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SCOPE

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Electronics & Instrumentation Engineering

Department of Electronics & Instrumentation Engineering
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DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING
KAKATIYA INSITUTE OF TECHNOLOGY & SCIENCE: WARANGAL-15

VISION

To provide quality education in Electronics & Instrumentation Engineering by nurturing the students with strong technical, analytical, practical skills and ethics to make them engineering professionals who cater to the societal needs with a high degree of integrity and social concern.

MISSION

1. To provide progressive and quality educational environment with the help of dedicated faculty and staff by fully utilizing the information technology aiming at continuous teaching and learning process.

2. To produce engineering graduates fit for employability with a competence to design, develop, invent and solve instrumentation engineering problems.

3. To make the students ethically strong by inculcating sense of brotherhood.

4. To make the students research oriented by providing latest technical knowledge and thus cater to the changing needs of industry and commerce.

EDITORIAL BOARD

PREFACE

This magazine summarizes the current state of Electronics and Instrumentation Engineering, providing an arena for the student community to showcase their technical talents in a great way. Keeping in view of the present era of technological revolution in the field of Instrumentation Engineering, the students of E&IE department, KITS Warangal presents you **SCOPE**.

We acknowledge the essential contribution of the reviewers, whose efforts are deeply appreciated.

We feel that such technical magazine is very well required as it helps in updating the knowledge of future engineers.

The Department of E&IE is very much thankful to the Management for their continuous support and encouragement for making the Technical Magazine **SCOPE**.

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CHAPTER 1
DUAL CLUTCH TRANSMISSION

1. INTRODUCTION

The technology of "Dual clutch transmission", which is a relatively new technology, has the advantage of both automatic and manual gears. It helps the driver to control the clutch without a pedal, hence giving him a smoother driving. The technology has been used by various car manufacturers and is gaining a large market.

A dual clutch transmission offers the function of two manual gearboxes in one. When the driver wants to change from one gear to another in a standard stick-shift car, he first presses down the clutch pedal. This operates a single clutch, which disconnects the engine from the gearbox and interrupts power flow to the transmission. So in a conventional manual transmission, there is not a continuous flow of power from the engine to the wheels. For an unskilled driver, this can result in passengers being thrown forward and back again as gears are changed.

A dual clutch gearbox, by contrast, uses two clutches, but has no clutch pedal. Sophisticated electronics and hydraulics control the clutches, just as they do in a standard automatic transmission. In a DCT, however, the clutches operate independently.

Commercialization of the dual clutch transmission however has not been feasible until recently.

DCT system is said to incorporate the best of the other two worlds (manual and automatic transmission), without altering the engine performance in any way. It can be described as the best solution to improve acceleration: 1-100kmph figures-while eliminating more or less the jolts produced by manual gear shifting, at least for beginners.

With so many advantages of DCT over the manual, it seems to be the next manual. It is also the best transmission for the high end performance cars and racing cars where cost is an issue.

2. Overview

In DCTs where the two clutches are arranged concentrically, the larger outer clutch drives the odd numbered gears, while the smaller inner clutch drives the even numbered gears. Shifts can be accomplished without interrupting torque distribution to the driven road wheels, by applying the engine's torque to one clutch at the same time as it is being disconnected from the other clutch. Since alternate gear ratios can preselect an odd gear on one gear shaft while the vehicle is being driven in an even gear, (and vice versa), DCTs are able to shift more quickly than cars equipped with single clutch automated manual transmissions (AMTs), a.k.a. single clutch semiautomatics. Also, with a DCT, shifts can be made more smoothly than with a single clutch AMT, making a DCT more suitable for conventional road cars. Dual clutch transmissions use two fundamentally different types of clutches: either two wet multi-plate clutches, bathed in oil (for cooling)—or two dry single plate clutches. The wet clutch design is generally used for higher torque engines that can generate 350 newton metres (258 lbf·ft) and more (the wet multi-plate clutch DCT in the Bugatti Veyron is designed to cope with 1,250 N·m (922 lbf·ft)), whereas the dry clutch design is generally suitable for smaller vehicles with lower torque outputs up to 250 N·m (184 lbf·ft). However, while the dry clutch variants may be limited in torque compared to their wet clutch counterparts, the dry clutch variants offer an increase in fuel efficiency, due to the lack of pumping losses of the transmission fluid in the clutch housing. There are now three

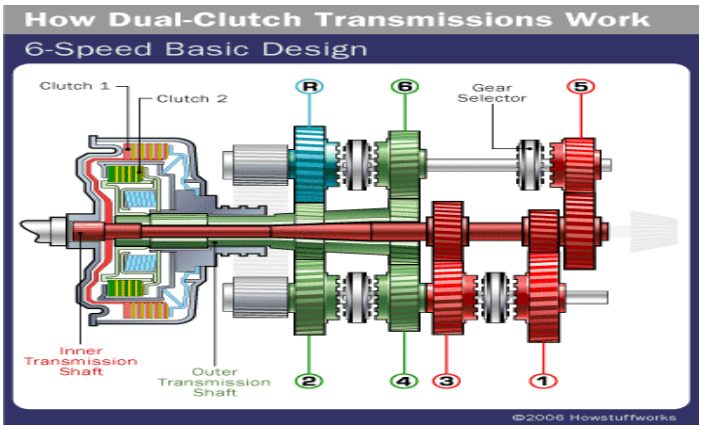
variations of clutch installation. The original design used a concentric arrangement, where both clutches shared the same plane when viewed perpendicularly from the transmission input shaft, along the same centre line as the engine crankshaft; When viewed head-on along the length of the input shaft, this makes one clutch noticeably larger than the other. The second implementation uses two single plate dry clutches—sidebyside from the perpendicular view, but again sharing the centre line of the crankshaft.A later variation uses two separate but identical size clutches. These are arranged sidebyside when viewed head-on (along the length of the input shaft and crankshaft centre line), and also share the same plane when viewed perpendicularly. This latter clutch arrangement (unlike the other two variations) is driven via a gear from the engine crankshaft.

3. WORKING OF A DCT

Most people know that cars come with two basic transmission types: manuals, which require that the driver change gears by depressing a clutch pedal and using a stick shift, and automatics, which do all of the shifting work for drivers using clutches, a torque converter and sets of planetary gears. But there's also something in between that offers the best of both worlds – the dual-clutch transmission, also called the semi-automatic transmission, the "clutchless" manual transmission and the automated manual transmission.

In the world of racecars, semi-automatic transmissions, such as the sequential manual gearbox (or SMG), have been a staple for years. But in the world of production vehicles, it's a relatively new technology – one that is being defined by a very specific design known as the dual-clutch, or direct-shift, gearbox.

A two-part transmission shaft is at the heart of a DCT. Unlike a conventional manual gearbox, this houses all of its gears on a single input shaft, the DCT splits up odd and even gears on two input shafts. How is this possible? The outer shaft is hollowed out, making room for an inner shaft, which is nested inside. The outer hollow shaft feeds second and fourth gears, while the inner shaft feeds first, third and fifth. The diagram below shows this arrangement for a typical five-speed DCT. Notice that one clutch controls second and fourth gears, while another , independent clutch controls first, third and fifth gears. That's the trick that allows lightning-fast gear changes and keeps power delivery constant. A standard manual transmission can't do this because it must use one clutch for all odd and even gears.



Hopefully it's becoming clear why the DCT is classified as an automated manual transmission. In principle, the DCT behaves just like a standard manual transmission: It's got input and auxiliary shafts to house gears, synchronizers and a clutch. What it doesn't have is a clutch pedal, because computers, solenoids and hydraulics do the actual shifting.

4. PROS AND CONS

The Dual Clutch Transmission or DCT is a type of automated manual transmission that uses two clutches which results in extremely quick gearshifts and acceleration. Dual clutch transmissions are also known by several other names such as sequential manual gearbox, double clutch transmissions or a clutchless manual transmission. The Dual Clutch Transmission or DCT is a type of automated manual transmission that uses two clutches which results in extremely quick gearshifts and acceleration. Dual clutch transmissions are also known by several other names such as sequential manual gearbox, double clutch transmissions or a clutchless manual transmission. A dual clutch transmission takes one set of gear ratios (a seven speed for example) and splits them into odd and even gears. The odd gears is operated via one clutch and the even gears are operated via another clutch. Any clutch can be used for reverse.

The entire arrangement is still in one gearbox and both clutches are in one housing with two shafts sharing the same center axis (the outer shaft is hollow with the inner shaft inside it) is used. A clutch pedal is not required as with a regular manual. An ECU and hydraulics operate the clutches so gear changes can be made. Gearshifts are extremely quick which results in better acceleration as less time is used disconnecting the engine from the driveline to shift between gears. These benefits arise because gears can be pre-selected before they are changed so as one clutch selects 2^{nd} gear the other clutch pre-selects the 3^{rd} gear. The fraction of a second needed for gearshifts will vary between marques but this is the main benefit over single clutch automated manuals. You also have the option of driving in automatic mode and let the computer change the gears or you can change the gears manually by using the regular gearshifter or the paddle shifters to upshift and downshift and features such as launch control can be easily incorporated into DCTs.

Dual clutch transmissions were originally used on racecars but it has now found its way into production vehicles. They were brought to production vehicles by Porsche and Audi in the 1980s who started using DCTs in their production performance cars. It is still used mostly used on performance vehicles such as BMW M cars, Audi S and RS, Ferrari's and others. There are two types of clutches used in DCTs, one is the wet clutch and the other is the dry clutch. The transmission will have either two wet or two dry clutches and not one of each. The wet clutch is designed for higher performance vehicles as the clutches are constantly lubricated so they can deal with the high torque of formula one cars, supercars and vehicles with similar amounts of power. The dual clutch transmission has been referred to as the future of automotive transmissions. They are not as cost effective as the conventional transmissions but some expensive features have a way of reaching down to the everyday car even if it's a scaled down version of it.

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CHAPTER 2
ARTIFICIAL INTELLIGENCE

1. INTRODUCTION

Artificial intelligence (**AI**) is intelligence exhibited by machines. In computer science, the field of AI research defines itself as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of success at some goal.

Colloquially, the term "artificial intelligence" is applied when a machine mimics "cognitive" functions that humans associate with other human minds, such as "learning" and "problem solving".

The field of AI research was born at a workshop at Dartmouth College in 1956. Attendees Allen Newell (CMU), Herbert Simon (CMU), John McCarthy (MIT), Marvin Minsky (MIT) and Arthur Samuel (IBM) became the founders and leaders of AI research.

As machines become increasingly capable, mental facilities once thought to require intelligence are removed from the definition.

Capabilities currently classified as AI include successfully understanding human speech,competing at a high level in strategic game systems , autonomous cars, intelligent routing in content delivery networks, military simulations, and interpreting complex data.

The central problems (or goals) of AI research include reasoning, knowledge, planning, learning, natural language processing(communication), perception and the ability to move and manipulate objects.

General intelligence is among the field's long-term goals.

Many tools are used in AI, including versions of search and mathematical optimization, logic, methods based on probability and economics. The AI field draws upon computer science, mathematics, psychology, linguistics, philosophy, neuroscience, artificial psychology and many others.

2. CONCEPT OF AI

Artificial Intelligence is a way of **making a computer, a computer-controlled robot, or a software think intelligently**, in the similar manner the intelligent humans think. AI is accomplished by studying how human brain thinks, and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems.Artificial intelligence is a science and technology

based on disciplines such as Computer Science, Biology, Psychology, Linguistics, Mathematics, and Engineering. A major thrust of AI is in the development of computer functions associated with human intelligence, such as reasoning, learning, and problem solving.Out of the following areas, one or multiple areas can contribute to build an intelligent system.

In the real world, the knowledge has some unwelcomed properties.Its volume is huge, next to unimaginable.It is not well-organized or well-formatted.It keeps changing constantly.AI Technique is a manner to organize and use the knowledge efficiently in such a way that –It should be perceivable by the people who provide it.It should be easily modifiable to correct errors It should be useful in many situations though it is incomplete or inaccurate.AI techniques elevate the speed of execution of the complex program it is equipped with.

3. NEURAL NETWORKS

Yet another research area in AI, neural networks, is inspired from the natural neural network of human nervous system.A neural network is a computing system made up of a number of simple, highly interconnected processing elements, which process information by their dynamic state response to external inputs." These systems understand, interpret, and comprehend visual input on the computer. For example,A spying aeroplane takes photographs, which are used to figure out spatial information or map of the areas.Doctors use clinical expert system to diagnose the patient.Police use computer software that can recognize the face of criminal with the stored portrait made by forensic artist.

Natural Language Processing − It is possible to interact with the computer that understands natural language spoken by humans.

Expert Systems − There are some applications which integrate machine, software, and special information to impart reasoning and advising. They provide explanation and advice to the users.

Intelligent Robots − Robots are able to perform the tasks given by a human.They have sensors to detect physical data from the real world such as light, heat, temperature, movement, sound, bump, and pressure. They have efficient processors, multiple sensors and huge memory, to exhibit intelligence. In addition, they are capable of learning from their mistakes and they can adapt to the new environment.

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CHAPTER 3
ROBUST IMAGE SEGMENTATION ALGORITH FOR NOISY SAR IMAGES

1. INTRODUCTION

Image Segmentation is the process of partitioning an image into several segments. By grouping image pixels into segments, the goal of image segmentation is simplification or change the exhibition of an image into something which is more significant and easier to survey

Synthetic aperture radar (SAR) systems have been widely used in remote sensing applications. We present a SAR image segmentation based on image filtering and thresholding using morphological operations. In general, K-means and Spectral Clustering methods are used for Image Segmentation but they will not be efficient for Noisy SAR images.

The K-means technique is a repetitive method which is used to severance an image into K clusters. Spectral clustering separate data into cluster through constructing a weighted graph, this encodes the similarity among data points.

The proposed method involves applying Median filter to SAR image to remove speckle noise, image segmentation using grey-level thresholding technique and applying morphological closing for enhancing the obtained results. This method may give less error percentage and increase the SAR image segmentation efficiency.

1.1 Image Processing Operations

Image processing operations can be roughly divided into following major categories:

a) Image Restoration

b) Image Enhancement

c) Image Compression

d) Image Segmentation

1.2 Digital Image Segmentation

Image Segmentation refers to the process of partitioning a digital image into multiple segments. It subdivides an image into constitute regions or objects. The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze. Segmentation should stop when the object of interest in an application have been isolated. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images.

1.2.1 Applications of Image Segmentation

Some of the practical applications of medical image segmentation are:

- Locate tumors and other pathologies
- Measure tissue volumes
- Computer-guided surgery

Some other applications are:

- Locate objects in satellite images (roads, forests, etc.)
- Fingerprint &Face recognition
- Traffic control systems

1.2.2 Algorithms used for Image Segmentation.

- K- means clustering
- Spectral clustering

2. CLUSTERING TECHNIQUES

2.1 Cluster Analysis

Cluster analysis divides data into groups (clusters) that are meaningful, useful, or both. Cluster analysis groups data objects based only on information found in the data that describes the objects and their relationships. The goal is that the objects within a group be similar (or related) to one another and different from (or unrelated to) the objects in other groups. The greater the similarity (or homogeneity) within a group and the greater the difference between groups, the better or more distinct the clustering.

2.2. Different Types of Clustering Techniques

K- means clustering, Spectral clustering

2.2.1 K-means

Prototype-based clustering techniques create a one-level partitioning of the data objects. There are a number of such techniques, but two of the most prominent are K-means and K-medoid. K-means defines a prototype in terms of a centroid, which is usually the mean of a group of points, and is typically applied to objects in a continuous n-dimensional space. K-medoid defines a prototype in terms of a medoid, which is the most representative point for a group of points, and can be applied to a wide range of data since it requires only a proximity measure for a pair of objects. While a centroid almost never corresponds to an actual data point, a medoid, by its definition, must be an actual data point. In this section, we will focus solely on K-means, which is one of the oldest and most widely used clustering algorithms.

2.2.1.1 The Basic K-means Algorithm

The K-means clustering technique is simple, and we begin with a description of the basic algorithm. We first choose K initial centroids, where K is a userspecified parameter, namely, the number of clusters desired. Each point is then assigned to the closest centroid, and each collection of points assigned to a centroid is a cluster. The centroid of each cluster is then updated based on the points assigned to the cluster. We repeat the assignment and update steps until no point changes clusters, or equivalently, until the centroids remain the same.

K-means is formally described by Algorithm 8.1. The operation of K-means is illustrated in Figure 8.3, which shows how, starting from three centroids, the final clusters are found in four assignment-update steps. In these and other figures displaying K-means clustering, each subfigure shows (1) the centroids at the start of the iteration and (2) the assignment of the points to those centroids. The centroids are indicated by the "+" symbol; all points belonging to the same cluster have the same marker shape.

2.2.2 Spectral clustering:-

Spectral clustering derives its name from spectral analysis of a graph, which is how the data represented. Spectral clustering techniques reduce dimensions using the eigen values of the similarity matrix of the data. The similarity matrix is provided as an input and consists of a quantitative assessment of the relative similarity of each pair of points in the dataset.

The spectral clustering algorithm is an algorithm for putting N data points in an I-dimensional space into several clusters. Each cluster is parameterized by its similarity, which means that the points in the same group are similar and points in different groups are dissimilar to each other. We start the algorithm by presenting the data points in the form of similarity graph, and then we need to find a partition of the graph so that the points within a group are similar and the points between different groups are dissimilar to each other. The partition can be done in various ways such as minimum cut method, ratio cut method, and normalized and MinMax Cut Method.

2.2.2.1 Spectral clustering algorithm:-

Spectral clustering refers to a family of methods that separate data into cluster through constructing a weighted graph; this graph encodes the similarity among data points. In fact, SC relies on the spectum (eigenvalues) of an affmity matrix to divide samples into disjoint clusters. The affinity matrix defines the similarities between any two samples. Spectral clustering can be done by means of standard linear algebra techniques; despite its simplicity, it outperforms conventional clustering algorithms such as k-means.

Given a data set Z={ Z_1, Z_2, . . . , Z_n }, wherein is the number of samples, Z_i=[Z_{ih} Z_{iZ}, ... , Z_{if}] ,f is the dimensionality of samples or the number of features. In the most of the SC applications, the Gaussian function is employed as the similarity function with the following for:

$$G_{ij} = \exp\left(-\frac{\|Z_i - Z_j\|^2}{2\gamma^2} \right)$$

where G y measures the similarity between samples Z_i and Z_j' ||Z_i -Zj|| denotes the Euclidean distance between two samples Z_i and Z_j' and ris the scaling parameter selected according to problems. based on N-cut criterion, a widely used spectral clustering algorithm (NJW) was introduced; thi algorithm is described as follows:

Input: a data set Z c R^f , the number of clusters c .

1. Construct the affinity matrix G described by Equation (2);
2. Define the M diagonal matrix as M(i, j) = $\sum_j$G(i, j) , and construct the Laplacian matrix L = $M^{-1/2}GM^{-1/2}$;
3. Compute the k largest eigenvectors of L, and normalized each of eigenvectors;
4. Classify the normalized eigenvectors into c clusters via k means or other clustering algorithm.

   Output: k clusters of Z

2.2 Thresholding:-

Thresholding is an important technique in image segmentation applications. The basic idea of thresholding is to select an optimal grey-level threshold value for separating objects of interest in an image from the background based on their grey-level distribution. Thresholding creates binary images from grey-level ones by turning all pixels below some threshold to zero and all pixels about the threshold to one. If g(x, y) is a threshold version of f(x, y) at some global threshold *T*, it can be defined as,

$$g(x, y) = 1 \text{ if } f(x, y) \geq T$$
$$= 0 \text{ otherwise}$$

Thresholding operation is defined as:-

$T = M[x, y, p(x, y), f(x, y)]$

In this equation, T stands for the threshold; f (x, y) is the gray value of point (*x*, *y*) and p(x, y) denotes some local property of the point such as the average gray value of the neighborhood centered on point (*x*, *y*)

Based on this, there are two types of thresholding methods.

1) Global thresholding: When T depends only on f (x, y) (in other words, only on gray-level values) and the value of T solely relates to the character of pixels, this thresholding technique is called global thresholding.

2) Local thresholding: If threshold T depends on f (x, y) and p(x, y), this thresholding is called local thresholding. This method divides an original image into several sub regions, and chooses various thresholds T for each sub region reasonably.

2.5.1. Morphological Thresholding:-

Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. According to wikipedia, morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images. Morphological operations can also be applied to greyscale images such that their light transfer functions are unknown and therefore their absolute pixel values are of no or minor interest. Morphological techniques probe an image with a small shape or template called a **structuring element**. The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighbourhood of pixels. Some operations test whether the element "fits" within the neighbourhood, while others test whether it "hits" or intersects the neighbourhood:

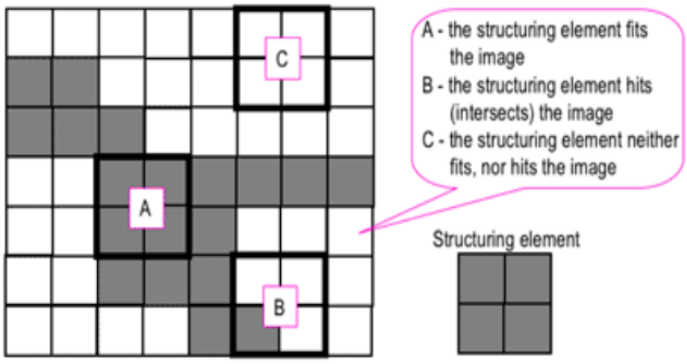
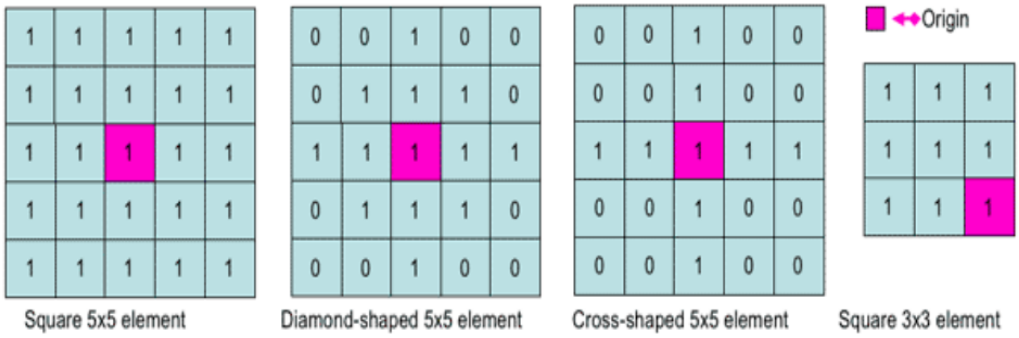


Figure. Probing of an image with a structuring element (white and grey pixels have zero and non-zero values, respectively).

A morphological operation on a binary image creates a new binary image in which the pixel has a nonzero value only if the test is successful at that location in the input image.

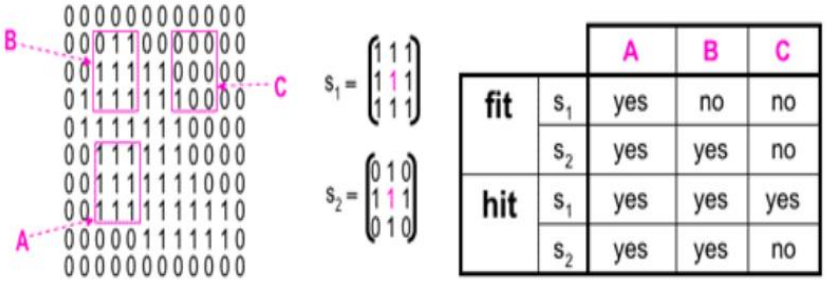
The structuring element is a small binary image, i.e. a small matrix of pixels, each with a value of zero or one:

- The matrix dimensions specify the *size* of the structuring element.
- The pattern of ones and zeros specifies the *shape* of the structuring element.
- An *origin* of the structuring element is usually one of its pixels, although generally the origin can be outside the structuring element.



Examples of simple structuring elements.

A common practice is to have odd dimensions of the structuring matrix and the origin defined as the centre of the matrix. Structuring elements play in morphological image processing the same role as convolution kernels in linear image filtering. When a structuring element is placed in a binary image, each of its pixels is associated with the corresponding pixel of the neighbourhood under the structuring element. The structuring element is said to fit the image if, for each of its pixels set to 1, the corresponding image pixel is also 1. Similarly, a structuring element is said to hit, or intersect, an image if, at least for one of its pixels set to 1 the corresponding image pixel is also 1.



		A	B	C
fit	s_1	yes	no	no
	s_2	yes	yes	no
hit	s_1	yes	yes	yes
	s_2	yes	yes	no

Fitting and hitting of a binary image with structuring elements s_1 and s_2.

Zero valued pixels of the structuring element are ignored, i.e. indicate points where the corresponding image value is irrelevant.

2.4 Morphological closing operation:-

The closing operation dilates an image and then erodes the dilated image using the same structuring element for both operations, i.e.

$$A \bullet B = (A \oplus B) \ominus B$$

where *A* is the original image and *B* is the structuring element.

The closing operation fills holes that are smaller than the structuring element, joins narrow breaks, fills gaps in contours, and smoothes objects contours.

2.5 Morphological opening operation:-

The opening operation erodes an image and then dilates the eroded image using the same structuring element for both operations, i.e.

$$A \circ B = (A \ominus B) \oplus B$$

where *A* is the original image and *B* is the structuring element.

The opening operation is used to remove regions of an object that cannot contain the structuring element, smooth objects contours, and breaks thin connections.

The opening operation can also be used to remove small objects in an image while preserving the shape and size of larger objects.

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CHAPTER 4
ANTI-LOCK BRAKING SYSTEM

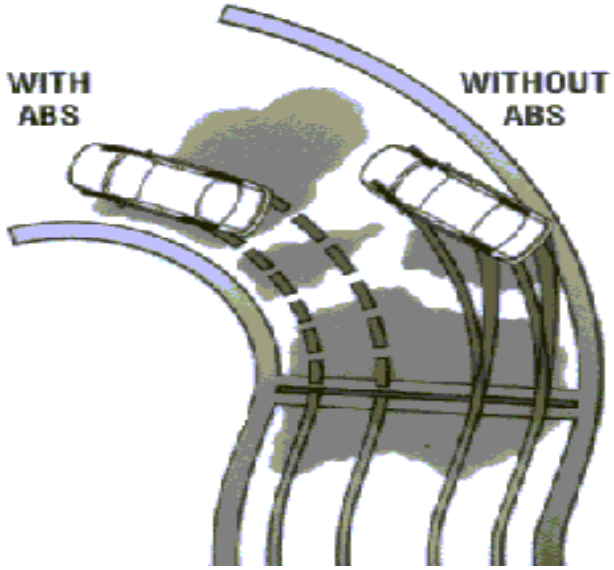
1.INTRODUCTION

Car manufacturers world wide are vying with each other to invent more reliable gadgets there by coming closer to the dream of the 'Advanced safety vehicle' or 'Ultimate safety vehicle', on which research and development has been going on for the past several year. Most of the newer vehicle models offer ABS as either standard or optional equipment .Wheel lockup during braking causes skidding which in turn cause a loss of traction and vehicle control. This reduces the steering ability to change direction. So the car slides out of control. But the road wheel that is still rotating can be steered. That is what ABS is all about. With such a system, the driver can brake hard, take the evasive action and still be in control of the vehicle in any road condition at any speed and under any load. ABS does not reduce stopping distance, but compensates the changing traction or tyre loading by preventing wheel lockup.

During panic braking when the wheels are about to lockup, sensors sense that the wheel has just begun turning slower than others on the vehicle. So they momentarily reduce braking force on the affected wheel. This prevents sliding of the wheels on the pavement. When the wheel resumes rolling, full braking force is again applied. ABS repeats the process until there is no longer any need for modulated braking. ABS acts faster than any driver could, pumping the brakes several times per second. Depending on the type of system, ABS adjusts the braking force at each wheel or set of wheels, whereas a driver's foot on the brake pedal operates all the brakes at once in normal braking.

2.CONCEPT OF ABS

The theory behind anti-lock brakes is simple. A skidding wheel (where the tire contact patch is sliding relative to the road) has less traction than a non-skidding wheel. If the vehicle have been stuck on ice and if the wheels are spinning then the vehicle have no traction. This is because the contact patch is sliding relative to the ice. By keeping the wheels from skidding while you slow down, anti-lock brakes benefit you in two ways: You'll stop faster, and you'll be able to steer while you stop. Good drivers have always pumped the brake pedal during panic stops to avoid wheel lock up and the loss of steering control. ABS simply gets the pumping job done much faster and in much precise manner than the fastest human foot.



3. ABS COMPONENTS

Many different ABS are found on today's vehicles. These designs are varied by their basic layout, operation and components. The ABS components can be divided into two categories.

1. Hydraulic components
2. Electrical/electronic components

Besides these normal and conventional brake parts are part of the overall brake system.

3.1 Hydraulic components

- **Accumulator**

  An accumulator is used to store hydraulic fluid to maintain high pressure in the brake system and provide the residual pressure for power assisted braking. Normally the accumulator is charged with nitrogen gas and is an integral part of the modulator unit.

- **Antilock hydraulic control valve assembly**

  This assembly controls the release and application of the brake system pressure to the wheel brake assemblies. It may be of integral type and non integral type. In integral type the unit is combined with the power boost and master cylinder unit into one assembly. The non integral type is mounted externally from the master cylinder /power booster unit and is located between the master cylinder and wheel brake assembly. Both types generally contain solenoid valve that control the releasing, holding and applying of brake system pressure.

- **Booster pump**

  The booster pump is an assembly of an electric motor and pump. The booster pump is used to provide pressurized hydraulic fluid ABS. The pumps motor is controlled by systems control unit.

- **Booster/Master cylinder assembly**

  It is referred as the hydraulic unit, contains the valves and pistons needed to modulate hydraulic pressure in the wheel circuit during the ABS operations.

- **Fluid accumulator**

  Different than a pressure accumulator, fluid accumulator temporarily store brake fluid, that is removed from the wheel brake unit during ABS cycle. This fluid is then used by pump to build pressure for the brake hydraulic system.

- **Hydraulic control unit**

  This assembly contains solenoid valve, fluid accumulator, pump and electric motor. The unit may have one pump and one motor or it have one motor and two pumps.

- **Main Valve**

  This is a two position valve and is also controlled by ABS control module and is open only in the ABS mode. When open pressurized brake fluid from the booster circuit is directed into the master circuit to prevent excessive pedal travel.

- **Modulator unit**

  The modulator unit controls the flow of pressurized brake fluid to the individual wheel circuits. Normally the modulator is made up of solenoid that open and close valves, several valves that control flow of fluid to wheel brake units and electrical relays that activate or deactivate the solenoids through the commands of the control module. This unit may also be called the hydraulic actuator, hydraulic power unit or the electro hydraulic control valve.

- **Solenoid valves**

  The solenoid valves are located in the modulator unit and are electrically operated by signals from the control module. The control module switches the solenoids on or off to increase, decrease, or maintain the hydraulic pressure to the individual wheel units.

- **Wheel circuit valves**

  Two solenoid valves are used to control each circuit or channel. One controls the inlet valve of the circuit, the controls the outlet valve .the position is determined by the control module. Outlet valves are normally closed and inlet valves are normally open. Valves are activated when abs

control module switches 12 volts to the circuit solenoids. During normal driving the circuits are not activated.

3.2 Electrical\ electronic components

- **ABS control module**

  This small computer is normally mounted inside the trunk on the wheel housing, mounted to the master cylinder or is part of the hydraulic control unit. It monitors system operation and controls antilock function when needed. The module relies on input from the wheel speed sensors and feedback from the hydraulic unit to determine if the abs is operating correctly and to determine when the anti lock mode is required.

- **Brake pedal sensor**

  The antilock brake pedal sensor switch is normally closed. When the brake pedal exceeds the antilock brake pedal sensor switch setting during an antilock stop, the antilock antilock brake control module senses that the antilock brake pedal sensor switch is open and grounds the pump motor relay coil. This energizes the relay and turns the pump motor on. When the pump motor is running, the hydraulic reservoir is filled with high pressure brake fluid and the brake pedal will be pushed up until antilock brake pedal sensor switch closes. when the antilock brake pedal sensor switch closes , the pump motor is turned off and the brake pedal will drop some with each abs control cycle until the antilock brake pedal sensor switch opens and the pump motor is turned on again .this minimizes pedal feedback during abs cycling .

- **Pressure differential switch**

  It is located in the modulator unit. This switch sends a signal to the control module whenever there is an undesirable difference in the hydraulic pressures with in the brake system.

- **Relays**

  Relays are electromagnetic devices used to control a high current circuit with a low current switching circuit. In abs relays are used to switch motors and solenoids. A low current signal from the control module energizes the relays that complete the electrical circuit for the motor or solenoid.

- **Toothed ring**

  It can be located on an axle shaft, differential gear or a wheels hub. This ring is used with conjunction with the wheel speed sensor. The ring has a number of teeth around its circumference. As the ring rotates and each tooth passes by the wheel speed sensor, an ac voltage signal is generated between the sensor and tooth.

- **Wheel speed sensor**

  It is mounted near the different toothed ring. As the rings teeth rotate past the sensor an ac voltage is generated. as the teeth move away from the sensor, the signal is broken until the next tooth comes close to the sensor .the end result is a pulsing signal that is sent to the control module. The control module translates the signal in to wheel speed. The sensor is normally a small coil of wire with a permanent magnet in its center.ABS has been so far developed to a system, which provides rapid, automatic braking in response to signs of incipient wheel locking by alternatively increasing and decreasing hydraulic pressure in the brake line. Statistics show that approximately 40 % of automobile accidents are due to skidding. These problems commonly occur on vehicle with conventional brake system which can be avoided by adding devices called ABS. If there is an ABS failure, the system will revert to normal brake operation. Normally the ABS warning light will turn on and let the driver know there is a fault.

#N. SWATHI

(III/IV)

CHAPTER 5
VOICE BASED WEB TECHNOLOGY-PhoNET.

1.Introduction

Today's telecom business has seen recent growth, especially in bandwidth infrastructure for long distance (LD) and data. The industry is currently experiencing strong growth in the wireless segment as mobile devices prove to be very popular with both consumers and business. An evolving market segment is "Internet anywhere," and many companies are trying approaches to present viable products for this market. One approach is Internet access over wireless devices such as cell phones with a screen. However, this method has inherent limitations such as small screen size, lack of a keyboard, the need for a special device (web-enabled phone), the need to rewrite and maintain a special website, and severe bandwidth constraints using wireless data transfer protocols.

Our solution, which presents a third option, gives users all of the benefits of the voice portals, yet has complete access to the entire Internet without limitation. With our Voice Internet technology **PhoNET**, anyone can surf, search, send and receive email, and conduct e-commerce transactions, etc. using their voice from anywhere using any phone, with the more freedom of movement than a standard Internet browser which requires a PC and an Internet connection.

PhoNET technology is faster and cheaper than existing alternatives. Today, only the largest of companies are making their Web sites telephone-accessible because existing technology requires a manual, costly and time-consuming re-write of each page. With the voice internet technology-**PhoNET**, *existing* Web pages are used, allowing users to leverage their Web investment. The software dynamically converts existing pages into audio format, significantly lowering the up-front investment a business must make to allow users to hear and interact with their Web site by phone.

2.The PHONET Solution

An audio Internet Technology that allows users to listen to email, buy on-line or surf and hear any Web site, using a simple and natural interface – an ordinary telephone. No computer is needed.

Subscribers dial a toll-free number, and start accessing the Internet using voice commands. Speech recognition technology in the company's system allows users to give simple commands, such as "go to Yahoo" or "read my email" to get to the Net-based information they want, when

they want it, whether they're out on an appointment, stuck in traffic, sitting in an airport, or cooking dinner. They'll be able to quickly locate information, such as late-breaking news, traffic reports, directions, or anything else they're interested in on the World Wide Web. Our product **phoNET** has the capability to automatically down load web contents, filter out graphics, banners and images. It then renders extracted texts into concise, meaningful and very suitable in audio format texts before using TTS to convert into speech.

3.Technology Overview.

The idea of listening to the Internet may at first sound a bit like watching the radio. How does a visual medium rich in icons, text, and images translate itself into an audible format that is meaningful and pleasing to the ear? The answer lies in an innovative

integration of three distinct technologies that render visualcontent into short, precise, easily navigable, and meaningful text that can be converted to audio.The technologies and steps employed to accomplish this feat are:

Document Processing

Speech recognition 2. Text-to-speech translation, and

Document Rendering

3. Artificial Intelligence

The phoNET platform acts as an "Intelligent Agent" (IA) located between the user and the Internet. The AI automates the process of rendering information from the Internet to the user in a meaningful, precise, easily navigable and pleasant to listen to audio format. Rendering is achieved by using Page Highlights (a method to find and speak the key contents on a page), finding right as well as only relevant contents on a linked page, assembling right contents from a linked page, and providing easy navigation.

The platform incorporates the highest quality speech recognition and text to speech engines from third party suppliers. The PhoNet architecture is shown in Figure 2. The process starts with a telephone call placed by a user. The user is prompted for a logon pass phrase. The users pass phrase establishes the first connection to the Web site associated with that phrase and loads the first Web page. The HTML is parsed, as described later, separating text from other media types, isolating URL from HTML anchors and isolating the associated anchor titles (including ALT fields) for grammar generation. Grammar generation computes combinations of the words in titles to produce a wide range of alternative ways to say subsets of the title phrase. In this process simple function words (i.e., "and," "or," "the," etc.) are not allowed to occur in

isolation where they would be meaningless. Browser control commands are mixed in to control typical browser operations like "go back "and "go home" (similar to the typical browser button commands).

3.1 DOCUMENT PROCESSING

Document analysis is performed in the HTML parser, grammar generator, and Hyper Voice processor modules. The typical HTML Web page is first parsed into a list of elements based mostly on the HTML tags structure. Some elements are aggregations (tables, for instance) but the element list is not a full parse tree, which we found was not needed and in some cases actually complicates processing. Images, tables, forms and most text structure elements like paragraphs are recognized and processed according to their recognized type. Much of the effort in building a robust HTML processor is dealing with malformed HTML expressions such as unclosed tag scope, overlapping tag scopes, etc. Unfortunately space does not allow for fully addressing this issue here. Commercial browsers currently handle these issues in differing ways. Briefly, the handling of HTML errors by Phone Browser mostly follows the style of Netscape Communicator. Images often have ALT attribute tags that are used to derive the voice navigation commands for these items. The location of each image is announced along with any associated caption.

This feature can be disabled on a site-by-site basis when the user does not want to hear about images. Tables are first classified according to purpose, either layout or content. Most tables are actually used for page layout which can be recognized by the variety and types of data contained in the table cells. Data tables are processed by a parser according to one of a set of table model formats that Phone Browser recognizes. This provides primarily a simple way of reading the table contents row by row, which is often not very satisfying. Alternatively a transcoder can be used to reconstruct the table in sentential format.

3.2 DOCUMENT RENDERING

Rendering-Definition Information technology uses this term ‘Rendering’ refers to how information is presented according to the medium, for example, graphically displayed on a screen, audibly read using a recording device, or printed on a piece of paper.

In the context of voice/audio Internet, Web content rendering entails the translation of information originally intended for visual presentation into a format more suitable to audio. Conceptually this is quite a straightforward process but tactically, it poses some daunting

challenges in executing this translation. What are those challenges and why are they so difficult to overcome? These questions are explored in the next section of this paper.

The Rendering Problem- Computers possess certain superhuman attributes, which far outstrip that of mortal man—most notable are their computational capabilities. The common business spreadsheet is a testament to this fact. Other seemingly more mundane tasks, however, present quite a conundrum for even the most sophisticated of processors. Designing a high-speed special purpose computer capable of defeating a grandmaster at chess took the computing industry over 50 years to perfect. Employing strategic thinking is not a computer's forte. That is because in all the logic embodied in their digitized ones and zeroes, there is no inherent cognitive thought. This one powerful achievement of the brain along with our ability to feel and express emotion separates the human mind from its computerized equivalent—the centralized processing unit (CPU).

Solving the problem- To solve the rendering problem, some intelligent techniques must be applied. The relevant data must be selected, navigated to its conclusion, and reassembled for presentation by a different medium. All of this must be done for all web pages, dynamically, in real-time and in an automated fashion. We have used an Intelligent Agent (IA) that uses various intelligence techniques including "artificial intelligence".

Using Visual Clues Understanding the process that our brains go through in making qualitative choices is key to developing an artificially intelligent solution. In the example of Web page navigation we know that our brains do not attempt to read and interpret an entire page of data rather they take their cues from the visual clues implemented by the Web designer.

Simplifying for speech- The first step involves dynamically removing all the programming constructs and coding tags that comprise the instruction to a Web browser on how to visually render the data. HTML, CHTML, XML, and other languages are typically used for this purpose. Because the data is now being translated or rendered to a different medium, these tags no longer serve any purpose.

#SYED AAMIR UDDIN

(III/IV)

CHAPTER 6
SIXTH SENSE TECHNOLOGY

1.INTRODUCTION

We've evolved over millions of years to sense the world around us. When we encounter something, someone or some place, we use our five natural senses which includes eye, ear, nose, tongue mind and body to perceive information about it; that information helps us make decisions and chose the right actions to take. But arguably the most useful information that can help us make the right decision is not naturally perceivable with our five senses, namely the data, information and knowledge that mankind has accumulated about everything and which is increasingly all available online.

Although the miniaturization of computing devices allows us to carry computers in our pockets, keeping us continually connected to the digital world, there is no link between our digital devices and our interactions with the physical world. Information is confined traditionally on paper or digitally on a screen. SixthSense bridges this gap, bringing intangible, digital information out into the tangible world, and allowing us to interact with this information via natural hand gestures. 'SixthSense' frees information from its confines by seamlessly integrating it with reality, and thus making the entire world your computer.

"Sixth Sense Technology", it is the newest jargon t hat has proclaimed its presence in the technical arena. This technology has emerged, which has its relation to the power of these six senses. Our ordinary computers will soon be able to sense the different feelings accumulated in the surroundings and it is all a gift of the "Sixth Sense Technology" newly introduced.

2.WORKING OF SIXTH SENSE TECHNOLOGY

COMPONENTS:

2.1 <u>Camera</u>: A webcam captures and recognises an object in view and tracks the user's hand gestures using computer-vision based techniques. It sends the data to the

smart phone. The camera, in a sense, acts as a digital eye, seeing what the user sees. It also tracks the movements of the thumbs and index fingers of both of the user's hands. The camera recognizes objects around you instantly, with the micro-projector overlaying the information on any surface, including the object itself or your hand.

2.2 <u>Projector</u>: Also, a projector opens up interaction and sharing. The project itself contains a battery inside, with 3 hours of battery life. The projector projects visual information enabling surfaces, walls and physical objects around us to be *used as interfaces*. We want this thing to merge with the physical world in a real physical sense. You are touching that object and projecting info onto that object.

2.3 <u>Mirror</u>: The usage of the mirror is significant as the projector dangles pointing downwards from the neck.

2.4 <u>Mobile</u>: The mobile devices like Smartphone in our pockets transmit and receive voice and data anywhere and to anyone via the mobile internet. An accompanying Smartphone runs the SixthSense software, and handles the connection to the internet. A Web-enabled smart phone in the user's pocket processes the video data. Other software searches the Web and interprets the hand gestures.

2.5 <u>Color Markers</u>: It is at the tip of the user's fingers. Marking the user's fingers with red, yellow, green, and blue tape helps the webcam recognize gestures. The movements and arrangements of these makers are interpreted into gestures that act as interaction instructions for the projected application interfaces.

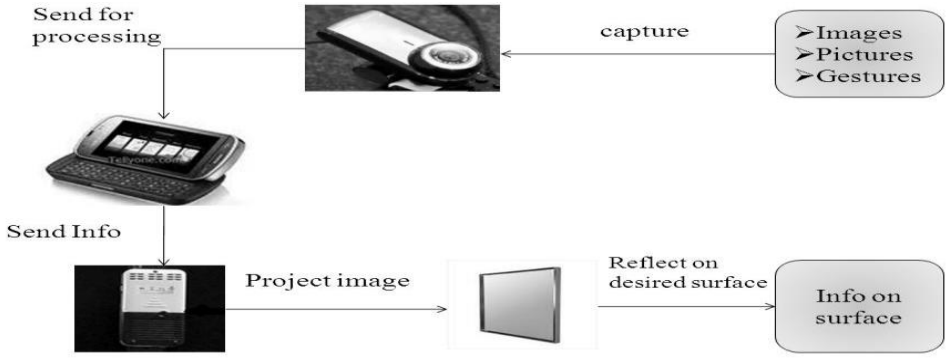


Figure: Working

3.CONCLUSION

Sixth sense is the science of tomorrow with the aim of connecting the digital world with the physical world seamlessly, eliminating hardware devices. Even though the sixth sense devices are in development stage and have not been used in widely, it is predictable that this technology will revolutionize the way people interact with the digital world. Sixthsense has potential to become the extreme transparent user interface for accessing information about everything around it. And as different de-vices have already started to come out with the implementation of this concept, it can be predicted that in near future everyone will have this device in the way they are having cellphones now. Diminishing the mouse and keyboard from everywhere is a challenge. Regardless of that challenge it will for-sure reduce the number of users who uses devices like keyboard and mouse.

The key here is that Sixth Sense recognizes the objects around you, displaying information automatically and letting you access it in any way you want, in the simplest way possible. Clearly, this has the potential of becoming the ultimate "transparent" user interface for accessing information about everything around us. If they can get rid of the colored finger caps and it ever goes beyond the initial development phase, that is. But as it is now, it may change the way we interact with the real world and truly give everyone complete awareness of the environment around us.

#B. AKHILA

(III/IV)

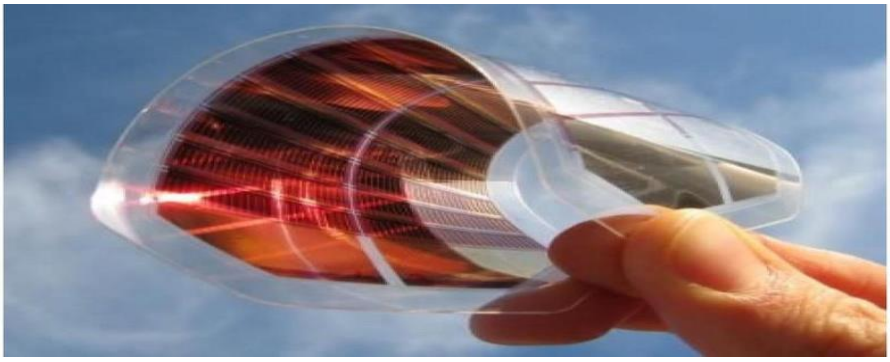
CHAPTER 7

FLEXIBLE ELECTRONICS

1.INTRODUCTION

Flexible electronics, also known as *flex circuits*, is a technology for assembling electronic circuits by mounting electronic devices on flexible plastic substrates, such as polyimide, PEEK or transparent conductive polyester film. Additionally, flex circuits can be screen printed silver circuits on polyester. Flexible electronic assemblies may be manufactured using identical components used for rigid printed circuit boards, allowing the board to conform to a desired shape, or to flex during its use. An alternative approach to flexible electronics suggests various etching techniques to thin down the traditional silicon substrate to few tens of micrometers to gain reasonable flexibility, referred to as flexible silicon (~ 5 mm bending radius).

Flexible electronics have recently attracted much attention since they enable many promising applications such as RFID tags, solar cells ,bio-sensors, wireless power and signal transmission sheets ,e-skin, e-paper and flexible display. The characteristic of flexible electronics is not only reduced cost and they have light weight, thinner, non-breakable & new forms to create many new applications. It is an attractive candidate for next-generation consumer electronics and they will soon be part of our daily lives. Development strategy of flexible electronics is dependent on global technology progresses and market forecasts. Currently, it has been estimated that there are about 1500 worldwide research units working on various aspects of flexible electronics.



2. MATERIAL OF FLEXIBLE ELECTRONICS

2.1 FLEXIBLE CIRCUIT BOARDS

2.1.1 BASE MATERIAL:

The base material is the flexible polymer film which provides the foundation for the laminate. Under normal circumstances, the flex circuit base material provides most primary physical and electrical properties of the flexible circuit. In the case of adhesiveless circuit constructions, the base material provides all of the characteristic properties. While a wide range of thickness is possible, most flexible films are provided in a narrow range of relatively thin dimension from 12 µm to 125 µm (1/2 mil to 5 mils) but thinner and thicker material are possible. Thinner materials are of course more flexible and for most material, stiffness increase is proportional to the cube of thickness. Thus for example, means that if the thickness is doubled, the material becomes eight times stiffer and will only deflect 1/8 as much under the same load. There are a number of different materials used as base films including: polyester (PET), polyimide (PI), polyethylene naphthalate (PEN), polyetherimide (PEI), along with various fluropolymers (FEP) and copolymers. Polyimide films are most prevalent owing to their blend of advantageous electrical, mechanical, chemical and thermal properties.

2.1.2 BONDING ADHESIVES

Adhesives are used as the bonding medium for creating a laminate. When it comes to temperature resistance, the adhesive is typically the performance limiting element of a laminate especially when polyimide is the base material. Because of the earlier difficulties associated with polyimide adhesives, many polyimide flex circuits presently employ adhesive systems of different polymer families. However some newer thermoplastic polyimide adhesives are making important in-roads. As with the base films, adhesives come in different thickness. Thickness selection is typically a function of the application. For example, different adhesive thickness is commonly used in the creation of cover layers in order to meet the fill demands of different copper foil thickness which may be encountered.

2.1.3 METAL FOIL:

A metal foil is most commonly used as the conductive element of a flexible laminate. The metal foil is the material from which the circuit paths are normally etched. A wide variety of metal foils of varying thickness are available from which to choose and create a flex circuit, however copper foils, serve the vast majority of all flexible circuit applications. Copper's excellent balance of cost and physical and electrical performance attributes make it an excellent choice. There are actually many different types of copper foil. The IPC identifies eight different types of copper foil for printed circuits divided into two much broader categories, electrodeposited and wrought, each having four sub-types.) As a result, there are a number of different types of copper foil available for flex circuit applications to serve the varied purposes of different end products. With most copper foil, a thin surface treatment is commonly applied to one side of the foil to improve its adhesion to the base film. Copper foils are of two basic types.

2.2 FLEXIBLE ELECTRONIC COMPONENTS

2.2.1 Resistors and Capacitors :

The past approach presents severe challenges to achieve effective doping and desired material topology. Here we demonstrate the doping techniques with self-sustained strain sharing by applying a strain-sharing scheme between Si and SiGe multiple epitaxial layers, to create strained print-transferrable SiNMs. We demonstrate a new speed record of Si-based flexible electronics without using aggressively scaled critical device dimensions.

The given figure aboves shows the structures of thin flim resistors and capacitors which are constructed on flexible substrate and the conductive paths are made up of flexible materials such as silicon nanomembranes, grapheme, carbon nanotubes etc. Nanotechnology is to a large extent for the manufacturing of electronic components

2.2.2 Memory, Amplifiers and Ring Oscillators

At the International Electron Devices Meeting (IEDM) last fall IBM researchers demonstrated CMOS circuits —including SRAM memory and ring oscillators—on a

flexible plastic substrate. The extremely thin silicon on insulator devices had a body thickness of just 60 angstroms. IBM built them on silicon and then used a room-temperature process called controlled spalling, which essentially flakes off the Si substrate. Then they transferred them to flexible plastic tape. The devices had gate lengths of <30 nm and gate pitch of 100 nm. The ring oscillators had a stage delay of just 16 ps at 0.9 V, believed to be the best reported performance for a flexible circuit.

In a recent edition of the journal Nature Communications a team of researchers from the University of Pennsylvania showed that nanoscale particles, or nanocrystals, of the semiconductor cadmium selenide can be "printed" or "coated" on flexible plastics to form highperformance electronics. Because the nanocrystals are dispersed an amplifier and a ring oscillator. All of these circuits were reported to operate with a couple of volts, according to the researchers an important point since If you want electronics for portable devices that are going to work with batteries, they have to operate at low voltage or they won't be useful.

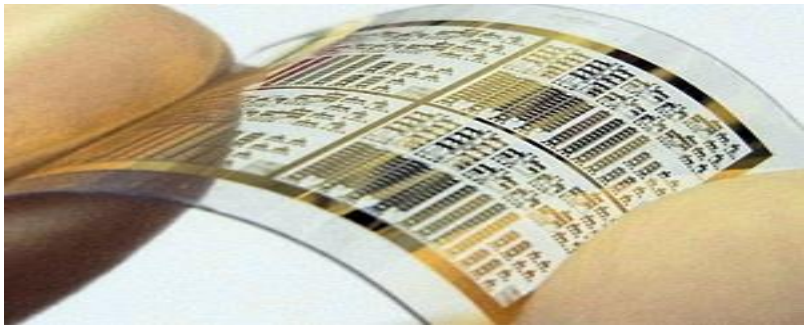


FIG. NON VOLATILE MEMORY

2.2.3 Batteries

One of the things seemingly hampering advances in bendable electronics research is uncertainty surrounding a product's power source. At the University of Delaware, Bingqung Wei and his colleagues are researching energy sources that are scalable and stretchable. In a report published in Nano Letters, a journal of the American Chemical Society, Wei's research team reported significant progress in developing scalable, stretchable power sources using carbon nanotube macrofilms, polyurethane membranes and organic electrolytes. According to Wei, the supercapacitor developed in his lab achieved excellent stability in testing and the results will

provide important guidelines for future design and testing of this leading-edge energy storage device. Also in NanoLetters researchers from the Korea Advanced Institute of Science and Technology (KAIST) in Daejeon, South Korea published a study on a new bendable Li-ion battery for fully flexible electronic systems.

Although the rechargeable lithium-ion battery has been regarded as a strong candidate for a high-performance flexible energy source, compliant electrodes for bendable batteries are restricted to only a few materials, and their performance has not been sufficient for them to be applied to flexible consumer electronics including rollable displays.

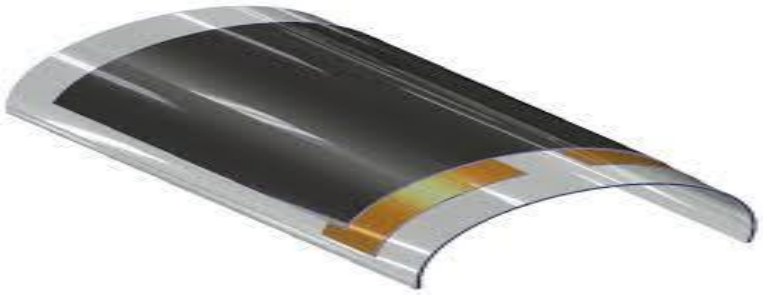


FIG. FLEXIBLE LITHIUM ION BATTERY

2.3 FLEXIBLE DISPLAYS

The desire for a display that has the flexibility and even "foldability" of paper, but with the capability to update the information on the page almost instantly is what drives the interest and commercial funding of flexible electrophoretic devices. Though the electronic paper application is probably in our near future, with some prototypes already available, it is likely that other applications will be more interesting from a commercialization and social acceptance point of view. Large area displays, smart cards, mobile phones, and automotive applications will be some of the targets for flexible electrophoretic displays.

For large area signage and displays, flexible electrophoretic display technology holds promise for several reasons. First, for applications where flexibility or even conformability is desired or useful, the strong optical contrast at nearly all viewing and illumination angles is of interest. The compartmentalization of the ink and the drive electronics into physically separated pixels also allows for greater flexibility than polycrystalline or polymeric materials. Additionally this technology holds promise for remote or mobile display applications due to its low power

usage and relative toughness when built with polymeric substrates. The slow refresh time in these applications is a minimal issue because most signs are updated on much longer time scales. At the same time, companies are making significant strides towards higher refresh rates, nearing video speed.

Finally, the electrophoretic display technology is the only technology with which large area (up to 30 inches wide) flexible displays have already been realized and are in the process of commercialization, giving this technology a market lead. With a higher refresh rate, electrophoretic displays will be able to break into the low end automotive and mobile phone markets.

FIG. FLEXIBLE DISPLAY BY SONY

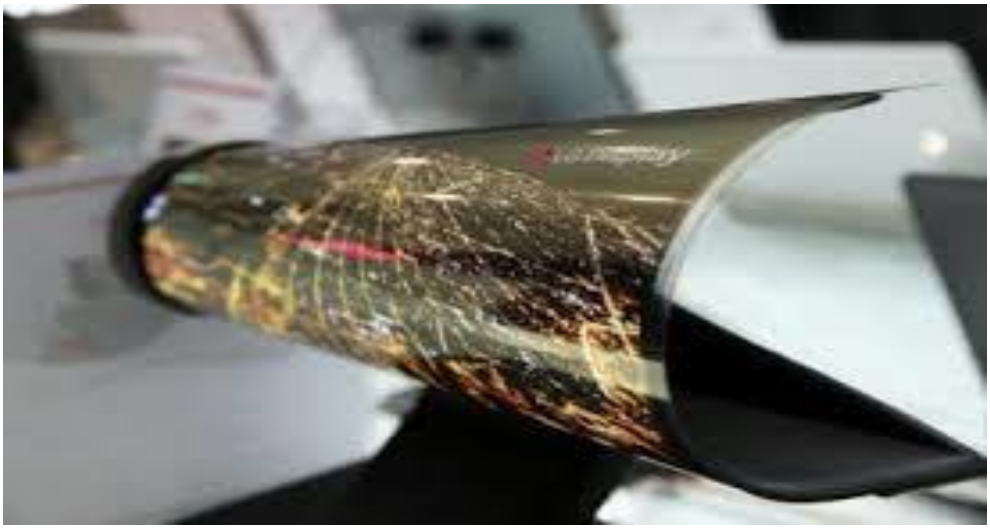


FIG. ORGANIC LIGHT EMITTING DEVICE (OLED)

3.APPLICATIONS

A.Healthcare Flexibility

In electronic materials is very attractive for medical and bio engineering.Some electronics have been integrated into human bodies . For example ,bionic eye, bionic ear, optic nerve etc .heat, humidity ,salt or pressure sensor arrays can be used as bed sheet and monitor a patient in real time. Flexible thin films could also play a key role in deciphering the thought processes occurring in the brains.

B. Automotive Industry

Intelligent roads will be engineered with the aim of improving road safety, lowering road congestion and energy consumption. The road and vehicle will also be able to interact dynamically, adjust either party to energetically optimize their systems.

C. Displays and Human-Machine Interactivity

As a user slide fingers on the surface, the applied time varying potential includes intermittent attractive and repulsive electrostatic forces between the buried conducting layer and the finger. This electrostatic attraction varies the normal contact forces between the user's skin and surface and in turn, modulates the dynamic friction and touch perception.

D. Smart Textiles

Recently, there is increase interest in smart textiles for health monitoring, entertainment and display applications. These smart textiles can be embedded with multiple sensors and display devices for monitoring stress, toxic gases in environment. Each smart thread is basically a shift register with a small display pixel and possibly a sensor, which can be used to transfer data from one end to other.

E. Wireless Networking

Stretchable antennas have been fabricated using PDMS, which is usually cast on a photo-resist mould with the desired design. The PDMS structure is then peeled away and holes introduced for

injection of a liquid eutectic (Galinston:68.5%Ga,21.5%In, 10%Sn),to form the radiating elements. Another recently explored route for fabrication of stretchable PIFA antennas uses direct deposition of thinfilm gold onto elastomeric substrate.

F. Electronic Paper

Currently, the most successful technology and industry is electronic paper, the main applications are e-Readers, electronic shelf labels, smart cards, electronic posters and so on, Currently, the e-Reader is not really flexible because it use a glass backplane. E-Ink Holdings and ITRI includes organic conductor and printing process, substrate is PET films which only can be processed at low temperature. ITRI also develops a passive technology of cholesterol liquid crystal which can be manufactured by full roll-to-roll technology.

4.CONCLUSION

In this report, we have discussed some of the fabrication techniques, applications, challenges and future socioeconomic trends of thin –film technology are likely to enhance the performance of the devices. Although this field is growing and getting matured, it has been expanding rapidly and dynamically. The keys to success include grasping the tempo, building up a complete value chain ,and attracting the necessary entities to join the efforts and cooperate. This paper gives a brief overview of how the field of flexible electronics has evolved over the years and what the future holds for the large area, rugged, low power electronics. Some of the applications which can be developed on flexible substrates have been introduced.

#S. NIKHITHA

(III/IV)

CHAPTER 8

CRYO-CMOS CIRCUITS AND SYSTEMS FOR QUANTUM COMPUTING

1.INTRODUCTION

Quantum computing is a new paradigm that exploits basic principles of quantum mechanics, such as entanglement and superposition potentially enabling unprecedented speedups in solving intractable problems The new computing opportunities include prime factorization, quantum simulations for synthesis of drugs and materials, and complex optimizations.

In its fundamental embodiment, a quantum computer comprises a quantum processor and a classical electronic controller. The quantum processor consists of a set of quantum bits (qubits) operating at extremely low temperatures, typically a few tens of mK, while the classical electronic controller is used to read out and control the quantum processor, as shown in Fig.1. Although the classical controller is implemented today with room-temperature laboratory instruments, this approach becomes increasingly challenging and less cost-effective as the number of qubits grows toward the thousands and millions, as required by practical quantum algorithms.

Here, there is a monolithic integration of the read-out and control circuitry in a standard CMOS technology operating at cryogenic temperatures (cryo-CMOS).

Although other specialized electronic technologies can handle cryogenic temperatures, only CMOS can work down to at least 30 mK while providing complex system-on-chip integration capable of handling thousands or millions of qubits [A drastic reduction of the complex interconnections between the cryogenic chamber and the room-temperature electronics will result in enhanced compactness and reliability, thus paving the way to the creation of practical quantum computers. More-over, the cryo-CMOS circuits and systems could prove useful in other domains, for example, in applications that require cryogenic environments as an integral part of their operation, such as space and high-energy-physics experiments, or wherever extremely low noise is essential, such as in metrology, imaging, and instrumentation.

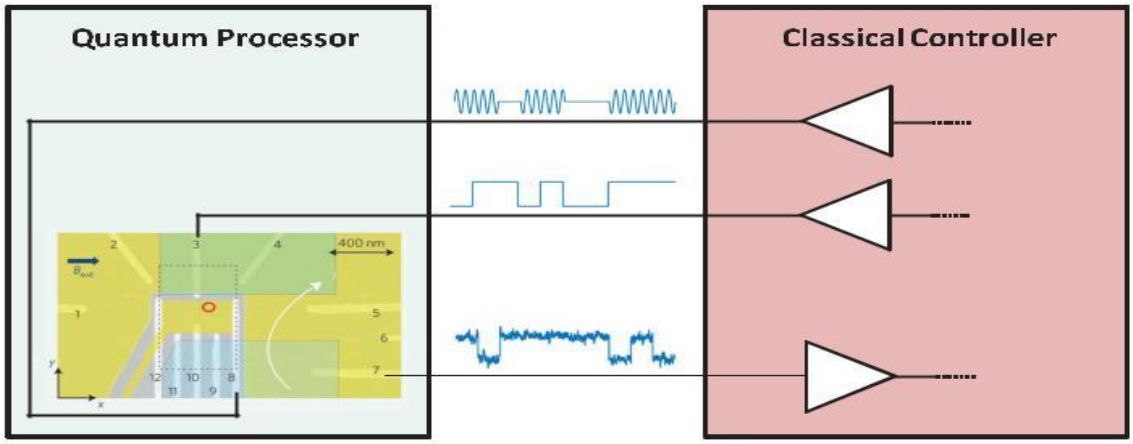


Fig. Quantum processor and classical controller connected in a control/readout configuration

2. ARCHITECTURE OF THE CLASSICAL CONTROLLER

Qubit control and readout require generation and acquisi-tion of specific electronic and/or optical signals. Typically, for the manipulation of a single qubit, microwave bursts of short duration (<1 μs) must be applied, e.g., 4–8-GHz bursts for transmons and >12-GHz bursts for spin qubits. Two-qubit operations typically require current (for transmons) or voltage pulses (for spin qubits) with a bandwidth of tens of MHz. The readout is often performed fully electrically, e.g., by measuring the resonance frequency of a microwave resonator in the case of transmons , or by measuring the impedance of a charge detector, such as a quantum point contact, in the case of spin qubits.

In order not to disturb the quantum state of the qubit, the controller must generate accurate and extremely low-noise signals. Since contemporary quantum computers operate at deep cryogenic temperatures, well below 1K, individually interconnecting each of potentially millions of qubits to a room-temperature controller becomes infeasible due to the sheer interconnect complexity, cost, and poor system reliability. To address those issues, we propose a cryo-CMOS controller.

3.CRYO-CMOS CONTROLLER

Cryogenic CMOS circuits have been proposed before for applications ranging from space missions to low-noise amplifiers (LNAs). However, quantum processors require extremely high performance from the classical electronic controller in terms of bandwidth and noise, so as to ensure accuracy and speed in the control and readout of the qubits. In this, we demonstrate two

critical sub-systems of the electronic controller: an LNA and an RF oscillator, which are optimized for cryogenic operation. It comprises both the control and readout sections, in addition to service blocks, such as current, frequency, and voltage references, and a digital controller.Cryo-CMOS whose block diagram is as shown fig.2

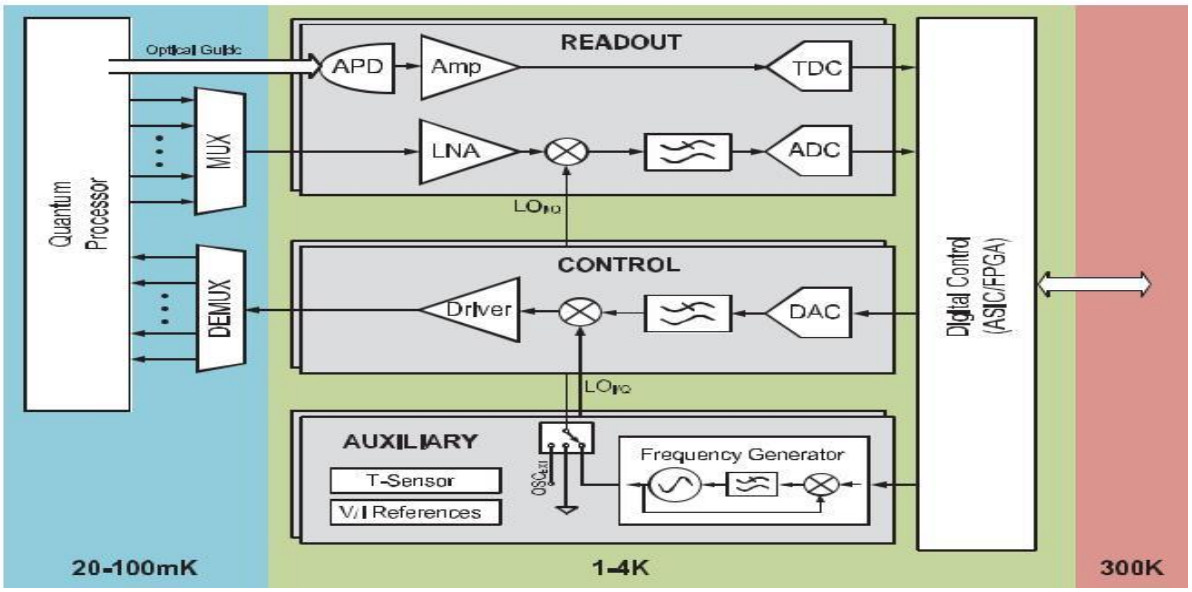


Fig. Cryo-CMOS controller for the control and readout of qubits.

Demultiplexing, such as frequency or time multiplexing, is envisioned at the quantum-processor temperature to reduce the number of interconnects. For the spin-qubit readout, an LNA can be employed to sense the reflection coefficient at the end of a 50- line connected to the charge sensor in a so-called reflectometry readout. Due to the limited sensor sensitivity ($R/R \approx 1\%$), as well as the fact that qubits are sensitive to electric field variations, only a very weak reflected power. It means that the readout circuitry must √be operating at very low-noise levels (at least below 40 pV/ Hz for an SNR > 0 dB). However, by taking advantage of the low thermal noise at cryogenic temperatures, a good power efficiency can be achieved using a wideband LNA offering frequency multiplexing of many qubit channels The lower thermal noise at cryogenic temperatures also benefits the photon detector employed for the readout of qubits implemented using nitrogen-vacancy centers in diamond (operating from 500 to 1550 nm). , a single-photon avalanche diode (SPAD) has a highly improved dark count rate (DCR) at 77 K over a wavelength range of 350–800 nm.

4. CRYO-CMOS CHARACTERIZATION

The first challenge to address when designing CMOS circuits at cryogenic temperatures is the availability of device models. Figs. 3 and 4 show the measured I_D -V_{DS} characteristics for both NMOS and PMOS transistors at 300 and 4K in 160-nm and 40-nm CMOS technologies, respectively. As expected, the drain current at 4 K is higher than that measured at 300 K, mainly due to increased carrier mobility. The mobility-induced current increase is partially mitigated by the increase in threshold voltage that is shown in Fig. 5 for both thin-oxide 160-nm NMOS and PMOS. In addition to a large variation of the transistor parameters, specific cryogenic non-idealities can be present, such as akink and hysteresis.

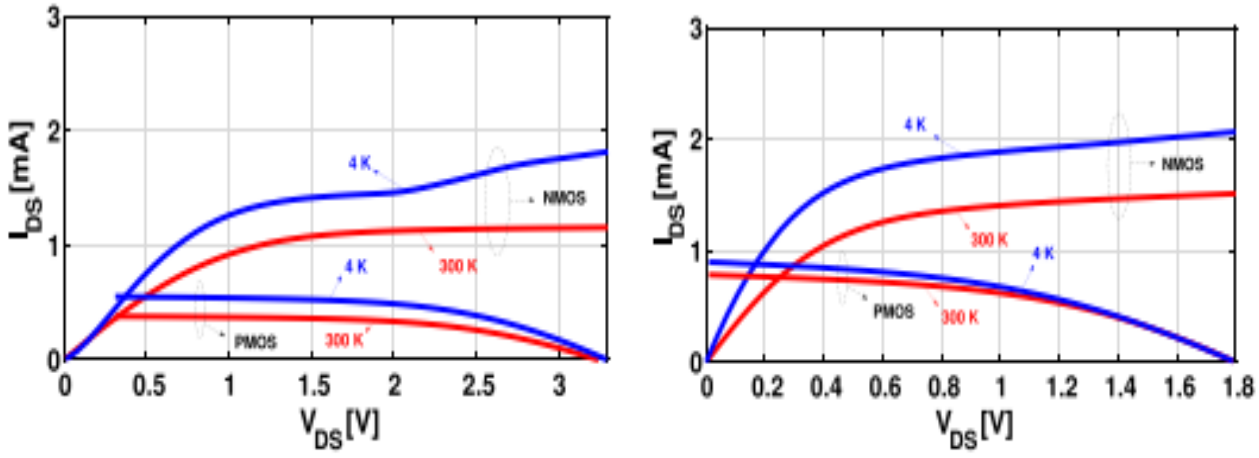


Fig. Output characteristics of thick and thin oxide NMOS and PMOS in 160-nm CMOS technology.

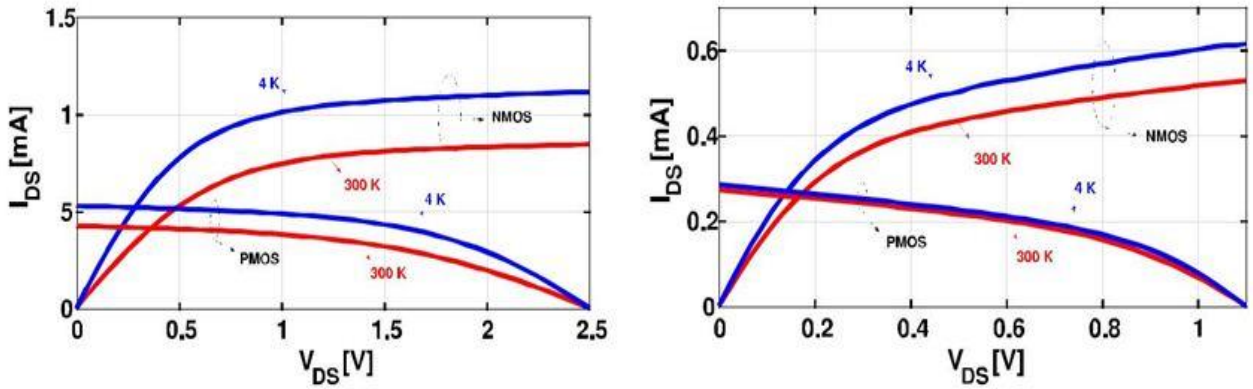


Fig. Output characteristics of thick and thin oxide NMOS and PMOS in 40-nm CMOS technology.

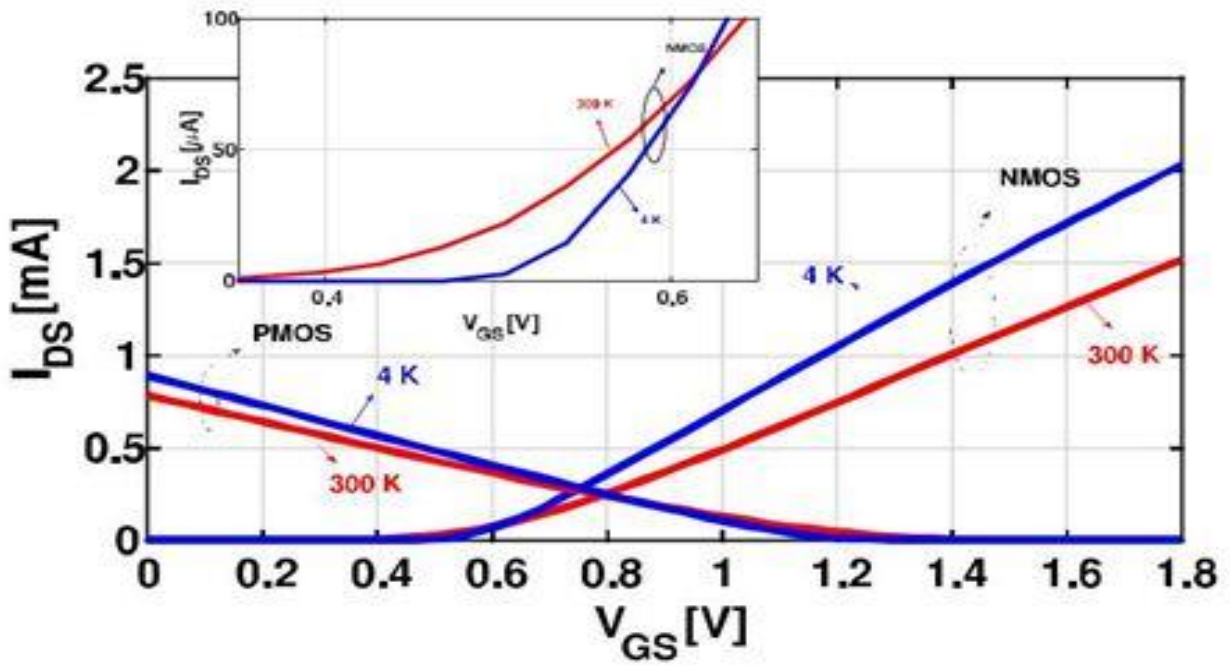


Fig. I_D-V_G characteristic of thin-oxide NMOS and PMOS in 160-nm CMOS technology

The measured delay of an inverter in 160-nm CMOS at a nominal supply voltage improves by 20%, from 38.3 ps at 300 K to 30.6 ps at 4 K. In 40-nm CMOS, the improvement is 36%, indicating that significant speedups can be achieved at cryogenic temperatures. From the cryogenic behavior of CMOS devices there are no standard cryogenic models exist for commercial technologies and simulators. Therefore, to enable the design of cryogenic circuits, a modified MOS11 model for transistors operating at 4 K has been developed and extensively used in the simulations.

5.CONCLUSION

This is an experimental validation of several major circuit blocks critical for the implementation of a CMOS classical electronic controller to operate at cryogenic temperatures (i.e., cryo-CMOS) in order to interface with practical quantum processor. Thus establishing cryo-CMOS circuits and systems as an enabling technology for the fabrication of practical quantum computers with thousands or even millions of qubits.

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