In Phase
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Inside the 6 String Machine

Cover Article

In Phase, November 2007

From the editor...

No matter what field or profession you are in, is it not everybody's dream to be in front of a cheering, screaming crowd, with a seducing guitar in hand? Well as electronics engineers we definitely have a head start from others as we can easily understand all that goes behind an electronics guitar. The cover article tries to explain the nitty gritty of the stringed instrument even for absolute newbie. Talk of 'Applied' Engineering in the real sense of the term! Also an electronics engineer tries to muse over the question "What would I be, if not an engineer" in a reproduced article in this issue. Do have a read.

I believe the worth and quality of each article in In Phase is of utmost importance to have the reader's attention and to serve its purpose of bringing people 'in phase' with each other. And with each issue we are really trying to upscale the caliber of the articles. I hope you will be able to perceive the improvements with this issue. Two new regular columns have been introduced - 'The Next Trend' will look at an upcoming field in ECE every issue and the 'In Phase Tech Article' will offer a platform to showcase technical papers from students. We have tried to keep a balance between technical and non technical parts and to cater to a 'general' reader with varied interests. It has also been our conscious effort to have a mix of articles from students, alumni and faculty which is evident in this issue. I would like to specially thank the alumni community for their extensive support and encouragement for this initiative.

Also, we must all understand how easily the good initiatives die down if they dont get continuous support and encouragement. And I would thus really urge you to let us know how we are doing, if there is something you liked or disliked and how do you wish In Phase to turn out to be in the future. Hope you enjoy this issue.

Akash Baid
Editor-in-chief
Final Year B.Tech

Call for Articles

We are looking for technical as well as non technical and experience sharing articles from students, alumni, faculty members and industry professionals. Articles pertaining to completed/ongoing projects, views, discussions, topic introductions, applications and professional or educational experiences are most welcome. Articles must be 1500 - 3000 words in length and should be written keeping in mind the diverse range of targeted audience including people with little as well as extensive knowledge of electronics. Please email us at cepstrum@iitg.ernet.in for any clarifications or suggestions.

Weather forecasts going mad!!

What's the big deal in forecasting weather? Its not difficult, it is simply impossible: argues the author!

Dr. Amit Kumar Mishra

"Oh! The Assam rain is just unpredictable"! We all must have made or heard remarks like this. But then weather at which part of the world is predictable? Can we really predict weather in the long run? Will better instruments and better models let us predict rainfall data for the next year? With lots of computers, can we predict weather changes? The answer is an imposing "NO"! Not that any God sitting up above the world is adamant about not giving us the right keys. It's rather the way certain things behave.

"As you sow so you reap". Yes, we all know this; the present determines the future. It's a chain action-and-reaction all the way. The Karma as the Hindus would put it! Temperature of today will depend on the temperature of yesterday and of course on some external factors. We predict weather of tomorrow depending on the weather of today. Simple!

Next we come to fairness in nature! Nothing is fair in life you know..... Nor is weather! For example, if yesterday's temperature was 3° and today it is 6°. Does that mean that if any other day the temperature is 4° the next day it will be 8° (twice) or 7° (an increase of 3°)? It is not common sense to say so, and it is also theoretically proved that weather does not follow this sort of relation, which they term as linear relation. Nature is not fair;... nature is "non-linear"!

So, now we know, weather follows cause-and-effect rule in a non-linear way. Non-linear things are very interesting. Any of those fat algebra books can tell you that, they can fall into three categories. Either they settle down to a constant non-changing state. Definitely weather is not like this. It changes ...definitely it changes! Next path that non-linearity can follow is cycle! It will go through exactly the same way over and over again, like a pendulum. Does weather follow a clock like regularity? Then what's the use of all the research? We could record one dial and predict the clock. It is NOT. We all know, weather as of now, is anything BUT predictable.

Third and the only option left for us is chaotic!! Chaos in science mean some system which is too dependant on its initial conditions; like some over-dependant kid! Let's take a simple example. Our old example of the weather of tomorrow, and today. Let us call temperature of tomorrow as Tb and that of today as Ta. Let's apply a simple relation

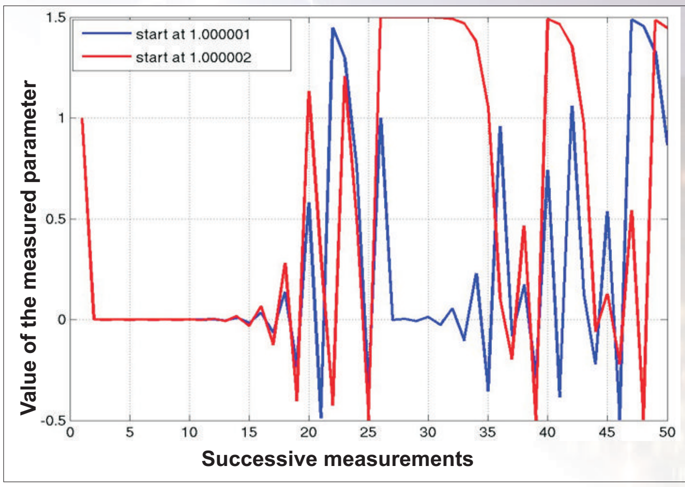
$$T_b = 2 \times T_a \times (1 - T\ )$$

You can take my words on it, that weather definitely is much more complicated than this. Let's say temperature is 1° today. Then using a calculator, we can calculate the temperature for next 20-30 days. Simple and straight forward! Nothing is straight in nature!! But is the temperature exactly 1°? Depending on my thermometer, it can have some error. No thermometer is exact. Using a very good thermometer I measured the temperature of today to be 1.000001°. And I calculate the temperature of next 50 days and plot them in a graph. If you see the figure below, the blue line shows what I got.

Ops! Sorry I slightly misread the thermometer (getting old you know!); my temperature in fact was 1.0000002°. Well, I can do the stuff again. So I calculate the 50 days' temperature again and plot it as a red line on the same graph (to compare). What do you see? For few days the prediction from both the calculations are the same. But after 5-10 days, the predictions differ drastically, nothing near to each other. Beauty of chaos!! So if I want to know the temperature of 30th day, which temperature should I take? The one from the blue line or the one from the red line? Each of them is equally right or equally wrong, because the temperature of the first day is not known exactly!!

So where is the problem? We have a perfectly predictable system, and simple calculations. Scientific and engineering equations can't be any simpler! So what's wrong? Its "chaos"! It makes the system so fickle, that a slight push here or there makes the future completely uncertain!!

But if we get a very nice thermometer to measure the exact temperature, then everything is solved? Well, yes and no! Things are solved, but such a device, to measure things exactly is not possible. One scientist named Heisenberg proved that there is a limit to the correctness with which we can measure stuffs! And my friends from engineering and experimental science streams must have read a good number of different types of noise ever-ready to corrupt a measurement. As an old professor used to tell "I don't know if God is omnipresent or not; noise certainly is". We can't be perfectly accurate! And if initial measurement is not accurate, then as we saw, future is completely beyond any prediction. You can predict for few days, few weeks.........that's all you can do. Nothing is wrong with our knowledge, or models, or simulations, or computing power, or data. Its just the way some things are .... CHAOTIC !!



(Dr. Mishra is a faculty member at the Dept. of Electronics & Communications Engineering, IIT Guwahati)

Network Security for Geeks!!

-By Mohit Jaggi

The Greek cellphone tapping scandal...
The TJMaxx data breach...
The storm worm's botnet...
....What's it all about ??

Information technology(IT) today is plagued with security problems and there is no sign of this stopping anytime soon. Like any other technology, IT has its share of problems. Being engineers and the advancements that each stream has made over the years, all of us would have or might face such problems. Its better then to be on guard against these problems. .In this article I will try to characterize some of the security problems, that are rampant today.

To begin with, let us have an overview of the technical stuff...

Technical Aspects

Basic Concepts: There are two things that need to be protected. One is data and the other is transactions. The definition of data is obvious. We define a transaction to be any command given to an IT system. For example, "rm file.txt " is a transaction that deletes a file. Another example is a money transfer from one account to another. Yet another example is the opening of a door to a bank vault. [One may argue that reading data is a transaction and we just need to protect that.]

The basic IT security problem is summarized by this acronym: *PAIN*. It stands for the following interrelated concepts:

- Privacy - All information is not for everyone. Data can be "secret" at times.
- Authentication* - Not everyone has access to all data or can perform all transactions.
- Integrity - Unauthorized change in data needs to be detected.
- Non-repudiation - Transactions need stored proof so that the parties involved cannot deny that it took place.

Securing data at rest and in motion: Securing stored and in-transit information has been a problem that existed even before the modern day IT systems came into existence. Fortunately, advances in cryptography have kept pace with developments in information technology and failures of this aspect are rare. Cryptography is a system of mathematical locks and keys and virtually guarantees security of the data while it is locked. Secure as it might be, this does not imply that cryptography always needs to be used. Sometimes, an IT system may be secured by the use of physical security. For example, lock computers in a room that only those with appropriate privileges can access. In practice, cryptography is often used in conjunction with physical locks.

Securing access to data (and transactions): Information cannot always be kept encrypted otherwise it will be useless. Before the data is used the lock needs to be opened and data decrypted. Once the lock is open, the data is no longer protected by cryptography. It is either in the hands of a human being or a computer program. Both , as all of us would agree are weak links! Let us start with the computer programs.

Most computer programs are written without any consideration for security. Not encrypting data at rest or in motion, or at best encrypting with weak credentials (e.g. shared public password) or algorithms (e.g. WEP or the Wired Equivalent Privacy) is a common occurence.

The infamous buffer overflow: This weak link is particularly important because it can be exploited to completely subvert a computer system and render all other security solutions useless. Broadly speaking, buffer overflow occurs anytime the program writes more information into the buffer than the space it has allocated in the memory. This allows an attacker to overwrite data that controls the program execution path and hijack the control of the program to execute the attacker's code instead the process code. Due to the way in which the stack in a computer program works it is possible to exploit programming bugs to introduce arbitrary code into a program and gain access to all data and privileges of that program.

Other Injection attacks: Buffer overflow is an injection attack because a user of an IT system can inject arbitrary (often malicious) code into a program that handles sensitive information. There are other injection attacks that operate at higher levels. For example, an SQL(structured query language) injection attack introduces a malicious SQL query into a database. Similarly , a shell script injection attack introduces malicious arguments into a shell script. Cross site scripting injects malicious JavaScript programs into a browser. Thus there are many ways in which the code can be violated and useful information can be lost or be tampered with.

Incorrect trust boundary implementation: There are a number of attacks that exploit incomplete or incorrect implementation of trust models in software like internet browsers. Data being transferred is submitted to a web server which then transfers it to the desired location. Clearly, we are facing a problem if we do not have proper trust boundaries. If there's significant business logic running in the browser, it stands to reason that the browser should validate data that crosses a trust boundary on its way from the server. Here's the thing, though: while on the server side our code runs in a trusted environment (or what we hope can be trusted), in a browser our code (or what we hope is our code) runs in an untrustworthy environment accepting untrusted input. For example, a malicious server can impersonate honest servers and yet again our data is in trouble.

Non-technical Aspects

After all these technical details let us consider some of the non-technical aspects of IT security.

Social engineering: Remember from the previous section that the human being is one of the weak Links and in some cases, the weakest link! A lock is no good, if you give out your key to anyone who asks.
However many naive users of IT do exactly that. You can find an amazing number of incidents where people have been lured into revealing their password and other essential security details. Phishing and pharming exploit this weakness on massive scales.

Wilfully malicious insider: Not a lot can be done to counter intentional malice by a person who has access to secured information. All that can be done is to reduce the "surface area of exposure" by limiting access to sensitive information to as few people as possible and having strategies in place to deal with a breach, which in turn reduces the chances of a security breach from the inner circle. For example, a system administrator does not need to know the passwords of all users, so that's one way of curbing such leakages..

Economics: The sad state of affairs today is not due to the lack of technical solutions. It is due to economic, social and political factors. In a Utopian system those responsible for the storage and transmission of information choose the right policy to secure it and deploy the appropriate technology to enforce the policy. In practice however, it often turns out that those who make this decision have no responsibility for making the right choice. In Economics, this is known as an externality. The information security problem is analogous to the water (or air or noise) pollution problem. In our capitalist economy, industries(including the IT industry) are profit making entities. Their sole job is to optimize profits. Just like the pollution caused by a leather tannery does not reduce its profits, the cost of security failure does not impact the IT vendors. They have no motive(incentive) to solve the problem (if they did, the technical aspect of the problem is not intractable). On the contrary, they benefit from ignoring the problem(in much the same way that the leather tannery benefits by not having to pay for proper disposal/recycling of its waste water) and/or making it worse because it reduces R&D costs for them.

Motivations of hackers: This article is incomplete without a digression into the glamorous world of hacking. Have you ever wondered what motivates bad hackers (supposed to be called "crackers" but nobody uses that term)

Mischief/nuisance: Computer hacking was initially considered just nuisance created by mischievous people looking for fun. As more and more people got into it, this became more of a cyber crime from just being a fun game.

Money - However, hacking for money is more prevalent now. It is believed that organized crime syndicates, not unlike the drug mafia, design and distribute malicious software (malware). They rent their services to fraudsters, spies and other criminals.

Governments - Spying and suveillance has evolved to use computer hacking. Ever heard about one country complaining about another hacking into its system and stealing nuclear secrets?

If I called the above "bad hackers" then there must be the concept of a "good hacker"? Yes, these are called "ethical hackers". An ethical hacker is a computer and network expert who attacks/hacks a security system on behalf of the owners, but instead of taking advantage of its vulnerabilities, like malicious hackers , he reports and improves the problems of the system. To test a system, the techniques used are the same as that of their less principled counterparts. Ethical hacking is also referred to as penetration testing , intrusion tesing and red teaming. An ethical hacker is sometimes called a “white hat”, a term inspired by the good guys in the western classic movies.

One of the very first uses of the principle of ethical hacking was made by the US government in 1970s. Groups of experts called red teams were used to hack the government's computer systems. Since then ethical hacking has continued to grow in an otherwise lackluster IT industry, and is becoming increasingly, as you would appreciate, a necessary tool to combat the nuances of malicious hacking. In fact companies such as IBM , maintain a separate employee team of ethical hackers.

Hacking in fact is fun for most of the computer geeks, the challenges involved make sure of that. But let ourselves just be on guard against these. You never know when a hacker is tampering with all you have got on your “geek box”.

(The author is a 99 batch alumni, graduating from the CSE department at IITG. After a short stint at Hughes software systems, he went on to join Cisco systems in the US in the year 2000. Mr. Jaggi has been involved in 5 patents for Cisco till date and is an expert in the field of internet security.)

Inside the 6-String Machine

I'm sure the name 6-string machine must have instigated creative thoughts in your minds. The name itself is striking in its appeal. Clearly you must have guessed what we are talking about. If not, then let me tell you that it's an instrument which has shaped the music industry since early 1950's and has been an integral part of all music genre be it classical, country folk, jazz, rock n roll, blues, heavy metal, grunge etc. Yes folks, we are talking about the electric guitar. But what gives this instrument its beastly nature, what all is responsible for producing those notes down from melodious clean to crunching grunge? Is it only the guitar or is there something else too? What's the basic fundamental behind its working? Although, perplexing as they are, let us first take a brief look at the history of these beastly machines.

The need for something like an electric guitar became apparent during the big band era, as amplified instruments became necessary in order to compete with the loud volumes of the large brass sections common to jazz orchestras of the thirties and forties. Initially, electric guitars consisted primarily of hollow arch top acoustic guitar bodies to which electromagnetic transducers had been attached. In 1941, Les Paul designed and built one of the first solid-body electric guitars. Gibson Guitar Corporation designed a guitar incorporating Paul's suggestions in the early fifties, and presented it to him to try. He was impressed enough to sign a contract for what

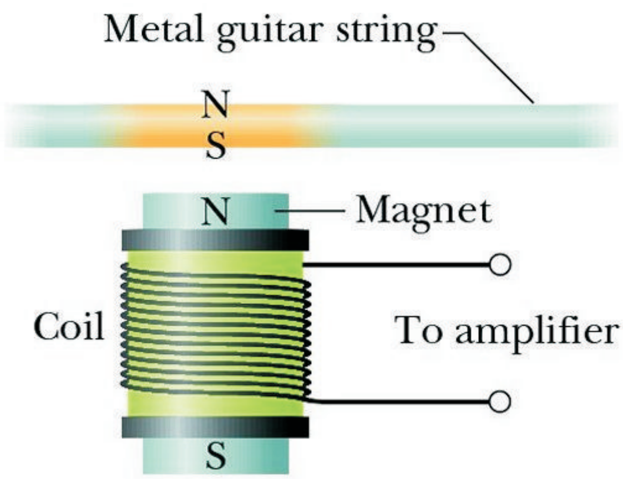
became the "Les Paul" model. This name marked an era in the history of rock and roll music and is profoundly written in the minds of novice and professional guitarists.

In 1951, electronics and instrument amplifier maker Clarence Leonidas Fender, better known as Leo Fender, through his eponymous company, designed a solid-body electric guitar with a single magnetic pickup, which was initially named the "Esquire". The two-pickup version of the Esquire was called the "Telecaster". Features of the Telecaster included: an ash-wood body; a maple-wood 25½" scale, 21-fret neck attached to the body with four-bolts reinforced by a steel neckplate; two single-coil, 6-pole pickups (bridge and neck positions) with tone and volume knobs, pickup selector switch; and an output jack mounted on the side of the body. A black bakelite pickguard concealed body routings for pickups and wiring. The main breakthrough though was achieved in 1954 with the release of the "Stratocaster", which can be seen as a deluxe model and offered product improvements and innovations over the Telecaster.

In 1966, Eric Clapton recognized the professional potential of the late '50s Les Paul guitars (particularly the 1958-1960 Standard sunburst models), and gave them wide exposure. Artists such as Jimmy Page, Peter Green and Mike Bloomfiel, influenced by the sound of Clapton, picked them up by 1967. These '50s models featured the thicker, more sustaining tone of Gibson's "humbucking" pickups with the original units known as PAF (Patent Applied For) pickups. This innovation became a standard pick up design for Gibson, and subsequently, many other guitar companies followed suit, outfitting their electrics with copycat versions of the humbucking pickup. As a result, over the years, authentic 1950s Les Pauls have become some of the most desirable and expensive electric guitars in the world. In re-sale today, a 1959 Les Paul in good condition can be easily priced between $100,000 and $500,000.

Well, the history still does not solve a very intrigue yet simple question… what is an electric guitar? Folks, an electric guitar is a type of guitar that uses "pickups" to convert the vibrations of its steel-cored strings into electrical current, which is then amplified. The signal that comes from the guitar is often electrically altered to achieve various tonal effects prior to being fed into an amplifier, which produces the final sound. Various devices commonly used by guitarists are meant to add distortion, wah-wah, equalization, tremolo, and phase shift, amongst others, in some cases radically changing the sound that is emitted from the amplifier.

The fundamental working parts of a guitar are its pickups. Although peculiar as it seems, its working is reflected by its name. It "Picks-Up" the oscillating frequency of the plucked string oscillating overhead and produces an equivalent frequency sinusoidal signal. The process underlying this marvel conversion is no hard nut



to

Pictorial representation of a single coil pickup (only one pole shown) at work

crack. There are two basic kinds of pickups, magnetic pickups and piezoelectric pickups, the latter meant generally for acoustic and semi-acoustic guitars. A magnetic pickup consists of a permanent magnet wrapped with a coil of a few thousand turns of fine enameled copper wire. In this case, due to magnetic nature of the pickups, opposite polarity poles are induced on the string lying overhead. When the string is plucked on a note, the string vibrates with that particular frequency. This causes a change in mutual induction between the pickup magnet and the string and hence causes a current to be induced in the pickup. The sinusoidal movement of the string causes the mutual induction to vary in a sinusoidal way and hence current of equivalent sinusoidal frequency is generated.

Since it is the pickup which generates the actual guitar sound output in the form of current, an electric guitar's sound greatly depends upon its pickups. As with all technologies, even the magnetic pickup system has its drawbacks. These single coil pickups are sensitive to magnetic fields and hence along with musical notes they also pick-up the power-mains hum, which usually consists of a fundamental signal at a nominal 50 or 60 Hz, depending on local alternating current frequency. This drawback proved a nuisance in live performances. To overcome this effect, Gibson pioneered the "Humbucking" pickup. A humbucking pickup comprises two standard pickups wired together with identical coils of opposite magnetic polarity. Hence the mains hum reaches the coils as common-mode noise and gets cancelled out. Now as the two pickups of a humbucker are wired in series the total inductance increases. Looking at this from a musical perspective, this lowers the resonating frequency and hence attenuates the higher frequencies, giving a fatter and less trebly tone accompanied by a more powerful sound due to summing of signals. This, my friends, has been the secret to the hidden powerful voice of the Les Paul, which comprised of two humbuckers.

Almost all electric guitars have more than one pickup, one each placed on the neck, middle and bridge or only on the neck and the bridge. Different parts of the string oscillate in a particular manner and hence produce a different sound. Refurbishing our old physics classes, we might remember that a string vibrates most freely at its center and somewhat vibrates under hindrance near the edges. As a consequence of this the sound produced by a pickup on the neck will be brighter in tone than that produced by a pickup on the bridge, the latter having a more twangy touch. To accomplish this pickup selection task all electric guitars have either a 3-way or a 5-way switch. Accompanying this switch, you will also notice volume and tonal controls on the guitar main board. The Volume control is realized by introducing a pot in series, whereas the Tonal control is realized by having a capacitor in parallel with the pot. The resistances of the pots lies in the range of 500kOhm and the capacitors are generally near 0.05mfd.

The above mentioned electronics accompanied by a one-by-four inch output jack sum up to pretty much whatever you will find in an electric guitar. Try it out for yourself, and then be ready for a disheartening shock. Why! The instrument sounds nowhere like a roaring mammoth. It sounds way too acoustic but even lacking the luster of an acoustic guitar. Did anything go wrong?

Guitar with two humbuckers one each on the neck (center) and the bridge (towards back)

Do you need to do some tweaking beforehand? Or is your instrument bad? Before you do anything, let us just refurbish what the guitar actually does. An electric guitar just produces a somewhat sinusoidal current signal and nothing else. Well then, what's the secret behind all those eccentric sounds produced by musicians? The secret lies in a small device known as the processor. It is this device that works on the guitar output and reshapes it to a desired waveform thereby ultimately sending it to an amplifier.

In the early days, vacuum tube amplifiers were used for processing the guitar output signals. Like any amplifier, these tube amplifiers had a maximum amplification above which they began to clip the peaks of the waveforms. While the distortion produced by this phenomenon posed as a nightmare for the common electronics engineer, it turned out to be a boon for the music industry. It was the likes of Jimmy Page and Jimmy Hendrix who realized the potential power in this new kind of music and hence gave birth to the era of Rock n Roll. This so called revolutionary effect is known as overdrive and distortion. As mentioned above, earlier vacuum tubes were used for producing distortion and overdrive. These analog devices were known as stomp boxes or pedals. With the advancement of technology, these analog devices have been replaced by their digital counterparts, which have the power to reproduce the legendary sound of the stomp boxes and to apply many such effects at the same time.

The distortion pedal uses a square wave generator in the form of a Schmitt trigger to introduce a variable frequency square wave to accompany or even replace the original signal. Today, overdrive effects usually mean soft clipping, where gain is reduced beyond the clipping point, while distortion usually means hard clipping, where the level is fixed beyond the clipping point. The overdrive effect gives a natural sound due to the maintenance of the sinusoidal structure whereas the latter distortion effect gives a harder and crunchier sound. The guitarist can control the gain (often labeled

A Vintage Distortion Pedal

as "Drive") that controls the amount of overdrive, the tone to compensate for additional highs caused by the actual clipping process and the volume (or "Level") to balance the effect volume in accordance to the players needs. In addition to the above mentioned two effects, other additional effects available by these devices are clean, wah-wah, reverb, delay, echo etc. All these effects can be cascaded one after another to produce a wide variety of tones, the variation of which can be increased

A Digital Guitar Effects Processor (Zoom GFX-5)

exponentially by changing the effect parameters.

An interesting fact about all the relationships between these devices is that no matter how superior quality effect processors you use, the required essence of sound that a true musician runs after comes only from the guitar itself. The factors definitely include the quality of pickups and strings used, but also hugely depend upon the wood with which the guitar's body is made, wood used on the neck and the fret-board, how the guitar is made, its shape, size etc. For all those guitar enthusiasts out there, the most important guitar buying tip is that you should go out over there, into the stores and play as much as you can. Only buy a guitar in which you feel comfortable playing and which suits your style of music. No matter how much costly or classic guitar you own, the essence of music can only be fragmented by the person playing the guitar. So unless and until you don't buy a guitar which fits your own style, you won't be able to play it with your full potential. The specialty of the music created by the likes of Jimmy Page from Led Zeppelin and David Gilmour from Pink Floyd came from their own individual style of fretting the guitar, each of which could never be duplicated by anyone else. So remember folks, no matter what lies behind, the beauty of the beast can only be unleashed by guitar player himself.

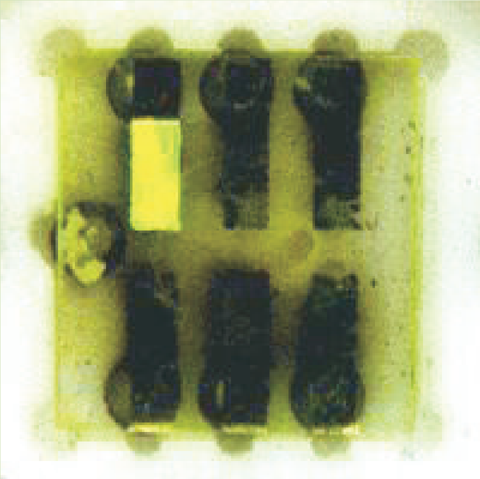
(By Vikram Jit Singh & Amit Pal, 3rd yr. B. Tech students at the Dept. of Electronics & Communication Engineering, IIT Guwahati)

Organic LED Displays (OLEDs)

- Talla Vamsi

Wouldn't you like to be able to read off the screen of your laptop in direct sunlight? Your mobile phone battery to last much, much longer? Or your next flat screen TV to be less expensive, much flatter, and even flexible? Thanks to a breakthrough technology called Organic Displays, this could soon be reality.

The OLED technology is based on a revolutionary discovery that light-emitting, fast switching diodes could be made from polymers as well as from semiconductors. Technically speaking, an OLED is composed of an emissive layer, a conductive layer, a substrate, and anode and cathode terminals. The layers are made of special organic polymer molecules that conduct electricity. Their levels of conductivity range from those of insulators to those of conductors, and so they are called organic semiconductors.



OLED works on the principle of recombination of holes and electrons (like conventional LED's) but here it happens closer to the emissive layer, because in organic semiconductors holes are more mobile than electrons (unlike in inorganic semiconductors). The recombination causes a drop in the energy levels of electrons, accompanied by an emission of radiation whose frequency is in the visible region. Indium tin oxide is commonly used as the anode material. It is transparent to visible light and has a high work function which promotes injection of holes into the polymer layer. Metals such as aluminium and calcium are often used for the cathode as they have low work functions which promote injection of electrons into the polymer layer.

A great benefit of OLED displays over traditional liquid crystal displays (LCDs) is that OLEDs do not require a backlight to function. Thus they draw far less power and, when powered from a battery, can operate longer on the same charge. OLED-based display devices also can be more effectively manufactured than LCDs and plasma displays. OLEDs can be printed onto any suitable substrate using inkjet printer or even screen printing technologies, hence they can theoretically have a significantly lower cost than LCDs or plasma displays. Printing OLEDs onto flexible substrates opens the door to new applications such as roll-up displays and displays embedded in clothing.

OLEDs enable a greater range of colors, brightness, and viewing angle than LCDs, because OLED pixels directly emit light. OLED pixel colors appear correct and unshifted, even as the viewing angle approaches 90 degrees from normal. LCDs use a backlight and cannot show true black, while an "off" OLED element produces no light and consumes no power. Energy is also wasted in LCDs because they require polarizers which filter out about half of the light emitted by the backlight. Additionally, color filters in color LCDs filter out two-thirds of the light. OLEDs also have a faster response time than standard LCD screens. Whereas a standard LCD currently has an average of 8-12 millisecond response time, an OLED can have less than 0.01ms response time.

OLED technology is nowadays used in commercial applications such as small screens for mobile phones and portable digital audio players (MP3 players), car radios, digital cameras and high-resolution microdisplays for head-mounted displays. Such portable applications favor the high light output of OLEDs for readability in sunlight, and their low power drain. Portable displays are also used intermittently, so the lower lifespan of OLEDs is less important here. Prototypes have been made of flexible and rollable displays which use OLED's unique characteristics.At the Las Vegas CES 2007, Sony showcased 11-inch (28 cm, resolution 1,024×600) and 27-inch (68.5 cm, full HD resolution at 1920×1080) models claiming million-to-one contrast ratio and total thickness (including bezels) of 5 mm. On October 1st, 2007,Sony became the first company to announce an OLED television, which will be released in Japan in December 2007.

Research and development in the field of OLEDs is proceeding rapidly and may lead to future applications in heads-up displays, automotive dashboards, billboard-type displays, home and office lighting and flexible displays. Because OLEDs refresh faster than LCDs -- almost 1,000 times faster -- a device with an OLED display could change information almost in real time. Video images could be much more realistic and constantly updated. The newspaper of the future might be an OLED display that refreshes with breaking news and like a regular newspaper, you could fold it up when you're done reading it and stick it in your backpack or briefcase. So, sit back and enjoy the power of OLED technology.

(Talla is a 3rd yr. B. Tech student at the Dept. of Electronics & Communication Engineering, IIT Guwahati)

A New Method to Generate Binomial coefficients for Efficient Hardware Implementation

In Phase - Technical Article

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Generation of binomial coefficients for a binomial of order $n \geq 0$ and $n \in$ N in hardware by direct method using binomial theorem requires $2n^2 - n - 3$ multiplication operations and $n+1$ division operations. Multiplications and divisions are very complex processes and require many clock cycles to carry out the operations. In this article a new method for generation of these binomial coefficients has been suggested which requires only n shift operations and $n-1$ addition operations to obtain cofficients for a binomial of order n. Also a simple block diagram has been presented to implement this method in hardware and it's operation has been discussed in this article.

I. Introduction

An expression of the form $a+b\ ^n$; a, b $\in \mathbb{R}$, n $\geq$ 0and n $\in \mathbb{N}$, is called a binomial expression [1] of order/exponent/index n. One of the earliest methods known to expand these binomial expressions of different positive integral indices is 'Pascal's Triangle', named after the French mathematician Blaise Pascal [2] (June 19, 1623 - August 19, 1662). Pascal's Triangle is a triangle in which each row has one more entry than the preceding row, each row begins and ends with "1", and the interior elements are found by adding the adjacent elements in the preceding row. The first row i.e. row 0 of this triangle corresponds to the index n = 0. The triangle is symmetrical about it's central entry/entries for even and odd indices respectively.

1	row 0
1 1	row 1
1 2 1	row 2
1 3 3 1	row 3
1 4 6 4 1	row 4
1 5 10 10 5 1	row 5
1 6 15 20 15 6 1	row 6
1 7 21 35 35 21 7 1	row 7
...	

Fig 1. Pascal's Triangle

In Row 6, for example, 15 is the sum of 5 and 10, and 20 is the sum of 10 and 10. Note that the triangle begins with Row 0. The most common and compact method to get binomial coefficients has been contributed by Sir Isaac Newton [3] (January4, 1643 - March 31, 1727) which is widely known as 'Binomial Theorem'. The theorem states that the $(r+1)^{th}$ coefficient in the expansion of a binomial of order n will be given by ${}^nC_r$ where n! represents the product of first n natural numbers starting from 1, i.e. n! = n(n − 1)(n − 2)3 · 2 · 1. 0! is defined as 1. So expansion of a binomial into a series will be

$$(a+b)^n = {}^nC_0a^n + {}^nC_1a^{n-1}b + {}^nC_2a^{n-2}b^2 + \cdots + {}^nC_{n-1}a^1b^{n-1} + {}^nC_nb^n$$

In a more general form $(a+b)^n = \sum_{r=0}^{n} {}^nC_r a^{n-r}b^r$ for $n \in \mathbb{N}$. In this expansion, coefficients ${}^nC_o, {}^nC_1, \ldots {}^nC_r \ldots, {}^nC_n$ are known as binomial coefficients. Note that there are (n+1) coefficients in the expansion of a binomial of order n.

II. Problem Formulation

In hardware implementation of binomial coefficients generator if we employ a direct method to generate these coefficients using binomial theorem, then in order to get any coefficient ${}^nC_r$ we need to do (n − 1) + (r − 1) + (n − r − 1) = 2n − 3 multiplication operations and one division operation. Proceeding in this way, in order to get all the coefficients in the expansion of a binomial we require $(n+1)(2n-3) = 2n^2 - n - 3n - 1$ multiplication operations and n+1 division operations. Multiplication using hardware is a very complex process and requires many clock cycles [4]. In this article a new method to get these coefficients has been devised which avoids the complexity of multiplication and division processes. This method employs the shift and addition processes, much simpler and easy to implement using hardwares compared to the process of multiplication and division.

III. Suggested Method

The suggested method is a result of observation that the simplified form of the exponential $(11)^n$, $n \in \mathbb{N}$ gives the binomial coeffients corresponding to index n. Observe that

$$11^0 = \mathbf{1}$$
$$(a+b)^0 = \mathbf{1}$$
$$11^1 = \mathbf{11}$$
$$(a+b)^1 = \mathbf{1}a + \mathbf{1}b$$
$$11^2 = \mathbf{121}$$
$$(a+b)^2 = \mathbf{1}a^2 + \mathbf{2}ab + \mathbf{1}b^2$$
$$11^3 = \mathbf{1331}$$
$$(a+b)^3 = \mathbf{1}a^3 + \mathbf{3}a^2b + \mathbf{3}ab^2 + \mathbf{1}b^3$$
$$11^4 = \mathbf{14641}$$
$$(a+b)^4 = \mathbf{1}a^4 + \mathbf{4}a^3b + \mathbf{6}a^2b^2 + \mathbf{4}ab^3 + \mathbf{1}b^4$$
$$11^5 = \mathbf{161051}\ ??$$
$$(a+b)^5 = \mathbf{1}a^5 + \mathbf{5}a^4b + \mathbf{10}a^3b^2 + \mathbf{10}a^3b^2 + \mathbf{5}ab^4 + \mathbf{1}b^5$$
$$11^6 = \mathbf{17715161}\ ??$$
$$(a+b)^6 = \mathbf{1}a^6 + \mathbf{6}a^5b + \mathbf{15}a^4b^2 + \mathbf{20}a^3b^3 + \mathbf{15}a^2b^4 + \mathbf{6}ab^5 + \mathbf{1}b^6$$
$$\ldots$$

Fig 2. Binomial coefficients by exponentiation method

It is quite clear that coefficients for a binomial of order n, n $\in$ N can be obtained from $(11)^5$. For example, $(11)^4$ = 14641 implies coefficients for the binomial of order 4 will be 1, 4, 6, 4 and 1 which is true as ${}^4C_0$ = 1, ${}^4C_1$= 4, ${}^4C_2$ = 6, ${}^4C_3$ = 4 and ${}^4C_4$ = 1. But in this method problem arises when index becomes greater than or equal to 5, as $(11)^5$ = 161051 and segregating the individual digits from it doesn't give valid coefficients. This problem can be solved by obtaining coefficients for order n+1

from $(11)^n \times 11$, where $(11)^n$ corresponds to the binomial coefficients for the index n. This multiplication is carried out by adding the corresponding elements of a column in
a product and grouping them separately. For n = 5 the procedure has been illustrated to find the coefficients from $(11)^4$ = (1)(4)(6)(4)(1) by multiplication of $(11)^4$ with 11 to obtain $(11)^5$.

$(11)^5$ = $(11)^4 \times 11$

(1) (1)(4)(6)(4)(1)
+ (1)(4)(6)(4)(1)
____
= (1)(5)(10)(10)(5)(1)

Continuing in this way coefficients corresponding to order n+1 can be obtained from the coefficients of binomial of order n. Hardware implementation of this process can be done by
loading the coefficients for oder n i.e. $(11)^n$ in a linear register array of size n+1 and shifting the content of this array to another linear memory array of same size but shifted by one register to mimic the process of multiplication by 11 and adding the contents of the corresponding registers will give the coefficients corresponding to the binomial of order n+1. The detail process of implementation and operations has been given discussed in the next section.

IV. Hardware Implementation and Circuit Operation

A simplified block diagram for the hardware implementation of above processes has been drawn below :

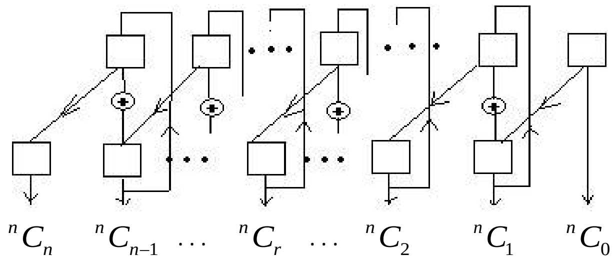

Figure 2 :Simplified block digram for hardware implementation

In this diagram □ and ⊕ represents register to store the coefficients and the addition operation respectievely. Direction of arrows → shows the direction in which data have to be shifted.

On starting the system all theregisters are reset to zero except the upper left one, which is set to one. To compute coefficients for index n, 2n clock pulses are required. On first clock pulse contents from the upper array are transferred to the lower array. On the second clock pulse corresponding register contents are added and the result is loaded into the corresponding registers in the upper array. This process is continued till 2n clock pulses are consumed. The final result is obtained by taking first n + 1 results from the right. These n + 1 values give the
required binomial coefficients. The process has been illustrated below for some particular values of indices :

A. n = 0

Number of clock pulses required = 0, i.e. no clock pulse required.
Operation : No operation.
Results : Take 0 + 1 = 1 outputs from the right. That will give the binomial coefficient corresponding to n = 0.

B. n = 1

Number of clock pulses required = 2.
Clock pulse 1 : Shift contents of upper array to lower array of registers.
Clock pulse 2 : Add the corresponding register contents from upper and lower arrays and load the summation to the upper array in correspongin spaces.
Results : Take 1+1 = 2 outputs from the right. Those will give the coefficients for n = 1 in the order $^1C_0$, $^1C_1$ starting from the right.

C. n = 2

Number of clock pulses required = 4.
Clock pulse 1 : Shift the contents of upper array to lower array of registers.
Clock pulse 2 : Add the corresponding memory space contents from upper and lower arrays and load the summation to the upper array in corresponding registers.
Clock pulse 3 : Shift the contents of upper array to lower array of registers.
Clock pulse 4 : Add the corresponding register contents from upper and lower arrays and load the summation to the upper array in corresponding spaces.
Results : Take 2+1 = 3 outputs from the right. Those will give the coefficients for n = 2 in the order $^2C_0$, $^2C_1$, $^2C_2$, starting from the right.

D. n = 3

Number of clock pulses required = 6.
Clock pulse 1 : Shift the contents of upper array to lower array of registers.
Clock pulse 2 : . . .
. . .
Clock pulse 6 : . . .
Results : Take 3+1 = 4 outputs from the right. Those will give the coefficients for n = 3 in the order $^3C_0$, $^3C_1$, $^3C_2$, $^3C_3$ starting from the right.

E. n = 4

Number of clock pulses required = 8.
Clock pulse 1 : . . .
Continuing in this way we can generate binomial coefficients for any positive integral index n and for this purpose we'll be requiring 2n clock cycles. Shift and addition operations are done on alternate clock pulses as demonstrated above till all the 2n clock pulses are consumed.

V. Conclusions

By employing this new method for the generation of binomial coefficients, we have reduced the complexity of $2n^2 - n - 3$ multiplication operations and n + 1 division operations to 0+1+ +n = $\frac{n(n+1)}{2}$ addition operations and

$2\ 0+1+2...+n\ = 2\left\{\frac{n(n+1)}{2}\right\} = n^2 + n$ shift operations. In order to perform all these operations of additions and shift only 2n clock pulses are required for a binomial of index n, which is much lower than the number of clock pulses required in carrying out $2n^2 - n - 3$ multiplication operations and n+1 division operations.

References

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London: Macmillan, 1960.
[2] http://en.wikipedia.org/wiki/Blaise Pascal
[3] http://en.wikipedia.org/wiki/Isaac Newton
[4] J. M. Rabey, A. Chandrakasan, B. Nikolic, "Digital Integrated Circuits,"Pearson Education, 2nd edition, 2003.

Internship Italiano !!

Reminiscence and musings from Final year's Harsh Fadnavis after a memorable internship in Italy.

Perhaps the most awaited moment for the 3rd yearites is on its way, naïve, but definitely awaited! For me, the day was 8th April, when I received the confirmation of my internship in Italy. I was assigned a studentship for 3 months with a predetermined stipend. My work involved MATLAB survey and implementation of a wireless channel model for a given frequency range. Specifically, I had to implement the physical layer of the channel model, while a Phd student was working on MAC layer protocols.

The university was located near lush green forests and deep blue waters, and inhabited by Italy's most bon vivant people, the city boasts of a rich heritage and blissful serenity. I was given an apartment, fully furnished, with a kitchen and a big bedroom. Every morning, I used to wake up at 7, go out in the balcony for a view of the coast, get ready and carry my laptop to the university which was at a 5 min walking distance. Given the fact that the university is not rated highly in Europe, I was taken aback by the amazing infrastructure and the environment in the laboratories. The work culture in laboratory was one of the things that really made me love that place. The lab was open 24X7 and there were no rules defining the timings in and out. The students and the professors shared a relationship of not only respect, but also friendship and understanding.

My initial days were spent in reading and doing a literature survey. I was assigned a PC in a cubicle and I was treated like no outsider, but a part of their team. Probably its because of the societal structure here, but in my 3 and half years of B.Tech I have never found a professor coming to me, patting my back and asking me whether I am doing fine or not, leave aside offering lunch and discussing Paris Hilton. These kind of small things, though trivial, go a long way in creating a bonding and we should all strive to consciously create such an environment here too. This was one of the reasons I enjoyed working there, and one of the reasons why I will never forget the experience and always cherish it. I was given coupons for my meals so I never really had to spend much on my food. And in a few days I got used to a rich heavy meal, and a glass of Sicilian wine, all for no money!

I usually stayed in the lab till 6 pm and then leave for my apartment to dump my laptop and go to 'via marina' , which is where, as people say, the real colours of Italy can be seen. A long straight path canopied with huge street lights on both sides, a beach on the right with huge frothy waves gushing from the vast ocean, and a large number of contiguous shops, all adorned with colours and sparkling lights on the left. Streets thronged by Italians, known for their joviality and artistic expressions, fine taste of food and wine, the scene and the ambience made me feel relaxed every time I visited that place. And it was this way every evening, regardless of whether it's a festival or not. I spent the first two weekends seeing the beautiful city, meeting new people and making friends.

One thing almost every person who visits Europe, realizes, is that one can very easily reach from one part of the continent to the other within no time and at very cheap rates. Which is why I decided to make trips to Paris, Rome, Amsterdam, Brussels etc. one weekend after the other during this short time. Every Monday, I had to submit a report of my weekly updates. On Tuesdays, I along with the Phd scholar and my professor used to meet in a cafeteria and discuss the progress. What motivated me the most was the fact that I was working on a project that was funded by the EU and the fact that my work was going to make a difference. I must say, the university surely may be ranked below IITs, that is if that kind of comparison can be made in the first place, but I really doubt this when it comes to the overall work environment, infrastructure and administration. In brief I can say that these three months were probably the best part of my life till now, meeting new people, of new culture, working in new environment, seeing a new world (which also includes seeing 2 of the 7 wonders!:), gaining some insight to how research work goes on, how intricate even a small error can become if not handled at the right place. I learnt a lot from this internship socially, academically and personally… the most awaited moment has now really become the most cherished moment….again I would say - though naïve!

Signal Processing......

What is it for, really?

-Amit Juneja

It was the 2nd year (1996-1997) when Professor K. S. Venkatesh (currently at IIT Kanpur) was teaching the Signal Processing course to our ECE batch. The course was, of course, taught with the extreme passion, interest, articulation and devotion that "Venky" was famous for. While I loved the subject matter - containing mostly mathematics and little practical orientation - I and many others wondered, "What is this for?". The question was answered to a good measure by the time we graduated and as we took other courses, did projects and came across various applications. Still my appreciation for the wide applicability of signal processing has been perpetually increasing since then.

I once told a professor at Boston University (during my Masters) about a computed tomography (explained in the next paragraph) project that I did at IITG as a part of a signal processing course. He replied, "What did that have to do with signal processing?". A simple question but I was dumbfounded. The project had been based on a method called “algebraic reconstruction” and it involved no Fourier/other transforms, no filters, and not even the sampling theorem. I could not answer what the project or tomography in general had to with the theory I learnt in the signal processing classes. In my first job after PhD (University of Maryland College Park) I was involved in building algorithms for computed tomography (CT) scanners and I intensively applied signal processing methods to solve the problems at hand.

In CT, an X-ray source moves either in circles or in one big spiral around the full or a certain part of the human body. The X-rays attenuated by the human tissues are captured by photon detectors at a preset sampling rate. “Reconstruction”, as applied to CT, is then the process of making images of internal human tissues from the photon counts measured at the detectors. One of the minor issues is to “convert” data collected at M samples per rotation to N samples per rotation. It is, of course, not possible to successfully achieve this goal without the understanding of the sampling theorem. A commonly used algorithm for reconstructing medical images from the raw detector data is called the “filtered backprojection”. Two very basic components of the filtered backprojection method are (1) an FFT (Fast Fourier Transform) and an inverse FFT, and (2) a frequency domain filter. The raw data collected at the detectors contains many artifacts that distort the reconstructed images. Digital filters are used extensively to fix these artifacts, and sophisticated filter design methods are used to design those filters.

It is easy to forget that signal processing is all around us in our day-to-day life. Your cell phones have various signal processing components - anti-aliasing filters, algorithms for speech compression inspired by a frequency domain representation of speech, communication protocols involving modulation and multiplexing methods, cancellation of echo (speaker output that is captured by the microphone) using adaptive filters, and so on. Your digital cameras, the digital videos you watch using the internet or digital cable or DVDs, soundcards, video cards, noise cancelling headsets, all contain algorithmic components that require a thorough background in signal processing to work on.

Apart from the applications in the electrical engineering field that typically involve speech, music, images, video and communication, there is also a plethora of ever-increasing and interesting narrowly focused applications. People apply it to study the structure of proteins using mass spectrometers, analyze deep space data from various kinds of telescopes, analyze meteorological data for weather forecasting, forecast the stock market trends using financial data, etc. If you are bored of electrical/electronics engineering you can take your knowledge of signal processing and make a relatively smooth transition to another field using it. Such fields typically include bioinformatics, finance, experimental physics, etc. A keyword search of “signal processing” on the job site www.monster.com gives more than 1000 hits in US alone.

Currently I work as an engineer in the R&D team in a start-up company called “Think-A-Move, Ltd” where I am able to make an intensive use of my IITG and graduate school background in signal processing and speech recognition. Some of you - the current ECE students at IITG - will switch to fields where they will not use much of the ECE knowledge. For those of you who won't I hope you will cherish the knowledge you gained from the strong faculty at IITG. I cherish it every time I solve a signal processing problem at work.

(The author is a 99 batch alumni, graduating in ECE from IITG. He completed his Doctoral degree from the University of Maryland College Park and now works for a start up 'think-a-move'. Mr.Juneja`s initiative, a website by the name of 'scientific India' promotes and encourages the work of Indian`s in the field of science.)

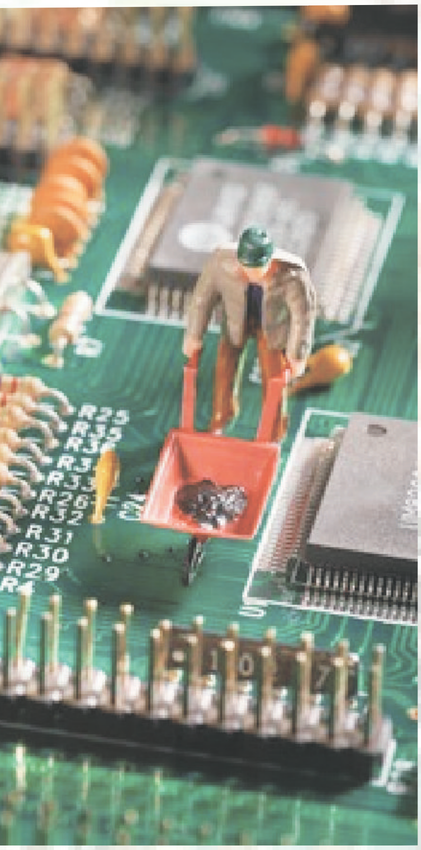
What would I be........
.....if not an engineer?

By Paul Vincent, EE Times
This article appeared in the Embedded.com online magazine

I am an engineer. Period. I have always loved the adventure and challenge of creative problem solving, of finding a way to make something work and persuading others to let me do it. If I were not an engineer, I suppose I would be an architect. Then again, maybe I would be an attorney, or a psychiatrist, an entrepreneur, a novelist, a performer.

Being an engineer at heart, I find that most other careers provide only portions of what I love about engineering. The truth is, I would probably find most other careers too limited in variety and challenge.

What attracts me to architecture is how it blends inspiration with utility. I once engineered a remote control for whole-house automation. It provided the utility of control of all in-house systems while being intuitive enough for a guest to be able to use. It had to fit into your hand, look perfectly in place next to the good china and inspire oohs and ahs from visitors.



Being an attorney provides the opportunity for competitive persuasion. Facts and evidence are great, but how well they are researched, understood and presented makes all the difference in the world to the outcome. Engineering is full of competing ideas, trade-offs and pathways to end solutions. They must be researched, strategically weighed out and agreed upon. The pathway from idea to end product is greatly shaped by engineers' abilities to understand the requirements and persuade themselves and others of the best possible solutions.

Psychiatrists help people understand that what you get out of life is largely due to what you put in. They have to deal with stress, insanity, emergencies and finding balance. They help people cope with life, deal with change, find strength, overcome weakness. Engineers have to deal with the laws of physics: You can't get more out of a system than you put into it. They have to balance target requirements with reality, time and effort. Engineers constantly deal with change: feature creep, performance failures, resources, international design efforts and technologies, and more. New designs have to strengthen output power, range, throughput, user interface and functionality while overcoming weaknesses in power consumption, size and noise susceptibility.

Entrepreneurs deal with creating strategy, organizing resources and generating plans of action to form new businesses. Entrepreneurs are evangelists for ideas and their potential to yield a return on investment. They form ideas into viable, compelling business plans. I've been an entrepreneur. I founded a company, raised millions of dollars, created a product, presented it to the market, sold it to customers and moved on to other adventures. Every engineer requires the wherewithal for strategic planning--a course of action for project completion. Engineering requires getting buy-in for budget, tools, talent, resources and schedule. Ideas have to be sold to those who need to contribute to making them reality.

Novelists are communication artists. They use words to create understanding in their readers' minds. Books solidify ideas so that people can envision and follow a story. Writers create definition and personality for characters and depict how they interact. Books create a reproducible standard that can be interpreted and delivered in many languages. I have written thousands of pages of architectural specifications, product feature requirements, design reviews, theories of operation, research findings, project plans and technical specifications. For groups to work together effectively, they must be on the same page when it comes to project specifications, component specs, interface specs, performance requirements and intended operation. It is not good enough to write documents that you can understand; it is neces-sary to write documents that others will not misunderstand.

Performers are artists who make complicated actions look simple. A good and entertaining performance requires preparation, timing, coordination, the right materials, a lot of skill and a little luck.

Engineering is like a good song and dance. It requires a lot of coordination--and a lot of failure in practice before the final presentation. The quality of the final product is directly related to the combined talent of the company. Engineering also requires good frequency control, noise reduction and contingency plans, and often improvises when things don't go as planned.

I remember as a youth pulling apart an old phonograph and a small transistor radio to create a stereo sound system. I remember taking over installation of the electrical wiring in our house when my father was having difficulty with a four-way switch. I remember my first electronics kit and putting together all the projects. I remember plugging my first multimeter into a 120-volt outlet and making sparks because I had used the wrong inputs.

I guess I have always been destined to be an engineer. And in a way, choosing to be an engineer has enabled me to be much, much more.

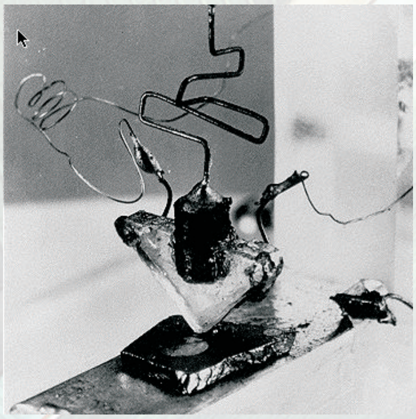
Why would I choose to be any one other thing, when being an engineer has enabled me to be so many?

(Paul Vincent is mixed-signal ASIC team manager at Cirque Corp. - Salt Lake City, USA)

In the Beginning

For a long time the USA led the world in microelectronic technology. Even today other countries are only keeping pace with it, no one has managed to surpass it. How did the USA manage to set up this industry? Can India do the same thing? Let's see how it all started.

Microelectronic technology is very complex. The design and production of microelectronic devices involve chemical, mechanical, metallurgical, and photographic processes, each complex in itself. Furthermore because microelectronic is a science-rich technology it frequently benefited from advances in scientific technology. So we have a situation in which you know the improvements to be made (e.g. lesser impurities, reduced size so on), but we don't know how to exactly go about it. But due to the diverse areas involved there was great potential for innovation. Or as Nathan Rosenberg so succinctly put it, “The essential feature of technological innovation is that it is an activity that is fraught with many uncertainties. This uncertainty, by which we mean an inability to predict the outcome of the search process, or to predetermine the most efficient path to some particular goal, has a very important implication: the activity cannot be planned.”



This means that a single company cannot always solve problems on its own. This problem is even bigger when the industry is in the nascent stage and you do not have huge multinationals like Intel today. So how did the industry flourish? The fact of the matter is that it had help. Lot's of help. Not only did the US government provide a lot of funding to the companies, it also provided an assured market for them. That is, it brought all the products of these companies, provided that these products were state of the art. The US still follows this policy today. DARPA is an agency which funds companies involved in cutting edge research. Not only does it fund them it makes sure that the US military buys those products. Hence providing a very important boost to these start ups. That is why the US has had such success with innovation.

However an assured market is not the only thing which allows this superiority. In the early 1950s Bell Telephone Laboratories (BTL) was the world's richest source of technical and scientific information about transistors and semiconductor materials. BTL garnered the first military contract for R&D in transistor technology a Joint Services contract issued in 1949 and extended consistently throughout the 1950s. A provision of the Joint Services contract required BTL to hold a symposium in 1951 for invited military personnel and contractors. "We have been in touch with members of the three Military Departments regarding recent transistor developments in Bell Telephone Laboratories," D. A. Quarles, a vice-president of Bell Labs, wrote to those nominated to attend. The developments "may have application in the field of military equipment, "and so "it has seemed desirable to make this information available at the earliest feasible date to as many in military and in military contractor organizations as can be accommodated.” Hence we see that that information was made freely available not just to the government but also to other companies. This transfer of knowledge was critical to the success of the industry.

But this dissemination did not stop at conferences. For other firms, patents that resulted from military projects were subject to compulsory, royalty-free licensing for military purposes. Because most if not all microelectronics manufacturers were also military contractors, patents were not an effective barrier to the flow of information in the early years of the microelectronics industry. This patent policy was part of a conscious government effort to promote the usefulness and efficacy of its research outlays. The distribution of technical and scientific information was as essential to this plan as increased funding for R&D and for larger and more modern production facilities.

These days patents are regarded as sacrosanct. The US and the multinational companies promote this attitude wherever they can, so it is quite surprising to find that at one time these same multinationals thought so little of them. In fact industry. In the early years, firms frequently infringed each others' patents in, explicit recognition of the need for innovations on many different technical and scientific fronts. Patent holders calculated that prosecuting infringers would halt their own access to the infringers innovations as likely infringers themselves they were not interested in promoting prosecution. This dynamic changed as the technology matured, innovative opportunities became less common and a few firms came to control crucial patents.

The military did not just wait for the companies to develop products and make new discoveries. They took a very active approach and told the industry of their needs. The Army, for example, established the Qualitative Development Requirements Information program" to alert industry to the unsolved problems confronting the Army," the Army Research Technical Studies program" to inform industry of the current research programs underway," and the Unfunded Study Program" to encourage industry to submit unsolicited proposals that might benefit the future development of Army materiel. This had immediate results. Raytheon for example, quickly applied transistor to some of its products, hearing aids; Philco Corporation soon produced junction transistors by an electrochemical process; GE produced junctions by an alloying process. Another example was that of NASAy8. The explicit purpose of NASA's Office of Technology Utilization was to see that technologies developed in the course of space-related R &D made their way quickly and efficiently into industry's hands.

Clearly the huge multi-billion dollar industry that we see today could not have reached its present day strength if it did not have so much help. There is an important lesson here for us. If we in India want to set up a thriving industry like in the US and Japan and Korea and other countries it is clear that the government will have a big hand in it.

Upcoming student challenge - Microsoft Imagine Cup '08

"The Imagine Cup is one way Microsoft is encouraging young people to apply their imagination, their passion and their creativity to technology innovations that can make a difference in the world – today. Now in its sixth year, the Imagine Cup has grown to be a truly global competition focused on finding solutions to real world issues."

The theme this year is -
"Imagine a world where technology enables a sustainable environment." Entry is currently open and the contest categories are:

Embedded Development, Game Development, Project Hoshimi, IT Challenge, Algorithm, Photography, Short Film, Interface Design

IIT Guwahati teams have been participating in this contest for last two years and winning laurels as well. Contact Saurabh Nangia, 4th yr. CSE (s.nangia@iitg.ernet.in) for more details.

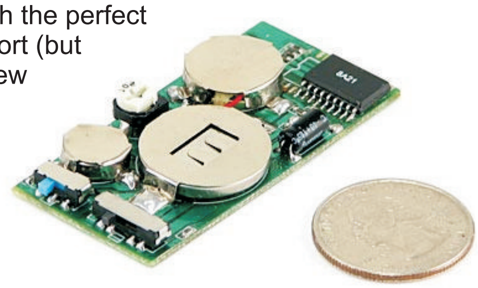
Contest website - http://imaginecup.com/

Crazy Gadgets

Here's our pick of some cool, crazy gadgets, that only geeks would dare possess. Certainly a lot of imagination has gone into their making and you would need a lot of that to use them as well.

- assorted from 'cyberspace'

Annoy-o-tron



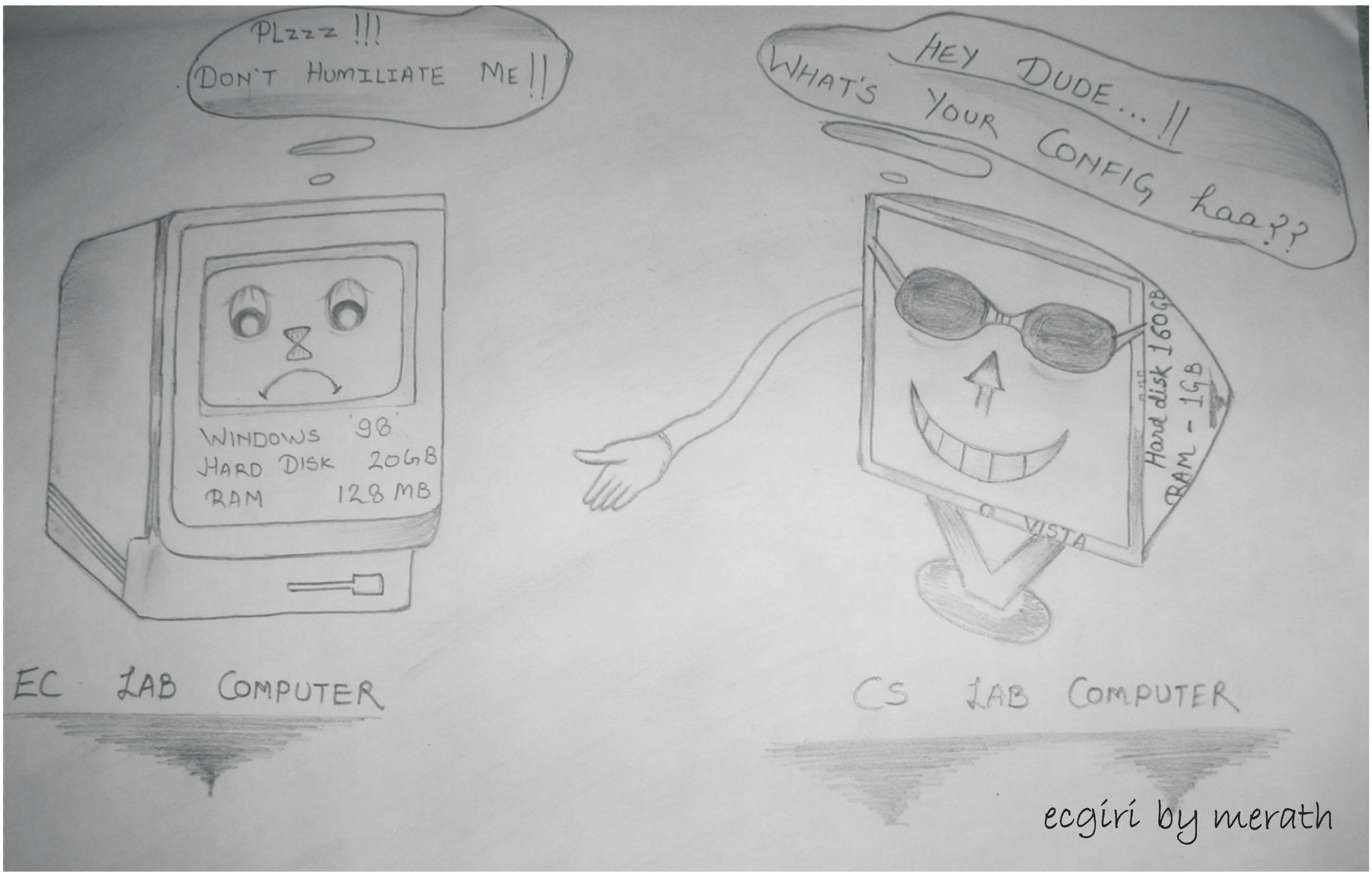
Ever felt the nagging need to just annoy the hell out of some one!! Well, electronic geeks have come up with the perfect 'toy' for you. The Annoy-a-tron generates a short (but very annoying, hence the name) beep every few minutes. Your unsuspecting target will have a hard time 'timing' the location of the sound because the beeps will vary in intervals ranging from 2 to 8 minutes. Just select a higher frequency for n even annoying noise.

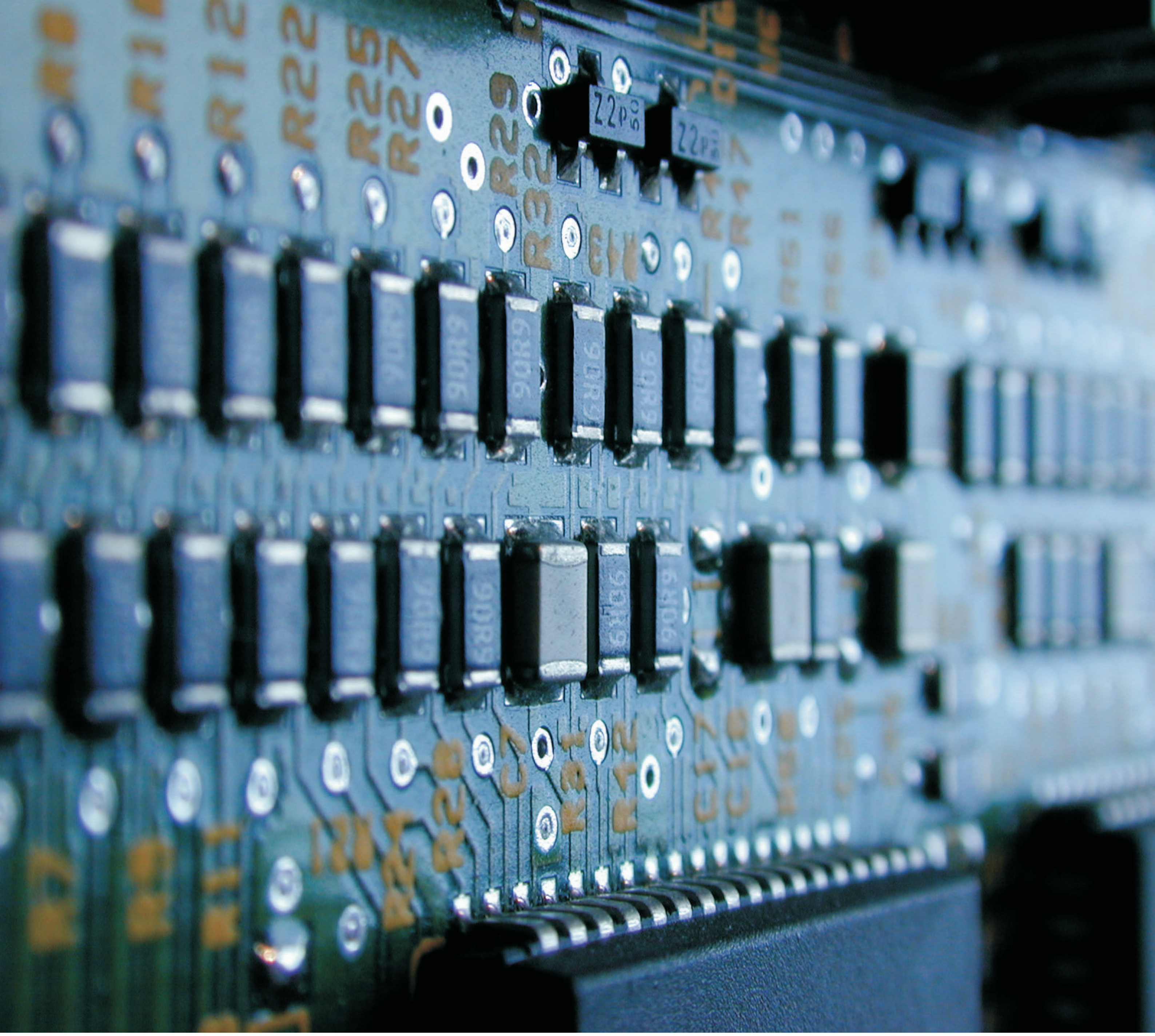
Light-Talk

Picture this: you are in a class, bored out of your mind. So you doodle on your note pad, pretending to take notes. Suddenly, you realize you might have created the world's greatest doodle and you need to share it with your equally bored friend, sitting right next to you. Pull out your LighTalk II; problem solved. With a push of a button, the LighTalk II has scanned the image into its memory. Flip the switch to the display mode, and wave the pen-shaped LighTalk II back and forth like an upside down pendulum. Your image will be created in the air by a strip of orangey LEDs, and all will be amazed. Persistence of vision at it's best.

Intelli-umbrella

. The Ambient Forecasting Umbrella, however, has received the ultimate upgrade - it's been made smarter. It tells you when you need to take it along with you. This umbrella has been injected with some wonderful technology in the handle. A built-in wireless receiver gets a daily weather forecast from Accuweather.com, and blue LEDs will flash to let you know if the forecast is rain or snow.





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