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Recent Innovations in Sophisticated Electronics

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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DEPARTMENT VISION

To be identified as a reputed technological department by offering quality education in Electronics and Communication Engineering so as to promote higher learning, research, provide professional career and produce creative solutions to social needs.

DEPARTMENT MISSION

Mission1 (M1)	To impart quality technical education in Electronics and Communication Engineering with the best pedagogical atmosphere of the highest quality through modern infrastructure and cutting edge skills.
Mission2 (M2)	To promote the establishment of centre of excellence to foster the spirit of innovation and creativeness among faculty and students.
Mission3 (M3)	To develop leadership qualities and also provide ethical and value based education by encouraging operations focused on social needs.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

After successful completion of the program, the graduates can have the ability to

PEO1	Be cognizant in basic sciences, fundamental engineering stream along with contemporary problem solving, critical analytical skills in electronics and communication engineering and the allied fields.
PEO2	Understand the issues related to design and development; update the knowledge, and skills through continuous learning in the field of Electronics and Communication Engineering.
PEO3	Demonstrate their technical skills, communication skills and research abilities along with leadership skills in professional environment to empower employability, to go for higher education and to become entrepreneurs.
PEO4	Be motivated with high ethical, human values and team work towards development of the society.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

At the end of the program, the student :

PSO1	Able to gain knowledge in diverse areas of electronics and communication for successful career entrepreneurship and higher studies.
PSO2	An ability to make use of acquired technical knowledge in core subjects to analyze and design process for variety of real time application, along with life skills to arrive appropriate solutions.

Smart Dust

INTRODUCTION

Smart dust is a tiny dust size device with extra-ordinary capabilities. Smart dust combines sensing, computing, wireless communication capabilities and autonomous power supply within volume of only few millimeters and that too at low cost. These devices are proposed to be so small and light in weight that they can remain suspended in the environment like an ordinary dust particle. These properties of Smart Dust will render it useful in monitoring real world phenomenon without disturbing the original process to an observable extends. Presently the achievable size of Smart Dust is about 5mm cube, but we hope that it will eventually be as small as a speck of dust. Individual sensors of smart dust are often referred to as motes because of their small size. These devices are also known as MEMS, which stands for *micro electro- mechanical sensors*.

WHAT IS A SMART DUST?

Berkeley's *Smart Dust* project, led by Professors Pister and Kahn, explores the limits on size and power consumption in autonomous sensor nodes. Size reduction is paramount, to make the nodes as inexpensive and easy-to-deploy as possible. The research team is confident that they can incorporate the requisite sensing, communication, and computing hardware, along with a power supply, in a volume no more than a few cubic millimeters, while still achieving impressive performance in terms of sensor functionality and communications capability. These millimeter-scale nodes are called "Smart Dust." It is certainly within the realm of possibility that future prototypes of Smart Dust could be small enough to remain suspended in air, buoyed by air currents, sensing and communicating for hours or days on end.

THE MEMS TECHNOLOGY IN SMART DUST

Smart dust requires mainly revolutionary advances in miniaturization, integration & energy management. Hence designers have used MEMS technology to build small sensors, optical communication components, and power supplies. Microelectro mechanical systems consists of extremely tiny mechanical elements, often integrated together with electronic circuitory. They are measured in micrometers, that is millions of a meter. They are made in a similar fashion as computer chips. The advantage of this manufacturing process is not simply that small structures can be achieved but also that thousands or even millions of system elements can be fabricated simultaneously. This allows systems to be both highly complex and extremely low-cost.

OPERATION OF THE MOTE

The Smart Dust mote is run by a microcontroller that not only determines the tasks performed by the mote, but controls power to the various components of the system to conserve energy. Periodically the microcontroller gets a reading from one of the sensors, which measure one of a number of physical or chemical stimuli such as temperature, ambient light, vibration, acceleration, or air pressure, processes the data, and stores it in memory. It also occasionally turns on the optical receiver to see if anyone is trying to communicate with it. This communication may include new programs or messages from other motes. In response to a message or upon its own initiative the microcontroller will use the corner cube retro reflector or laser to transmit sensor data or a message to a base station or another mote.The primary constraint in the design of the Smart Dust motes is volume, which in turn puts a severe constraint on energy since we do not have much room for batteries or large solar cells. Thus, the motes must operate efficiently and conserve energy whenever possible. Most of the time, the majority of the mote is powered off with only a clock and a few timers running. When a timer expires, it powers up a part of the mote to carry out a job, then powers off. A few of the timers control the sensors that measure one of a number of physical or chemical stimuli such as temperature, ambient light, vibration, acceleration, or air pressure. When one of these timers expires, it powers up the corresponding sensor, takes a sample, and converts it to a digital word. If the data is interesting, it may either be stored directly in the SRAM or the microcontroller is powered up to perform more complex operations with it. When this task is complete, everything is again powered down and the timer begins counting again.

COMMUNICATING FROM A GRAIN OF SAND

Smart Dust's full potential can only be attained when the sensor nodes communicate with one another or with a central base station. Wireless communication facilitates simultaneous data collection from thousands of sensors. There are several options for communicating to and from a cubic-millimeter computer.

Radio-frequency and optical communications each have their strengths and weaknesses. Radio-frequency communication is well under- stood, but currently requires minimum power levels in the multiple milliwatt range due to analog mixers, filters, and oscillators. If whisker-thin antennas of centimeter length can be accepted as a part of a dust mote, then reasonably efficient antennas can be made for radio-frequency communication. While the smallest complete radios are still on the order of a few hundred cubic millimeters, there is active work in the industry to produce cubic -millimeter radios.

Moreover RF techniques cannot be used because of the following disadvantages: -

1. Dust motes offer very limited space for antennas, thereby demanding extremely short wavelength (high frequency transmission). Communication in this regime is not currently compatible with low power operation of the smart dust.
2. Furthermore radio transceivers are relatively complex circuits making it difficult to reduce their power consumption to required microwatt levels.
3. They require modulation, band pass filtering and demodulation circuitry.

So an attractive alternative is to employ free space optical transmission. Studies have shown that when a line of sight path is available, well defined free space optical links require significantly lower energy per bit than their RF counter paths.

There are several reasons for power advantage of optical links.

1. Optical transceivers require only simple base band analog and digital circuitory.
2. No modulators, active band pass filters or demodulators are needed.

As another consequence of this short wavelength, a Base Station Transceiver (BTS) equipped with a compact imaging receiver can decode the simultaneous transmissions from a large number of dust motes from different locations within the receiver field of view, which is a form of space division multiplexing. Successful decoding of these simultaneous transmissions requires that dust motes not block one another's line of sight to the BTS. Such blockage is unlikely in view of dust mote's small size. Semiconductor lasers and diode receivers are intrinsically small, and the corresponding transmission and detection circuitry for on/off keyed optical communication is more amenable to low-power operation than most radio schema. Perhaps most important, optical power can be collimated in tight beams even from small apertures. Diffraction enforces a fundamental limit on the divergence of a beam, whether it comes from an antenna or a lens. Laser pointers are cheap examples of milli radian collimation from a millimeter aperture. To get similar collimation for a 1-GHz radio-frequency signal would require an antenna 100 meters across, due to the difference in wavelength of the two transmissions. As a result, optical transmitters of millimeter size can get antenna gains of one million or more, while similarly sized radio frequency antennas are doomed by physics to be mostly isotropic.

LISTENING TO A DUST FIELD

Many Smart Dust applications rely on direct optical communication from an entire field of dust motes to one or more base stations. These base stations must therefore be able to receive a volume of simultaneous optical transmissions. Further, communication must be possible outdoors in bright sunlight which has an intensity of approximately 1 kilowatt per square meter, although the dust motes each transmit information with a few milli watts of power. Using a narrow-band optical filter to eliminate all sunlight except the portion near the light frequency used for communication can partially solve this second problem, but the ambient optical power often remains much stronger than the received signal power.

Advantages of imaging receivers

As with the transmitter, the short wavelength of optical transmissions compared with radio frequency overcomes both challenges. Light from a large field of view field can be focused into an image, as in our eyes or in a camera. Imaging receivers utilize this to analyze different portions of the image separately to process simultaneous transmissions from different angles. This method of distinguishing transmissions based on their originating location is referred to as space division multiple access (SDMA). In contrast, most radio-frequency antennas receive all incident radio power in a single signal, which requires using additional tactics, such as frequency tuning or code division multiple access (CDMA), to separate simultaneous transmissions.

Imaging receivers also offer the advantage of dramatically decreasing the ratio of ambient optical power to received signal power. Ideally, the imaging receiver will focus all of the received power from a single transmission onto a single photo detector. If the receiverhas an *n* array of pixels, then the ambient light that each pixel receives is reduced by a factor *n*2 compared with a non imaging receiver.

CORE FUNCTIONALITY SPECIFICATION

Choose the case of military base monitoring wherein on the order of a thousand Smart Dust motes are deployed outside a base by a micro air vehicle to monitor vehicle movement. The motes can be used to determine when vehicles were moving, what type of vehicle it was, and possibly how fast it was travelling. The motes may contain sensors for vibration, sound, light, IR, temperature, and magnetization. CCRs will be used for transmission, so communication will only be between a base station and the motes, not between motes. A typical operation for this scenario would be to acquire data, store it for a day or two, then upload the data after being interrogated with a laser. However, to really see what functionality the architecture needed to provide and how much reconfigurability would be necessary, an exhaustive list of the potential activities in this scenario was made. The operations that the mote must perform can be broken down into two categories: those that provoke an immediate action and those that reconfigure the mote to affect future behavior.

MAJOR CHALLENGES

1. To incorporate all these functions while maintaining a low power consumption
2. Maximizing operating life given the limited volume of energy storage.
3. The functionality can be achieved only if the total power consumption is limited to microwatt levels.
4. An unbroken line of sight of path should be available for free space optical links.

APPLICATIONS

1. Environmental protection (identification and monitoring of pollution).
2. Habitat monitoring (observing the behavior of the animals in there natural habitat).
3. Military application (monitoring activities in inaccessible areas, accompany soldiers and alert them to any poisons or dangerous biological substances in the air).
4. Indoor/Outdoor Environmental Monitoring
5. Security and Tracking
6. Health and Wellness Monitoring (enter human bodies and check for physiological problems)
7. Power Monitoring
8. Inventory Location Awareness
9. Factory and Process Automation
10. Seismic and Structural Monitoring
11. Monitor traffic and redirecting it.

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INTRODUCTION

Haptic technology refers to technology that interfaces the user with a virtual environment via the sense of touch by applying forces, vibrations, and/or motions to the user. This mechanical stimulation may be used to assist in the creation of virtual objects (objects existing only in a computer simulation), for control of such virtual objects, and to enhance the remote control of machines and devices (teleoperators). This emerging technology promises to have wide-reaching applications as it already has in some fields. For example, haptic technology has made it possible to investigate in detail how the human sense of touch works by allowing the creation of carefully controlled haptic virtual objects. These objects are used to systematically probe human haptic capabilities, which would otherwise be difficult to achieve. These new research tools contribute to our understanding of how touch and its underlying brain functions work. Although haptic devices are capable of measuring bulk or reactive forces that are applied by the user, it should not be confused with touch or tactile sensors that measure the pressure or force exerted by the user to the interface.

WORKING OF HAPTIC SYSTEMS

A haptic system consists of two parts namely the human part and the machine part. In the figure shown above, the human part (left) senses and controls the position of the hand, while the machine part (right) exerts forces from the hand to simulate contact with a virtual object. Also, both the systems will be provided with the necessary sensors, processors, and actuators. In the case of the human system, nerve receptors perform sensing, the brain performs processing, and muscles perform actuation of the motion performed by the hand while in the case of the machine system, the above-mentioned functions are performed by the encoders, computer and motors respectively.

Haptic information: The haptic information provided by the system will be the combination of (i) Tactile information and (ii) Kinesthetic information. Tactile information refers to the information acquired by the sensors which are connected to the skin of the human body with a particular reference to the spatial distribution of pressure, or more generally, tractions, across the contact area. For example, when we handle flexible materials like fabric and paper, we sense the pressure variation across the fingertip. This is a sort of tactile information. Tactile sensing is also the basis of complex perceptual tasks like medical palpation, where physicians locate hidden anatomical structures and evaluate tissue properties using their hands. Kinesthetic information refers to the information acquired through the sensors in the joints. Interaction forces are normally perceived through a combination of these two pieces of information.

HAPTIC DEVICES

A haptic device is the one that provides a physical interface between the user and the virtual environment through a computer. This can be done through an input/output device that senses the body's movement, such as a joystick or data glove. By using haptic devices, the user can not only feed information to the computer but can also receive information from the computer in the form of a felt sensation on some part of the body. This is referred to as a haptic interface.

Haptic devices can be broadly classified into

Virtual reality/ Telerobotic based devices:

i) Exoskeletons and Stationary device

ii) Gloves and wearable devices

iii) Point-sources and Specific task devices

iv) Locomotion Interfaces

Feedback devices:

i) Force feedback devices

ii) Tactile displays

COMMONLY USED HAPTIC INTERFACING DEVICES

Phantom It is a haptic interfacing device developed by a company named Sensible technologies. It is primarily used for providing a 3D touch to the virtual objects. This is a very high resolution 6 DOF device in which the user holds the end of a motor controlled jointed arm. It provides a programmable sense of touch that allows the user to feel the texture and shape of the virtual object with a very high degree of realism. One of its key features is that it can model free-floating 3-dimensional objects.

Cyberglove

The principle of a Cyberglove is simple. It consists of opposing the movement of the hand in the same way that an object squeezed between the fingers resists the movement of the latter. The glove must, therefore, be capable, in the absence of a real object, of recreating the forces applied by the object on the human hand with (1) the same intensity and (2) the same direction. These two conditions can be simplified by requiring the glove to apply a torque equal to the interphalangeal joint. The solution that we have chosen uses a mechanical structure with three passive joints which, with the interphalangeal joint, make up a flat four-bar closed-link mechanism. This solution use cables placed at the interior of the four-bar mechanism and following a trajectory identical to that used by the extensor tendons which, by nature, oppose the movement of the flexor tendons to harmonize the movement of the fingers. Among the advantages of this structure one can cite: Allows 4 dof for each finger Adapted to different size of the fingers Located on the back of the hand Apply different forces on each phalanx (The possibility of applying a lateral force on the fingertip by motorizing the abduction/adduction joint)

HAPTIC RENDERING

Principle of the haptic interface:

As illustrated in Fig. given above, haptic interaction occurs at an interaction tool of a haptic interface that mechanically couples two controlled dynamical systems: the haptic interface with a computer and the human user with a central nervous system. The two systems are exactly symmetrical in structure and information and they sense the environments, make decisions about control actions, and provide mechanical energies to the interaction tool through motions. 4) Balanced range, resolution, and bandwidth of position sensing and force reflection; and:

System architecture for haptic rendering: Haptic-rendering algorithms compute the correct interaction forces between the haptic interface representation inside the virtual environment and the virtual objects populating the environment. Moreover, haptic rendering algorithms ensure that the haptic device correctly renders such forces on the human operator. Several components compose typical haptic rendering algorithms. We identify three main blocks, illustrated in Figure shown. Collision-detection algorithms detect collisions between objects and avatars in the virtual environment and yield information about where, when, and ideally to what extent collisions (penetrations, indentations, contact area, and so on) have occurred. Force-response algorithms compute the interaction force between avatars and virtual objects when a collision is detected. This force approximates as closely as possible the contact forces that would normally arise during contact between real objects. Force-response algorithms typically operate on the avatars' positions, the positions of all objects in the virtual environment, and the collision state between avatars and virtual objects. Their return values are normally force and torque vectors that are applied at the device-body interface. Hardware limitations prevent haptic devices from applying the exact force computed by the forceresponse algorithms to the user. Control algorithms command the haptic device in such a way that minimizes the error between the ideal and applicable forces. The discrete-time nature of the haptic-rendering algorithms often makes this difficult; as we explain further later in the article. Desired force and torque vectors computed by force response algorithms feed the control algorithms. The algorithms' return values are the actual force and torque vectors that will be commanded to the haptic device. A typical haptic loop consists of the following sequence of events:

1) Low-level control algorithms sample the position sensor sat the haptic interface device joints.

2) These control algorithms combine the information collected from each sensor to obtain the position of the device-body interface in Cartesian space—that is, the avatar's position inside the virtual environment.

3) The collision-detection algorithm uses the position information to find collisions between objects and avatars and report the resulting degree of penetration.

4) The force-response algorithm computes interaction forces between avatars and virtual objects involved in a collision.

5) The force-response algorithm sends interaction forces to the control algorithms, which apply them to the operator through the haptic device while maintaining a stable overall behavior

The simulation engine then uses the same interaction forces to compute their effect on objects in the virtual environment. Although there are no firm rules about how frequently the algorithms must repeat these computations, a 1-KHz servo rate is common. This rate seems to be a subjectively acceptable compromise permitting the presentation of reasonably complex objects with reasonable stiffness. Higher servo rates can provide crisper contact and texture sensations, but only at the expense of reduced scene complexity (or more capable computers)

APPLICATIONS

Graphical user interfaces: Video game makers have been early adopters of passive haptics, which takes advantage of vibrating joysticks, controllers and steering wheels to reinforce the on-screen activity. But future video games will enable players to feel and manipulate virtual solids, fluids, tools, and avatars. The Novint Falcon haptic controller is already making this promise a reality. The 3-D force feedback controller allows you to tell the difference between a pistol report and a shotgun blast, or to feel the resistance of a longbow's string as you pull back an arrow.

Surgical Simulation and Medical Training:

Various haptic interfaces for medical simulation may prove especially useful for training of minimally invasive procedures (laparoscopy/interventional radiology) and remote surgery using teleoperators. In the future, expert surgeons may work from a central workstation, performing operations in various locations, with machine setup and patient preparation performed by local nursing staff. Rather than traveling to an operating room, the surgeon instead becomes telepresence. A particular advantage of this type of work is that the surgeon can perform many more operations of a similar type, and with less fatigue. It is well documented that a surgeon who performs more procedures of a given kind will have statistically better outcomes for his patients. Haptic interfaces are also used in rehabilitation robotics.

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PLASTIC SOLAR CELL TECHNOLOGY

INTRODUCTION

A Plastic solar cell that can turn the suns power into electric energy even on cloudy day. Existing solar cells are only able to harness the sun's visible light. While half of the sun's light power lies in the visible spectrum, the other half lies in the infrared spectrum. The new material is first plastic compound that is able to harness the infrared portion. Every warm body emits heat. This heat is emitted even by man and by animals, even when it is dark outside. The plastic material uses nanotechnology and contains the 1st generation solar cells that can harness the sun's invisible infrared rays. This breakthrough made us to believe that plastic solar cells could one day become more efficient than the current solar cell.

The researchers combined specially designed nano particles called quantum dots with a polymer to make the plastic that can detect the energy in the infrared. With further advances the new PLASTIC SOLAR CELL could allow up to 30% of sun's radiant energy to be harnessed completely when compared to only 6% in today plastic best plastic solar cells. A large amount of sun's energy could be harnessed through solar farms and used to power all our energy needs. Solar reaching the earth is 10000 times than we consume.

If could cover 0.1% earth surface with the solar farms we could replace all our energy habits with a source of power which is clear and renewable. The first crude solar cells have achieved efficient of today's standard commercial photo voltaic cell the best solar cell, which are very expensive semi-conductors laminates converts at most 35% of the sun's energy into electricity.

MANUFACTURING OF PLASTIC SOLAR CELLS

Nano rods are manufactured in a beaker containing selenide, aiming for rods of diameter 7 nanometres to absorb as much sunlight as possible. The length of the Nano rods may be approximately 60nanometers.then the Nano rods are mixed with a plastic semiconductor's called 3-hexylthiopene a transparent electrode is coated with the mixture. The thickness of 200 nanometres. An aluminium coating acting as the back electrode complete the device. The Nano rods act like a wires. When they absorb light of a specific wavelength, they generate an electron pulse an electron hole vacancy in the crystal the moves around just like an electron. The electron travels the length of the rod until it is collected by aluminium electrode. The hole is transferred to the plastic, which is known as a hole carrier, and conveyed to the electrode, creating a current.

WORKING OF PLASTIC SOLAR CELL

The plastic solar cell is actually a hybrid, comprised of tiny dispersed in an organic polymer or plastic. The active layers of polymer solar cells typically contain a mixture of polymers chains that can donate electrons. The technology takes advantage of recent advances in nanotechnology specially the production of Nano crystals and Nano rods. This are chemically pure clusters of 100 to 100000 atoms with dimensions of the order of a nano meter are a billionth of a meter because their small size, they exhibit unusual and interesting properties governed by quantum mechanics such as the absorption of different colures of light dependent upon their size. Nano rods where made of a reliable size out of cadmium selenide, a semi conducting material.

A layer only 200 nanometres thick is sandwiched between electrodes and can produce at present about .7volts. the electrode layers and Nano rods polymer layers could be applied in separate coats, making production fairly easy. And unlike today's semiconductor based photovoltaic devices, plastic solar cells can be manufactured in solution in a beaker without need for clean rooms or vacuum chamber.

NANOTECHNOLOGY

The pursuit of nanotechnology comprises a wide variety of disciplines: chemistry, physics, mechanical engineering, materials science, molecular biology, and computer science.

WORKING OF CONVENTIONAL SOLAR CELLS

Basically conventional type solar cells Photovoltaic (**PV**) cells are made of special materials called semiconductors such as silicon, which is currently the most commonly used. Basically, when light strikes the cell, a certain portion of it is absorbed within the semiconductor material. This means that the energy of the absorbed light is transferred to the semiconductor. The energy knocks electrons loose, allowing them to flow freely. PV cells also all have one or more electric fields that act to force electrons freed by light absorption to flow in a certain direction.

This flow of electrons is a current, and by placing metal contacts on the top and bottom of the PV cell, we can draw that current off to use externally. For example, the current can power a calculator. This current, together with the cell's voltage (which is a result of its built -in electric field or fields), defines the power (or wattage) that the solar cell can produce.

INFRARED plastic solar cell

Scientists have invented a plastic solar cell that can turn the suns power into electric energy even on cloudy days. Plastic solar cells are not new. But existing materials are only able to harness the sun's visible light. While half of the sun's power lies in the visible spectrum, the other half lies in the infrared spectrum.

The new material is first plastic compound that is able to harness infrared portion. Every warm body emits heat. This heat is emitted even by man and by animals, even when it is dark outside. The plastic material uses nanotechnology and contains the 1st generation solar cells that can harness the sun's invisible infrared rays. This breakthrough made us to believe that plastic solar cells could one day become more efficient than the current solar cell. The researchers combined specially designed nano particles called quantum dots with a polymer to make the plastic that can detect energy in the infrared. With further advances the new plastic solar cell could allow up to 30% of sun's radiant energy to be harnessed completely when compared WHEN COMPAWHEN COMPARED to only 6% in today plastic best plastic solar cells.

WORKING OF PLASTIC SOLAR CELL

The solar cell created is actually a hybrid, comprised of tiny nanorods dispersed in an organic polymer or plastic. A layer only 200 nanometers thick is sandwiched between electrodes and can produce at present about .7 volts. The electrode layers and nanorods / polymer layers could be applied in separate coats, making production fairly easy. And unlike today's semiconductor-based photovoltaic devices, plastic solar cells can be manufactured in solution in a beaker without the need for clean rooms or vacuum chambers. The technology takes advantage of recent advances in nanotechnology specifically the production of nano crystals and nano rods. These are chemically pure clusters of 100 to 100000 atoms with dimensions of the order of a nano meter, or a billionth of a meter. Because of their small size, they exhibit unusual and interesting properties governed by quantum mechanics, such as the absorption of different colors of light depending upon their size. Nano rods were made of a reliable size out of cadmium selenide, a semi conducting material. Nanorods are manufactured in a beaker containing cadmium selenide, aiming for rods of diameter-7 nanometers to absorb as much sunlight as possible.

IMPROVEMENTS

Some of the obvious improvements include better light collection and concentration, which already are employed in commercial solar cells. Significant improvements can be made in the plastic, nano rods mix, too, ideally packing the nano rods closer together, perpendicular to the electrodes, using minimal polymer, or even none-the nano rods would transfer their electrons more directly to the electrode. In their first-generation solar cells, the nano rods are jumbled up in the polymer, leading to losses of current via electron-hole recombination and thus lower efficiency.

They also hope to tune the nano rods to absorb different colors to span the spectrum of sunlight. An eventual solar cell has three layers each made of nano rods that absorb at different wavelength.

APPLICATIONS

SOLAR POWER FOR HOMES AND COMMERCIAL BUILDINGS

Currently solar electricity generating systems for homes and commercial buildings are getting the highest attention. Recently, the existence of an office building that consumes zero electrical power, generates no carbon dioxide emissions or greenhouse effects, and requires no fossil fuels for heating or air conditioning. The firm have remodeled the electrical and lighting systems incorporating the latest solar cell technology. He has installed solar panels on the building roof along with skylights in between the panels to illuminate the building with natural sunlight. It is important to mention that the skylights are sometimes supplemented with efficient fluorescent lights. It has disconnected the natural gas pipes for heating the building and recommended an alternate heating scheme, namely, solar electrical energy, by installing enough photoelectric panels to meet the entire electrical load of 30 kW, approximately.

CORPORATE ROOF TOPS USING SOLAR ENERGY SYSTEMS

Corporate rooftops with solar energy generation capabilities are getting worldwide attention. Factories in Germany, Spain, Japan, and the Netherlands are involved in design and development of rooftop solar energy power sources. Markets for photovoltaic rooftop installations are increasing by 40 percent annually in the United States alone. Solar rooftop installation grew 100 percent in Spain in the year 2006. The German solar energy market was relatively flat in 2006, but Germany will install more PV generating systems in the very near future, according to a report by the Solar Energy Industries Association.

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OLED

INTRODUCTION

Organic light emitting diodes (OLEDs) are optoelectronic devices based on small molecules or polymers that emit light when an electric current flows through them. Simple OLED consists of a fluorescent organic layer sandwiched between two metal electrodes. Under application of an electric field, electrons and holes are injected from the two electrodes into the organic layer, where they meet and recombine to produce light. They have been developed for applications in flat panel displays that provide visual imagery that is easy to read, vibrant in colors and less consuming of power.

OLEDs are light weight, durable, power efficient and ideal for portable applications. OLEDs have fewer process steps and use both fewer and low-cost materials than LCD displays. OLEDs can replace the current technology in many applications due to following performance advantages over LCDs.

1. Greater brightness
2. Faster response time for full motion video
3. Fuller viewing angles
4. Lighter weight
5. Greater environmental durability
6. More power efficiency
7. Broader operating temperature ranges
8. Greater cost-effectiveness

OLED is a self-light emitting technology composed of a thin, multi-layered organic film placed between an anode and cathode. In contrast to LCD/TFT technology, OLED does not require a backlight.

OLED DEVELOPMENT

OLED was discovered in a

University research was

Launch of industrial R&D`

1994

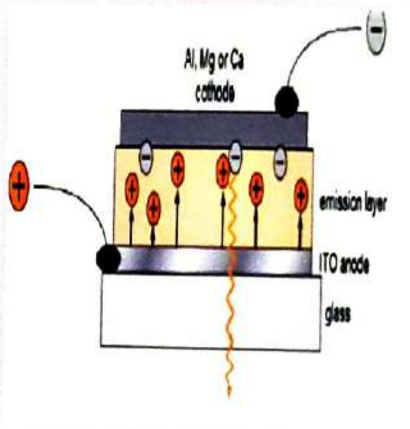
First OLED product in the

OLED will emerge as a leading next generation technology. It is expected that in the forthcoming years oled will replace led and by OLED display market will see sales hit $3.1 billion by 2012.

There has been tremendous progress in all aspects of OLED lighting over the past five years including materials, architectures and manufacturing processes. The industry consensus is that OLEDs have reached the point where they are now adequate for niche lighting applications. In the long-term, as their core capabilities improve, they will ultimately become contenders for mainstream applications that require an area, rather than a point, source of light. Applications where OLED lighting could play a role include backlighting, general-purpose illumination, architectural and specialized industrial lighting, vehicular lighting, and signage.

ARCHITECTURE

The light emission in the presented OLED is based on the formation of electron hole pairs within conjugated polymers with semiconducting properties. Therefore a suitable polymer like PPV has to be placed between a transparent anode and a metallic cathode. By application of an electric voltage electrons (on the cathode side) and holes (on the anode side) are injected into the polymer layer. The charge carriers drift along the electric field towards each other and recombine via fluorescence (or thermal radiation). Electroluminescence leads to high efficient illuminants with low driving voltages.



A voltage is applied across the anode and cathode. Current flows from cathode to anode through the organic layers. Electrons flow to emissive layer from the cathode. Electrons are removed from conductive layer leaving holes. Holes jump into emissive layer. Electron and hole combine and light is emitted.

WORKING OF AN OLED

OLEDs basic structure consists of organic materials positioned between the cathode and the anode, which is composed of electric conductive transparent Indium Tin Oxide (ITO).

By applying the appropriate electric voltage, holes and electrons are injected into the EML from the anode and the cathode, respectively. The holes and electrons combine inside the EML to form excitons, after which electroluminescence occurs. The transfer material, emission layer material and choice of electrode are the key factors that determine the quality of OLED components.

We all know that when electrons and holes are combining with each other, energy is emitted as light. Same is the case here.

During operation, a voltage is applied across the OLED such that the anode is positive with respect to the cathode. A current of electrons flows through the device from cathode to anode, as electrons

are injected into the upper conducting layer of the organic layer at the cathode and withdrawn from the lower conducting layer at the anode. This latter process may also be described as the injection of electron holes into the lower conducting layer.

Electrostatic forces bring the electrons and the holes towards each other and they recombine forming an exciton, a bound state of the electron and hole. This happens in the emissive layer, because in organic semiconductors holes are generally more mobile than electrons. This accompanied by emission of radiation whose frequency is in the visible region.

TYPES OF OLED

There are six types of OLEDs

1. Passive Matrix OLED
2. Active Matrix OLED
3. Transparent OLED
4. op Emitting OLED
5. Foldable OLED
6. White OLED

ADVANTAGES:

1. *They are super thin*. Some small displays are less than 1.3mm. Larger displays are typically still less than 2.5mm thick.
2. *Fantastic contrast*. Sharp and eye-catching displays that are to read.
3. *Wide viewing angle*. These are small but mighty displays have a wide viewing angle approaching 180 degrees.
4. *Emissive Display*. OLEDs create their own light, so there is no need for a separate backlight.
5. *Scaled power consumption*. Power used scale with the number of pixels in it. A sparse display can be used to save power.
6. Low cost in future.
7. Safer for environment.

DISADVANTAGES:

OLED seems to be the perfect technology for all types of displays, but it also has some problems:

1. Their lifetime is shorter compare to other display types. White, Red and Green OLED offer lifetime of about 5 to 25 years where as blue OLED offers about 1.6 years. While red and green OLED films have longer lifetimes (46,000 to 230,000 hours), blue organics currently have much shorter lifetimes (up to around 14,000 hours).
2. It is expensive when compare to LCD.
3. It is susceptible to water and hence it can be easily damaged by water. OLED screens are even worse compare to LCD when subjected to direct sunlight. Overall luminance degradation Limited market availability.
4. Manufacturing - Manufacturing processes are expensive right now
5. Water - Water can easily damage OLEDs

FUTURE ASPECTS

Currently OLED technology is mainly used for making small displays that measure two to five inches, on mobile devices like cameras, phones, and players. OLED displays provide better power efficiency and brighter pictures; hence, they are ideal for gadgets powered by batteries.

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