

Optimum Compression of Iris Templates by using Multiple Source Coding

Aparna Singh¹, Deepak Paranjape²

P.G. Student, Department of Computer Science & Engineering, Global Engineering College, Jabalpur, MP, India¹

Assistant Professor, Department of Computer Science & Engineering, Global Engineering College, Jabalpur, MP, India²

ABSTRACT: The aim of this Research work is to improve the performance of the system by using the Adaptive Delta & Shannon-Fano Codes. Using error detection and correction methods to tackle erroneous frames in such environment is inefficient, because of the large number of steps needed in these methods (4). Also these methods introduce high latency, where the repeated retransmission or regeneration consumes considerable time, which leads to a high delay between detection moment of an event at the sensor nodes, so that the informing the base station about that event may be very late. Retransmission or regeneration also consumes large amount of energy of the nodes. Whereas energy saving is sometimes one of the main aspect here.

KEYWORDS: Error detection and correction, Adaptive delta code, Shannon-fano code.

I. INTRODUCTION

One of the main applications of Authentication system is to recognize the correct personnel and collecting information about expected finer points. In this context it is hard for the system to deliver a huge file of the collected information, even when transmitting at the maximum power, without strong error correction techniques. In the last of 70s offer geometry scanners, and since 80s, there is continuing investigate on iris and retina scans. Biometric system was initially existed since about 70s. An improvement of such systems is based in the fact individuality and behaviour is totally dependent to its holder and cannot be detached in usual situation. With repetitive improvement these systems get many implications, even on the personal areas.

Essentially, an Iris biometric characteristic is supposed to be (1):

- **CONSTANT** – This characteristic must be anti aging.
- **UNIQUE** – It means that this characteristic must be different from individual to someone.
- **MEASURABLE** – It means that the particular characteristic must be simply measured.
- **WORLDWIDE** – that is, each person must have these specific characteristic.

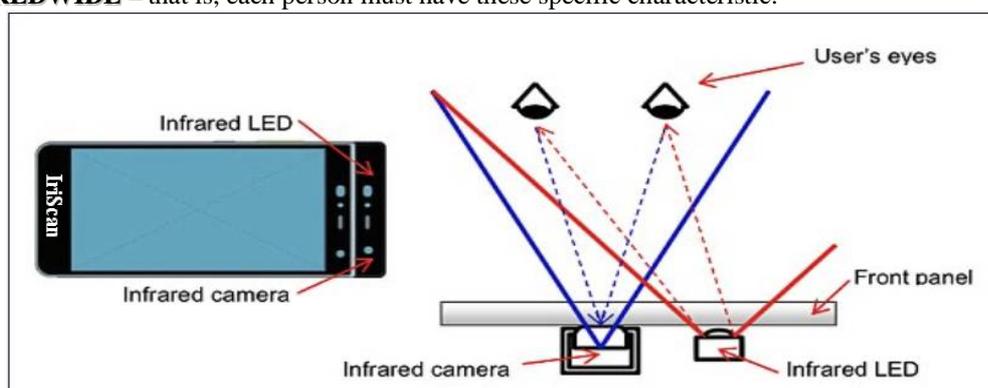


Fig 1: Iris Scanning by Biometric Machine

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II. ARCHITECTURE OF HUMAN EYE

Unique that is basis for identification is provided by both dots patterns on the iris and blood vessel pattern on retina. Only one company, Eye-Dentify Inc. generates retinal scan products, and no others are expected to enter the field. However many companies working on devices that examine the human iris; the most famous, Iris Scan, owns the patent. This technique's main advantage over retina scans is the client does not need to focus on a target, because this is exist on the eye's surface. Retina scans, performed by directing a low intensity IR light through the pupil and Retina of the eye; has been available commercially from the time when 1985. A company that has licensed the iris scanning technology, from IriScan hopes to position its Iris dent product into ATMs in the coming years is Sensor.

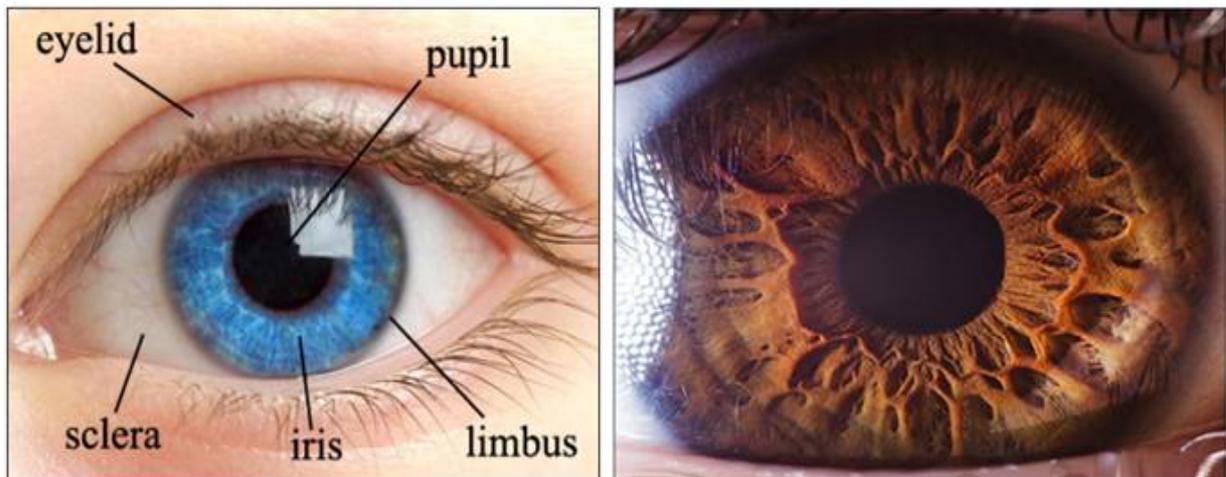


Fig 2 Structure of Iris and its Finer Points

III. RECOGNITION OF SHAPE OF OBJECT

Let, scanning camera is made by (8x8) Pixels Matrix (8). Then firstly we decide the number of Gray Levels and the Threshold Value.

Let,

There are 8 Levels.....

0 = 000 → Black Level	Undesired Gray Levels
1 = 001	
2 = 010	
3 = 011 → Threshold Level	Desired Gray Levels
4 = 100	
5 = 101	
6 = 110	
7 = 111 → White Level	

Table 1: Grey Level Classification

N4 = Direct Connected Pixels

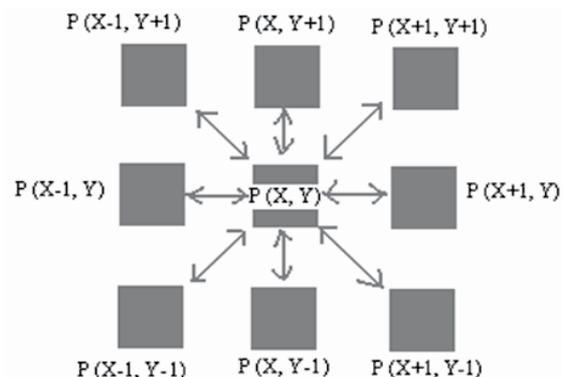


Fig 3: Calculation of Object Finer Points Gray Levels

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N8 = Direct and Diagonally Connected Pixels

If $P(X, Y) = N8 [P(X, Y)] = V$

Where, Level Set $V \in \{0, 1, 2, 3\}$

Then the Pixels are on the same Gray Level Set, i.e. all are connected with each other. The corner is the point at which a grey level stops. It has 2 neighbours. Point 1 is the regular part of the object. It has 3 neighbours. In this type of recognition system, we may store the position of corners and points of Edge of the Object into a database. To store these points 3 elements are used as X – coordinate, Y-coordinate, and rotation angle θ of object, i.e. x, y, θ .

IV. RECOGNITION OF POSITION OF OBJECT

X= Pixel value in Horizontal direction

Y= Pixel value in Vertical direction

Θ = Orientation from Origin

Bifurcation is a point where three ridges met with each other. There is a single point which has the gray level that is not similar to the neighbouring point; it is defined as the Pore. Corner has only one matching gray level. It means it is the end point of any ridge. The diagonal of the central location (Retinal location) is known as the Bridge.

There are 3 neighbours of point-P so that it is a point of Bifurcation of the object. This is our desired point.

Object Position at Bifurcation = $P(X, Y, \Theta)$

= $P(1, 6, 80)$

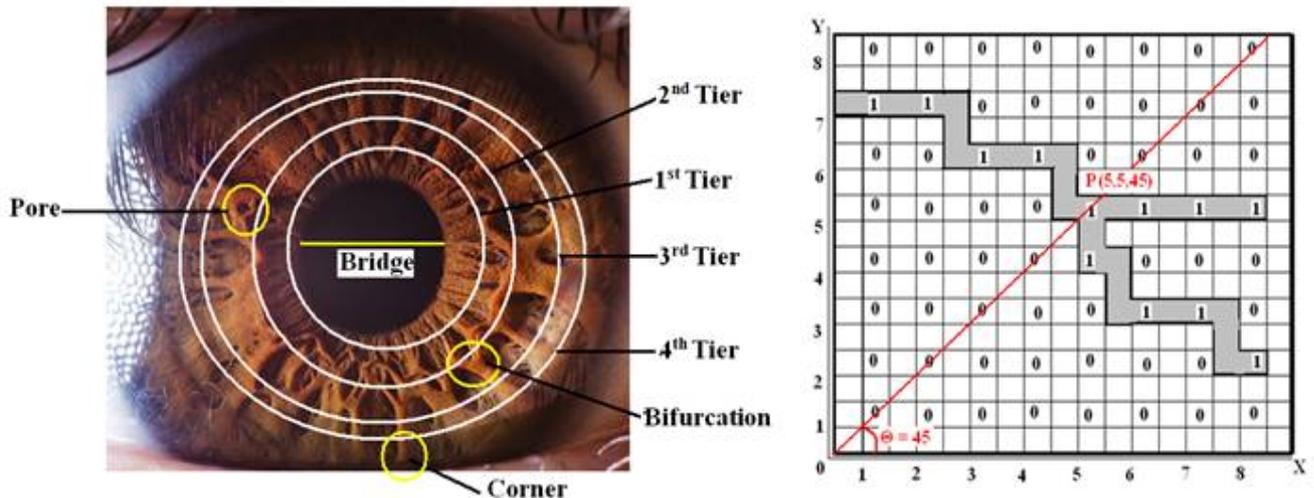


Fig 4: (a) Recognition of finer point, (b) Recognition of Bifurcation

V. CODING THEORY

Coding theory is the study of the properties of codes and their fitness for a specific application (1). Codes are used for data compression, cryptography, error-correction and more recently also for network coding (7). Codes are studied by various scientific disciplines such as information theory, electrical engineering, mathematics, and computer science for the purpose of designing efficient and reliable data transmission methods. This typically involves the removal of redundancy and the correction (or detection) of errors in the transmitted data (5).

There are essentially two aspects of coding theory:

1. Data compression (or, source coding)

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2. Error correction (or channel coding)

S.	X - field	Bits for X - field	Y- field	Bits for Y- field	Θ - field	Bits for Θ- field
1	64	001000000	44	00101100	357	101100101
2	75	001001011	80	01010000	243	011110011
3	79	001001111	70	01000110	59	000111011
4	85	001010101	86	01010110	145	010010001
5	92	001011100	88	01011000	333	101001101
6	125	001111101	83	01010011	255	011111111
7	132	010000100	91	01011011	293	100100101
8	136	010001000	157	10011101	249	011111001
9	176	010110000	85	01010101	263	100000111
10	177	010110001	147	10010011	271	100001111
11	188	010111100	171	10101011	275	100010011
12	189	010111101	148	10010100	83	001010011
13	199	011000111	168	10101000	282	100011010
14	202	011001010	203	11001011	271	100001111
15	205	011001101	90	01011010	53	000110101
16	214	011010110	116	01110100	254	011111110
17	216	011011000	196	11000100	263	100000111
18	225	011100001	161	10100001	322	101000010
19	232	011101000	206	11001110	9	000001001
20	242	011110010	176	10110000	299	100101011
21	246	011110110	209	11010001	296	100101000
22	248	011111000	199	11000111	275	100010011
23	252	011111100	230	11100110	113	001110001
24	261	100000101	198	11000110	271	100001111

Table 2: Storing of Finer Points in binary format

S. No.	X - Field	Break Numbers (a + b)	Shannon-Fano Coding (a)	Binary Coding (b)
1	64	60+4	100	100
2	75	60+14	100	1110
3	79	60+19	100	10011
4	85	60+25	100	11001
5	92	90+2	00001	10
6	125	120+5	001	101
7	132	120+12	001	1100
8	136	120+16	001	10000
9	176	150+26	0001	11010
10	177	150+27	0001	11011
11	188	180+8	11	1000
12	189	180+9	11	1001
13	199	180+19	11	10011
14	202	180+22	11	10110
15	205	180+25	11	11001
16	214	210+4	01	100
17	216	210+6	01	110
18	225	210+15	01	1111
19	232	210+22	01	10110
20	242	240+2	101	10
21	246	240+6	101	110
22	248	240+8	101	1000
23	252	240+12	101	1100
24	261	240+21	101	10101

Table 3: Calculated Shannon-Fano & Additional Binary Codes for X-Field

Let for example we take the templates of X- field. Here we use Shannon-Fano code with Adaptive-delta compression. Hence for that we have created the group of 30 numbers and find the values present in this group.

S.	Periods	Values	Probabilities
1	0-30	0
2	30-60	0
3	60-90	64, 75, 79, 85	4
4	90-120	92	1
5	120-150	125, 132, 136	3
6	150-180	176, 177	2
7	180-210	188, 189, 199, 202, 205	5
8	210-240	214, 216, 225, 232	4
9	240-270	242, 246, 248, 252, 261	5

Table 4: Periods of Points & their respective Probabilities for the Group of X-Field

180	5	1	1						
240	5	1	0	1					
60	4	1	0	0					
210	40	1							
120	3	0	0	1					
150	2	0	0	0	1				
90	1	0	0	0	0	1			
0	0	0	0	0	0	0	1		
30	0	0	0	0	0	0	0	1	

Fig 5: Shannon-Fano Code Formula to Reduce applied Samples of Finer Points

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VI. EXPERIMENTAL RESULTS

Total bits required for storing X-field without coding

$$= 9 \text{ bits} * 24$$

$$= 216 \text{ bits}$$

Total bits required for storing X-field with coding

$$= 6+7+8+8+7+6+7+8+9+9+6+6+7+7+7+5+5+6+7+5+6+7+7+8 \text{ bits}$$

$$= 164 \text{ bits}$$

The compression ratio of template is:

$$= \frac{(216 - 164)}{216} * 100 \%$$

$$= \frac{(52)}{216} * 100 \%$$

$$= 24 \%$$

Therefore it is clear that with this technique approximately 24% compression ratio can be achieved.

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