Wi-Fi Network in Bangladesh: A New Revolution for Communication System

Abstract

The popularity of Wi-Fi Network has grown spectacularly in the recent years. “Going Wireless” is becoming the mainstream in this regard. Moreover, the costs of the Wi-Fi Networking devices have dropped dramatically, which insists the network designer to use Wi-Fi. In this paper, we have pointed out the areas in Bangladesh where Wi-Fi Network can improve the modern life. Requirement analysis has been performed thoroughly for the proposed network. Though it is a new concept for our country, it can bring a revolutionary change in the field of networking and hence in ICT.

Keywords*: Wi-Fi, Radio Frequency, Hotspot, VoIP.*

1.Introduction

Wi-Fi means Wireless Fidelity [1]. Fidelity is a notion that at its most abstract level implies a truthful connection to a source. A Wi-Fi network creates a Wireless Local Area Network (WLAN) and uses the radio technologies to provide secure, reliable, fast wireless connectivity. Radio frequency (RF) [2] connections between a base station and laptop/handheld computer fitted with add-on wireless cards replace the wires and cables of a conventional Local Area Network. The main attraction of WLANs is their flexibility [3]. It can extend access to local area networks, such as corporate intranets, as well as support broadband access to the Internet - particularly at "hot spots"[4], public venues where people tend to gather. WLANs can provide quick, easy wireless connectivity to computers, machinery, or systems in a local environment where a fixed communications infrastructure does not exist or where such access is not permitted. These hosts can be stationary, handheld, or even mounted on a moving vehicle. Bandwidth considerations have thus far been secondary in WLAN design and implementation. Once the IEEE 802.11[5, 6] standard was published in 1997, vendors developed Wi-Fi equipment prototype around two variants of the 802.11 standard: 802.11a/b. Newer variants of the 802.11 standard were developed over time offering higher bandwidth for data transmission. Roughly, Wi-Fi network can provide the following features:

- Quick or easy temporary network access
- Staff access to corporate network
- Patron Internet access (hotspot)
- Interconnection between two networks
- Establish Point to point link between large skyscrapers or other office buildings
- Provide coverage to a large office or business complex
- Bring Internet to remote construction sites or research labs

ISBN 984-300-002131-3

- Bring Internet to a vacation home or cottage on a remote mountain or on a lake
- Bring Internet to a large sea-faring vessel

Wi-Fi networking is now popularly used in different countries like USA and UK, but some other countries in Asia and Africa have started using the Wi-Fi network.

In this paper, we discuss about the concepts of Wi-Fi Network and the necessary steps required to setup Wi-Fi Network in Bangladesh. Finally, we have pointed out the areas in Bangladesh where the Wi-Fi networking is possible to implement.

Rest of the paper is organized as follows: Section 2 discusses about the background study of Wi-Fi Networking. Present status of Wi-Fi Network in different countries are highlighted in Section 3. Section 4 discusses about the possibility of Wi-Fi Network in Bangladesh. In Section 5 we have clearly focused the suitable areas to apply Wi-Fi in Bangladesh. Section 6 concludes the paper. Some important references are included at the end of the paper.

2. Background Study

A typical Wi-Fi setup contains one or more Access Points (APs) and one or more clients. An AP broadcasts its SSID (Service Set Identifier, "Network name")[7,8] via packets (known as beacons), which are usually broadcasted every 100 ms. The beacons are transmitted at 1 Mbps, and are of relatively short duration; therefore do not have a significant effect on performance. Since 1 Mbps is the lowest rate of Wi-Fi it assures that the client who receives the beacon can communicate at least 1 Mbps based on the settings (e.g. the SSID). If two APs of the same SSID are in range of the client, the client firmware might use signal strength to decide which of the two APs to make a connection. The Wi-Fi standard leaves connection criteria and roaming totally open to the client. Collisions may occur in the Wi-Fi network as it transmits data in the air and hence uses the Collision Avoidance (CA) technique [9, 10].

Wi-Fi networks operate in the unlicensed 2.4 and 5 GHz radio bands, with an 11 Mbps (802.11b) or 54 Mbps (802.11g) data rate or with products that contain both bands (dual band). They can provide real world performance similar to the basic 10BaseT wired Ethernet networks [11]. Fig. 2.1 shows the Wi-Fi network having 5 zones [12] and several Hotspots. Only the people of those zones with Wi-Fi compatible devices can access Wi-Fi Network and share data with all other needs via radio frequency. Table 2.1 shows the center frequency with channel number available in IEEE standards [13].

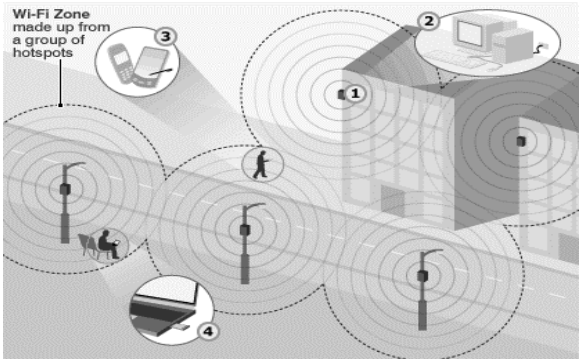

Fig. 2.1 Wi-Fi Zones

Table 2.1 Channels with Center Frequencies

Channel Number	Center Frequency [GHz]	Channel Number	Center Frequencies [GHz]
1	2.412	8	2.447
2	2.417	9	2.452
3	2.422	10	2.457
4	2.427	11	2.462
5	2.432	12	2.467
6	2.437	13	2.472
7	2.442	14	2.484

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3. Wi-Fi in Different Countries

The costs of the Wi-Fi networking devices have dropped dramatically which insist government of different countries to adopt Wi-Fi Network for the people, like Indonesia, Malawi, Rwanda, India and so on. Working areas of Wi-Fi in those countries are the key concerns for the feasibility study of Wi-Fi Networking in Bangladesh.

Indonesia [14]: The typical ISP network can be divided into an access and infrastructure network, as shown in Fig. 3.1. In the infrastructure network, ISPs are connected to each other (peers) via a fiber backbone for exchanging traffic and to connect to a higher tier ISP to link to the Internet. From their points-of-presence (PoPs), ISPs may either use twisted copper pair, coax or fiber optic cable to connect to the kerb [15,16] and the last meters to the customer premises is typically via a twisted pair or coaxial cable.

Rwanda: First Mile Solutions (FMS) [17], which has patented the "store-and-forward" system, which has been used in India in the DakNet project, has basically deployed variations of this technology in a number of countries including in Rwanda. Working with e-ICT [18], a local NGO and the local telecom operator Artel, FMS has set up a number of network hubs in the capital city Kigali that connect wirelessly to a truck that provides store-and-forward access to the surrounding villages. Although the villages connect to the Internet asynchronously, in Kigali, real-time Internet access is available via the hubs.

Malawi: Africa-Online, an ISP based in Blantyre [19], has provided broadband Internet access using wireless infrastructure for more than three years. Seventy-percent of Africa-Online's customers are corporate Customers who are connected to the access network wirelessly. Connection to the Internet backbone is via satellite. The Fig. 3.2 shows how open Wi-Fi hotspot works in Malawi.

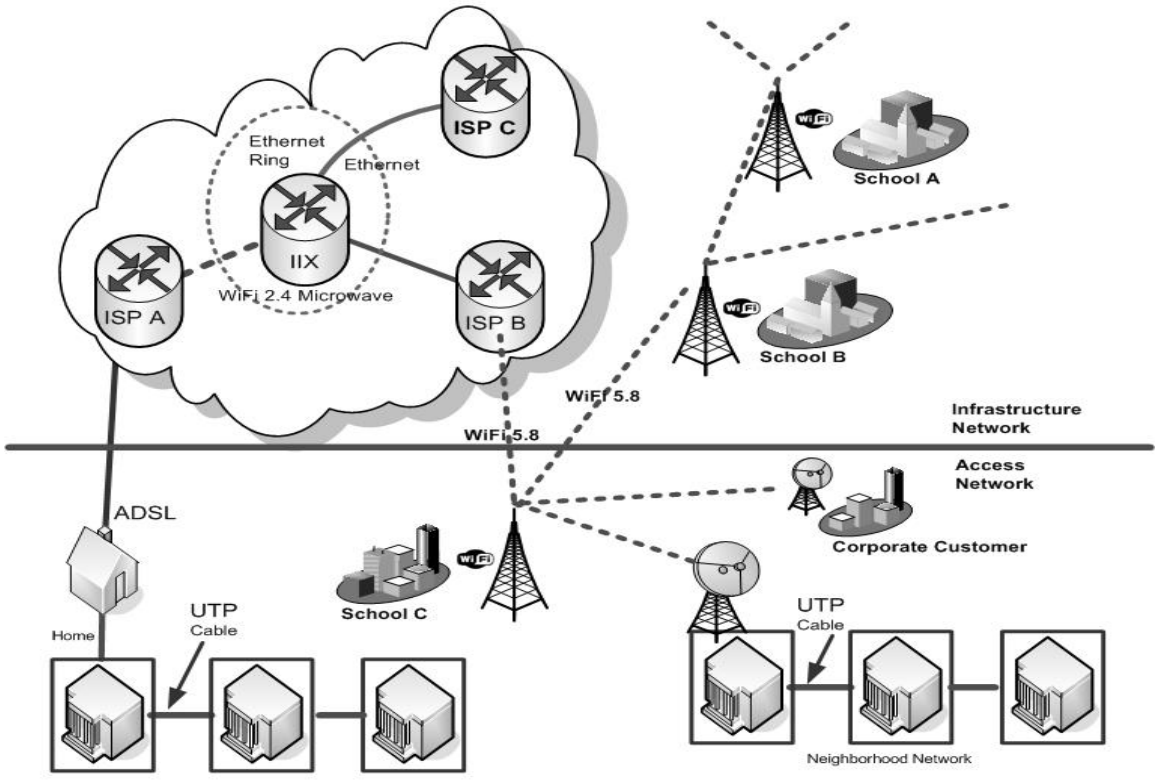

Fig. 3.1 Wi-Fi Network Architecture in Indonesia

Fig. 3.2 Open Wi-Fi Hotspots in Malawi

India: One of the earliest experiments of Wi-Fi technology in a developing country context was the DakNet project funded and developed by MIT's Media Lab. The DakNet project has provided asynchronous Internet connectivity in a few villages in Karnataka and Harayana; two well-known cities in India. DakNet is a wireless communication system that fixes Mobile Access Points on vehicles that exchange data wirelessly with Wi-Fi enabled kiosks in villages that the vehicle passes through. After making its rounds through the villages, the vehicle returns to a hub and uplinks the data collected to the Internet backbone.

Cambodia: In Cambodia, FMS has deployed Wi-Fi based store-and-forward system on motorcycles in 2003, which is depicted in Fig. 3.3. "Internet Village Motormen" on five motorcycles equipped with a Mobile Access Points, go around 15 solar-powered village schools and telemedicine clinics in a remote province of Cambodia to provide asynchronous email and web access via a 256Kbps satellite uplink. The approximate cost per village to set up the system was $500; though the recurring costs of satellite connectivity is not mentioned. American Assistance

Fig. 3.3 Mobile Hotspots on Motorcycle

to Cambodia and the World Bank financed the project.

4. Possibility of Wi-Fi Network in Bangladesh

Bangladesh is a developing country and Internet services were first introduced in 1996 at that time [20, 21]. Currently there are 159 ISPs (64 are actively providing services). 80% ISPs are located at capital Dhaka, Government owned Bangladesh Telegraph and Telephone Board (BTTB) has extended ISP services to all 64 districts Head Quarter and 165 Sub district Head Quarter out of 465. There are 0.2 Million Internet users in the country. 80% populations live in rural areas and they are still out of reach of Internet facilities. In a very few places of these rural areas some NGOs are working for Internet connectivity, such as: Grameen communication (ISP), Village e-mail Services, Village Internet Program.

In this circumstance, we should think about the latest technology (Wi-Fi Networking) for providing better Internet service in whole Bangladesh with more flexibility; that is reliable, easy, secure, cheap and faster connectivity for the users. If Bangladeshi people want to be competitive to other countries then

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they should provide Internet facility to maximum people with very low cost and faster access. For this reason we need to adopt Wi-Fi Networking technology (IEEE 802.11 b/g unlicensed band, 2.4-5.1 GHz). Bangladesh government has the ability to provide such kind of facility for the people, just need the following two steps to be ensured [22].

- Deregulate the portions of the radio spectrum used by the IEEE 802.xx standards. This spectrum is already deregulated in developed countries, which has unleashed an enormous commercial expansion and brought plummeting prices.
- Permit voice-over Internet protocol, or VoIP. Currently many countries strictly limit the carriers of real-time voice signal, but now that voice can be broken into Internet packets, or IP, these regulations are increasingly archaic and expensive and limit the growth of digital businesses.

In Bangladesh there are typically Internet-connected computer users, such as Internet cafés, that allow nearby users to access their Internet connection with an 802.11 wireless local area network. By allowing such connections, the evidence is that there will follow an explosion of connectivity within village and city centers. The key change is that recent advances in wireless computer networking-particularly the IEEE 802.xx standards-have led to huge commercial success and very low pricing for broadband networks. While these networks are thought of as mainly for offices, they can provide broadband access to even the most remote areas at very low prices. In general, adopting Wi-Fi, there is no need for big up-front costs. One installation can be made with a few thousand dollars and it can make the next installation easier. Train line can be used as infrastructure (as it is used in India) for Wi-Fi Network installation, **Fig. 4.1**.

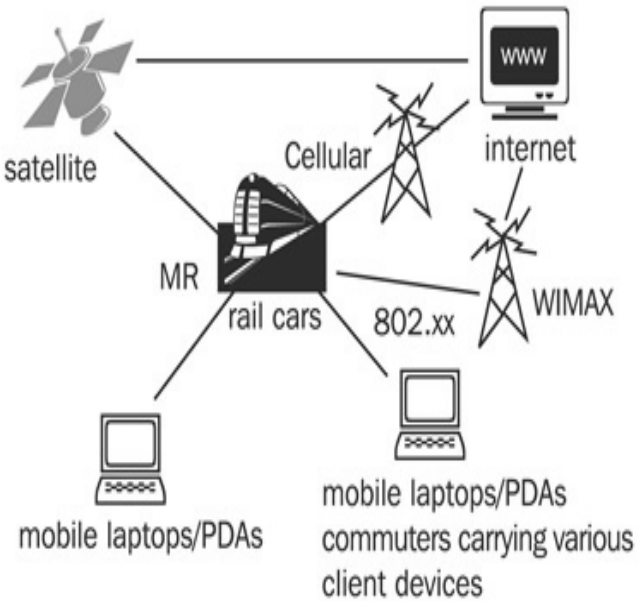

Fig. 4.1 How rail line can be utilized for Wi-Fi network

The low up-front costs can help the emergence of many small entrepreneurs, who contribute to genuine economic development, not only by spreading the economic benefits but also by dispersing power and helping democracy take root. When the regulations will come, the government needed to be sensitive to the needs of the entrepreneurs and of the consumers who were already enjoying the service. In the case of Wi-Fi, or in general for a technology where many entrepreneurs can emerge because of the economics of the technology, eventual regulations tend to be healthy. Entrepreneurs participating in the field can argue for their rights, making eventual regulations conducive to growth. The relative ease with which entrepreneurs can enter the business preserves competition and protects consumers, even without regulations Wireless data networks based on the IEEE 802.11 perhaps the most promising wireless technology for Bangladesh. These features include: its ease of set-up, use, and maintenance; its relatively high bandwidth; and, most importantly, its relatively

ISBN 984-300-002131-3

low cost for both users and providers. Newer versions of Wi-Fi provide 22 Mbps in this band, and versions that operate at higher frequencies provide up to 54 Mbps. Even if enabling regulation allow unlicensed use of the Wi-Fi spectrum [23], it seems unlikely that entrepreneurs are going in a hurry to rural areas unless the underlying factors for high cost of domestic and international leased lines and bandwidth are addressed. In countries where incumbent operators are monopoly suppliers of fixed line infrastructure it is difficult to achieve a level playing field for the provision of Internet service if the incumbent is also an Internet Service Provider (ISP). Typically, ISPs lease lines from telecom operators to connect to the Internet backbone or to reach customer premises. Hybrid systems that bring a connection to a village by satellite redistribute the bandwidth inside a building or common area and also via point-to-point systems that can extend the connection many kilometers using a special antenna and line-of-sight [24,25]. However, in some countries the regulations crafted for these technologies are not being enforced, and the signal and throughput degrade. Bangladesh is a classic case of government policies inhibiting economic development by monopolistic practices in the telecommunications sector. There is much research provided elsewhere on the benefits of Telecommunications (TC) sector liberalization, most notably lower prices that stimulate demand and economic growth across many sectors.

Conceptual view of connecting rural areas within Wi-Fi network is shown in Fig. 4.2 whereas the conceptual view of Wi-Fi Network for Bangladesh for any divisions is shown in Fig. 4.3. Here, BTTB Base Transceiver Station (BTS) can be used in six divisions for Wi-Fi Network Frequency transmission and it will reduce the total setup cost; that means infrastructural development are not required greatly.

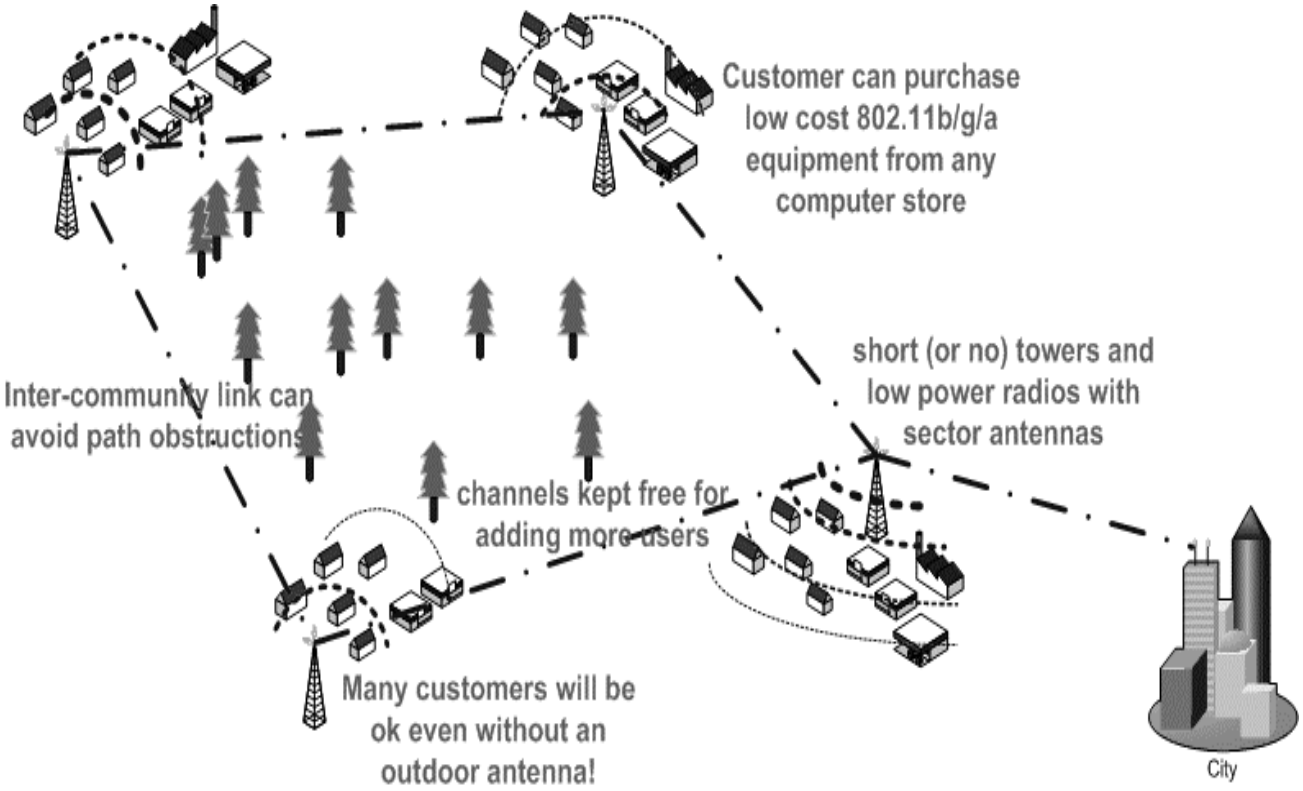

Fig. 4.2 How Wi-Fi Network will work in rural areas

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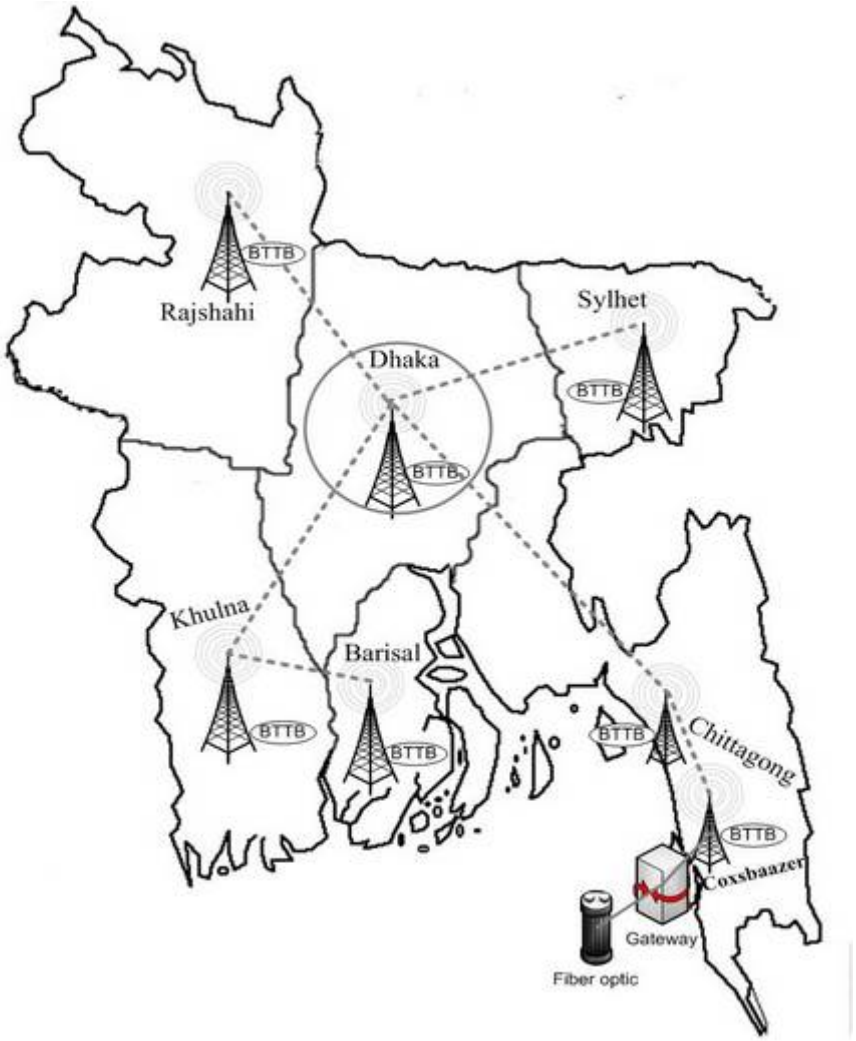

Fig. 4.3 Divisional conceptual view of Wi-Fi Network for Bangladesh

The idea is to begin from fiber optic backbone in Cox'sbazar via a gateway to access the Internet by using BTTB BTS and cover the whole Bangladesh.

In Fig. 4.4 we have shown that, how Dhaka City can be organized for Wi-Fi Network. The figure depicts the general architectural view of local ISP's where those ISP share the frequency from BTTB BTS and create one or more hotspots via which they can provide the services.

We can now concentrate on mobile communications and value-added services, such as Internet and other data communications networking, the private sector has the potential to provide these services at a lower cost than is currently possible in Bangladesh due to government pricing and access controls. The local infrastructure can accommodate Internet access in a variety of ways, including the existing microwave backbone, excess capacity on the national railway fiber optic cable and the telephone network. There are emerging wireless fidelity networks (Wi-Fi, using 802.11, 16 and 20 standards) which are promising because they are broadband (high capacity) but do not require digging networks and laying cable. The government's role should be limited to provide Internet and mobile telephone connectivity in areas where the private sector is not attracted. A local Point of Presence (POP) in urban areas organized with the help from government would reduce costs of providing Internet services by the private sector and relieve

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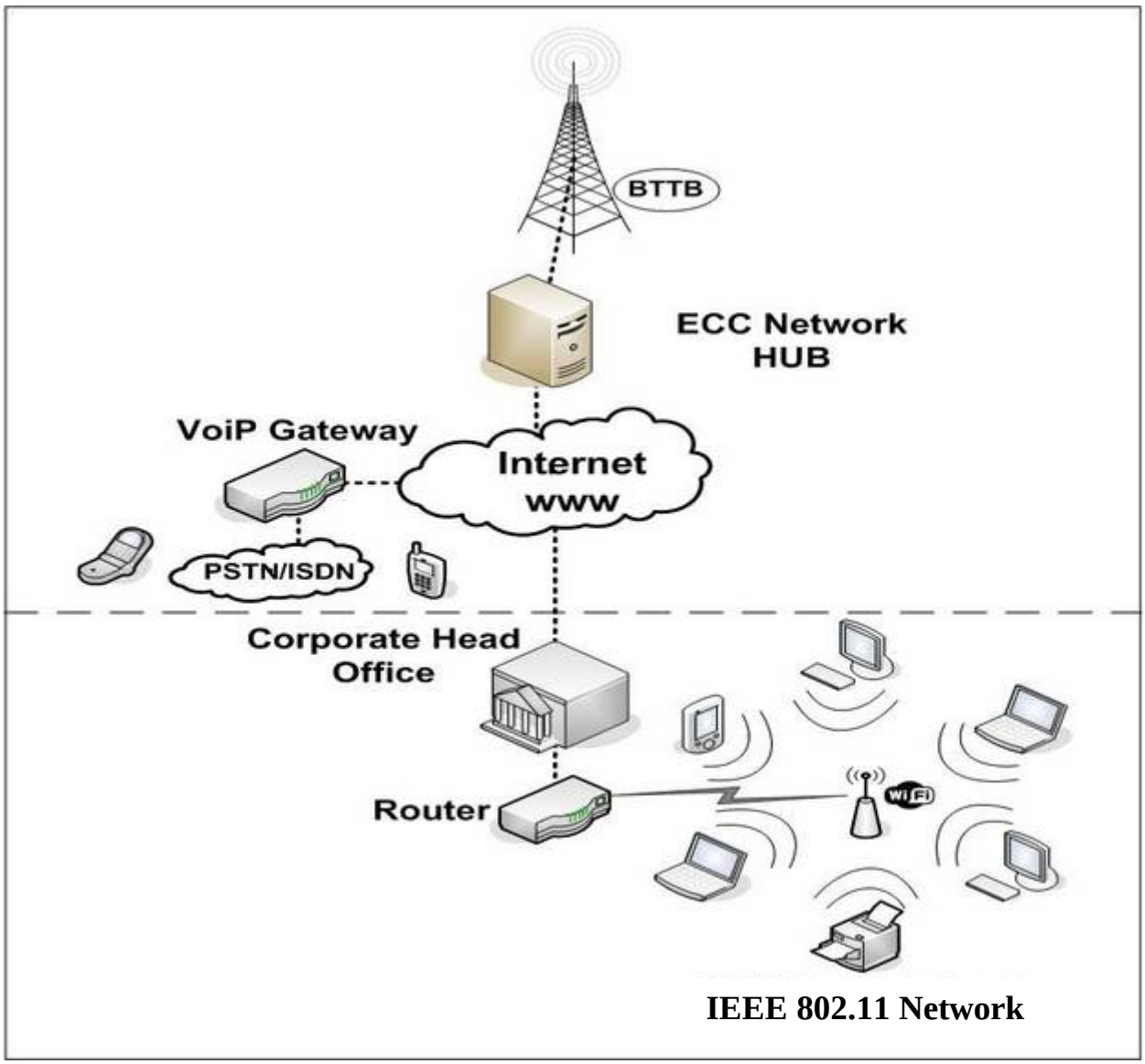

Fig. 4.4 Conceptual view of Wi-Fi Networking in Dhaka city (Capital of Bangladesh)

traffic on already congested trunk lines. Wireless communications are particularly promising in Bangladesh due to the difficulty of digging and maintaining cable trenches across most regions of the country. In short, the private sector is key to stimulating investment in the Internet infrastructure and services in particular.

The regulations regarding the private provision of services should be liberalized and reformed to encourage such investment. This is at the base of reducing the cost of access and applications adoption and development for all providers and users. Until this fundamental reform is achieved, Internet access and applications will be the preserve of the privileged, wealthy few. The Internet's potential to stimulate social and economic development, as shown by many projects and program demonstrations elsewhere will remain latent. Without sector liberalization, the Internet will only further widen the divide between information haves and have-nots. Bangladesh is a poor country and so Internet facility should be cost effective [26-29]. Wi-Fi is the best for Bangladesh as today's wireless economics are already compelling. Wireless local loops are about one third the cost of copper or fiber landline service, while packet-based broadband computer networks

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cost one ninth of landline service. Ease of set-up, use, and maintenance are affordable for both users and providers for Wi-Fi Networks.

5. Suitable Application Areas for Wi-Fi Network in Bangladesh

Bangladesh is one of the emerging developing countries and if the government gives support to setup Wi-Fi Network in this region then the overall modern life style of the people of Bangladesh will be changed remarkably. The following points discuss the area where Wi-Fi Network can be used extensively:

- **VoIP:** VoIP [30] could prove one of the better opportunities for Wi-Fi mesh in Bangladesh. Bangladesh is using their networks to provide phone service to subscribers. Doing so is quicker and less expensive than rolling out either wire-line or cellular infrastructure to do the job. But the technology has inherent disadvantages when it comes to carrying voice. The more wireless "hops" a call has to traverse, the more likely it is to suffer increased latency, especially when the network gets busy and the spectrum crowded. The result can be voice quality problems involving factors such as cadence, echo and jitter.

The cost of voice call is dropped dramatically if we adopt Wi-Fi for VoIP. Table 5.1shows a comparative result regarding the use of Wi-Fi for VoIP.

Table 5.1 Call Cost Using Wi-Fi Over VoIP

Minute	Technology Used in VoIP	Cost (*)
1	Wi-Fi	$.02
1	Traditional approach	$1.25

The information is provided based on [30]

The increase in Wi-Fi hotspots worldwide is creating more opportunity for travelers to utilize VoIP services, therefore threatening mobile roaming revenues.

- **In Hotels:** In Bangladeshi five stars hotel see a guest who wants Wi-Fi connectivity as a trussed up turkey waiting to be cooked? Isn't there a business case for providing Wi-Fi as an add-on service at a reasonable rate, or even for free, we think hotels who provide free Wi-Fi to business guests will get more customers and the resultant gain will more than pay for the expenditure incurred by the hotel on Wi-Fi. Community.
- **In Universities:** Wi-Fi Network is suitable for huge university campuses like Dhaka University, Jahangirnogor University, Rajshahi University etc.
- A **Hospital**, **Coffee-house, Stadium**, **Air Port** etc. can be easily controlled by Wi-Fi Network
- If we install Wi-Fi Network in Bangladesh then Logical network of **e-government** *&* **e-commerce** in Bangladesh will be easier and more reliable.
- Wi-Fi can change Bangladeshi people life style because after enabling this technology, Wi-Fi compatible devices (**Audio Visual & Home Appliances,** shown in **Fig 5.1**) will be available for use.
- In Bangladesh any association can built the Network (Wi-Fi) for farmers who monitor irrigation equipment in the field and for residential and business customers who have limited access to cable or digital subscriber line service.

ISBN 984-300-002131-3

(a)Wi-Fi TV (b) Wi-Fi Cell Phones (c) Wi-Fi PDA

(d)Wi-Fi Freeze (e)Wi-Fi Gun (f)Wi-Fi Printer

Fig. 5.1 (a-f) Wi-Fi Home Appliances

9. Conclusions

This paper presents an overall idea about a latest technology: Wi-Fi Networking. Wi-Fi Network has attained a position of overwhelming dominance in the realm of modern computer based society. Recently, modern countries are enjoying the blessing of Wi-Fi Networking and it can play an important role in Bangladesh as well. We have proposed some ideas about the successful implementation areas of Wi-Fi Network in Bangladesh. Experiences from different countries are exercised to point out the feasibly of Wi-Fi Networks in this country. Our proposed guidelines can help the higher authority and network designers to establish Wi-Fi Network successfully in Bangladesh.

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Geometrical Property and Histogram-based Korean Vehicle License Plate Detection

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ABSTRACT *In this paper describes a new approach to analyze road images which often contain vehicles and extract license plate (LP) from natural properties by finding vertical and horizontal edges from vehicle region. The proposed technique consists of three main modules: (a) segmentation technique named as sliding concentric windows (SCW) on the basis of a novel adaptive image for detecting candidate region, (b) refining by using HSI color model on the basis of using hue and intensity in HSI color model verifying green and yellow LP and white LP, respectively and (c) finally, verifying and detecting VLP region which contains predetermined LP alphanumeric characters by using position histogram.*

KEY WORDS: License plate (LP), HSI color model, position histogram.

1. INTRODUCTION

The task of recognizing some object in an image is one of the most difficult in the field of computer vision or digital image processing. Vehicle license plate (VLP) detection is also a very interesting, finding license plate area from vehicle image. The vehicle license plate detection (VLPD) is widely used for detecting speeding cars, security control in restricted areas, unattended parking zone, traffic law enforcement and electronic toll collection. Last few years have seen a continued increase in the need for and use of vehicle license plate recognition (VLPR). The license plate detection is an important research topic of VLPR. Because of different conditions such as poor illumination and varied weather, how to segment license plate fast and perfectly from road images which often contain vehicles. The quality of a detection process will directly influence the accuracy and the speed of entire system.

Researchers have found many methods of locating LP. For example, Hough transform (HT) for line detection was proposed on the assumption that the shape of license plate is defined by lines [1]. A method based on image segmentation technique named as Sliding windows (SW) was also proposed for detecting candidate region (LP region) [2]. Fuzzy logic has been applied in detecting license plates. Authors made some intuitive rules to describe the license plates and gave some membership functions for fuzzy sets e.g. “bright,” “dark,” “bright and dark” sequence, “texture,” “yellowness” to get the horizontal and vertical plate positions [3]. Prior knowledge of license plate and color collocation are used to locate plate in the image [4] as part of the procedure of location and segmentation. Currently, some researchers prefer a hybrid detection algorithm, where license plate location method based on characteristics of license shape, character connection and projection is presented [5, 6].

In this paper candidate regions are found by sliding concentric windows and verifying candidate regions which contains predetermined LP color by using HSI color model and LP alphanumeric character based on position histogram.

2. SPECIFIC FEATURES OF KOREAN VLP

2.1 Color Arrangement of the License Plate

Table 1 shows assorted styles of license plates found on vehicles in South Korea. Each style has a different foreground and/or background color. However, in all only five distinct colors (white, black, green, yellow, and deep blue) are utilized in these license plates. We shall pay attention to three different plate colors when searching for license plates in an input image. Color arrangements for the Korean VLPs are shown in Table 1.

Table 1 Styles of license plates.

Vehicle type	Plate color	Character color
Private automobile	White	Black
	Green	White
Taxi, truck and bus	Yellow	Deep blue

Other type of vehicles, such as diplomatic cars, government vehicles and military vehicles, are not addressed since they are rarely seen.

2.2 Outline of the Korean VLP

Standard LP contains Korean alphabets and numbers. Where plate color is white and character color is black, they contain seven alphanumeric characters. And where plate color is green and character color is white, they contain Korean LP in two rows. The upper row consists of two small Korean characters of region name followed by one or two numbers of class code or two numbers and one Korean character. The lower row is one Korean character and four big

numbers or only four big numbers to indicate the usage and serial number respectively.

3. PROPOSED ALGORITHM

This algorithm consists of three modules: (1) detecting rectangular regions (2) authenticate candidate regions color and (3) verifying candidate regions based on position histogram. General scheme for detecting LP region are shown in Fig. 1. Typical color images are represented as red (R), green (G) and blue (B) i.e. RGB images, but a gray scale images (referred to as monochrome) only contains the brightness information but not color information. In order to improve image processing speed, input vehicle image (RGB) is converted to gray–level image.

3.1 Detect Rectangular Regions

Edges display irregularities in intensity or color of the image. It is supposed that there is presence of a possible edge, if abrupt changes in such local characteristics of the image are observed. This idea is transferred to programming steps where the standard deviation value of a processing block should vary with the standard deviation value in the neighboring blocks in the case of an edge in the image.

Based on the above, using segmentation technique named as sliding concentric windows (SCW) this paper proposes a new approach to analyze road images which often contain vehicles and extract license plate from natural properties by finding vertical and horizontal edges from vehicle region.

According to the prior knowledge of vehicle LP inspection, all license plates must be rectangular and have the dimensions and have all alphanumeric characters written in a one or two row in LP region. Under the practical environments, the inclined angle is constant.

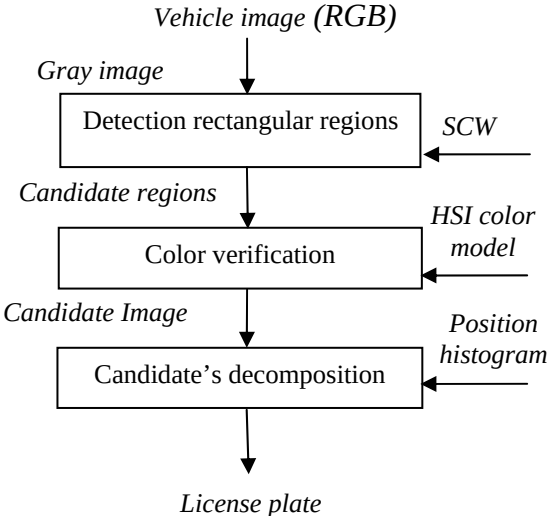

Fig. 1 General scheme for detecting license plate region.

SCW used for faster detection of regions of interest (ROI), operating in different natural backgrounds, an algorithmic sequence handling plates of various size and positions.

The algorithm was developed and implemented as follows.

1. A and B were two concentric windows of size $(X_1) \times (Y_1)$ pixels and $(X_2) \times (Y_2)$, were created for the first pixels of the image.
2. Calculating of the standard deviation of the pixels in windows A and B.
3. Definition of segmentation rule: if the standard deviation ratio of the two windows exceeds a threshold set by the user, then the central pixel of the windows is considered to belong to a vertical and horizontal region (ROI). Following that, the pixel in the new image is set to 1; otherwise it is set to zero.

Accordingly, let *x, y* be the coordinates of the observed pixel in input vehicle image *I*. The pixel value in the respective coordinates *x, y* of the resulting image I_1 is set either 0 (no ROI) or 1(ROI) according to the following equations:

$$I_1(x, y) \Rightarrow \begin{cases} 0, & \text{if } \dfrac{M_B}{M_A} \le T \\ 1, & otherwise \end{cases} \quad (1)$$

where, M is the statistical measurement (standard deviation).

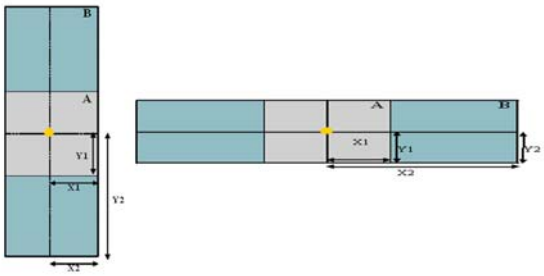

Fig. 2 Concentric windows for detecting vertical and horizontal regions.

In the proposed method, the input to this model is a gray–level image. The resulting image after the SCW method is the binary image. After finding vertical and horizontal regions, morphological OR masking operation to be used for finding rectangular area. Connected components labeling (CCL) is a well-known technique in image processing that scans an image (binary or gray-level) and labels its pixels into component based on pixel connectivity.

Figs. 4~5 show the steps for candidate region detection (green back ground LP and white back ground LP respectively). (a) initial (RGB) image, (b) gray image, (c) vertical edges, (d) horizontal edges, (e) masking operation, (f) inverse operation, (g) sub candidate region, and (h) candidate region detection.

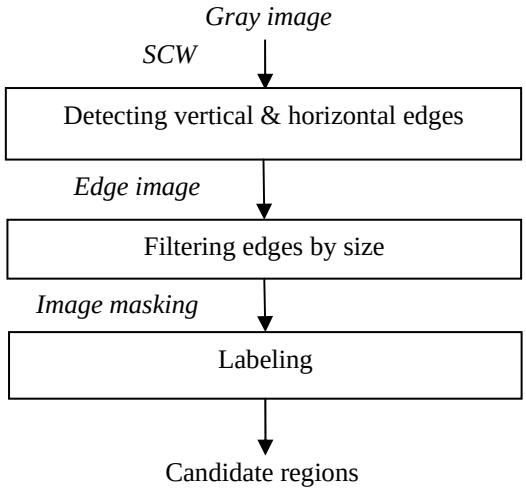

Fig. 3 Candidate regions detection.

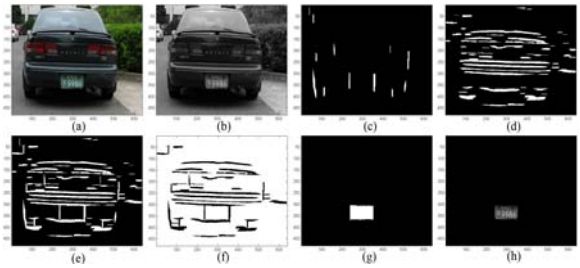

Fig. 4 Candidate region detection (green back ground LP).

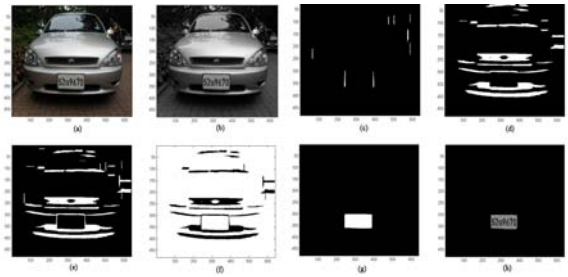

Fig. 5 Candidate region detection (white back ground LP).

3.2 Authenticate Candidate Regions

Many applications use the HSI color model. Machine vision uses HSI color space in identifying the color of different objects. Image processing such as histogram operations is often applied in the HSI color space.

RGB model is represented by a 3-dimensional cube with red, green and blue at the corners on each axis and HSI color space, hue, saturation and intensity are three properties used to describe color. The hue (I^H) is represented as angle 0, varying from 0° to 360°. Adjusting the hue will vary the color from red at 0°, through yellow at 60°, green at 120°, blue at 240° and back to red at 360°. Saturation (I^S) corresponds to the radius, varying from 0 to 1. When I^S =0, color is a gray value of intensity 1. When I^S =1, color is on the boundary of top cone base. Intensities (I^I) vary along Z axis with 0 being black and 1 being white.

Using Hue in HSI color model, verify green and yellow License plate and analyzing our database we find different illumination and varied weather conditions Hue value changed in specific range. Using Intensity in HSI model we verify white license plate.

The transform from (R, G, B) to (H, S, I) is

$$I^I = \frac{\left(I^R + I^G + I^B\right)}{3}$$

$$I^S = 1 - \frac{3}{\left(I^R + I^G + I^B\right)}\left[\min\left(I^R, I^G, I^B\right)\right] \qquad (2)$$

$$I^H = \cos^{-1}\left\{\frac{\frac{1}{2}\left[\left(I^R - I^G\right) + \left(I^R - I^B\right)\right]}{\left[\left(I^R - I^G\right)^2 + \left(I^R - I^B\right)\left(I^G - I^B\right)\right]^{1/2}}\right\}$$

3.3 Verify and Detect VLP Region

Information extracted from image, intensity histograms play a basic role in image processing, in areas such as enhancement, segmentation and description.

Finally, we verify and detect vehicle license plates (VLP) region which contains predetermined LP alphanumeric character by using vertical and horizontal position histogram.

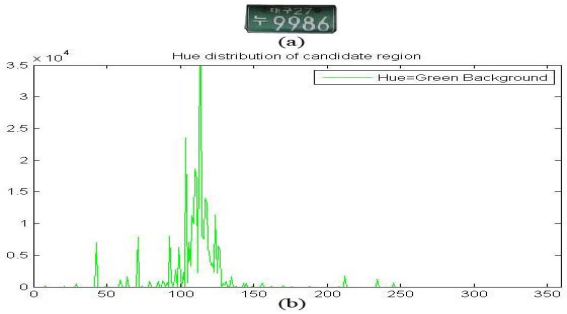

Fig. 6 Hue distribution of candidate region.

Fig. 7 show the results for verify predetermined alphanumeric character (white back ground LP). (a) extracting candidate region, (b) vertical position histogram with LP border, (c) horizontal position

histogram with LP border, (d) horizontal position histogram without LP border, (e) view of candidate region after removing border area, and (f) vertical position histogram (seven peaks for predetermined seven alphanumeric characters in LP region).

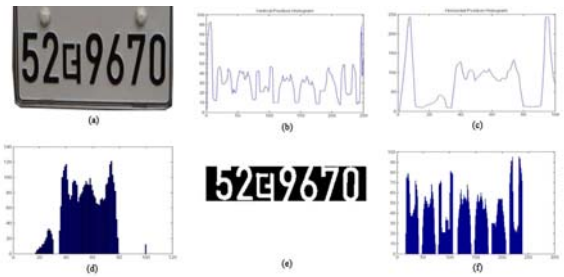

Fig. 7 Predetermined alphanumeric character (White back ground LP).

Fig. 8 Successful segmentation of alphanumeric characters (white back ground LP).

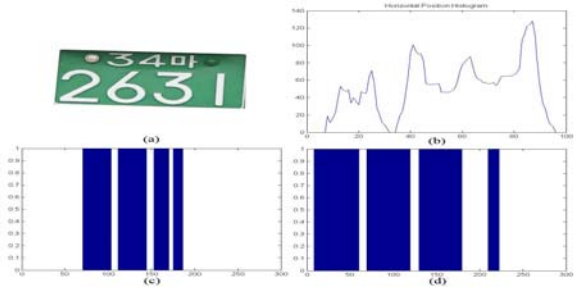

Fig. 9 Predetermined alphanumeric character (Green back ground LP).

4. CONCLUSIONS

All experiments were done on Pentium IV 2.4 MHz with 1024 RAM under Matlab R2006b environment. In the experiments, 40 images are employed and the size of the images is 640*480 pixels. For these images, all of them were taken by digital camera (canon 570 power shot A570 IS) from various scenes and under different lighting conditions of the real world and varied weather. The satisfactory result has been obtained; the success detection rate of license plate is up to 82.5%.

In conclusion, a new approach was proposed to detect candidate regions from natural properties by finding vertical and horizontal edges from vehicle region. Vertical and horizontal edges detection has been addressed through the implementation of sliding windows method for image segmentation and connected component analysis.

Finally, color arrangement and predetermined LP alphanumeric character of the Korean license plate is an important feature for verification and detection license plate regions by using HSI color model and position histogram.

From the experiment, different illumination conditions and varied distances between vehicle and camera are often occurred. In the case, we confirm the result is so effective when the proposed approach is used. However, the proposed method is sensitive to the angle of view and environment conditions, e.g. the plate of car license is defiled etc.

These problems can be solved by using image processing operation as like as histogram equalization, high dynamic range imaging (HDR) and so on.

4. ACKNOWLEDGMENTS

The authors would like to thank to Ulsan Metropolitan City, MOCIE and MOE of Korean Government which partly supported this research through the NARC and post BK21 project at University of Ulsan. The first author also expresses special thanks of the support by the MIC through IITA International graduate students scholarship.

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Removal of Salt and Pepper Noise by Tolerance based Selective Arithmetic Mean Filtering Technique

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Abstract

Removal of noises from the images is a critical issue in the field of digital image processing. This paper proposes a tolerance based arithmetic mean filtering technique to remove salt and pepper noise from corrupted images. Arithmetic mean filtering technique is modified by the introduction of two additional features. In the first phase, to calculate the arithmetic mean, only the unaffected pixels are considered. In the second phase, a tolerance value has been used for the replacement of the pixels. This proposed technique provides much better result than the existing mean filtering techniques.

KEY WORDS

Tolerance Based Selective Arithmetic Mean Filtering Technique (**TSAMFT**), Peak Signal to Noise Ratio (**PSNR**), Arithmetic Mean Filtering (**AMF**), Geometric Mean Filtering (**GMF**), Harmonic Mean Filtering (**HMF**)

1. INTRODUCTION

Noise is any undesired information that contaminates an image. Noise appears in an image from a variety of sources. The digital image acquisition process is a technique that converts an optical image into a continuous stream of electrical signal, which is then sampled in the primary process and eventually noise appears in the digital images. The Salt and Pepper type noise is typically caused by malfunctioning of the pixel elements in the camera sensors, faulty memory locations, or timing errors in the digitization process. For the images corrupted by Salt and Pepper noise, the noisy pixels can take only the maximum and the minimum values in the dynamic range. To recover the image from its noise there exits many mean filtering techniques which are application oriented. Some filtering techniques have better performance than the others according to noise category. The working procedures of the existing mean filtering techniques are very simple. For the existing mean filtering technique one pixel is taken at a time and a sub window is considered around that pixel. Then mean is calculated using the pixel values of that sub window. Then the considered pixel is replaced with that mean. In this way, all the mean filtering techniques work.

There are some problems associated with the existing mean filtering techniques. Geometric and Harmonic Mean Filtering Techniques can not remove Salt and Pepper noise from the distorted images. The PSNR of the filtered images obtained by these two filtering techniques are actually lower than that of the corrupted images. So these two techniques actually decrease the quality of the noisy images rather than improving the quality. The Arithmetic Mean Filtering Technique can successfully remove Salt and Pepper noise from the distorted image but in this case the filtered image suffers the blurring effect.

To overcome this problem, some preventive measures must be ensured so that the affected pixels are not considered while calculating the mean and the uneffected pixels are not replaced at all. In the proposed approach these two features have been considered. These two features ensure that the affected pixels are not considered during the calculation of mean and the unaffected pixels are not changed.

2. IMAGE PROCESSING TERMINOLOGIES

Some important features and terminologies that are related with these paper and image processing are given below

2.1 PROBABILITY DENSITY FUNCTION (PDF) OF IMPULSE NOISE

The PDF of (Bipolar) Impulse noise is given by

$$p(z) = \begin{cases} p_a & \text{for } z = b \\ p_b & \text{for } z = a \\ 0 & \text{otherwise} \end{cases}$$

if b>a, gray-level b appears as a light dot in the image. Conversely, level a appears like a dark dot. If either p_a or p_b is zero, the impulse noise is called unipolar.

Noise impulses can be either negative or positive. Impulse noise generally is digitized as extreme (pure black and white) values in an image. For an 8 bit image this means that a=0 (black) and b=255 (white).

2.2 RESTORATION

The ultimate goal of restoration techniques is to improve an image in some predefined senses. Restoration attempts to reconstruct or recover an image that has been degraded by using a priori knowledge of the degradation phenomenon.

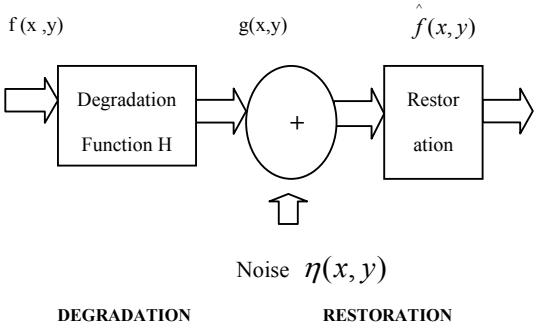

Fig. 1: Model of the image degradation restoration process

2.3 PEAK SIGNAL TO NOISE RATIO (PSNR)

The phrase **Peak Signal to Noise Ratio**, often abbreviated **PSNR**, is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupted noise that affects the fidelity of its representation. As many signals have wide dynamic range, PSNR is usually expressed in terms of the logarithmic decibel scale. The PSNR is the most commonly used measure of quality of restored image. The PSNR is defined as:

$$PSNR = 10 \cdot \log_{10}\left(\frac{MAX_I^2}{MSE}\right) = 20 \cdot \log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right)$$

Here, MAX_I is the maximum pixel value of the image. When the pixels are represented using 8 bits per sample, this is 255.

3. EXISTING MEAN FILTERING TECHNIQUES

To recover the image from its noise there exits many mean filtering techniques which are application oriented. Some filtering techniques have better effects than the others according to noise category. Mean filtering techniques are described below:

3.1 ARITHMETIC MEAN FILTERING (AMF) TECHNIQUE

This is the simplest of the mean filtering techniques. Let S_{xy} represent the set of coordinates in a rectangular sub image window of size m * n centered at point (x, y). The AMF technique computes the average value of the corrupted image g(x, y) in the area defined by S_{xy}. The value of restored image ***f*** at any point (x, y) is simply the arithmetic mean computed using the pixels in the region defined by S_{xy}. We can express AMF by equation

$$f(x, y) = \frac{1}{mn} \sum_{(s,t) \in S_{xy}} g(s, t)$$

3.2 GEOMETRIC MEAN FILTERING (GMF) TECHNIQUE

For GMF technique each restored pixel is given by the product of the pixels in the sub image window, raised

to the power 1/mn. GMF can be expressed by the expression given below:

$$f(x,y) = \left[\prod_{(s,t) \in S_{xy}} g(s,t) \right]^{\frac{1}{mn}}$$

3.3 HARMONIC MEAN FILTERING (HMF) TECHNIQUE

The Harmonic Mean Filter works well for salt noise but fails for pepper noise. It does well also with other types of noise like Gaussian noise. The HMF operation is given by the expression below

$$f(x,y) = \frac{mn}{\sum_{(s,t) \in S_{xy}} \frac{1}{g(s,t)}}$$

4. PROPOSED APPROACH (TOLERANCE BASED SELECTIVE ARITHMETIC MEAN FILTERING TECHNIQUE (TSAMFT))

Salt & pepper noise is considered as the extreme case among all types of noises. To recover the images affected by this noise, we have developed a technique called TSAMFT. In this technique our main concern is to use the Arithmetic Mean Filtering Technique efficiently to recover from Salt and Pepper noise. We know that for Salt and Pepper noise the pixel value of the noisy image is converted to 0 and 255. When we use Arithmetic Mean Filtering Technique we take 3 * 3 windows and find out the arithmetic mean and in this case all the 9 pixels of this 3 * 3 window are used to calculate the arithmetic mean. But to calculate mean using the extreme value, provide us with erroneous result in our technique. To avoid this effect we ignored the pixel of value 0 and 255 while calculating the mean. But it may be the case that the pixels of the 3* 3 window represent a black or white object. Hence the pixels are not affected by the noise rather the original values 0 and 255. To deal with this situation, we consider one pixel and a sub window of size 3*3 around that pixel and find out arithmetic mean from the pixels of the sub window ignoring the pixels with the maximum (255) and minimum (0) value. If the number of pixels is less than 3 out of 9 (window size m*n) adjacent pixels, we use the traditional Arithmetic Mean Filtering Technique. Otherwise we use the calculated mean found by this technique.

In this technique we have also used a variable called tolerance value. For Arithmetic Mean Filtering Technique we take one pixel at a time and consider a 3 * 3 window around that pixel. Then we calculate arithmetic mean and replace the value of the considered pixel by this arithmetic mean. In our technique we also consider one pixel at a time and take a 3 * 3 window around that pixel. Then we calculate the arithmetic mean and save the arithmetic mean in a temporary variable. After that we find the absolute difference between the arithmetic mean and the value of the considered pixel. If the difference is greater than the tolerance value, we replace the value of the considered pixel by the arithmetic mean. Otherwise the value of the considered pixel is unchanged.
So the main concept is that first we ignore the pixels containing the values 0 and 255 and then we use the tolerance value.

4.2 ALGORITHM OF TSAMFT

1. Find the number of pixels in the horizontal and vertical direction.
2. Take the following steps for all pixels in the image
3. Take one pixel and a sub window of size m*n arround that pixel.

    i. Find out the arithmetic mean from the pixels of the sub window ignoring the pixels with the

maximum (255) and minimum value (0).

ii. If the number of pixels obtained after ignoring pixels of minimum and maximum value is greater than 1/3 rd of m*n then calculate mean with the selected pixels.

Otherwise calculate mean with all the pixels in the m*n sub window.

Consider a suitable tolarence value.

iii. Find the difference between arithmetic mean and the value of the considered pixel

a) If the difference is greater than the tolarence value replace the value of the considered pixel by arithmetic mean

b) Otherwise leave the pixel value unchanged.

4.3 THE SIGNIFICANCE OF THE TOLERANCE VALUE

For Salt and Pepper noise the value of the distorted pixel is 0 or 255. So we find a significant difference between the mean and the value of the distorted pixel. Replacing only the distorted pixel will provide us with better result than replacing all the pixels. Our tolerance value ensures that only the distorted pixels are replaced.

If we take tolerance value 0, it will provide same result as Arithmetic Mean Filtering Technique. If we take small tolerance value such as 5 or 10, then not only the distorted pixels but also the other pixels are replaced. If we increase the tolerance value then for Salt and Pepper noise PSNR increases. If we take a very large tolerance value (like 65 or greater than 65), some distorted pixels are not replaced which decreases the PSNR for Salt and Pepper noise.

From our experiments this technique produces a very good result for Salt and Pepper noise when the tolerance value is 60. Considering a moderate tolerance value such as 30 to 35, will provide better result than that of minimum tolerance value (e.g. 5 to 10), but it will provide lower performance than taking high tolerance value 60.

4.4 SIGNIFICANCE OF THE PROPOSED TECHNIQUE

For Salt and Pepper noise the PSNR obtained by the proposed technique is much higher than that of all other mean filtering techniques and the image is free from blurring effect. If we use a suitable tolerance value like 60 or around 60, the best result is achieved. If we increase the tolerance value from that level, the PSNR and image quality both will be decreased.

5. SIMULATION

For the simulation purpose we have used Multimedia Education System (MTES), Microsoft Visual C++ and Adobe Photoshop. In our proposed approach the PSNR of the filtered image varies with the tolerance value. Whenever we take a smaller tolerance value we obtain comparatively lower PSNR. The PSNR Value increases along with the increase of the tolerance value up to a certain level. Then the PSNR decreases again. From table1 we can see that when the tolerance is 0 we get PSNR 24.5621, PSNR value increases from that stage. For the tolerance value 60 we obtain the highest PSNR 25.4341. After that PSNR decreases again.

We see the change of PSNR for different threshold value in the graph as

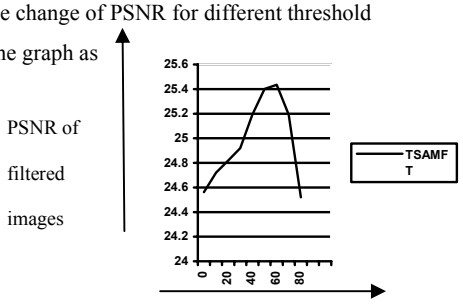

Fig 2: PSNR vs Tolerance value

From figure 2, we observe that if we increase the tolerance value, the PSNR of the affected image will be increased. Ultimately the quality of the image will be increased. When the tolerance value is 60 the PSNR is the highest, which means the image will be in super quality. But if the tolerance value exceeds 60 the PSNR decreases as well as the quality of image decreases. In figure 2, we can see for tolerance values of 70 to 80 the PSNR of the image decreases with a sharp edge. So we consider 60 as the upper limit of the tolerance value.

5.2 PERFORMANCE ANALYSIS AMONG FILTERING TECHNIQUES

In our paper we have considered PSNR and Visual perception as the criteria of comparison. So the filtering technique which provides greater PSNR reduces noise from the corrupted image.

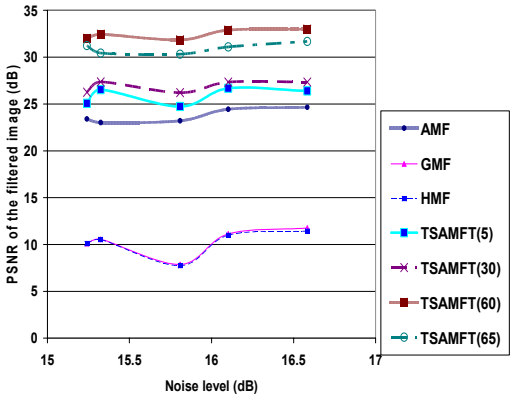

Fig.3: PSNR of filtered image Vs noise (Salt & Pepper noise) level by various techniques on image Lena.jpg

In figure 3, noise level is plotted in X axis and PSNR of filtered image is plotted in Y axis. For different noise level we observe different PSNR. From figure 3, it is clear that our proposed technique provides the highest PSNR than others.

In figure 4, we observe the effect of different filtering technique on noisy Lena image. Here we can clearly identify that the mage recovered by **TSAMFT (t = 60)** is the closest to the original image and with highest PSNR. Hence from the visual perception the image looks extremely well.

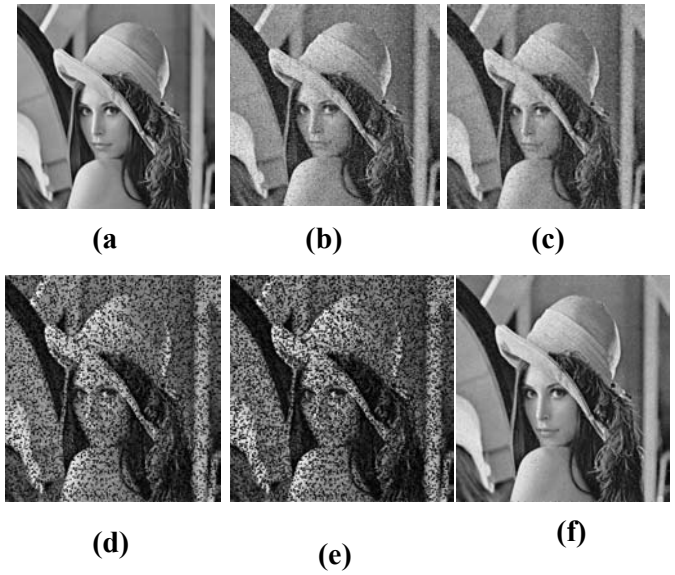

Fig. 4: Restoration of Lena image. (a) Original image, (b) Corrupted image with Salt & pepper noise (16.1023 dB), (c) Image recovered by AMF technique (24.4312 dB), (d) Image recovered by GMF technique (11.1253 dB), (e) Image recovered by HMF Technique (10.9820 dB), (f) Image recovered by TSAMFT (t = 60) (31.0934).

From the above shown figures, we can claim that our proposed **TSAMFT** is better than any other existing Mean Filtering Techniques.

5. CONCLUSION AND FUTURE PLAN

In this paper we developed a new filtering technique, which is better than the existing Mean Filtering Techniques. In our analysis we find that the Arithmetic Mean Filtering Technique works better than that of Geometric and Harmonic Mean Filtering Techniques, while our proposed filtering technique works better than the Arithmetic Mean Filtering Technique for the Salt and Pepper noise. Here we introduce a new term Tolerance value. If we increase the tolerance value, the PSNR and the quality of the image increase. This technique gives the best result when the tolerance value is 60. Greater tolerance value than this decreases both image quality and the PSNR. So we have defined a

ISBN 984-300-002131-3

range of the tolerance values. Finally we can say that our proposed technique can be effectively used to filter the images in the spatial domain. It performs better than that of the traditional filtering techniques and we hope that our effort will help to improve the future experiments over image processing and performance analysis.

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VHDL Model of an Image codec for mobile communication

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Abstract - Modified Set Partitioning In Hierarchical Trees (MSPIHT) is an efficient, low memory consuming, real-time image compression system. This paper describes the VLSI implementation of the MSPIHT codec for real-time mobile communication in a chip. The objective of the project is to design the architecture for implementation of MSPIHT encoder and decoder for real-time mobile communication using the IEEE standard VHDL language on Quartus II platform targeting the EP2S60F1020C4 FPGA. As the chip is exclusively designed for the compression, the high speed, low memory and power requirements constraints are met by parallel processing of the designed algorithm with less dedicated chip area. The simulation results of the implemented model regarding the visual quality have been shown the performance with its software implementation.

Keywords: FPGA, SPIHT, MSIHT, Absolute Zerotree, LPM RAM

1. INTRODUCTION

To save transmission time or storage space of an image, nowadays many people widely use image compression technique to transmit or to store an image. Among various compression techniques, "transform coding" is a favorite technique. To implement the coding algorithm in hardware, Field Programming Gate Array (FPGA) is the best choice of researchers and R & D Engineers which is reconfigurable, efficient, flexible, high speed, low cost design The modern FPGA ICs are having higher density which is suitable to use in virtually any digital logic system by using the property of reconfigurability of FPGA.

In related work, Panigrahi et. al.[1] presented a hardware/software (HW/SW) reconfiguration methodology, considering co-design of adaptive algorithms and reconfigurable architecture of JPEG algorithm provided necessary flexibility and performance for adaptive image compression algorithms. Ismailoglu et. al. [2] developed a real-time image processing subsystem named GEZGIN, a highly flexible and reconfigurable signal processing satellite subsystem employing JPEG2000 compression algorithm. XCV300E device from Xilinx was used to implement the algorithm. Image compression time was reduced by run-time at the expense of reconstructed image quality. Lian et.al [3] presented detailed analysis and dedicated hardware architecture of the block-coding engine to execute the Embedded Block Coding with Optimized Truncation (EBCOT) algorithm efficiently which is known as the heart of JPEG2000 standard. It is shown that about 60% of the processing time is reduced compared with sample-based straightforward implementation. In the latest work this year, Gangadhar and Bhatia [7] proposed and implemented high speed FPGA based architecture for EBCOT Tier-I algorithm utilizing pipelined architecture implemented on XC2V1000 device.

This architecture improved the processing time by more than 75% compared to a sample-based implementation by Adams and Kossentini [8] and by more than 34% when compared to the architecture proposed by J. S. Chaing et. al. [9].

In other work, V. Ritter [4] introduced the well-known state of the art image compression algorithm using partitioned wavelet-based transformation to avoid the drawback of higher memory requirement as well as it divided the image into small sub images with little modification of original SPIHT algorithm proposed by Said and Pearlman, which mainly consists of two one-dimensional DWT units (1D-DWT) for horizontal and vertical transforms. Fry and Hauck [5] demonstrated an implementation of the image compression routine SPIHT in reconfigurable logic by analyzing the range of data processed by implementing it as an Intellectual Property (IP) resorting to a VHDL description and the logical synthesis was carried out targeting an FPGA device Virtex-E from Xilinx. Low memory was used yielding efficient data transfers with Variable Fixed Point (VFP) presentation of data.

Corsonelloa et. al. [6] proposed a *Field-programmable System-on-Chip* (FPSoC) for lossy image compression algorithm using wavelet based SPIHT. The higher frequency subband wa eliminated by the first level of the wavelet decomposition which was not effective significantly on image quality. The advantage of the technique was significantly low memory requirement and encoding computational load. The system was not applicable for lossless image compression. The entire FPSoC was implemented on Virtex II board containing an XC2V1000 device, synthesized using Xilinx ISE 5.2i tools. A complete review articals regarding FPGA implementation of image compression techniques has been organized in the research work [10] by Akter et. al.

In this paper, an architecture and complete implementation has been demonstrated for hardware prototyping of the MSPIHT algorithm developed by Akter et. al. [11] approach for wavelet-based image compression for programmable hardware. All designs were specified using the hardware description language VHDL. The focus of this research is restricted to synthesize the design targeting FPGA device, as a consequence the synthesis and timing simulation results mainly show the mightiness of the MSPIHT algorithm. The entire system was coded in IEEE-compliant VHDL language on Quartus II

version 6.0 platform from Altera Corporation targeting EP2S60F1020C4 FPGA device. This coding of the entire system provided an opportunity to detect and correct errors early in the design process.

The organization of this study is as follows. In the following section describes briefly the algorithm of SPIHT and addresses the coding algorithm of MSPIHT. In Section III, design architecture of the MSPIHT algorithm is discussed. Section IV discusses the simulation and synthesis results of the proposed methodology. Finally, we make the concluding remarks in Section V.

II. CODING METHODOLOGY

In SPIHT [13], the usage of three temporary lists is a powerful way to improve the codec's efficiency. But they are quite memory consuming. It is a major drawback for SPIHT algorithm. In addition, during coding we often insert or delete the elements in the lists. These frequent operations will greatly increase the coding time with the expanding of the lists. In order to realize the implementation of SPIHT algorithm in real-time for mobile communication, a successful fast and low-memory solution must be provided. In this algorithm, the sorting and refinement phase are combined as one scan pass. It is shown that co-ordinates of wavelet coefficients are never stored in LSP and LIP. There are no such lists in this algorithm. In the MSPIHT [12] algorithm, the sorting pass and the refinement pass are combined as one scane pass. Below we present two concepts, called *absolute zerotree*, and *number of error bits* to modify the original SPIHT algorithm.

After wavelet decomposition, most of the significant coefficients are concentrated in low-pass subbands. And the magnitudes of transform coefficients decrease rapidly with the decline of the pyramid level. Through extensive experiments, it is shown that the coefficients in many sets are so small that these trees will always be zerotrees before the expected compression ratio is reached. In SPIHT coding, the coordinates of these zerotree roots are stored in the LIS and will never be removed. It results in the rapid expansion of the LIS.

The introduction of *absolute zerotree* is a simple solution to this problem. We have defined to indicate the number of truncating error bits. For a zerotree, if the magnitudes of all its descendants are lower than $2^{\mu e}$, it becomes an *absolute zerotree* and will never be significant in the last *scan passes*. Their coordinates need not be stored in the LIS. Obviously, the length of the LIS is shortened due to not scan among *absolute zerotrees* any longer, the coding time is also greatly reduced.

The *Number of error bits* defined before encoding will indicate the number of bits that will be omitted finally. During implementation, when a wavelet coefficient will be found as significant or insignificant, its last error bits will be omitted and rest of the bits will be outputted. In addition, the co-ordinates of the coefficient will not be stored in LSP and LIP for further processing. Therefore, M-SPIHT is the low memory solution of SPIHT algorithm by eliminating the temporary list LSP and LIP.

III. HARDWARE IMPLEMENTATION

A MATLAB implementation of MSPIHT algorithm was done for the coding and decoding sequence of MSPIHT algorithm and the inputs of the raw image is extracted using MATLAB software used as the input data for the simulation of VHDL program. The simulation results of software implementation are used as reference for verification.

The four main block of proposed algorithm is designed individually with several numbers of sub-modules. The primary blocks are controlled by controlled unit with Finite State Machine (FSM) technology which is a sub-module of the architecture. Figure 1 has shown the top level architecture of the proposed MSPIHT algorithm including Discrete Wavelet Transform (DWT), Encoder, Decoder, Inverse Discrete Wavelet Transform (IDWT) and Control Unit.

While the DWT module calculates the wavelet coefficients, the encoder module wait for the data. After getting the coefficient from the DWT module, the control module sends a signal to encoder to start the coding. With a certain delay, the DWT module and encoder module work in parallel to reduce the total coding time.

Figure 2 has demonstrated the internal architecture of MSPIHT encoder consisting several modules including controller, MSPIHT core, address generator, Zerotree calculator, Decendant, contains Library of Paramameterized Memory (LPM) RAM. 8 bit data bus and 18 bit address bus are used to transfer data from LPM RAM to destination module. The LPM memory module embedded in the Stratix II FPGA IC are used to store the data in the different state of the architecture such as stored the wavelet coefficients. The sequence of the coding algorithm is executed in the module along with the other modules concurrently. The entire working sequence of the architecture is maintained and synchronized by generating the appropriate signal of controller at the right time.

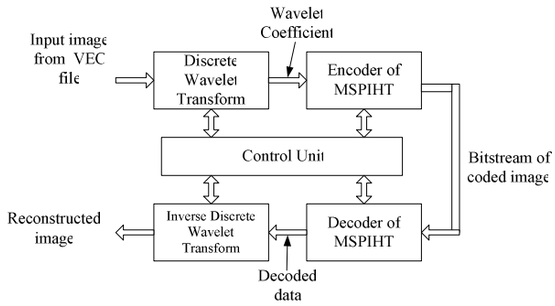

Figure 1: Block diagram of the top architecture of the proposed MSPIHT algorithm

The address generator generates the address of the corresponding data in the data bus.

Decendants of the Hierarchical tress is calculated in this module and sent the data to the next module Zerotress calculator to check out whether the zerotree is absolute zerotree or not. The decision is sent back to the MSPIHT core to help the execution of the algorithm.

Output bits of the coded data are stored in a buffer memory temporarily included the encoder module as a sub-module.

Each block of the DWT, developed MSPIHT algorithm were designed and tested in isolation before being incorporated into the higher levels of the design. The simulation results of the modules will be presented and discussed in the following sections. In the next section, the comparison of output image will be shown. Besides that, the steps involved in hardware implementation will be outlined.

A visual performance comparison with its software implementation to determine the feasibility of this architecture by simulator will be presented.

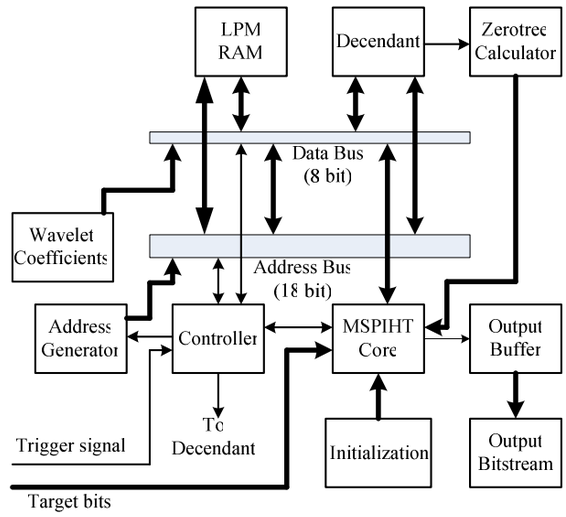

Figure 2: Block diagram of the internal architecture for the proposed MSPIHT Encoder Module

IV. SIMULATION RESULTS

For the sake of completeness, comparison with general-purpose processor has been made in terms of execution time calculated by timing simulation using simulator tools on Quartus II, targeting EP2S60F1020C4 FPGA device. The platform of simulation is the CPU, Pentium IV, 1.7GHz, 256 RAM.

Figure 3 shows the simulation waveform of the top architecture of the proposed architecture. User can control the coding by changing the value of tagetbit (Total number of bit can be used). Datain is the input image data stored in the system, on the other hand IDWT is the reconstructed image data. As shown in Figure 3, the original data and decoded data is nearly same with some error value.

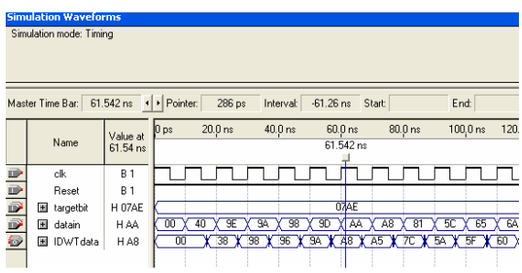

Figure 3: Timing Simulation Results for Top level entity

The clk signal activates the system. At the end of the processing, the results will be available on the bitstream output register. Reset resets the settings of the system.

The value obtain as waveform in the Vector Waveform File (.vwf) is saved as Vector Table Output (.tbl) file in the same directory of the project on Quartus II platform. This .tbl file is opened as .txt file which is easily read on Matlab platform to show the output image and PSNR measurement.

From Figure 4, Figure 5 and Figure 7, Figure 8, it is noticed that the visual quality of the reconstructed image between software, hardware implantation is not different to be detectable by human eyes with respect to original image shown in Figure 6 and Figure 9. The difference is calculated by mathematically or shown in graphycally only. Figure 10, Figure 11 are the comparison of PSNR value among SPIHT, MSPIHT (Matlab) and MSPIHT (VHDL) implementation for Lena, and Boat image, respectively. In those figures, the star, square and triangle shape is representing the PSNR value for MSPIHT of Matlab implementation, MSPIHT of hardware implementation and SPIHT algorithm.

Figure 4: Reconstructed Lena Image Using Matlab at bit rate 0.038 bpp

Figure 5: Reconstructed Lena Image Using VHDL at bit rate 0.038 bpp.

Figure 6: Original Lena Image

Figure 7: Reconstructed Boat Image Using Matlab at bit rate 0.038 bpp.

Figure 8: Reconstructed Boat Image Using VHDL at bit rate 0.038 bpp.

Figure 9: Original Boat Image

From the plots, it is clear that the modeled architecture of this research work is working efficiently showing the PSNR value is exactly same as the its software implementation with little reduction because of using the 8 bit integer data of wavelet coefficients instead of floating point data. A huge amount of memory has been saved at the expense of the reduction of PSNR.

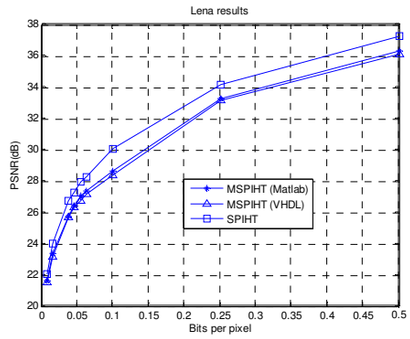

Figure 10: Comparison of PSNR value among SPIHT, MSPIHT (Matlab) and MSPIHT (VHDL) implementation for Lena image.

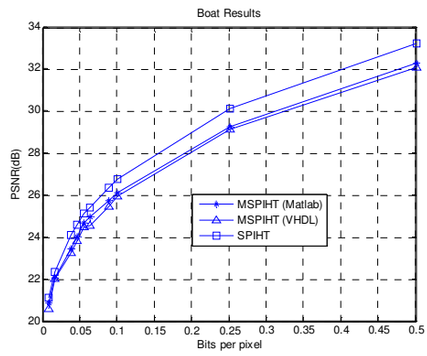

Figure 11: Comparison of PSNR value among SPIHT, MSPIHT (Matlab) and MSPIHT (VHDL) implementation for Boat image.

The above results are proving feasibility of VHDL design of developed MSPIHT image compression system. The Synthesis and speed-up comparison results are shown and elaborated in the continued paper [12].

V. CONCLUSION

This paper presents the architecture model of MSPIHT and simulation results of all the components as well as the combined system. The results obtained from the simulation are verified manually to make sure that the components are functionally correct. Simulation is an important process that must be carried out in order to obtain a good design that meets the objective. The proposed codec preserves most of the merits of SPIHT (such as simple computation, effective compression, and embedded coding). Thus, the proposed MSPIHT is highly promising image compression system for real-time mobile communication. The synthesis and timing simulation will proof the processing speed of the design. Moreover, the utilization of MegaFuntion for the module of DWT and Inverse DWT from Alter Corporation can increase the overall performance of the design.

ISBN 984-300-002131-3

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The mass of a photon is the key of all source of energy & the result of complete unified theory; it can explain the structure of electron, which is the basic source of all energy like particles, stars, and computer's function, EMR etc.

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ABSTRACT

The structure of electron and electromagnetic radiation is unknown to us. Knowing the mass of a photon, the structures of these have been shown in this script. The accurate mass of a photon is not known. The scientists are trying to find out the mass from 1936, but the results are not matching each other. It has been described in the book complete unified theory, this theory is very important and applicable from the particle to the universe. The application of this structure will help to improve & bring the computer fast, can omit lot of hazarded.

Key words : New style of concept Structure of electron, EMR; Planck constant, Eigen value of electron, quantum circulation of black hole, Curie, Einstein equation.

Determination of mass of a photon (σ), structure of electron, EMR and unification of physics

In this article we shall adopt an unusual and hitherto unknown concept involving the magic number (N_A = Avogradro number = 6.0221367x10^{23}) of one-gram molecules or atoms of any substance. According to the quantum theory, the energy has discrete nature having smallest possible value $h\nu$. From the theory of mass energy equivalence of Einstein, the total energy contain in an atom can be equivalently represented by means of the aggregate of discrete quanta. Now let us suppose that Avogadro number of photons are equivalent to the energy of any atom in its lowest state. If each photons of mass say, σ & if these photons behaves like ideal gas inside the atom, then we can write :

$E = ½\ N_A\ \sigma\ c^2$ ----- (1) as its energy stored in ground state. Again the Compton theory of photons scattering by an atom (taken as atomic mass constant $m(c^{12})/12 = m_u$) gives us Compton wavelength of electron $\lambda_c = h/m_e c$ & for atom $\lambda_u = h/m_u c$. The energy of an electron bounded in the atom in its ground state is given by $E = m_e c^2$. Let the hypothetical atom (m_u) as $E_1 = m_e c^2 \text{x}\ (\lambda_u/\lambda_c) = 4.49128\text{x}10^{-10}$ erg = 0.2803 kev (This energy is showing the average energy of Eigen value of electron between first and generating state)---- (2) Again Avogadro number of this value brings 1.68x10^{17} Gev, the energy range of unified theory. So, the equation (2) has some meaning and now this may utilized which based on the assumption that total energy of the said atom can be expressed numerically as same multiple of electron rest energy. Then from equating (1) &(2),

$$½\ \ N_A\ \sigma\ c^2 = m_e\ c^2\ \text{x}\ \frac{\lambda_u}{\lambda_c}$$

$$\sigma = \frac{2h^2}{N_A m_u\ \lambda_c^2\ c^2} = 1.659619614\text{x}10^{-54}\ \text{gm} \text{ ----(A) Or } N_A\ \sigma = \frac{2h^2}{m_u\ \lambda_c^2\ c^2} = 9.99445618\text{x}10^{-31}\ \text{gm} \text{ ---(B)}$$

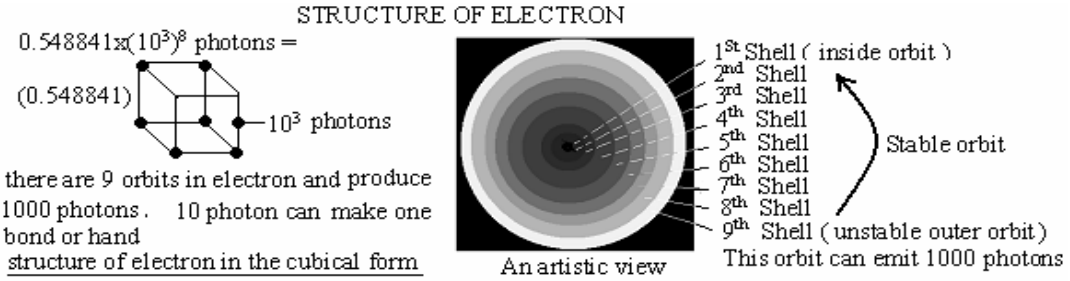
The equation (A) is showing the mass of a photon, where some investigators tried to find out the mass of a photon experimentally[1] from 1936, but the results are not tallying each other. The application of A or B proves in the field of photochemical relation of Stark-Einstein equation[2]. On changing the mass of atom by an electron in the above equation and by applying the theory of relativity of mass of Einstein, we get the equation of the *unification of physics* which is applicable from the particle to the universe in simple way:

$$N_A\ \sigma' = \frac{m_e\ (m_0^2 - m_1^2)}{\pi^2\ m_1^2} \text{ ------(C) or } \sigma' = \frac{m_e\ (m_0^2 - m_1^2)}{\pi^2\ N_A\ m_1^2} \text{ ------ (D)}$$

But to explain the complete unified theory, it require to know the mass of a graviton by which gravitational force is occurred. Here, the equation of mass of a photon is explained as :

$$\sigma = 8\,\pi^2 g_\eta^2 G^2 \frac{m_e^{\,2}\; m_u}{N_A\,\lambda_c^2\,(\lambda\!\!\!^{-}\beta)^4\,c^2} = 1.659619615\text{x}10^{-57}\ \text{Kg} \qquad \text{(E)}$$

This equation is the master key of the universe; the complete unified theory & so explain many known and unknown phenomena from the particle to universe. Lot of examples are there of the equation A, C and E. Here, we will discuss about the *Structure of electron*:
The electron is made up of by $0.548841\text{x}10^{27}$ photons. Now $0.548841\text{x}10^{27}$ photons be shown as $0.548841\text{x}10^3\text{x}10^3\text{x}10^3\text{x}10^3\text{x}10^3\text{x}10^3\text{x}10^3\text{x}10^3$ photons = $0.548841\text{x}(10^3)^8$photons. If 10^3 photons makes bond as $10^3 = \vdash$ and so,



Determination of energy by using 1000 photons from an electron which will similar to Eigen value of electron as follows :

$$\text{Energy of electron} = \frac{(1000\ \text{photons})\,(\text{energy of a photon})}{2\,\sqrt{\frac{3}{2}}\ (\text{Å})^2} = 38\ \text{ev at zero point energy}$$

Where,3/2 is the angular quantum number (l=1) and we can write Å as l also which scientist Eigen use this l as length. But the Eigen value of energy[3] of electron at zero point is 37.6 ev. $E_n = n^2\,\pi^2\,\hbar^2 / 2m\,l^{\,2}$ = 37.6 ev (when, n = 0, E_n = 0). So the above system follows quantum number accordingly. In a computer, the function of electron is most important and the photons may liberate from electron to do work to follow the above hand over take over process by taking 10^3 photons from one electron to other. Similarly, if we divided 10^6 photons by √2 as quantum number (l = 0), then we will get $6.5830\text{x}10^{-16}$ev which is showing the value similar to Planck constant[4] ($\hbar$ /[e] = $6.5821\text{x}10^{-16}$ev-s). So, the mass of a photon is very important in the microscopic field of particle. The equation C or D is the equation of unification of physics, this equation is applicable in materialistic world from the particle to the universe. If we classify the equation E, we will get Hawking equation[5] and finally it bring the quantum circulation of black hole $(2\pi\,h\,G\,/\,c\,)^{1/2} = 3.0440727\text{x}10^{-26}\ \text{m}2\ /\ \text{sec}$), a new phenomena by which we can classify the black hole in proper way. On arranging the equation E, it is possible to calculate the lifetime of electron, atom[6] also. The equation of unification physics is very important which is deducing from the equation of mass of a photon. In this equation, the value of Pi at excited state changes as :

$$\pi_e = 3.152970491\text{x}\sqrt{\frac{m_0^{\,2} - m_l^{\,2}}{m_0}} \quad \text{(The equation to determine the value of Pi at excited state)}$$

here, m_l is the mass of Alfa particle (4.033 amu) and it is constant for calculating the energy in excited state of particle. As a result, the value of Pi changes accordingly on the mass of particle. The real equation of unification of physics will :

$$N_A\,\sigma_0' = \frac{m_e\,(m_0^{\,2} - m_l^{\,2})}{\pi_0^{\,2}\,m_l^{\,2}} \quad \text{or} \quad \sigma_0' = \frac{m_e\,(m_0^{\,2} - m_l^{\,2})}{\pi_0^{\,2}\,N_A\,m_l^{\,2}} \quad \text{at rest}$$

$$N_A\,\sigma_e' = \frac{m_e\,(m_0^{\,2} - m_l^{\,2})}{\pi_e^{\,2}\,m_l^{\,2}} \quad \text{or} \quad \sigma_e' = \frac{m_e\,(m_0^{\,2} - m_l^{\,2})}{\pi_e^{\,2}\,N_A\,m_l^{\,2}} \quad \text{at excited state}$$

The equation for the unification of physics

we can use the above equation for the universe as $\sigma_e' = \frac{m_e\, m_0^2}{\pi_e^4\, N_A\, m_1^2}$

(because, the mass of Alfa particle is very small to compare the mass of the star universe. For the white dwarf, π^4 will change to π^5 as the value of Pi can not large enough, the max. value of Pi at excited state found as 3.152974091. This equation will use for the birth of stars).

Avogadro number of this energy indicates the birth of stars, galaxies thus the birth of the universe. If the mass of populated photons (σ') is same as the mass of electron, then we will get the energy spent by the sun per second and putting this value in the equation $m_0 = N_A \sqrt{\sigma'} / Cic$, we can get the mass of the sun. Here, Ci = One Curie unit, c = velocity of light and m_0 is showing the internal function of matter & is the definition of matter which we cannot get from the traditional theories. Accordingly, Einstein equation ($E = m_0 c^2$) will turn into $E = N_A^2 \sqrt{\sigma'}\, c/Ci$.

Again, if $\sigma' = m_0$, then get the maximum mass of the universe which is 1.967902767 times larger than the mass of the observed universe (5.4×10^{53} gram). When $W = N_A \sqrt{\sigma'} / c\lambda$, here, λ = disintegration constant, then we can determine unknown weight of radioactive elements after calculating the value of Pi. But the Curie equation[7] for this purpose is $W = m_0\, Ci / N_A \lambda$, both the result will same. Again this proves that the equation of mass of a photon is perfectly correct. Now we want to enter into the electromagnetic radiation which is important for communication. We know the energy range of it, but we have no information about its structure. So let us try to find out the structure of EMR here taking the mass or energy of a photon.

Introduction: Since radiation and propagation of radio waves cannot be seen, all our descriptions must be based on theory, which is acceptable only to the extent that it has measurable and predictive value. The theory of EMR was proposed by the British physicist James Clerk Maxwell[8] in 1857 and finalized in 1973.

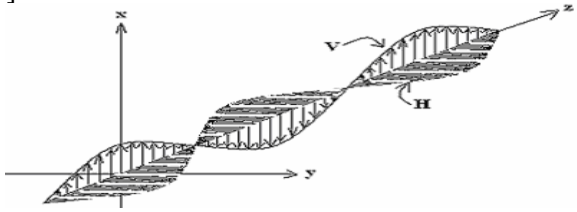


Figure : EMR Transverse wave in free space.

The direction of electric field, the magnetic field and propagation are mutually perpendicular in EMR. This is a theoretical assumption that cannot be checked since wave is invisible.

To determine the structure of EMR, we can take the energy level of radio frequency and microwave as a reference from the following energy range of electromagnetic radiation[9].

Name of the radiation	Energy range
Radio frequency	$0 - 10^{-5}$ ev
Microwave	10^{-5} ev – 10^{-3} ev
Infrared spectrum	10^{-3} ev – 1.6 ev
Visible spectrum	1.6 ev – 3.2 ev
Ultraviolet	3- 2 x 10^3 ev
X - ray	1.2×10^3 ev – 2.4×10^5 ev
Gamma rays	10^4 ev – 10^7 ev

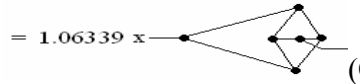
The energy range of electromagnetic radiation is 10^{-5}ev – 10^{-3} ev, the difference of energy between 10^{-5} and 10^{-3} is 9.9×10^{-4} ev. This energy is responsible to create microwave radiation and contain 1.06339×10^{18} photons (because, energy of a photon is 9.309779×10^{-22} ev) & so,

1.06339×10^{18} photons = $(1.06339) 10^3 \times 10^3 \times 10^3 \times 10^3 \times 10^3 \times 10^3$ photons

If 10 photon can make 1 bond as ⊢, then 10^3 photons will produce 3 bonds as ⊢

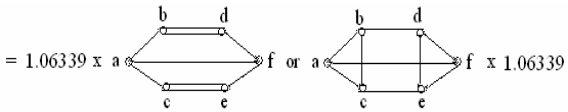
1.06339×10^{18} photons = (1.06339) x ⊢ x ⊢ x ⊢ x ⊢ x ⊢ x ⊢

We can arrange the above bonds of microwave to create the structure as :



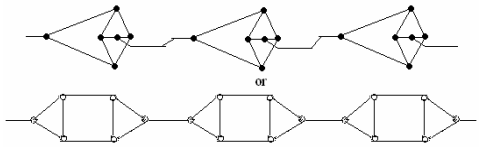
(Outer bond or active link, which may ready to form bond)

Figure –1



Hexagonal type picture

Figure - 2

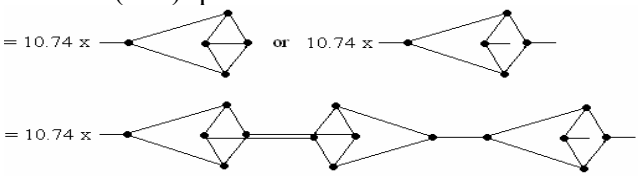


(Figure – 3 Open bond system structure)

(probable structure of microwave)

In the case of Radio frequency, we can write,

10^{-5} ev = 10.74x$(10^3)^5$ photons.



(Figure – 4, Structure of Radio Frequency)

Conclusion: If it is possible to detect the structure, then we can able to make new type energy, which may help for mankind in future. So, the mass of a photon[10] is very important in all energy fields, even in computer science, this may help to run fast the data process by using the structure of electron in a software/hardware. Moreover the complete unified theory will help to find the unknown characteristics of particle thus matter, stars, black hole etc. It is really strange that there are many distasteful assumptions present in our traditional theories, which need to clarify for the better achievement of the world science by using this theory.

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To,
Prof. Md. Mozaffor Hossain
Convener, Organizing Committee,
International Conference on Electronics, Computer and Communication-2008
Department of Applied Physics and Electronic Engineering, University of Rajshahi,
Rajshahi – 6205, BANGLADESH

Subject: **The mass of a photon is the key of all source of energy & the result of complete unified theory; it can explain the structure of electron, which is the basic source of all energy like particles, stars, computer's function, EMR etc.**

Respected Sir,

With due respect I am informing you that I have already send 4 pages scientific paper to you by your Email: icecc2008@yahoo.com and received your ID 181 on 9th March, 2008. After consulting about this paper, I follow your rules accordingly and sending this in your E-mail for your kind consideration. Please sent me your invitation as early as possible as I can attain in your nice seminar in June 2008.

Thanking you Sir,

Yours Faithfully,

Nirmalendu Das

Dated – 10/04/2008

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ISBN 984-300-002131-3

Ti-O-N Photocatalytic Film Processed by Atmospheric Plasma Jet

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ABSTRACT
We have made a visible light Ti-O-N photocatalytic film processed by atmospheric N_2 plasma jet. The atmospheric N_2 plasma jet was paid attentions, because of the high density reactive radicals by which the processing time can be shortened. We used a normal glass plate coated by TiO_2 film of 1 μm thickness on the market. Hydrophilic properties were observed by water contact angle meter and found sharp reduction of the water contact angle. Chemistry of the films were observed by ESCA.

Key words: Photocatalytic film, Atmospheric pressure plasma jet

1. Introduction

Low – pressure plasmas have a dominant and long established role in processing of materials ranging from silicon wafers to magnetic storage disks and thin film coatings. This is because of the unparalleled capability of plasmas for production of chemically reactive species at a low gas temperature while maintaining high uniform reaction rates over relatively large areas.[1,2] Currently, the majority of plasma processing is done at low pressure and vacuum operation is viewed as a necessary requirement. In principal, however, atmospheric pressure plasma can provide a critical advantage over widely used low-pressure plasmas, as they do not require expensive and complicated vacuum system. Without a vacuum system, the material cost could be reduced substantially and material issues related to vacuum compatibility would not be of great concern. Therefore the use of atmospheric pressure plasmas could greatly expand the scope of material processing.

Some novel atmospheric pressure discharge sources have been developed. These sources include the atmospheric pressure plasma jet (APPJ) [3-7], the cold plasma torch [8], the one atmosphere uniform glow discharge plasma (OAUGDP)[9], the micro hollow cathode discharge [10], and the surface wave discharge [11]. Though all these sources demonstrate differences in dimension, electrode materials and frequencies of the electric field, these sources share some common aspects. They produce discharge with a low gas temperature, typically below 300^0C and provides reasonable reaction rate for etching and deposition over limited areas.

Since the Honda-Fujishima effect, titanium dioxide (TiO_2) materials have become very important for environmental purification because of many basic TiO_2 criteria, including sterilizing effect, deodorizing, dissolving, hydrophilic effect, and the high refractive index will some day be proved to be useful for the improvement of most of human life [H. Taoda: private communications]. And the market scale of environmental industry for photo-catalytic TiO_2 is now going to a billion yen, while the public pollution of ferosilt is coming out. Taking the advantage of atmospheric pressure plasma jet, as an industrial application of plasma process for Japan's textile wool industry [12], we have used an atmospheric N_2 plasma jet here injected on a normal glass plate coated by TiO_2 film of 1 μ on the market in order to make a visible light Ti-O-N photocatalytic film [13].

2. Experimental setup

A schematic of the experimental set up is shown in Fig.1(a).The plasma jet as shown in Fig.1(b), was already presented in the JJAP meetings. The discharge used in this study was produced between the coaxial electrodes. The supplied gas coupled in the sandwiched region, as shown in the diagram, producing controlled plasma. The outer and inner diameters of nozzle are 25mm and 4mm. Temperature and speed of the plasma jet can be controlled from the device as per the desired deposition condition. The operational conditions are that the frequency of electrical discharge

source is 16 KHz, the electrical power is 1.5 KW, and the N_2 gas flow is 30 L/m.

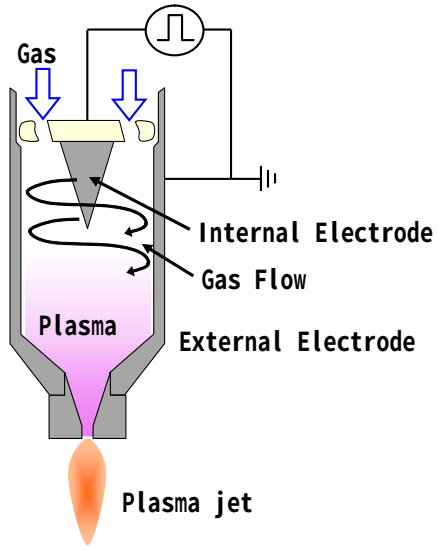


Fig.1(a) Principal of atmospheric plasma jet

As a substrate we have used a normal glass plate 1cm x 1cm coated by TiO_2 film of 1 μ with Sol-Gel processing on the market. And the nitrogen radicals were injected by the atmospheric N_2 plasma jet on the surface.

Fig.1(b) Atmospheric pressure Plasma Jet Nozzle

The parameters *t* and *d* are plasma jet processing time and distance between glass pate and jet nozzle.

3. Result and discussion

3.1 Hydrophilic property

A normal glass substrate 1cm x 1cm was used in the atmospheric pressure jet spray. The plate was set in different distance from the nozzle of the jet. But the best deposition performance was observed at a distance (d) of 8mm. The operational time was also varied from 5 sec to 300 sec.

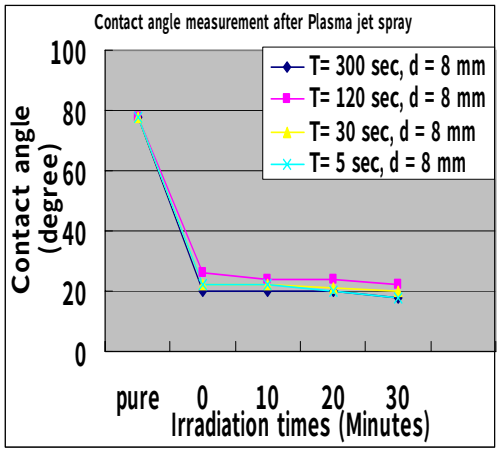


Fig.2. Two Steps Reduction of Contact Angles
(Tungsten Lamp Irradiation)

Water contact angle (hydrophilic property) was measured by CA-D (FACE; Kyowa Interface Science Co.). The parameters *t* and *d* ,in Fig.2, are the total spray time and the distance between substrate and Nozzle. For all the deposition conditions shown in Fig.2, successive two steps reduction of contact angle can be observed. Before the plasma jet application on the glass (represented as pure in Fig.2) the water contact

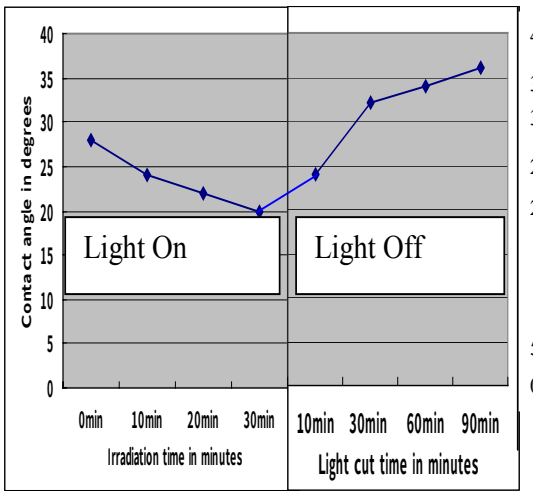


Fig.3 Contact angle recovery

angle was about 76 degree where as after the atmospheric pressure plasma jet application it was reduced to about 24 degree (which is mentioned here a first step reduction). Thereafter, when the tungsten lamp (power: 40 W, distance:35 cm) was irradiated on the surface, the water contact angles further reduced with the increasing irradiation time (the 2nd step decrease). In Fig.2 , it is shown that the second step reduction goes up to about 18 degrees. This show that the glass substrate under the atmospheric plasma jet treatment possess hydrophilic behavior. As one knows that the tungsten lamp includes only a visible light without ultraviolet rays.

As shown in Fig.3, we have also observed the contact angle recovery when the lamp was switched off. After the light source was cut off, the water contact angle went on increasing gradually and reached the previous condition after about 1.5 hour. This recovery of water contact angle further enhance that the surface is reproducible hydrophilic.

3.2 Surface chemistry of the film

The X-rays photoelectron spectroscopy was performed by ESCA-3300 KM electron spectrometer utilizing an ALKα(*hv* = 1486.6 eV) radiation as an X-ray source, under high vacuum

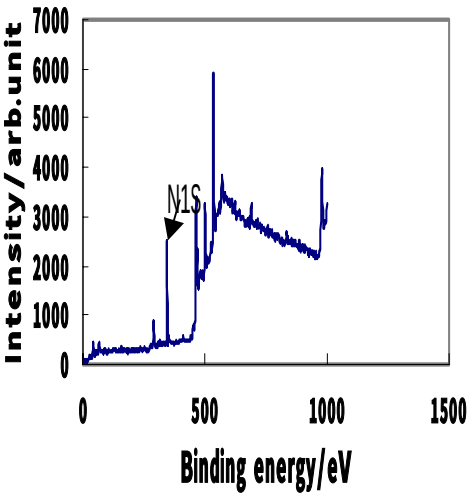
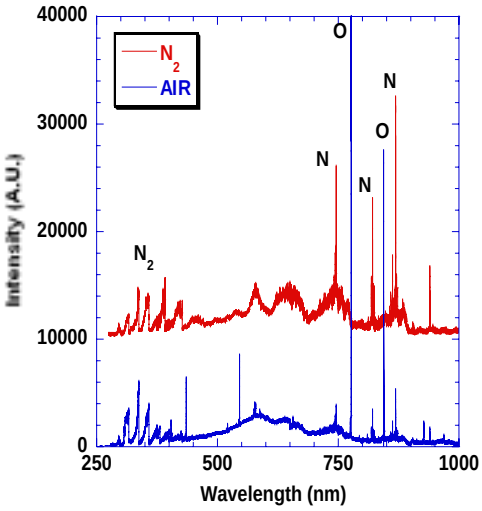


Fig.4. XPS wide spectrum of the sample at t=300sec,d=8mm

conditions of about 10^{-7} Pa. The XPS measurement was used to investigate the chemical and structural properties of the films. This technique is one of the most likely used techniques in the literatures to characterize the chemical bonding structure and to acquire useful information on the chemical environment around oxygen, and nitrogen of TiN. Fig. 4 shows XPS spectrum of the films prepared at distance of 8mm and time 300 sec was measured by ESCA and confirmed that the nitrogen peak at binding energy about 400 eV and intensity counts 500~2400, which is similar to the spectrum measured by Taga as N1S peak at 396 ev [13] as for a visible light Ti-O-N photocatalytic film.

3.3 Photospectrometry measurement

The spectral comparison of the film treated with Nitrogen jet and Air jet are shown in Fig.5. In this comparison we can see the spectra in the visible region as in the form of molecular N2 and in near infrared region in the form of atomic N and O. This pure N spectrum confirms that the plasma contains reactive nitrogen.



of the sample at t=300sec,d=8mm

4. Conclusion

The Atmospheric Pressure Plasma Jet (APPJ) is fundamentally different from other atmospheric pressure plasma sources and can offer critical advantage for materials application. The plasma pressure can be managed as per the need by adjusting the distance between the nozzle and the sample. Plasma discharge can be controlled by selecting the parameters. Thus the treated sample showed hydrophilic character deposited at d= 8mm, and successful deposition of nitrogen was observed at t= 300sec and d= 8mm.

Acknowledgments

One of authors , S. Ikezawa would like to thank H. Sugai for his supports, Y.Taga for his

discussion. And we thank many students of Toyota Technological Institute, and Chubu University for their helps.

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