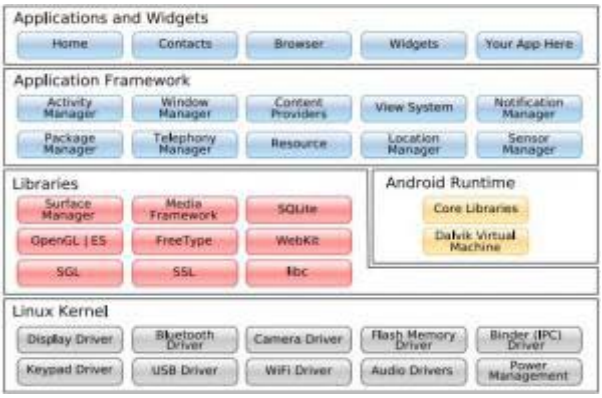

Figure 4 : Android

Android uses Linux as a hardware abstraction layer and use the powerful of Linux kernel and the wide range of hardware drivers it supports, android uses Linux also for memory management , Networking , managing processes, however you programs will not make Linux calls directly , you always use the Dalvik(Android Virtual Machine).andSome of you may be aware that Android does not show adhoc networks. More precisely, and quoting from the AOSP Android uses wpa_supplicant as the platform interface to the Wi-Fi device. Your Wi-Fi driver must be compatible with the standard wpa_supplicant in addition to extensions added to the supplicant.

XI. Android Platform Differences

Android is hailed as "the first complete, open, and free mobile platform." Complete: The designers took a comprehensive approach when they developed the Android platform.They began with a secure operating system and built a robust software framework on top that allows for rich application development opportunities. Open: The Android platform is provided through open source licensing.

Developers have unprecedented access to the handset features when developing applications. Free: Android applications are free to develop.There are no licensing or royalty fees to develop on the platform. No required membership fees. No required testing fees. No required signing or certification fees.Android applications can be distributed and commercialized in a variety of ways.

For Android 1.5, the Linux kernel received an upgrade from version 2.6.25 to 2.6.27. Although this type of change might not have an obvious effect for the typical Android developer, it is important to note that the kernel can and will be upgraded frequently. These seemingly minor incremental updates often include major security, performance, and functional features. Kernel changes often have an impact on the security of the underlying device operating system and provide features and improvements for OEM-level Android device manufacturers. When stable, these features can be exposed to developers as part of an Android SDK upgrade, in the form of new APIs and performance enhancements to existing features. The Android 1.5 version provides substantial feature enhancements, many of which tie back to features of the upgraded Linux kernel. Although the kernel memory footprint is larger, overall system performance has improved and a number of bugs have been fixed.

XII. Conclusion

CR networks are envisaged to solve the problem of spectrum scarcity by making efficient and opportunistic use of frequencies reserved for the use of licensed users of the bands. To realize the goals of truly ubiquitous spectrum- aware communication, the CR devices need to incorporate the spectrum sensing, spectrum decision, spectrum sharing, and spectrum mobility functionalities. The main challenge in CRAHNs

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is to integrate these functions in the layers of the protocol stack, so that the CR users can communicate reliably in a distributed manner, over a multi- hop/multi-spectrum environment, without any infrastructure support. The discussions provided in this survey strongly advocate cooperative spectrum-aware communication protocols that consider the spectrum management functionalities. This cross-layer design requirement necessitates a rethinking of the existing solutions developed for classical wireless networks. Many researchers are currently engaged in developing the communication technologies and protocols required for CRAHNs. However, to ensure efficient spectrum-aware communication, more research is needed along the lines introduced in this survey.In this system can be implemented with ANDROID with Suitable functions.

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Longer Distance Hop Count based Priority Congestion Control Technique for Wireless Sensor Networks

By Neelu Rajput, Dr. Dharm Singh & Dr. Naveen Choudhary
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Abstract- Wireless Sensor Network consists of large number of tiny sensor nodes (Tsodes) distributed in an area, having insufficient processing power, communicating over a network. These Tsodes are circulated in given network environment so that they gather data, process that data and send it to the destination. Rising large applications need to transport massive data packets to the sink node from different sensor nodes without having much loss of data packets in the network. Network must be escaped from the congestion, occurs usually at the Tsodes nearer to base station / sink node. Congestion not only causes packet loss, but also leads to unnecessary energy consumption as well as delay. Therefore, in order to extend network lifetime and improve fairness and provide better quality of service, developing a novel solution for congestion estimation and control is important to be considered. This paper proposes a approach of packet level priority for controlling the congestion in WSN. It uses the hop count value and the distance vector among sink and Tsodes. The technique avoids the congestion faster and improves the overall network throughput and delay too for WSN.

Keywords: wireless sensor network, congestion control, priority congestion control protocol.

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Longer Distance Hop Count based Priority Congestion Control Technique for Wireless Sensor Networks

Neelu Rajput [α], Dr. Dharm Singh [σ] & Dr. Naveen Choudhary [ρ]

Abstract- Wireless Sensor Network consists of large number of tiny sensor nodes (Tsodes) distributed in an area, having insufficient processing power, communicating over a network. These Tsodes are circulated in given network environment so that they gather data, process that data and send it to the destination. Rising large applications need to transport massive data packets to the sink node from different sensor nodes without having much loss of data packets in the network. Network must be escaped from the congestion, occurs usually at the Tsodes nearer to base station / sink node. Congestion not only causes packet loss, but also leads to unnecessary energy consumption as well as delay. Therefore, in order to extend network lifetime and improve fairness and provide better quality of service, developing a novel solution for congestion estimation and control is important to be considered. This paper proposes a approach of packet level priority for controlling the congestion in WSN. It uses the hop count value and the distance vector among sink and Tsodes. The technique avoids the congestion faster and improves the overall network throughput and delay too for WSN.

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I. Introduction

A wireless sensor network (WSN) is a network of hundreds or thousands of Tsodes(tiny sensor nodes), where each node is capable of sensing, processing the data and communicating with other Tsodes through the components such as transmitter and receiver. Usually these Tsodes are found in the form of accelerometer, temperature sensors , acoustic, thermal and visual sensors, these are used for sensing the environmental characteristic like lightning condition, sound, direction or size of any object. A typical WSN is usually installed for the task requiring very precarious duty but at the same time the system must be able to operate automatically without necessitating human caution while extending the lifetime of whole network. These WSNs devices are very small in size but the network puts some constrains on Tsodes like the limited computation capability, limited battery life and off course the limited memory or space of each Tsode. Hence, in order to deploy such network i.e. a WSN, these constraints must be considered before creating the network. The autonomous Tsodes of WSNs communicate with each other to exchange and to forward the data gathered by sensing the environment and its physical condition parameters.

Typically, WSNs are considered as the network of lighter operations, but sometime network may undergo the sudden fluctuations of large, massive and immediate synchronized needs of data, these needs may suddenly result in congestion. Alternatively, some Tsodes may be the reason of constant generation of data streams. And this data is transmitted towards a single sink/Base Station. These large numbers of packets at sudden instance of time make the network condition unbalanced as such traffic load is uncontrollable for limited link capacity. Various other reasons like single intermediate Tsode failure and security attacks can also make the condition worsened. The network must be protected from such congestion building situations in WSN environment. This paper explores the problems faced by various congestion controlling protocols in WSNs. We propose a new packet level priority-based congestion control protocol (PPCCP). We aids following:

1. We use hop count value and distance vector to decide the priority of every node in order to control the congestion while data is being transmitted from Tsodes to Base Station(Sink).

Hop count is the number of intermediate nodes between source and sink node in route while transmitting the upstream data.The distance vector is the distance(in meters) between source and sink node.
It is more about avoiding the congestion rather than handling it.

2. It recognizes the priority dependent fairness among Tsodes so that high throughput can be achieved by controlling congestion at each node.
3. It avoids the high buffer occupancy. As a result it achieves the low packet delay and high link utilization.

The research paper is organized as follows: Section II gives a short description of congestion and their controlling phases for WSNs. Section III presents the priority based congestion controlling approach for WSNs. In Section IV, the existing techniques have been presented, and then in troducinga new technique to

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mitigate the congestion in WSNs. Simulation results, conclusion and references are presented in the completion section.

II. Congestion in wsn

Congestion is an additional problem that must be considered carefully in transport protocols because the impacts of congestion are very drastic in terms of both packets and energy loss. And these influence the overall network delay, through put and efficiency of WSN. Congestion cannot be neglected when the priority of traffic is high as sometimes in some critical areas the loss packets and delay can bring down the system to failure permanently. It is also a major reason for cost concern. WSN needs very high attention towards the congestion control as:

Energy (Transmission of one KB data)

=Energy(Execution of three million instructions)

The above statement shows that the loss data/ packets is not simply affordable in WSNs. Network must be protected from congestion.

Packets are discarded because the network is not adopting any fairness among Tsodes; sometimes the higher priority traffic is compromised and discarded unselectively. Network is needed to afford high energy consumption for communicating the data and this flooded data causes the failure of channels. These over flooded channels make the life of whole network diminished. The problem of congestion increases when some nodes are ideal but still they are wasting the energy by occupying the routes worthlessly. The drastic impacts of congestion cannot be ignored, an effective step is needed to control the congestion while there are various schemes have been coined to mitigate the congestion, these schemes are usually found in the form of differentiated and priority based technique.

Each Tsode has a limited battery life; the undesired retransmission of packets requires the higher power consumption, which is worthless when the packet drops increases above a threshold value. Because, the life of network has already been deteriorated.

Typically sensor networks suffer from two types of congestion. One of them is node level congestion that is triggered by node's queue or buffer overflow and results in high packet loss, and high queuing delay also. The lost packets are required to be retransmitted and therefore it requires more or additional energy.

When the architecture of network is consisted of a simple flat topology, a single sink/base station node design, the probability of occurring congestion is higher at the node deployed nearer to the base station. These nodes are called as intermediate nodes also, having higher probability of congestion because all data is routed through these nodes.

Congestion of packets at such nodes causes the high packet loss as sometimes the number of source Tsodes connected to intermediate nodes is very high. The energy consumed in such dropped packets is also worthless after congestion. The problem increases when large number of Tsodes attempt to access the same medium or channel at the same time for packet transmission. The number of packets goes beyond the capacity of channel and this state makes the network condition worsened. It drops the channel utilization factor by great extent. Consequently it decreases the overall network throughput. The congested WSN is not efficient in terms of energy as well as in terms of QoS, makes the network unreliable also.

III. Congestion Control in wsn

a) Congestion

Congestion occurs mainly in the sensor to sink way when packets are transmitted in a many to one direction. Therefore mainly various congestion control techniques are invented to lighten the congestion in this direction only.

Congestion control generally goes through three phases: Detection of Congestion, notification, and congestion handling i.e. rate adjusting. The proficiency of any wireless sensor network can be determined by considering the following qualifying parameters: 1.System must be energy efficient; loss of power consumption is undesirable for such networks.2. Each Tsode must be treated impartially, fairness should be maintained to avoid the unwanted packet loss, and queue management is also an essential feature for any node. 3. Network must be responsive about the overall throughput, delay and packet loss rate, it is very important to be cautious about the networks Qos all the time.

IV. Priority based Congestion Control Technique-an Overview

The section presents the scheduling rate based priority congestion control technique for WSNs. Usually WSN is considered as the network of light load or slighter capacity but sometimes large number of nodes try to transmit the packet to a single sink node or a single intermediate node. .Congestion occurs mainly in the sources to sink directions when packets are transmitted in a many to one way. Therefore, many congestion controlling techniques usually aim toward this direction only.

PCCP(Priority Based Congestion Control Protocol) is designed to acquire following goals : i) In every WSN ,each sensor node might have different priorities due to their functionality or their location. So a PCCP technique is required to guarantee the biased equality among all nodes where each intermediate node

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gets a biased fair throughput from all Tsodes. 2) Network must have such congestion controlling techniques that should be able to improve energy efficiency and various Qos must not be compromised at any stage of transmission.

PCCP tries to confine the packet loss rate as low as possible by allowing the biased fairness for all Tsodes and it is also responsible for controlling the overhead of multipath routing. PCCP operates in three stages: Detection of Congestion, Congestion Notification Implicitly, and congestion handling/priority based flow rate adjustment.

First stage analyses the packet service time and packet inter arrival time to detect the congestion. It results in congestion detection by using this ratio, and therefore it provides very helpful and rich congestion detection information.

Priority based techniques introduces a sensible approach for notifying the congestion to network, called as implicit congestion notification. It does not need the extra overhead of notification bit explicitly. Information of congestion is implanted in the header field itself.

Finally, the PCCP technique aims to design the most promising approach for controlling the traffic scheduling rate at each Tsode to make sure that no impartiality is found among Tsodes. Throughput or fairness is not compromised for any Tsode. Here each Tsode/source is allotted a priority value. The rate adjustment algorithm is designed to sure that:1 Large Channel Bandwidth is allotted to the Tsode having higher priority value all the time. 2. No impartiality for two Tsodes having equal priority. 3. Another aspect for maintaining the fairness among all Tsodes is to ensure that more bandwidth should be allotted to the node having higher traffic generation capability. The use of three types of priority index makes the PCCP with highly flexible in weighted fairness.

a) Proposed Technique

i. Network Model

The upstream congestion controlling approach for a WSN has been proposed in the paper. It maintains the single-path routing. In Fig. 1, Each Tsode (Tiny Sensor Node) generates its own continuous source traffic and these all Tsodes form many-to-one convergent stream of traffic towards the upstream path. We assume that they are implementing CSMA-like MAC protocol. Each Tsode is founded to have two categories of traffic: source and transit. The first is generated at each Tsode(Tiny sensor node) locally , while the second one is streamed from other intermediate nodes. Hence each Tsode can play the role of a source node or intermediate node or both. The intermediate node of a specific Tsode can be elucidated as the node through which the traffic of this specific source node is being routed .Fig 1 shows that, the Tsode A has 4 intermediate nodes and node B has 2 intermediate nodes so Tsode B play two roles of both source and intermediate node, concurrently.

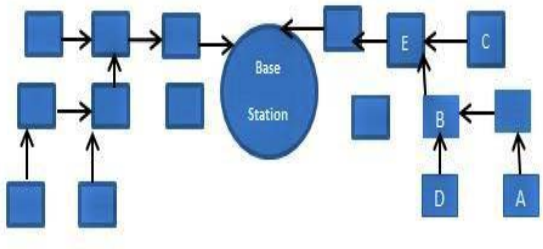

Figure 1 : Network Model

Fig 2 Depicts that by introducing a new scheduler between the network and MAC layer, the approach claims to adjust the traffic scheduling rate below a threshold value so that congestion can be avoided atthe prior stage only. Traffic scheduling rates are found in the form of origin and transit traffic rate.

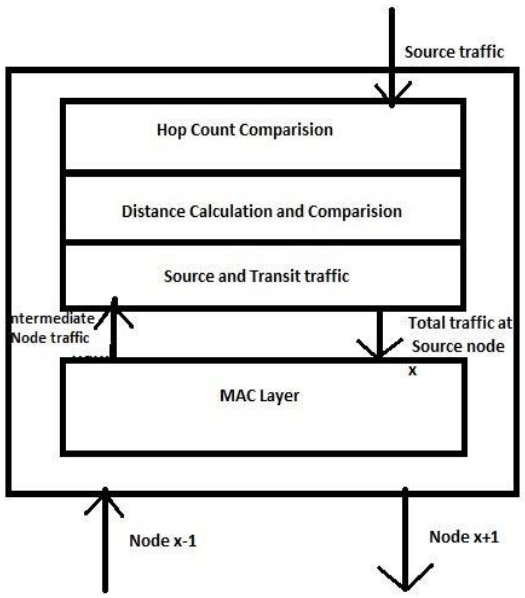

Figure 2 : Node Model

V. Longer Distance Hop Count Prioritization Congestion Controlling Approach

To avoid the congestion, we assign the priority to each node on the basis of their hop count value i.e the number of hops between the source node and Base Station (Sink). When two or more nodes have number of hop count value then the node with the longest distance is assigned higher priority to send the packets first.

To handle the congestion, whenever congestion is detected at any node, the approach says that the packets from higher priority nodes must not be

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dropped. The higher priority packets are transmitted first without being dropped.

Two novel approaches were coined for congestion control:

The first is AIMD(Additive Increase and Multiplicative Decrease) this approach uses the principle of detecting the congestion first and then it tries to solve the problem. It is being employed for TCP protocol. The information about congestion is propagated through congestion notification message bit. Unfortunately, AIMD is found to be inefficient as network has already made much loss of packets and the traffic scheduling rate adjustment procedure is not quite effectual after the congestion has already been detected. The congestion notification message does not contain the adequate information about the congestion. Sometimes the approach starts to work after the channels /links have already been declared failed by the network protocols.

To overcome the problem of AIMD, a new approach named as PRA(Priority Rate Adjustment) was introduced; the approach is capable to control the congestion to a great extent. Before the congestion is detected at any node, we can follow the given priority decision procedure to avoid the congestion .

Priority_Decision():

(1)Initialization with default values

(2)flag=0,i=0,node=-1,l=0,maximum=2500,Distance=0,ThresholdDistance=0,Packet_Size=256,Interval=0.05,count=0,p=1

(3)IF Packet_Type==Broadcast then

(4)Src=SourceNodeId, rd=Receiver,Maxn=src,time=Total Time for Broadcasting,fsnk=Final Sink ,fsnd=Final Source ;

End If

(5)If Packet_Type ET Upstream Then

(6)If NodeId GTET 0 AND NodeId ET 100 Then

(7)If Node NOTET NodeId Then

(8)flg=0 End If

(9)IF flg==0 Then

(10)Node=NodeId,flg=1

(11)s[i,1]=NodeId AND s[i,2]=Node_X_Coordinate AND s[i,3]=Node_Y_Coordinate

(12)Increment i by 1

(13)to(16)End If

(17)x1=s[src,2] AND y1=s[src,3] AND x3=s[fsnk,2] AND y3=s[fsnk,3]

(18)whileMaxNNotETFsink /* MaxN is the Node_ID having longest distance

(19) for each integer j ET 0 AND j LT i

(20)If j NOTET src Then

(21)x2=s[j,2] AND y2=s[j,3]

(22)d= Distance between intermediate/Neighbour node and Source/Tsodes node /* coordinate values(x1,y1) & (x2,y2) are used to calculate the distance

(23)IF d LTET 160 Then

(24)If(s[j,1] ET fsnk) Then

(25) MaxN=s[j,1] AND Distance=d ; break ; End if

(26) Else ni=s[j,1] AND x21=s[ni,2] AND y21=s[ni,3]

(27) dn=Distance between Neighbour/Intermediate node and sink node

(28) If max GTdn Then

(29) maximum=dn AND MaxN=ni AND Distance=d

(30)End If; End Else

(31) and (32) End If

(33) Increment I by 1 ; End For loop

(34)Maximum=2500

(35)src=MaxN /*Now the Node With the Highest distance is source,which goes first

(36)x1=s[MaxN,2] AND y1=s[MaxN,3] AND m[l]=Src AND Increment l by 1

(37)ThresholdDistance=ThresholdDistance+Distance

(38)Distance=0 AND Increment count by 1

(39)If count GT Maxn Then

(40)l=-2 BREAK

(41)End If ; End While ;

(42)END Priority_Decision

First the paper considers it to be a single-path routing, where each packet is routed through the chain of Tsodes connected in single parent fashion.

1) The nodes within in the range of 160 meters from any particular node are considered as neighbouring nodes. Among all these neighbouring nodes, the node which is at longest distance from Base Station is chosen to send the Packets as First Source Tsode.

2) The traffic generated by the highest distance node is given the priority to be scheduled first.

3) The decision of priority can be taken through the hop count value of each packet also at initial stage . Higher the hop count value, obtains the highest priority to schedule the traffic first.

However if congestion is detected at any node then it can be handled in the similar fashion. For e.g. If any intermediate node x gains the information of congestion about the Tsodes connected to this through the congestion notification. Node x then tries to mitigate congestion by altering the transit traffic rate or Tsode source traffic generation rate.

VI. Simulation Results

Even though PCCP could be affordable in terms of time, space complexity and consumed energy to mitigate the congestion in network, but the proposed approach shows that how PCCP can be extended to

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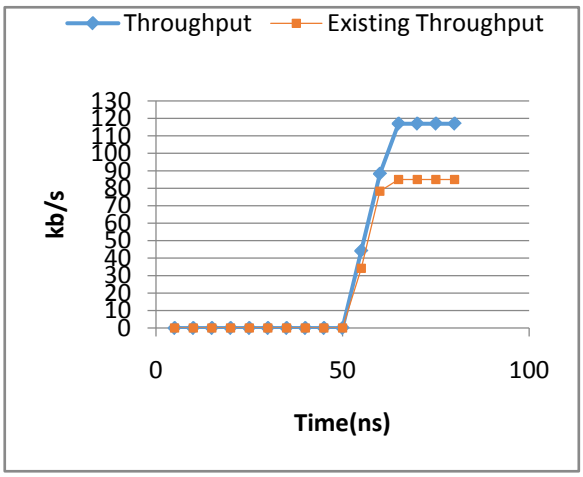
mitigate the congestion while showing the improvement in terms of various performance parameters like throughput, delay and number of packet drops.

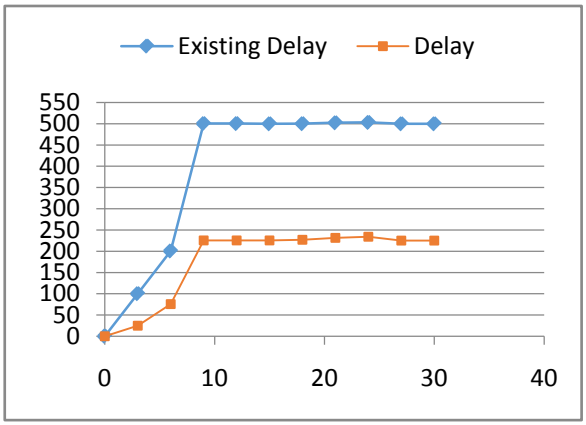
a) Throughput

The following graph shows that how at simulation time=50 ns , the throughput is increased from 80 kbps to 120 kbps. This is because some nodes always gets the higher priority to send the data and the packet drop of such nodes is always avoided so this can be seen here that the throughput is constant for such approach and higher than existing technique i.e. PCCP.



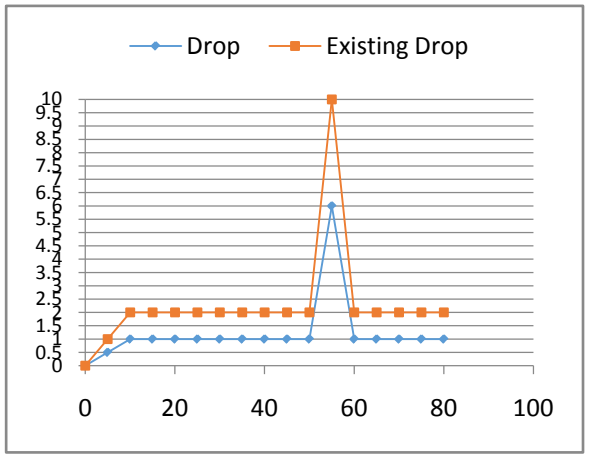
b) Delay

The following graph shows the overall network delay. Delay decreases dramatically as fairness is always maintained, the node at highest distance claims to be the first sender, the delay for such nodes is lowest and other nodes also gets their transmission on low delay because they are not so far from base station , it does not take high delay for such nodes.



c) Packet Drop

The proposed approach claims to minimize the number of packet drops because the traffic generated at higher priority node will never be allowed to compromise at any instance of time. Longer the distance of source node from sink, gets higher priority and in this way the packet transmitted from such nodes are never dropped. The following graph shows the number of packet drops at different-different instance of simulation time.



VII. Conclusion

The proposed longer distance hop count based approach for Wireless Sensor Networks works on the principle of packet level priority for each node. The results show that how it can be proved better than the existing one, when it is used to extend the PCCP. Simulation results show that: (1) Proposed approach achieves high throughput; (2) It claims to avoid/reduce packet drop and therefore improves energy-efficiency, and graphs show the lower delay than existing one.

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QoS Routing Solution based on Genetic Algorithm for MANETs

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Abstract- Qos routing protocol design for mobile ad-hoc networks is more challenging than wire lane network. Mainly due to node mobility, multi hop communications, contention for channel access and lack of central ordination.QoS guarantees are required by the most of the applications. Most optimal route has to be selected from source to destination by using QoS routing protocol. Many routing protocols are designed for single QoS metric. If it requires to design routing protocol for multi constrained routing path, normal algorithms can be failed. In this paper we proposed genetic algorithm based route selection protocol to solve the multi constrained QoS route. Genetic algorithm finds the optimal route with population initialization, cross over, mutation and fitness function calculation. QoS constraints consists of end to end delay, band width, packet loss rate, node connectivity index (Ni) and dynamic resource availability. Simulations have been performed in ns-2. Performance of genetic algorithm is compared with AOMDV and results shows that genetic algorithm is giving efficient results for different metrics (delay, throughput and Delivery ratio).

Keywords: genetic algorithm, AOMDV, mutation, cross over and fitness function.

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QoS Routing Solution based on Genetic Algorithm for MANETs

M. L. Ravi Chandra [α] & Dr. P. Chandra Sekhar Reddy [σ]

Abstract- Qos routing protocol design for mobile ad-hoc networks is more challenging than wire lane network. Mainly due to node mobility, multi hop communications, contention for channel access and lack of central ordination.QoS guarantees are required by the most of the applications. Most optimal route has to be selected from source to destination by using QoS routing protocol. Many routing protocols are designed for single QoS metric. If it requires to design routing protocol for multi constrained routing path, normal algorithms can be failed. In this paper we proposed genetic algorithm based route selection protocol to solve the multi constrained QoS route. Genetic algorithm finds the optimal route with population initialization, cross over, mutation and fitness function calculation. QoS constraints consists of end to end delay, band width, packet loss rate, node connectivity index (Ni) and dynamic resource availability. Simulations have been performed in ns-2. Performance of genetic algorithm is compared with AOMDV and results shows that genetic algorithm is giving efficient results for different metrics (delay, throughput and Delivery ratio)

Keywords: genetic algorithm, AOMDV, mutation, cross over and fitness function.

I. Introduction

a) Manet

Mobile Ad-hoc networks (MANETs) contain either set or portable nods allied wirelessly without the support of any fixed infrastructure. The nodes are self-employed and can be deployed to anywhere, to sustain a particular rationale. MANETs are envisioned to support sophisticated applications like martial operations, civil applications and ruin situations. In order to this multicasting protocols plays a serious task in the MANETs than uncast protocols and are faced with the defy of producing multi-hop routing in mass mobility and crowd width restriction.

After evaluates the QoS protocols, there are so many factors would impact on the results. In the part of these parameters are node mobility, network size, type and data rate of traffic sources, node transmission power, and channel personality. System resources need to supply the obligatory QoS. Some of the network resources are node computing time, node battery charge, node buffer space, channel capacity, band width etc.

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The most important function of a packet switching network is to admit packets from a source station and deliver them to the objective place. To carry out this, a path through the network must be determined. In general more than one route is possible, thus a route function must be performed. The obligation of this function includes: Correctness, Simplicity, Robustness, Optimality, Fairness, Stability, and Efficiency.

b) QoS Routing

A multicasting protocol plays a significant role in the Ad-hoc wireless networks to provide data transmission between sources to objective than uncast routing protocols. It is always beneficial to use multicast rather than multiple uncast, particularly in the ad-hoc environment, where band width comes at finest. Conservative wired networks, internet multicast routing protocols, do not carry out fine in ad-hoc networks, because of the energetic environment of the network topology. It is compiled with comparatively low band width and less consistent wireless associations, caused long convergence device and may give rise to configuration of transient routing loops which quickly consume already limited band width.

It is very difficult task to design of multicast routing protocols for ad-hoc networks, because of limited bandwidth ease of use, mobility of the nodes with the limited energy resources, and error prone shared broadcast channel, the hidden terminal problem and limited security. Consequently they may be used as constraints in the direction finding and selection. A number of algorithms have been wished-for multicasting protocols such as AOMDV, DCMP. Sometimes conventional routing protocols may not adequate for factual communication which requires QoS support from the network .Although it is substantial research area, most of the routing protocols take in to a single constraint. If it requires multi restraint QoS routing, excising protocols may be failed. Means in accessible protocols, one routing protocol is giving good results for one metric in one route and another route is giving good results for some other metric and so on.

Standard conservative routing algorithms provides QoS for any one of the bound, but routing algorithms supporting QoS differ from conventional routing algorithm in that ,in QoS routing, the pathway from basis to the goal needs to satisfy multiple contains

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simultaneously. Even as in straight routing, decisions are made based in single metric. QoS related routing metrics, as well as the equivalent constraints allied with them, can be categorized into minimal (maximal) metrics and stabilizer metrics. A typical minimal metric is band width, for which end to end band width is determined by the minimal residual of links along the chosen path.

This means that, if it required multi constrained QoS routing, existing routing protocols fails. To solve above mentioned problem efficiently, genetic algorithm can be used.

II. Genetic Algorithm

Random search algorithms are having achieved increasing popularity. Random paths and random schemes that search and save the best must also be discontinued because of the efficiency requirement. Random search can be expected to do number of better enumerative schemes. The genetic algorithm is a search procedure that uses random choice as a tool to guide a highly exploitative search through a coding of a parameter space. The schemes mentioned and countless hybrid combinations and permutations have been used successfully in many applications.

In a genetic algorithm, a population of candidate solutions (called individuals, creatures, or phenotypes) to an optimization problem is evolved toward better solutions. Each candidate solution has a set of properties (its chromosomes or genotype) which can be mutated and altered;

The evolution usually starts from a population of randomly generated individuals, and is an iterative process, with the population in each iteration called a generation. In each generation, the fitness of every individual in the population is evaluated; the fitness is usually the value of the objective function in the optimization problem being solved. These more fit individuals are stochastically selected from the current population, and each individual's genome is modified (recombined and possibly randomly mutated) to form a new generation. The new generation of candidate solutions is then used in the next iteration of the algorithm. Commonly, the algorithm terminates when either a maximum number of generations has been produced, or a satisfactory fitness level has been reached for the population.

A typical genetic algorithm requires:

1. A Genetic representation of the solution domain,
2. A Fitness function to evaluate the solution domain.

a) Genetic operators

The next step is to generate a second generation population of solutions from those selected through a combination of genetic operators: crossover (also called recombination) and mutation.

For each new solution to be produced, a pair of "parent" solutions is selected for breeding from the pool selected previously. By producing a "child" solution using the above methods of crossover and mutation, a new solution is created which typically shares many of the characteristics of its "parents". New parents are selected for each new child, and the process continues until a new population of solutions of appropriate size is generated. Although reproduction methods that are based on the use of two parents are more "biology inspired", some research suggests that more than two "parents" generate higher quality chromosomes.

These processes ultimately result in the next generation population of chromosomes that is different from the initial generation. Generally the average fitness will have increased by this procedure for the population, since only the best organisms from the first generation are selected for breeding, along with a small proportion of less fit solutions. These less fit solutions ensure genetic diversity within the genetic pool of the parents and therefore ensure the genetic diversity of the subsequent generation of children.

b) Termination

This generational process is repeated until a termination condition has been reached. Common terminating conditions are:

- A solution is found that satisfies minimum criteria
- Fixed number of generations reached
- Allocated budget (computation time/money) reached
- The highest ranking solution's fitness is reaching or has reached a plateau such that successive iterations no longer produce better results
- Manual inspection
- Combinations of the above
- Once the genetic representation and the fitness function are defined, a GA proceeds to initialize a population of solutions and then to improve it through repetitive application of the mutation, crossover, inversion and selection operators.
- Flow chart representation for simple Genetic algorithm is given below.

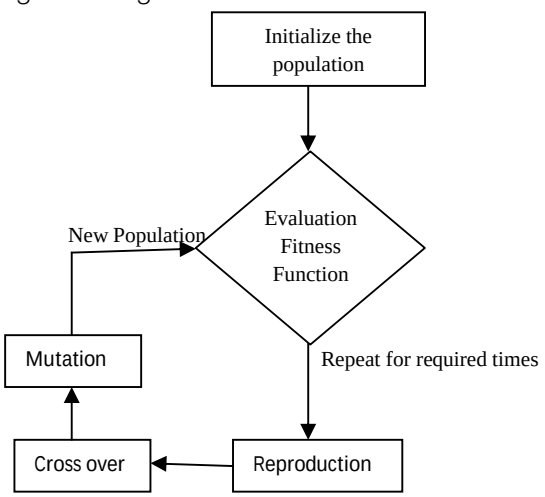

Figure 1 : Flow Chart for normal Genetic Algorithm

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III. Proposed Solution

In this section metrics used for selecting multi constrained QoS routing can be explained and also how the proposed solution work flow can be presented.

a) Route Selection metrics

The main route is selected based on the QoS metric. The path, which satisfies the combined QoS constraint, is selected for data transmission. The combined QoS constraint is set of parameters that maintain the good connectivity between the nodes.

i. *End-to-End Delay*

Sum of fixed propagation delay between the sender and the receiver and variable delay is called as end- Variable delay is the sum of the queuing delays encountered by the packets at each route. In this paper, we consider the link delay that is calculated using the following equation:

$$D = \sum_{i=1}^{S-T} D_i + \sum_{i=1,\ J=1}^{S-T} L_{i,J}$$

In equation (1), Di is the end-to-end delay and Li,J is the link from node i to j. Li,j is calculated using the following equation

$$L_{i,J} = \begin{cases} 1 & \text{if there exist connnectiv ity (i, j)} \\ 0 & \text{otherwise} \end{cases}$$

If the connectivity is exists between the i and j, then link delay is 1, otherwise it is zero.

ii. *Bandwidth*

To transmit the packet, bandwidth Bava is calculated and compared with the required bandwidth (Breq). Bandwidth is calculated using the following equation:

$$B = \begin{cases} 1 & if B_{avg} > B_{req} \\ 0 & Otherwise \end{cases}$$

In the equation (3), if the Bava is greater than the Breq, then the packets are sent thro otherwise another path is selected.

iii. *Packet Loss Rate*

Packet loss rate is the ratio of packets that are lost while transmitting from source to destination. Then the total packet loss rate Pi is as follows:

$$P_i = \lambda (P_1 + P_2 + P_3 \ldots\ldots P_n)$$

In equation (4), P1, P2, Pn packet loss rate of nodes 1, 2, …., n and where λ is the arrival rate of packets to the connection.

iv. *Node Connectivity Index (Ni)*

Ni checks the distance between the nodes whether the node is located in the transmission range or not.

Let i and j are the neighboring nodes. If the distance between i and j is less than the nodes transmission range, the node will be considered. Otherwise, the node will be omitted.

v. *Dynamic Resources Availability*

It is the availability of node at that time and it indicates the current node's load in resource usage. When the node that is already in another connection requires the service, the node will be omitted Using this metric, less congested nodes are selected. The Usage Rate (UR) of the nodes is calculated using the following equation.

$$UR = \frac{\text{Used Resource Quantity}}{\text{Available Resource Quantity}}$$

If the usage rate is less, then the node is selected. Otherwise, the node is omitted. The nodes with less usage rate indicate that it is not in use, so that it is selected for routing.

vi. *Combined QoS Constraint*

The combined QoS constraint is calculated using the following equation

$$QoS = Q\ (\ D,\ B,\ P_i,\ N_I,\ UR\ )$$

Using combined QoS constraint, the best route is selected and the good connectivity between the nodes is maintained.

Fitness function used in this algorithm is given below.

$$F = \frac{\alpha B - \beta N_i}{\gamma UR - \Delta D - \theta P_i}$$

where α, β, γ, Δ, θ are normalization constants (between 0 and 1), B denotes the bandwidth, N_i denotes the node connectivity index, UR denotes the usage rate, P_i denotes packet loss rate and D denotes the end-to-end delay.

b) Over view

In order to quite a few paths may be there from source to goal. Among them, proficient path can be chosen using hereditary algorithm based routing protocol. The path has to satisfy the combined QoS constrained. Generally mutual QoS is set of parameters. QoS parameters used here are End to End Delay, Band width, Packet loss rate, Node connectivity index,

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energetic source accessibility. As a result of combining all the parameters robustness function can be considered. As manipulative the fitness function efficiency of the QoS parameters are measured and the fitness function is calculated using genetic algorithm based routing protocol only. After calculating some pool of (this number can be varied according to our requirement) Fitness functions, an efficient fitness function value can be taken, which is giving efficient with individual to the above mentioned QoS parameters. To evaluate the presentation of proposed routing algorithm, Delay, Throughput and Packet Delivery Ratio Qos metrics are calculated. These results are compared.

IV. Simulation Results

a) Simulation Parameters

In this section proposed genetic algorithm is compared with the AOMDV and simulation results are performed in Network simulator (NS2).simulation area considered is 1250x1250 for 50 seconds of simulation time. The simulated traffic used here is Constant Bit Rate (CBR), Video and TCP.

The simulation scenario and settings are given below.

No. of Nodes	30,50,70,90,110
Area Size	1250 X 1250
Mac	IEEE 802.11
Transmission Range	250m
Simulation Time	50 sec
Traffic Source	CBR,Video and TCP
Packet Size	512
Routing Protocol	AOMDV and GA based Protocol
Speed	10,20,30,40 and 50m/s
Rate	250kb
Initial Energy	10.3 J
Transmission Power	0.660
Receiving power	0.395

b) Performance metrics

The proposed Genetic algorithm based routing protocol is compared with the AOMDV by considering the following metrics.

- Packet Delivery ratio: it is the ratio of number of packets received to the number of packets sent.
- Throughput: it is given as number of successful packets received per unit amount of time during the transmission.
- Delay: It is the time taken to transmit data from source to destination.

c) Results

i. *Based on number of nodes*

In this Simulation experiment, number of nodes can be varied as 30,50,70,90 and 110.the performance of AOMDV and Genetic Algorithm based protocol can be compared based on Delay, Throughput and Packet Delivery Ratio.

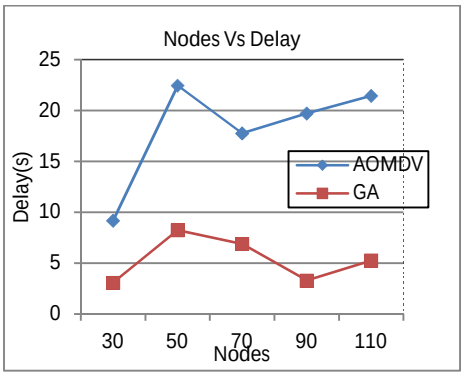

Figure 2 : Number of nodes Vs Delay

Fig.2 shows the comparative scenario for AOMDV and genetic algorithm based protocols. From above scenario it can be conclude that genetic algorithm based protocol is efficient than AOMDV with respect to Delay metric. It is giving less delay than AOMDV.

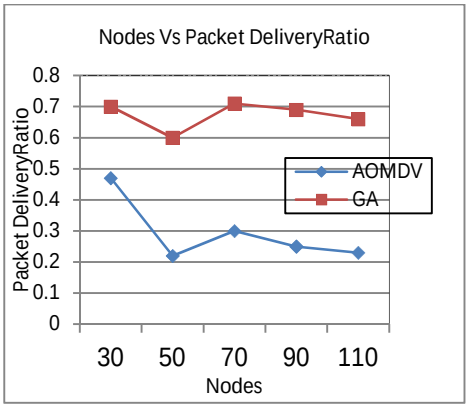

Figure 3 : Number of nodes Vs Packet Delivery Ratio

Fig.3 shows the comparative scenario for AOMDV and genetic algorithm based protocols towards Packet Delivery Ratio Vs Number of nodes. From above scenario it can be conclude that genetic algorithm based protocol is efficient than AOMDV with respect to Packet Delivery Ratio metric. It is giving high Packet Delivery Ratio than AOMDV.

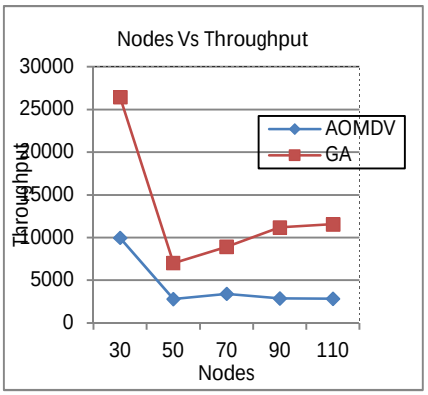

Figure 4 : Number of nodes Vs Throughput

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Fig.4 shows the comparative scenario for AOMDV and genetic algorithm based protocols towards Throughput Vs Number of nodes. From above scenario it can be conclude that genetic algorithm based protocol is efficient than AOMDV with respect to Throughput metric. It is giving high Throughput than AOMDV.

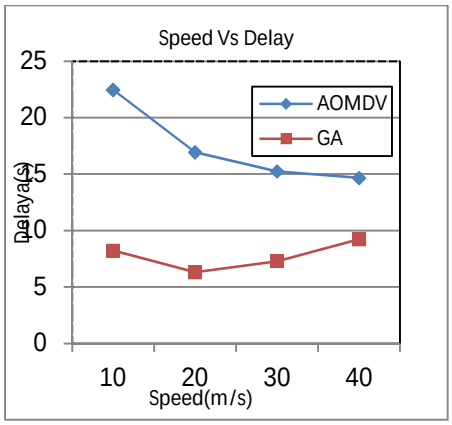

Figure 5 : Node Speeds Vs Delay

Fig.5 shows the comparative scenario for AOMDV and genetic algorithm based protocols towards Delay Vs Node Speeds. From above scenario it can be conclude that genetic algorithm based protocol is efficient than AOMDV with respect to Delay metric. It is giving less Delay than AOMDV.

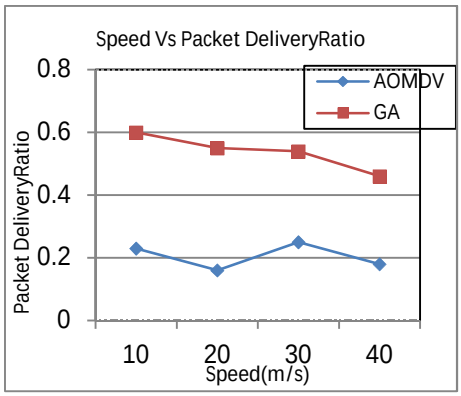

Figure 6 : Node Speeds Vs Packet Delivery Ratio

Fig.6 shows the comparative scenario for AOMDV and genetic algorithm based protocols towards Packet Delivery Ratio Vs Node Speeds. From above scenario it can be conclude that genetic algorithm based protocol is efficient than AOMDV with respect to Packet Delivery Ratio metric. It is giving high Packet Delivery Ratio than AOMDV.

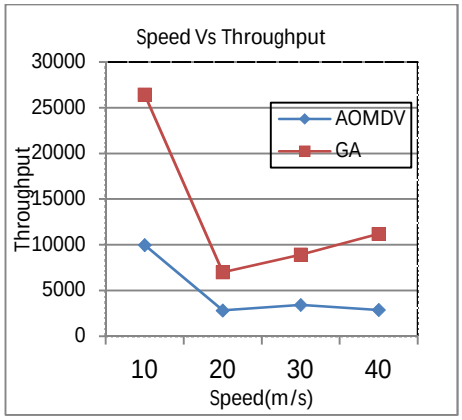

Figure 7 : Node Speeds Vs Throughput

Fig.7 shows the comparative scenario for AOMDV and genetic algorithm based protocols towards Throughput Vs Node Speeds. From above scenario it can be conclude that genetic algorithm based protocol is efficient than AOMDV with respect to Throughput metric. It is giving high Throughput than AOMDV.

V. Conclusion

This paper describes about Genetic Algorithm route selection protocol for MANET. Genetic Algorithm based routing protocol has been fruitfully applied to the multi constrained path selection. It has given good quality results for multi constrained parameters than AOMDV. Multiple QoS constraints measured are end to end delay, band width, packet loss rate, node connectivity index and dynamic resources availability. Replication results are performed in NS-2, by changeable number of nodes and node speeds. Contrast of AOMDV and Proposed Genetic Algorithm based routing protocol has done with respect to no. Of nodes vs delay, No. of nodes vs Packet delivery ratio, No. of nodes vs Throughput, node speeds vs Delay, node speeds vs Packet Delivery ratio and node speed vs Throughput. For all scenarios proposed genetic algorithm is giving efficient results than AOMDV.

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Influence of Facebook in Academic Performance of Sri Lankan University Students

By Thuseethan, S. & Kuhanesan, S.
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Keywords: *academic performance, GPA, electronic communication, social media.*

GJCST-E Classification : *J.4*

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Influence of Facebook in Academic Performance of Sri Lankan University Students

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Abstract- Facebook is only an electronic communication among human but unfortunately it has become an addiction for all. Also it is a latest trend of the youth, particularly high level students and the university students as well. This paper examines the usage of Facebook among university students and the influence it has on their academic performance. The impact of Facebook can either be good or bad on university students and their academic activities. Even though a closer look on the real impact of Facebook reveals that it leads to several problems among the university students' academic performances. Today Facebook is, however, ruining the future and academic carrier of university students. It motivate us to have a closer look to find the significance usage of Facebook by university students in their academic success with the help of a survey conducted by gathering the data among more than 250 students of different universities in Sri Lanka.

Keywords: academic performance, GPA, electronic communication, social media.

I. Introduction

Involvement of technology aspects for social needs has become the major communication strategy for most people during past decade. Internet is an inseparable part of human life and it involves in variety of routine activities. Social media has revolutionized corporate communications, rapidly changing the way that public relations campaigns or programs are distributed and measured (Matthews, L., 2010). Social networking has taken the world towards a rich communication society. Facebook, Twitter, LinkedIn and MySpace are the most popular social networking sites providing the electronic communication within society. In the last five years the rapid growth of social media that has been observed is indicative of its importance and its integration into the daily lives of many people in Sri Lanka (Thuseethan, S. and Vasanthapriyan, S., 2014).

Facebook is on lead in the social media race with more active users' worldwide. It has become one of the most frequently accessed website present. Facebook was founded in 2004 by Mark Zuckerberg, Eduardo Saverin, Dustin Moskovitz, and Chris Hughes, who are alumni of Harvard. The typical University culture loves Facebook deeply, builds the lifestyle, rather than just a hobby or a fun time passing activity. Academic success is a supreme goal to any student, with the social and family responsibility they have. University students are one of the major group using Facebook for fun, with the main purposes of connecting with their friends, sharing day to day activities, using features such as photo sharing, publishing wall posts, and stating their status updates.

Because of the social media platform's widespread adoption by college students, there is a great deal of interest in how Facebook use is related to academic performance (Junco, R., 2012). Like other social networking sites Facebook ruins the academic life of university students. In 2008, half of the students were completely unaware of Facebook, while in 2009 all our respondents were aware of it and 59% of them were also using it on a regular basis (Nicola Cavalli, Elisabetta Ida Costa, Paolo Ferri, Andrea Mangiatordi, 2011). Facebook use is nearly ubiquitous among U. S. college students with over 90% active participation among undergraduates (N. Ellison, C. Steinfeld, and C. Lampe, 2011). Even in developed countries Facebook is widely access by students.

This paper reviews the influence of Facebook in university students' academic activities and further analyzes both positive and negative impacts of using it.

II. Background of the Study

a) Social Networking Sites

Social media consists of online technologies, practicing activities or societies that people use to gener¬ate content and share thoughts, visions, experiences and viewpoints with each other (Television Bureau of Advertising, Inc., 2009). The word social networking is known as the alliance of individuals into specific set of potential groups or subdivisions. Social networking allows individuals to express their thoughts to other users. Social networking is the leader in promoting digital journalism (Thuseethan, S. & Vasanthapriyan, S., 2014). Social network is used for several purposes like promoting or distributing the news contents throughout the world.

Social networking sites and Facebook socializing via the internet has become an increasingly important part of young adult life (Gemmill & Peterson, 2006). Most of the high schools, colleges and universities get connected by internet encompass individuals who are looking forward to mingle other individuals with same point of interest, to gather and share knowledge and first-hand information. Social

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networking websites act like an online society of users who is familiar with internet.

Social networking is developed with more advanced features after the year 2003. Since Facebook holds the most number of active users it became referred by the name social network. Figure 1 indicates the leading social networks worldwide as of January 2014, ranked by number of active users.

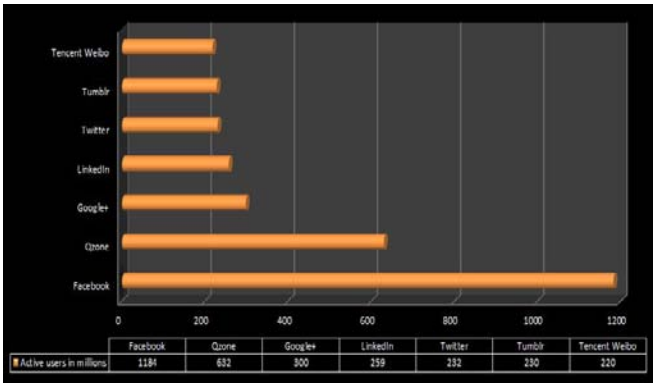

Figure 1 : Active users of top seven social networking sites (source: http://www.statista.com/)

b) An Overview of Facebook

The advancement in technology and communication leads to a considerable improvement in social networking such as Facebook and MySpace, used to keep in touch or share information with other individuals. By giving people the control over whole site, we are making the world more transparent (Zuckerberg, 2007). Making the world get connected is the ultimate goal behind Facebook. Facebook is an online directory that connects people through social networks in universities (Zuckerberg, 2005).

Facebook was launched in 2004 by Mark Zuckerberg, Dustin Moskovitz and Chris Hughes to help university students in purpose of identifying students who are residing in other residences. One month later, it was expanded by Mark and friends to any Harvard university students. Later, Facebook extended to all high schools local area networks, and then eventually expanded to internet users all around the world. In 2008 Facebook reached 100 million active users, half of them are spending more than 20 minutes in Facebook site per day (Facebook, 2008). Figure 2 shows the rapid growth of Facebook during the years 2008-2013.

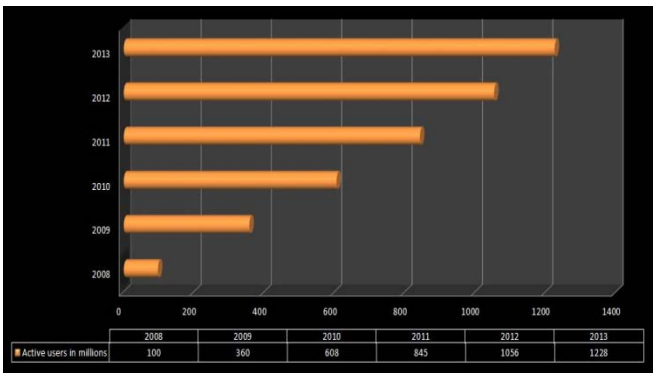

Figure 2 : Active users of Facebook from 2008 to 2013(source: http://www.statista.com/)

As like most of other social networking sites, Facebook is a single-page application(SPA) offers a well-organized web page where users' can store their personal info and make connections with same type of users. The disclosure of friends, not only each user view others personal profile but also their whole networks. This function allows users' to traverse from friends profile to anywhere, so that individual's social network grows rapidly across the world (Walther et al., 2008). This ability or capability is the backbone of Facebook and became the only reason of its rapid growth with comparing other social networking sites. Apart from this the simplicity of Facebook is one significant reason for attracts millions of users around the world.

c) Sri Lankan University Students Engagement in Facebook

Facebook is completely a communication tool for users'. Facebook is used by the huge number of undergraduate students and graduate students on a regular basis. There is huge amount of professional and common interest in the effects of social networking on undergraduate student development and achievement (Abramson, 2011). Students use Facebook in various ways to accomplish a wide range of social

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responsibilities and just for fun as well. In university students' perspective the widespread social media website is Facebook, anywhere between 85 and 99% of university students use Facebook (Jones & Fox, 2009).

In 2012 the World Bank reported that the Internet users in Sri Lanka were last reported at 2.5 million in 2010. Among those most of them are teenagers, Figure 3 shows the distribution of Facebook users in different age groups. Sri Lanka has nearly 1.2 million Facebook accounts, 20% of those are fake accounts (Sri Lanka Police, 2014). Even though there considerable number of legal accounts in Sri Lanka.

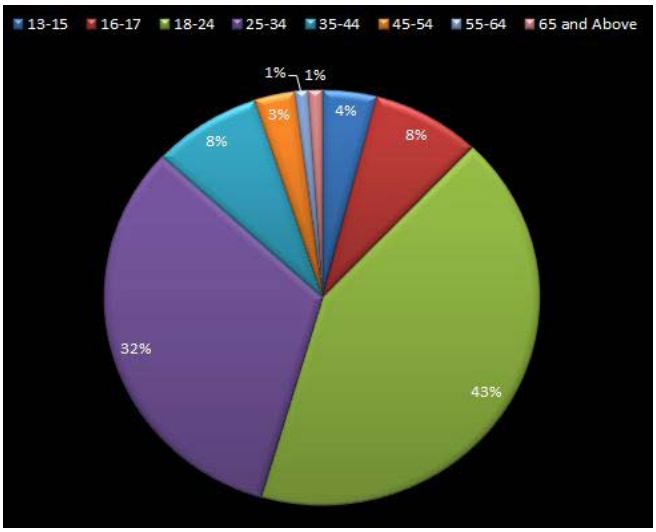

Figure 3 : Active users of Facebook in different age groups, Sri Lanka (source: http://www.statista.com/)

The above most recent data, collected by the www.statista.com from Sri Lankan Facebook users shows that of the 43% of Facebook users are in between the age 18 and 24. Most users in this group contain university students, Facebook allows them to express themselves, interconnect, and collect profiles that highlight their abilities and capability throughout lifetime.

Social Networking Sites allow students to express themselves, communicate, and collect profiles that highlight their talents and experience. There are several reasons demanding young people to use Facebook and even also few adults addicted to it and need to useFacebook. Based on themeeting had with university students, the following are some of the reason given by the students for using the Facebook

- Non-stop availability
- Good leisure time activity
- Supportive for studies – sort of collaborative study
- Exchange information among batch mates
- Easy access to publish social events, posts, photos and videos
- Mind soothing and stress free
- Uncluttered and clean interface
- Discovery and explorethe interests in both academic and personal interest

d) Academic Performance of Student

The students' performance (academic achievement) plays an important role in producing the best quality graduates who will become great leader and manpower for the country thus responsible for the country's economic and social development (Ali et.al, 2009). The undergraduates who obtain high quality and good education can contribute the country immensely. Even though the use of internet and World Wide Webis an important factor upgrade the academic performance, the Facebook causes certain bad effects on them. Most of the researcher around the word used the GPA to measure the student performance (Galiher, 2006; Darling, 2005; Broh, 2000; Stephen &Schaban, 2002). In Sri Lanka University Grant Commission defined the level of academic performance through the same Grade Point Average point system.

III. Methodology

a) Information Gathering

Information gathering was done through a web based survey among university students. Students who use the Facebook selected for this study. The web questionnaire was designed and distributed to selected students from five Universities across Sri Lanka – Sabaragamuwa University of Sri Lanka, University of Jaffna, University of Peradeniya, Wayamba University of Sri Lanka and University of Kelaniya. To get truthful information the university students were requested to respond the questionnaire anonymously.

The survey was carried out with the participation of 287 students. In the sample, only 32.5% students were from non-science streams and others were from science stream. The majority of students are full time course followers (91%).

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b) Measurement of Variables

The following variables were used to develop and test cases;

i. *Time spending on Facebook*

In this study, time spend on Facebook measured as how often he/she visits the Facebook and spends how much time by actively using Facebook. We categorized the frequency and time spending on Facebook in following manner.

Table 1 : Categorization of students in terms of frequency of access per day

Category	Number of times per day
A-1	Below 2
A-2	2-5
A-3	More than 5

Table 2 : Categorization of students in terms of number of hours per day

Category	Number of hours per day
B-1	Below 2
B-2	2-5
B-3	More than 5

ii. *Grade Point Average (GPA)*

It varies from 0.0 to 4.0 depend on the grades of the students in Sri Lankan universities'. Categorization of GPA considered in following way as given in Table 3.

Table 3 : Categorization of students in terms of GPA

Category	GPA
C-1	0-2
C-2	2-3
C-3	3-4

Of the occasional Facebook users, most of them received high grades, resides in category C-2 and C3.

IV. Results and Discussions

The test cases we defined will inspect the correlation between the frequency or amount of time spent on Facebook and the amount which a student participates in academic activities. Initially we think that there is an inverse relationship between time or frequency with GPA, as the more frequent/time spent on Facebook, the less time a student engage with his/her academic activities. Since majority students falls in to A-2 category, most of the students are moderate users' of Facebook. Table 4 and Table 5show the distribution of students in each category.

Table 4 : GPA distribution of students with frequency of use

	C-1	C-2	C-3
A-1	17	44	20
A-2	18	101	11
A-3	37	33	6

Table 5 : GPA distribution of students with time spending in Facebook

	C-1	C-2	C-3
B-1	8	90	30
B-2	12	71	5
B-3	52	17	2

a) Test Case 1

In this case, occasional Facebook users (A-1) analyzed with corresponding GPA categories, prime factor of student academic performance. Category A-1 students are less interested in Facebook; there may be inverse relationship with academic activities.

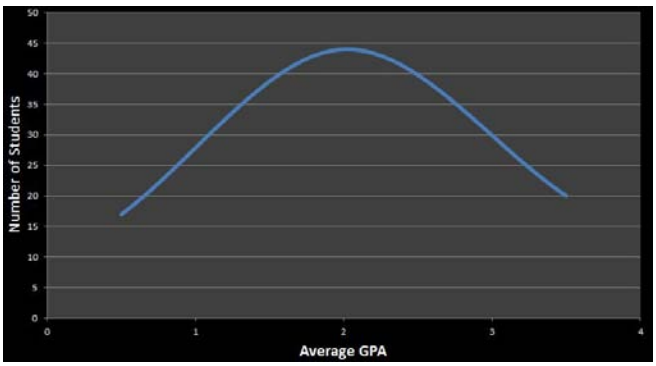

Figure 4 : Distribution of A-1 category users'

b) Test Case 2

In this case, medium frequent Facebook users (A-2) analyzed with corresponding GPA categories. Category A - 2 students are somehow interested in Facebook but not addicted.

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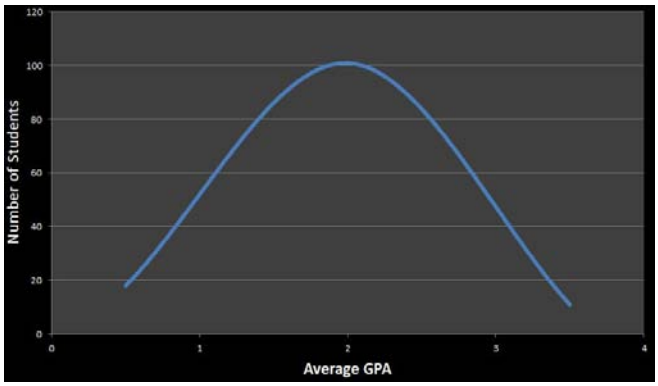

Figure 5 : Distribution of A-2 category users'

Of the medium frequentFacebook users, most of them received medium level grades, residesin category C2.

c) Test Case 3

In this case, frequent Facebook users (A-3) analyzed with corresponding GPA categories. Category A-3 students are who addicted to Facebook.

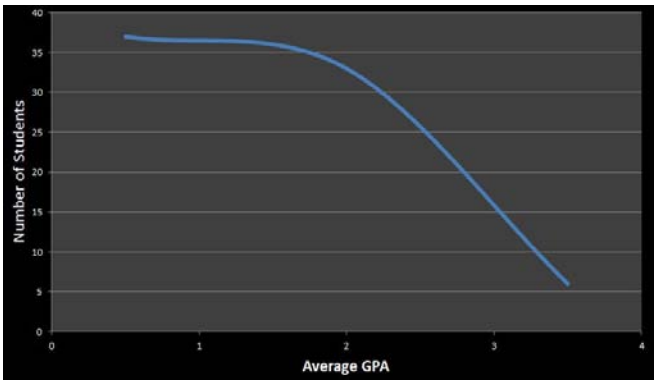

Figure 6 : Distribution of A-3 category users'

Of the frequent Facebook users, most of them received medium grades and low grades, resides in category C-1 and C-2.

d) Test Case 4

In this case, light Facebook users (B-1) analyzed with corresponding GPA categories. Category B-1 students are very occasional users of Facebook.

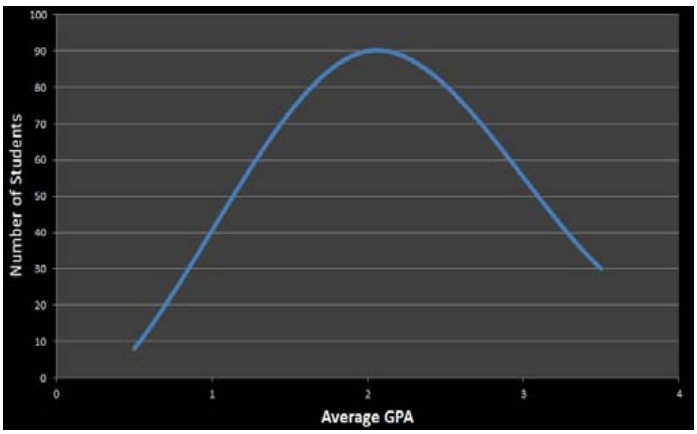

Figure 7 : Distribution of B-1 category users'

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Of the light Facebook users, most of them received medium and high grades, resides in category C-2 and C-3.

e) Test Case 5

In this case, medium time spending Facebook users (B-2) analyzed with corresponding GPA categories. Category B-2 students are somehow interested to stay in Facebook for some time.

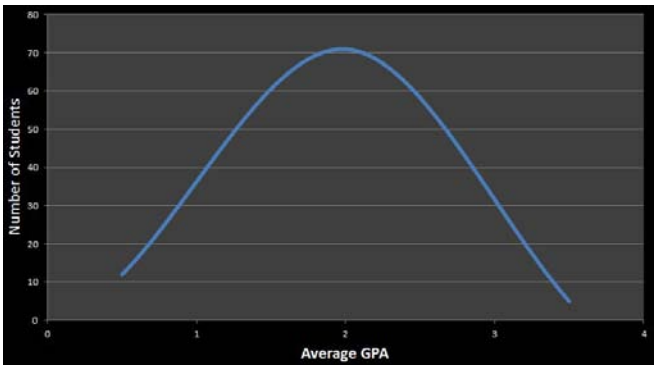

Figure 8 : Distribution of B-2 category users'

Of the medium time spendingFacebook users, most of them received medium grades, residesin category C-2.

f) Test Case 6

In this case, heavy Facebook users (B-3) analyzed with corresponding GPA categories. Category B-3 students are addicted in Facebook and spend much more time.

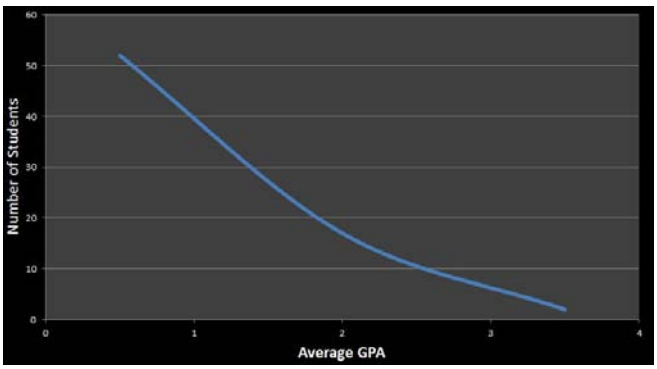

Figure 9 : Distribution of B-3 category users

Of the heavy Facebook users, most of them received medium and low grades, resides in category C-1

V. Conclusion

The study found the correlation between social media usage and academic performance. Most of the heavy or frequent users received low grades, compared to light users. We found similar results with lower grades. By considering Test Casest here is a significant difference in Grade Point Average between those considered to be heavy or frequent users of social media and those considered to be light or occasional users. As we employ more time on Facebook, there should be a significant decrement in performance. The results of our study indicate that time and the frequency of using Facebook were predictors of academic performance. In addition, it could predict the quality of life as well.

However, the unanticipated finding was that there are numerous positive usage of Facebook still employed. In future weexpect to expand the positive usages of Facebook among university students which help them to increase their academic performance.

VI. Acknowledgments

We would like to thank universities participate in this survey. Extend our sincere thanks to students who spent their precious time and for their assistance and support. Further we would like to acknowledge all friends who assisted us in conducting survey.

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- Author Name in Font Size of 11 with one column as of Title.
- Abstract Font size of 9 Bold, "Abstract" word in Italic Bold.
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- Two Column with Equal Column with of 3.38 and Gaping of .2
- First Character must be three lines Drop capped.
- Paragraph before Spacing of 1 pt and After of 0 pt.
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- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
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You can use your own standard format also.
Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

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Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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