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A Video Acquisition System to Develop a Real-Time Discomfort Recognition Algorithm

Pain Vision

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Katholieke Hogeschool Kempen

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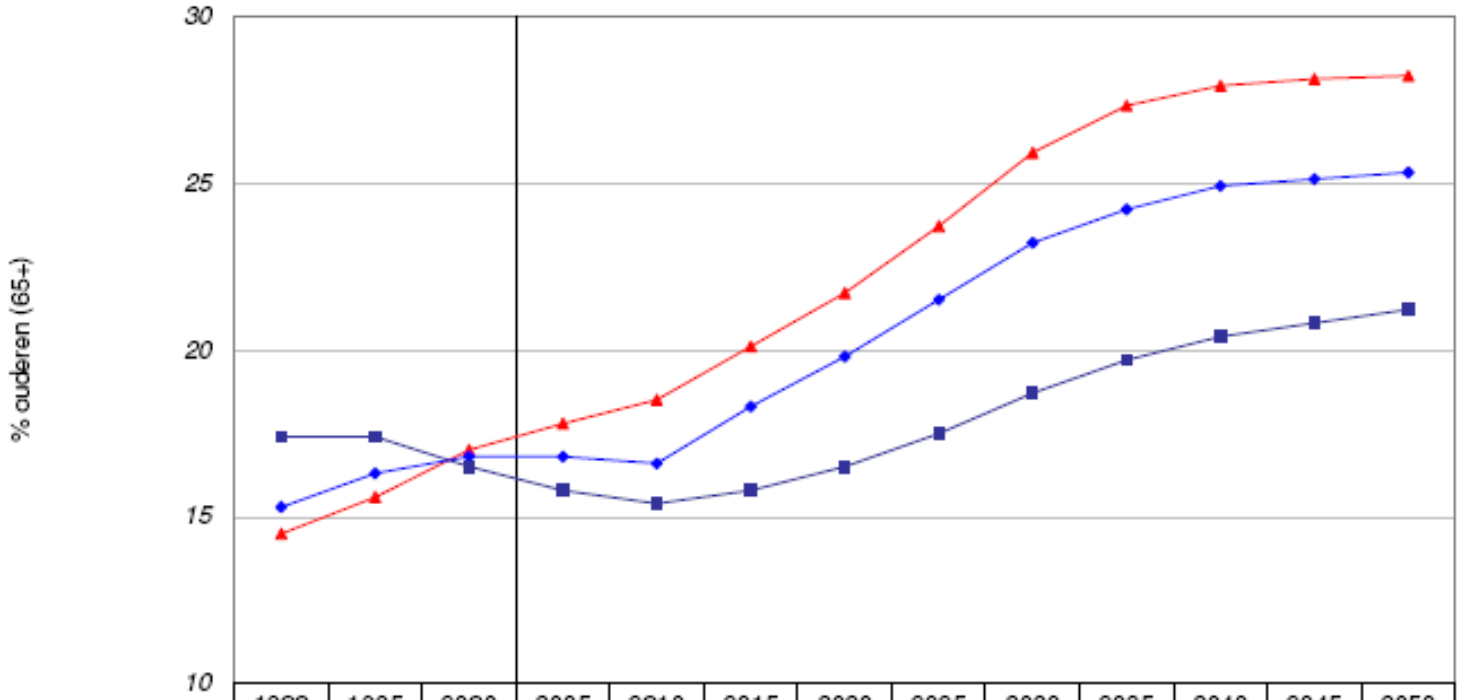
Figuur 6. Vergrijzing per gewest [% 65+ bevolking]



	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Vlaanderen	14,5	15,6	17,0	17,8	18,5	20,1	21,7	23,7	25,9	27,3	27,9	28,1	28,2
Wallonië	15,3	16,3	16,8	16,8	16,6	18,3	19,8	21,5	23,2	24,2	24,9	25,1	25,3
Brussel	17,4	17,4	16,5	15,8	15,4	15,8	16,5	17,5	18,7	19,7	20,4	20,8	21,2

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Table 1: The number of people with dementia in Belgium in 2005

	Eurodem			Ferri et al.
Age group	Men with dementia	Women with dementia	Total number of people with dementia	Total number of people with dementia
30–59	3,579	1,983	5,562	
60–64	3,814	1,188	5,002	4,447
65–69	5,055	2,872	7,926	7,410
70–74	9,709	10,080	19,789	16,983
75–79	7,945	15,239	23,184	23,166
80–84	12,276	24,406	36,682	34,413
85–89	5,497	16,100	21,597	
90–94	3,870	13,107	16,977	40,754
95–99	559	3,360	3,919	
Total	**52,304**	**88,335**	**140,639**	**127,174**

(on a total of about 11 million inhabitants)

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Table 3: The number of people with dementia in Europe

Country	Age group[5]	Number of people with dementia (EURODEM)	As % of total population	Number of people with dementia (Ferri et al.)	As % of total population
Austria	30–94	104,428	1.27	94,441	1.15
Belgium	30–99	140,639	1.35	127,174	1.22
Cyprus	30–99	6,725	0.9	6,054	0.81
Czech Republic	30–99	105,553	1.03	93,973	0.92
Denmark	30–99	68,430	1.26	62,318	1.15
Estonia (2004)	30–99	15,065	1.12	12,955	0.96
Finland	30–99	65,362	1.25	59,360	1.13
France	30–99	847,808	1.36	760,715	1.22
Germany	30–94	1,118,429	1.36	1,010,245	1.22
Greece	30–99	135,566	1.22	123,700	1.12
Hungary	30–89	100,567	1	88,070	0.87
Ireland	30–94	35,381	0.86	31,940	0.78
Italy	30–99	905,713	1.55	820,462	1.4
Latvia	30–99	25,969	1.13	22,509	0.98
Lithuania	30–99	35,298	1.03	30,169	0.88
Luxembourg	30–94	4,857	1.07	4,370	0.96
Malta	30–89	3,427	0.85	3,148	0.78
Netherlands	30–99	183,485	1.13	165,585	1.02
Poland	30–99	350,511	0.92	300,447	0.79
Portugal	30–94	129,916	1.23	119,308	1.13
Slovenia	30–99	21,788	1.09	19,302	0.97
Slovakia	30–99	44,813	0.83	38,232	0.71
Spain	30–99	583,208	1.36	533,388	1.24
Sweden	30–99	138,641	1.54	128,220	1.42
UK (2004)	30–89	660,573	1.11	621,717	1.04
EU25 TOTAL		**5,832,152**	**1.27**	**5,277,802**	**1.14**

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- target group
  - dementedelderly with severe dementia
    - GDS level 7 (highest level on the Global Deterioration Scale)
  - staying in living and care centres or nursing homes
  - life expectation of < 30 months
  - bedridden
  - unable to communicate verbally

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- problem
  - discomfort (pain) is an **important** and **underestimated** aspect
  - discomfort is observed by a nurse during daily treatments
    - subjective
    - not continuously

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- solution
  - compact video system which observes the patient's facial expression
    - facial expressions are more correlated with discomfort than other physiological parameters (hart rate, blood pressure, ...)
    - 24h/24h
    - objective
    - automatic alarm system
- first step
  - build a high quality image acquisition system to record a labelled dataset of facial expressions with respect to pain
  - labelled dataset is used as input to develop a discomfort recognition algorithm

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Recorder01:
- RAID-0
- Buffer voor ongeveer 5 opname sessies
- Automatisch overzetten van opgenomen sessies via WLAN

Tablet PC
- On-line label tool

Label PC:
- Extra opslag capaciteit
- Ontvangen van opgenomen sessies
- Off-line labelen
  - 1 standaard beeldscherm om de opgenomen beelden af te spelen
  - 1 touch screen voor het invullen van de off-line labels

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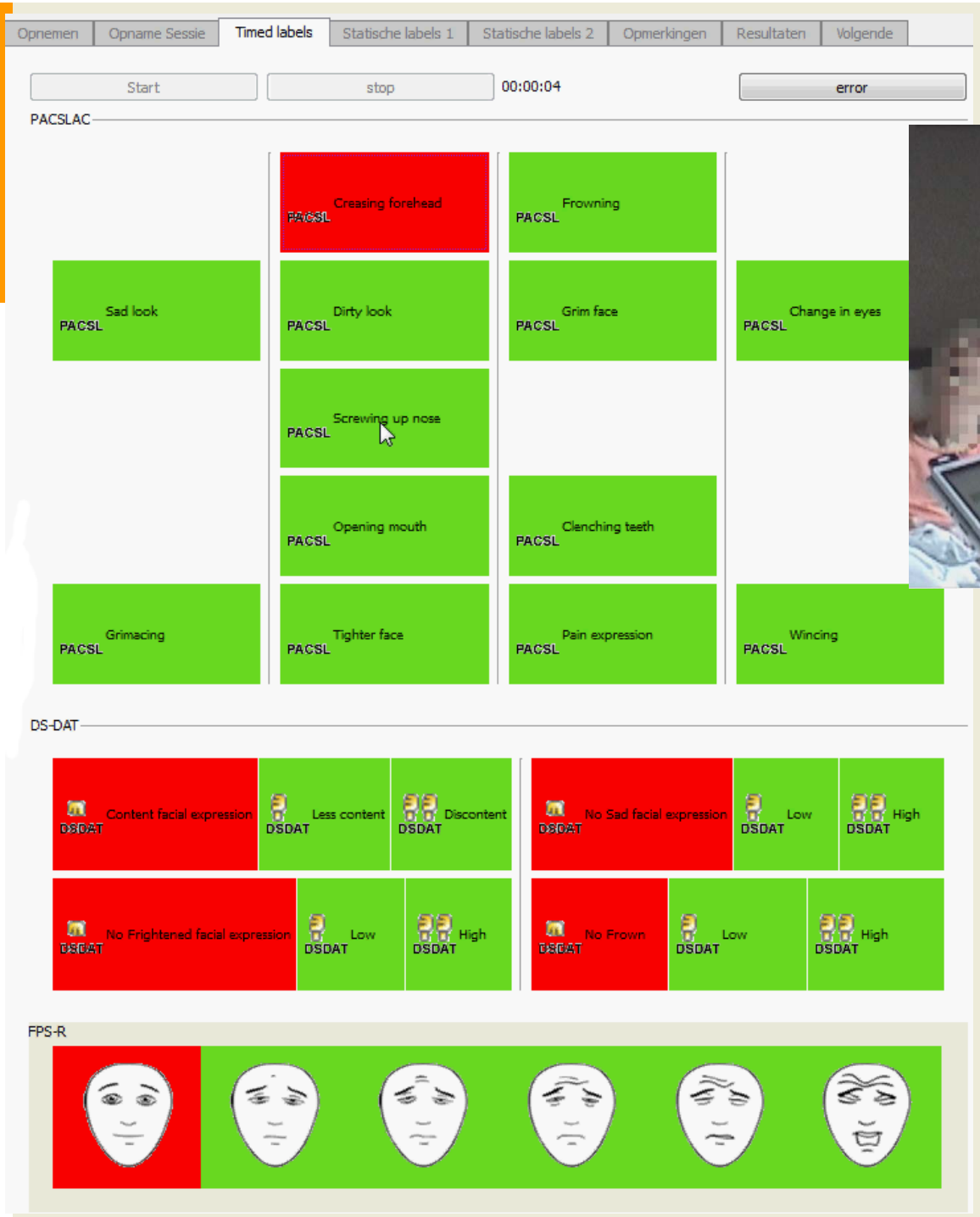

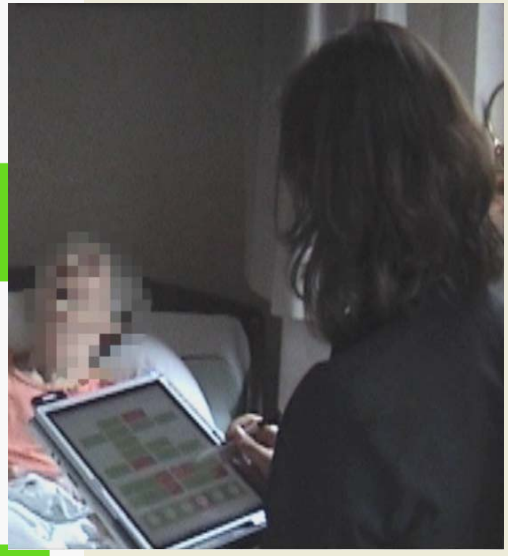

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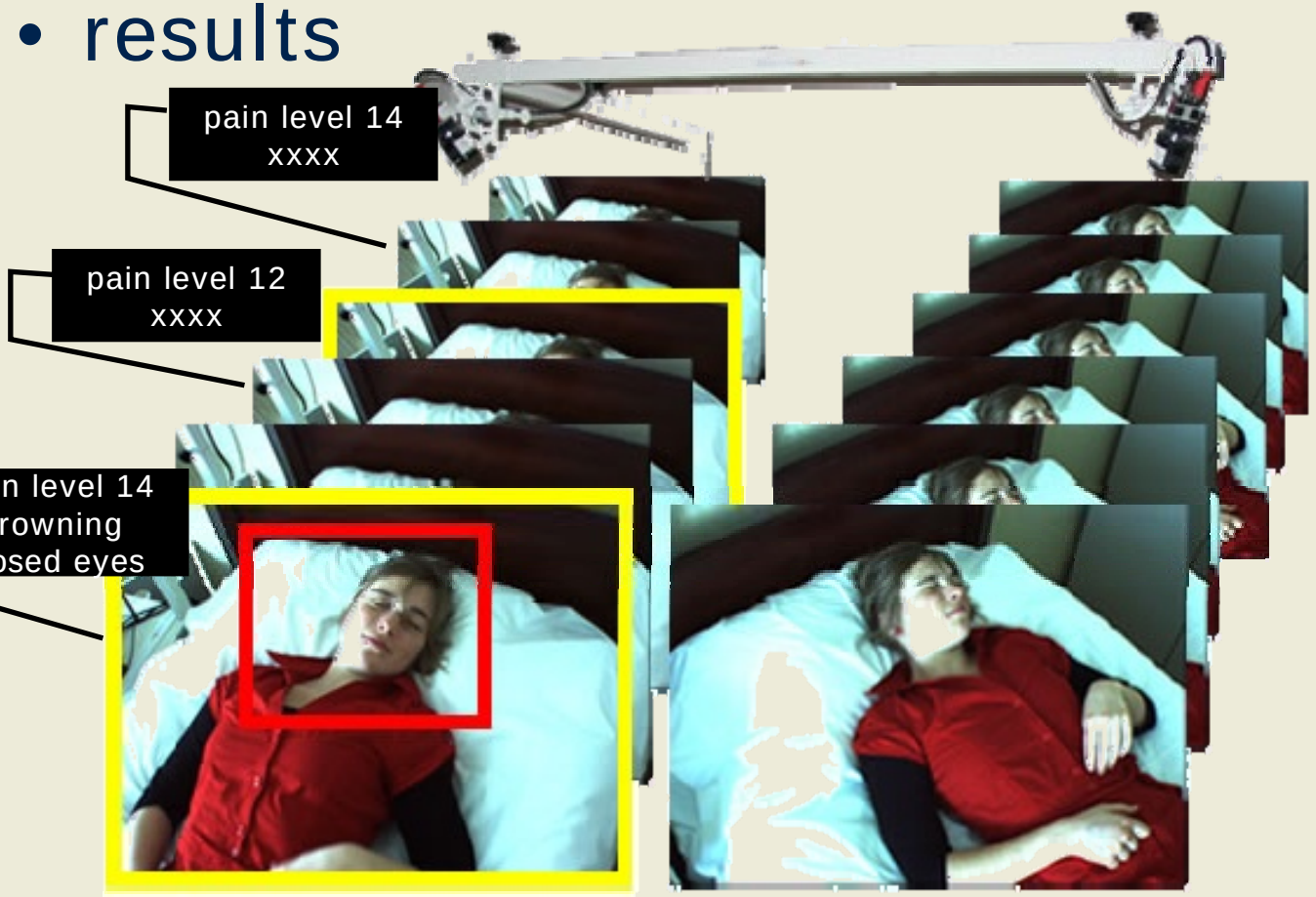
- results



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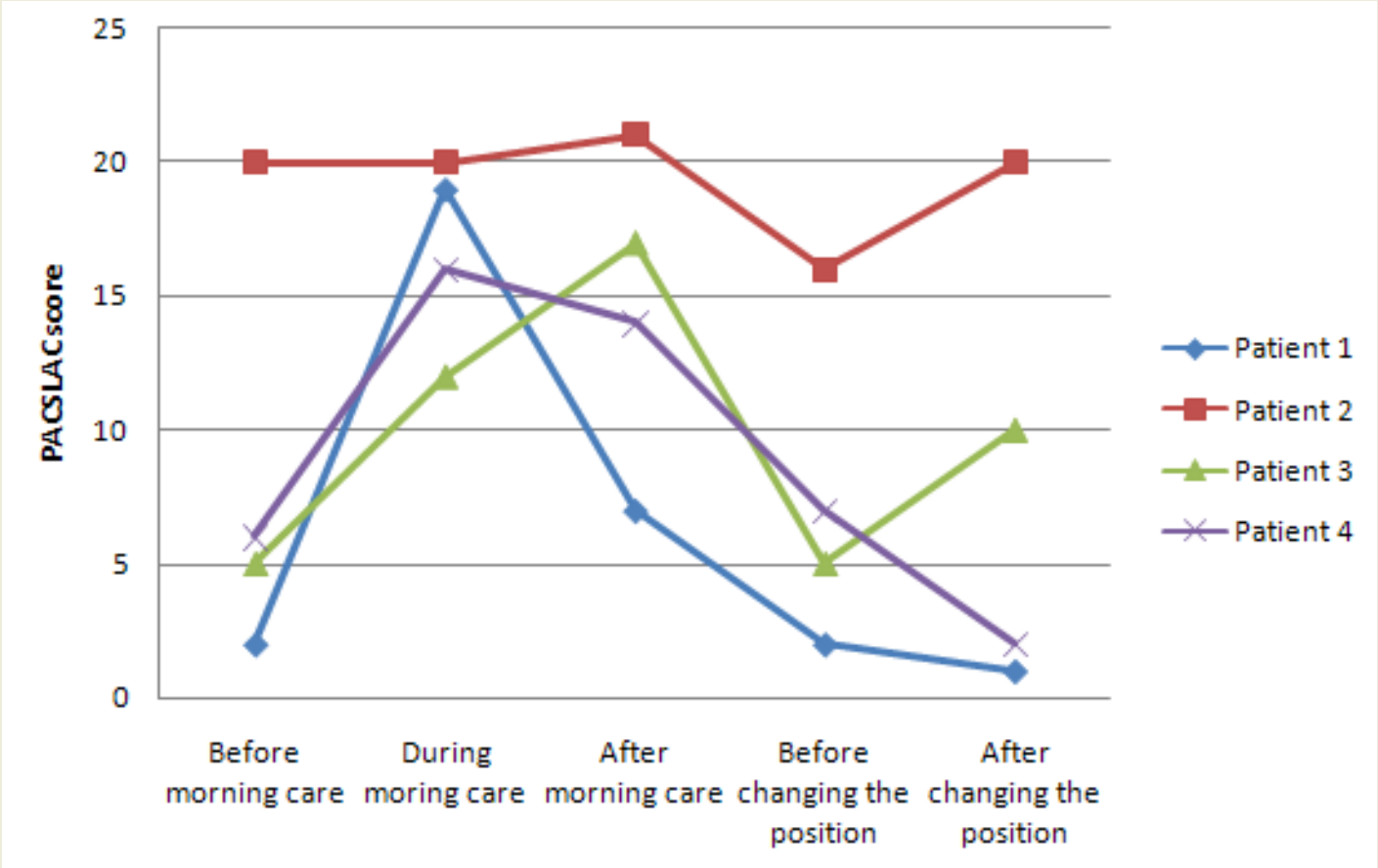

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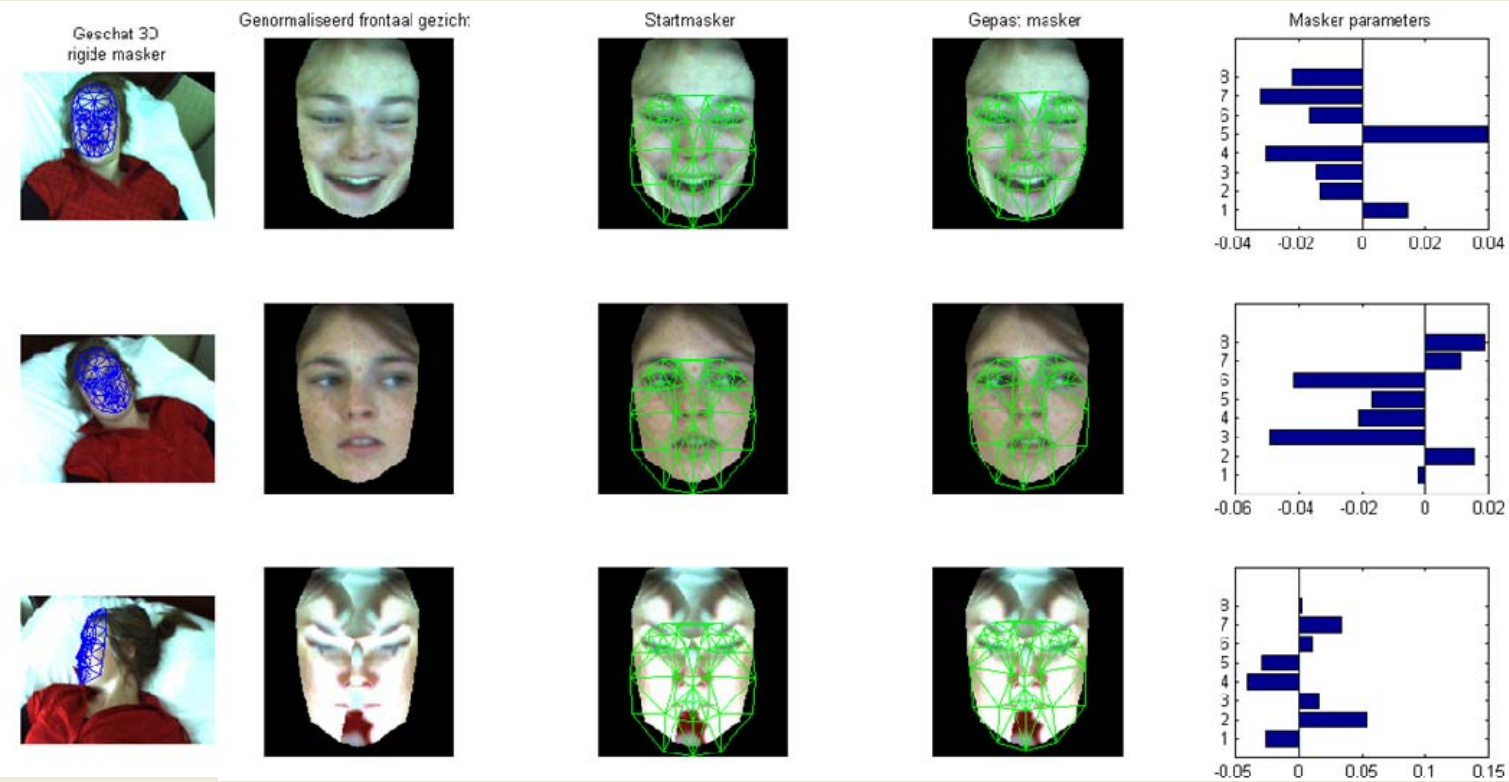

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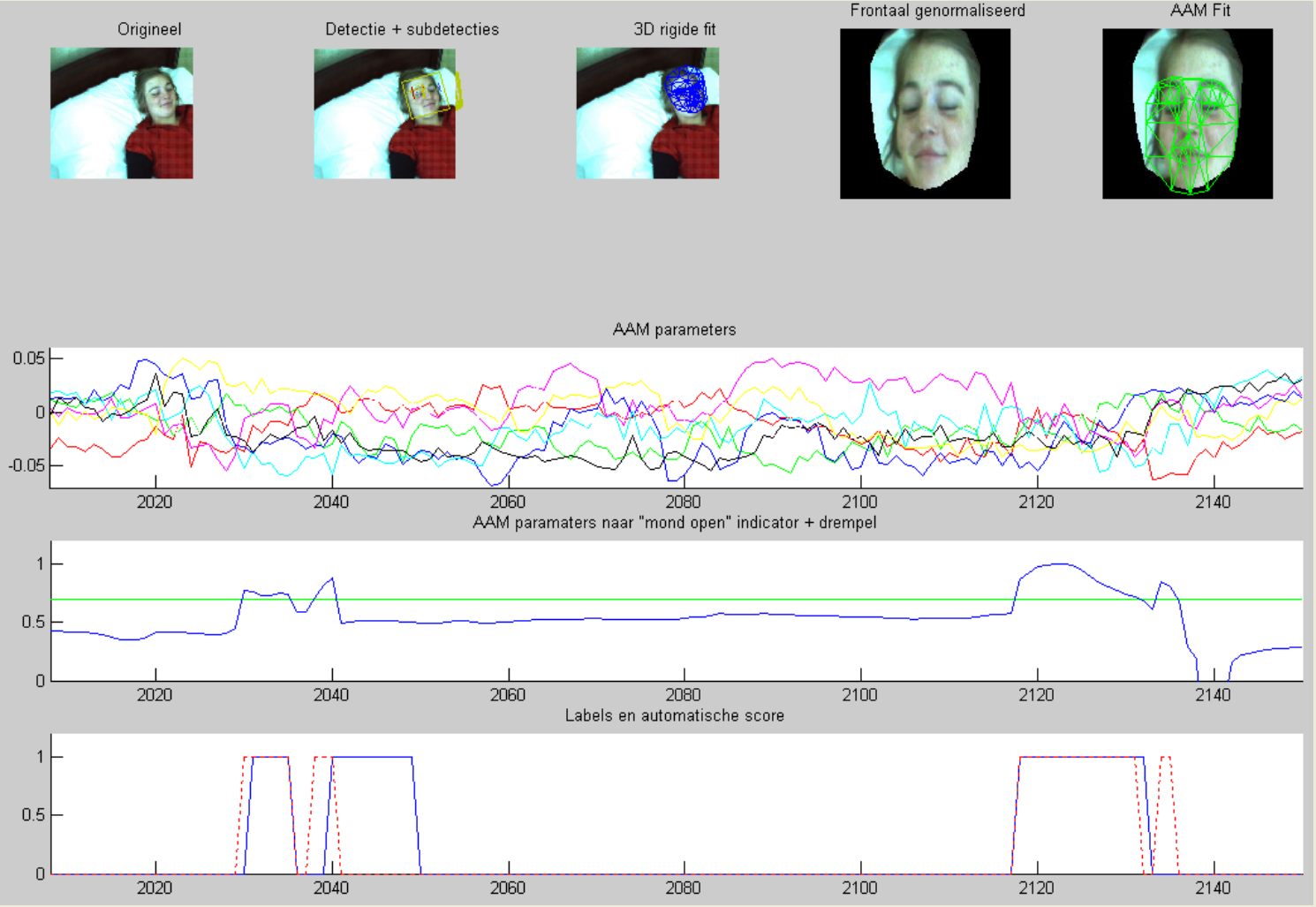

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- current issues
  - real-time
    - 3 seconds video takes 3 hours to process
      - MATLAB ➔ C ++ (OpenCV libs)
    - define bottlenecks
      - implementation on hardware (FPGA)
    - SW/HW co-design
      - PowerPC and FPGA

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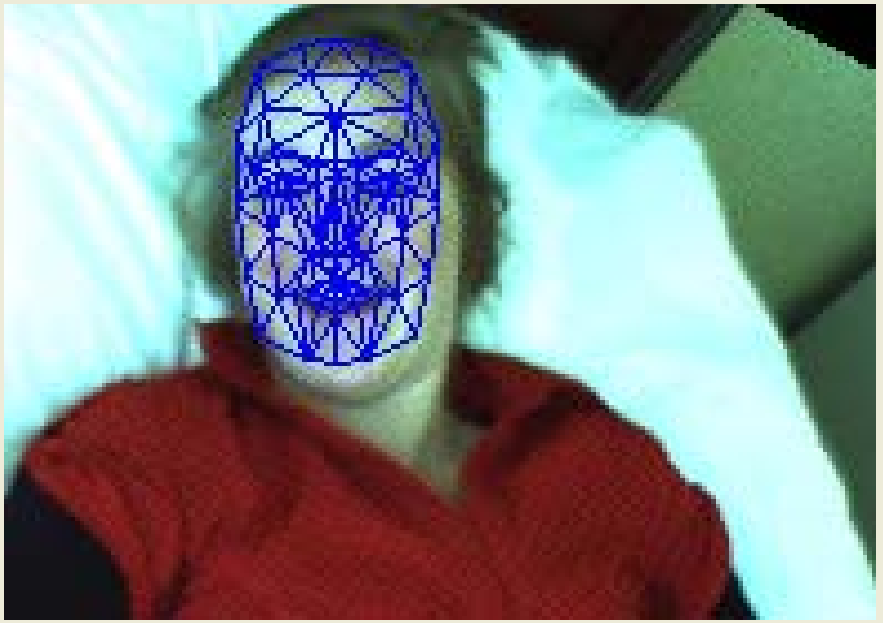
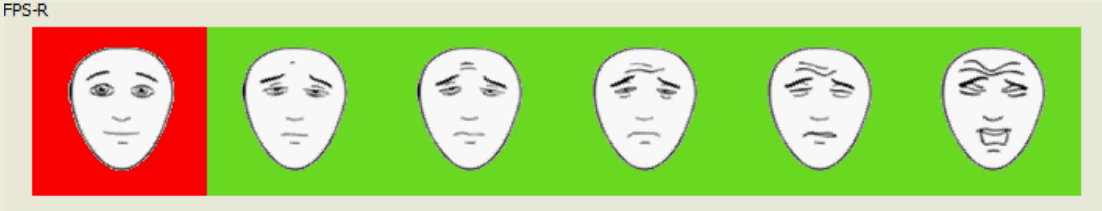
- future





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