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From the HoD's desk

Return to Science and Technology

Recently, it seems, the gap between talent supply and demand is widening. Number of unemployed graduate engineers is increasing every year. Engineering students all over the state, who have graduated with placements in IT industries, are plagued with doubts about the sustainability of the IT industry and the reliability of the job, as many companies could not retain their major US clients due to the financial crisis over there.

In the past few years the opportunities in the IT field were immense, and there was large intake of fresh graduates, with hefty packages. Therefore, young graduates have not shown any interest on higher studies or research activities.

The US economy is taking a really bad toll of the events so far, with major banks and Wall Street firms seeking to borrow more money from the Federal reserves. The bailing out of AIG, one of the most powerful financial institutions of the world by the Federal reserves is itself testament to the dangerous economic times we face.

On the Indian front also, news has not been very comforting. Inflation rate remains at above 12% and things are not looking very good for the IT industry either. This recent turn of events must form an eye opener for creating awareness among budding engineers. So is it "safe" to choose a carrier in IT only? Or, should we rather choose the core field we study?

I hope the Apptronics bulletin continue its endeavor to create this awareness among students so as to improve their innovative thinking in the area of science and technology.

Contents

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Major events in the Department of Applied Electronics and Instrumentation

Apptronics association inauguration and bulletin release were done at Seminar Hall, RASET on 30-08-2008.

What the readers say...

I felt you should have used colour printing to make it more attractive.

-**Bibin Mathew Jose**

Yes. Definitely colour printing will make it attractive. We understand the importance of colour in communication using print medium. Sure, we will not hesitate to use it whenever needed. Thank you.

Inauguration and address by chief guest Dr. K. Gopalakrishanan Nair (Director- Centre for Science in Society-CUSAT)

ASIMO

Want a robot to cook your dinner, do your homework, clean your house, or get your groceries? Robots already do a lot of the jobs that we humans don't want to do, can't do, or simply can't do as good as our robotic counterparts. In factories around the world, disembodied robot arms assemble cars, delicately place candies into their boxes, and do all sorts of tedious jobs. There are even a handful of robots on the market whose sole job is to vacuum the floor or mow your lawn.

From Honda Motor Co. in 1997comes a new small, lightweight humanoid robot named ASIMO that is able to walk in a manner which closely resembles that of a human being. ASIMO, which stands for **Advanced Step in Innovative Mobility**, is the most advanced humanoid robot in the world. According to the ASIMO Web site, ASIMO is the first humanoid robot in the world that can walk independently and climb stairs. One area of Honda's basic research has involved the pursuit of developing an autonomous walking robot that can be helpful to humans as well as be of practical use in society. Research and development on this project began in 1986. In 1996 the prototype P2 made its debut, followed by P3 in 1997.

"ASIMO" is a further evolved version of P3 in an endearing people-friendly size which enables it to actually perform tasks within the realm of a human living environment.

In addition to ASIMO's ability to walk like we do, it can also understand pre-programmed gestures and spoken commands**,** recognize voices and faces and interface with IC Communication cards**.** ASIMO has arms and hands so it can do things like turn on light switches, open doors, carry objects, and push carts. ASIMO is 4 feet 3 inches (1.3 meters) high, which is just the right height to look eye to eye with someone seated in a chair.

ASIMO has hip, knee, and foot joints. Robots have joints that researchers refer to as "degrees of freedom." A single degree of freedom allows movement either in right, left, up or down. ASIMO has 34 degrees of freedom spread over different points of its body in order to allow it to move freely. ASIMO's vision system consists of two eyes, located in its head.
It has a speed sensor and a gyroscope sensor mounted on its body.

ASIMO performs the tasks of:

- sensing the position of its body, and the speed at which it is moving
- relaying adjustments for balance to the central computer

ASIMO also has floor surface sensors in its feet and six ultrasonic sensors in its midsection. These sensors enhance ASIMO's ability to interact with its environment by detecting objects around ASIMO and comparing gathered information with maps of the area stored in ASIMO's memory.

History of ASIMO

1986– Static walking
In static walking, after the robot begins moving one foot forward, it has to wait until it has its weight balanced on that foot before it begins to move the other foot forward.

1987–Dynamic walking
By now engineers had developed a method for "dynamic walking," which is much more human-like.
1997 – ASIMO

2005–ASIMO became Better, Faster and Stronger.
Engineers further refined ASIMO's motion system, boosting its walking speed from 2.5 to 2.7 kilometres per hour and giving ASIMO the ability to run at speeds up to 6 kilometres per hour. The engineers switched ASIMO's power supply to a lithium battery that doubles the amount of time it can operate before recharging. They also implemented the IC Communication card technology that helps ASIMO interact with people. New sensors allowed ASIMO to move in sync with people while holding hands.
Current researchers are focussing on reducing the cost and power requirement of ASIMO.

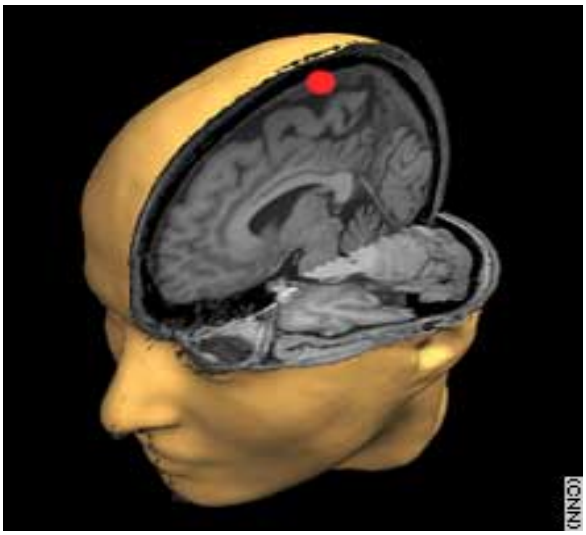
ASIMO does jobs that are too dangerous for humans to do, like going into hazardous areas, disarming bombs, or fighting fires. May be, the day is not far when ASIMO will replace human beings completely!!!

- Mohammed Shageel (S7 AEI)
Anuj Abraham

BRAINGATE

Those who have lost control of their limps, or other bodily functions don't lose heart, there is a new technology called BRAINGATE which helps us to retrieve the control of that body part. This technology converts thoughts into action. This was developed by the bio-tech company Cyber-kinetics in 2003 in conjunction with the Department of Neuroscience at Brown University.

The BrainGate System consists of an internal sensor to detect brain cell activity and external processors that convert brain impulses into computerized signals.

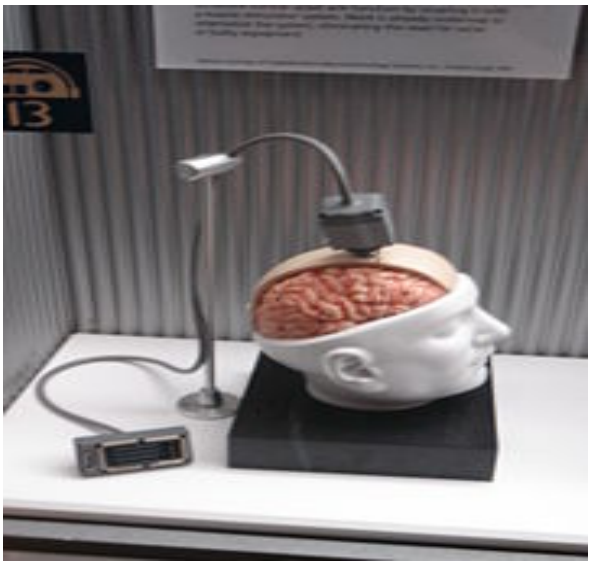


The chip is implanted on the top of the motor cortex, the main movement-controlling area of the brain.

Do you know how the BrainGate converts brain activity into computer command?

For this a sensor is implanted on the motor cortex of the brain, and electrodes are hooked up to wires that travel to a pedestal on the scalp. The sensor is extremely thin and is embedded about a millimeter into the brain. From there, a fiber optic cable carries the brain signals to a computer.

Currently, BrainGate uses 100 hair-thin electrodes. These electrodes sense the electro-magnetic signature of neurons firing in specific areas of the brain (the area that controls arm movement). This activity is translated into electrically charged signals and sent to the computer. The computer decodes the signals from the neuron using a program, which can move either a robotic arm or a computer cursor.



In addition to this, the BrainGate array helps in recording electrical data for later analysis. The data aids neurologists who study seizure patterns in a patient with diseases like epilepsy.

According to John Donoghue, Director of Brown University, "BrainGate provides an interface with a computer that works immediately, without weeks or months of training... and it provides significantly more utility than devices that rely on 'substitutes' for the brain's own arm movement signal, such as eye movements. "

In future, the BrainGates are more useful to those individuals whose injuries are less severe. Next generation products may even provide control devices that allow breathing, bladder and bowel movements.

Technological advances of this kind are giving hope of a better life to people with disabilities.

Radhika Varma (S7 AEI)
Sreejith Ravi

Try not to become a man of success, but try to become a man of values

-Albert Einstein

MPEG1 standard: An overview

Part 1

In the previous issue of the bulletin, different MPEG standards were introduced. In the subsequent issues, we will go into some details on each of these standards. Let us start with MPEG1. MPEG1 standard deals with 5 aspects in 5 parts- system, video, audio, conformance and a reference implementation. System deals with storage and synchronization of video, audio, and data together. In this issue, we will discuss MPEG1 video compression.

MPEG1 encodes audio and video together at a rate of 1.5 Mbps. This standard enabled video storage on a compact disc with quality comparable to VHS cassettes. (If we record video data into a CD without encoding, it can hold data that will play only for less than 5 minutes duration, and that too without any associated audio). How does MPEG1 do the magic of compression without affecting quality drastically?

MPEG1 does *hybrid coding*, addressing reduction of both *temporal* and *spatial* redundancy. Temporal redundancy is due to common information across frames. Video consists of still pictures or frames taken at regular intervals of time. Most videos consist of more than 15 such frames per second. Changes are minimal from one frame to another and are restricted to small regions within the frame. The common portions need not be saved multiple times. Spatial redundancy is within a frame. Frames with smooth background have more spatial redundancy than those with details. Spatial redundancy is due to the correlation of adjacent pixels.

Digital images have components that cannot be seen by human eye. These components can be eliminated without degradation in subjective quality.

MPEG1 operates on frames in YUV format. Video in RGB format has to be converted to YUV format and fed to the encoder. In YUV format, each unit of a picture, a pixel/pel, has a luminance/luma component (Y) and two chrominance/chroma components (Cb, Cr). RGB format has three colour components representing a pixel. Standard equations define the conversion between RGB and YUV.

Each application requires different bit rate. Bit rate can be changed dynamically. Bit rate control adjusts the quantization based on the current bit rate as seen by VB module.

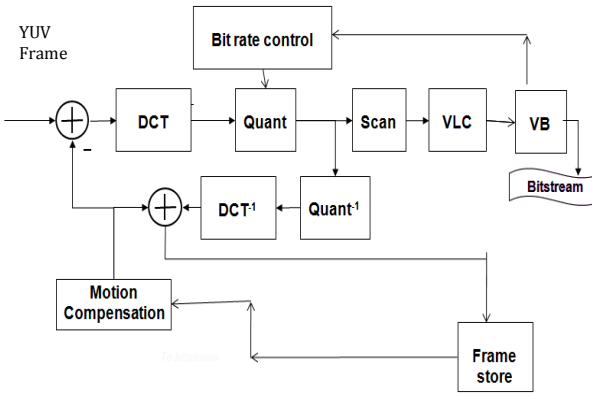


Figure 1. Block diagram of an MPEG1 video encoder

DCT is discrete cosine transform, done for energy compaction. DCT is done on 8x8 blocks. The first coefficient which results from this operation is the DC coefficient. It represents the energy of the block. The nonzero DCT coefficients are concentrated around the DC coefficient. Quantizer adjusts the step size based on the required bit rate. The quantized DCT coefficients are scanned in a zig-zag manner so that least significant coefficients are scanned at the end. The scanned coefficients are encoded using variable length run length entropy coder.

Motion compensation module looks at the current frame and previously coded frames to remove any temporal redundancy. Motion compensation operates on blocks of size 16x16, and searches for the best match of the current block in previously encoded frames. It gives the coordinates of the best matched block relative to the position of the current block. The search for the best match is one of the most computational intensive operations, as error is measured on a pixel to pixel basis and accumulated for a block.

The decoder performs the reverse operations. It extracts and decodes the variable-length coded words from the bit stream. Next, the location and quantized values of the nonzero DCT coefficients of the block are obtained. After inverse quantization (Q^{-1}) of the nonzero DCT coefficients belonging to the block and subsequent inverse DCT (DCT^{-1}), the quantized block pixel values are got.

Quantization introduces loss. The process results in lossy compression, but subjective quality is retained.

- Meena

CMRR METER

An operational amplifier or op amp, as we all know has two input terminals, an inverting terminal and a non-inverting terminal. Sometimes, both the terminals have to encounter some common signals, for example noise. Such signals are called common mode signals. An ideal op amp is completely immune to common mode signals, but that's not the case in a practical situation. There's a parameter called the common mode rejection ratio (CMRR), which signifies the ability of an op amp to reject a common mode input.

Till date, the CMRR is being found out through an experimental setup, which eats away lot of time. Just imagine an instrument, which allows an op amp to be plugged to it, and instantly display its CMRR value. It'll make the work much easier for us, engineers. Driven by this significance, we set out to realize this as our mini project.

The principle and the initial design were very simple. It was all about evaluating a mathematical equation using the output of the op amp. First our idea was to implement the instrument, entirely using analog components. Our main circuit composed of various types of amplifier configurations, cascaded. We wired the various functional blocks separately and tested them. Wow, they worked perfectly. Our confidence increased, we decided to integrate the elementary circuits to form the final one and switched it on. Instead of a dc signal at the output, what we got was a sine wave! Where did this come from?

At last, after a few hours, we got our answer. It was so simple. The frequency of the sine wave was 50Hz, same as our ac supply frequency. The output was due to the noise introduced by the power supply. We immediately introduced a filter in our design and tested again. The circuit wasn't working. It was due to some of the factors which we had neglected in our design. The main one was the offset voltage of the op amp.

The problem with our circuit was that, it had many analog components with varying tolerances. The circuit was unstable due to its temperature dependence. Because of these problems, we decided to make a drastic change in our design. Hey, why don't we make our circuit, digital?

We thought of using a microcontroller for the math-stuff and an ADC for making the analog signal digital. As expected, it took us some time to get the microcontroller working.

Students' Page

The initial prototypes developed had some trouble in displaying the output. The microcontroller failed to supply enough current to the display unit. Then we introduced a new component into our circuit, a driver IC. This solved the display problem.

The CMRR meter is becoming a reality. The only problem existing is the lack of stability. The op amp showed a slightly different CMRR value, when tested again, due to the effect of noise. Our circuit needs a much more powerful filter!

In order to realize our dream, the CMRR meter, we need to implement a filter. We are confident of finding a solution fast and, our dream will be reality!

-Kiran Stanly
S_7 AEI

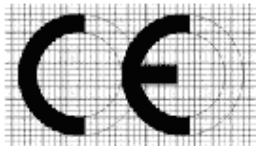
curiosity corner

10:10 4:40

Observe carefully the two watches. Can you find any relation between the timings shown by these two watches? (Second watch is turned 180^0 with respect to the first.)

First correct answer will win a small prize

Answer to the question in the previous issue



CE is a conformity marking, which stands for *'Conformité Européenne'*.

It is the French translation of European Conformity. The marking is an assurance of conformance of the product to the relevant essential requirements like safety and health. CE marking is not a quality mark. It is mandatory for the product it applies to, whereas most quality markings are voluntary.