

# Toward IntelliGlass

Glass that  
perceives  
and reacts



# AI on Glass

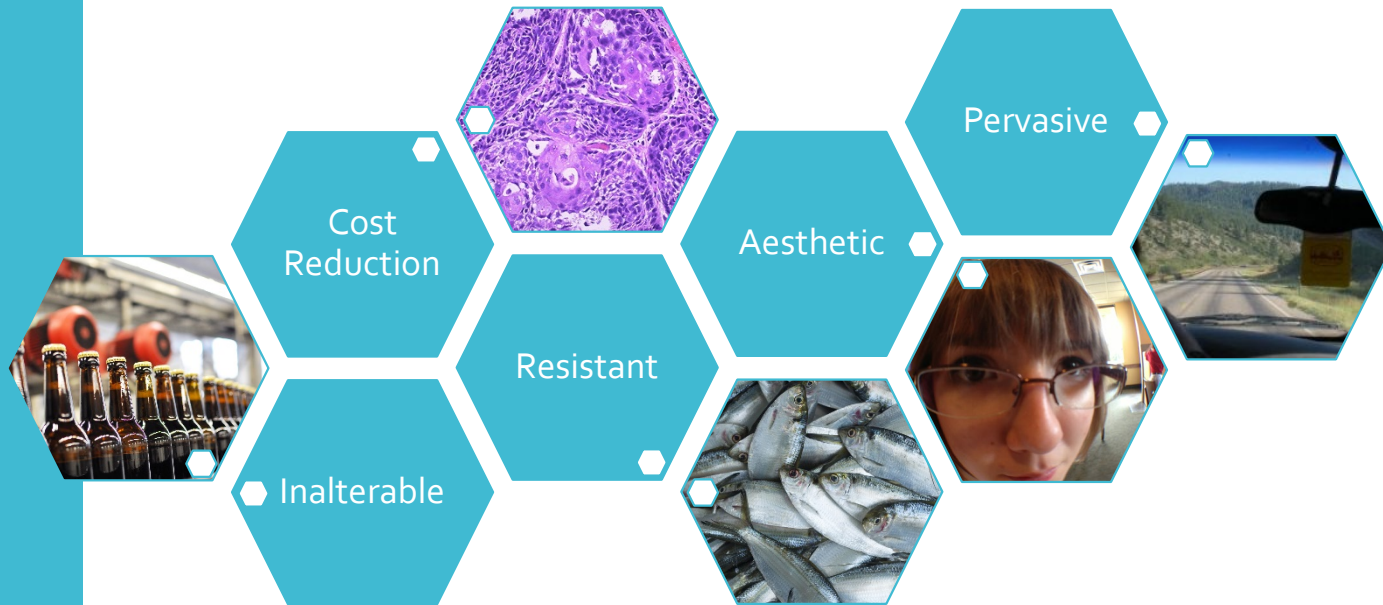
The concept



# The Applications



# The Benefits



# Patented worldwide

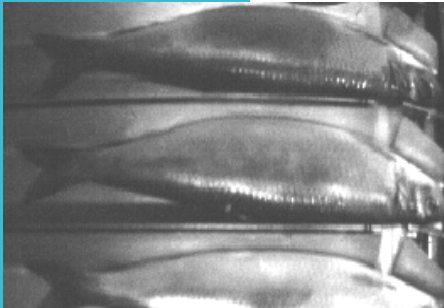
Monolithic Image Perception Device (MIPD)

(United States, Mexico, Japan, Korea, China, Europe, Russia, Canada, Brazil, and more)

(12) <b>United States Patent</b> Paillet et al.	(10) <b>Patent No.:</b> <b>US 7,796,841 B2</b> (45) <b>Date of Patent:</b> <b>Sep. 14, 2010</b>
(54) <b>MONOLITHIC IMAGE PERCEPTION DEVICE AND METHOD</b>	FOREIGN PATENT DOCUMENTS
(75) Inventors: <b>Guy Paillet</b> , Corte Madera, CA (US); <b>Anne Menendez</b> , Penngrove, CA (US)	CA 2 149 478 A1 1/1996
(73) Assignees: <b>AGC Flat Glass North America, Inc.</b> , Alpharetta, GA (US); <b>Norlitech, LLC</b> , Petaluma, CA (US)	(Continued) OTHER PUBLICATIONS
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1111 days.	Cat et al., "SIMPI: An OE Integrated SIMD Architecture For Focal Plane Processing Applications", 1996, Proceedings of MPPPOF '96, pp. 44-52.*
(21) Appl. No.: <b>11/477,571</b>	(Continued)
(22) Filed: <b>Jun. 30, 2006</b>	<i>Primary Examiner</i> —Jose L Couso
(65) <b>Prior Publication Data</b> US 2007/0014469 A1 Jan. 18, 2007	(74) <i>Attorney, Agent, or Firm</i> —Rothwell, Figg, Ernst & Manbeck, P.C.
<b>Related U.S. Application Data</b>	(57) <b>ABSTRACT</b>
(60) Provisional application No. 60/694,988, filed on Jun. 30, 2005.	An apparatus which can acquire, readout and perceive a scene based on the insertion, or etching of photosensitive elements into or on a transparent or semi-transparent substrate such as glass. The substrate itself acts as the optical device which deflects the photons incident to the reflected image into the photosensitive elements. Photosensitive elements are interconnected together by a transparent or opaque wiring. A digital neural memory can be trained to recognize specific scenery such as a human face, an incoming object, a surface defect, rain drops on a windshield and more. Other applica-
(51) <b>Int. Cl.</b> <i>G06K 9/20</i> (2006.01)	
(52) <b>U.S. Cl.</b> ..... <b>382/312</b>	
(58) <b>Field of Classification Search</b> ..... 382/312, 382/321; 348/207.99, 207.1, 207.2; 359/362; 398/164	
See application file for complete search history.	

- [Patent #1](#) (US7796841B2, Granted Sep 2010)
  - Photosensitive elements and neurons in glass
- [Patent #2](#) (US8478081B2, Granted Jul 2013)
  - Adding photo emission elements
- [Patent #3](#) (US9092689B2, Granted July 2015)
  - Multiplicity of primitive devices in a glass

Already  
deployed



- ZICAM camera with 312 neurons inspecting fishes
- Behind a glass to protect from water and scales
- Trained on the boat by the fishermen
- Works 24/7 faster than human operator
- Helped save \$6M/year per boat

# The Enabler: NeuroMem AI chip



## NeuroMem IP

- Neural Network
- Pattern learning and recognition
- High speed
- Low pin count
- Easy to deploy
- Fielded

## NM500 chip

- Current chip
- $4 \times 4 \times 0.32$  mm<sup>3</sup>
- WSP designed to laminate into glass
- 3.3 milliwatts
- Manufactured by Nepes (South Korea)
- Under license from General Vision

# Perception beyond touch

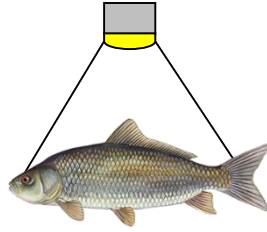
- Predicted by Corning...  
in a day made of glass



- Made possible by General Vision and Asahi Glass

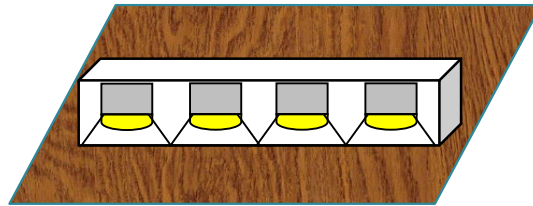


# Industrial Automation



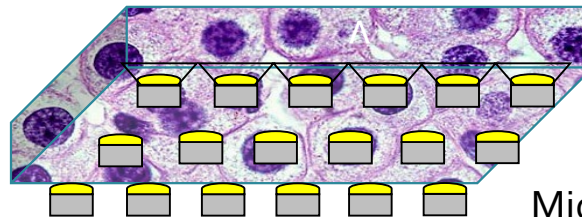
## Single photocell

Food, packaging, electronics, surveillance, etc.



## Inline assembly

Food, textile, glass float, etc.



## Grid assembly

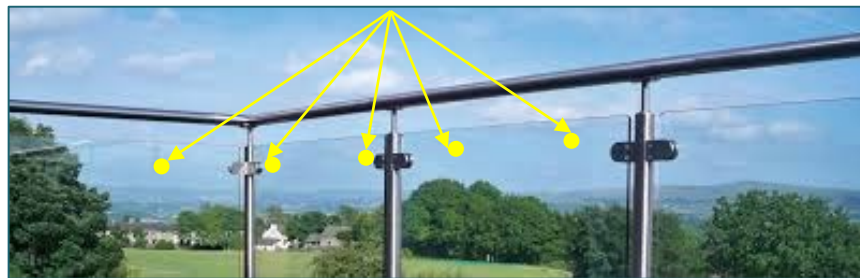
Microscopic slides, wafer inspection, etc.

# Smart homes, building and Cities



Incoming person or object, Gesture recognition  
Floor occupancy, People counting, Person tracking

## Plurality of Sensors



# Automotive

Obstacle detection and distance evaluation,  
traffic sign reading, etc.

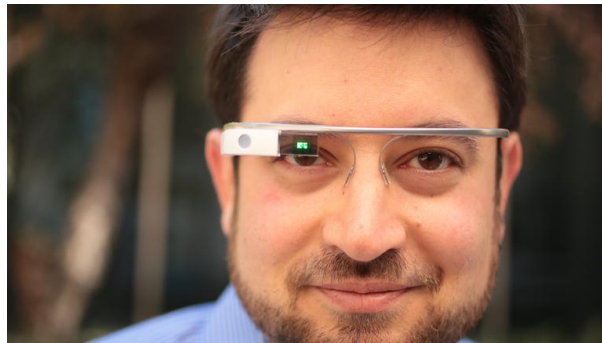


Driver vigilance  
monitoring,  
Gesture  
recognition, etc.

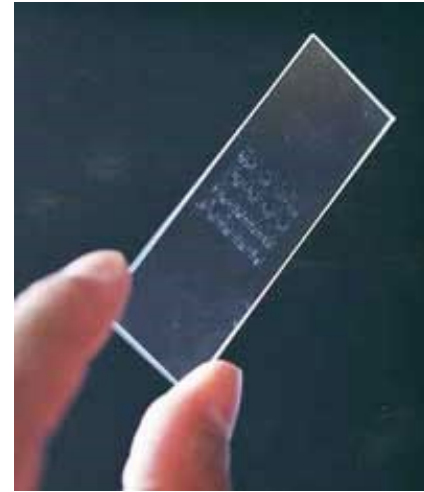
# Consumer and mobile devices

## CogniPad

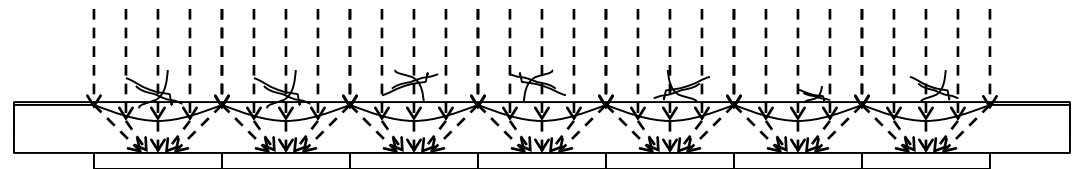
Person identification, gaze tracking, facial expression recognition



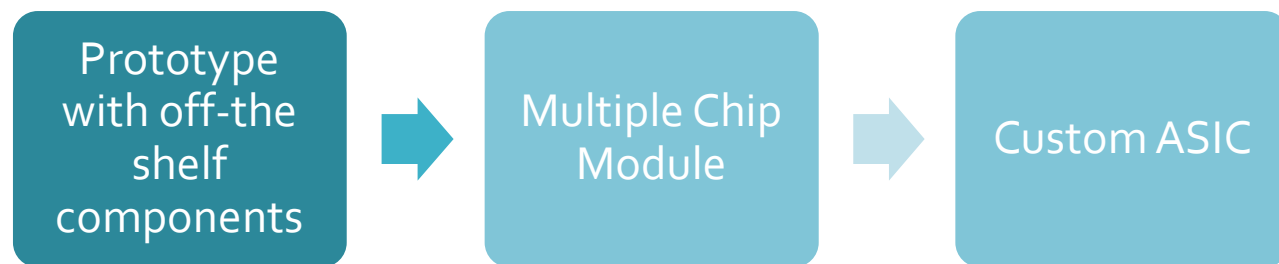
# Lab-On-Glass



Substance deposited directly on an IntelliGlass plate

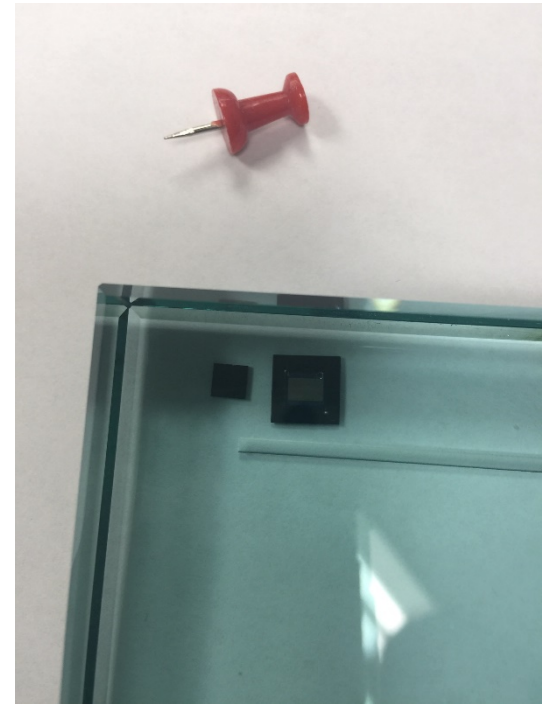
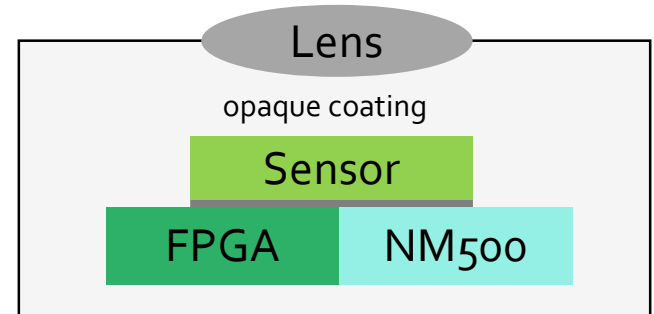


# Roadmap

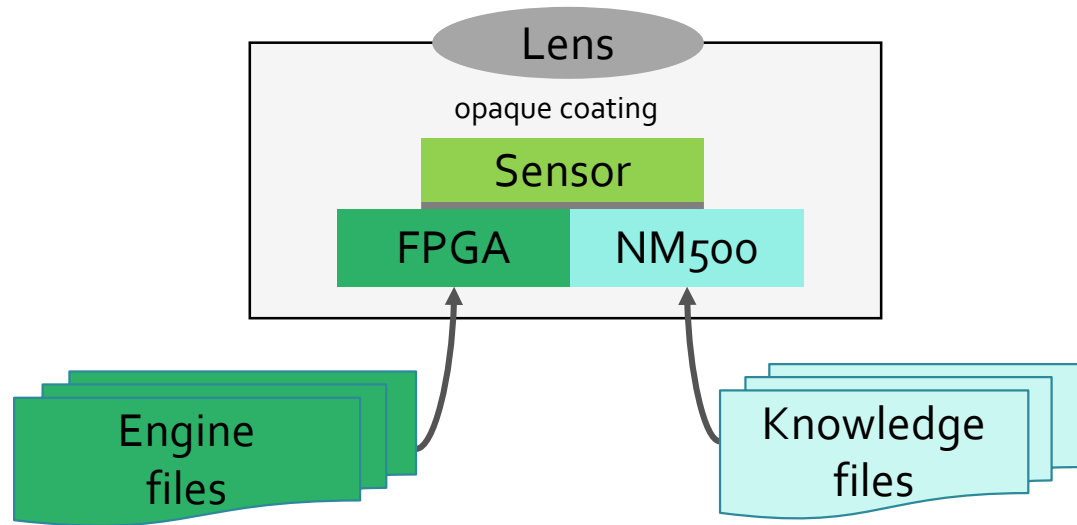


# Stage 1 Multi-chip module

- CMOS sensor
- NeuroMem NM500 chip
- Low power FPGA
- I2C/SPI
- Battery operated
- Glass substrate



# Stage 1 continued



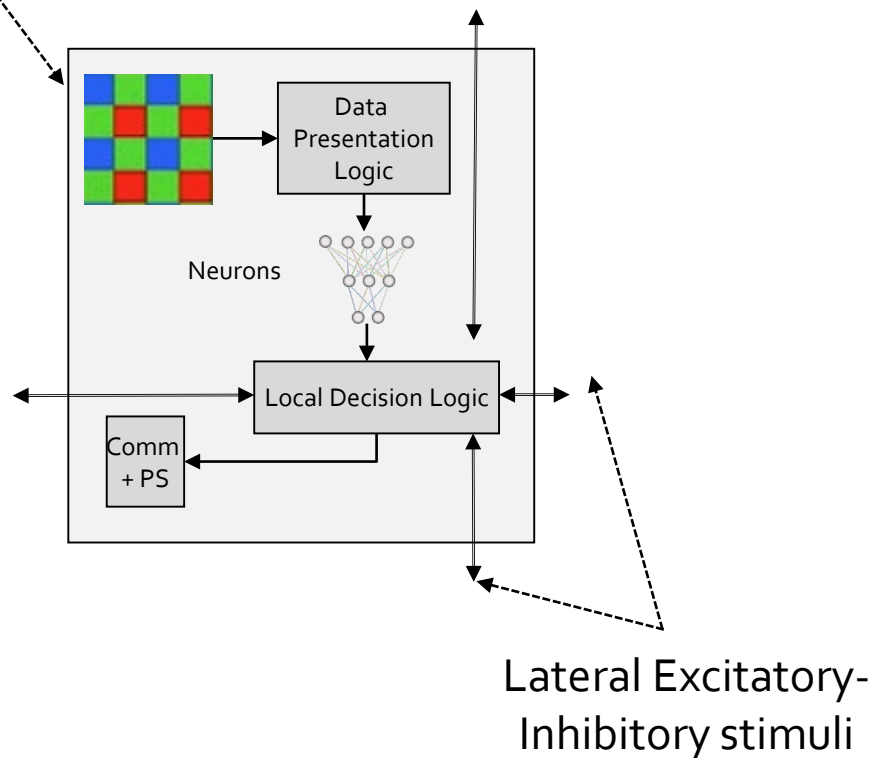
- Pass/Fail
- Classify
- Count, Locate
- Track
- Search
- Detect novelty
- Etc.

- Acceptable cookies
- OCR
- Generic faces
- Specific persons
- Cars and trucks
- Benign/Malign cells
- Etc.



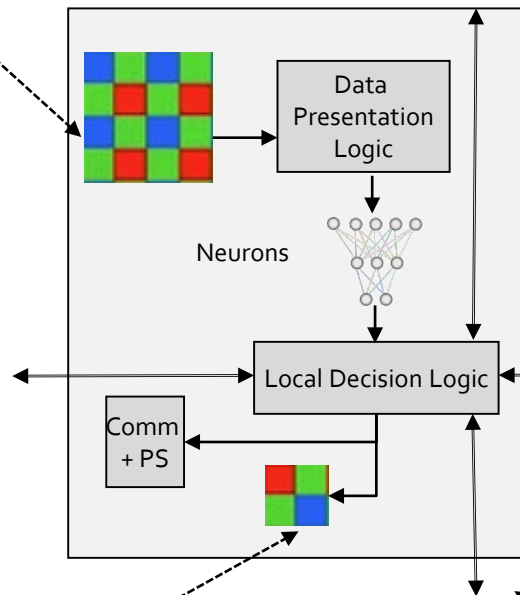
# Stage 2 Single chip, Receptive only

Sensor area  
(can be monochrome,  
color Bayer, color RGB)



# Stage 3 Single chip, Receptive and Emissive

Sensor area



Display area

Lateral Excitatory-  
Inhibitory stimuli

# Expertise to unite, Technologies to develop

## Next Step

\* Gradient index optics

