Cover story

# Integrated Circuits

Turn to page 14


8 ALUMNI TALK - VIKRAM RANA

16 3D MOVIE GENERATION

18 MOBILE MICROPROCESSORS

31 INTERNSHIP COVER LETTER



# In Phase

IIT Guwahati-Cepstrum Magazine

Decade Issue, 2010



## From the editor....

This edition marks the tenth effort from the Deparment of Electronics and Communications Engineering department towards bringing you 'In Phase' with know-hows, new products, technological trends and varied applications about hardware, software, tools, services and technologies. With every edition, in phase has grown bigger, and we have put in efforts to make the decade edition better than ever.

The cover article "In the beginning" focuses on one of the most essential and revolutioninzing technologies in the electronics industry : The birth of the transistor. As the world moves towards a future in which the computer is ubiquitous, we first explore the multi touch technologies finding space in our daily lives, and then through the research efforts of 'Project54' in this direction.

In the article 'Modern Movie Technology', we go behind the scenes to explain the evolution of the technology that brought Avatar to your screens. Articles on 'IPTV' and 'Blue Ray technology' also deal on recent advancements in multimedia technology.'Mobile Microprocessor' gives you the technical jargon behind the design of the ever growing capabilities of mobile micro processors.

In keeping with tradition, we have an account of a fun filled summer internship abroad. However, as a first, we have introduced a section on Industrial Internship, wherein the theory of video compression is explained through the work done by one of our students at Texas instruments.

On a lighter note, we have an interview with Vikram Rana, alumni of the ECE department, and the author of the best-seller book 'The Equation of My Life', a 'funny internship article' and the popular cartoon section 'Ecegiri'.

We have tried our best to reduce the technical jargons, and cater to a general audience. So, give it a try. You just might end up learning something worthwhile. As always, we thank you for all your support and cooperation and hope you will support us in the future through your feedback and constructive criticism.

Thanks,
Sahil Goyal,
In Phase Team.

### Team In Phase

Faculty in charge
Dr. Praveen Kumar

Chief Editor
Sahil Goyal

Members
Vivek Sharma
Vipul Garg
Palash Ranjan
Abhijit Mukkhopadhyay
Krunal M Harne
Tushar Sandhan

Designer
M.S.N.Karthik

Cartoonist
Kailash Atal

# contents

Internet Protocol Television page 4
Blu Ray Vs HD Technology page 6
Alumni Talk - Vikram Rana page 8
LCD Backlighting page 10
Fuzzy Logic Systems page 12
In the Beginning page 14
Modern Movie Technology: 3D page 16
Mobile Microprocessors page 18
Internship at Texas Instruments page 21
Just A Touch Away page 24
Project 54 page 27
Hup Holland Hup page 30
Internship Cover Letter page 31
Ecegiri page 32
Batch Pic 2010 page 33

# IPTV

-A.Akhilesh

## INTRODUCTION:

IPTV is one of the recent landmark inventions of this electronics-era sprawling the entire world day by day. As is known to everyone, IPTV stands for Internet Protocol Television. In a nutshell, it is a service that provides access to digital TV over the IP layer from the head-end device (like a broadcasting system) to the TV set top box. In other words it is a system through which internet television services are delivered using the Internet Protocol. The standardization process makes it different from traditional Internet-based or Web-based multimedia services.

What was the necessity of inventing IPTV where other predominant technologies like conventional TV,etc? Well, the main reason for its invention comes from the end-user requirements who demand a broad portfolio of video service offerings such as broadcast TV, VoD(Video on Demand),time-shift TV and many others, with guarenteed quality and convenient handling. This myriad of services, that cannot be achieved by conventional broadcasting is what makes IPTV prominent and of commer cial interest.

Let's get acquainted with some of the nuances of IPTV architecture.

## IPTV Architecture:

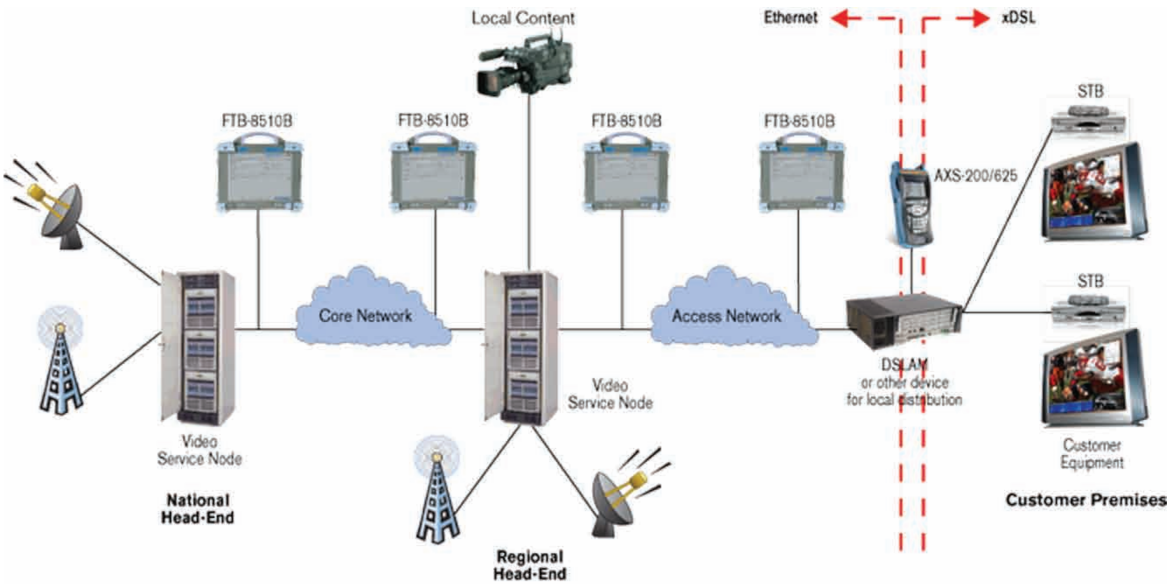
IPTV technique is essentially used in the transmission and control of broadcast video streams to the Set Top Box(STB). What makes this invention different from other IPbasevideo delivery mechanisms is the use of pure IP signalling to control channels and other functioning.

A typical IPTV network is comprised of the following functional blocks:

- National head-end: Where most of the IPTV channels enter the network from national broadcasters
- Core network: Usually an IP-based network transporting traffic to the access network
- Access network : Distributes the I P T V streams ( to the DSLAMs ) for local transmission.
- Regional head-end: Where local content is added to the network
- Customer premises: Where the IPTV stream is terminated and viewed.

The main schematic of IPTV transmission mechanism is given in the figure in the next page.

"Depending on the network architecture of the service provider, there are two types of video server architectures for IPTV deployment, centralized and distributed. The Relatively simpler, “centralized” architecture model does not require comprehensive content distribution system. This method is suitable for small video service providing. The more complex, “distributed” architecture however has bandwidth usage advantages and inherent system management features that are essential for managing a larger server network. For augmenting effective delivery of multimedia contents, distributed architecture




requires intelligent and sophisticated con tent distribution technolgies.

The playback of IPTV requires either a personal computer or a set-top-box connected to a TV. Video content is typically compressed using either an MPEG-2 or a MPEG-4 codec and then sent in an MPEG transport stream delivered via IP Multicast. There are various protocol standards for IPTV mode of transmission viz. IGMP version 2, IGMP version 3 and Real Time Streaming Protocol (RTSP) depending on the specific purpose of transmission.

It is not always true that IPTV and traditional satellite TV broadcasting can be considered as exclusive. On demand, a different and enhanced technique called hybrid IPTV transmission is used that combines both the technologies. Hybrid IPTV networks are usually viewed in the light of high performance and reliability.

## Pros and Cons:

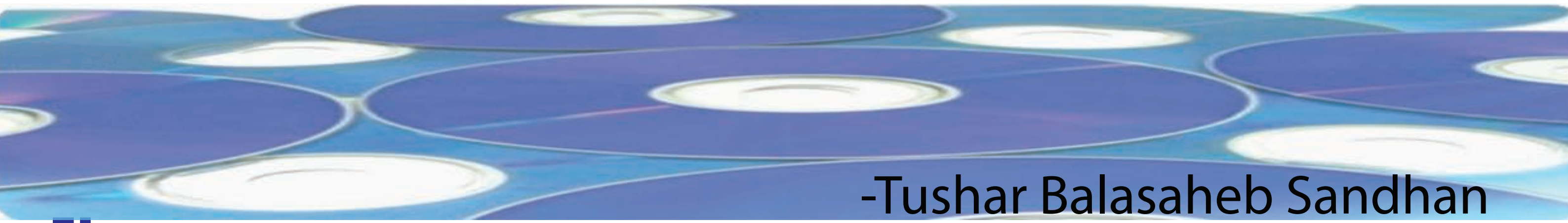
The main advantage arises out of the ability to integrate conventional Television with other IP based services such as high speed internet access and VOIP, thus creating a portfolio of services. Another remarkable feature of IPTV is the switched IP network- a network technique that's disparate from the typical satellite or TV network. In the latter, all the broadcast content flows to the customer who later switches the content via set-top-box, whereas in switched IP network, only that content that the customer chooses would be sent to his home. This in turn frees up bandwidth and other transmission related parameters.

Coming to the limitations, IPTV has strict minimum speed requirements in order to facilitate the right number of frames per second to deliver moving pictures. As a result, limited connection speed/bandwidth arises. If the streamed data is unreliable, it could be sensitive to packet loss and delays.

## Challenges ahead:

As mentioned, the main challenge is to overcome the packet loss and ensure reliability. If the packet loss occurs, even at relatively low rates, customers will be unsatisfied with the experience. The focus should therefore be on loss recovery techniques rather than network engineering alone. If the ongoing loss recovery research fructifies, one can dream of a prefect IPTV service with high quality reception.

# THE FORMAT WAR Bluray Vs HD

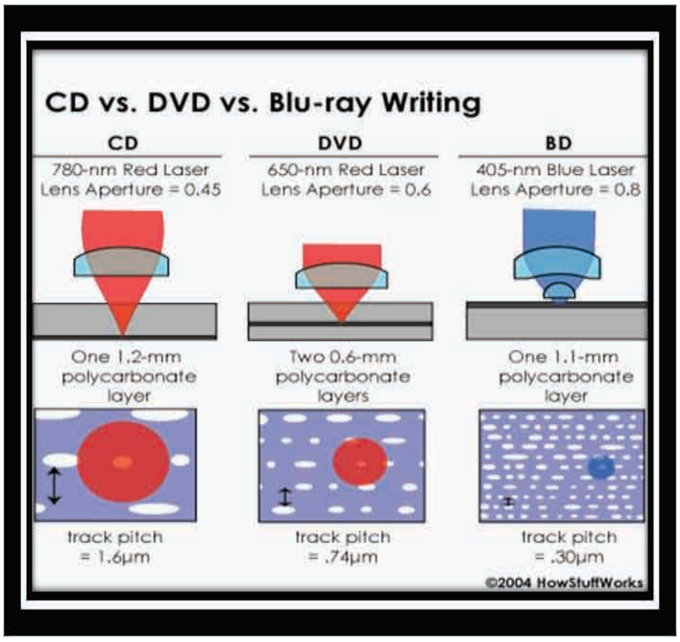


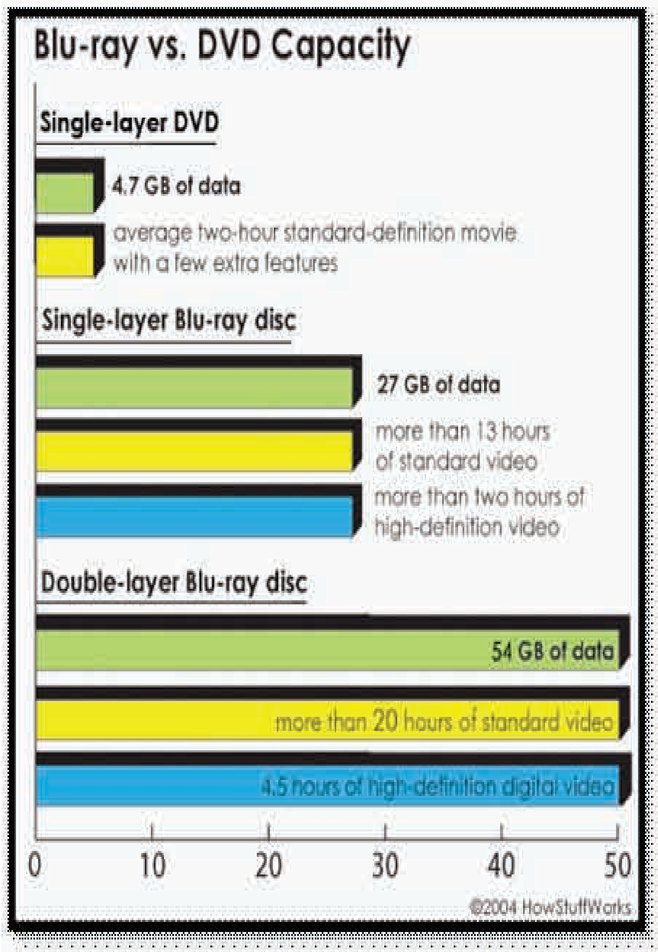
-Tushar Balasaheb Sandhan

*This was the battle for Technology. The players were fighting for the survival of their respective technologies. High Definition-HD format discs became somewhat inferior to Blu Ray. Now bringing in a rather subtle twist, what we see is the fact that "survival makes the fittest" and that you need to find your fit to survive. BluRay becomes the next generation optical disk format and HD becomes the technology for television HDTV.*

The Blu-Ray disc format was jointly developed by the Blu-ray Disc Association(BDA), a group of the world's leading consumer electronics. The format was developed to enable recording, rewriting and playback of high-definition video , as well as storing large amounts of data. The format offers more than five times the storage capacity of traditional DVDs and can hold up to 25GB on a single- layer disc and 50GB on a dual-layer disc.

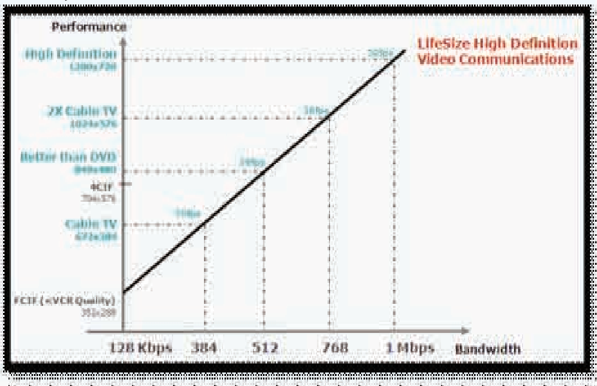
While current optical disc technologies rely on a red laser to read and write data,the new format uses a blue-violet laser instead, hence the name Blu-ray.The benefit of using a blue-violet laser (405nm) is that it has a shorter wavelength than a red laser ( 650 nm), which makes it possible to focus the laser spot with even greater precision.




This allows data to be packed more tightly and stored in less space, so it's possible to fit more data on the disc even though it's the same size as a CD. This together with the change of numerical aperture to 0.85 has pushed the storage capacity to 500GB on a single disc by using 20 layers. The Blu-ray disc overcomes DVD- reading issues by placing the data on top of a 1.1-mm thick poly carbonate layer.Having the data on top prevents birefringence and therefore prevents readability problems. And, with the recording layer sitting closer to the objective lens of the reading mechanism, the problem of disc tilt is virtually eliminated. Because the data is closer to the surface, a hard coating is placed on the outside of the disc to protect it from scratches and fingerprints. These discs are better armed than current DVDs. They come equipped with a secure encryption system - a unique ID that protects against video piracy and copyright infringement.

Blu-ray discs do just the injection-molding process on a single 1.1-mm disc, which reduces cost. That savings balances out the cost of adding the protective layer, so the end price is no more than the price of a regular DVD. However, the two formats (Blu-ray and DVD) will most likely co-exist for quite some time until HDTVs become more widespread. Sometimes it happens that, when dark clouds appear from the west and prevail over the sky, when they envelop the sun and put everything under the dark shade and when you are watching TV alone at home, suddenly “Ghost” like signals come on the TV. Standard television is broadcast over the air with an analog signal. Beause of this analog broadcast signal, the image is susceptible to interference. The real ghost is the “Noise”, which terrified engineers and is still terrifying.




HIGH-DEFINITION TELEVISION

HDTV [High definition Television] is the first quantum change to TV since colour was introduced in the 1950's. HDTV signals are digital instead of analog like 'standard' TV's, digital HDTV images are much clearer, and HDTV sound is far superior to standard television. There are no ghosts with HDTV , unless you switched on channel that itself is telecasting ghost. Because the nature of digital is either "Dead" or "Alive", you either have a 100% digitally perfect image, or you have no image at all.

A standard TV breaks up each image into 480 lines. It very quickly draws these lines on the screen in two passes of 240 lines each. It first draws all the even-numbered lines, and then draws the odd-numbered lines. This is an interlaced imaging [Images- 480i].These TV’s have aspect ratio 4:3 i.e. they are nearly square type.A true HDTV image is transmitted in [1080i ]format i.e.2 passes of 540 lines interlacing. Because the image is made up of far more image lines than standard TV, the image is far more clear and colourful. Most HDTV's also support [720p] which is an image made up of 720 lines drawn progressively or, all at once. Some newer HDTV's also supports [1080p]. Progressive drawing makes image smoother during motion also image has good sharpness. High Definition TV's have an aspect ratio of 16:9, making them more rectangular. Because of the wider image format, HDTV's display movies as they were intended to be displayed in the theatre . If you think that a DVD is clear and colourful, it is nothing compared to a good [720p] or [1080i] HDTV image!

We won’t be able to provide HDTV with a 1080p signal from a Blu-ray Disc or an HD-DVD player directly. For that one need to have compatibility device. Newer products which are going to launch will inbuilt compatible. The good news is that the first 1080p input capable televisions are on the way and if you are planning to get a big screen HDTV, this is the perfect time to invest in a future television rather than spending bucks here and there. Even in pleasant outside weather, watching a horror on HDTV creates a true artificial environment inside..!

# ALUMNI TALK - Vikram Rana

**The farewell party of your batch was rife with stories about you. Any standout memory regarding your time at IITG?**

Stay at an IIT becomes an ocean of memories for its every dweller. I tried to think about one and several flooded my mind. It was extremely difficult to pick one above the others. The four years merge together to become one's best time ever. For the records, my friends and I once went on a trip to Darjeeling with just a bagful of clothes. After cajoling the TC, we slept through the journey in the not-so-great space between the toilets and seating compartment. We escaped almost an assault in Sikkim for being slightly over demanding. Moreover, we were broke by the time we reached the train station for return journey. The always-delayed train was cancelled that day. We were stranded, not to mention penniless. I tried "Tomorrow is my exam."; "My grandmother was sick." and "Arun was being married against his wish." but to no avail. Fortunately, we found few juniors and rest was okay.

I believe by the time we graduate all four years add up to make a wonderful past to remember when needed. IIT Guwahati is different from rest for its own reasons. It has made me a better person than I would have become somemade me the dreamer I am.

**Many of us remember you as "Jack of all trades"? Can you tell more of your time management , here in IITG ,especially for the first yearites?**

I personally feel that prioritization is more important than time management. I tried four different sleep cycles in four semesters but none made me more efficient than I was earlier. I always did the stuff that interested me the most. I would advice everyone to focus on his or her passions first, and let rest follow. Chasing your dream keeps you active. Therefore, do your daily chores (read regular studies) amidst your pursuit of happiness. Everything should then be just fine.

**How did you venture into being an author when you took a job in Schlumberger? Was writing a book always an idea, even in college?**

My quest began way before Schlumberger happened.During my first year, one of my friends asked me, 'What do you want to become?' I replied, 'someone famous' but had no clue how. I have been involved in performing arts since school. Later, at IIT, my friends encouraged me to continue my interests and their persuasion made me try. I did sparks me from inside. I believe like every other industry even the entertainment industry will soon experience the era of entrepreneurship, and the existing monopolies will recede. Therefore, to become a part of it I have started with a book. Let us see how the jouney goes.

**What was the motivation behind writing TEOML?**

Honestly, I wanted to see if I could do it. IIT fills us with uncontainable self-confidence but we seldom put it to test. Ideas excite me because they trigger a chain reaction, a reaction to synthesize something new. As I mentioned earlier, everyone's encouragement strengthened my resolve of writing a book. Post FPS, the market was swarmed with college-set novels but with a repetitive storyline. I wanted to be different and highlight certain issues like teen misconceptions, parental pressure, stereotypes, etc but in a mild tone. Another thing I had in my mind was to give my Alma mater and its community something to relate with as appropriate. Of course, certain people and their life experiences contributed to the completion of the TEOML story.

**You are still working as a Manufacturing Engineer for Schlum, can you describe to**

# ALUMNI TALK - Vikram Rana

**our current fourth year how the Corporate world works and What are the expectations?**

I am glad you asked this question. *It is just like what Monica tells Rachel in Friends 101– It sucks but you will love it.*

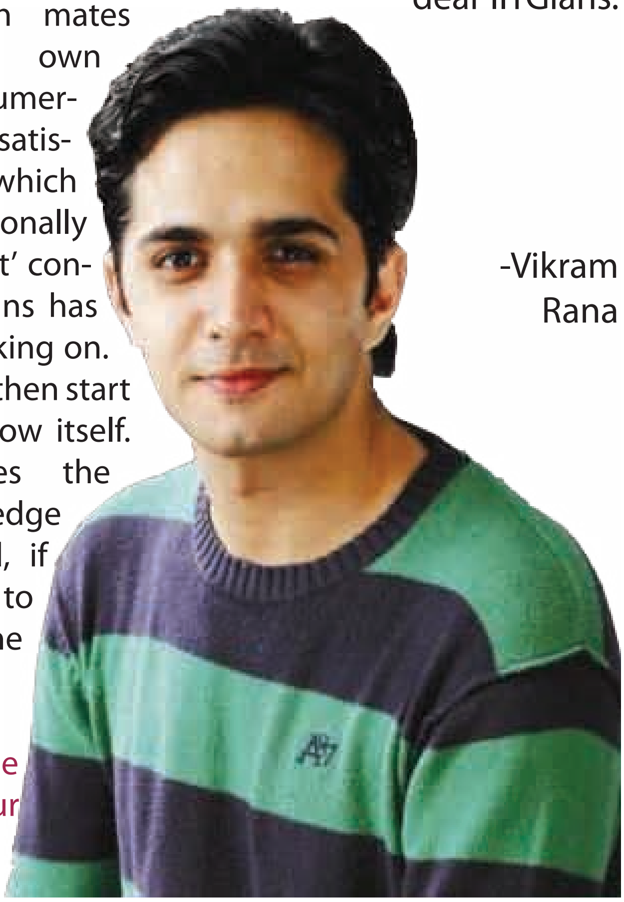
It has been two years with Schlumberger, survived three rounds of layoffs and travelled around the world. The brand IIT certainly helps to form a noteworthy first impression. It also gives a special responsibility - A responsibility to live up to the expectations and lead from the front. There should be no problem doing that if we keep our engineering fundamentals clear and be confident at what we do. I have been involved in Schlumberger's latest technologies in the fields of downhole drilling and artificial lift. Every electronics topic I avoided in IIT came back knocking my door. Communication skills are equally important for success in corporate world. They help in gaining visibility and recognition. We don't get much opportunities to work on these in IIT until placement season. These skills will stay with you forever. I have been fortunate enough to work in a stimulating environment of Schlumberger, which boasts of multi-cultural peers and challenging work.

The other dilemma that often boggles one's mind is **higher studies or job**. It is simply a matter of immediate priorities and future goals. In India, a company often prefers Bachelors but in most other countries, a Master's is a minimum requirement. Many of my batch mates have quit their jobs to pursue MS abroad; some have made it to the IIMs while others are in job sector as employees or employers. I will suggest everyone to walk their own path and not be manipulated by others gait.

**A Start-up** is different from the other two. It has its own hurdles and challenges. Some of my batch mates have started their own companies.Despite numerous issues,there lies a satisfaction ontheir faces, which is very inspiring. I personally feel that every 'decent' conversation among IITians has some idea worth working on. So,if you have an idea then start working on it from now itself. An IITian possesses the strength and knowledge to excel in any field, if he/she is interested to do so. I wish everyone best of luck!

**We all loved the equation of your love. Any future equations waiting to be formulated?**

There has been an encouraging response for TEOML so far. I am sure the expectations will be more next time, and I am determined to exceed them. Currently, I am working on two stories at parallel. Let us see which one finds the stores first. Eventually, I plan to open my own film company but that's a long way from now. It's my first step to become famous and too early to say more. I am thankful for the love and support shown by everyone, especially to my dear IITGians.



-Vikram Rana

# LCD Backlighting

-Ajaykumar Kannan

Liquid Crystal Display (LCD) panels are one of the most common types of displays available in the market today, from watches to cell phones, from laptop screens to even HD-3D Televisions. They're nearly everywhere!

An LCD basically consists of two polarizing plates and in between them a layer of a twisted (Typically) nematic liquid crystals. Usually, the two polarizers are at an angle of 90 degrees. Twisted nematic liquid crystals rotate liquid to varying angles depending on the voltage applied across them. When the voltage applied is zero, the crystals align themselves in a helix such that they rotate the light by the same angle as formed by the two polarizers (In this case, 90 degrees). When an electric potential is applied across the liquid crystal, the nematic untwists, rotating the light by a smaller angle (than 90 degrees). Thus, by placing electrodes on either side of the liquid crystals, we can control how much the light is rotated and thereby control the gray-shade. Following this logic, each pixel would then require its own set of electrodes on either side.


Normally, the pixels are arranged in the form of a matrix. The anode of each column is interconnected and the cathode of each row is interconnected so that each pixel can be uniquely addressed without there being too many connections. The display is of course multiplexed because elements from two separated rows cannot be addressed at the same time. Each row of pixels is selected individually, one after the other. The pixels are turned on and the row displayed, and then switched off as it goes to the next row. If the frequency is high enough, then the human eye will perceive only images. This is a form of passive matrix addressing.

It may seem apparent that passive matrix addressing would be very slow, especially in the case of large screens.This is where active matrix addressing comes in. Most LCD manufacturers have already started using active matrix addressing. Active matrix LCD's make use of Thin-Film Transistors (TFT) which are basically tiny transistors and capacitors.They are addressed in the same manner as the passive matrix but the TFT's retain the charge so the pixels hold the data assigned to them as opposed to switching off as soon as it goes to the next row. The output of the screen is once again controlled by multiplexing the display at high enough frequencies such that it appears like a moving image to the human eye. A lot of work in LCD's is done on various addressing techniques which improve the quality of the output as well as reduce motion blur. The same principle is applied to a colour screen with each colour (Red, Green and Blue) having its own sub-pixel.

One small problem with LCD panels is that they are a class of non-emissive displays so they either need a reflective panel behind the panel (Like in digital watches) or they need a backlight. Since reflective screens have a limitation on the light transferred back to the viewer and don't provide a good colour reproduction, backlights are used in most modern LCD screens.

There are a large number of options when it comes to backlighting solutions. Cold cathode fluorescent lamps (CCFL's) were earlier the most dominant. They require high voltages so usually there is a transformer which helps in providing that voltage. CCFL backlights come in two types, edge-mount and direct back-lit. In the direct back-lit, several CCFL's are place horizontally across the screen behind it. Diffusers, light scattering films and brightness enhancements films are used to provide uniform illumination of the screen. Edge-mount backlight units can be made much thinner than direct backlit screens as the light source is located at the edge of the screen. The light is directed onto the screen uniformly by using diffusers, light scattering films and brightness enhancements films inaddition to a light-guide plate. A light-guide plate uses total internal reflection to direct the light from the CCFL's on the side to the screen. Electroluminescent panels are a surface-mount replacement type of backlight. However, they didn't offer much of an improvement.

Recently, LED (Light Emitting Diode) backlighting has become very popular. The advantages of LED's over other backlighting solutions are that they are of low cost, consume less power for the same brightness (i.e. They have a better luminous efficacy which is lumens per watt), long life (Over 100,000 hours), low voltage required to run the backlight as compared to CCFL's (Around 3.2 V for a single white LED), better colour reproduction, wider colour gamut and fast reaction times.

There are two different types of LED's used for backlighting purposes. One is a white LED which emits white light. The junction in such LED's emits ultraviolet rays. These rays fall on a phosphor coating on the encapsulation of the LED and cause the electrons in the phosphor coating to jump into the conduction band. When the electron returns to the valence band, they emit photons belonging to a wide spectrum of electromagnetic radiation. However, certain wavelengths have lower intensities than others, this leading to some colours (Or more specifically wavelengths) being brighter than others. This is quite an issue for LCD backlights. The other type of LED used in backlights is the RGB LED. They consist of three independent junctions each of which emits light corresponding to red, green and blue. If they have a common anode, then each colour will have an independent cathode so each colour can be independently switched on and off. This mixed light falls on the entire pixel but each sub-pixel only allows one colour to pass through. This produces an RGB output which the eye perceives to be a natural colour. RGB LED's are better in that they provide a wider range of colours.

LED backlight units come in two types, as with CCFL's backlight units, edge-mount and direct back-lit. Edge-mount LED backlight units can be made a lot thinner than the direct lit. In edge-mount, there is a line array of LED's located on one or more of the sides of the screen.This light is redirected to the screen to provide uniform illumination by making use of a light-guide plate, diffuser sheets, scattering films and brightness enhancement films.The one problem with edge-mount backlights is that backlights is that it is difficult to achieve uniform brightness on large size screens (e.g. big-screen television). Direct lit type can overcome these limitations but only by compromising on thickness and power. In direct back-lit type, the LED's are arranged in an array, usually a matrix. This type of backlight allows for local dimming which is capable of providing a much greater contrast and a very high dynamic ratio. This is achieved by dimming the backlight in the dark areas of the picture and is only possible due to the fast reaction time of LED's.

LCD screens have another small problem. They create a motion blur. Unlike in CRT's in which each pixel is only illuminated for a very small period of time (This does not create a blur), LCD's have a short period during which the liquid crystal returns to the twisted state after the applied potential is removed or when the potential is applied. This leads the human eye to perceive a very slight blur. This can be reduced significantly using pulse width modulation on the LED's. By switching the backlight on and off in sync with the LCD addressing, each row can be dimmed during the period when the pixel is switching. The pulse width modulation frequency and phase of each row of the LED's must be synchronized with the LCD addressing and the LED's are addressed in the same manner as the LCD itself.

As opposed to CRT and CCFL back-lit LCD screens which can have less than 82% NTSC colour gamut (i.e. display less than 82% of the colors available in NTSC), LED back-lit LCD's have already achieved over 114% reproduction of the NTSC colour gamut (i.e. they can display more colours than NTSC). This helps in generation of more realistic images. This is a great advantage over CRT and other backlight sources as it can produce and display more colours.

The lower power consumption and high luminous efficacy of LED's is especially useful for laptops and hand-held devices. Normally, the backlight accounts for over 30% of the total power used by a laptop. With LED backlight units, the power required for the backlight can be brought down to 60% of the original power consumption and by doing so, the battery life of the device can be greatly increased. Recently, laptop and monitor manufacturers have also started releasing screens which use LED backlighting.

The term LED television is an intentional misnomer. LED Screens are actually the screens that you see in certain cricket and football stadiums which have one LED to represent one pixel. As opposed to those screens, an LED television is in fact an LED back-lit LCD television. These televisions provide an improvement over CCFL back-lit television in terms of less output power and improved colour.

LCD panels have been so well developed that they are thoroughly integrated into many modern day applications. There is still a lot of room for development in the field of liquid crystals and their backlights which can significantly improve their quality. Unlike CCFL's where development has saturated, LED backlights are still in active development. The luminous efficacy is being increased even further along with the colour gamut. As the displays get better, we will be able to generate images on screens which better resemble real life images.

# FUZZY Logics

-Debanga Raj Neog

## FUZZY LOGIC SYSTEM:

Why do we need Fuzzy Logics? Or how practical is it to use Fuzzy logic system in our day to day life? Before answering these questions we need to know what actually Fuzzy Logic System is. The following quote from Lotfi A. Zadeh; who is considered as Father of Fuzzy Logic, is very crucial in this context:

*"As the complexity of a system increases, it becomes more difficult and eventually impossible to make a precise statement about its behavior, eventually arriving at a point of complexity where the fuzzy logic method born in humans is the only way to get at the problem."*

The concept of Fuzzy Logic (FL) was introduced by Lotfi Zadeh, and he is a professor at the University of California at Berkley. Fuzzy logic is a superset of conventional (Boolean) logic that has been extended to handle the concept of partial truth values between "completely true" and "completely false". Fuzzy Logic is a way of processing data by allowing partial set membership rather than crisp set membership or non-membership. But his early work with this innovative concept was severely criticized by many of his colleagues in the field and it struggled to get acceptance in the scientific community of that time. Besides this due to insufficient small-computer capability prior to that time, this approach to set theory was not applied to control systems until the 70's. Professor Zadeh had reasoned, "People do not require precise, numerical information input, and yet they are capable of highly adaptive control". It is worthwhile to note that now if feedback controllers could be programmed to accept noisy, imprecise input, Fuzzy logic based controller would be much more effective and also easier to implement.

Instead of modeling a system by using mathematical principles, Fuzzy Logic employs a simple, rule-based approach to solve control problems The Fuzzy Logic model is empirically-based, relying on an operator's experience rather than their technical understand ing of the system. One typical example is: terms like "IF (process is too cool) AND (process is getting colder) THEN (add heat to the process)" or "IF (process is too hot) AND (process is heating rapidly) THEN (cool the process quickly)" are used in Fuzzy Logic models. These terms are imprecise and yet very descriptive of what must actually happen.Rule-based Fuzzy Logic Systems (FLS) contain four components-rules, fuzzifier, inference engine and output processor. Rules are basically the heart of a FLS, and may be provided by experts or can be extracted from numerical data. The fuzzifier maps crisp numbers into fuzzy sets. The inference engine maps fuzzy input sets into fuzzy output sets; it handles the way in which the rules are activated and combined. Finally for practical usage; crisp numbers must be obtained at its output and this is accomplished by the output processor known as defuzzifier. The following diagram gives a overview of the Fuzzy Logic System.

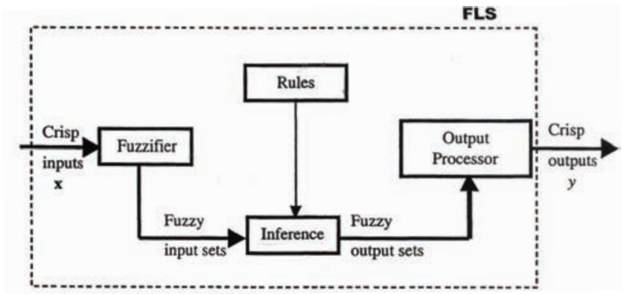


Fig 1: Fuzzy Logic System (FLS)

Fuzzy Logic is capable of mimicking this type of behavior at a very high rate. Fuzzy Logic has proven to be an excellent choice for many control system applications since it mimics human control logic. It can be built into anything from small, hand-held products to large computerized process control systems. It uses an imprecise but very descriptive language to deal with input data more like a human operator. It is very robust and forgiving of operator and data input. The Fuzzy Logic based control systems often works when first implemented with little or no tuning. Some of the very specific well known applications of Fuzzy Logic are: auto focusing of a camera, temperature controlling in an air conditioner, antilock braking systems etc. Although U.S. manufacturers have not been so quick to espouse this technology but the Europeans and Japanese have been aggressively building real products around it. Japanese companies have used fuzzy logic to direct hundreds of electronics products and household appliances. This advancement in Japan is in much higher pace in comparison to U.S. or European coun tries.

## FUZZY LOGIC IN COMPUTER VISION:

Now, the next question is: how Fuzzy Logic System can be incorporated in Computer Vision? Computer vision is the study of theories and algorithms for automating the process of visual perception. The tasks that computer vision can deal with are mainly noise removal, smoothing, and sharpening of contrast; segmentation of images to isolate objects and regions, description and recognition of the segmented regions; and finally interpretation of the scene.

The results of computer vision algorithms are mostly abounded by uncertainties. The image segmentation is considered to be one of the most critical components of computer vision. It is therefore desirable to obtain more accurate results in this stage. The first connection of fuzzy set theory to computer vision was made by Prewit (1970, "First Approach toward Fuzzy Image Understanding"). He suggested that the results of image segmentation should be fuzzy subsets rather than crisp subsets of the image plane. It is also expected that these characteristics or features should be significantly different for adjacent regions. Researchers in the field of computer vision have observed that fuzzy sets can alleviate the problems encountered in traditional crisp set based methodologies. Fuzzy logic are currently being introduced within the traditional image segmentation techniques like thresholding, clustering, supervised segmentation and rule -based segmentation- for improving segmentation results. The usual process consists in associating a fuzzy set to every region and then to obtain the degree of membership of each pixel to the corresponding fuzzy sets. Finally, fuzzy techniques are applied to methods of: thresholding, clustering, supervised segmentation and rule–based segmentation.

## FUZZY LOGIC IN IMAGE THRESHOLDING:

In gray level image segmentation finding optimal threshold is a key step. Image thresholding is used to create binary images; which are broadly used for feature extraction and classification. It is worthwhile to mention that bimodal image segmentation is more similar to two class clustering procedure. According to the information exploitation; thresholding techniques have been categorized as: histogram shape based, clustering based, entropy based, object attribute based and the spatial and local methods. Among histogram based thresholding techniques; Rosenfield's convex hull method analyses the concavities of histogram and selects the threshold at deepest concavity of histogram. Sezan's Peak and valley thresholding performs peak analysis of histogram by convolving it with smoothing and differencing kernel and selects thresholding between first terminating and secondly initiating zero crossing.

## MY EXPERIMENTS WITH FUZZY LOGIC

In a project undertaken by me during my summer internship; my aim was to use entropy feature of an image for thresholding because it is indicative of maximum information transfer. Maximum entropy graylevel can be used to distinguish between foreground and background of a graylevel image. By observation one can observe that

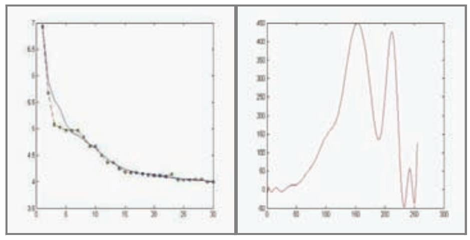


Fig.2. (a) Plot of variation of Average sum of squared errors and degree of polynomial function (smoothed graph is also shown). The knee is at around N = 20. (b) Polynomial fitting of histogram corresponding to order N shows four significant peaks.

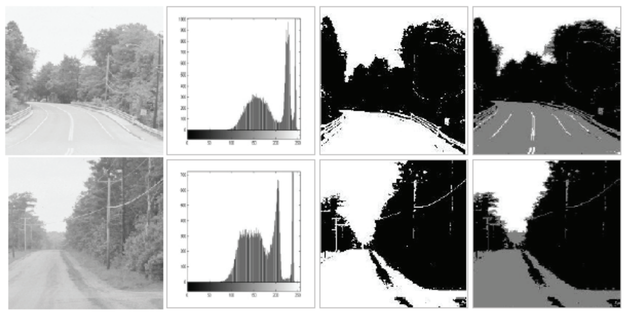


Fig 3: Example of multilevel image segmentation of grayscale images

optimal threshold for separation of background and object exists at the deepest valley of bimodel histogram of the image. It is difficult to obtain optimal threshold when distribution of histogram is complex. To cope up this problem entropy (fuzziness) has been first proposed by T Pun, to quantify the vagueness in images. Liang Kai Huang introduced Type 1 fuzzy approach to the Shannon entropy and concluded that the gray level point where the fuzziness is maximum; is the optimal threshold. Information theoretic approach maximizes or minimizes the image information on basis of fuzziness or crispness. This approach is simplest and commonly used for thresholding. I used a fixed point iteration based fast numerical method to find optimal threshold using Type 2 fuzzy sets. Type 2 fuzzy sets are better at handling uncertainties than Type 1 fuzzy sets. In addition to that I proposed a multistage thresholding technique by modeling Gaussian Interval Type 2 Fuzzy Membership Function using definition of embedded Type2 fuzziness. The approximate number of objects in an image was estimated by observing the trend of average error in polynomial fitting of histogram along with increasing order.

The results of my proposed algorithm were more accurate and fast compared to previous approaches. By incorporating Fixed Point Iteration, I was able to find optimum value without computing ultrafuzziness (Type 2 fuzzy entropy measure) for all gray levels, which reduces computation time.

# IN THE BEGINNING....

## INTEGRATED CIRCUITS-EVOLUTION

We are currently living in a generation of intelligent machines, rendering them capable of performing millions of complex computations within the fraction of a second. If we delve into the intricacies of such complex machines like a computer or cell phone, we find a remarkable resemblance with the human body which, as we know, consists of microscopic building blocks called cells. Likewise, all complex computations at their basic level are simple logic operations carried out by an ensemble of logic devices consisting of both, active semiconductor devices such as transistors and passive elements such as resistors and capacitors.

A modern day microprocessor (or more commonly known as chip) , which is the heart and soul of all computational devices, is an integrated circuit consisting of billions of transistors and other passive element intrinsically knit in a compact area. One may say that any layman would be really intrigued with the manufacturing process that makes this possible. But, the less asked questions are "How did we come up with such an idea? What was the necessity to create something like that?" In this article, we shall see how, from the development of a single transistor, we developed technology of VLSI which integrates billions of such transistors into a single chip. Before we proceed with the historical journey, there is something one needs to know about the electronics technology. "Every digital technology has an analog beginning". Logically following, the beginning to our digital world starts with the invention of the simple analog device, "Transistor".

## INVENTION OF TRANSISTOR: A TALE OF SCIENTIFIC PRODIGY AND TREACHERY

The invention of Transistor, which is probably the most important advance of the 20th century, is the story of scientific marvels, clashing egos, top secret research and treachery! By definition, a transistor, at the most basic level is a three terminal solid-state device which can control electric current or voltage between two of the terminals by applying an electric current or voltage to the third terminal. However, it was not an 'out-of-the-blue' invention but was preceded by the invention of another three-terminal device called the Vacuum tube, which was in use more than 50 years before the invention of the transistor. The transition was initiated by a telephone giant, AT&T (American Telephone and Telegraph) in its primary research wing, Bell Laboratories.

In early 1900s, in an effort to fight the increasing competition caused as a result of the expiration of Alexander Graham Bell's telephone patents, AT&T was forced to look for new options, most notable of which, was transcontinental telephone service. However, the required technology to make it viable was not available with them until 1906. That very year, an eccentric American inventor Lee De Forest developed a triode in a vacuum tube, known as audion that could amplify signals including ones on telephone lines connecting switch-boxes across countries. AT&T bought De Forest's patent and vastly improved the tube, thus giving them the required edge for making long distance telephone calls possible. The invention of vacuum triodes boosted the development of computers during the 1940s and 1950s. However, the limitations of vacuum tubes were soon realized. Extreme unreliability (owing to the fact that they used too much power) and excessive heat dissipation features were among the main shortcomings. The tendency of the vacuum tubes to leak and the fact that the metal that emitted electrons in the vacuum tubes burned out added to the disadvantages. Another constraining factor was space. Big computer made using 10000 vacuum tubes occupied about 93 square meters of space! These factors led scientists and engineers to look for viable alternatives, one of which turned out to formulate the idea behind transistors! The question raised by them was '*How does one control the flow of electron in* *solid materials, such as metals and semiconductors as opposed to transfer over vacuum?'*

In the 1930s, director of research at Bell labs, Mervin Kelly, realized the potential of semiconductor devices in revolutionizing the telephone industry. Soon after the end of World War II, Kelly put together a team of specialized scientists and engineers to develop a semi-conductor switch, which used the concept of point-contact transistor (used in crystal detectors developed during the war that made radar possible). In 1945, William Schokely, the leader of the group, came up with a device that he hoped would be the first semi-conductor amplifier. It was a small cylinder, coated thinly with silicon, mounted close to a small, metal plate and used the concept of the "field effect". However, upon the failure of this device, he referred to two of his team members, Waltar Brattain and John Bardeem, to figure out the reason for the same.

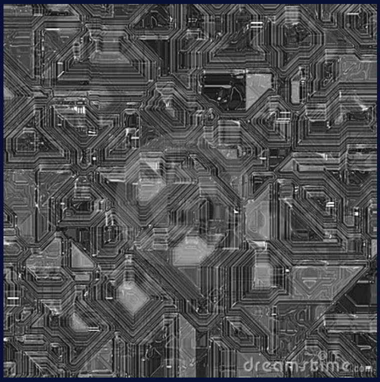
Brattain, an experimental physicist and Bardeem, a theoretical physicist, however carried out their experiments to a whole new level and tried to further understand the process of electron mobility inside a semiconductor. For months, varied experiments ranging from altered purity of germanium to elimination of liquid layer (and using gold-germanium) were carried out without giving any significant result. But the moment of success came when Bradeem proposed and experimentally confirmed the electron barrier formation on the surface of the metal-semiconductor junction. Thus, on December 16, 1947, they built the point-contact transistor made from strips of gold foil on a plastic triangle, pushed down into contact with a slab of germanium.

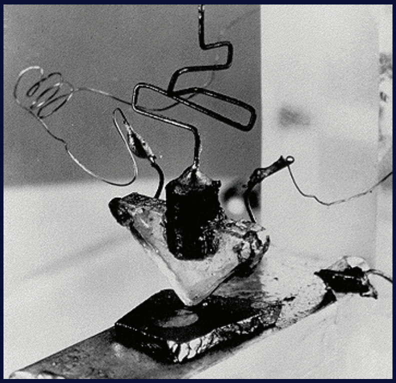
Schokley, furious over his non-involvement in the development of the transistor, later developed his own version of transistor, called as the Bipolar Junction Transistor (simply referred to as 'transistor' or 'BJT' by many today). This new design eliminated flaws of previous design like troublesome point contacts and the likes of it. The BJT, which was designed using layers of semiconductors, was much easier to understand theoretically and easier to be manufactured. Bell Labs finally unveiled the invention on June 30, 1948 and named it "transistor" combining the terms of "trans-resistance" and "varistor".Though it initially had very little attention from the industry, Schokley realized its potential left Bell Labs and found Schokley Semiconductors by recruiting top brass engineers and scientists. However, he was a very difficult man to work with and drove away eight of his brightest minds. These "traitorous eight", as they were later known, became successful entrepreneurs and founded companies like "Fairchild Semiconductors" and "Intel Corporation", which are the present day market giants. Being based in California, these companies were the beginning of the famous 'Silicon Valley'!

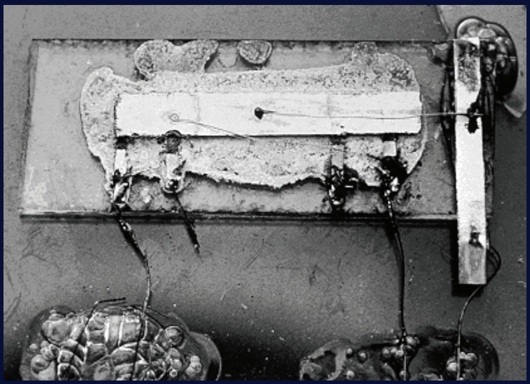
Thus, the invention of transistor led to a series of technological changes. With the acquisition of rights to manufacturing transistors, the Japanese company "Sony Electronics" began mass-production of tiny tran sistorized radio and went on to revolutionize the information age!

Next Edition: Development of Integrated Circuits

-Abhijit Mukkhopadhyay



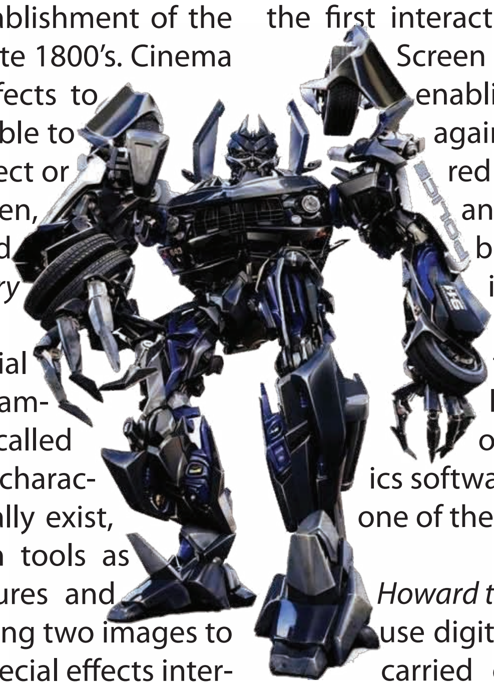


# MODERN MOVIE 3D Character generation

**"Behind the curtains of Lights, Camera & action"**

-Tushar Sandhan and Vipul Garg

Early cave paintings show the very first artistic expression of man's desire to represent this world. This art form has been developed and diversified over the centuries until the establishment of the motion picture industry in the late 1800's. Cinema has always relied on special effects to make the impossible seem possible to viewers .The first ever special effect or '*Illusion*' as they were known then, was produced in 1895 by Alfred Clark in '*The Execution of Mary Queen of Scots*'.



In the early days of cinema, special effects were produced as the cameras rolled to create what are called ***"in-camera effects"***. To create characters and locations that don't really exist, filmmakers would turn to such tools as stop-motion animation, miniatures and matte paintings, often compositing two images to create the effect of actors and special effects interacting. Over the years, the tools filmmakers use have evolved from actual physical objects to relying on computers to create special effects for films. Elements created for films via computers are called ***computer-generated imagery [CGI].***

As the image making capabilities advanced during the move from the lab to full scale production in the 1970s, Hollywood took notice. There were several movies that included one or more special effects scenes that were CGI.The technique of using Mattes to composite several images onto one negative was employed in such films as *The Great Train Robbery* (1903) and *The Motorist* (1906).

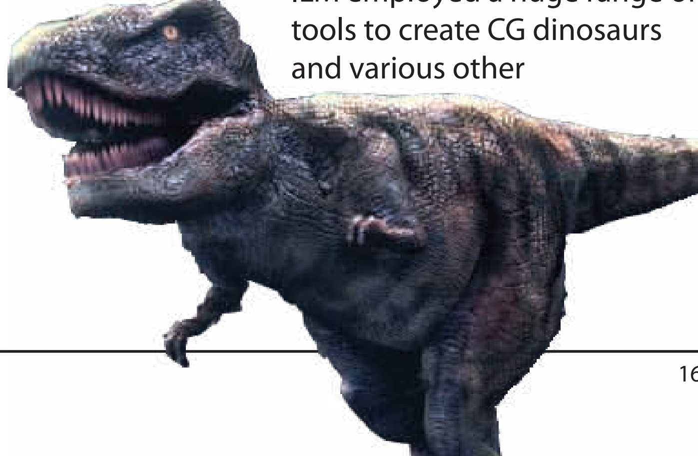
The Schüfftan Process artfully employed in *Metropolis* and other movies, utilized forced perspective techniques to create an illusion of size and distance. Such techniques are still common today, being used in such films as *Mighty Joe Young* and *Armageddon* (1998). Alongside this, the Composite Reduction process allowing previously photographed footage to be inserted into specific areas of another frame.

In 1934 Walt Disney's *Snow White* arrived ushering in a new era of full-length animated films.

Meanwhile the SAGE Machine (Semi-Automatic Ground Environment) was created to follow enemy fighter planes during the Cold War. This provided the first interactive computer graphics. The Blue Screen technique was also invented, enabling a person or object to be filmed against a blue, green, or sometimes red background, and then extracted and composited against a different background. Although the FX industry had not moved forward tremendously until the late 60's, the computer graphics industry had made headway. The invention of the Sketchpad interactive graphics software by Ivan Sutherland in 1962 was one of the major breakthroughs.

*Howard the Duck* (1986) was the first film to use digital wire removal and the first work carried out by the new ILM computer graphics department. A wire frame model is a visual presentation of a three dimensional or physical object used in 3D computer graphics. It is created by specifying each edge of the physical object where two mathematically continuous smooth surfaces meet, or by connecting an object's constituent vertices using straight lines or curves. The object is projected onto the computer screen by drawing lines at the location of each edge.

Using a wire frame model allows visualization of the underlying design structure of a 3D model. Traditional 2-dimensional views and drawings can be created by appropriate rotation of the object and selection of hidden line removal via cutting planes. Various things happened the following year,but all were overshadowed by the release of *Jurassic Park(1993)* ILM employed a huge range of tools to create CG dinosaurs and various other



special effects needed for the film. These included Alias PowerAnimator, Softimage 3D, Matador and Lightwave (for simple animatics) Pixar won an Academy Award (in March 1999) for *Geri's Game* (1998) which utilized Subdivision surfaces. Among the digital tools used to create this ground breaking achievement were Power-Animator, Maya, Softimage 3D, Commotion, FormZ, Electric Image, Photoshop, After Effects, Mojo, Matador, and RenderMan. Various proprietary in-house software packages were also used including Caricature, Isculpt, ViewPaint, Irender, Ishade, CompTime and Fred. People are still fascinated by the concept of entirely digital photorealistic humans. With the improvement in both hardware and software our ability to create more and better digital characters improved over the years.

*Elephants Dream*(2006) releasedas the first CGI short movie, was completely made with Open Source software. *Flatland*(2007), the 1st CGI feature film to be animated by one person, was made with Lightwave 3D and Adobe After Effects. Software created by Pixar includes REYES (Renders Everything You Ever Saw,) CAPS (with Disney), Marionette, an animation software system that allows animators to model and animate characters and add lighting effects, and Ringmaster, which is production management software that schedules, coordinates, and tracks a computer animation project.

3D computer animation combines 3D models of objects and programmed movement. Models are constructed out of geometrical vertices, faces, and edges in a 3D coordinate system. Objects are sculpted much like real clay or plaster, working from general forms to specific details with various sculpting tools. A bone/joint system is set up to deform the 3D mesh (e.g., to make a humanoid model walk). In a process called rigging, the virtual marionette is given various controllers and handles for controlling movement. Animation data can be created using motion capture, or keyframing by a human animator, or a combination of the two. 3D models rigged for animation may contain hundreds of control points - for example, the character "Woody" in Pixar's movie Toy Story, uses 700 specialized animation controllers. 'Rhythm and Hues Studios' labored for two years to create Aslan in the movie The Chronicles of Narnia: The Lion, the Witch and the Wardrobe which had about 1851 controllers, 742 in just the face alone. As CGI technology improved, filmmakers became able to create entire characters in films. For example, the film "Young Sherlock Holmes" became the first film to use an entirely CGI character in the form of a supernatural knight. Also notable for popularizing CG characters is "Terminator 2: Judgment Day," which integrates a CGI character with actors to create a robot made of "liquid-metal" that's capable of transforming into human forms.

*Avatar*(2009) was the first full length movie made using performance-capture to create photo-realistic 3D characters and to feature a fully CG 3D photo-realistic world. The first Virtual Art Department (VAD) and complete Virtual Production pipeline was developed by director James Cameron and his team to create the film in real-time. It specifically used a novel technique called "image-based facial performance capture" that required actors to wear some special headgears already equipped with camera. As the actors performed, the camera transmitted facial movements that were put on the virtual characters. This made the movements of the body back to a connected array of systems which acted out their scenes on a 'performance capture' stage six times bigger than anything that was ever used earlier in the industry. This resulted in an amazingly emotional authenticity by the movie characters. The movie's footage was built from around 70% CGI including its female lead. Every minute detail was taken care of, by rendering every tree, leaf or even rock , with the most innovative methods in rendering, lighting and shading that used over a 1000 terabytes of hard disk storage.

The latest inventions in the motion capture area are the Simul-Cam and the Virtual camera, which combined the best features of the 3D and the CGI technologies for Avatar. To build or develop his virtual world in a more enhanced way, the virtual camera acted more as a virtual monitor that allowed the director to judge the overall effect of the final cut of the movie, and which was fed with CGI data by the supercomputers.

The closer we get to creating a completely digital character, the more our senses seem to alert us to the fact that something is not completely right and therefore we dismiss it as a cheap trick or imitation. No doubt there are many reasons for using digital humans, "Why bother! Why not focus on what doesn't exist as opposed to recreating something that is readily available. Within recent few years with the advance of processing power through hardware improvement and better algorithm implementation we can construct total live characters, which will perform any desired action that the director wants at any time, any place and of course without

**"Light Camera.. And Action!"**

# MOBILE MICROPROCESSORS

-Palash Ranjan

## What goes into making processors that they don't (literally) burn holes in your pockets?

Our lives are now practically infested with portable devices. Whether its your new (or old) cell phones, Ipods, Ipads, or the latest Ultra-mobile PCs (UMPCs), the quest now is to pack in as much PC-like functionality into these gadgest as is possible. The challenges come in when one realizes that the processors for these devices don't have the luxury of a capacious cabinet with huge heat-sinks to keep them cool – with the walls closing in on them, they must deal with computation in a completely differ ent way.

Nearly 75 percent of all embedded processors as based on the ARM Architecture (Advanced RISC Machine, or Acorn RISC machine. 5th Sem students would know what RISC means, others, look it up!). This is because it meets such requirements beautifully – it's half the size of an old 486 CPU, is almost as powerful (with potential for more), it doesn't heat up even under load, and consumes but a smidget of battery power. How does it do it and why don't we have such features in our desktop computers?

## History Lesson I: Less is More

Today's mobile processors owe their architecture to a division in processor design philosophies that started sometime in the 1970s. Flashback (in black and white if you wish) to a darker age when no com pilers existed.

## And how they keep cool!

Processors were hand-coded in their own assembly language instructions. These instructions sets were then quite simplistic, and something as simple as comparing two numbers could take upto ten instructions to execute. Imagine trying to write an operating-system with that! But that was just half the problem.

When you give an instruction to a processor, you do so as a hexadecimal op-code, which is stored in a register on the CPU itself before being executed. This register (a pipeline of many registers in today's processors) us an expensive resource to waste, and the number of instructions required for the simplest of operations only made that painfully obvious – more so when processors were getting powerful enough to do so much more. The goal, then was to create instructions that were the same length (in bits, that is), but that led to the execution of many micro-operations. For examples, the 8085 had a JMP command which made the processor jump to the specified instruction. The more advance 8086 in contrast, had a JPE (jump if-equal) instruction, which loads two numbers from the system's memory, subtracts them, checks whether the result is zero so as to determine whether the numbers are equal or not, as then jump to a new instruction if they are indeed equal.

This was the birth of Complex Instruction Set Computing (CISC) – simple instructions that performed complex tasks. It didn't waste CPU resources as much, and gave programmers some relief while they waited for the rise of higher-level languages and their compilers.

## History Lesson II: Enough is too much

With the arrival of languages like C, programming trends started shifting away from the ungainly assembly languages to the more elegant (by those standards, anyway) higher-level languages – which used compilers that translated code to assembly language. As it turned out, these compiler weren't exploiting the potential that CISC had to offer – mostly because compiler designer were at a loss to figure out which instruction to use when. The 8086 has 32 different "Jump If…" instructions (!) to choose from, and time and effort that went into designing CISC processors started to seem futile.

The processor design community split into two schools of thought – one concentrated on developing better compliers for CISC processors (notably the Intel x86, which is all-pervasive today), while the other believed that CISC processors were grossly over-designed, and a simpler, more compiler-friendly instruction set was in order. The idea came to be known as Reduced Instruction Set Computing (RISC), and came with its own advantages and disadvantages.

Every RISC instruction takes one single clock cycle to execute, so the CPU never has to wait for complex instructions to finish executing (instructions in CISC can take from 2-32 or even more clock cycles to complete); the time saved is even more prominent when instructions are sent alternately to multiple processors. Most operations would take the same amount of time on both RISC and CISC processors regardless, but the hardware required to decode RISC instructions is less complex, which makes it easier and cheaper to implement. The most significant disadvantage of RISC architecture is that it relies heavily on software – a badly written compiler can have devastating effects on performance, as can badly written programs.

In a nutshell, RISC architecture is simpler, but can often take longer to execute simple instructions. On the other hand CISC architecture is complex and power hungry, but is usually faster. The simplicity of implementing a RISC machine makes it perfect for mobile processors, so that's precisely what Acorn decided to use when they came up the ARM.

### At the Drawing Board

The paramount issue to consider when designing a mobile processor is power consumption. Every single decision that follows – architecture, clock speed and so on – is driven by the need to use as little power as possible, and naturally so. How would you like it if you had to keep recharging your smart phone every three hours? Keeping power consumption low also ensures that less energy is dissipated as heat – Which is good, because one doesn't want to be saddled with a heat-sink in one's pocket.

It's also important that these processors cost very little, which in turn means that they should be easy to design.

So, in 983, Acorn Computers designed the ARM (Acorn RISC Machine), a 32-bit RISC processor which had only a third of the transistors as the Motorolla 68000 – which was 6 years older than the ARM – and yet could actually do stuff.

***The most significant disadvantage of RISC architecture is that it relies heavily on software.***

### Taking more RISCs

Consider the following code that calculates the HCF (Highest Common Factor) for two numbers i and j:

```
while(i!=j)
        if (i>j)
                i=j;
        else
                j-=i;
return i;
```

The idea is that if the lower of i and j is subtracted from the greater perpetually till they're finally equal, the final number is the HCF.

When this code is compiled to x86 assembly, you'll have instructions that do the following:

1. Check the equality of i and j; the CPU will execute the following code if they are equal, or will start executing code from another (specified) memory location if not. This is called branching – when there are two possible outcomes of the same situation.
2. Once inside the loop, check which of i and j is greater and subtract the lower from it – resulting in another possible branch.

The x86 processor has an instruction pipeline which loads instructions from the system's memory and keeps them ready for the CPU to execute. In the above case, let's say that while the CPU is performing the first comparison, the code for the rest of the loop is already in the pipeline. If i and j are equal, however, all that code is unnecessary, so the pipeline has to be cleared, and instructions need to be loaded from a memory location all over again. This wastes the pipeline and CPU time, as we've mentioned before, these are expensive resources, so wastes are unacceptable. The x86 compensates for this with a branch predictor, which does exactly what its name suggests. Today' predictors are accurate around 99 percent of the time, and the overall gains offset the losses caused by the one percent.

ARM, however, would have none of this. Branch predictors add complexity, so Acorn decided to use the last four bits of their instruction code as conditional code, which forgoes the branching issue altogether - for smaller loops atleast. The ARM assembly code for the above operation would go thus:

```
loopCMPRi,Rj        ;-> "NE (not equal)" if (i!=j)
                    ;-> "GT (greater than)" if (i>j)
                    ;-> "LT (less than)" if(i<j)

   SUBGT   Ri, Ri, Rj  ; if "GT", i=i-j;
   SUBLT   Rj, Rj, Ri  ; if "LT", j=j-i;

   BNE loop            ; if "NE", then goto "loop"
```

The result of the CMP (Compare) instruction is stored as a conditional flag in the Current Processor State Register (CPSR) on the CPU for later

reference.
Of the 32 bits that form the ARM's instruction, 28 are used for the actual instruction, and the remaining for carry the conditional flag – this is ARM's own way of implementing the RISC.
So, when the SUBGT (Subtract if Greater than) instruction is sent to the CPU, it isn't going to waste CPU cycles loading the condition flag and then checking it – the flag is right there in a register, and, depending on its contents, the instruction executes.
The final instruction tells the ARM to branch back to the label "loop", if i and j aren't equal. Notice that at no point here does the ARM have to jump to different memory locations – saving precious nano seconds.
This clean, efficient way of going about things means that the ARM doesn't have to fight a Megahertz war – it can get more done per clock cycle, so it can run at a lower clock frequency without too much loss. Lower clock frequencies translate to less heat generated within the chip, so the only thing that's heating up your ARM is probably the sunlight you're basking in.

***ARM doesn't have to fight a Megahertz war – it can get more done per clock cycle, so it can run on a lower clock frequency without too much loss***

### Jargon Buster

**Registers:**
Every processor has a number of registers built right on to the chip. These serve as temporary storage for data or instructions that come into the processor, or for storing important like the processor's current state, or the memory address that it needs to access next. This is the fastest possible storage in your PC, so wasting it is a design no-no.
**Assembly Language:**
When one gives instructions to a microprocessor, one does so in Assembly Langauge. The instructions involve very granular operations in the processor, moving a byte of date from the main memory to the processor's internal registers, for instance. You write assembly vode in the form of mnemonics – MOV, ADD, DIV and so on (the poor devils in the 5th sem would know). These are then converted to hexadecimal operation codes or op-codes, which are finally given to the processor.
**Microprograms:**
Microprograms (written in microcode) take op-codes and convert them into real processor actions. The ADD instruction, for example, will bring numbers from the system's memory to the processor's registers before adding them – it's the microcode that implements this part. Microcode is hard-wired into the processor when it is designed, and optimizing it for perfor mance is one of the designers' biggest headaches.

### Coffee with Jazelle

Most of us probably know how Java works, but if not, then here's how: when one compiles a program written in Java, it doesn't get converted to the assembly code for the processor one is working on. Instead, it's translated to Java bytecode, which runs on the Java Virtual Machine (JVM). The JVM then translates the bytecode to assembly language for the processor. The advantage here is that unlike other languages, where you write different code for different platforms (very tedious), you write code just for the JVM. Now you have code that will run on any platform that has JVM built for it!
The problem with Java, as should be fairly obvious, is that the time taken for the JVM to translate Java bytecode to assembly causes it to take a huge performance hit. This is not good.
Enter Jazelle, ARM's way of combating this performance lag. The Jazelle Direct Bytecode eXecution (DBX) makes a JVM for Arm redundant – the ARM7, ARM10 and ARM11 families of processors can now run Java code directly! If you've ever experienced the tedium of using a Java application on you mobile phone, this is a ray of hope for you. To see the difference that Jazelle makes, watch the video at *http://www.arm.com/products/esd/jazelle_home.html*

### Bells and Whistles

RISC works wonderfully with data that comes in long, continuous streams – video and music, for example – making it a natural choice for any portable multimedia player (PMP). The IPod, amongst many others, sits on an ARM7 based processor, which is built specifically for multimedia. It is tiny, fast and lasts hours on a single battery-charge. Another licensee of the ARM, Freescale Semi-condcutor build the i.MX, based on the ARM9 architecture. These processors feature an on-board Multimedia Card (MMC) and Memory Stick controllers, a Multimedia Accelerator chip and a Bluetooth accelerator. The architecture supports Windows CE, Linux and Symbian, and devices based on this should be available shortly.

# INDUSTRIAL INTERNSHIP

-Akash Dwivedy

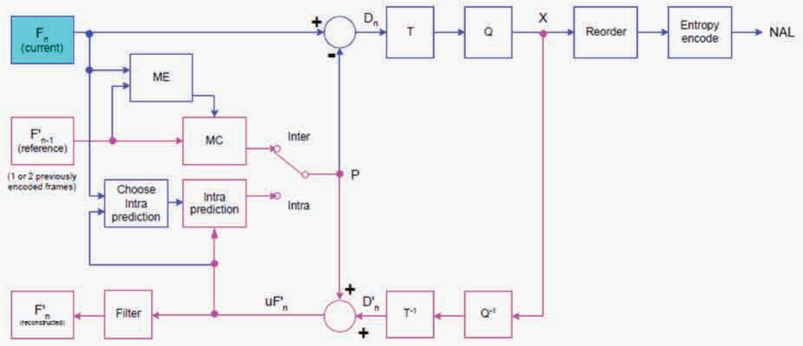
In the summer of 2010, I had an opportunity to work at Texas Instruments. My work was in the field of video compression and in this article, I will discuss about my work there.

## Theory behind Video Compression

Video is basically a three-dimensional array of colour pixels. Two dimensions serve as spatial (horizontal and vertical) domains of the moving pictures, and one dimension represents the time domain. A data frame is a set of all pixels that correspond to a single time instant. Basically, a frame is the same as a still picture. Video data contains spatial and temporal redundancy. Similarities can thus be encoded by merely registering differences within a frame (spatial), and/or between frames (temporal). Spatial encoding is performed by taking advantage of the fact that the human eye is unable to distinguish small differences in colour as smoothly as it can perceive changes in brightness, so that very similar areas of colour can be "averaged out" in a similar way to jpeg images. With temporal compression, only the changes from one frame to the next are encoded as often a large number of the pixels will be the same on a series of frames.

## Tools utilized to get rid of this redundancy in H.264

The goal is to maintain the same information content but reduce the bit rate needed to transfer this information by utilizing information redundancy reduction process. A three tier system is followed at the encoder side for Redundancy reduction system.




Levels of compression:

1)To search for best match block and the corresponding Motion Vector.

2)Find the Discrete cosine transform of the difference (residual) of these blocks

3)Do the coding compression on this transform.

The coupled effect of first and second removes the temporal redundancy where as the last removes the spatial redundancy of the transformed domain. The encoder and decoder both store previous frames .These are called Reference frames.

## Encoder

The diagram and the explanation below explain how each frame in the video sequence is encoded.An input frame Fn is presented for encoding. The frame is processed in units of a macroblock (corresponding to processed in units of a macroblock (corresponding to 16x16 pixels in the original image). Each macroblock is encoded in intra or inter mode. In either case, a prediction macroblock P is formed based on a reconstructed frame. In Intra mode, P is formed from samples in the current frame n that have previously encoded, decoded and reconstructed ($uF'_{n-1}$ in the Figures; note that the unfiltered samples are used to form P). In Inter mode, P is formed by motion-compensated prediction from one or more reference frame(s). In the Figures, the reference frame is shown as the previous encoded frame $F'_{n-1}$; however, the prediction for each macroblock may be formed from one or two past or future frames (in time order) that have already been encoded and reconstructed. The prediction P is subtracted from the current macroblock to produce a residual or difference macroblock $D_n$. This is transformed (using a block transform) and quantized to give X, a set of quantized transform coefficients. These coefficients are re-ordered and entropy encoded. The entropy encoded coefficients, together with side information required to decode the macroblock (such as the macroblock prediction mode, quantizer step size, motion vector information describing how the macroblock was motion-compensated, etc) form the compressed bit stream. This is passed to a Network abstraction Layer (NAL) for transmission or storage. Between inter and intra prediction schemes the former has been explained below.

## Inter prediction

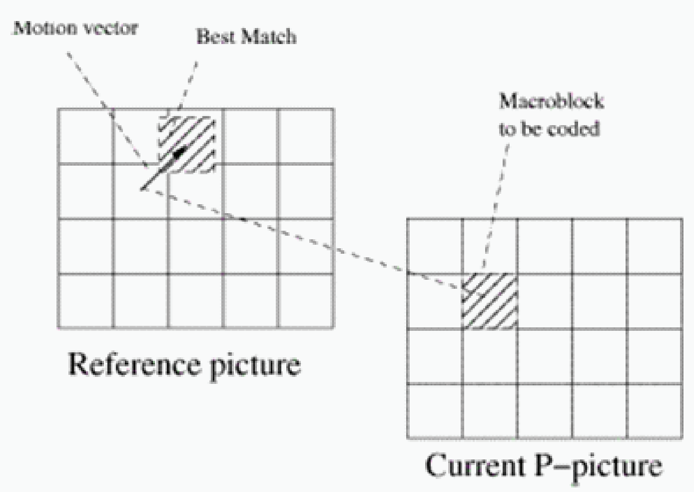
In this scheme the encoder tries to find the best matching block for the current block from the reference frame. This best match algorithm is one of the toughest fields in algorithm design.

Subsequently it sends this motion vector along with the difference of the current block and the best match block (The encoded version of the DCT transform of this residual is sent to decoder).The decoder fetches the required data for the current block from a particular location in the previous frame based on motion vectors and adds it to the residual to construct the current block.

The information content in the residual block is negligible hence the coding standards like CABAC, CAVLC do the rest of the job.

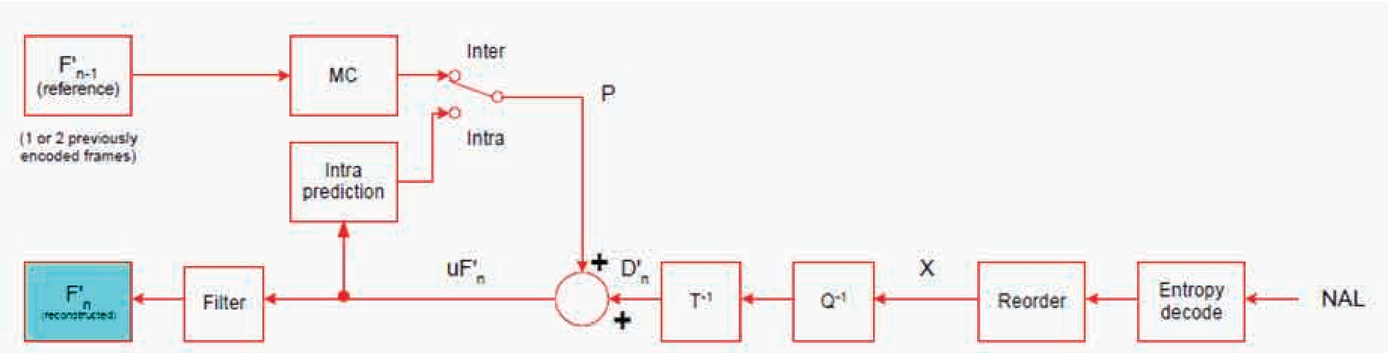
An illustration below shows how one 16x16 block in .

current frame is made from the previous frame.




The standard provides a quarter pixel resolutions .A six tap FIR filter is used to extrapolate the pixels. Hence if the motion vector for one 16x16 block is (2.5, 2.5) then a 21x21 block will be fetched to construct this block. This overhead also leads to overlapping of the required potion of data.

## Decoder




The decoder receives a compressed bit stream from the NAL. The data elements are entropy decoded and reordered to produce a set of quantized coefficients X. These are rescaled and inverse transformed to give Dn' (this identical to the Dn' shown in the Encoder). Using the header information decoded from the bit stream, the decoder creates a prediction macroblock P, identical to the original prediction P formed in the encoder. P is added to Dn' to produce uF'n which this is filtered to create the decoded macroblock F'n.

It should be clear from the Figures and from the discussion above that the purpose of the reconstruction path in the encoder is to ensure that both encoder and decoder use identical reference frames to create the prediction P. If this is not the case, then the predictions P in encoder and decoder will not be identical, leading to an increasing error or "drift" between the encoder and decoder.

This concludes the odyssey on the Digital video and this standard.

## My Goal

The objective of my project was to Design a H.264 decoder architecture which should be energy efficient and follows raster memory organization.

**Idea behind this project**

Performance optimization is very important in today's IC industry .Gadgets from I-pod to smart phone have multimedia functionality. Software markets have mushroomed on these gadgets.The market competition forces the companies to optimize their product in every possible aspect. Energy saving and maximum functionality also is the intention behind this project. The raster memory organization is aimed for the big multimedia market which is compatible to this particular organization. Many open source software work in this fashion and companies make variants to capture this market. Before the DDR architecture I would like to discuss some thing about raster organization.

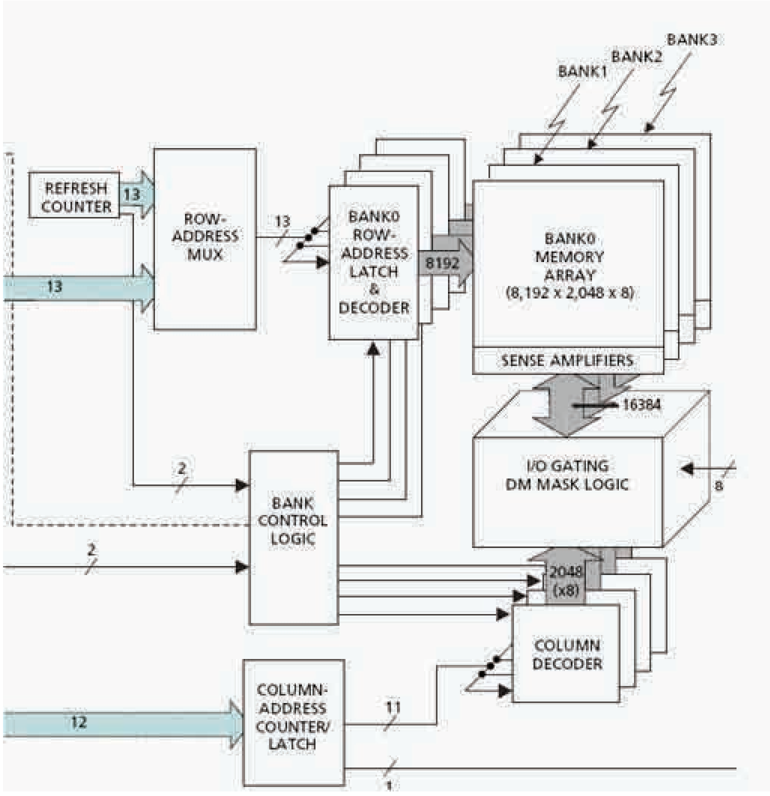
**Raster Organization**

- Reference frames are organized in the raster order in the decoder .1x16 sixteen aligned pixel block is the minimum data that can be fetched per DDR request.
- And adjacent 1x16 blocks were stored in the DDR.
- The memory used was low power DDR2 (lpDDR2)

## DDR memory

The Dynamic memory has some back draws like it has to be refreshed regularly, requires activation like (RAS ,CAS) and other overheads before fetching the data. The processor generally has very high speed and the memory fetch becomes the bottle neck in the process.

To bypass this problem data is fetched at both the edges of the clock and a pre fetch buffer is used, which causes eight adjacent locations to be fetched per request. This is based on the assumption that generally this extra data will also be required by the processor for further calculations. Statistically this is idea is favourable because generally related code or data is present in adjacent places but unfortunately this assumption played havoc in my project .




## Challenges in design

The memory used was low power DDR2 which has a page size of 1 KB and the system was to be designed for HD videos with 1920x1080 resolution.Normally one row had a spread along 3-4 pages in DDR.

Consequently two major problems were encountered in the design.

1) Fetching useless or the same data again
2) Excessive Page faults

The granularity of 1x16 size had this constraint that if I want to fetch data for 16x16 pixel block I'll fetch 16x16 pixel in best case 16x32 in average case and thirty two 9x32 pixels in worst case.

The last one surely amazes but quarter pixel resolution and bi-directional prediction causes this.

## Proposed ideas to overcome these challenges:

Statistics showed a high correlation in the fetched blocks. Not only they were overlapping but also had high correlation in the motion vectors.Set associative cache was proposed to overcome this. Philosophy behind cache is that some frequently used data is kept nearer to the processor, but associatively of the data is a crucial step in the system design.There is a tradeoff between the memory and data search. Direct associative and fully associative are the two extremes of caching schemes .Set associatively is a mid way through. The set associative cache was used in a novel fashion exploiting the relationship between the regional distributions of the data in the image to tag them in the cache. Further elaboration is prohibited as per company's policy and its also not too interesting. Hence using the cache I was able to bring down the bandwidth of the DDR to permissible levels. But page faults were still a major problem.

The simple rule to count page faults in my architecture was count the number of rows in the Data block to be fetched. On an average there were 16 page faults per MB and the magical figure was 2-3.

Seemed impossible first but later when my mentor explained the whole pipelined architecture to me, I came up with a new scheme in which more than one MB were to be decoded simultaneously. I knew this would ease out my problem but other modules of the decoder had to be redesigned. The team accepted the proposal so I went ahead with the idea.The simultaneous decoding of the MBs lead to more relevant data per MB .Still the scheme was not working well on some of the engineered streams. Yes they have engineered video streams which provide the benchmark for the performance. Then I did some modifications in the DMA commands itself which proved to be fruitful. These common sense algorithms do well in Designing Technology. In the last week I thought of introducing some mathematics in the design so I proposed prediction of the DMA commands.

I calculated some feature vectors on the current chunk and the one which closely matches the DMA of the one to be predicted. Based on the matching I modified the DMA commands. The results were good but surely not complete and laid some scope of future work.

# TOUCH SCREEN Just a Touch away

-Krunal M Harne

In 1971, when the revolutionary concept of the very first 'touch sensor' (known as Elograph) was introduced by Dr. Sam Hurst (founder of Elographics), it was tough to imagine that Touchscreens would simply sweep the consumer electronics, leaving few devices 'untouched' in near future ! Now the Touch screens are everywhere: they are embedded in phones, office equipments, speakers, digital photo frames, TV control buttons, remote controls, GPS systems, automotive keyless entry, and medical monitoring equipments. As a component, they have reached into every industry, every product type, every size, and every application at every price point. Display manufacturers and chip manufacturers worldwide have acknowledged the trend toward acceptance of touchscreens as a highly desirable user interface component and have begun to integrate touchscreen functionality into the fundamental design of their products.

## How does a Touchscreen work ??

How can a simple electronic visual display detect the presence and location of a touch within the display area?

The basic idea is pretty simple -- when you place your finger or a stylus on the screen, it changes the state that the device is monitoring. In screens that rely on sound or light waves, your finger physically blocks or reflects some of the waves.

## The "big three" of touchscreen technology :

1) Resistive touchscreen is the most common touchscreen technology. A resistive touchscreen panel is composed of thin, metallic, electrically conductive layers separated by a narrow gap. It is designed in such a way that the pressure from your finger or a stylus causes conductive and resistive layers of circuitry to touch each other, changing the circuits' resistance. This causes a change in the electrical current, which is registered as a touch event and sent to the controller for processing.

2) Surface-capacitive touchscreens sensors in the four corners of the display detect capacitance changes due to distortion of the body's electrostatic field measurable as a change in capacitance.

3) Projected-capacitive touchscreens are the latest entry to the market. They require no positional calibration and provide much higher positional accuracy. They can detect multiple touches simultaneously.

## Multi-touch technology :

Until recently, most consumer touchscreens could only sense one point of contact at a time, and few have had the capability to sense how hard one is touching. This is starting to change with the commercialization of multi-touch technology.

Single-touch touch screens based on resistive touchscreen technology. While amazing and revolutionary in their own right, had two significant drawbacks: 1) resistive technology relied on the physical movement, albeit small of the touchscreen, something that proved to cause poor performance after normal wear and tear, and 2) it was just single-touch, i.e. only one finger can do one thing at one time on a particular screen.

This is where Apple made its monumental contribution to the user interface revolution, with its projected-capacitive based touchscreen iPhone. Even in small devices like smart phones, the functionality inherent within the applications and operating system screams for multiple fingers for optimal usability..

# Just a Touch away TOUCH SCREEN

Already users are wondering how they ever lived without one and two fingers gestures, like manipulating picture sizes and orientation of web page views.

Multi-Touch All-Point technology brings touchscreens to the next level of reliable usability across a broader set of feature-rich applications. Reliability refers to the ability to accurately capture all raw data points touched on a screen in the highest granularity in a way that minimizes any confusion on what exact points in the screen were touched. Usability refers to the many powerful applications, within small and large screens, that can benefit from more than two fingers or hands on the screen.


Interactive 3D gaming, keyboard entry, and map manipulation are but a few more examples of applications that are prime candidates for this level of touchscreen functionality. Ultimately multi-touch all-point technology provides device and system OEMs with even more touch data to empower them to unleash their creativity for developing the next generation of user interfaces.

## iPhone

Everyone knows, Life's so simple with iPhone. You can glide through albums with Cover Flow, flip through photos and email them with a touch, or zoom in and out on a section of a web page -- all by simply using iPhone's multi-touch display.

In January 2007, Steve Jobs introduced the Apple iPhone during his keynote address at the Macworld Conference and Expo. In its first appearance onscreen and in Jobs's hand, the phone looked like a sleek but inanimate black rectangle. Then, Jobs touched the screen. Suddenly, the featureless rectangle became an interactive surface with plentiful of features resembling to a palmtop computer to certain extent !!

In 2008, Apple introduced the second generation iPhone. This iPhone can operate on third-generation (3G) cellular networks and has a GPS receiver. The iPhone also lets you view map and satellite data from Google Maps, including overlays of nearby businesses.

In 2009, Apple launched the iPhone 3GS. The newest iPhone models have more storage capacity than earlier iPhones. They also have a better camera that's capable of taking still shots and video at 30 frames per second. Another new feature is a compass, which comes in handy when you need to find your way through unfamiliar territory.

## iPad

iPad -The tablet computer designed and developed by Apple was released in April-2010 and guess what ? They sold 3 million of the devices in just 80 days !!

Like the iPhone, the iPad is designed to be controlled either by bare fingers or special gloves and styli designed for this use. The display responds to two other sensors: an ambient light sensor to adjust screen brightness and a 3-axis accelerometer to sense iPad orientation and switch between portrait and landscape modes. It is particularly marketed as a platform for audio and visual media such a s books, periodicals,movies, music and games,

# Just a Touch away

## Features of iPad

The Mail app on iPad gives you a natural new way to see your email. You just have to hold your iPad in landscape for a split-screen view showing both an opened email and the messages in your inbox, each with a two-line preview of its contents. The gorgeous 9.7-inch iPad display shows off your photos in vivid color with excellent brightness and contrast. It uses a premium technology called IPS (in-plane switching) to provide an extremely wide viewing angle, so friends and family can crowd around your iPad and still get a great view.

iPad works seamlessly with Faces and Places in iPhoto for the Mac, so you can view your photos not only by date and event but also by who's in them and where they were taken. For example, to see all the photos you snapped in London, tap the Places button and tap London. Your stack of photos appears above the London pin, and you can pinch or tap to view them.

The iPad can use Wi-Fi network trilateration from Skyhook Wireless to provide location information to applications such as Google Maps. The 3G model contains A-GPS to allow its position to be calculated with GPS or relative to nearby cellphone towers; it also has a black plastic accent on the back side to improve 3G radio sensitivity.

No wonder the 'iPad' with endless feature will undoubtedly rule the world in near future!!

## Something About MICROSOFT SURFACE

Microsoft Surface is a revolutionary multi-touch computer that responds to natural hand gestures and real-world objects, helping people interact with digital content in a simple and intuitive way. With a large, horizontal user interface, Surface offers a unique gathering place where multiple users can collaboratively and simultaneously interact with data and each other.

Direct interaction is the best feature of Microsoft Surface. Users can grab digital information with their hands and interact with content on-screen by touch and gesture – without using a mouse or keboard.

Multi-user experience: The large, horizontal, 30 inch display makes it easy for several people to gather and interact together with Microsoft Surface - providing a collaborative, face-to-face comput ing experience

How does Microsoft Surface work?

Microsoft Surface uses cameras and image recognition in the infrared spectrum to recognize different types of objects such as fingers, tagged items and shapes. This input is then processed by the computer and the resulting interaction is displayed using rear projection. The user can manipulate content and interact with the computer using natural touch and hand gestures,instead of a typical mouse and keyboard.

So, if you are still to experience this technology, all we can say is '**Touch it to believe it.**'

# PROJECT 54

-Sahil Goyal

*"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."    -Mark Weiser*

The focus of the computer industry in recent times has shifted from making better computer processors to bringing the computer into the real world. Technologies now need to take into account the cognitive limits of the human mind, accept its idiosyncrasies and constantly update themselves to make them safer, and in Weiser's words,' disappear'.

Project 54, an ubiquitous computing research group at the University of New Hampshire,is a multi million dollar effort in this direction. Led by Andrew Kun, a professor of the Electrical and Computer Engineering department, in their own words, "the focus is not on the interaction between the machines and humans, but rather on the goals that we are trying to achieve through the interaction." In recent years, Prof. Kun has invited interns from IIT Guwahati to work in Project 54 labs, enabling students from IIT Guwahati to be part of interesting research topics .

We have a look at the two research topics : In car user interfaces and multi-touch interfaces at the Project 54 labs, as well as the challenges they are looking to answer in the near future.

## In car-user interfaces

### Motivation

Police officers are indispensable. A normal day at the office for a police officer involves high speed car chases, constant vigilance, and interaction with umpteen gadgets and devices such as the GPS and sirens. Now, suppose we wish to make him safer, and to do that, we would like to replace the buttons for devices and instead install a speech recognition system. On a desktop, with all the speech recognition technologies in place, this won't be much of a problem. Now, imagine bringing this technol ogy to a moving police car.

Where would you place the microphone, on the steering wheel or in his hand? Can you make the officer accustomed to this new technology easily? Will the officer be able to use it irrespective of the car speed, his posture or where he is looking? Is it safe for the officer to be speaking in a microphone, when at the same time he is involved in a car chase? Surely you would not want the speech recognition system to be working when the officer is ordering donuts?

### Solution

Clearly, only an adroit programmer won't do. We need to know how the officer behaves in response to the technology. To make the use of the technology completely oblivious to the one using it, is to study a plethora of factors, such as behavioral sciences, interface design, ergonomics and many more, or in other words study how the technology proposed affects the performance of the police officer.

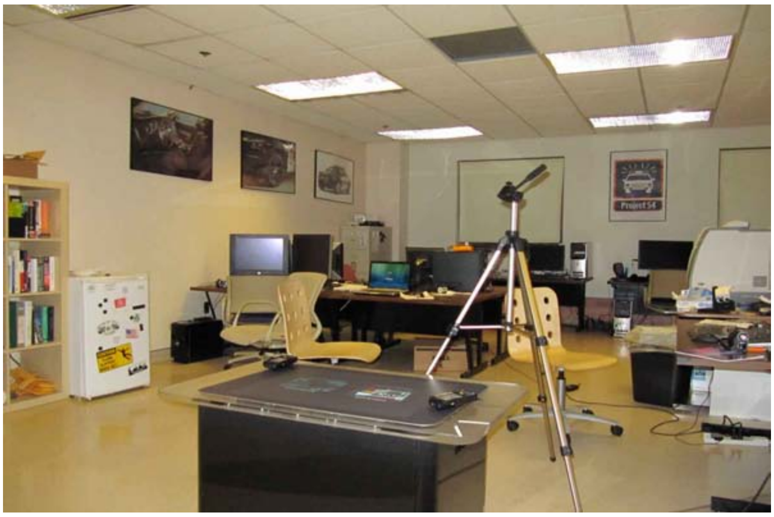
Pupil diameter has been shown to be a physiological response to effects such as cognitive load, illumination, fear, arousal etc. At Project54, driving conditions are simulated using a state-of-the-art **Driving simulator**, and measuring pupillary responses through **remote eye trackers.**

### Problem Statements

Some of the problems currently being explored at Project54 are:

1)Estimating cognitive load using remote eye tracking in a Driving Simulator,

2)The effects of playing songs on a iPod while



driving,

3)Cumulative effects of illumination and cognitive load while driving,

4)Replacing the speech based switching system with a gaze based system.

### Experiment

Although this might seem to be a trivial part of the study at first, conducting the experiments is a very crucial process. An experiment usually consists of weeks worth of data, cajoling friends to do your sample studies, a lot of trial and error, and data collection. The study takes into account the previous history of each subject, and also involves constant improvisation using feedback from the subjects.

### Analysis

The data collected from the eye tracker is then mathematically analyzed in a variety of statistical methods to derive conclusions.

## Internship experience

(Sahil Goyal, 4th year, ECE IITG)

Being involved in the illumination experiment in the summer of 2010, working with the simulator and the offered eye tracker a great learning curve. The involvement of the human factor is something we rarely experience back in India, and it was nice to see some real world application for what I was doing. The simulator is an excellent place to relax and enjoy some driving, and if you have got the place to yourself, maybe sometimes enjoy the FIFA World Cup on the big screen. The work is done under the supervision of research engineer Oskar Palinko, who is a great source to learn a lot. Plus, his eclectic tastes keep you interested if you ever drift away from the task at hand.

## Multi-touch interfaces

### Motivation

The minority report interface. No place for buttons. Multi-touch interfaces that make the world around you easier. Impossible to achieve in reality, one might think. Not really.

With the spate of touch interfaces like IPod touch, HTC touch mobile phones and the recently introduced IPad, touch is the most intuitive method of interacting with computing devices. At Project54, the aim is to develop applications for touch interfaces. Let us take an example of an application developed at Project54 by Jatin Matani, an intern from the CSE department at IITG.

I have 700 photos of New York. You have 800 photos of the Sonisphere festival. We want to exchange our photos. I come to your room, ask you to copy your photos in a flash drive, while I do the same, after frustrating minutes of Ctrl+C and Ctrl+V, I finally have your photos. Still, I don't want your entire head banging extravaganza. What follows is a photo-by-photo scan, and somehow, if I am still interested till the end, I will select the best.

Alternatively, Jatin has an interface where we can both go and splash our photos around. I can use my hands to see your photos, zoom into them, and select which I want. And using intuitive hand gestures, which makes it even more fun. You are meanwhile doing the same with my album. There are also options for uploading the photos to 'flickr'. And better still, I can see exactly where these photos were taken, on a world map.

The possibilities of "communicating through touch" are endless, and we can imagine a world where even the walls that surround us are touch interfaces. This aims towards taking the computer to public places like hospitals, libraries, schools and restaurants.

### Solution

At Project 54, the work on multi-touch is carried out on the state-of-the art Microsoft Surface, a surface computing platform which responds to real world objects and natural hand gestures. The Microsoft

Surface offers a unique environment where multiple users can collaboratively and simultaneously interact with data and each other. The Surface lets you grab digital content with your hands and perform various functions using simple gestures and touch. This paradigm of interaction with computers is known as a natural user interface (NUI).

A Surface Software Development Kit is also shipped with the Surface table which allows researchers and other software developers to develop their own applications for the Surface. The major aim of the programmer is not only to get his application running, but also to design the interface in such a way that it is appealing and self explanatory to a layman. The coding is done in C# and XAML.

The surface can also interact with real world devices, such as mobile-pc handhelds. For example, Trupti Telang, interning at Project54 from the design department at IITG, had to develop an application in which the surface is used to interact with on-the-move human subjects. Handhelds were used in her application for sending and receiving text messages/ pictures from the surface.

### Problem Statements

Some of the applications currently being devel oped at Project54 are:

1)Photo sharing application where multiple users interact with their data and share them among other users.

2)Storytelling with Geo-tagged Images: Increasing Integration of mobile devices such as smart phones and cameras with built-in GPS devices facilitates generation of geo-tagged images. Show them on touch based globe application, and telling stories becomes an exciting new immersive experi ence.

3)Multi-touch Dispatch system which allows user to dispatch resources by sending messages in form of plain data, images , voice memos , videos to different field agents . Imagine a 911 dispatch system having a multi-touch environment making emergen cies a little bit easy to deal with.

### Experiment

To get a fair feedback of the applications developed, experiments in the form of user studies are conducted. To determine the market value of the application, it is necessary to test if it is intuitive or not. This is done by having people participate who are naive with respect to the touch interface technology. The subjects interaction with the application in recorded, and the recordings are used to observe the possible improvements that could be made to the application.

## Internship experience

( Jatin Matani, 4th year, CSE IITG)

Working on the Surface was an overwhelming experience, especially because one doesn't find a 15000$ multi touch table here in India so easily. The working environment was friendly and professional. The internship helped me learn the basics of HCI with some of the coolest technologies in the field. Add to this the beautiful countryside and charming landscape of New Hampshire with its beautiful lakes which offers great recreational activities such as camping and kayaking. In all, the internship gave me some of the most cherish able moments of my life and some great new friends to share them with.

## Internship experience

( Trupti Telang, 4th year, DoD IITG)

It was a wonderful experience working on the Microsoft Surface table at UNH. My work was to develop an application for the multi-touch user interface which the Surface table provides. The internship provided me with an opportunity to work on a project in ubiquitous computing in the field of HCI. During my stay I got an exposure to the work culture and life style of people there. Apart form the work, I also enjoyed the natural scenic beauty that the place provided.

# HUP HOLLAND HUP


Hours of being frustrated at my design project circuit that just wouldn't work turned into exultation once I checked my webmail and saw the much coveted "your profile looks interesting for a summer position" in my inbox. What ensued was a series of negotiations with the professor, passport and visa applications, and some of the best days of my life, in the beautiful country of The Netherlands.

My internship was at the University of Twente, a reputed university of the country, located in the university town of Enschede, which greeted us with its shivering cold. Enschede is the greenest city of The Netherlands, managing to preserve its natural beauty along with its industrialization.The city has a well defined connectivity to the rest of Europe, and is just ten minutes from the Dutch-Deutsch border. The public transport system is very good, eliminating the need for a personal vehicle to go around. It is a bit odd to see the city shutting down at six in the evening, and the roads being empty after ten in the night, but one gets used to it.

One of the things that impressed me was how the country worked like a well-oiled machine, with every small part of the machinery well lubricated. I soon realized that unlike India where most of the laws are merely on paper, the laws there were implemented strictly. The laws on even small things such as having lights on the bicycle were stringent. The roads are divided into separate lanes for pedestrians, cycles and vehicles, and fines are heavily imposed on anyone trying to play around with them. One can easily identify the difference of living in a developed country, with the things ranging from juice can openers to train stations having a level of human understanding and comfort. There is no place for laxity or the "chalta hai" attitude. The people are really friendly (not to mention really huge!) and welcoming.

My work was related to my previous work in the field of Wireless sensor networks. I visited the Smart XP lab in the university, where you could simulate real time wireless signal attenuation using objects such as model trees and buildings. As I got used to being called "Manoy" (in the same way "Arjen" is "Aryen"), I got accustomed to the work culture at the lab. There was no restriction on the time slots that I could work, which meant that I had the luxury of working whenever my mind was refreshed. My professor was really nice, who met me weekly at the group presentations. I worked towards making an adaptive power control algorithm for wireless networks.

The internship also gave me an opportunity to visit many places in Europe. I visited Paris, Bruges and Amsterdam, all of which were a unique experience in themselves. I personally liked the city of Amsterdam the best. Most of my batch mates were in Europe, and we had an awesome party in a blizzard at Mount Titlis in Switzerland. One of the best things about the European summer is the rock concert extravaganza, of which I enjoyed by seeing Lamb of God perform live. As the football world cup drew closer, the entire country took to the shade of Orange, in support of the Oranje. Offices would shut down at four in the afternoon whenever Holland was playing. The soccer frenzy in the country is simply amazing. People would congregate in large numbers at the city center to support the team, wearing the ubiquitous orange and chanting 'Hup Holland Hup' wherever you go.This was the first time I had to cook myself, and I discovered that I cook really well! The largely non-vegetarian food outside works well to motivate you to cook, and making a plate of dal-chawal doesn't seem that difficult. This is also a point of difference in the lifestyle of students in India and Netherlands. On that note of a sense of a personal acheivement, I would like to conclude this article with the hope that I will get to visit the Netherlands again.

-Manoj Kaushik

Current Folder: **INBOX** Sign Out

Compose Addresses Folders Options Search Help Bookmarks Calendar IITG Passwd change

To: ireallydontcare@justanotheruniv.com

Cc:

Subject: INTERNSHIP COVER LETTER

Priority Normal Receipt: On Read On Delivery

Signature Addresses Save Draft Send Check Spelling

Dear Prof. ABC (what's in a name, after all? Optimization for the greater good, you see!),

Let's get straight to the point. This is supposed to be a cover letter for an internship application, and I am the humble applicant. In as much capacity as a pre-final year student, I am sending out this application at the behest, and the persistant nagging, of the academic authority. I hereby modestly bessech you to vouch for me, an internship position under your ostensibly imposing and pedantic guidance. For the records, this application is being multicast from the Indian Institute of Technology in Guwahati, surprisingly, and not in Bangalore.

After a few hours of research for obscure scientists in the field of wireless communication, I discovered you homepage. You have a really nice photograph up there, and the multitude of books on your desk, with satellite antennae on the cover page, assured me of my choice. The website lists your projects with emphasis on field work. To develop some background, I have read some research papers that you have co-authored on diverse topics like diversity coding techniques and co-operative diverstiy. I was particularly fascinated by the one in which you were assigned the task of climbing up the mobile antenna for measuring the antenna aperture, and realigning the sectored segments, thereby reducing the interference. Besides, I have some hands-on experience in installing and repairing the Yagi-Uda antennas, first in the villages of "India Shining" and then, "India Rising". With an inclination towards practical engineering, I believe that I will be a great asset to your university's research ambitions.

Academically, I have an extraordinary record, both in the departmental courses and the others. You should not be surprised to note that I have been obtaining the maximum awarded grades in the Humanities courses, the minimum in the maths courses and I proudly represent an average IITian in the departmental courses. I have shown my resilience by passing in a network theory course even after procuring two entwined noughts. I have contributed to the large volume of research being carried out in the institute, by associating with the projects in this field. With a long history in maths, I have assisted my guides here by solving many complex integrals and executing speedy arithmetic. I have helped them frame their research into printable stuff so that their efforts lead to betterment of the existing wireless technology. My contributions also include two stolen sensor boards from the lab, a detailed survey of two mobile towers in the campus and a thorough application of the Friis transmission equation, thorughout the three semesters. I also have an appetite for research in such fields as robotics and automobile design. I have been active in the co-curricular sphere as well, by winning an antenna design competition and organising an autonomous robotics competition.

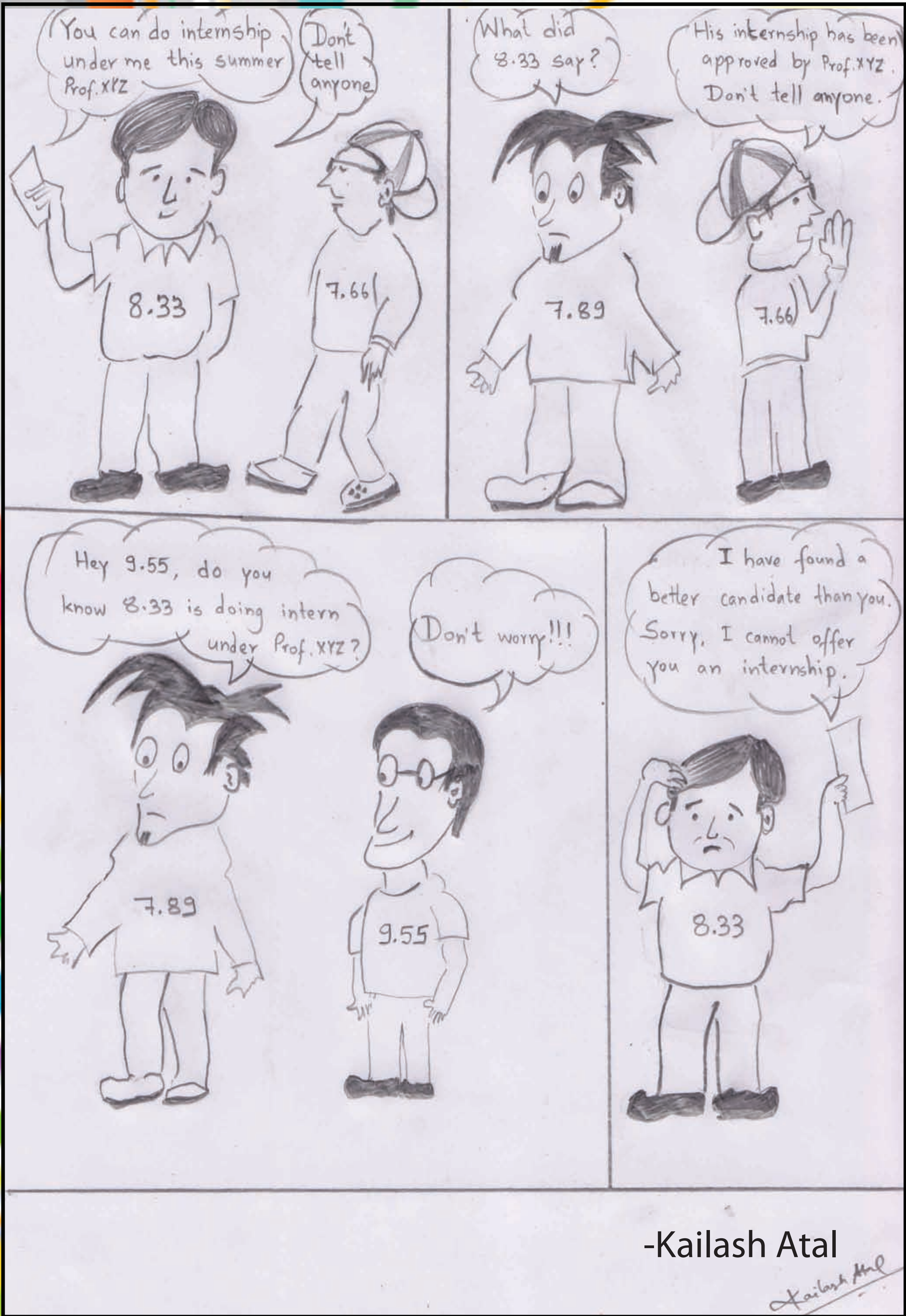
Hence, I would like to apply for a position in the "One Europe" project which requiers the RSSI measurement at various geographical positions with respect to different transmitting antenna locations, spread throughout the continent. I am totally aware that it requires immense physical and mental resolve for a project for such magnitude and impact, including extensive travelling throughout Europe. But for the advancement of human race and the technology, I am ready to do my bit for the greater good, like I said, in the three months during the summer of this year. I would like you to at least reply, even if not positive. If you recieve this email before the DAAD deadline, be sure that I will take care of the scholarships. If this email reaches after the deadline, do not forget that I am from an impoverished country and to benefit from my efforts, you need to pay for my stay there. All said, I would expect a positive reply from your side, and stay connected through follow ups.

Thank you for your time and consideration,

Yours sincerely,
Vivek Sharma.

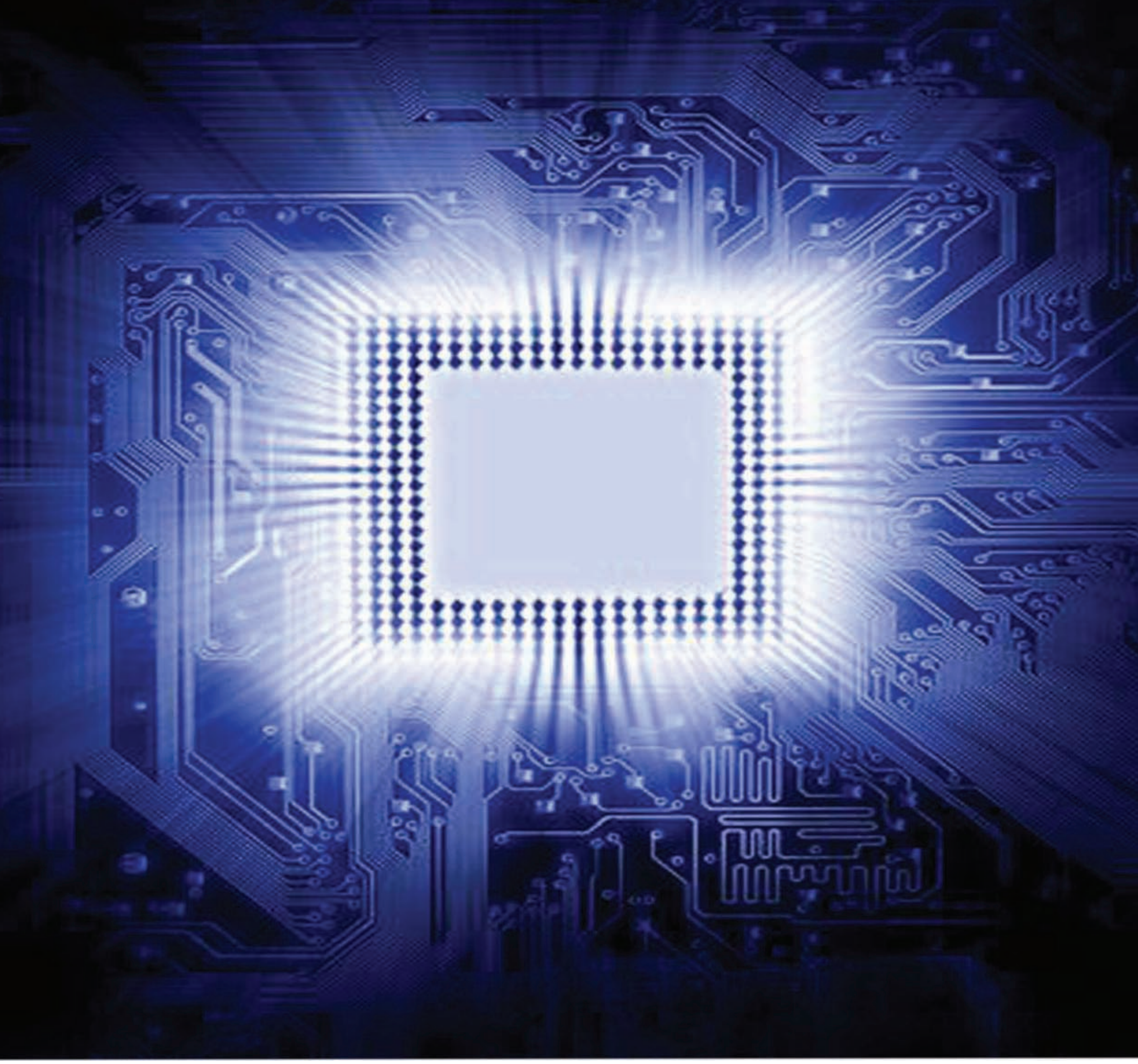
Send

Attach: IITs are ranked No.3 in the world.jpg Browse... Add (max. 10 M)




-Kailash Atal

# CLASS OF 2010



In Phase Magazine
By Cepstrum Student Society
Dept. of Electronics and Communication Engg.
Indian Institute of Technology Guwahati

# AWAITING YOUR FEEDBACK

*inphase@iitg.ernet.in*

DESIGNED BY M S N KARTHIK