



Automated Access Control via License Plate recognition using Neocognitron Neural Network

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Outline

- Problem definition
- Neocognitron Neural network
- Adapted version of original Neocognitron to recognize license plates
- Characteristics of Dutch license plates
- Database of Dutch license plate
- Workbench of license plate recognizer
- Test results
- Conclusion



Problem definition

- Is it possible to use an adapted version of the Neocognitron Neural network to recognize Dutch license plates automatically in real time.
- The recognised license plate may be used to check access control of the car and its driver

Procedure

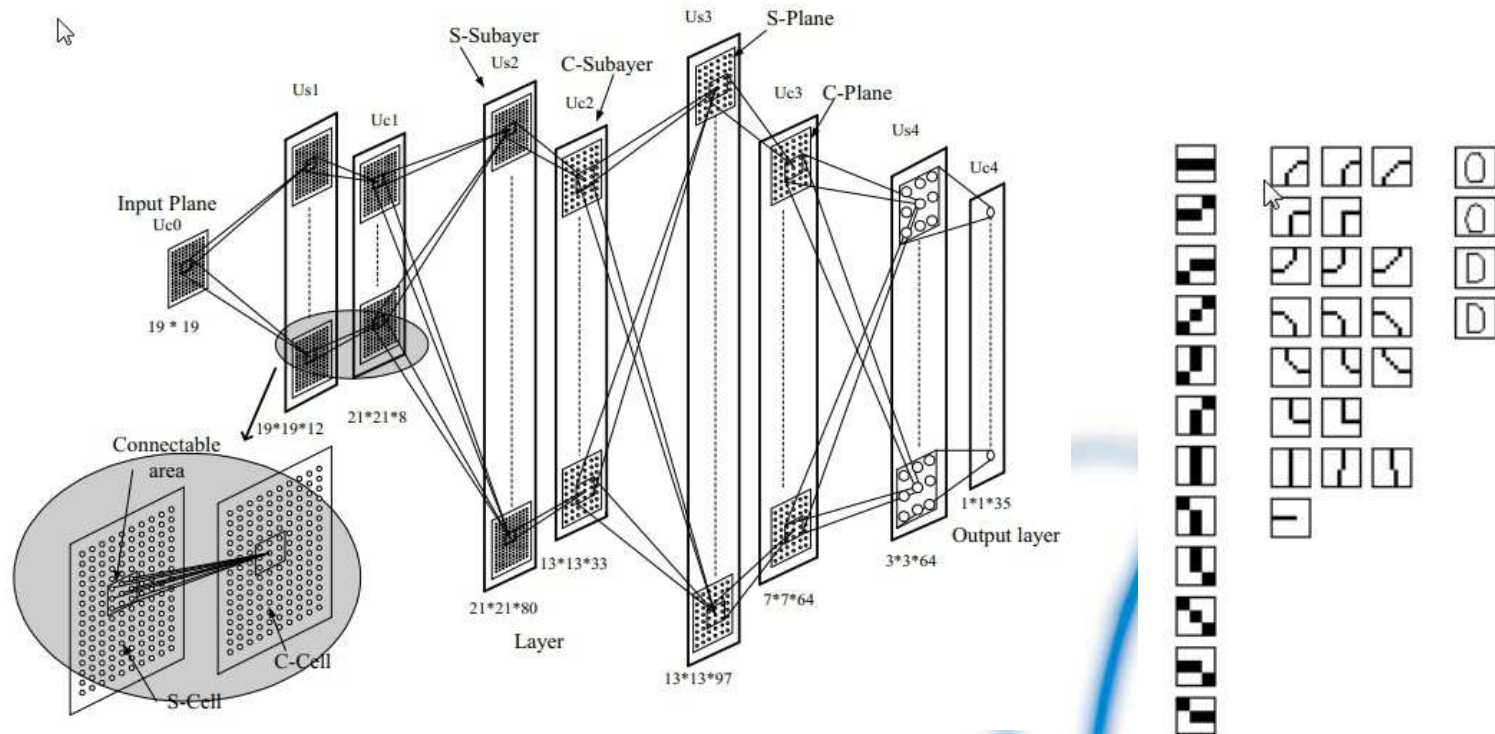
- Design an adapted version of the Neocognitron Neural network designed by Fukushima to recognise handwritten symbols
- Define characteristics of Dutch license plates to facilitate the recognition
- Design a special database of Dutch license plate to train the neural network
- Train and test the adapted Neocognitron Neural Network
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The architecture of the Neocognitron neural network

The network is composed of several connected layers. The first layer is used to recognise simple line segments of three pixels in several positions.

In the next layer composites of the simple line segments will be recognised, up to the final layer which will be used for recognition of a character

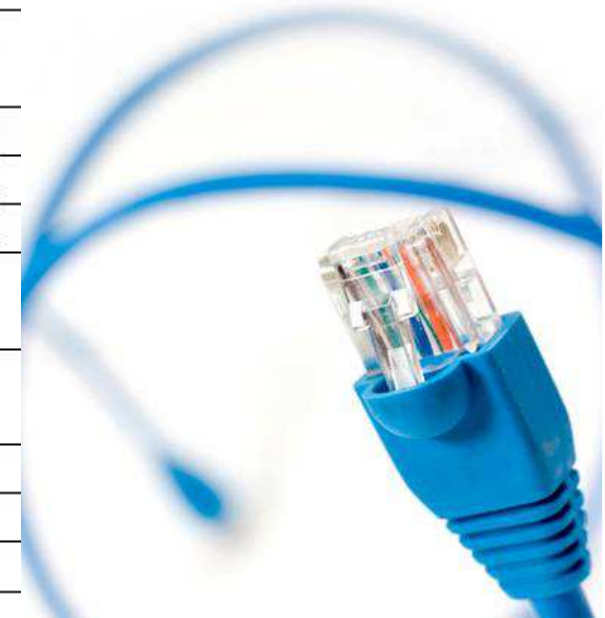


Characteristics of Dutch License plates

A Dutch license plate is a specific string of numbers and characters satisfying specific grammar rules



Seri es	Year	Combination	Series	Year	Combinati on
1	1951	XX-99-99	8	2009	9-XXX-99
2	1965	99-99-XX	9	2006	XX-999-X
3	1973	99-XX-99	10	2008	X-999-XX
4	1978	XX-99-XX	11	2015	XXX-99- X
5	1991	XX-XX-99	12	-	X-99- XXX
6	1999	99-XX-XX	13	2016	9-XX-999
7	2005	99-XXX-9	14	2019	999-XX-9
....



Workbench with image processing tools and Neocognitron

The screenshot displays a software interface for image processing and license plate recognition. It consists of several main components:

- Image Window:** Shows a photograph of a dark car with a license plate that reads "02 DR GR". White arrows point to the license plate area, labeled "segment annotations" and "original segment cutouts".
- Control Panel:** A vertical panel on the right containing various processing options:
 - AUTO PRE-PROCESSING:** Includes buttons for "Open", "Exit", "FileSeries", "Method I", "Method II", and "Method III".
 - PRE-PROCESSING:** Includes buttons for "Invert Image", "GrayScaling", "Local" (with a dropdown set to "195"), "White Boundary", "FloodFill White", "LowPass Filter", "Sobel", "Foreword FFT", "Restore Image", "Reduce Noise", "Global Binarisation", "Black Boundary", "FloodFill Black", "HighPass Filter", "Thinning" (with a dropdown set to "16"), and "Backword FFT".
 - SEGMENTATE:** Includes buttons for "Color" and "Mono".
 - RECOGNISER:** Includes buttons for "ML Perceptron" and "NeoCognitron". Below these is a text input field containing the recognized text "02DRGR".
- Segment Window:** A small window showing a binary (black and white) representation of the license plate area, labeled "segmentation demonstration".
- Status Window:** A window at the bottom displaying a table of processing results for segment candidates.

Processing segment list selecting plate candidate characters					
segment num=	loc=	size=	pos=	recog=	
1	[256,267,219,235]	[17, 12]	[0,256]	recog=[0D800]	
2	[272,282,219,234]	[16, 11]	[0,272]	recog=[2ZL00]	
3	[293,304,219,234]	[16, 12]	[0,293]	recog=[D0000]	
4	[309,319,219,234]	[16, 11]	[0,309]	recog=[RPH80]	
5	[330,340,219,234]	[16, 11]	[0,330]	recog=[G0000]	
6	[345,355,219,234]	[16, 11]	[0,345]	recog=[RP8HB]	
No More Characters Found					
No More Characters Found					

Entrance barrier of the Netherlands Defence Academy used to record license plates



Composition of database of Dutch license plates recorded at the Netherlands Defense Academy, Dutch Highways and inner city of Delft

Location of recordings	Single pictures	Videos
Inner city of Delft	300	50
Recordings at the entrance of Military Defence Academy	150	100
Recordings traffic on the highway	-	225



Recognition rate of the Dutch license plate recogniser using Neocognitron Neural network

Recognition rate (correctly classified license plates)	93.2%
Error rate (misclassified plates)	2.3%
Rejection rate (unclassified plates)	4.5%



Questions?

