Abstract- Flexible displays like OLEDs, flexpads etc are emerging display technologies that enables beautiful and efficient displays and lighting panels. Thin OLEDs are already being used in many mobile devices and TVs, and the next generation of these panels will be flexible and bendable and Flexpad is an interactive system which is highly flexible and deformable. We are presenting study of novel approach for those flexible devices which have several advantages over simple display devices like LCDs, LEDs etc. They find a number of applications because of their flexibility, easy-to-use, light weight, enhanced quality etc.

Introduction-

The demand for ubiquitous and easy-to-use displays as human interfaces is increasing. One of these interfaces are lightweight, flexible display that can be rolled up or folded. It might be possible to carry a large home display device simply by rolling it up for anyone. While the dream of a flexible display has a long history, roll-up and paper-like displays. It has also become apparent that the advent of flexible display systems will have a significant impact on the market, not only because of the ubiquitous and convenient systems that could be supported, but also because of the potential to provide unconventional visual effects that are not possible with conventional systems. Moreover, the manufacturing technology for these displays will likely be low-cost and environmentally friendly. Studies on display systems and materials have just begun, and it is unwise to give definitive statements about such a display system for television. That said, however, the following pages describing the issues and prospects of flexible displays will hopefully give the reader an overall introduction to the present research. Some of the devices are OLEDs, E-Paper display device and flexpads.

- What are OLEDs?
  OLEDs (Organic Light Emitting Diodes) are flat light emitting technologies, made by placing a series of organic thin films between two conductors. A bright light is emitted, when electrical current is applied. OLEDs can be used to make lighting and displays. Because OLEDs emit light they do not require a backlight. They are more efficient than LCD displays (which do require a white backlight) and are thinner.

- What is E-Paper?
  Flexible electronic paper uses plastic substrates and plastic electronics for the display backplane. There is ongoing competition among manufacturers to provide full-color ability. An ideal e-paper display can be read in direct sunlight without the image appearing to fade. Electronic paper technologies have a very low refresh rate compared to other low-power display technologies, such as LCD.

- What is a flexpad?
  Flexpad is an interactive system that combines a depth camera and a projector to transform sheets of plain paper or foam into flexible, highly deformable, and spatially aware handheld displays. Flexpad, a system that supports highly flexible bending interactions for projected handheld displays. Flexpad enables users to interact with highly flexible projected displays in interactive real-time applications. Its unique strength is the detailed capturing of its deformation and the high flexibility of the display.

Fig. Exploring curved cross-sections (a), flat view (b), comparing contents across layers (c) of flexpads
Impact of flexible displays

CRTs and FPDs are rapidly being replaced by matrix displays i.e. a sequential display with a cell structure corresponding to pixel dots. Its main effects are a significant space saving and enhanced mobility. Some impacts are given below:

1) Ubiquitous, Convenient System - Flexible display is two orders of magnitude lighter than a conventional wall-mounted PDP, LCD, or CRT display (Figure). Its volume would be at least three orders of magnitude smaller than that of a CRT display. It will be able to be rolled up or folded, transported anywhere, and operated indoors or outside. These characteristics will drastically diversify viewing style.

2) Power Consumption reduction - Every effort needs to be made to suppress the display's power consumption. This need is especially evident in the case of flexible displays for outdoor applications, since these will be battery-operated. Although the reflective systems in Table 1, such as liquid crystal, electrophoretic, electrochemical/thermal response, and mechanical modulation are low power consumption systems, attaining highly efficient light emission is still a problem for organic EL devices. Our laboratories have succeeded in realizing higher efficiency light emission by using phosphorescence, which bears the promise of reduced power consumption.

3) Enhanced Picture Quality - The organic EL device is especially promising because it is the only self-emissive device. Liquid crystal film can use backlighting, obviating the need for external light. On the other hand, reflective systems, such as the electrophoretic and electrochemical/thermal systems and the mechanical modulation scheme, cannot be viewed in dim conditions without an external light and require high reflectivity. Organic EL and liquid crystal film devices require a memory function, namely active-drive TFTs, to retain large images of sufficient quality.

4) Low-energy, Low-cost Manufacturing Technology - Present LCDs, which use amorphous silicon thin film transistor (a-Si TFT) for driving, must be fabricated at high temperature (up to 300°C). A lot of raw materials are used by present technology, e.g., a massive amount of glass substrate. On the other hand, flexible displays use very little raw material for the approximately 0.2-mm-thick substrate and using a plastic substrate can be manufactured at near ambient temperature. The flexibility of display material enables space-saving production through rolling technology such as roll up and roll over. These have low cost and also less impact on the environment.

5) Visual Effects of Curved Display - A slightly curved display (a concave surface as viewed by an observer) is preferable to a flat display. Also some research using simulation method supports the idea that a curved display presents a stronger sensation of reality and it can attain a larger viewing angle. Since there have been no extensive or systematic experiments conducted using a direct-view-type display, it is anticipated that a flexible display system serves as a research tool for such visual effects.

6) Fusion of Medias - A display device is an essential piece of hardware for a variety of media, including broadcasting, communications, and personal computers. If a flexible display like paper is equipped with an information storage function, e.g., printing of TV screen image, it will open up an array of application possibilities.

Principles of flexible displays - The basic display principles of flexible display devices can be...
classified according to five aspects: 1) external optical modulation systems based on liquid crystal molecular orientation changes by an electric field, 2) electroluminescent (EL) systems 3) mechanical external optical modulation systems, 4) reflected light modulation systems by electrochemical (thermal) response, and 5) reflected light modulation systems caused by colored particle shifts and rotation in electric or magnetic fields. There are several systems and materials proposed for each principle. Among these, liquid crystal, except for liquid crystal film, and 3),4), and 5) are the lines of research that have been advanced for realizing an electronic paper device for stillpicture presentation.

1. Curved OLED displays, placed on non-flat surfaces and Wearable OLEDs
2. Transparent OLEDs embedded in windows,OLEDs in car windshields ,New designs for lamp
3. Applications of electronic visual displays include electronic pricing labels in retail shops, and digital signage,time tables at bus stations, electronic billboards, mobile phone displays, and e-readers able to display digital versions of books and e-paper magazines.
4. Exploring and Analyzing Volumetric Datasets
5. Animating Virtual Paper Characters
6. Flexpad enables people to create slices through time in videos.

**References**

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**The future - flexible displays**

1. OLEDs can be used to create flexible and even transparent displays. This is pretty exciting as it opens up a whole world of possibilities.