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Study Of Electrical and Structural Properties Of An Electronic Paper , Display and Technology

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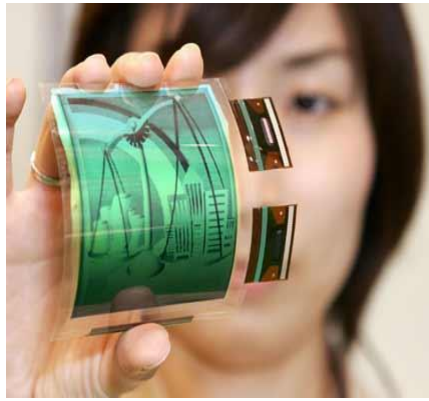
ABSTRACT

In This paper the focus of electronic Paper's characteristics, their electrical and structural Properties is shown. And also focus On their electrophoretic display, which work on the Principle of electrophoresis. Colored Dye and charged pigments are used for representations of color. Most common type E paper used which used least power consumption. When We study about the electrical properties of E paper ,which shows brightness increases slightly with increase in voltage in electrophoretic displays.

Keywords: E-Paper, Electrophoretic Display, Electrical Properties.

INTRODUCTION:

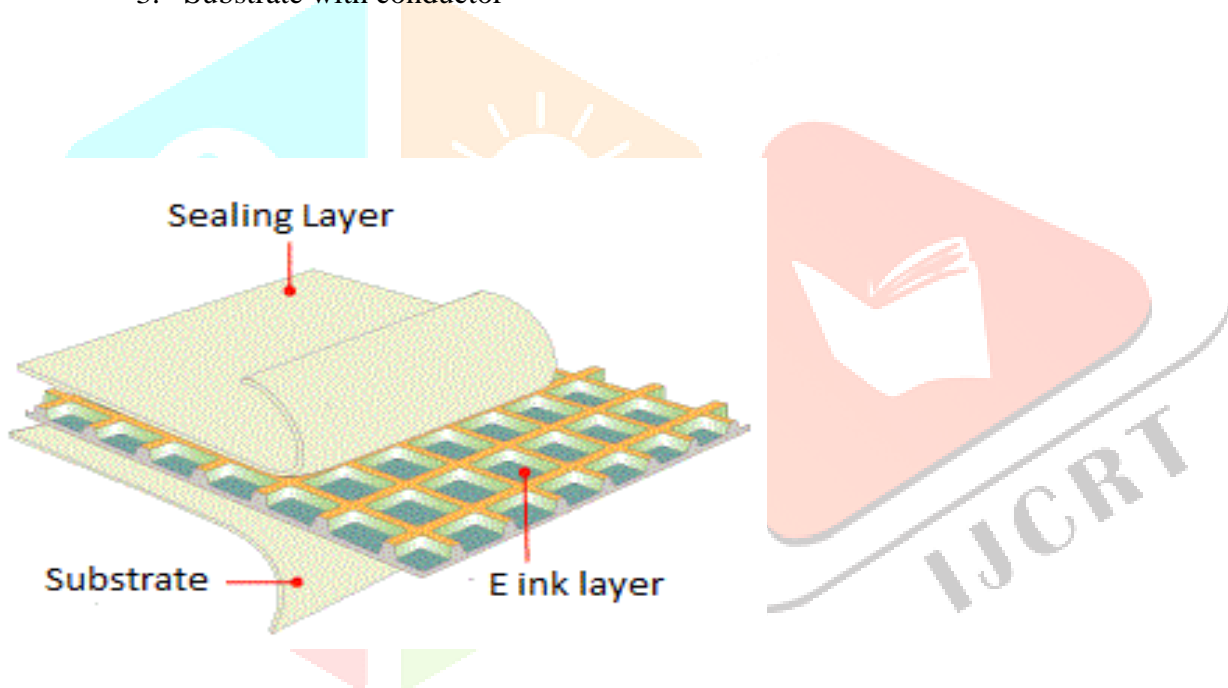
E-Paper is an electronic display device that possesses qualities of paper and it is unique as it is flexible in nature, E -paper display or EPD is also known as Electronic ink display. The first electronic paper was developed in 1970 and was named as GYRICON . Gyricon consisted of tiny charged capsules that were white on one side and black on other. The balls turned up or down to change the color. Which is shown in Fig(1).The electronic ink technology is a display technology and product of E ink. it gives the feeling of paper as it used same pigments that is used in Printing industries. It is alternative for LCD and in future it may be replacement of LCD in Electronic book. It is made up of million tiny microcapsules which are as thin as human hair. Each microcapsule contains both positive charged white particles and negative charged white particles. When a positive and negative electric field is applied, corresponding charged particles move to the top of the microcapsule where they became visible to user. This makes the surface appear black and white at that spot of observation. Electronic display paper doesn't required additional power to maintain once the images have been drawn. This display even doesn't require the backlight like conventional LCD display and it can be read in sunlight like paper.This display technology has been used by major e-readers like Amazon' Kindle, Sony's E-reader, Kobo e-reader and Barnes and Noble's Nook. Forrester Research estimates 3 million units of E-readers to be sold in 2009. It predicts 900,000 devices will be sold during the holiday season.



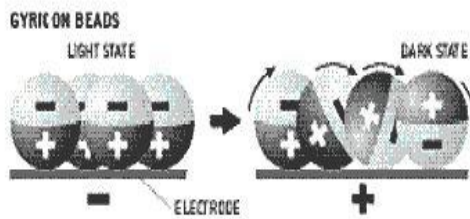
Ffig (1) The E-Paper Display

Structure of E- Paper: The Electronic Paper has the following three layers, which are as follows. And the Structure of E Paper is shown in Fig (2).E paper consists of three layers :

- 1. Sealing layer
- 2. E ink layer
- 3. Substrate with conductor



Fig(2) The Three Layers Of E-Paper.



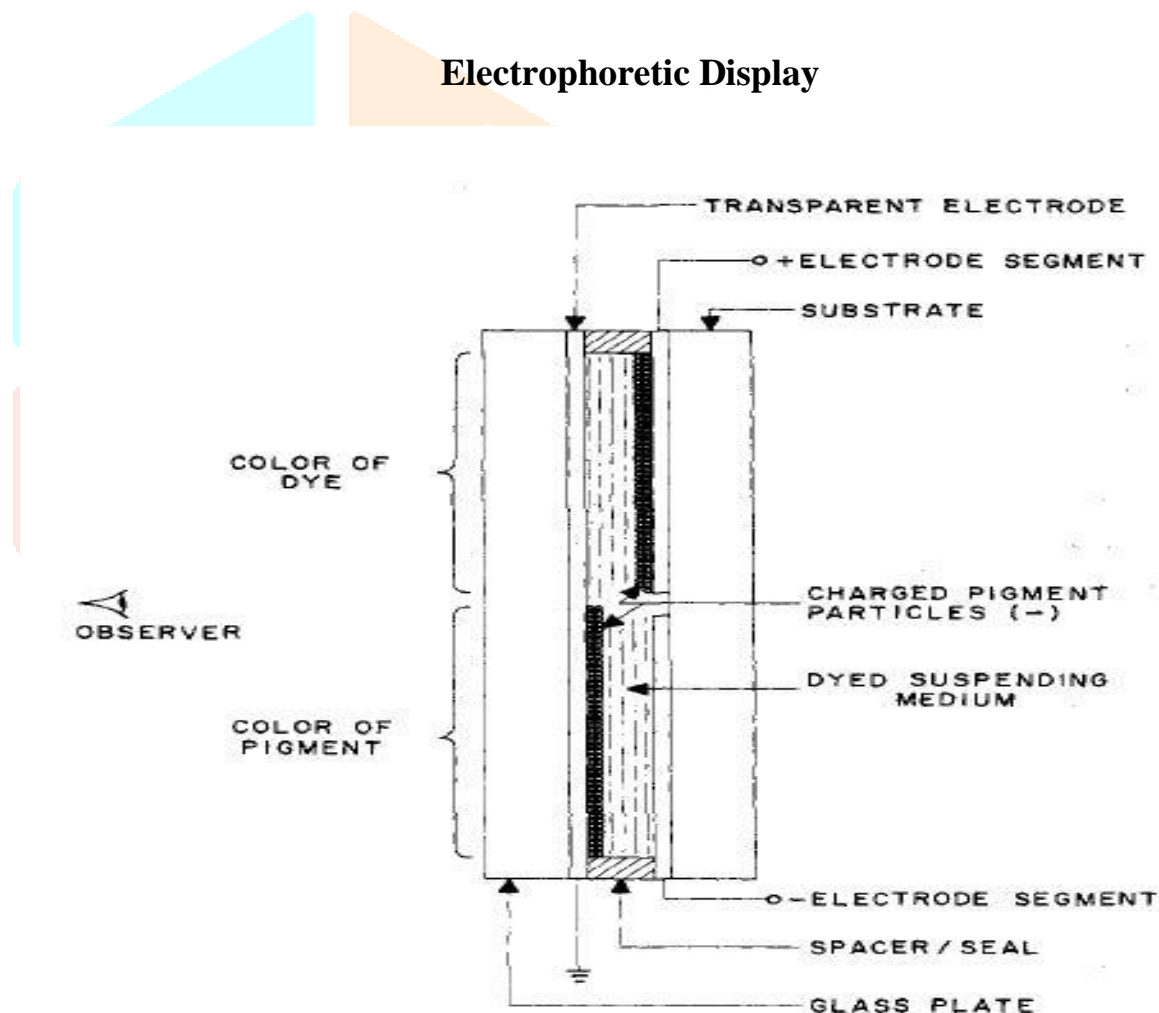
Type Of E-Paper Display:

There are Following Three types of E-Paper Display which are follows.

- a. Electrophoretic Display
- b. Electro wetting Display
- c. Electro fluidic Display

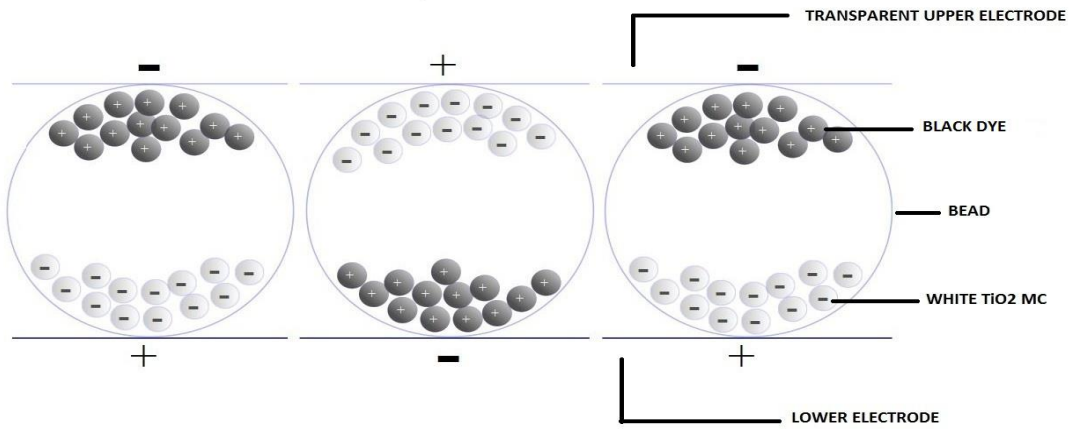
a .Electrophoretic Display: The electrophoretic display

1. Works on the principle of Electrophoresis.
2. Colored dye and charged pigments are used for representation of colors.
3. Most common type of E paper used.
4. Which used Least power consumption.



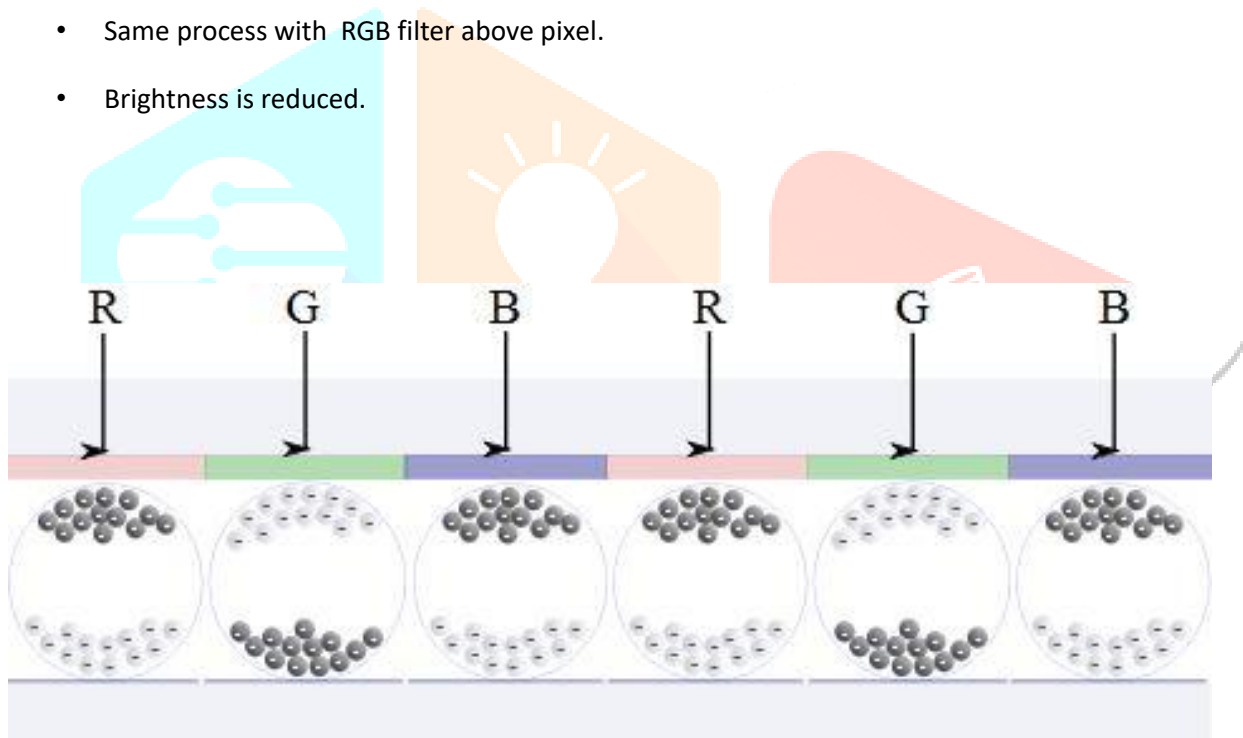
Modified Electrophoretic Display

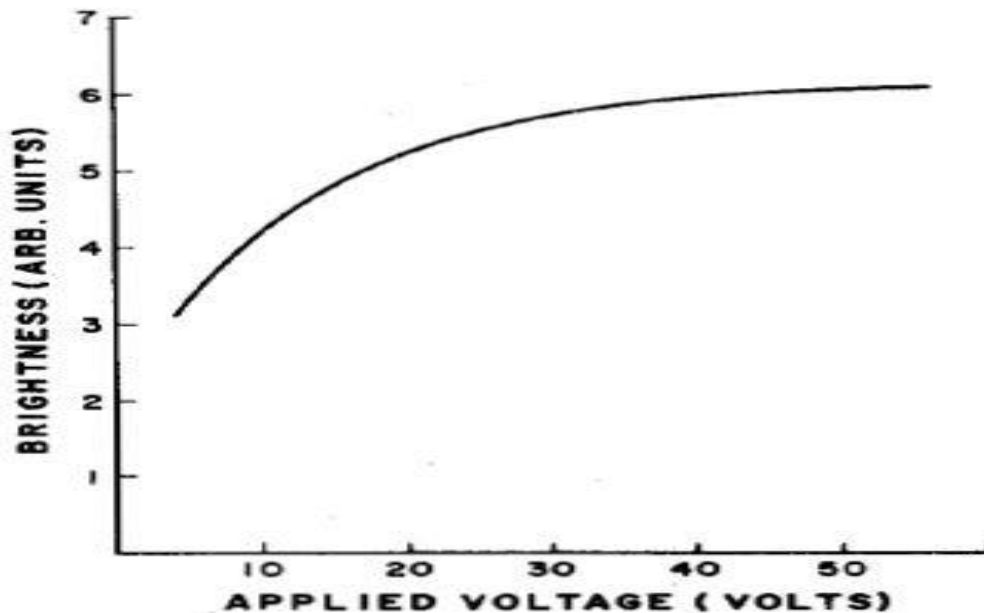
- ❖ Each pixel is separated in form of a spherical bead.
- ❖ TiO₂ microcapsules and dye present in each bead.
- ❖ Modified form of Gyricon.
- ❖ Contrast ratio is higher.



COLOUR DISPLAY

- Same process with RGB filter above pixel.
- Brightness is reduced.





Graph shows brightness increases slightly with increase in voltage in electrophoretic displays.

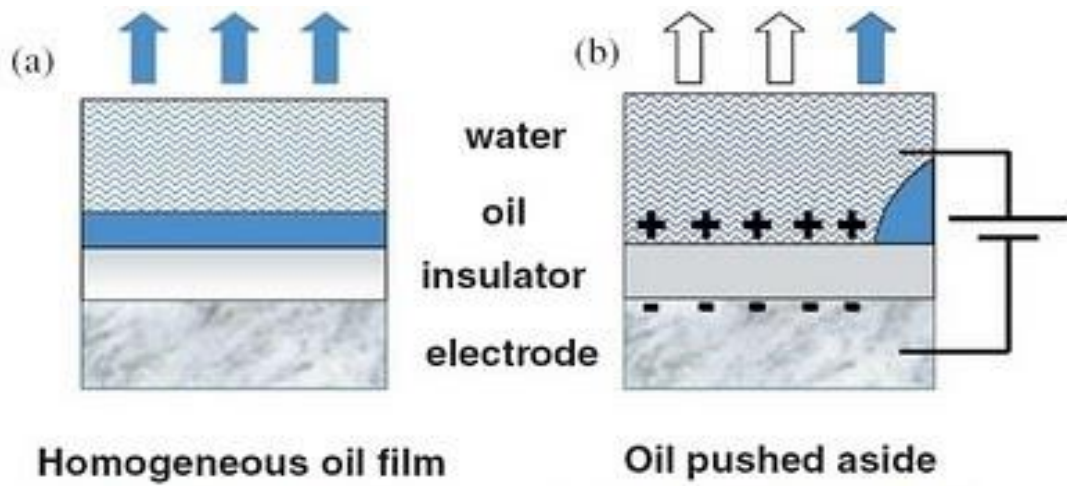
b. Electro Wetting Display

- ❖ Electro wetting display is based on the changing shape of confined water/oil interface inside the electrodes.
- ❖ Oil used are generally colored hydrocarbon oils.
- ❖ Highest brightness and color reproducibility among all technologies.



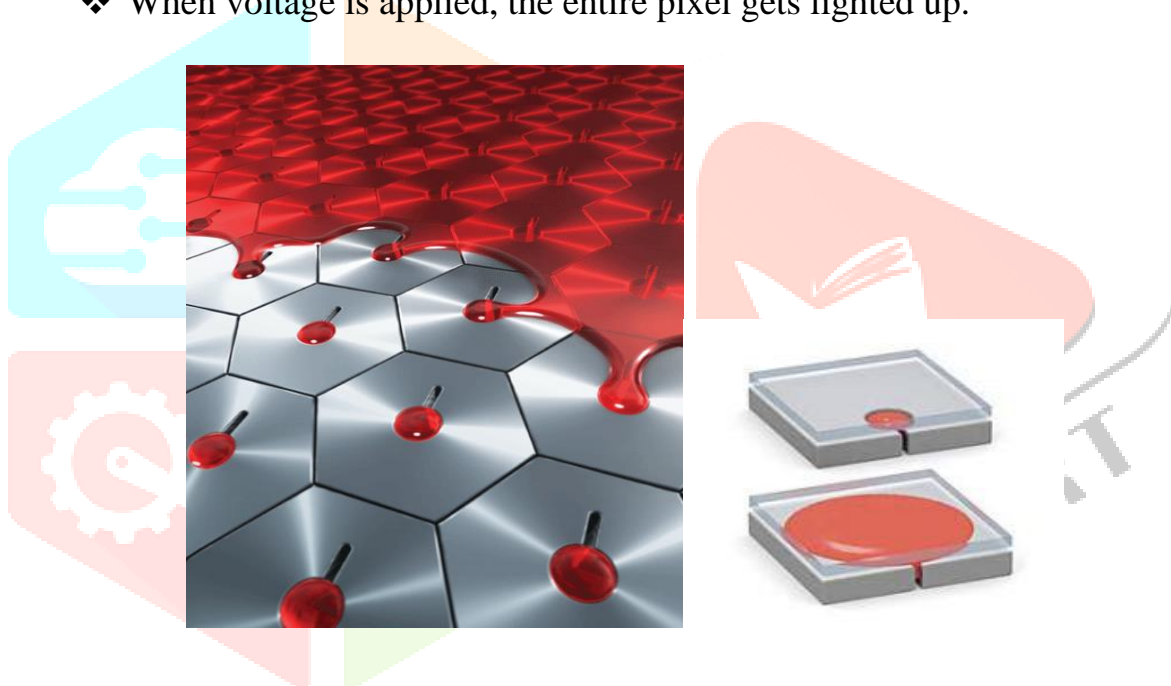
Electro Wetting Display

- ❖ When no voltage is applied, the output is a pixel with the color of the oil.
- ❖ When voltage is applied, the output is a dark pixel.
- ❖ On application of voltage, interfacial tension in water causes it to push the oil.



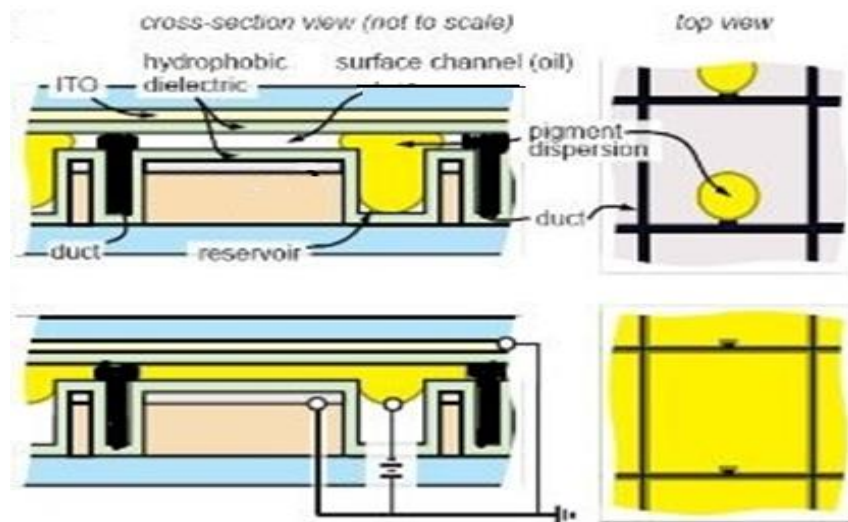
c. Electro Fluidic Display

- ❖ Voltage is applied to both the electrodes as well as the dye particle.
- ❖ When no voltage is applied, the output is a pixel with color of the substrate.
- ❖ When voltage is applied, the entire pixel gets lighted up.



Electro fluidic Display

- ❖ When no voltage is applied, the ink pigments remain inside the cavity.
- ❖ On application of voltage, due to increase in surface tension the pigments disperse and the entire pixel is colored.



Specifications

- ❖ Voltage Rating : 5V – 50V
- ❖ Power Rating : 5 μ Watts/sq. cm
- ❖ Operating Temperature : -10^o C to 70^o C
- ❖ Resolution : 5 lines per mm
- ❖ Display Size : 1in to 10ft or even more

Properties of E Paper

- ❖ Highly flexible and portable Displays.
- ❖ Reflects ambient light rather than emitting own light.
- ❖ Very wide viewing angle (approx 170 degrees).
- ❖ Accurate color reproduction.
- ❖ Various organic and inorganic substances can be used as ink pigments. Eg – TiO₂ Microcapsules, Cellulose

Advantages of E Paper

- ❖ Ultra low power consumption compared to any other kind of display.
- ❖ Unique as it is the only flexible display.
- ❖ Brightness remains intact even under direct sunlight.
- ❖ Very light weight and portable.
- ❖ Low cost.
- ❖ High lifetime of 20000 hours.

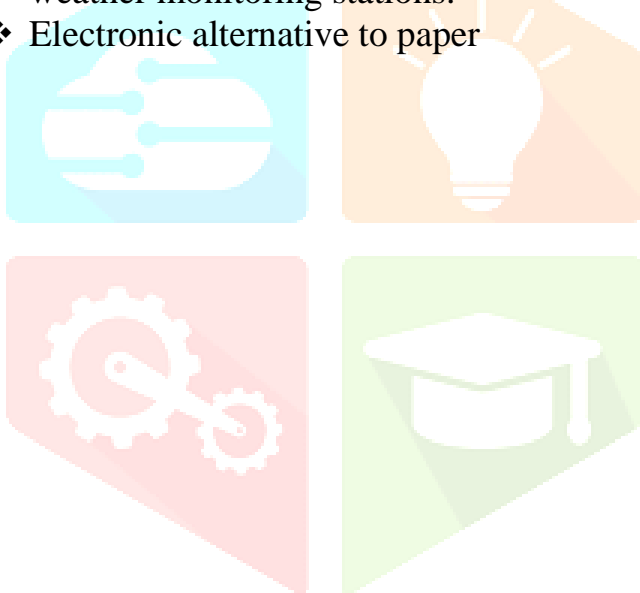


Disadvantages of E Paper

- ❖ Refresh rate is very low.
- ❖ Ghosting of image when fast moving pictures are displayed.
- ❖ Poor Contrast ratio compared to LCD, LED and Plasma Displays.

Applications of E Paper

- ❖ Can be used as Primary or secondary displays in mobile equipment's.
- ❖ Digital wrist watches.
- ❖ Integrated displays on Smartcards.
- ❖ Large scale advertisement hoardings.
- ❖ Price tag in retail outlets.
- ❖ Public information panels in Railway stations, weather monitoring stations.
- ❖ Electronic alternative to paper



Conclusions

Finally, we can conclude that E paper displays are the displays of the future because they are very energy efficient, truly portable and can be used universally in various fields in which electronic displays haven't ventured till now. It can also be assumed that after a few years this technology will eventually replace paper and lead us to a "paperless" world. This technology will be replacement of the paper which may result less trees cut. So improvement of this technology will create greener planet.

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