

# Presentation of a model to study facsimile coded signals from a fourth group

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**Abstract** - The paper presents investigation of the advantages and disadvantages of the coding methods and the compression level, error sensitivity and selecting an eventual compromise set of coding methods have made MRCII (Modified READ Code II)

**Keywords** – coding, Modified READ Code, images

## I. INTRODUCTION

Coding of facsimile signals is used for shortening the amount of transmitted messages (data). Using these codes ensure not only efficiency but also the compatibility of different groups of terminals [1]. Essential requirement for the development of various codes is that of economy, ie code combinations equivalent to certain messages should have shortest length possible. This length is defined primarily from basis of the selected code. If source generates various messages, the length of a code combination is :

$$N = \{ \text{Log}_m N \} \quad (1)$$

where “m” is basis of the selected code, and “N” is length of the codeword.

Facsimile devices of fourth group use two-dimensional coding line by line. Before transmission errors are corrected by control procedure at a higher level. Scanned lines in Group 3 are coded two-dimensional and every K lines adds a one-dimensional coded line to prevent the spread of errors.

Signal for end of line (EOL) and filling bits are not used. Signal for end of facsimile coding is indicated by the end of facsimile block (EOFB) with length of 24 bits instead of previously used RTC 78 bits. As a result coding economy grew by almost 40% compared with Group 3's two-dimensional coding.

MRCII code (Modified READ Code II) is able to encode lines with more than 2623 items. This option is needed to achieve higher resolution. Series lengths from 0 to 2623 elements are coded in the same way as in group 3 with main and ending codeword for the relevant color. Lengths longer than 2623 are coded first with main word for 2650, and if the balance exceeds this number code words are added until the balance remains lower than 2650[2]. Then the balance is encoded with code for completion or a combination for Group 3.

## II. ANALYTICAL RESULTS

Coding scheme uses the method for two-dimensional coding line by line, where location of each changed element of the current code line is coded as per location of the reference standard element situated on the same line or line above it. After coding of this line it becomes reference for the next line.

To reduce the error probability two-dimensional (K - 1) consecutive lines are coded after each one-dimensional coded line. Value of the parameter K is “2” for standard vertical resolution and “4” for additional (higher) resolution.

The coding is done line by line. The position of each changed element of the image is encoded as per the position of the relevant reference standard element situated in the coding line or reference line above it. After encoding, each line is reference for the follow [3] .

Coding procedure:

The following algorithm is performed after selecting appropriate mode:

**Step 1:** If you select operating mode, that is indicated by the codeword “0001”. “A0” element, located under “b2”, is established for an initial (reference standard) element for the next coding. If operating mode is not selected, step 2 followed.

**Step 2:** Absolute value of the relative distance “a1b1” is determined. If  $|a1b1| \leq 3$ , then “a1b1” is encoded in vertical mode. Then the “a1” position is regarded as a position of the new reference standard element “a0” in the next encoding.

If  $|a1b1| > 3$ , then horizontal coding mode is used. “A0a1” and “a1a2” are coded one-dimensional, the position of “a2” is used as a reference for further encoding.

Coding procedure determines the coding mode which will be used for encoding of each changed item in coded line. The code of selected coding mode is taken from Table 1 end Fig.1.

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TABLE I  
CODE OF SELECTED CODING MODE

Regime	Elements Coding	Indication	Codeword
PASS mode	b1, b2	P	0001
Horizontal mode	$A0, A1, A1A2$	H	$001 + M(a0a1) + M(a1a2)$
Vertical mode	a1 in b1    a1b1=0	(0)	1
	a1b1=1	Vd(1)	001
	a1 right of b1    a1b1=2	Vd(2)	000011
	a1b1=3	Vd(3)	0000011
	a1 left of b1    a1b1=1		
	a1b1=2	VI(1)	010
a1b1=3	VI(2)	000010	
	Bl(3)	0000010	
Extension			0000001xxx

Identification of modified element

Changed element is an element whose color is different from that of previous element on the same scan line [4].

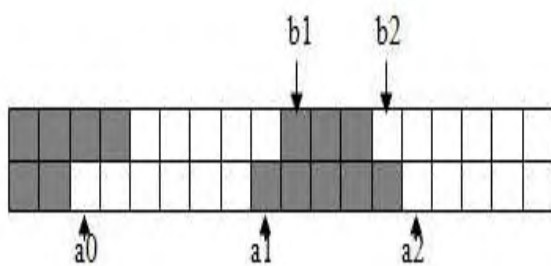


Fig.1. Coding Procedure

“a0” - reference standard or starting changed element of the code line. During encoding of the current line, “a0” position is determined by the coding mode;

“a1” - next changed item on the right of “a0”;

“a2” - next changed item on the right of “a1”;

“b1” - first changed element of the reference line on the right of “a0” and with color different from “a0”;

“b2” - next changed element on the right from “b1” on the reference line [5].

The algorithm for investigation of facsimile codes is shown in Fig. 2.

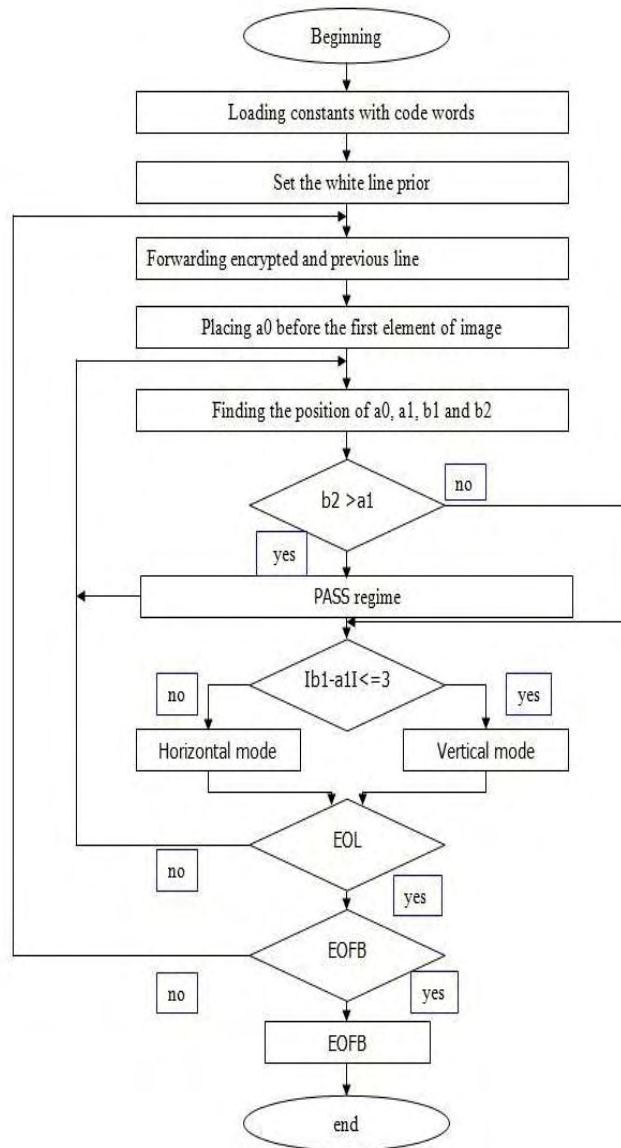


Fig.2. Block diagram of the algorithm for investigation of facsimile codes

PASS mode

It is initialized with codeword 0001. In this mode, "b2" and "b1" must be located to the left of "a1". After coding, "a0" is placed under the position of "b2".

Vertical mode

This mode has seven sub modes : VR3, VR2, VR1, V0, VL1, VL2, VL3 and is indicated when "I a1-b1 I" is equal to or less than 3. "R" indicates that "a1" is on the right of "b1", and "L" – on the left.

Code words are :

- a1-b1=0 (V0).....1;
- a1-b1=1(VR1).....011;
- a1-b1=2(VR2).....000011;
- a1-b1=3(VR3).....0000011;

a1-b1=-1(VL1).....010;

a1-b1=-2(VL2).....000010;

a1-b1=-3(VL3).....0000010;

After coding, "a0" replaces "a1".

**Programming model parameters**

- **Image [T Bitmap]** – coded image
- **Out Image [T Bitmap]** – decrypted image
- **Out Stream [T Memory Stream]** – stream for encoding / decoding information
  - **Out Bits [String]** – presents OutStream in text 1010 .....
  - **Coding Method [T Fax Coding Method]** – type of encoding algorithm
    - **Pure Bytes [Long Int]** – correct number of bytes that image contains
    - **Compressed [Long Int]** – number of compressed bytes

**TFaxCodingMethod = (fcmBlock, fcmHuffman, fcmMHC, fcmREADMHC);**

**Class Tfax Custom Coding (in file u coding.pas)**

- **Code** – code "Image" in Out Stream

**Decode** – decode Out Stream

Test results are shown in Fig. 3 end

Fig.4 :

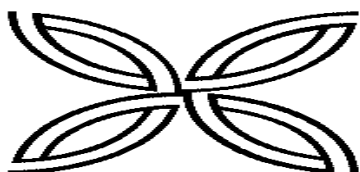


Fig. 3. Original image 1



Fig. 4. Test result with noise intensity 30%;

Coefficient of contraction:

K = 2 : **74,52%**;

K = 4 : **81,88%**;

Performance 0,062 sec (62 ms);

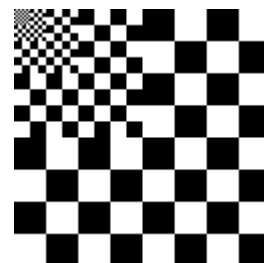


Fig. 5. Original image 2

Experiment with an array: dimensions 128/128 and size 2048byte. [6]

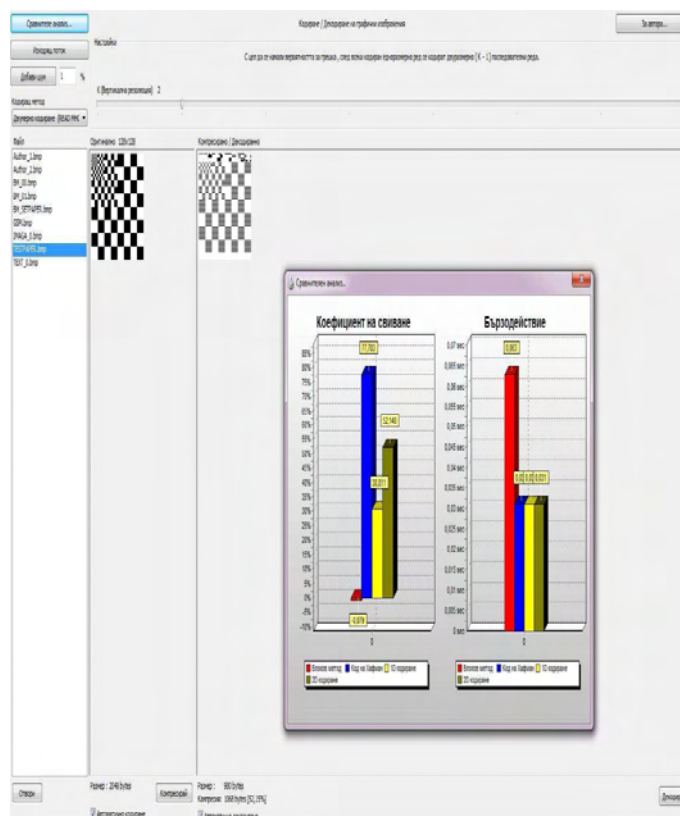


Fig. 6. Experimental results. Coefficient of contraction and performance

### III. CONCLUSION

Different results for the investigated methods are obtained with noise importation in the data channel. Increasing the error probability in data channel, the total number of errors in image reconstruction also increase. At the same time the number of transitions from black to white element are increased. [7]

Modified READ code (MRCII), used for fax machines group 4 has high stability, high compression levels, but in comparison with READ-code has more transformations white-black and black-white, that decreases it noise protection

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