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New Era of Energy Efficient, Flexible, Thin Display Technology "OLED TECHNOLOGY"

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Abstract:- *OLED is a LED in which emissive electroluminescent layer is a film of organic compound that emits light in response to electric current. This article is a study of advancement in various technologies and methods that lead to the improvement of qualities of OLED display and is also study of various parameters which will lead to complete replacement of conventional displays with modern OLED displays .OLED can be fabricated using polymers or by small molecules in flat penal display zone .Unlike traditional displays OLED'S are self luminous and do not require any kind of backlighting. This eliminates need for bulky and environment undesirably mercury lamps and yields a thinner and more compact displays. Thus it can display deep black levels and can be thinner and lighter than liquid crystal display.In low ambient light conditions(such as dark rooms),an OLED screen can achieve a higher contrast ratio than an LCD regardless of whether the LCD uses cold cathode fluorescent lamps or an LED backlight.OLED'S are biodegradable. OLED'S have wide viewing angle of about* 180^0 *and their low power consumption (only 2 to 10v)provides for maximum efficiency and helps in minimizing the heat and electric interference in electronic devices .these are cheaper,sharper,thinner and flexible displays.OLED'S may lead to future applications in head up displays, billboard type displays. OLED'S refresh faster than LED'S(almost 1000 times).A device with an OLED display changes information in real time .*

Keywords- *OLED-organic light emitting diode,LED-light emitting diode, electroluminescence, LCD-liquid crystal display,*

I. INTRODUCTION

OLEDs work in a similar way to LEDs and conventional diodes , but they use organic molecules instead of using layers of n-type and p-type semiconductors, to produce their electrons and holes[1]. A simple OLED consists of six different layers. On the top and bottom there are layers of protective glass or plastic. The top layer is called the seal and the bottom layer the substrate[2]. In between those layers, there's a negative terminal (sometimes called the cathode) and a positive terminal (called the anode). Finally, in between the anode and cathode are two layers made from organic molecules called the emissive layer (where the light is produced, which is next to the cathode) and the conductive layer (next to the anode). Here's what it all looks like[3]

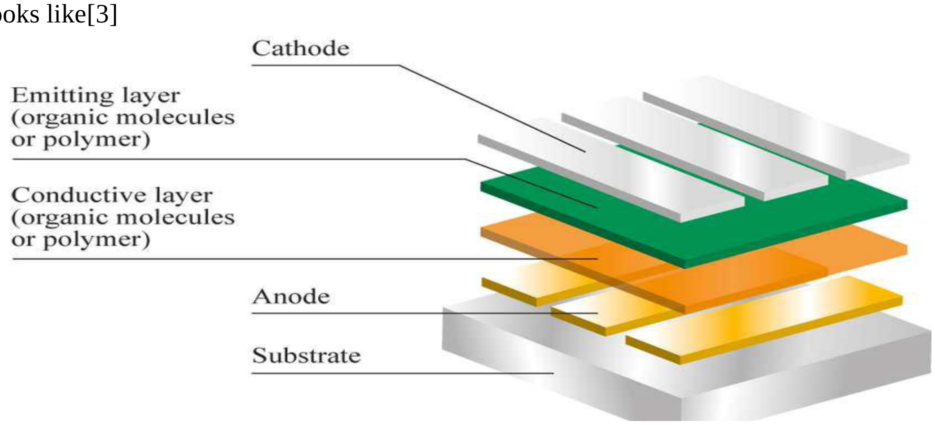

Fig 1.0 construction of OLED

II. WORKING

When avoltage is applied between theelectrodes, charges are injected in the organic material,electrons from cathode and holes from anode. Then, the charges move inside thematerial, mostlyby hopping processes and then recombine to formexcitons. The location of the recombination zone inthe diode is a function of the charge mobility ofthe Organic material as well as of the electric field distribution. aphoton isemitted when the exciton recombines due to diffusion process[4].The color of the photon is a function of the energydifference between thehighest occupiedmolecular orbital (HOMO)and the lowest unoccupied molecularorbital (LUMO) levels of the electroluminescentMolecule[5-9].The extent of the conjugationin the molecule or the polymer decides the wavelength of light emitted. For efficient holeinjection from the anode, a low barrier is required irrespective of the HOMO level of the organic material(typically 5–6 eV). ITO is usually used for the anodebecause of its goodtransparency in the visible range as well as high work function. Hole injection isfurther enhanced by oxygen plasma treatment ofthe ITO.5,6 On the cathode side, a low barrier for electronsis needed in respect of the LUMOlevel of the organic material (typically 2–3 eV).Low work function metals such as Ca and Mg arerequired but they are very sensitive to moisture, and more stable cathodes have been introduced, such asMg/Ag alloys or Al in combination with alkali metalcompounds. A thin LiF layer cappedwith a thicker Al layer is widely used as the cathode, andmany other insulating layers such as CsF, MgO.

III. PROPERTIES OF OLED MAKIMG IT SUPERIOR TO OTHER DISPLAYS

A) Energy efficient Smartphones provide end users with a wide range of sensors that can be combined with data and applications via the Internet. This makes the smartphone’s capabilities almostboundless and very popular with end users. However,the basic and primary limitations of smartphones is that they dependon battery power. Smartphones are energy constrained devices andthe use of these capabilities is very expensive. In particular, the energy to drive as smartphone's display is oneof the dominant energyconsuming components in a smart phone.*Organic light- emitting diode* (OLED) technology is deemeda promising display alternative for the emerging genre of mobiledevices as it provides brightercolors, wider viewing angles,and faster response times, as well as allows fabricationon flexible plastic substrates, compared with conventional *liquidcrystal display* (LCD) technology Unlike LCD displayswhose power consumption is dominated by the external lighting,an OLED display is elf-emissive and its power consumption is highly dependent on the image content (more precisely, thepixel values). While OLED displays consume nearly zero powerwhen presenting a black image.

B) Power saving techniques Inrecent years, researchers and vendors have exploredvarious power saving techniques for OLED displays . Anintuitive way is to darkenthe contents that are not of interestto the user , referred to as partial displaydimming/disabling.The challenge thus lies in identifying those regions which areunimportantto end userPsychological experiments have demonstrated that the attentions regions in any image varies andnot everypixel or region in an image receives the same attention level This is due to the human visual system’s selectivity to first respondto that regions that aremost attractive parts ina visual scene, with subsequenteye movements from one fixation location to another, the so called focus of attention. For modelling the mechanism human attention In computer vision, many effortshave been made[10-11].In particular, the saliency map indicates a saliency valuefor each region orpixel in an image . Thus,the segmentation of an image can be based on its saliency map into a set ofNdisjointattention regions, R = {r1, r2, r3, ..., rN}, associated with anN × N adjacency matrix A, where A[i, j] is 1 if riandrjareadjacent regions, and 0 otherwise.Note that there can be several non adjacent sub regions in any attention region.. Figure 2 showsfive attention regions of an images segmented according toits saliency map in practice.As regions in an image does nor receive equal attention but receive varying degrees of attention,they can tolerate different degrees of image distortion. A numberof visualquality metricsintended for the human visual systemhave been proposed to quantify image distortion . Inother words, attention regions should begiven tolerable distortionin inverse proportion to their levels of attention . Thus, eachregion ri∈R is associated with a critical scaling ratio, c(i),representing the lowest ratio that will not violate the tolerabledistortion (quantified by a certain visual quality metric). Thisdistortion constraint limits the lowest scaling ratio of each attentionregion[12- 14]However, lowering thepixelvaluesbyapplying the critical scaling ratio to each region may result insharp edges between adjacent regions, and these sharp edgeswill severely interfere with visual experience. Therefore, thedifference between the scaling ratios applied to two adjacent regionsshouldbe limited, so that the region boundaries are tooindistinct to be discerned by the human eye. In human visualsystems, the just noticeable difference is the minimum amountby which the stimulus intensity must be changed in order to producea noticeable variation in sensory experience. Weber’sLaw states that the just noticeable difference between two stimuliisproportional to the magnitude of the stimuli . Based onthe law, we define the differential constraint that the differencebetween the scaling ratios applied to two adjacent regions is notgreater than either ratio multiplied by a differential constant d.[15]

Fig 2 segmenting image into region of interests

C) OLED Dynamic voltage scaling Motivatedby an observation that different colorsrequire drastically differentpower,the color remapping techniquechanges the original colors into colors that consume less power. This technique is applicable to graphics user interfacesand applications not dealing with natural images .To retainthe original visual experience, another technique called OLED dynamic voltage scaling was developed . It tries todecrease the supply voltage of each pixel's circuit to the minimumsufficient to sustain the pixel's (luminance)value.Thetechnique requires hardware support and extra costs; thus, adisplay is normally partitioned into a limited number of rectangular regions.An OLED display comprises a matrix of pixels, each of whichconsists of three sub pixels emitting red, green, and blue lightrespectively. Unlike an LCD display that relies on a light sourceto illuminate from behind, each sub pixel on the OLED displayis self-emissive and emits light individually in response to anelectric current that corresponds to the given pixel value Thus, the amount of power that a sub pixel consumes varies significantlydepending on its value ranging from 0 to 255.Asmodeled in [5, 7, 8], the power consumption of an image on anOLED display is the sum of each individual pixel's power consumption, which is the sum of the power consumed by itsthreesub pixels. Lowering the pixel values of an image is an effective way to reduceits power consumption on an OLED display; however, thiscan also have an adverse impact on visual experience if the pixelvalues are scaled down inappropriately. Note that any changein a pixel value will lead to a change to the chrominance and/orthe brightness of thepixel, but not every change is noticeable to the human visual system As the same magnitude ofchange is much more noticeable in chrominance than in brightness, to maintain the chrominance of a pixel when its value isscaled down, its red, green, and bluesub pixelsmust be appliedwith the same scaling ratio. In contrast, a single scaling ratio should not be applied to all the pixels so as to save more powerwhile retaining perceptual visual quality to a tolerable extent.Thisis because scaling down the values of different pixels canhave varying degrees of impact on image distortion, which isnormally defined as the resemblancebetween the original image and the pixel-scaled image[14,16].

IV. FLEXIBLE

OLED is an emerging display technology that enables beautiful and efficient displays and lighting panels. Thin OLEDs are already being used in many mobile devices and TVs, and the advanced panels are flexible and bendable are also used in many applications. When we talk about flexible OLEDs, it's important to understand what that means exactly. A flexible oled is based on a flexible substrate which can be plastic, metal or flexible glass. The plastic and metal panels will be light, thin and very durable – in fact they will be virtually shatter-proof. the first range of devices to use a flexible display won't be flexible at all[17]. While the manufacturer may bend the displayor curve it around a non-flat surface, the final user will not be able to actually bend the device. Still it will have several advantages: these displays will be lighter, thinner and much more durable compared toglass based displays. Second generation flexible OLED devices are flexible to the final user. Finally, when the technology is ready, we may see OLED panels that you can fold, bend or stretch. This may create all sorts of exciting designs that will enable large displays to be placed in amobile device and only be opened when required. Fabricating a flexible OLED display is very challenging. The two major challenges are the backplane and the encapsulation.[18]

Fig 3 flexible OLED display

V. BRIGHT

OLEDs are brighter than LEDs. Because the organic layers of an OLED are much thinner than the corresponding inorganic crystal layers of an LED, the conductive and emissive layers of an OLED can be multilayered. Also, LEDs and LCDs require glass for support, and glass absorbs some light. OLEDs do not require glass.[19]LED stands for light-emitting diode. These are little solid-state devices that make light because of the movement of electrons through a semi-conductor. LEDs are relatively small compared to compact fluorescent and incandescent light bulbs, but they can get extremely bright. However, LEDs aren't small enough to be used as the pixels of a television – they're way too big for that. That's why LEDs are only used as the backlight for LCD televisions. OLEDs do not require backlighting like LCDs. LCDs work by selectively blocking areas of the backlight to make the images that you sees, while OLEDs generate light themselves. Because OLEDs do not require backlighting, they consume much less power than LCDs (most of the LCD power goes to the backlighting). This is especially important for battery-operated devices such as cell phones.

VI. CONCLUSION

Lower power consumption makes OLED'S perfect for portable deviceswhich rely on battery power. OLED'S offer a brighter ,more vibrant display as well as larger viewing angle. A great deal of progress has been made in organic electroluminescent material and devices in terms of synthesis of electron transport material as a mean to improve OLED'S performance .OLED seems to be perfect technology for all types of displays but challenges are stillahead including high production cost ,sensitive to water vapor(water can damageoled displays).research in OLED'S have resulted in future applications like dashboard and in flexible displays .video images seems more realistic and updated due to OLED'S.

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