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Chapter 1 : Electronics News and Product Design Updates | New Electronics

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The vacuum tube era Theoretical and experimental studies of electricity during the 18th and 19th centuries led to the development of the first electrical machines and the beginning of the widespread use of electricity. The history of electronics began to evolve separately from that of electricity late in the 19th century with the identification of the electron by the English physicist Sir Joseph John Thomson and the measurement of its electric charge by the American physicist Robert A. Edison had observed a bluish glow in some of his early lightbulbs under certain conditions and found that a current would flow from one electrode in the lamp to another if the second one anode were made positively charged with respect to the first cathode. Work by Thomson and his students and by the English engineer John Ambrose Fleming revealed that this so-called Edison effect was the result of the emission of electrons from the cathode, the hot filament in the lamp. The motion of the electrons to the anode, a metal plate, constituted an electric current that would not exist if the anode were negatively charged. This discovery provided impetus for the development of electron tubes, including an improved X-ray tube by the American engineer William D. The detection of a radio signal, which is a very high-frequency alternating current AC , requires that the signal be rectified; i. These devices were undependable, lacked sufficient sensitivity, and required constant adjustment of the whisker-to-crystal contact to produce the desired result. The fact that crystal rectifiers worked at all encouraged scientists to continue studying them and gradually to obtain the fundamental understanding of the electrical properties of semiconducting materials necessary to permit the invention of the transistor. In Lee De Forest , an American engineer, developed a type of vacuum tube that was capable of amplifying radio signals. De Forest added a grid of fine wire between the cathode and anode of the two-electrode thermionic valve constructed by Fleming. The new device, which De Forest dubbed the Audion patented in , was thus a three-electrode vacuum tube. In operation, the anode in such a vacuum tube is given a positive potential positively biased with respect to the cathode, while the grid is negatively biased. A large negative bias on the grid prevents any electrons emitted from the cathode from reaching the anode; however, because the grid is largely open space, a less negative bias permits some electrons to pass through it and reach the anode. Small variations in the grid potential can thus control large amounts of anode current. The vacuum tube permitted the development of radio broadcasting, long-distance telephony, television, and the first electronic digital computers. These early electronic computers were, in fact, the largest vacuum-tube systems ever built. The special requirements of the many different applications of vacuum tubes led to numerous improvements, enabling them to handle large amounts of power, operate at very high frequencies, have greater than average reliability, or be made very compact the size of a thimble. The cathode-ray tube , originally developed for displaying electrical waveforms on a screen for engineering measurements, evolved into the television picture tube. Such tubes operate by forming the electrons emitted from the cathode into a thin beam that impinges on a fluorescent screen at the end of the tube. The screen emits light that can be viewed from outside the tube. Deflecting the electron beam causes patterns of light to be produced on the screen, creating the desired optical images. Notwithstanding the remarkable success of solid-state devices in most electronic applications, there are certain specialized functions that only vacuum tubes can perform. These usually involve operation at extremes of power or frequency. Vacuum tubes are fragile and ultimately wear out in service. Failure occurs in normal usage either from the effects of repeated heating and cooling as equipment is switched on and off thermal fatigue , which ultimately causes a physical fracture in some part of the interior structure of the tube, or from degradation of the properties of the cathode by residual gases in the tube. These shortcomings motivated scientists at Bell Laboratories to seek an alternative to the vacuum tube and led to the development of the transistor. The semiconductor revolution Invention of the transistor The invention of the transistor in by John Bardeen , Walter H. Brattain , and William B. Shockley of the Bell research staff provided the first of a series of new devices with remarkable potential for expanding the utility of electronic equipment see photograph. Transistors, along with such subsequent developments as integrated circuits , are made of crystalline solid materials called semiconductors , which have electrical properties that can be varied over an extremely wide range by the addition of minuscule quantities of other elements. The availability of two kinds of charge carriers in semiconductors is a valuable property exploited in many electronic devices made of such materials. Early transistors were produced using germanium as the semiconductor material, because methods of purifying it to the required degree had been developed during and shortly after World War II. Because the electrical properties of semiconductors are extremely sensitive to the slightest trace of certain other elements, only about one part per billion of such elements can be tolerated in material to be used for making semiconductor devices. During the late s, research on the purification of silicon succeeded in producing material suitable for semiconductor devices, and new devices made of silicon were manufactured from about Silicon quickly became the preferred raw material, because it is much more abundant than germanium and thus less expensive. In addition, silicon retains its semiconducting properties at higher temperatures than does germanium. There was one other important property of silicon, not appreciated at the time but crucial to the development of low-cost transistors and integrated circuits: This film is utilized as a mask to permit the desired impurities that modify the electrical properties of silicon to be introduced into it during manufacture of semiconductor devices. The mask pattern, formed by a photolithographic process, permits the creation of tiny transistors and other electronic components in the silicon. Integrated circuits By vacuum tubes were rapidly being supplanted by transistors, because the latter had become less expensive, did not burn out in service, and were much smaller and more reliable. Computers employed hundreds of thousands of transistors each. This fact, together with the need for compact, lightweight electronic missile-guidance systems, led to the invention of the integrated circuit IC independently by Jack Kilby of Texas Instruments Incorporated in and by Jean Hoerni and Robert Noyce of Fairchild Semiconductor Corporation in Kilby is usually credited with having developed the concept of integrating device and circuit elements onto a single silicon chip, while Noyce is given credit for having conceived the method for integrating the separate elements. Early ICs contained about 10 individual components on a silicon chip 3 mm 0. By the number was up to 1, on a chip of the same size at no increase in cost. Late in the following year the first microprocessor was introduced. This type of large-scale IC was developed by a team at Intel Corporation , the same company that also introduced the memory IC in The stage was now set for the computerization of small electronic equipment. Until the microprocessor appeared on the scene, computers were essentially discrete pieces of equipment used primarily for data processing and scientific calculations. They ranged in size from minicomputers , comparable in dimensions to a small filing cabinet, to mainframe systems that could fill a large room. The microprocessor enabled computer engineers to develop microcomputers â€”systems about the size of a lunch box or smaller but with enough computing power to perform many kinds of business, industrial, and scientific tasks. Such systems made it possible to control a host of small instruments or devices e. The very existence of computer hardware inside such devices is not apparent to the user. The large demand for microprocessors generated by these initial applications led to high-volume production and a dramatic reduction in cost. This in turn promoted the use of the devices in many other applicationsâ€"for example, in household appliances and automobiles, for which electronic controls had previously been too expensive to consider. Continued advances in IC technology gave rise to very large-scale integration VLSI , which substantially increased the circuit density of microprocessors. These technological advances, coupled with further cost reductions stemming from improved manufacturing methods, made feasible the mass production of personal computers for use in offices, schools, and homes. By the mids inexpensive microprocessors had stimulated computerization of an enormous variety of consumer products. Common examples included programmable microwave ovens and thermostats, clothes washers and dryers, self-tuning television sets and self-focusing cameras, videocassette recorders and video games, telephones and answering machines, musical instruments, watches, and security systems.

Microelectronics also came to the fore in business, industry , government, and other sectors. Microprocessor-based equipment proliferated, ranging from automatic teller machines ATMs and point-of-sale terminals in retail stores to automated factory assembly systems and office workstations. By mid memory ICs with a capacity of , bits binary digits were available. In fact, Gordon E. Moore , one of the founders of Intel, observed as early as that the complexity of ICs was approximately doubling every 18â€”24 months, which was still the case in Moore observed that the number of transistors on a computer chip was doubling about every 18â€”24 months. Compound semiconductor materials Many semiconductor materials other than silicon and germanium exist, and they have different useful properties. Silicon carbide is a compound semiconductor, the only one composed of two elements from column IV of the periodic table. It is particularly suited for making devices for specialized high-temperature applications. Other compounds formed by combining elements from column III of the periodic tableâ€”such as aluminum, gallium, and indiumâ€”with elements from column Vâ€”such as phosphorus, arsenic, and antimonyâ€—are of particular interest. These so-called III-V compounds are used to make semiconductor devices that emit light efficiently or that operate at exceptionally high frequencies. A remarkable characteristic of these compounds is that they can, in effect, be mixed together. One can produce gallium arsenide or substitute aluminum for some of the gallium or also substitute phosphorus for some of the arsenic. When this is done, the electrical and optical properties of the material are subtly changed in a continuous fashion in proportion to the amount of aluminum or phosphorus used. Except for silicon carbide , these compounds have the same crystal structure. This makes possible the gradation of composition , and thus the properties, of the semiconductor material within one continuous crystalline body. Modern material-processing techniques allow these compositional changes to be controlled accurately on an atomic scale. These characteristics are exploited in making semiconductor lasers that produce light of any given wavelength within a considerable range. Such lasers are used, for example, in compact disc players and as light sources for optical fibre communication. Digital electronics Computers understand only two numbers, 0 and 1, and do all their arithmetic operations in this binary mode. Many electrical and electronic devices have two states: A light switch is a familiar example, as are vacuum tubes and transistors. Because computers have been a major application for integrated circuits from their beginning, digital integrated circuits have become commonplace. It has thus become easy to design electronic systems that use digital language to control their functions and to communicate with other systems. A major advantage in using digital methods is that the accuracy of a stream of digital signals can be verified, and, if necessary, errors can be corrected. An example is the sound from a phonograph record , which always contains some extraneous sound from the surface of the recording groove even when the record is new. The noise becomes more pronounced with wear. Contrast this with the sound from a digital compact disc recording. No sound is heard that was not present in the recording studio. The disc and the player contain error-correcting features that remove any incorrect pulses perhaps arising from dust on the disc from the information as it is read from the disc. As electronic systems become more complex, it is essential that errors produced by noise be removed; otherwise, the systems may malfunction. Many electronic systems are required to operate in electrically noisy environments , such as in an automobile. The only practical way to assure immunity from noise is to make such a system operate digitally. In principle it is possible to correct for any arbitrary number of errors, but in practice this may not be possible. The amount of extra information that must be handled to correct for large rates of error reduces the capacity of the system to handle the desired information, and so trade-offs are necessary. A consequence of the veritable explosion in the number and kinds of electronic systems has been a sharp growth in the electrical noise level of the environment. Any electrical system generates some noise, and all electronic systems are to some degree susceptible to disturbance from noise. The noise may be conducted along wires connected to the system, or it may be radiated through the air. Care is necessary in the design of systems to limit the amount of noise that is generated and to shield the system properly to protect it from external noise sources.

Chapter 2 : electronics | Devices, Facts, & History | www.nxgvision.com

News and Research in Electronics. Read about new discoveries in electronics including electronic circuits, polymer-based electronics, nanotubes and more.

Signal processing Signal processing deals with the analysis and manipulation of signals. For analog signals, signal processing may involve the amplification and filtering of audio signals for audio equipment or the modulation and demodulation of signals for telecommunications. For digital signals, signal processing may involve the compression , error detection and error correction of digitally sampled signals. Analog signal processing is still important in the design of many control systems. DSP processor ICs are found in many types of modern electronic devices, such as digital television sets , [57] radios, Hi-Fi audio equipment, mobile phones, multimedia players , camcorders and digital cameras, automobile control systems, noise cancelling headphones, digital spectrum analyzers , missile guidance systems, radar systems, and telematics systems. In such products, DSP may be responsible for noise reduction , speech recognition or synthesis , encoding or decoding digital media, wirelessly transmitting or receiving data, triangulating position using GPS , and other kinds of image processing , video processing , audio processing , and speech processing. Telecommunications engineering Telecommunications engineering focuses on the transmission of information across a communication channel such as a coax cable , optical fiber or free space. Popular analog modulation techniques include amplitude modulation and frequency modulation. Once the transmission characteristics of a system are determined, telecommunication engineers design the transmitters and receivers needed for such systems. These two are sometimes combined to form a two-way communication device known as a transceiver. A key consideration in the design of transmitters is their power consumption as this is closely related to their signal strength. Satellite dishes are a crucial component in the analysis of satellite information. Instrumentation engineering Instrumentation engineering deals with the design of devices to measure physical quantities such as pressure , flow , and temperature. For example, flight instruments measure variables such as wind speed and altitude to enable pilots the control of aircraft analytically. Similarly, thermocouples use the Peltier-Seebeck effect to measure the temperature difference between two points. Flight instruments provide pilots with the tools to control aircraft analytically. Computer engineering Computer engineering deals with the design of computers and computer systems. This may involve the design of new hardware , the design of PDAs , tablets, and supercomputers , or the use of computers to control an industrial plant. However, the design of complex software systems is often the domain of software engineering , which is usually considered a separate discipline. Related disciplines[edit] The Bird VIP Infant ventilator Mechatronics is an engineering discipline which deals with the convergence of electrical and mechanical systems. Such combined systems are known as electromechanical systems and have widespread adoption. Examples include automated manufacturing systems , [68] heating, ventilation and air-conditioning systems , [69] and various subsystems of aircraft and automobiles. They design, develop, test, and supervise the deployment of electrical systems and electronic devices. For example, they may work on the design of telecommunication systems , the operation of electric power stations , the lighting and wiring of buildings , the design of household appliances , or the electrical control of industrial machinery. Fundamental to the discipline are the sciences of physics and mathematics as these help to obtain both a qualitative and quantitative description of how such systems will work. Today most engineering work involves the use of computers and it is commonplace to use computer-aided design programs when designing electrical systems. Nevertheless, the ability to sketch ideas is still invaluable for quickly communicating with others. The Shadow robot hand system Although most electrical engineers will understand basic circuit theory that is the interactions of elements such as resistors , capacitors , diodes , transistors , and inductors in a circuit , the theories employed by engineers generally depend upon the work they do. For example, quantum mechanics and solid state physics might be relevant to an engineer working on VLSI the design of integrated circuits , but are largely irrelevant to engineers working with macroscopic electrical systems. Even circuit theory may not be relevant to a person designing telecommunication systems that use off-the-shelf components. Perhaps the most important technical skills for electrical engineers are reflected in university programs, which emphasize strong numerical skills , computer literacy , and the ability to understand the technical language and concepts that relate to electrical engineering. A wide range of instrumentation is used by electrical engineers. For simple control circuits and alarms, a basic multimeter measuring voltage , current , and resistance may suffice. Where time-varying signals need to be studied, the oscilloscope is also an ubiquitous instrument. In RF engineering and high frequency telecommunications, spectrum analyzers and network analyzers are used. In some disciplines, safety can be a particular concern with instrumentation. For instance, medical electronics designers must take into account that much lower voltages than normal can be dangerous when electrodes are directly in contact with internal body fluids.

Chapter 3 : Communications Technology News | New Electronics

The primary goal of the IEEE Communications Magazine's Design and implementation of Devices, Circuits, and Systems Series of articles is to provide insights into the latest technological developments in devices, circuits and systems that are used in communication systems/applications of all types, from home/consumer networks to service-provider networks.

The performance of silicon-based devices has improved rapidly in the past few decades, mostly due to novel processing and patterning technologies, while nanotechnology has allowed for miniaturization and cost reduction. For many years silicon remained the only option in electronics. Carbon atoms in graphene form a hexagonal two-dimensional lattice, and this atom-thick layer has attracted attention due to its high electrical and thermal conductivity, mechanical flexibility and very high tensile strength. Graphene is the strongest material ever tested. Graphnene may have started this 2D revolution in electronics, but silicene, phosphorene and stanene, atom-thick allotropes of silicon, phosphorus and tin, respectively, have a similar honeycomb structure with different properties, resulting in different applications. All four have the potential to change electronics as we know it, allowing for miniaturization, higher performance and cost reduction. Several companies around the globe, including Samsung and Apple, are developing applications based on graphene. Organic electronics The development of conducting polymers and their applications resulted in another Nobel prize in , this time in chemistry. MacDiarmid and Hideki Shirakawa proved that plastic can conduct electricity. Unlike conventional inorganic conductors and semiconductors, organic electronic materials are constructed from organic carbon-based molecules or polymers using chemical synthesis. Organic electronics is not limited to conducting polymers, but includes other organic materials that might be of use in electronics. In terms of performance and industrial development, organic molecules and polymers cannot yet compete with their inorganic counterparts. However, organic electronics have some advantages over conventional electronic materials. Low material and production costs, mechanical flexibility, adaptability of synthesis processes and biocompatibility make organic electronics a desirable choice for certain applications. Commercially available high-tech products relying on organic semiconductors, such as curved television screens, displays for smartphones, coloured light sources and portable solar cells, demonstrate the industrial maturity of organic electronics. In fact, several high-tech companies, including LG Electronics and Samsung, have invested in cheap and high-performance organic-electronic devices. It is expected that the organic electronics market will grow rapidly in the coming years. Memristors In Leon Chua reasoned from symmetry arguments that there should be a fourth fundamental electronic circuit-board element in addition to the resistor, capacitor and inductor which he called memristor, a portmanteau of the words memory and resistor. In transistors, once the flow of electrons is interrupted for example by switching off the power all information is lost. There will be no information loss, even if the power is off. Memristor-based circuits will allow us to switch computers on and off instantly, and start work straight away. For the past several years, Hewlett Packard has been working on a new type of computer based on memristor technology. HP plans to launch the product by This provides an additional two binary states to the conventional low and high logic values, which are represented by simple currents. Carrying information in both the charge and spin of an electron potentially offers devices with a greater diversity of functionality. So far, spintronic technology has been tested in information-storage devices, such as hard drives and spin-based transistors. Spintronics technology also shows promise for digital electronics in general. So far this technology is in the early development stage and, irrespective of intense research, we have to wait a couple of years to see the first commercial spin-based electronic chip. Molecular electronics The ultimate goal of electrical circuits is miniaturization. To clarify, organic electronics refers to bulk applications, while molecular-scale electronics refers to nano-scale, single-molecule applications. However, the trend of miniaturization in electronics has forced the feature sizes of the electronic components to shrink accordingly. In single-molecule electronics, the bulk material is replaced by single molecules.

Another advantage of some molecular systems is their tendency to self-assemble into functional blocks. Several molecular electronic solutions have been developed, including molecular wires, single-molecule transistors and rectifiers. However, molecular electronics is still in the early research phase, and none of these devices has left the laboratory.

Chapter 4 : Advances in Communication Technology | It Still Works

But recent developments in materials-engineering and nanotechnology have introduced new pathways for electronics. While traditional silicon electronics will remain the main focus, alternative trends are emerging.

Advances in Communication Technology by John Papiewski Modern civilization depends on advanced communication technologies. The application of electricity to communications with inventions such as the telephone and telegraph meant people could send information instantly over long distances. More recent advances such as satellites and the Internet have extended communications worldwide and made global news and information commonplace. Communications technology continues to improve with each passing year, bringing more information choices to you at lower costs. The system was a simple electrical circuit consisting of a battery, a switch and an electromagnet. Pressing the switch key closed the circuit; this energized the electromagnet which produced a clicking sound from a piece of metal. Operators sent messages as a series of coded key taps; the receiving station heard the corresponding clicks produced with virtually no delay. Telegraph wires eventually connected cities across the country, carrying news, commerce and personal messages. Telephone In the late s, further experiments in electricity led inventors to develop the telephone. As with the telegraph, the telephone sends electrical signals through wires to a distant receiver; in place of staccato clicks which take training to understand, telephone wires carry the sounds of actual speech. Although telephones and telegraphs coexisted for several decades, telegraphs are now mostly museum pieces; in , telephones continue to be a dominant form of personal communications. Radio Radio systems send voice, data and video by means of wireless signals. Not long after Bell developed the telephone, other inventors such as Nikola Tesla and Guglielmo Marconi experimented with sending signals over the air using high-frequency electronic circuits and antennas. Radio systems introduced the concept of broadcasting, in which thousands of listeners hear speech and music sent by a single transmitter. Today, the concept of radio extends from traditional broadcast stations to cell phones and wireless data networks. Satellites Although radio waves carry signals reliably, long-distance transmissions are complicated by the ionosphere, a layer of thin, energetic gas that lies above the breathable atmosphere. Satellites solve the distance problem by receiving radio signals in space, amplifying and retransmitting them to ground-based receivers thousands of miles from the original source. In the s, networks of satellites permitted the first instantaneous, world-wide communications. Internet The Internet had its beginnings in a military research project called the Advanced Research Projects Agency Network in the s. It was an early data network which permitted computer users at different locations to share information. Devices called routers pass packets along from one system to another until they arrive at their destination. Originally, researchers used the Internet for data and simple emails, but in the late s, Tim Berners-Lee developed a standard format for linked pages of text, and the World Wide Web was born. Today, the Internet continues to grow and develop, both in the services it offers and the speed of the network hardware which carries data.

Chapter 5 : List of emerging technologies - Wikipedia

Introduction. This chapter presents recent developments and design approaches in analog devices and circuitry that will enable incredible bandwidths and multi-gigabit per second (Gbps) data rates for mobile devices through the use of mmWave wireless carrier frequencies.

Chapter 6 : The 5 next trends in electronics | World Economic Forum

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Chapter 7 : Electrical engineering - Wikipedia

Recent Developments in Microwave Semiconductor Devices for Satellite Communications and Direct Broadcasting Abstract: Activities on microwave and millimeter-wave compound semiconductor devices in Japan are reported.