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COMPARATIVE STUDY OF ZNO BASED THIN FILM & NANOWIRE GAS SENSORS

M. Kashif*, U. Hashim*, Jamali. A.S**

ABSTRACT

ZnO nanowires are ideal building blocks for a wide range of nanoscale electronics, optoelectronics, and chemical sensing devices. The material properties change when the material is in nanowire form as compare to thin film or bulk. Nanowires are very promising for the development of new generation gas sensors. In nanowires, surface effects dominate due to increase of their particular surface that enhances the surface related properties like catalytic activity or surface adsorption. Sensitivity of nanowire to a particular gas increases if the catalyst is use to grow the nanowire. There are two methods for the synthesis of nanowire bottom up and top down. Both methods have their merits and demerits that will be discussed under the topic of nanowire synthesis and deposition methods. This paper presents the synthesis methods and comparative study on thin film and nanowire gas sensors.

Keywords: ZnO, nanowire, gas sensor, synthesis, adsorption.

1. INTRODUCTION

ZnO has received intense attention in the group of II-VI compound semiconductors due to its remarkable physical, gas sensing and optical properties. It has wide band gap (3.37 eV at room temperature), high excitation binding energy (60 meV), has a stable wurtzite structure with lattice spacing a_o = 0.325 nm, c_o = 0.521 nm and c_o/a_0= 1.602 and its diverse growth morphologies make ZnO a key material in the fields of nanotechnology and wide band-gap semiconductors. The potential uses of ZnO is the fabrication of short wavelength devices, operating in the blue and ultra-violet regions of the electromagnetic spectrum, such as light emitting diodes, laser diodes and sensors. ZnO is one of the most widely applied oxide-gas sensor. ZnO gas sensing materials owe to their high chemical stability, low cost, and good flexibility in fabrication. ZnO sensor elements have been fabricated in various forms including single crystal [1-4], thin film [5-9]. The gas sensing mechanism involves chemisorptions of oxygen on the oxide surface followed by charge transfer during the reaction between chemisorbed oxygen reducing and target gas molecules. However, the physical and sensing properties of semiconductor gas sensors are directly related to their preparation e.g. particle size, sensing film morphology, and film thickness [10-15] as well as sensing film characteristics.

ZnO was pioneering material in gas sensing, though researchers preferred to extensively study SnO_2 because of its high gas sensitivity and its morphological and chemical stability. With the advent of modern nanotechnologies, zinc oxide has been rediscovered. ZnO has been successfully employed to detect various gases, such as H_2, NO_2, O_2, H_2S, CH_3CH_2OH and NH_3 [16-19].This paper will discussed synthesis methods and deposition techniques and comparison between thin film and nanowire gas sensors.

Zinc oxide crystallizes in three forms: hexagonal wurtzite, cubic zinc blende, and the rarely observed cubic rock salt. The wurtzite structure is most stable at ambient conditions and thus most common. The zinc blende form can be stabilized by growing ZnO on substrates with cubic lattice structure. In both cases, the zinc and oxide centers are tetrahedral. The tetrahedral coordination is an indicator of covalent bonding (sp3). Thus, ZnO lies on the borderline between being classified as a covalent or ionic compound.

2. SYNTHESIS METHODS & DEPOSITION TECHNIQUES OF 1D NANOSTRUCTURES

The preparations of nanomaterial are generally divided into two main categories which are top-down methods and bottom-up methods.

2.1 TOP DOWN

Top-down approach is based on standard micro fabrication methods with deposition, etching on planar

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substrates in order to reduce the lateral dimensions of the films to the nanometer size. Top-down approaches usually utilize planar, lithographic techniques to transfer a pre-designed pattern to a substrate which can form complex high density structures in well-defined positions on substrates [20-21]. For example, Im et al. [20] synthesized ZnO nanowires using a complicated nanoscale spacer lithography method, which can be used to detect H_2 and CO gases. Electron beam, focused ion beam, X-ray lithography, nano- imprinting and scanning probe microscope techniques can be used for the selective removal process. Top-down approaches have been widely used in the current microelectronic industry. They can produce nanostructures with very uniform shapes and electronic properties. With the passage of time and rapidly changes in the size of the devices the microelectronic industry advances towards ever smaller devices, this approach will soon reach their physical and economic limits, which motivates global efforts to search for new strategies to meet the expected demand for increased computational power as well as for integrating low-cost and flexible computing in unconventional environments in the future. The capability figures listed in Table 1 are based on majority of reported results and they are generally reproducible with certain type of equipment and process conditions [22].

Table 1: Direction nanofabrication techniques capabilities

Technology	Capability
Optical Lithography	~ 30 nm
E-Beam Lithography	~ 10 nm
Nanoimprint Lithography	~ 10 nm
Scanning probe Lithography	~ 20 nm
Reactive- Ion Etching	~ 50 nm
Metal lift-off	~ 10 nm
Focused Ion Beam	~ 30 nm

The advantages of top-down approach are the use of the well developed technology of semiconductor industry and the ability to work on planar surfaces, on the other hand this approach has the disadvantages like their extremely elevated costs and preparation times. In top-down method nanoscale spacer patterning lithography method will be cover only.

(a) *nanoscale spacer patterning lithography*

Nanoscale spacer lithography is one of the most promising techniques that are used for the fabrication of aligned nanowires. That technique involves conventional lithography steps followed by RIE etching. This is an alternative way for the production of nanowires as compare to E-beam lithography. In this process sidewall/spacer was formed using sacrificial and etch stop layers. Sacrificial and etch stop layers were deposited using PECVD or LPCVD depends on the material. After that sacrificial layer was pattern using conventional lithography and etch by ICP process using suitable gases to etch that material or layer. In the next step ZnO or other metal oxide semiconductor material was deposited using ALD, RF sputtering or PLD process. The metal oxide semiconductor layer except for the spacer part was then removed by ICP etching with suitable gas discharges, so that the plasma damage to the metal oxide semiconductor spacer could be minimized. Finally, metal oxide nanowire arrays were obtained by etching the sacrificial oxide using the etch-stop layer. Figure 1 shows the steps of nanoscale lithography process for the fabrication of ZnO nanowire arrays [20].

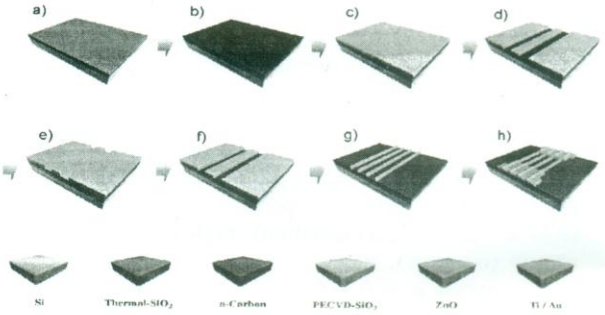

Figure 1: Schematic diagram illustrating the fabrication processes of the ZnO nanowire device based on NSL: **a)** thermal SiO2 deposition, **b)** a-carbon deposition (etch-stop layer), **c)** PECVD of SiO2 (sacrificial layer), **d)** sacrificial layer patterning, **e)** ZnO ALD, **f)** top view after ZnO plasma etching, **g)** sacrificial layer removal, and **h)** ZnO nanowire device after metal electrode deposition.

(b) *bottom-up*

Bottom-up refers to methods where devices 'create themselves' by self assembly. In bottom-up approach, functional electronic structures are assembled from chemically synthesized nanoscale building blocks; represent flexible alternatives to conventional top-down methods. They can go far beyond the limits of top-down technology in terms of future physical and economic limits. [23-24].Table 2 lists a host of 1-D metal oxide nanostructures grown from bottom-up approaches using different techniques. Bottom-up, consists of the assembly of molecular building blocks or chemical synthesis by vapor phase transport, electrochemical deposition, solution-based techniques or template growth. By using the bottom-up approaches the advantages are the high purity of the nanocrystalline materials produced, their small diameters, the low cost of the experimental set up together with the possibility to easily vary the intentional doping and the possible formation of junctions. The main disadvantage of this approach is their integration on planar substrates for the exploitation of their useful

Table 2: Synthetic Methods Developed for the Synthesis of 1-D Metal Oxide Nanoma Terial [25 – 28]

Vapor phase synthesis(thermal evaporation, CVD, Laser ablation, MOCVD)	**VLS Growth**	ZnO, SnO_2, In_2O_3, Fe_2O_3, MgO Nws, etc.	**Advantages:** 1. Typically produce high quality single-crystalline NWs with easy control over the diameter & length. 2. Capable of producing NWs on a large scale. **Disadvantages:** 1. Need high temperature. 2. Complicated procedures are needed in some methods.
	VS Growth	ZnO, SnO_2, In_2O_3,Cu_2O,WO_3, Co_3O_4,V_2O_5, MgO,Ga_2O_3 NWs, etc.	
Solution phase synthesis	**Template-free growth**	ZnO, SnO_2, V_2O_5, MnO_2 NWs, etc.	Advantages: 1. Only need ambient temperature with reduced fabrication complexity and cost. Disadvantages: 1. Typically difficult to control the diameter of NWs. 2.Template-assisted method usually produce poly-crystalline NWs.
	Template-assisted growth	ZnO,SnO_2, TiO_2 NWS, etc.	
Other methods	**Electrospining etc.**	TiO_2, ZnO, SnO_2 NWs etc.	It usually requires complicated procedure and is difficult to control diameter.

properties, for example transfer and contacting on transducers can be troublesome.

(c) *vapor phase growth*

ZnO growth was performed in tubular furnace to obtain the proper temperature gradient in vapor phase growth method. The main advantage of the vapor phase process is the possibility to produce different type of materials in an easy way and with cheap deposition systems [29].Once the source material is evaporated it is transported by a gas carrier towards the growth site where it nucleates. The process of nucleation can start from particles or catalyst. There are different categories for the vapor phase technique such as the self catalyzed vapor solid (VS), the catalyst assisted vapor liquid solid (VLS) and vapor phase transport (VPT), which are all based on the vapor phase technique but differ in the nucleation and growth mechanisms of the solid from the vapor species on the substrate.

2.2 CATALYST-ASSISTED VAPOR-LIQUID-SOLID METHOD (VLS)

In this method, the vapor species are generated and then condensed into a metal drop which acts as a catalyst for the growth. For ZnO, the morphology of the nucleated growth is generally wire or rod shaped. The diameter of the nanowires is controlled by the size of the liquid catalyst droplets (smaller catalyst yield thinner nanowires). Nanowires and nanorods produced by this method are remarkable for the uniformity of their diameter [30].

This method uses metals such as Au, Fe, Co and Ni as catalysts therefore this method is called catalyst assisted VLS method. The metal catalysts can be mixed with the source material or spread on the substrate where the nanowires grow. In either case, the metal catalyst is either patterned or self-organized into nanoparticles. These nanoparticles react with the source vapor forming solution droplets on the substrate that serves as a preferential site for absorption of reactant, since there is a much higher sticking probability on liquid versus solid surfaces. When the droplets become supersaturated, they are the nucleation sites for crystallization. Preferential 1D growth occurs in the presence of reactant as long as the catalyst remains liquid. During this process, the catalyst particle tends to remain at the tip of the growing nanowire (Fig. 2 ref 31). The size of the catalyst particles used to generate the nanowires depends on the preparation process. Typical methods include thin film deposition of the metal catalyst on the substrate by thermal evaporation or sputtering [32-33]. The metal thin film will cluster into small particles when heated up to the growth temperature. This typically leads to a wide distribution in nanoparticle diameter that is reflected in the diameter distribution of the resultant nanowires. The second approach is to deposit prefabricated mono-disperse catalyst nanoparticles on the substrate. Since the prefabricated nano-particles are uniform in size, nanowires can grow more uniformly in diameter [34].

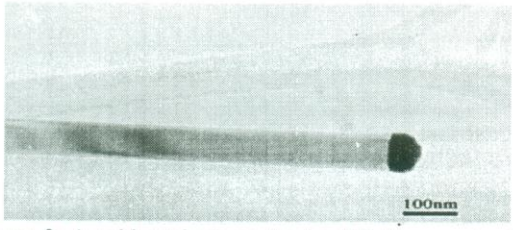

Figure 2: A gold catalysts on the tip of ZnO nanowire [31]

2.3 SELF-CATALYZED VAPOR-LIQUID-SOLID METHOD (VLS)

This technique is a catalyst-free method, during which the nanostructures are produced by condensing directly from the vapor phase. Therefore, morphology and alignment of the nanostructures are less controlled compared to the catalyst assisted VLS, in which the diameter of the nanowires is controlled by the size of the catalyst. However, it has been reported that under this synthesis more varied morphologies are possible due to the absence of constraints by the catalyst. Also, the technique has the advantage that contamination from the catalyst can be avoided during the growth process [30].

2.4 VAPOR –SOLID METHOD (VS)

Vapor solid (VS) growth takes place when the nanowire crystallization originates from the direct condensation from the vapor phase without using any catalyst. At the beginning the growth was attributed to the presence of lattice defects, but when defects-free nanowires were observed this explanation can not be any longer accepted. Vapor solid occur in many catalyst-free growth processes. Under high temperature condition, source materials are vaporized and then directly condensed on the substrate placed in the low temperature region. Figure 3 shows the set up for the vapor solid synthesis process.

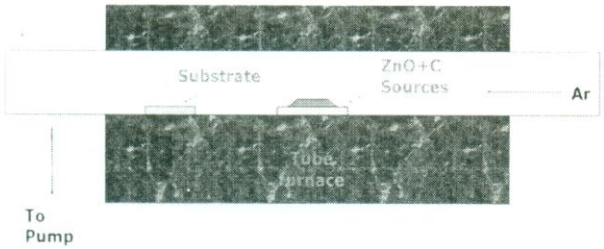

Figure 3: The setup of the vapor-solid (VS) synthesis process

2.5 SOLUTION PHASE GROWTH

The solution-based catalyzed-growth mechanism is similar to the VLS mechanism, in this case a nanometer-scale metallic droplet catalyze the precursors decomposition and crystalline nanowire growth. These growth methods usually require ambient temperature so that complexity and cost of fabrication are considerably reduced. The variants of VLS growth in solutions SLS and supercritical fluid–liquid–solid (SFLS) growths provide nanowire solubility control over surface ligation, and smaller diameters. But the VLS growth in general produces nanowires of the best crystalline quality.

2.6 SOL-GEL

The sol-gel process is a wet-chemical procedure in which a solution of a metal compounds or suspension of very fine particles in a liquid (referred to as a sol) is converted into a semi-rigid mass (a gel). The sol-gel consists of mixture of solid materials suspended in a liquid solution. Gel occurs when the individual molecules form structures which then form molecules matrix network are same with the formation of semiconductor crystals but without ordered spacing. During thin film deposition, the parameters of deposition process such as deposition speed, deposition time, drying time and drying temperature will determine final material properties including structural, optical and electrical properties.

In the sol–gel process, a molecular precursor in a homogeneous solution undergoes a succession of transformations: (i) hydrolysis of the molecular precursor; (ii) polymerization via successive bimolecular additions of ions; (ii) condensation by dehydration; (iv) nucleation; and (v) growth [35].Zinc precursors such as nitrate, chloride, acetylacetonate and alkoxides such as ethoxide and propoxide, are used but the most often used is the acetate dehydrate. Metal salts are mostly used as a precursor because of their low cost, facility of use, and commercial availability. Inorganic salts like nitrates are often used, as precursors for sol–gel ZnO-based materials, even though their main drawback is related to the inclusion or difficult removal of anionic species in the final product [36]. An overview of the sol-gel process is presented in Figure 4.

The advantages of sol-gel technique are the ability to produce high-purity metal oxide because the organo-metallic precursor of the desired ceramic oxides can be mixed, dissolved in a specified solvent and hydrolyzed into a sol, and subsequently a gel; the composition can be highly controllable, the low temperature sintering

capability, usually 200–600°C; and last but not least the simple, economic and effective method to produce high-quality coatings. Despite its advantages, sol-gel technique never arrives at its full industrial potential due to some limitations, e.g., weak adhesion, low wear-resistance, and difficult controlling of porosity. In particular, the limit of the maximum coating thickness is 0.5 mm when the crack-free property is an indispensable requirement. The trapped organics with the thick coating often result in failure during thermal process. The substrate–layer expansion mismatch limits the wide application of sol-gel technique.

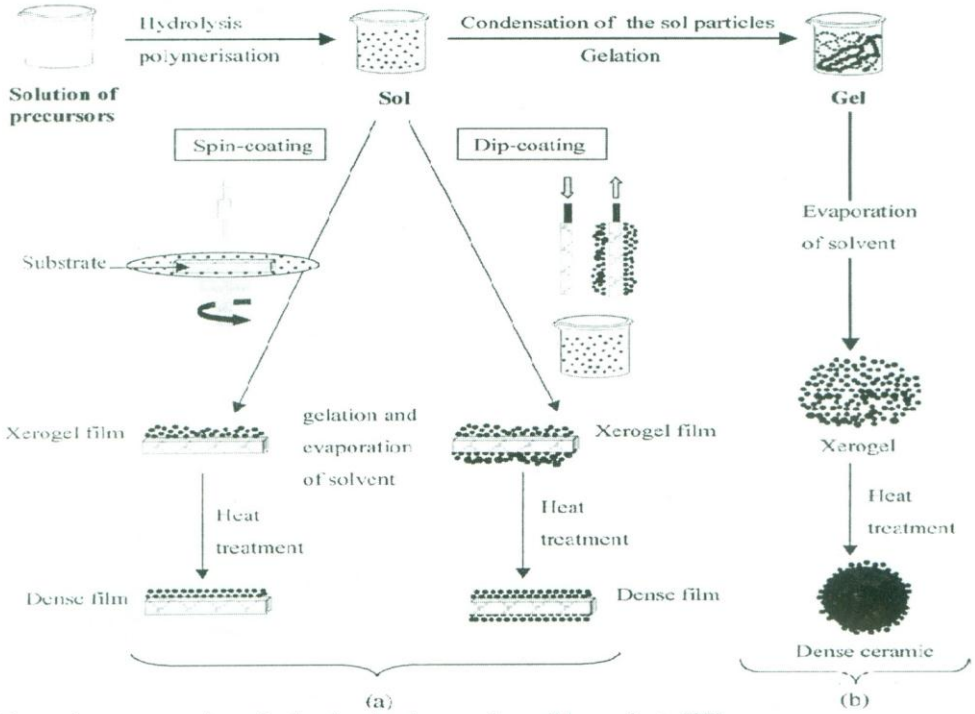

Figure 4: Schematic representation of sol-gel technology and possible products [37]

2.7 TEMPLATE GROWTH

Template growth is another powerful method for the nanostructures synthesis for the electronic device applications. In the template growth method the template can serve as a container, the nanostructure grows within or around it; the shape of 1D nanostructure is complementary to the one of the chosen template. This technique provides a good control of the uniformity and on the dimension (owing a good control on pores dimensions and distribution), however the number of nano-wires that can be produced are limited by the template and the template removal can cause damage to 1D structure.

In this method materials are to be fill into a nanoporous template (mostly by electrochemistry) to form nanostructures that can be released by dissolving the template. Nanoporous anodic aluminum oxide (AAO) membranes are the most extensively used templates for nanowire synthesis [38-41]. The pores inside the membrane are perpendicular to the surface and positioned in the form of a hexagonal lattice (See figure 5a). The size of the pore is proportional to the anodizing voltage.

For the nanowire synthesis, materials have to be filled into the nanoporous in some way. Electrochemistry is a powerful method for such applications and has been used to synthesize nanowires consisting of nonconductive metal oxides [38-42], metals [43-46], and semiconductors [47]. It is straight forward to fill metals and conducting polymers into the template by electrochemistry, while semiconducting and non-conducting materials can only be filled into the nanoporous in an indirect way.

There are also some other techniques to prepare metal oxides by electro-chemistry. For example, Zn (OH) x can be formed through electroplating Zn $(NO_3)_2$ solutions at an elevated temperature in the presence of O2 [48]. The Zn (OH) x can also be filled into nanoporous templates and form ZnO crystal nanowires after a high temperature annealing.

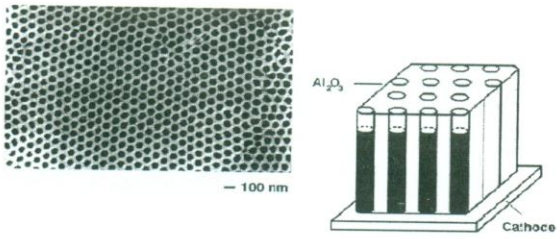

Figure 5 (a): The SEM image of AAO membrane surface (from Ref. [49]) and **(b)** AAO membrane used a template to make nanowires by electroplating.

3.7COMPARISON BETWEEN NANOWIRE & THIN FILM GAS SENSORS

Nanowire-based sensors can potentially exhibit a fast response with higher sensitivity and selectivity than existing thin film sensors. The basic principle behind nanowire-based gas sensors is the detection of small concentrations by measuring changes in electrical resistances in nanowires caused by the absorption or desorption of the chemical species or by phase changes in the nanowire [50].

Hyun-Wook Ra, fabricated ZnO nanowire sensor using nanoscale spacer patterning lithography in his paper he compare the response of nanowire sensor and thin film sensors. In his paper he shows the time dependence of the sensitivities of the ZnO nanowires obtained using the NSL technique and the ZnO thin film of thickness 100nm to various concentrations of H_2 and CO in the range of 500–5000ppm at 200 °C that is shown in figure 6. In the figure it indicates that both the ZnO nanowires and the thin films follow the fully general gas-sensing mechanism. The ZnO nanowires show a much higher sensitivity (about five times) compared to the ZnO thin film for both H_2 and CO. It is clear that the enhancement in gas sensitivity of the nanowires can be attributed to the higher surface-to-volume ratio than that of the thin film.

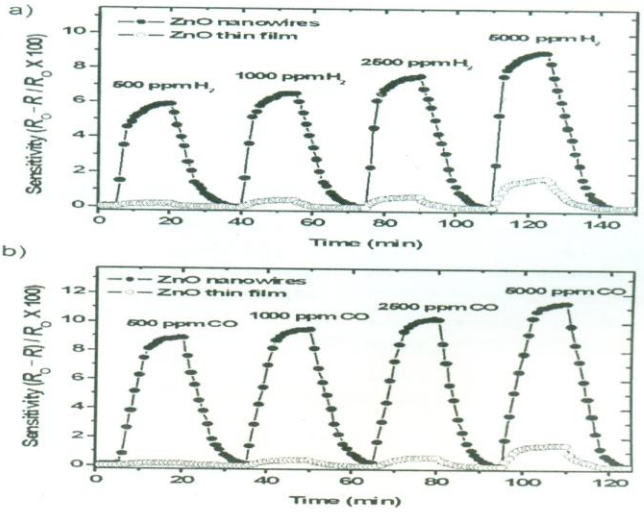

Figure 6: Sensitivities of the ZnO nanowires and ZnO thin film of thickness 100nm to different concentrations of **a)** H_2 and **b)** CO at 200 °C. **[20].**

In another paper jing wang & his team fabricate a nanowire sensor for gas detection using nanoimprint on SU8/ SiO_2/PMMA trilayer. In his paper he fabricates three devices with different thickness. Table 3 that is taken from his paper shows the resistance and relative sensitivity of the three devices.

Table 3: Resistance and relative sensitivity for the three devices

Samples	Resistance (Ω)	Sensitivity for NH_3 (%)	Sensitivity for NH_2 (%)
Thin film device	1x 10 exp3	-1.3	7.8
130 nm nanowire	177.9 x 10 exp3	-9.9	27.3
75 nm nanowire	916.4 x 10 exp3	-19.7	61.8

By comparing the values of three devices he mentioned that the resistance is anomalously large for the NW devices, especially for the narrower one. He indicate that this may be caused by the defects and traps generated in the RIE process which will make the channel partially depleted. Even with traps and defects, the NW devices still show a large enhancement in the sensitivity when compared to the thin film devices. The enhancement is even more obvious for the 75 nm one due to its higher surface to volume ratio.

From the above discussion it is very clear that the nanowire devices has more sensitivity as compare to thin film gas sensor and the gas sensitivity is dependent on the grain size or diameter of the nanowire. By decreasing the grain size the surface to volume ratio increase and surface to volume ratio play a major role in the gas sensing of nanowire gas sensors.

4. SUMMARY

This article reviewed the current progress in ZnO nanowire based gas sensors. For the gas sensing application sensitivity, selectivity and stability are the there important factors. Sensitivity depends on the grain size whereas selectivity depends on the appropriate selection for material for the gases of interest. Selectivity can be increased by doping the material with other selective sensing materials.

For the gas sensing grain size plays a major role in the sensitivity of the nanowire device as compare to thin film devices. The smaller the diameter of the nanowire greater will be the sensitivity. A great effort has been done to understand and control the growth process for the production of high quality nanowire with bottom up techniques as well as with top down techniques. In bottom-up approach VLS mechanism is still widely employed for growing most of the nanowires produced nowadays. Solution-based techniques can be a promising alternative approach for mass production of metal oxide nanowires with good control of shape and composition. The main drawback of bottom up approach is the lack of full understanding of growth mechanism. Most of the methods are based on trial and error procedure and after getting nanowires transfer of single nanowire from one substrate to another substrate is very difficult and time consuming process.

On the other hand top-down approach has the advantages such as the use of the well developed technology of semiconductor industry and the ability to work on planar surfaces, while disadvantages are their extremely elevated costs and preparation times. Top-down approach there are various methods for the production of nanowires but now a days nanoscale spacer lithography is one of the promising method because of simple processing steps as compare to E-Beam lithography. By using spacer lithography one can get the nanowire of up to 40nm diameter. With the advancement of technology in the future it will be possible to go beyond this range.

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MAN MADE SECURITY SYSTEM BY USING DIGITAL SIGNALS PROCESSING

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ABSTRACT

Bio-metric project always based on the testing on leaving parts or human body parts, In bio metric security system the different parts of human body are used for recognitions purpose. The face is mostly attracting part of human body which used in face recognition to make security system more secured. It is software based security system and MATLAB as programming tool. This based on Password technique to provided authentication while without password we can never operate the system. This system takes password from users and captures picture, make database and verify image according to bio metric techniques. These techniques based on algorithms and programming and physical appreance of face image, there are many bio metric platforms for digital security system but we have selected PCA through applicable of Eigen face approach.

Keywords: Digital security techniques, PCA, face recognition, Hardware descriptions, software descriptions, Real times results, Future aspect.

I. INTRODUCTION

Security system is one major task nowadays. There are many DSP techniques used for security system. Its reliability depends upon electronics software based techniques.

Nowadays computation electro security system package (software based) are most in operates and reliable.

Every software based security system has different principles and algorithms but we require authentification solution. For authentification system bio metric technology is the first choice because bio metric gives study of measure and recognition human body parts such eye, ear,figure,face etc. In technical termilogy we define "The system through which living person are recognized by automatic system according to consideration of physical and behavioral characteristics "This system called as bio metric security system because which given result by using different tools such as Matlab,C language etc. There are many bio metric system such as Signature identification, Hand geometry, body Oder identification, Iris identification, Retinal identification, Face identification.

2. DIGITAL SECURITY TECHNIQUES

Matlab use as programming tool (MATLAB VERSION 7) and it is very important to proof all mathematically terminology through programming. Through such factors Standard Deviation, Variance, Co-Variance, Eigen vectors and Eigen values give mathematical authentications of that security system.

2.1 STANDARD DEVIATION

Recognition of images depends upon database. The measuring of spread of data from data set under its given conditions is called standard deviation. Mathematically it is explained as "mean of data from average distance towards the set points within the limits "formulaically defined below

$$S.D = sqr\left(En\ \frac{(Xi-meanX)^2}{N-1}\right) \quad (1)$$

Where n for ranging to its maximum value
Due standard deviation used to give suitable dimensions.

2.2 VARIANCE

Variance is minimization of data set because of more suitable dimensions. It is the square of standard deviation

$$variance = (S.D)\text{^}2 \quad (2)$$

2.3 CO -VARIANCE

Both standard deviation and variance are used to measure the one dimension of the given image or target to measure three dimensions. The mathematically factor used to measure more than one dimension is known co variance. formulatically defined below

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$$Vx = \frac{\sum_{i=0}^{n=1}(xi - x)\hat{}2}{n-1}$$

$$Vy = \frac{\sum_{i=0}^{n=1}(yi - y)\hat{}2}{n-1} \quad (3)$$

In co-variance between X and Y represented as below

$$cov(vx, vy) = \frac{\sum_{i=0}^{n=1}(xi - x)(yi - y)}{n-1} \quad (4)$$

Dimeminalitis of co- variance give following result

- If expected values (X and Y) are positive than our dimension of the data set increase positive.
- If expected values are negative than our dimension of the data set increase negatively.
- If expected values (X and Y) are zero than our dimension of the data set became independent.

2.4 EIGEN VECTORS AND EIGEN VALUES

Eigen vectors and Eigen values are used to represent the data (images) in the matrix form and give final result with suitable dimension. Below relationship define Eigen vectors and Eigen values.
Where

M*u=LAMDA*u

u =An Eigen vector of the M matrix
LAMBDA =Eigen values of the Eigen vector

2.5 PROPERTIES OF THE EIGEN VECTORS & VALUES

Eigen vectors and Eigen values are used to form square matrix and square matrix give suitable dimension of the mean image. Eigen vectors placed at right angle with each other.

3. PCA

There are many techniques with most suitable applications used for recognition human parts. We are going to recognize the face. We have worked through PCA (Principle component techniques) for getting suitable dimension of image.

3.1 PCA (Principle component techniques)

It is mathematical technique, which used to defined the simplicity of data from dataset.PCA reduce the dimension of data set according to verification of standard deviation, variance , co-variance, Eigen vector and Eigen values with summarized words PCA used to reduce the dimension of the database and Recognition meaningful images or data according to verification of mathematics factors.

3.2 FINDING OF THE PCA

Finding of PCA depend upon two factors, Normalization of the data set, Evaluation of Eigen vectors and Eigen Values.

(a) *normalization of the data set*

Before study normalization process, we need to suitable dimension of the images (data), regarding this co variance matrix is used for that purpose .our task is to get mean image, so co- related images and get one most suitable co-variances matrix .which can be done by using normalization because normalization is the statistical process of spread of data ("images") at suitable range. If we don't consider normalization it became difficult for us to manage the various components and get one suitable component that is called PCA.

(b) *evaluation of the eigen vectors & values*

Actually the PCA depend upon co variance matrix. It is collection of Eigen vectors and Eigen values select according to the dimension based and give priority to the suitable dimension. Highest priority component is known 1st "principle component and next highest one is known 2nd principle component and so on". It is easy to identify the 1st, 2nd PCA component...nth component but programming verification is related to apply of PCA.

(c) *apply pca on the face recognition*

Now we know about PCA but our task does not just know about PCA but it's applicable on our recognition system (face recognition) or not. So authication applying of the PCA on face recognition depend upon following process.

- Make training sets of images or data
- Arrange the training set in particular form, so that training sets are known data set or image space
- Apply the PCA and intend it to work in the 1st phase (Normalization) because making good dimensions
- Apply the PCA for 2nd phase (Eigen vectors and Eigen values)
- Get linear combination of the Eigen vectors and normalization for result purpose

(d) *selection pca technique*

There are many techniques but PCA is one of the most suitable for mathematically as well as programming level and result also and most important reason of using PCA defined below.

- Easy to make programming of the PCA and their mathematics conditions
- Reduce the dimension with wide range

- Easy to applicable for face recognition through verifying mathematics factors.

4. FACE RECOGNITION

Eigen face approached based on the principal component analysis and which follow the terminologies of the Eigen vectors and Eigen values. The Eigen face approach based on PCA for given high quality image result from Eigen face space (data base).proper dimension of mean image depend upon proper projection of the Eigen vectors and Eigen values.
The following are key factors which have done by applicable of Eigen face approach.
Input image with arrangement of suitable dimension in face space, Normalization of the face space, User password system, and Final result recognition process.

4.1 MATHEMATICS OF EIGEN FACES FOR FACE RECOGNITION

Face recognition with application of Eigen face depend upon following factors with respect to its mathematics

- Initialization of the capture image
- Mathematics of the key vector
- Mathematics of the face space
- Mathematics of resulting face

(a) *initialization of the capture image*

Our first task will to make proper arrangement of the input images mathematics is necessary for software point view. first step is formation of the co variance matrix and 2nd step is comparing with existing images in the data base. Consider Γ is new image and Γn images vector formation occur with dimension of Nx1.and note mean image (capture's image) will subtract from average image Ψ

(b) *mathematics of the key vector*

The resulting image in the form of vector and give average image Ψ (average image –capture image=mean image) and mathematical define below

$$\Omega = \mu \hat{} T(1 - \omega) \qquad (6)$$

(c) *mathematics of the face space*

The arrangement of images in particular form is known face space. Mathematics of face space in the form of the matrix and we give elements of matrix as class in place of rows and columns. Such as
Mean result will be

Mean image=Database images/Number of the images

Ns no of the samples in the database.

Class No	Mathematically	Remarks
1.Toufique	W1	Class no.01
2.Siraj	W2	Class no.02
3.Irfan	W3	Class no.03

(d) *mathematics of resulting face*

Resulting image is formed according to following mathematics

Total Image=input image – mean image

Where
Γ = input image
Ψ = mean image
According to this
a face class both have same co variance matrix mathematics there are four ways to recognitions the image

- face space and (recognized correct)
- face space but face class both have not same co variance matrix (non recognized)
- face space and face class have different face key vectors (unknown a face)
- face space and face class have not different face key vectors (unknown a face)

HARDWARE DESCRIPTIONS

Basic diagram of the face recognition shown below

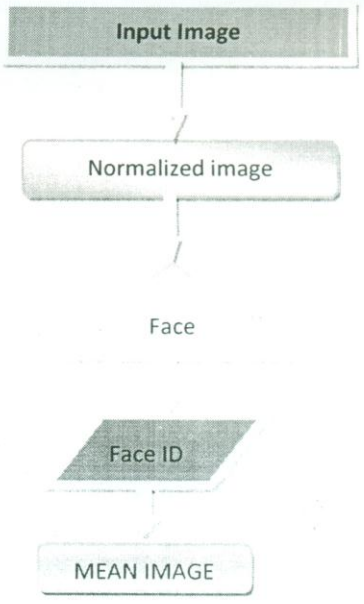
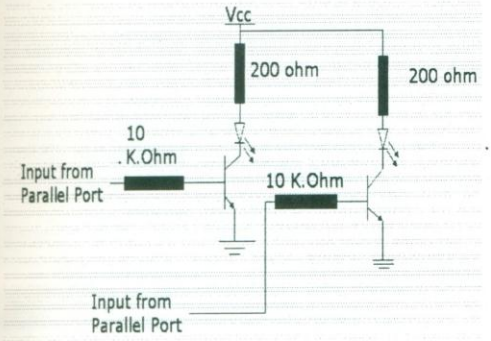


Figure 1: System Flow Chart

It is PC based and only two hardware devices are connected with system. One is camera for capture image



and one external circuit for access grant and access Denied.

Figure 2: Parallel port interfacing circuit

6. SOFTWARE DESCRIPTIONS

Software is the Matlab, which used as programming tool and system work according to below graphical algorithm.

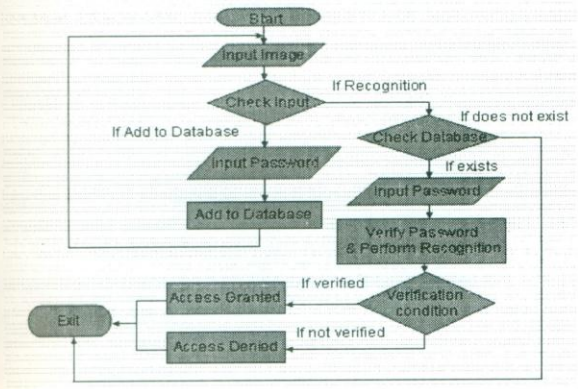


Figure 3: Code flow chart

7. REAL TIMES RESULTS

Real time result contains on following blocks according to interconnecting with software code

- Access grant
- Data base
- Access denied

7.1 DATA BASE

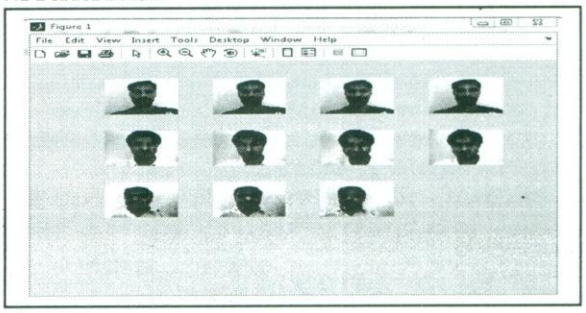


Figure 4: View of real time Database

7.2 ACCESS GRANTED

Figure 5: Access Granted database view

7.3 ACCESS DENIED

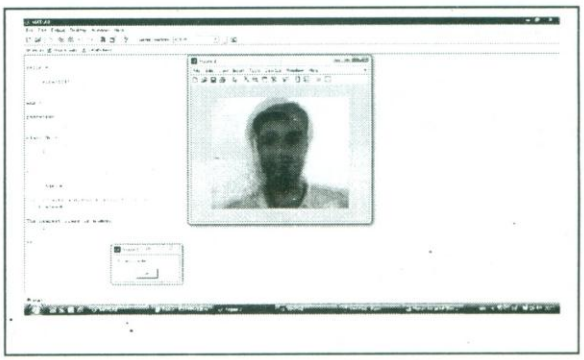


Figure 6: Access Denied Database view

8. FUTURE ASPECTS

It is the one easy software based system and used in the offices, colleges. and universities for high security authentications. Matlab is used as programming tool due to this we can use just in colleges and universities because matlab have not suffient effiency to give fast result for comparing large amount of data base (contain no more

than 200 classes and each class contain with 5 images).for its fast processing of giving result of large data base c++ will be better platform and our work is in progress for that purpose. In future research related this software image can capture from live video and recognized. After such nice capturing and recognitions technique than software will even become more authenticated and robust for security purpose.

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PENETRATION TESTING: A SURVEY OF WEB VULNERABILITIES

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ABSTRACT

Penetration testing is one of the hottest research areas regarding security that deals with auditing of websites for various security breaches. Penetration test is carried out by the security professional to audit the websites to identify the security issues that were not addressed by web developers. Several methods have been employed for penetration testing by utilizing various vulnerability scanners to identify security breaches. The results of penetration test can be used to overcome the discovered vulnerabilities to secure any organization from disaster. Same approach can be used by the hackers to identify the security breaches to hack website and cause any organization to lose their valuable assets. Pakistan is one of the emerging countries where usage of Internet has drastically increased; most of the organizations from government sectors, education sector, or private sector now rely on websites to provide valuable information to their rapidly increasing visitors. Many of commercial websites in Pakistan are now doing their businesses online. Some recent attacks against Pakistani websites suggest that the developers of these web applications have ignored the security issues and just paid attention towards the development of the eye catching websites. Many of the websites found today are vulnerable to some major attacks such as SQL injection, cross site script, cross site request forgery, cross site tracing, denial of service, and buffer overflow. The goals of this paper is to provide a profound survey of various types of vulnerabilities found in Pakistani websites and present the statistical data of vulnerable attacks in graphical form, which is gathered from educational websites, commercial websites and government sector websites.

1. INTRODUCTION

Internet invention has brought revolutionary changes in the world and it has offered a new approach to communicate and has brought new opportunity to the business and individuals, but the drawbacks were that we were only become able to view the information. Later web 2.0 [1] and AJAX [2] have further significantly improved the world of Internet; we really became able to interact in real time. Web 2.0 has really changed the way we use internet today, with this ease of using web 2.0 also brought new threats by opening the gates for hackers. Millions of web applications were developed by web developers to facilitate business and individual for sharing information, with this rush, web developers have significantly ignored web application security issues and developed web applications with variety of vulnerabilities, as listed in [3]. The malicious users have taken advantage and exploited these vulnerabilities. Various organizations in the world are now involved in providing awareness for these vulnerabilities and they are publishing every year a list of top vulnerabilities and also providing the solutions to take measures for these vulnerabilities as to minimize the damage, such as OWASP (Open Web Application Security Project) [3]. OWASP is an open-source application project, which has released list of top ten web vulnerabilities for 2010. In developed countries various security related measures have been taken to minimize security breaches as much as possible, but in Pakistan situation is often changed and no attention has been paid regarding web security. Recently we have seen that some attacks on Pakistani website were made by some hackers and they successfully were in control of complete websites. We have audited total of 15 Pakistani websites of different organization from government sector, education, and commercial websites and collected statistics of the vulnerabilities found in each websites. The outcome of this paper can provide valuable information to these organizations to take counter measures and save their valuable assets, and as well as for the web developers to pay attention to the security while developing web applications. This paper is divided into the five sections, first section gives a brief introduction about web security, and second section discusses the most common found web vulnerabilities. In third section we discuss the analysis and results of audit that we have performed, fourth section gives the comparison of web vulnerability sector wise and finally in fifth section we give our conclusion.

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2. WEB VULNERABILITIES

In this section we discuss most commonly found vulnerabilities, how attackers exploit these vulnerabilities and give example of each vulnerability, many of these vulnerabilities are in the list of The OWASP (Open Web Application Security Project) Top 10 Web Application Security Risks for 2010[3]. Here are some of common vulnerable attacks on Pakistani websites.

2.1 SQL INJECTION

SQL injection is at number one in the OWASP for 2010 list [3], as most of the web applications today uses database at the backend to store user authentication, such as online banking, emails, etc, that's why main choice of attackers is still the SQL injection vulnerability. SQL injection is one of the most observed vulnerability found in web applications that is caused by improper filtrating of user input, allows hacker to inject an additional SQL-query that will be executed at back-end database and allows hackers to view or modify the database without any rights. Various injecting techniques [4] can be used by the attacker to inject malicious code in the database. Many of the proposed solutions have been given by the different researcher to counter SQL injection attacks [4].

EXAMPLE

```
SELECT eName, eNIC, eSalary FROM employees
WHERE department ='Computer Systems Engineering'
```

The query above verifies each row in the employees table, yields each record where the department columns have the value Computers Systems Engineering, the set of all matching records will be finally presented to the user.

```
SELECT SELECT eName, eNIC, eSalary FROM
employees WHERE department ='Computer Systems
Engineering' OR 1=1
```

Attacker has changed the query and appended a second condition; this will cause the database to verify each row in the employees table and yields all of the records where department column has the value computer systems engineering or 1=1 as 1 is equal to 1, so databases will yields each row where it finds its matching column name.

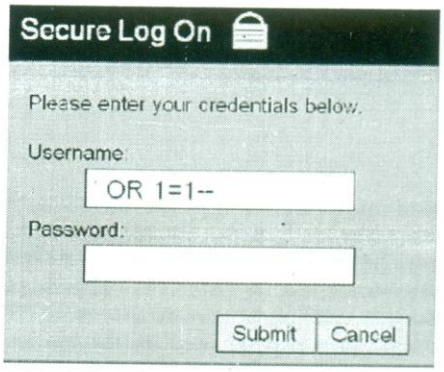

Figure 1 : SQL Injection Attack [5]

2.2 CROSS SITE SCRIPTING (XSS)

Cross site scripting is one of the extensive and dangerous web vulnerability, allows an attacker to inject a malicious code in the website that causes the visitors of the website to be the ultimate victim of the attacker. Cross site scripting was first observed by the CERT [6]. Cross site scripting is at second position in OWASP (Open Web Application Security Project), list for 2010, [3]. Unlike SQL Injection where web application is the target of the attacker, In Cross site scripting web application is being used by the attacker to target its visitors. Victim is trusting the website and becomes target of the attacker, in results victim may lose his valuable information such as cookies. Usually a scripting code is embedded in the targeted web application like java script, VB script. Suppose a book website accepts reviews about their books, and this website is vulnerable to XSS attack. Attacker visits website and submits his review along with malicious script. Website stores that script in their database. This script will execute to each visitor's browser of this website. Depending on the script that is embedded by the attacker, may allow attacker to steal cookies of all the visitors of the website.

```
<script type = "text/JavaScript" >
<!- windows.location = "http://www.anywebsite.com"//-> </script>
```

The above java script redirects a legitimate user to a malicious website, it may be that hacker steal victims cookies or something else, and it depends upon the hacker's will.

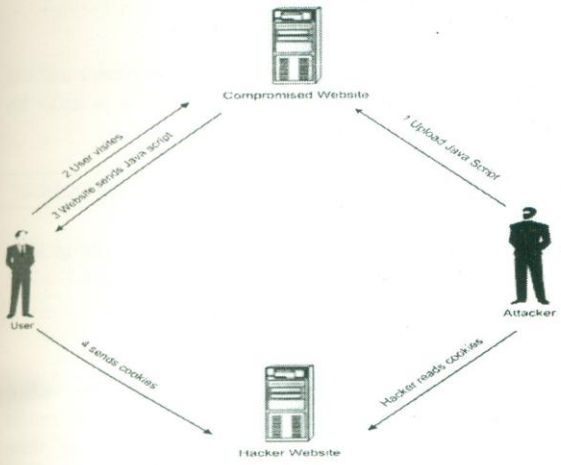

Figure 2 : Cross site scripting attack

2.3 CROSS-SITE REQUEST FORGERY

Cross site request forgery attack has fifth position in list of top ten web vulnerabilities of OWASP [3]. Cross site request forgery attacks allow an attacker to target a website from its legitimate users, but that legitimate user is completely unaware about the actions being performed on his behalf for the attacker. Because the user is legitimate so the targeted website trusts the actions that are performed. As HTTP is a sessionless protocols that's why web application blindly trusts on the cookies for user authentication, when a user visits a website, a token is sent by that website for that complete session, each request is made by the user browser to the website that token will be sent with this request to identify that user for that particular session. The reason for popularity of this attack is that web developers think that preventing web applications from XSS also secure website from CSRF attack. We present following example to completely understand the process of exploiting this vulnerability. Suppose A is the legitimate user of the website www.bank.com.pk. A visits the site and enters his credential to login. A session id will be sent by the website to A's browser which will be stored in the cookies. At the same time A visits another website that is owned by the attacker, which causes the A's browser to send request to www.bank.com.pk. As request came from A's browser therefore www.bank.com.pk will response to his request. To prevent web applications from cross site request forgery attack, different authors has suggested different techniques and tools. After our analysis. we recommend these two tools which are proposed in [7].

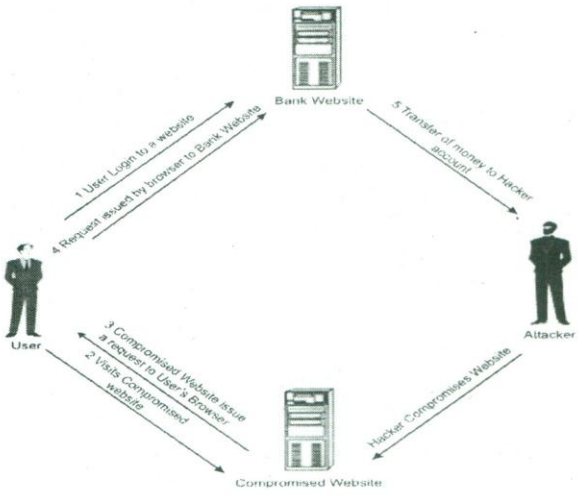

Figure 3 : Cross site forgery attack

2.4 CROSS SITE TRACING (XST)

Cross site tracing is response to httponly method that was introduced by the Microsoft to prevent http cookie from cross site script attack. As hacker's first target is to steal the cookies of the victim, to achieve their goal hackers mainly uses cross site script to steal cookies of the victim. Microsoft successfully found the way to stop hackers from stealing the cookies by introducing httponly feature. Httponly restricted the browser from executing scripting language to read cookies. But this feature provided security to some degree; it only became able to hide the cookie via document.cookie. HTTP TRACE method that was coined for the analysis, which is by default enabled on various browsers, has given the way to hackers to get access to cookie. As httponly feature has prohibited access to the cookies through document.cookie, hacker needs to exploit cross site script to achieve this goal. Finally hackers found a way to steal cookies using cross site script and TRACE method, hence this technique called cross site tracing (XST).

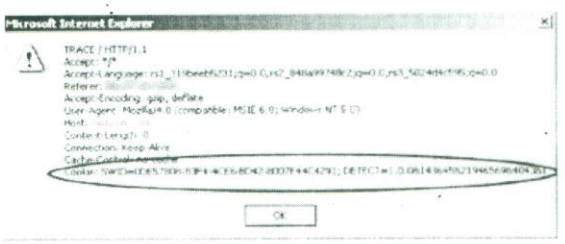

Figure 4 : Trace Request Response From Server [8]

2.5 REMOTE FILE INCLUSION

With so many powerful functionalities supported by the scripting languages, among them one is include file, which allows developer to place a code in a file that can be reused when required, PHP is prone to this vulnerability, as its include function accepts a remote file path. Hacker takes the advantage of this PHP vulnerability and can give a remote file path that is under the hackers control and can run arbitrary code to the PHP server. Suppose a web application that allows their users to enter their location. The malicious user can take the advantage of this and can enter a remote file location that is compromised or is the location of a file that contains bugs and can cause that website to be compromised. The code for this vulnerability can look like this.

```
https://xyz.com/main.php?city=nawabshah
```

The parameters for the city are processed as

```
$city =$_GET[`city']; Include($city .'. PHP');
```

Hacker can take the advantage of this behavior and can give parameter for the city to a URL that is under his control such as

```
https://xyz.com/main.php?city= http://ali.com/backdoor
```

PHP include function takes this malicious file as input and then the contents of the file will be executed.

3. ANALYSIS AND STATISTICS

Table 1 shows the list of websites that we have audited and found that each website is vulnerable to certain attacks, hackers can easily take advantage of these security breaches found in these websites. We have divided our targeted websites into three categories: government websites, educational websites, and private sector websites. The statistics we have collected shows that government websites are more vulnerable as compared to other categories, we have discussed statistics of each category separately.

Table 1: Vulnerabilities in each websites.

S.No.	Target Websites	SQL Injection	XSS	XSRF	XST	RFI
1	www.pec.org.pk	0	0	2	0	0
2	www.neduet.edu.pk	0	0	0	1	0
3	www.uok.edu.pk	0	0	0	1	0
4	www.muet.edu.pk	0	0	0	1	0
5	www.usindh.edu.pk	0	0	0	1	0
6	www.nadra.gov.pk	0	0	4	2	0
7	www.moitt.gov.pk	0	0	0	1	0
8	www.sngpl.gov.pk	0	0	0	1	0
9	www.fbr.gov.pk	0	0	2	0	0
10	www.moitt.gov.pk	0	0	0	1	0
11	www.hbl.com	0	0	2	0	0
12	www.ubl.com.pk	0	0	1	0	0
13	www.mcb.com.pk	0	0	3	1	0
14	www.homeshoping.pk	0	0	2	0	0
15	www.vmart.pk	0	0	0	1	0

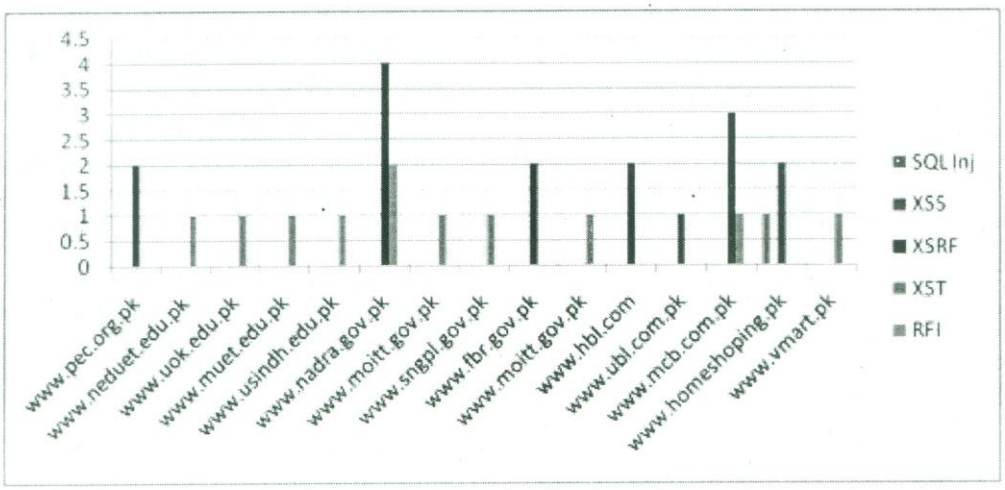

Figure 5: Vulnerabilities Graph for each websites

3.1 GOVERNMENT WEBSITES

Results we have generated in the form of graph from our analysis show that government sector websites contain various vulnerabilities and can be easily targeted by the malicious users. Figure 6 shows that XST vulnerability found in 4 out of 5 websites and XSRF vulnerability found in 2 out of 5 websites, other vulnerabilities such as SQL Injection, Remote file inclusion, and cross site scripting are not found in government websites. Data we have collected from NADRA's website shows that the NADRA website is vulnerable to two types of vulnerabilities out of six. We have analyzed it further that XSRF was found four times and XST two times.

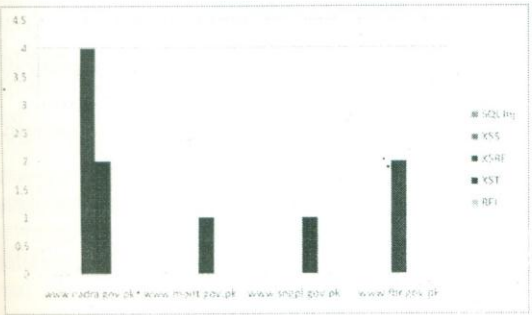

Figure 6 : Vulnerabilities found in Government Sector websites

3.2 EDUCATIONAL WEBSITE

Figure 7 shows the graph that we have generated from our audit against education sector websites. We have taken five websites from education sector and found that each website is vulnerable to at least one vulnerability; among these PEC is most vulnerable and contains two vulnerabilities of XSRF. Although results we have obtained from education sector websites are less vulnerable as compared to the government but it shows that how much these organizations are unaware about the web application security. As our analysis shows that the PEC is most vulnerable and contains two web vulnerabilities of Cross Site Request forgery, which is very alarming. Rest of the websites in this category contain one vulnerability of cross site tracing.

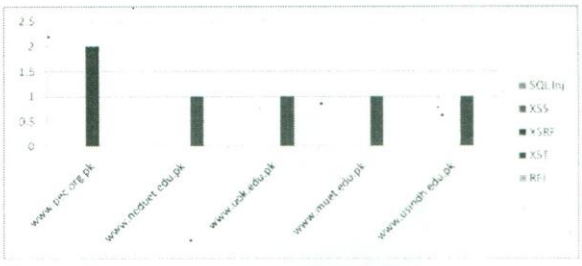

Figure 7 : Vulnerabilities found in Education Sector websites

3.3 COMMERCIAL WEBSITES

The results that we have obtained from our analysis against commercial websites show that these website are also vulnerable to various attacks. Hackers can easily exploit these vulnerabilities, and this can be disaster for these commercial organizations. Figure 4 shows that Muslim Commercial Bank contains total four vulnerabilities. Among these four it contains three cross site request forgery (XSRF) and one cross site tracing (XST) vulnerabilities. We have found Habib bank limited contains two vulnerabilities of cross site request forgery (XSRF). www.homeshoping.pk contains total three vulnerabilities, two cross site request forgery and one SQL injection vulnerabilities. Similarly United Bank Limited and www.vmart.pk each contains one vulnerability Cross Site Request Forgery and Cross Site Tracing, respectively.

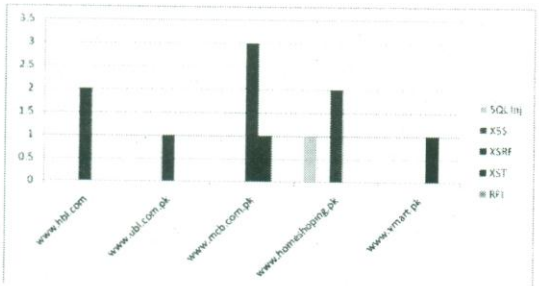

Figure 8 : Vulnerabilities found in Commercial Sector websites

4. COMPARISONS OF GOVERNMENT, COMMERCIAL AND EDUCATION WEBSITES

Figure 8 shows a comparison of the overall vulnerabilities that we have found against each category. Results show that government websites are more vulnerable than other two categories.

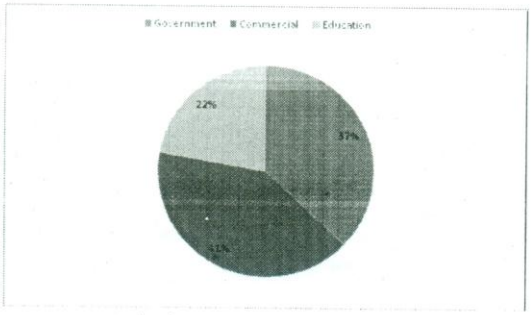

Figure 9 : Comparison of vulnerabilities found in each sector

The overall results of our statistics show that the majority of web applications in Pakistan contain security threats and it has been observed that web developers are unaware about security issues or they have ignored security issues. As malicious users are frequently experimenting new techniques to find out security breaches in web applications and defacing rapidly web applications, therefore we think that web application penetration testing must be carried out on regular basis. The software developing organizations must appoint at least one security expert who should conduct penetration test before submitting the application to their customers. The findings of this paper can provide significant awareness to heads of organizations as well as to the developers to take certain measures so as to avoid frequent defacement of Pakistani websites.

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GRID BASED ROUTING IN DELAY TOLERANT NETWORKS (DTN)

Adnan Ahmed*, Asim Imdad Wagan**, Zahid Hussain**

ABSTRACT

Currently a lot of research work is being carried out in wireless networks, especially in an area where the goal is to provide connectivity in Delay Tolerant Network. Traditional routing protocols fail in this particular scenario because they rely on end-to-end connectivity. Therefore in last few years many different routing protocols have been proposed by researchers for DTN with the objective to efficiently route messages under the limitation of intermittent connectivity. DTN routing protocols are based on store-and-forward strategy. In this paper, we proposed "Grid based routing protocol for DTN" that makes use of the idea of location information of nodes. This protocol is basically an improved version of epidemic and PROPHET protocol whose purpose is to control flooding and number of message transmissions in the network.

Keywords: Delay tolerant network, Routing algorithm, Epidemic routing protocol.

1. INTRODUCTION

Sharing of information is one of the necessary tasks to be performed on networks, no matter they are wired or wireless. Wireless networks are becoming more popular because with the development of cheap technologies like GSM and Wi-Fi information is available anywhere and anytime. But the problems with these technologies is that they are infrastructures based, and can not be deployed in environments such as remote areas, disaster areas and military battle fields [9]. So, the Mobile Ad-hoc network comes in to play. In mobile ad hoc networks nodes are self organized and communicate with each other without using any infrastructure like access point or base station. Routing in ad-hoc networks can be categorized as proactive (e.g DSDV [6]) and reactive (e.g DSR [3]). These types of networks heavily rely on continuous end-to-end connectivity in order to route the messages between source and destination. In case of high node mobility, end to end connection may not exist at all the time. If the link is broken there is no way to forward messages to destination. This idea can be exploited by Delay Tolerant Network (DTN) [2], where continuous end to end connectivity may not exist; still the messages are routed to the destination. DTN can be characterized by intermittent connectivity, long delays, asymmetric data rates and high error rates. DTN provide communication in various types of network such as inter-planetary networks, wireless sensor networks, underwater networks, terrestrial networks, vehicular ad hoc networks and military networks [11]. In order to route messages to destination, DTN employs store-and-forward method to overcome problems of intermittent connectivity and long delays. One of the key areas of research in intermittent connected networks is routing, selecting an appropriate path to get data from source to destination.

Existing routing protocols for DTN are not location aware or partially location aware. By keeping this idea in mind we propose "Grid based routing protocol" for delay tolerant networks that exploits location information to route messages. The basic idea of our proposed routing protocol comes from the "position-based routing in Mobile Ad-hoc networks (MANET)" [5]. In cellular communication handoff is performed when a user moves from one cell to another cell, similarly in our protocol a node handover the message to appropriate node in next grid. Grid based protocol the aims to control flooding and congestion in the network. One of the problems with epidemic protocol is that delivered messages continue to propagate on network until long TTL expires, which creates a lot of congestion on network. Grid based protocol provides solution to this problem in the form of acknowledgments that relayed throughout the network in order to remove delivered messages from buffer and reduced buffer size. Gird based protocol also provides the prior knowledge where to forward messaged which helps in reducing the transmission delay. Before we discuss the routing process of grid based protocol, first we discus some of the existing routing protocols for DTN.

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2. RELATED WORK

Many researchers have proposed routing protocols for delay tolerant networks. Epidemic routing protocol [10] was proposed by Amin Vahdat el al. Epidemic routing protocol based on flooding based approach to route messages. In delay tolerant networks there may not exist a path between source and destination. So, epidemic protocol relies on intermediate nodes called relay nodes. Figure 1 shows the routing process of epidemic protocol. In figure 1(a) source node desires to forward message to destination node, but there is no connected path available between these nodes. Source node finds that three relay nodes R1, R2 and R3 are in communication range, so it forward message to these nodes. In figure 1(b), at some later time, R2 comes in communication range of destination node and forwards the message to destination.

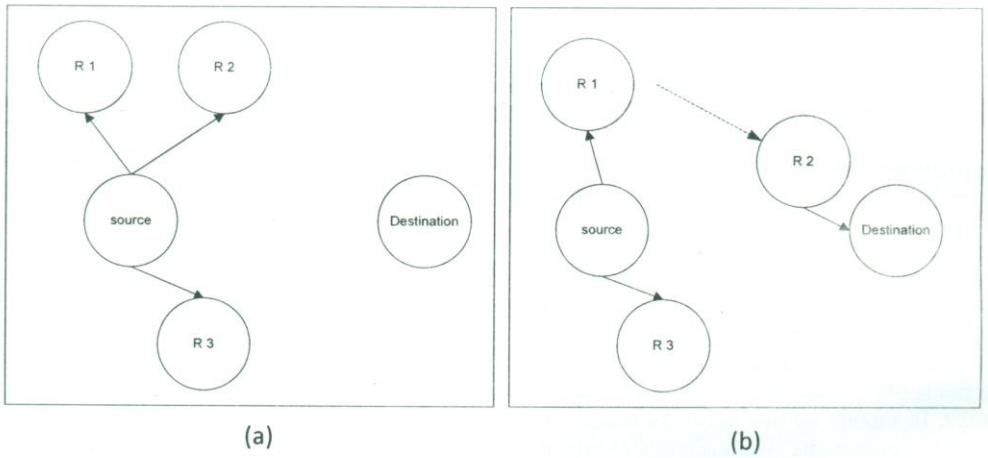

Figure 1: Epidemic routing protocol

Spray and wait protocol [7] was proposed by Thrasyvoulos Spyropoulos et al. Due to the number of transmissions in epidemic, it suffers from the problem of network congestion. In order to improve network capacity, a limit has been imposed on number of messages that are relayed among nodes. If no further transmission permissible then node can only send messages directly to the recipient when it comes in contact. This mechanism is employed by Spray and Wait protocol. Routing process consist of two phases: Spray and Wait. In spray phase, source node is responsible for spraying copy of message to "L" number of nodes. L indicates maximum allowable copies of message in the network. In wait phase, each relay node carrying copy of message waits and holds the message until it comes in contact with destination. Relay nodes carrying message will not forward message to any other node except destination node. This is similar to direct transmission where relay node forwards the message only to the destination. Problem with spray and wait protocol is that relay node with messages has to wait until it comes in transmission range of destination. One of the modified forms of Spray and wait is "Spray and Focus"[8]. Instead of waiting for destination node to be encountered, relay node focuses on suitable node and forward the message to that node.

Probabilistic Routing Protocol using History of Encounters and Transitivity (PROPHET) protocol [4] was proposed by Anders Lindgren et al, makes use of metric called *delivery predictability* to route messages between nodes. The delivery predictability is the probability which is used to select which of the node is more reliable to forward message. Whenever pair of nodes encounter they exchange delivery predictability metric and update each other. The node that is most frequently visited / encountered has higher delivery predictability and it is most suitable candidate to forward the messages. While the pair of nodes that do not visit each other within the given period of time their metric value will be low and they will be less suitable to forward the messages. PROPHET protocol also maintains age i-e the amount the time elapsed since the last delivery predictability was exchanged and updated. Transitivity based on the concept that if node X frequently visits node Y and node Y frequently visits node Z, then node Z will be suitable candidate to forward messages of X to destination.

Message Ferrying routing protocol [12] was proposed by Zhao W et al, make use of message ferries in order to allow communication in disconnected networks. Ferries gather data from source node and deliver them to destination while traveling in a specified route. Based on the role in communication, nodes may be classified in tow types: regular nodes and message ferries. Regular node is

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the node that needs to transmit message to some other node but does not have direct connection with that node, and rely on ferry node for message delivery. While message ferries are mobile devices having responsibility to carry messages to destination. One of the applications of message ferrying protocol is remote village communication where goal is to provide communication in disconnected. villages. Regular nodes in these villages can not directly communicate with each other. They have to relay of message ferries such as mobile devices in order to communicate. For example bus service between these villages can act as message ferries which collect data from village to village as they travel. This protocol is suitable for non real time applications.

3. GRID BASED ROUTING

With epidemic routing protocol, if source node wants to contact with destination node it simply passes the copy to relay nodes without knowing the fact that whether that relay node knows the destination or not. It simply floods the copy to all nodes it encounters. This mechanism suffers with few problems. It creates a lot of copies of transmission which may result in the wastage of bandwidth, buffer size and power or energy of node consumed in order to process the message. If network size is huge, then so many copies of messages are created, network suffers with serious congestion problem. Other alternative protocols are proposed such as PROPHET [4], MaxProp [1] and Spray and Wait [7] in order to control wild flooding. But problems with these protocols are that these are very complex.

We propose "Grid based routing protocol" which makes routing process optimized in comparison to epidemic. Today most of mobile devices are equipped with GPS systems. Therefore it is very easy to predict the position of node. In grid based protocol, we take advantage from location based devices like GPS to predict position of source node, next hop node and position of destination node. For our simplicity and under routing process of grid based protocol, consider the figure 2. We labeled the grid with number (X, Y), where X represent row position and Y represent column position. Source node S is in grid (3, 2) and destination node D is in (4, 5). In between there are many relay nodes in various grids.

Each node maintains a summary vector which contains information about node's grid position, next hop node, current grid position of next hop node and number of contacts made with other grids. When a source node S wanted to send message to node D, it first checks its summary vector to find out position of next hop. In our example source node can find node 1 and node 5 in grid (3, 3). But it only passes the copy to node 1 because it has higher number of contacts with adjacent grid in direction of destination. A header is also attached with message which contains destination's grid position. Node 1 checks its summary vector to know to which grid to pass message. Node 1 passes message to node 2 in grid (3, 4) which has higher number of contacts. As soon as node 2 receives message from node 1, it send acknowledgment signal to node 1 to indicate that it has received the message. This guarantees that the message is delivered successfully. Therefore node 1 can flush out message from its buffer.

Figure 2: Grid Based Routing Protocol

Now node 2 checks its summary vector and finds that in grid (4, 4) node 4 has higher number of contacts with destination node. So, it passes message to only node 4 in that particular grid. Finally, node 4 passes the message to destination node for final delivery.

This routing mechanism avoids wild flooding as in epidemic, of messages; it also helps in reducing buffer size and congestion in the network. It also provides prior knowledge where to forward messages, this will help in reducing transmission delay, and node will only forward the messages to the grid which is near to destination.

4. COMPARISON BETWEEN EPIDEMIC AND GRID BASED ROUTING

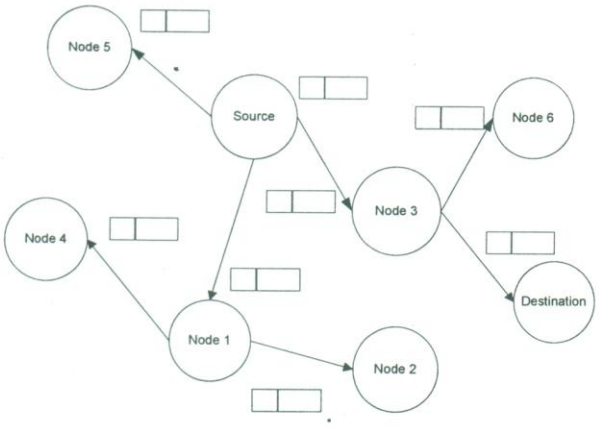

Figure 3: Routing process of Epidemic protocol

Figure 3 shows how the epidemic routing protocol route messages in the DTN. When source node S comes in contact with node 1, 5 and 3 it flood out the messages to these nodes without knowing the fact that whether these nodes will meet destination node or not and whether these nodes are near or far from destination. And when node 1 comes in contact with node 4 and node 2 it passes the message to these nodes. When node 3 comes in contact with node 6 and destination node, it forwards the messages to these nodes. In this way multiples copies of messages are available on the network.

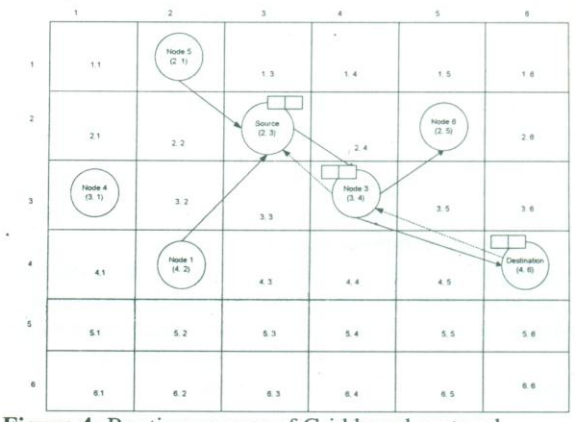

Figure 4: Routing process of Grid based protocol

Figure 4 shows the routing process of grid based protocol. At the time t=0, source node checks it summary vector and finds a neighbor node 3 in grid (3, 4) which has higher number of contacts with the grid near to destination. So, S passes copy to node 3 only. As node 3 receives the copy it sends back ACK signal to Source to ensure that message is received. ACK signal is shown by dotted arrows. Source node may discard the message from buffer. At the time t=1 node 5 and node 1 comes in contact with source node, S node will not forward the message to these nodes because of following two reasons:

- Message is already forwarded to better node 3, and message has been discarded from buffer.
- These two nodes (node 5 and node 1) are far away from destination as compared to node 3.

Node 3 checks its summary vector and finds that it has contact with destination node, so, it will route the message to D. After receiving ACK from D it discard message from buffer. At later time, when node 6 comes in contact with node 3, it will not route message to node 6 because it has received ACK from destination node.

5. CONCLUSIONS

In this paper, we proposed a routing protocol named "Grid based routing", to route the messages in delay tolerant networks where direct connected path does not exist between source and destination. This protocol is modified form of epidemic routing protocol, whose major purpose is to control flooding and congestion in the network as well as to provide the reliable transmission by sending acknowledgement signal to nodes which passes the copy. In this paper, we compared epidemic protocol and grid based protocol. The problem with routing protocols in MANET is that these protocols require prior end-to-end connection before sending packets to the destination. If connection is teardown, transmitted packets

are lost and sender has to retransmit packets. Our proposed routing protocol based on store-and-forward routing strategy where end-to-end connectivity does not required and serve the cause for DTNs. Sender transmit the message to intermediate nodes that stores them and looks for the route to destination or some better node. In gird based routing we make use of location based devices to predict position of nodes. This prediction helps in deciding where to forward message next. Message will be only forwarded to node that has higher number of contacts with other nodes. The goal of our proposed scheme is to improve message delivery and minimize flooding, delay and congestion in the network.

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A COMPUTER SIMULATION OF OPTIMAL TRAVEL TIME OF A TRANSPORT NETWORK

Hyder Bux Jatoi*, Iqbal Ahmed Ansari*, Chajro Khan Muhammad**

ABSTRACT

When the optimal routes between all nodes are sought and when all nodes are directly connected with all other nodes the matrix approaches are generally ore efficient then the tree building approaches. However, the existing matrix algorithms don't generate a hierarchy of optimal travel time paths.

A Point Location technique presented below has the following interesting features:

- **It generates a hierarchy of optimal travel time routes emanating between all nodes of a transport network;**
- **It considerably reduces the computer storages as compared to the one required by other matrix algorithms;**
- **It can easily be coded into a computer program and its efficiency in computing time is exactly determinable and independent of the structure of the network.**

Result of three different sample networks are obtained through the use of Point Location technique. Computer code is developed in Turbo C++ language on IBM PC.

1. INTRODUCTION:

Route assignment has been identified as the final phase of the travel demand forecasting process. The purpose of the route assignment analysis phase is to develop a technique that simulates the way in which the private mode and transit trips between each origin and destination pair distribute over the links of their respective networks. In most widely used traffic assignment models all trips between a fixed origin and destination are assigned to the links constituting a single shortest connecting path. This technique of assigning all traffic volume on a single shortest path between the origin and destination pair is designated 'all-or- nothing' assignment. Though very popular due to its model's simplicity and the macroscopic nature of transportation system design, at times, however, its ouput can be inaccurate to the point of being useless. In some cases a link can unrealistically shift from the most heavily used in the system to having too few trips to justify its construction.

In Ref. [1] it has been proved that the resulting such huge errors are contain to jeopardizes virtually any design decision based on the face-value acceptance of all-or-noting model's output.

A realistic solution to the problem passed above would be a "multipath" assignment model which allows for a number of potential path through the origin and destination pair and apportions trips to all of these paths reflecting their relative likelihood of use. Multipath assignments have been done either using the path diversion techniques or the capacity restraint techniques. Path enumerating models one of three (Diversion curve model; path enumerating models and Markov models) widely used method of a multipath assignment through the use of path diversion techniques, is the subject matter which this paper seeks to address.

In [2] has attacked the problem of determining a shortest route from origin to destination through the use of (a) Dynamic Programming approach for a network depicted in Figure 1 and (b) A technique [3] for a network depicted in Figure 2. On the dynamic programming approach author comments it is certainly difficult to imagine. a traveler plotting his path by jumping one node away from his starting point and looking back to find the best way of getting to the point he's just reached. This type of approach, being basis for dynamic programming, contradicters the usual one of beginning at the starting node and looking ahead to succeeding nodes [2]. Moore's technique applied to network of Figure 2, though

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efficient, fails to enumerate all the paths emanating from origin 1 to destination 7. It produces only two paths viz. {1 to 4 to 5 to 6 to 7} and {1 to 9 to 8 to 7}. Whereas, obviously we have other paths too leading from centroid 1 to centriod 7. as for example:

(a) {1 to 9 to 5 to 6 to 7}; (b) {1 to 2 to 4 to 5 to 6 to 7};
(c) {1 to 2 to 3 to 4 to 5 to 6 to 7} etc.

In [4] it has been solved the same problem for the network depicted in Fig:3 through the use of this technique the K shortest chains in graph. The technique, apart from the fact that it involves a large number of computations and is thus highly time consuming fails to build trees from all centriods in a single stroke.

In the light of the for mentioned limitations with the existing techniques of building trees from one centriod to all others, as imperative need for an efficient computing technique which can list all the possible alternatives from one centriod to all other centriods of a transport network in single stroke, is very much felt. This is what our Point Location technique seeks to accomplish.

2. POINT LOCATION TECHNIQUE

2.1 MATRIX FORMULATION OF THE TRAVEL TIME NETWORK PROBLEM.

A network with N nodes is given with very two nodes connected by a link Travel Time of the link (I,j) connecting to express a network by a matrix τ of elements τ_{ij}

The matrix τ is an N x N square matrix, with the subscripts i,j taking N values 1,2, ---- N; $N = n_0 + n_t + n_d$

Where n_0 = the number of origin nodes

n_t = the number of Transshipment (intermediate) nod origin nodes

and

n_d = the number of Destination nodes

If node i is not connected to node j by a single link we will assume a fictitious link for that pair of nodes and the travel time τ_{ij} for that fictitious link as infinite (for computerization we assign any value to such a τ_{ij} which is greater than all the given link times. As for example, say node 3 is not connected to nodes 5 and all the link times are given to less than 99 minutes. Then we will feed the computer a value of 99 for τ_{35} and the same 99 for all such nodes which are not connected). Link times from node i to node i, for all values off i will be fed as 0

i,e $\tau_{11} = \tau_{22} = - - - - - - - - = \tau_{nn} = 0$

Numbering of the modes will be as under:

1 to n_0 the origin nodes followed by $(n_0 + 1)$ to $(n_0 + n_t)$ the transshipment nodes followed by $(n_0 + n_d + 1)$ to N the destination nodes. Care has to be taken that no back no de should have a number assigned to it, greater in value to its succeeding nodes. For every link (i,j), i<j.

$$\tau_{ij}, i, j = 1,2, \ldots\ldots\ldots\ldots\ldots N$$

We have $\tau_{ii} = 0 \ \forall \ i = 1,2, \ldots\ldots\ldots N$

and

$$\tau_{ij} = \tau_{ji} \quad \forall \ i, j = 1,2, \ldots\ldots\ldots N$$

In the light of (1), the N x N link time matrix τ is shrunk to the size of N(N-1)/2 which is very heavy reduction in the size of memory requirements as demanded by the other existing matrix algorithms. The link time are fed into the computer as under:

[T(I,j), j = i+1, ---------, N), i = 1,2, - - - N]

2.2 PROPOSED ALGORITHM OF THE POINT LOCATION TECHNIQUE

The underlying principle is that the time taken for Forth Node of any link equal the minimum time taken upto its Back Node plus the travel time from its Back Node to its Forth Node

$$\tau_F = \tau_B + \tau_{BF}$$

Where τ_F stands for minimum Travel Time upto the Forth Node

τ_B stands for minimum Travel Time upto the Back Node

and τ_{BF} stands for Travel Time from Back Node to its Forth Node

It is this formula which the Point Location Method seeks to update at every node. To explain as how this updating is accomplished, we first need to be familiarized with the following terminology:

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PASS: A matrix of N Nodes has always (N-1) back nodes to its Nth node – the destination point. The link times of the Back nodes to all the Forth Nodes whether genuine or fictitious will be termed as Passes of the Matrix. As for example, Node 1 will have its succeeding or forth nodes numbered as 2,3,4, - - - - , N. A such the link times $\tau_{12,}\tau_{13,}\tau_{14,} ----T_{IN}$ constitute the Pass 1 of the matrix. Similarly node say 5 will consist of the link times $\tau_{56}\tau_{57,}\tau_{58,} ----T_{5N}$. In general Passes J will be the set of the link times $\tau_{ji+1,} ----\tau_{jN}$ where J = 1,2, ----, (N-1)

Computer scanning will always start in Pass 1 As soon as a genuine link (1,j) where j can take on values 2,3, - - - - , N is encountered, the scanning will shift (Point) to the Pass J and in that Pass Locating (Match) will be done with respect to the Forth Node of the genuine link of the (J-1) i.e. the previous Pass and the Back node of the link in the Pass J i.e. the reset Pass. This is what is meant by Point Locating.

Working stages: Let $J_{1,}J_{2,} ----J_{N-1}$ be the sets of the Forth nodes respectively of Pass 1, Pass 2 Pass 3, - - - - - , Pass N-1. Starting with $J_1 = 2$, we proceed with the following stages:

Stage 1: Is Node 1 genuinely connected to node J_1.

If yes go to stage 2, otherwise go to stage 3.

Stage 2: Put $J_2 = J_{1+1}$ and Travel Time = τ go to stage 4.

Stage 3: Increase J_1 by 1 and continue going to stage 1 till $J_1 \leq N$. Stop in the case when $J_1 > N$.

Stage 4: If $J_2 < N$, find whether the node J_1 is genuinely connected to the node J_2.

If yes goto stage 5. If no continue increasing J_2 by 1 and going to Stage 4 till $J_2 \leq N$. But when $J_2 > N$ goto Stage 3.

Stage 5: Put $J_3 = J_2 + 1$ and Travel Time $= \tau_{1j1} + \tau_{j1j2}$

Continue the above process till the Passes have beer scanned

Flow chart is a sample guide line for writing a computer program and obtaining a hierarchy of minimum travel time paths for a network of the size of 5 x 5. For a larger size, the similar process can be adopted.

3. SIMULATED SIMULATION

Reproduced as under is the hierarchy of minimum travel time routes in respect of the three sample networks.

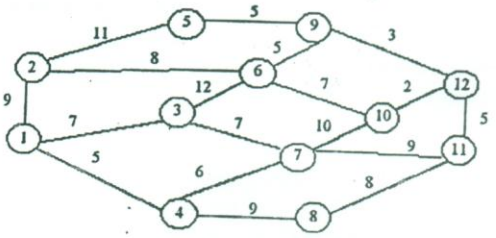

Figure 1: Network travel example for dynamic programming approach.

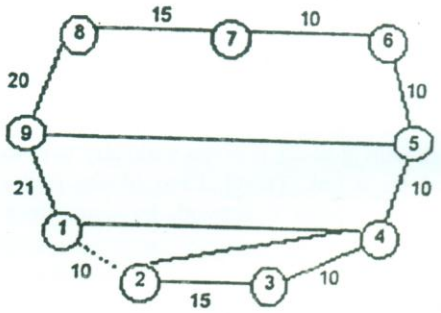

Figure 2: Network used in [3] approach.

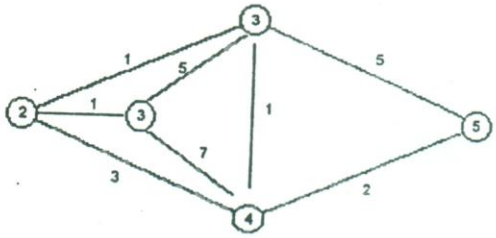

Figure 3: Net work used in [4]

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In the light of the requirement of the numbering of nodes of the Point Locating technique viz. No. Back node should be assigned a number greater than the number assigned to its succeeding nodes, the nodes 9th, 6th and 7th of the network of Figure 2 are renumbered as nodes 6th, 7th and 9th respectively.

Routes in respect of Network of Fig: 1		Routes in respect of Network of Fig: 2		Routes in respect of Network of Fig: 2	
Routes	Travel Time	Routes	Travel Time	Routes	Travel Time
1-2	9	1-2	10	1-2	1
1-2-5	20	1-2-3	25	1-2-3	2
1-2-5-9	25	1-2-3-4	35	1-2-3-4	3
1-2-5-9-12	28	1-2-3-4-5	45	1-2-3-4-5	5
1-2-6	17	1-2-3-4-5-6	70	1-3	5
1-2-6-9	22	1-2-3-4-5-6-8	90	1-3-4	6
1-2-6-9-12	25	1-2-3-4-5-6-8-9	105	1-3-4-5	8
1-2-6-10	24	1-2-3-4-5-7	55	1-3-5	10
1-2-6-10-12	26	1-2-3-4-5-7-9	65	1-4	7
1-3	7	1-2-4	30	1-4-5	9
1-3-6	19	1-2-4-5	40		
1-3-6-9	24	1-2-4-5-6	65		
1-3-6-9-12	27	1-2-4-5-6-8	85		
1-3-6-10	26	1-2-4-5-6-8-9	100		
1-3-6-10-12	28	1-2-4-5-7	50		
1-3-7	14	1-2-4-5-7-9	60		
1-3-7-10	24	1-4	20		
1-3-7-10-12	26	1-4-5	30		
1-3-7-11	23	1-4-5-6	55		
1-3-7-11-12	28	1-4-5-6-8	75		
1-4	5	1-4-5-6-8-9	90		
1-4-7	11	1-4-5-7	40		
1-4-7-10	21	1-4-5-7-9	50		
1-4-7-10-12	23	1-6	21		
1-4-8	14	1-6-8	41		
1-4-8-11	22	1-6-8-9	56		
1-4-8-11-12	27				

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4. EVALUATION OF THE TECHNIQUE

In matrix algorithms of [5] and [6] the actual lengths of the shortest paths and the back nodes are stored in two matrices of N x N elements. Thus the necessary storage for matrix algorithms is $2N^2$ (at a minimum), whereas the Point Locating technique requires only N(N-1)/2 fantastic reduction in memory locations.

By virtue of the specific coding of the network as desired by the technique which involves only Forward Pass and just the updating of the travel time given by the simple formula:

Travel Time from origin up to the link at Pass j = Travel time from origin on to the link at Pass (j-1) + the travel time of the link at pass requires less of simulation time as compared to the both Forward and Backwork Pass and decision making (as to which route is optimal) at each node as required by the Matrix Algorithms.

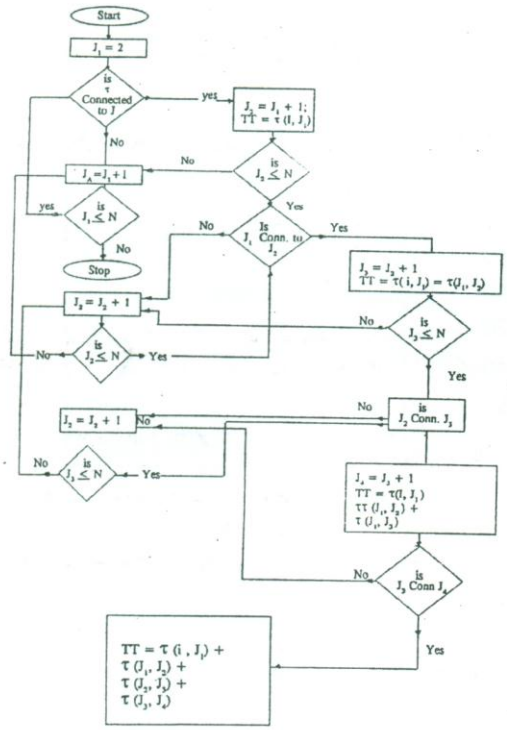

Figure 1: Matrix Algorithm

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