Midterm Project of Machine Vision

EAN-13 Barcode

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Background

- International Article Numbering Association (EAN) in Europe (originally European Article Number)

- UPC-A bar code standard can only be used in US and Canada. (UPC = Universal Product Codes)

- The UCC (Uniform Code Council) announced that as of January 1, 2005, all bar codes systems in the US and Canada must be able to handle EAN-13 bar codes for international compatibility.

Difference between UPC-A and EAN-13

12 digits: 1-5-5-1

UPC-A

0 75678 16412 5

13 digits: 1-6-6-0
12 data & 1 check
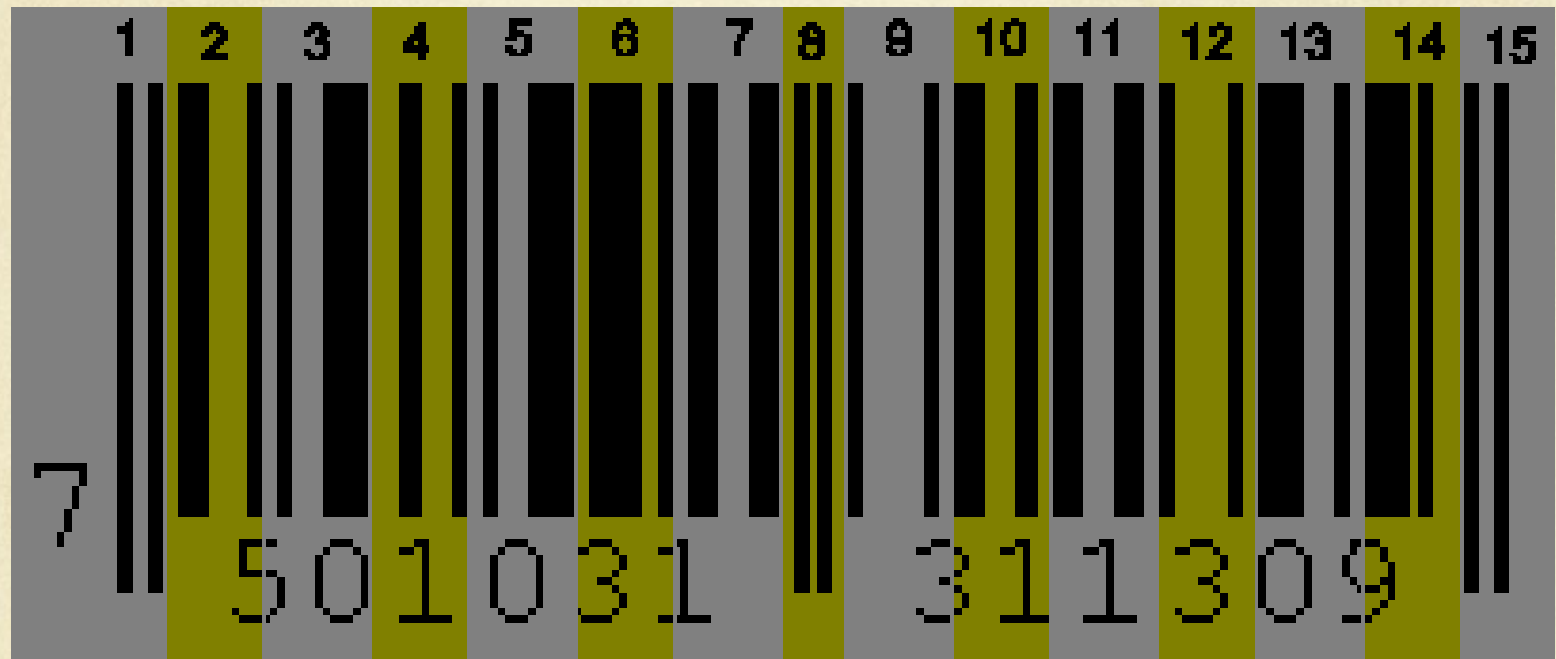
EAN-13

0 075678 164125

Encoding the symbol

1: "dark" or "bar"
0: "light" or "space"

11: double-wide bar
 0: single-wide space
 1: single-wide bar

Codes of EAN-13

Left-hand guard	Center guard	right-hand guard
101	01010	101

3 + 6*7 + 5 +6*7 + 3 = 95 areas
Each number consists of 7 areas

Structure of EAN-13

First two or three digits

Number system

00-13: USA & Canada   20-29: In-Store Functions   30-37: France
40-44: Germany   **45: Japan (also 49)** 46: Russian Federation
471: Taiwan   474: Estonia   475: Latvia
477: Lithuania 479: Sri Lanka 480: Philippines
482: Ukraine   484: Moldova 485: Armenia
486: Georgia   487: Kazakhstan   489: Hong Kong
49: Japan (JAN-13) 50: United Kingdom   520: Greece
528: Lebanon 529: Cyprus   531: Macedonia
535: Malta   539: Ireland   54: Belgium & Luxembourg
560: Portugal 569: Iceland   57: Denmark
590: Poland   594: Romania 599: Hungary
600 & 601: South Africa   609: Mauritius   611: Morocco
613: Algeria   619: Tunisia   622: Egypt
625: Jordan   626: Iran 64: Finland
690-692: China   70: Norway   729: Israel
73: Sweden   740: Guatemala   741: El Salvador
742: Honduras   743: Nicaragua   744: Costa Rica
746: Dominican Republic   750: Mexico   759: Venezuela
76: Switzerland   770: Colombia   773: Uruguay

The checksum digit

1. Consider the right most digit to be in an "odd" position and assign odd/even to each digit moving from right to left.

2. Sum the digits in all odd positions and multiply the result by 3.

   (0 + 1 + 3 + 3 + 1 + 5) * 3 = 39

3. Sum the digits in all even positions.

   3 + 1 + 1 + 0 + 0 + 7 = 12

4. Sum the totals calculated in steps 2 and 3.   **39 + 12 = 51**

5. The check digit is the number, which added to the totals calculated in step 4, result in a number evenly divisible by 10.   **51 + (9) = 60**

6. If the sum calculated in step 4 is evenly divisible by 10, the check digit is "0".

Parity encoding table

1st digit	2nd digit	3rd digit	4th digit	5th digit	6th digit	7th digit
0	Odd	Odd	Odd	Odd	Odd	Odd
1	Odd	Odd	Even	Odd	Even	Even
2	Odd	Odd	Even	Even	Odd	Even
3	Odd	Odd	Even	Even	Even	Odd
4	Odd	Even	Odd	Odd	Even	Even
5	Odd	Even	Even	Odd	Odd	Even
6	Odd	Even	Even	Even	Odd	Odd
7	Odd	Even	Odd	Even	Odd	Even
8	Odd	Even	Odd	Even	Even	Odd
9	Odd	Even	Even	Odd	Even	Odd

7
5: Odd
0: Even
1: Odd
0: Even
3: Odd
1: Even

Character set encoding table

Digit	Left-hand		Right-hand
	Odd parity	Even parity	
0	0001101	0100111	1110010
1	0011001	0110011	1100110
2	0010011	0011011	1101100
3	0111101	0100001	1000010
4	0100011	0011101	1011100
5	0110001	0111001	1001110
6	0101111	0000101	1010000
7	0111011	0010001	1000100
8	0110111	0001001	1001000
9	0001011	0010111	1110100

7
5: 0110001 (Odd)
0: 0100111 (Even)
1: 0011001 (Odd)
0: 0100111 (Even)
3: 0111101 (Odd)
1: 0110011 (Even)

3: 1000010
1: 1100110
1: 1100110
3: 1000010
0: 1110010
9: 1110100

Midterm project: An image barcode reader

1. The image barcode reader should be able to "read" a full EAN-13 barcode shown on a gray scale image.

2. The input is an EAN-13 barcode and the output is a 13-digit number that stands for the barcode.

3. Assume the optical axis of the camera is always perpendicular to the plane where the barcode is located.

4. Do not bother to recognize those small numbers inside the barcode.

5. Notice that both orientation and size of the barcode are not known in advance.

6. Good luck.