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The Hybrid Pixel

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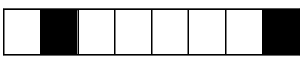
***Abstract*—In this paper, we will develop a new generation of paper display Data Storage to become 24 times more than actual capacity in 2D display such QR code. By compressing and decompressing 24 layers of 2D display into a single display without any loss of stored data. We based on RGB array by benefited of specified layers between back (0, 0, 0) and white (255, 255, 255) color.**

***Keywords*—The third display; 2D display; Data Store; Compress; Decompress; RGB array; Color**

I. Introduction

The digital data storage technologies continue to grow and evolve, we have seen the data stored on punch cards, on magnetic tapes, floppy disks, on hard drives, on CDs, on memory cards or USB sticks. These different media each have advantages and disadvantages, some are performing by their large storage capacities, others by their speed when writing or reading data, and others are valued for their miniature sizes or their price. In our modest paper we have presented a solution to improve the paper information storage capacity, the main question: what is the advantage of using this technique or that will bring more technical relative to the carrier's storage that just cited? In order to answer this question, it is sufficient to cite applications and new perspectives that can bring us such technology. For example, you can save on paper or packaging, moving picture sequences, or dynamic advertising slogans. Paper is a very abundant and low-cost product that can be used as temporary or disposable information medium, this can be exploited by advertisers, a commercial catalog can save multiple pages on a single sheet of paper. A business card can contain a lot of data.

Let's back to fundamentals. Computers use ''bits'' (short for ''binary digitals'') to represent information in a digital form. A computer bit is a binary value. When represented as a number, bits can have a value of either '1' (one) or '0' (zero). Modern computers generate bits from higher and lower electric voltages running through the device's circuits. In the next lines, we will focus on new ways of display information based in the binary language, we are going to discuss the use of a simple paper (an immaterial support). Every character that we know is represented in series of binary value, for example, the character {A} is represented in ASCII code by the number 65 that is in binary 01000001 in 1 byte. As result, we can represent the character {A} as following: (1, white square and 0, black one)



Generally, in the display system or the graphic representation of the characters we based on two major facts: • Representing binary states 0 and 1 using two colors, black and white. • The display capability is almost proportional to the size of the image dimensions. The capacity of data increases as well, dimensions increases too.

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II. Results and Discussion

In this paragraph we will present and explain our work, following the next plan:

1. Transform the data to Bit arrays (state 0 and 1).
2. Divide the Bit array into 24 arrays, following a defined size, and we multiply every Bit array by RGB array. The RGB array's value change following arithmetic sequence, so we got for every level a different color.
3. Merge the all layers in single picture (the third display).

In fact, this plan explains just the compress operation, so if we inverse the last plan we got the decompress operation. The possibility to decompress the final picture to 24 layers and get the same data without any loss is the most important part in our development. To make the decompress operation possible we based on the RGB array. In fact, we make the major process of this operation in the RGB values for each layer.

Let's $(v, q) \in \mathbb{N}^2$ and v < 255 and q < 255. $\boldsymbol{u}$ presents a value of RGB array, so $\boldsymbol{u}$ is number of 8 Bits.

$$v_n = q^n, \quad \text{n number of layer} \tag{1}$$

To get the maximum of layers we must choose q = 2. If we merge two layers we get a new RGB value (new color).

Let's v_i value of level i and v_j value of level j, if we merge its we get:

$$v_{i+j} = v_i + v_j \tag{2}$$

So, in finally display we have in a pixel n level, we get:

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$$V = \sum_{i=0}^{n} v_i \quad (3)$$

V is RGB value in the third display.

For example (in the third display), in a pixel we have three layers, layer 2, 4 and 6. If we consider q = 2, we get:

$v_2 = 4$, $v_4 = 16$ and $v_6 = 64$. So: V = 84.

To decompress we must decompose the V value (84) to

v_2, v_4, v_6 (4+16+64).

So we have a problematic, how to decompose the V value?

In fact, this problematic is solved if we choose: $v_n = q^n$

To decompose the V value, we just apply the next formula:

We consider c_i is boolean number can be 1 or 0. If c_i = 1, the layer i exist in this pixel.
If c_i = 0, the layer i not exist.
We must start by i = 7 and moving to 6, 5...0

$$C_i = \frac{V - \sum_{j=i+1}^{n} Cj\, v_j}{q^i} \quad (4)$$

Finally:

$$V = \sum_{i=0}^{n} v_i * c_i \quad (5)$$

Then easily we can build the Bit array, and we can build the data.

III. Conclusion

The storage capacity of the hybrid pixel proportional to the image size and printing resolution. Since the final image has certain limitations related to the resolution of the image and the camera, it is therefore necessary to choose the color layers with different reasonable values to avoid any loss of data.

As a suggestion, we suggest reducing the number of layers to 16 or less at 9. In addition, we propose to develop a new plastic material that can retain the maximum amount of resistance in order to maintain the strength of the hybrid pixel.