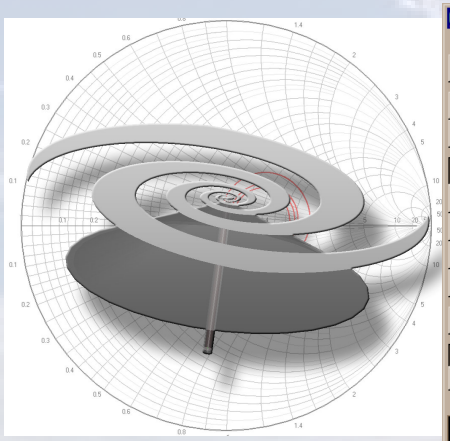
Politechnika Łódzka
Instytut Elektroniki

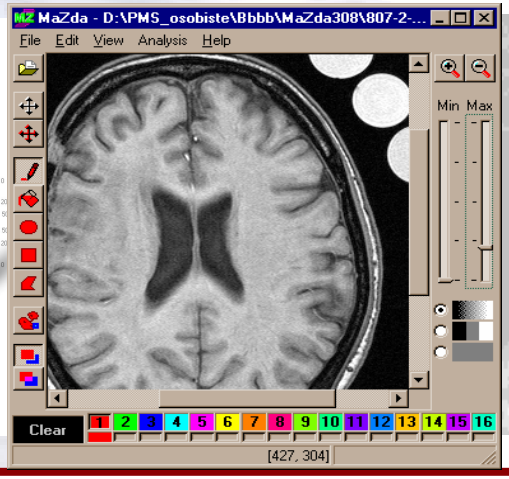
How to show the world to the blind?

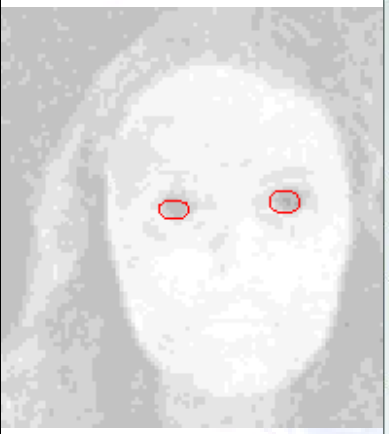
Paweł Strumiłło
Zakład Elektroniki Medycznej

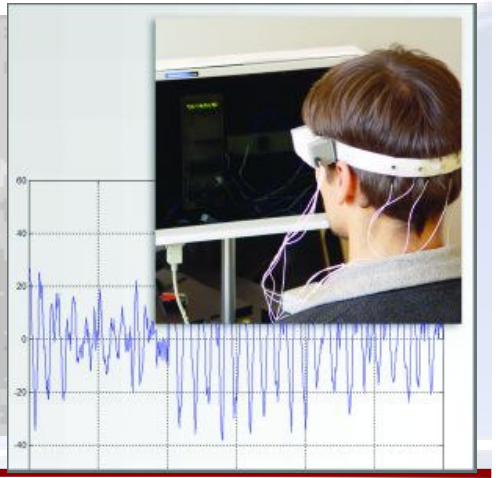
Instiute of Electronics

- ***medical electronics*** (*image and signal analysis*), ***human computer interfaces, assistive technologies for the disabled***
- ***electronic circuits and computed termography***
- ***telecommunication systems***







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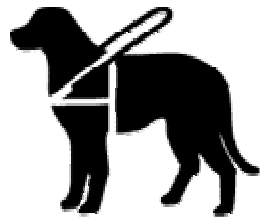
Blindness

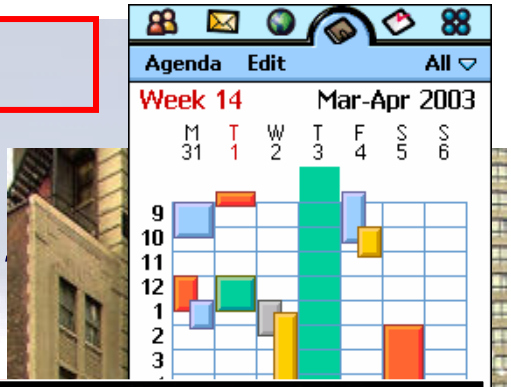
- ***Lack of sight is a loss of 80-90% perceptual abilities,*** *it affects other psychological functions*
- ***Exclusion from social and professional life;*** *poor education, low employment rate*
- ***Dependence on others*** *family, caregivers, guide dogs*
- ***1 mln visually impaired in Europe (approx. 80 000 in Poland),*** *ageing demographics*
- *Annual cost in the USA:* ***68 bln $***



Day-to-day problems of the blind

I. Safety and independent travel

- *avoiding obstacles and pedestrians*
- *detection of surface discontinuities (stairs, curbs...*
- *avoiding collisions with vehicles*
- *avoiding robbery and thefts, ...*



II. Navigation

- *identification of geographical location*
- *orientation and spatial awareness*

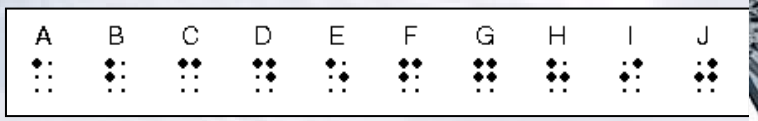
III. Access to information

- *text, graphics, GUI's (information society)*

Sensory substitution

- ~~*sight (80-90% informaytion about environment)*~~
- *hearing*
- *touch*
- *smell*
- *taste*

Braille Code



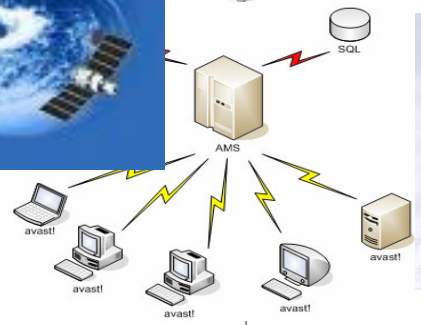
Kazimierz Noiszewski (1859–1930)

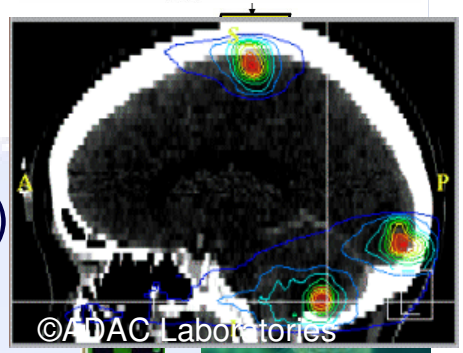
- *professor of ophthalmology USB (1919-21) i UW (1921-29); deviced an original method for cornea transplantation (1921)*
- *constructed **electroftalm** (an artificial eye), a device converting light energy into auditory or tactile stimuli (**1889**)*

Ophthalmology Clinic
Warsaw Medical Academy

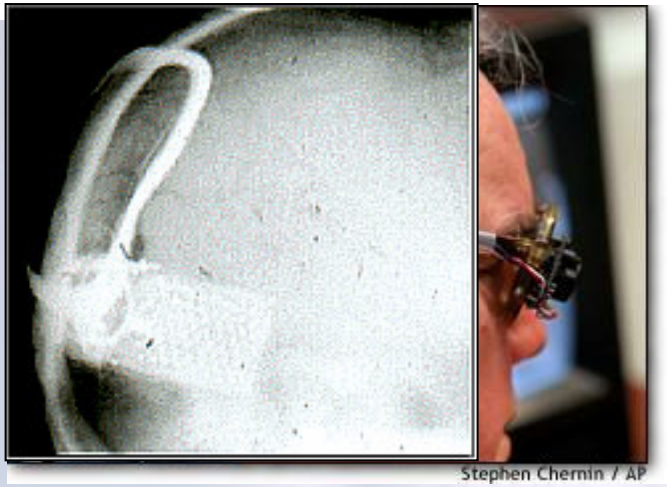
Technology of the XXI century

- *small and fast computing devices (minicomputers, notebooks, PDAs,…)*
- *telecommunication networks PAN, LAN, WAN (WiFi, internet, cellular networks 3G,…)*
- *satellite navigation systems (GPS, Galileo, Glonass, portable receivers)*
- *advanced computing algorithms and programming tools,*
- *miniaturization of electronic devices (sensors, implants, micromachines, nanotechnology)*
- *medical technologies (diagnostics, transplantology,…*





Visual prothesis



Stephen Chernin / AP

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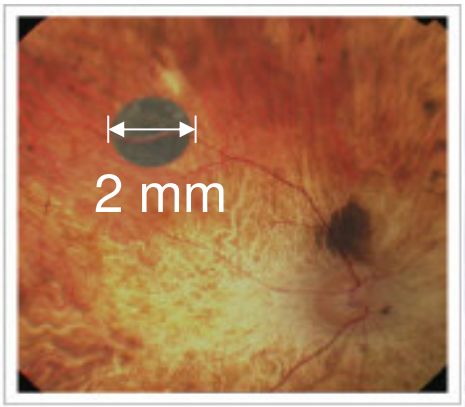
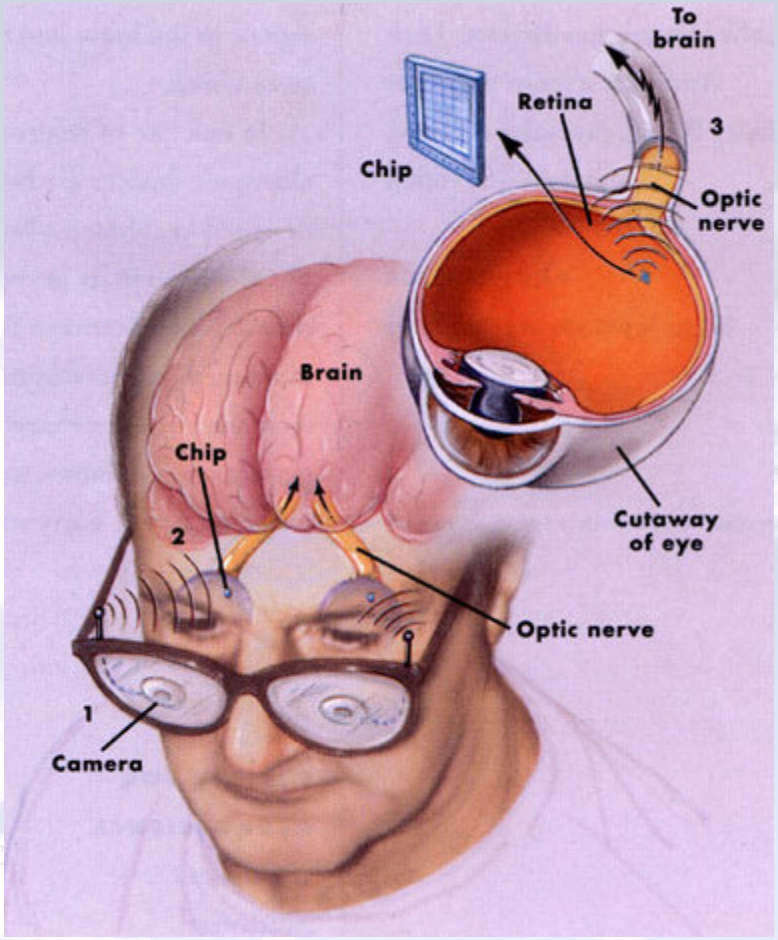
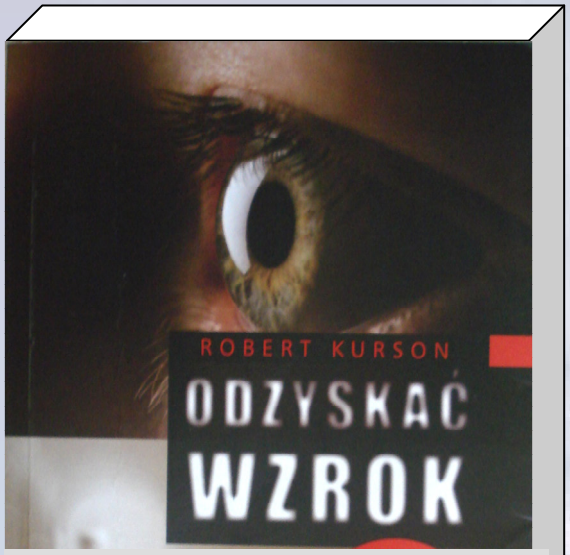


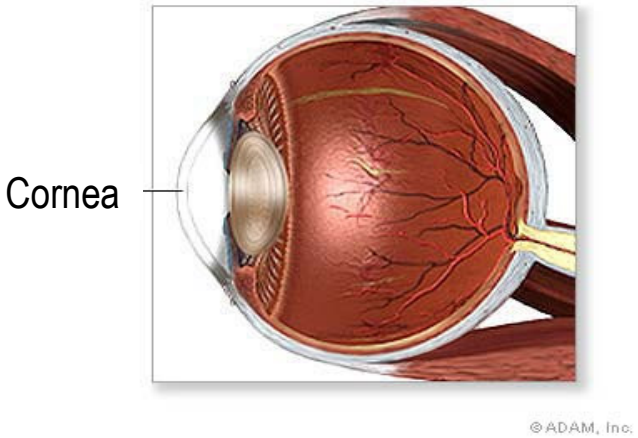
ASR® device implanted in the human eye



Consequences of long-term vision loss



R. Kurson, „*Crashing through: a true story of risk, adventure and the man who dared to see*”, Random House Inc., 2007



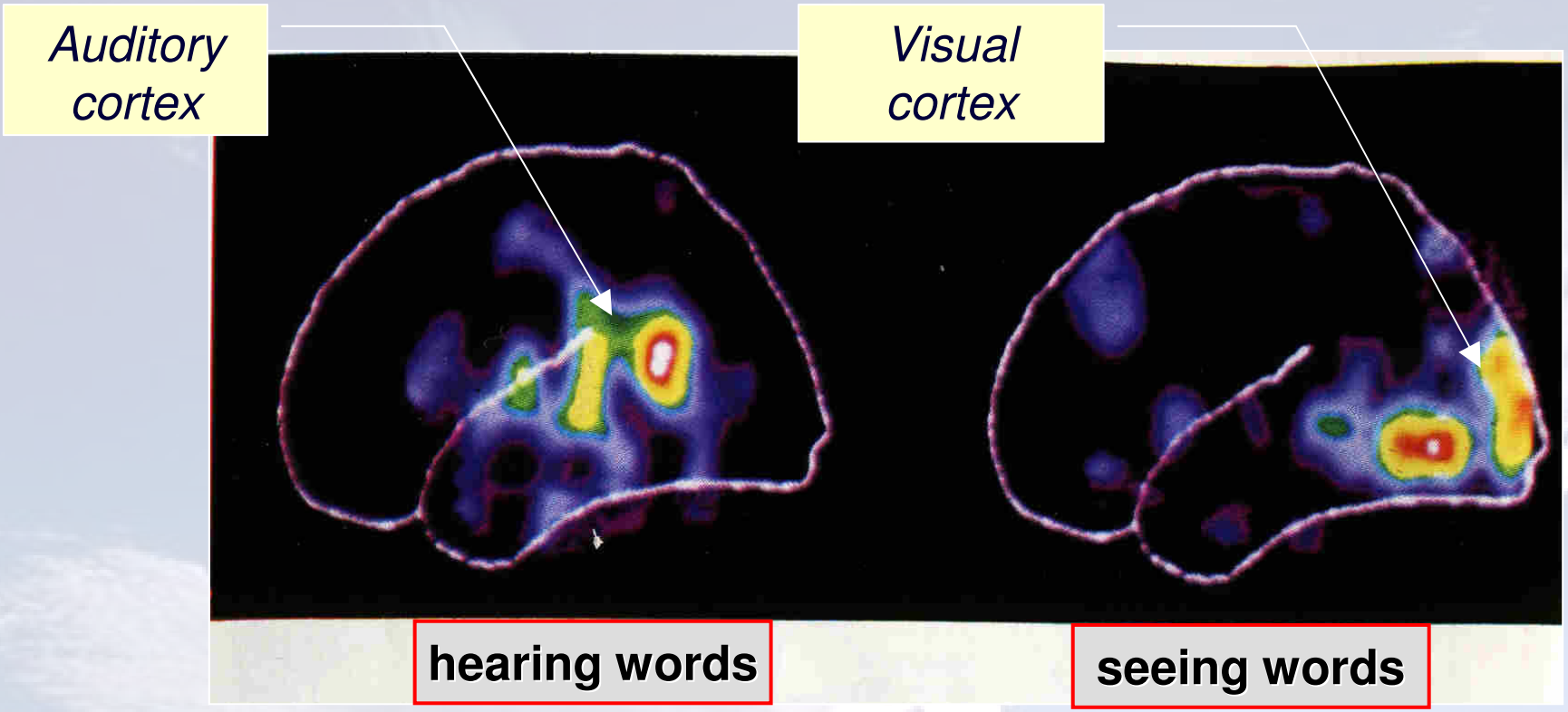
The blind who recovered sight:

- *recognise: motion and colours*
- *do not recognise: shapes, faces, objects*
- *false depth perception*

Cause:

plasticity of nerve cells

Computed fMRI



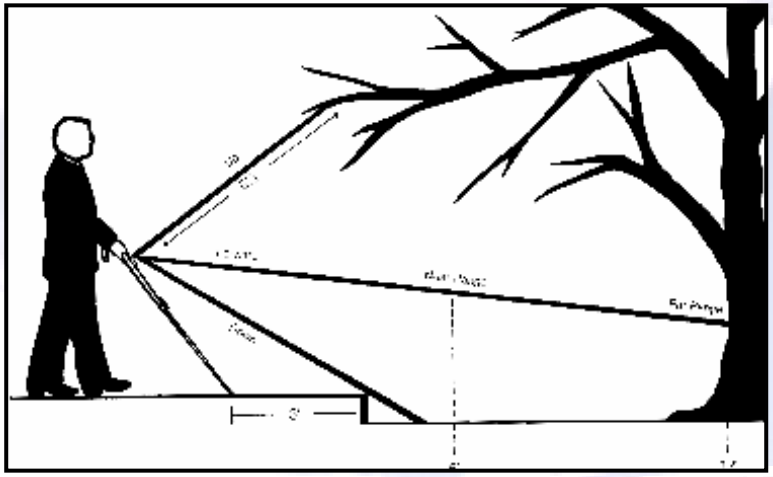
The sight activates approx. 70% of brain regions

Electronic travel aids

„Extension of cane functions”:

- *simple construction,*
- *limited (point like) field of detectiong obstacles*

LaserCane, UltraCane SonarCane



Electronic travel aids

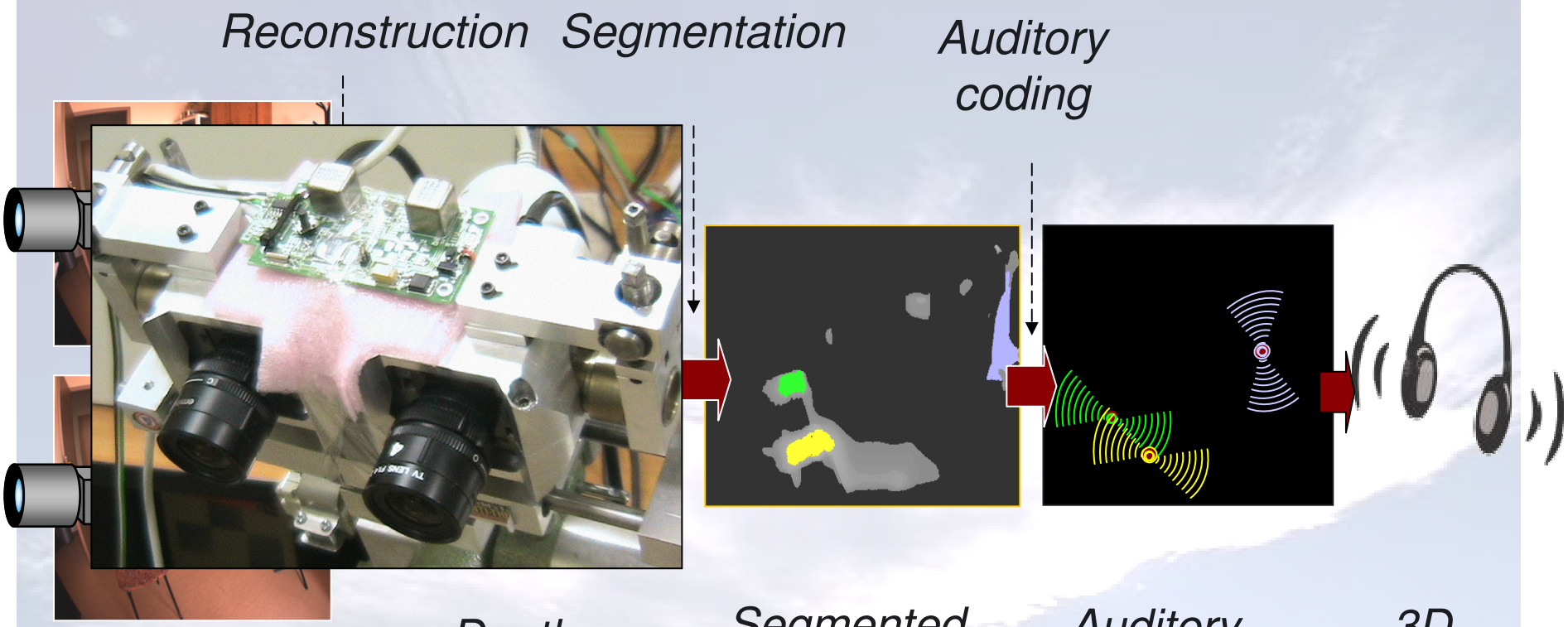
Environmental imagers:

- *complex*
- *expensi*
- *informat*

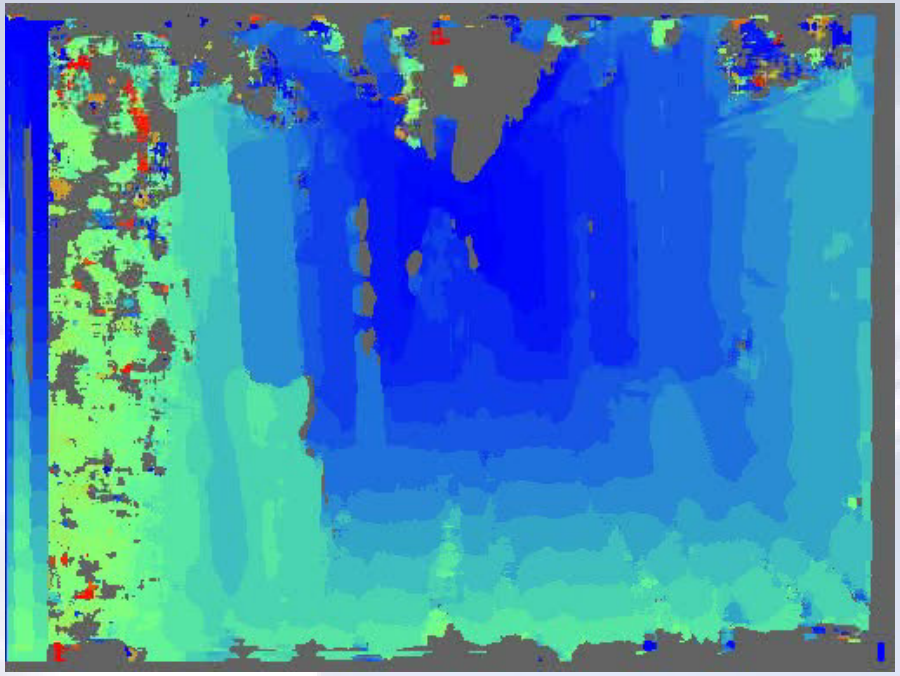
100 years after the first steps taken by Noiszewski, still no electronic travel aid has found ubiquitous acceptance by the blind!

SonicGuide, vOICe, Navbelt, Virtual Acoustic Environment

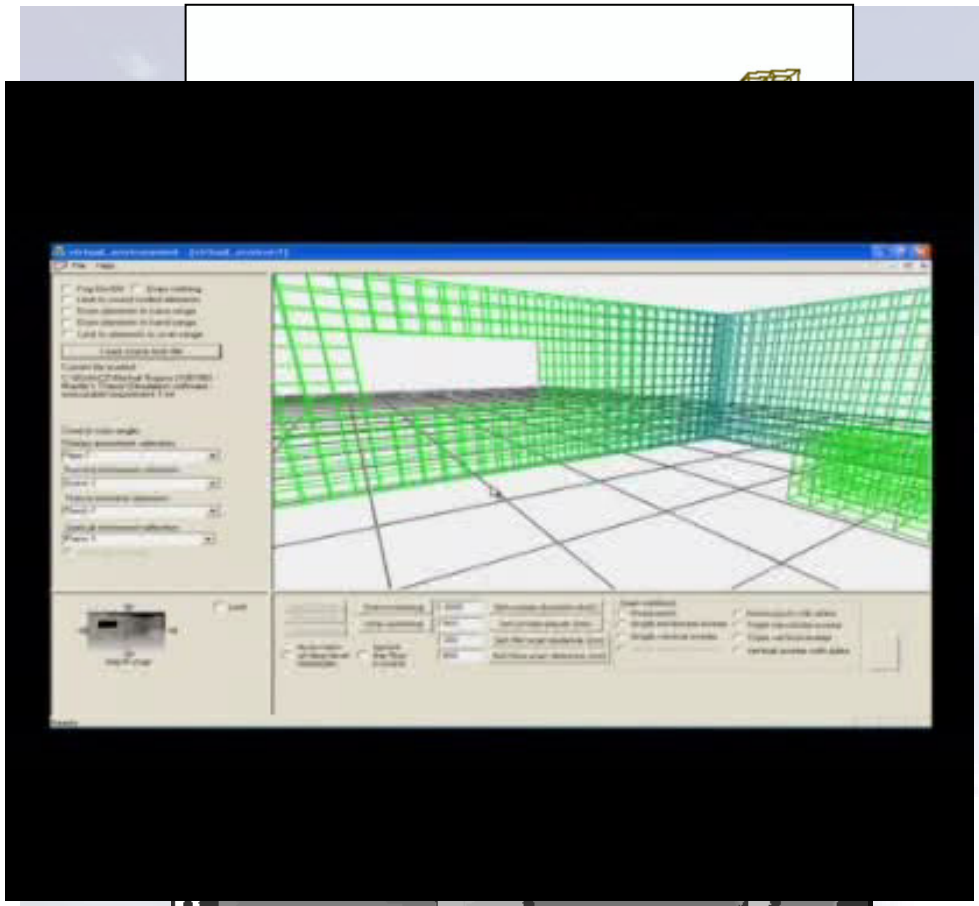
Dźwiękowe obrazowanie otoczenia



Imaging of depth



Auditory display concepts

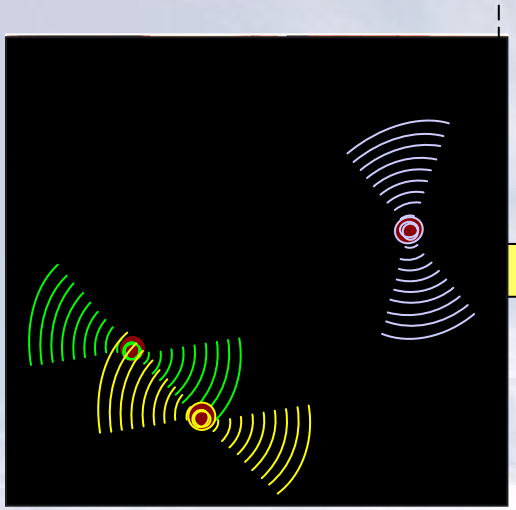


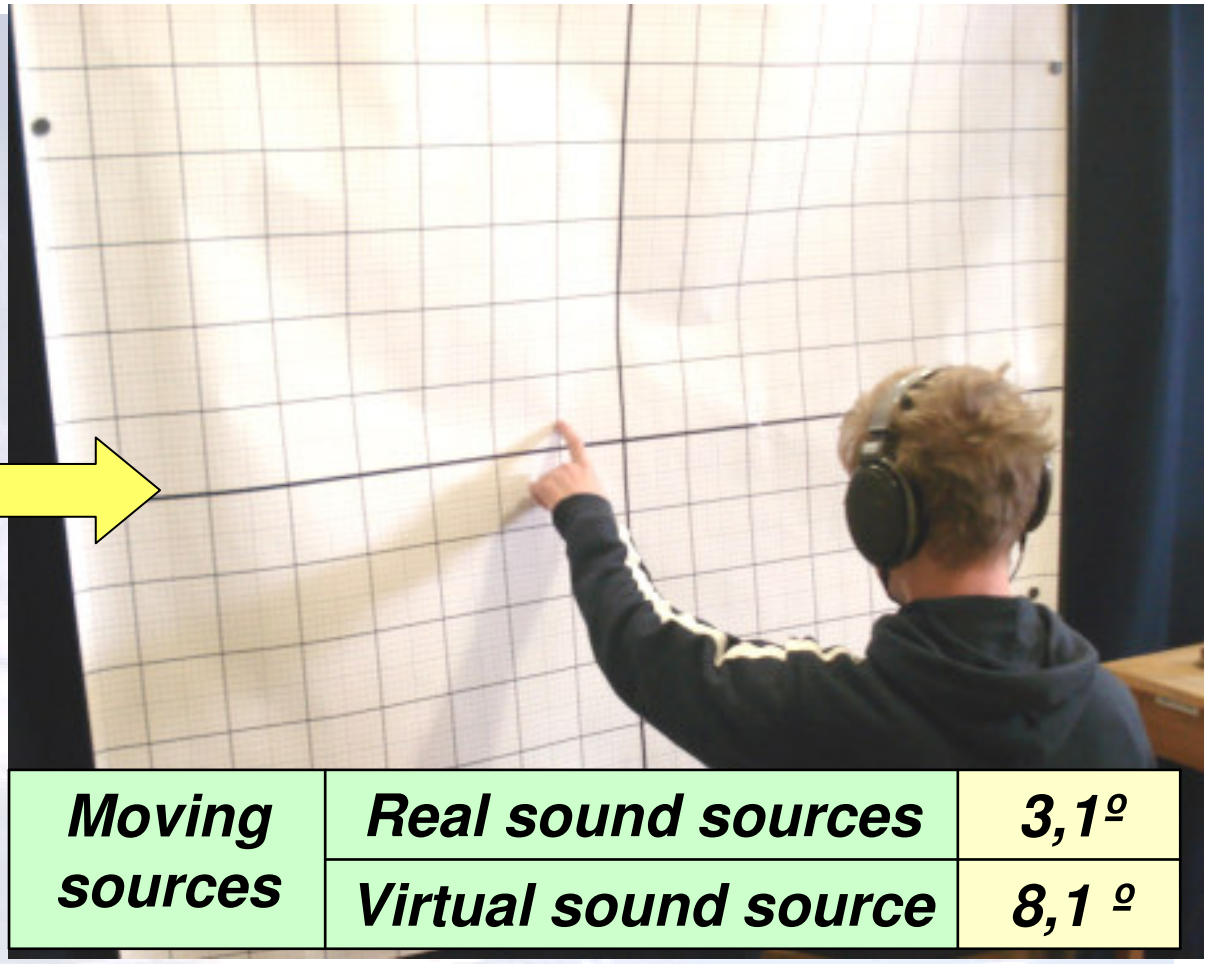
Acoustic model of the human head

Measurement of Head Related Transfer Functions

(HRTF)

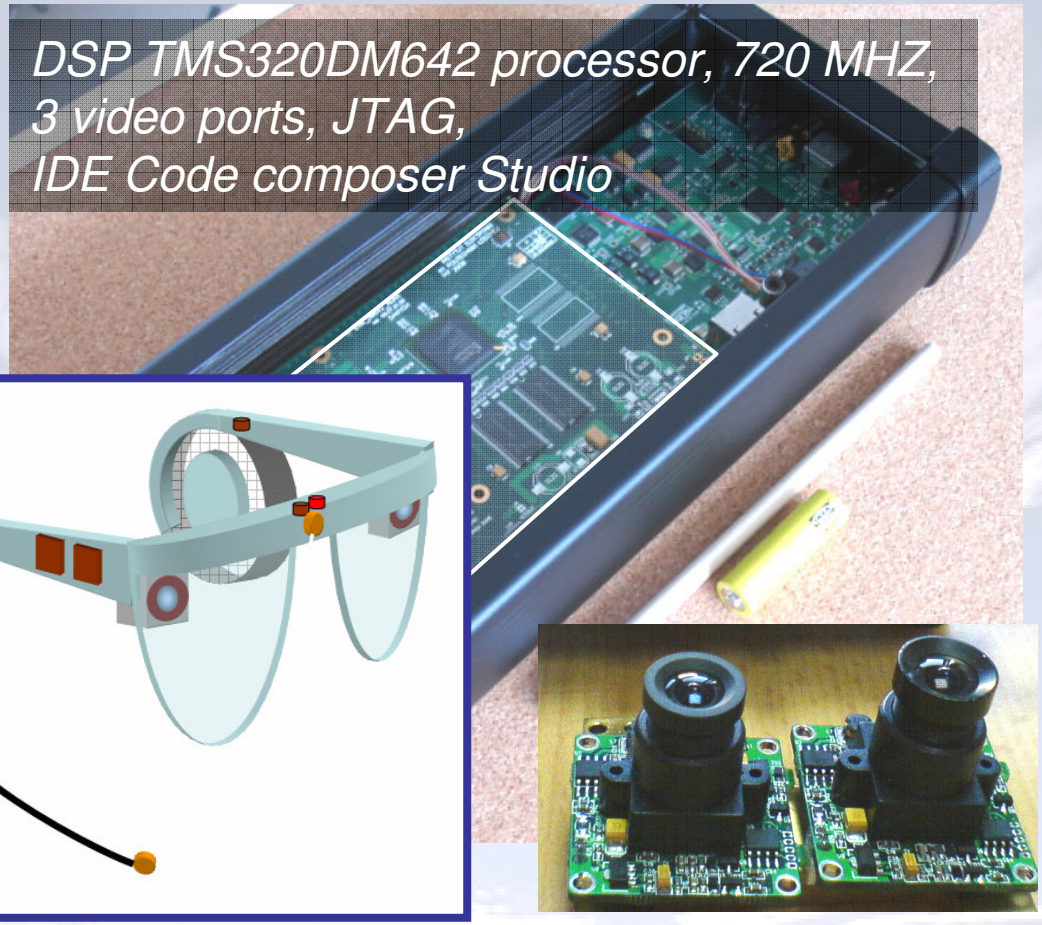
Spatial sound



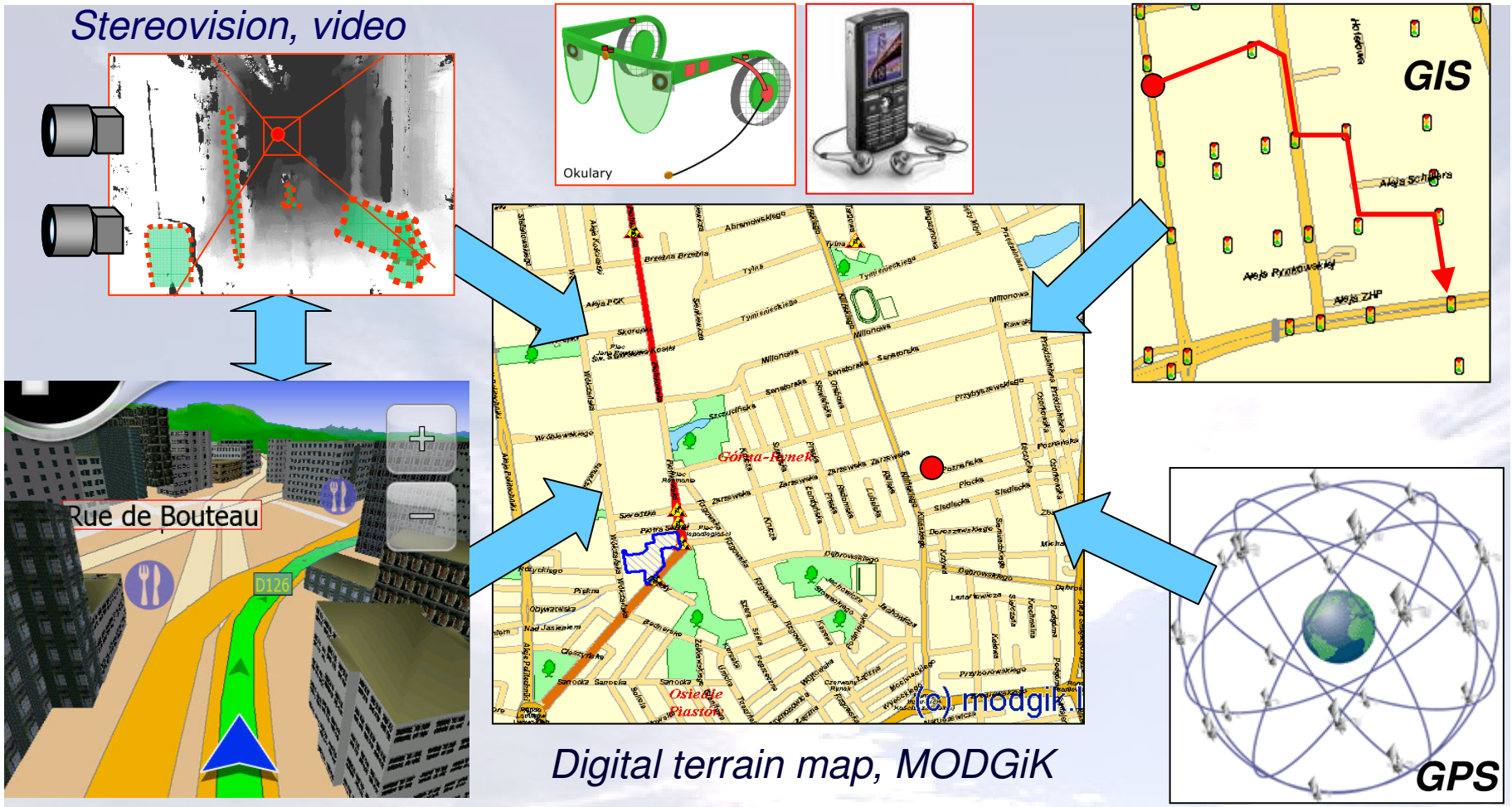


Moving sources	***Real sound sources***	***3,1º***
	Virtual sound source	***8,1 º***

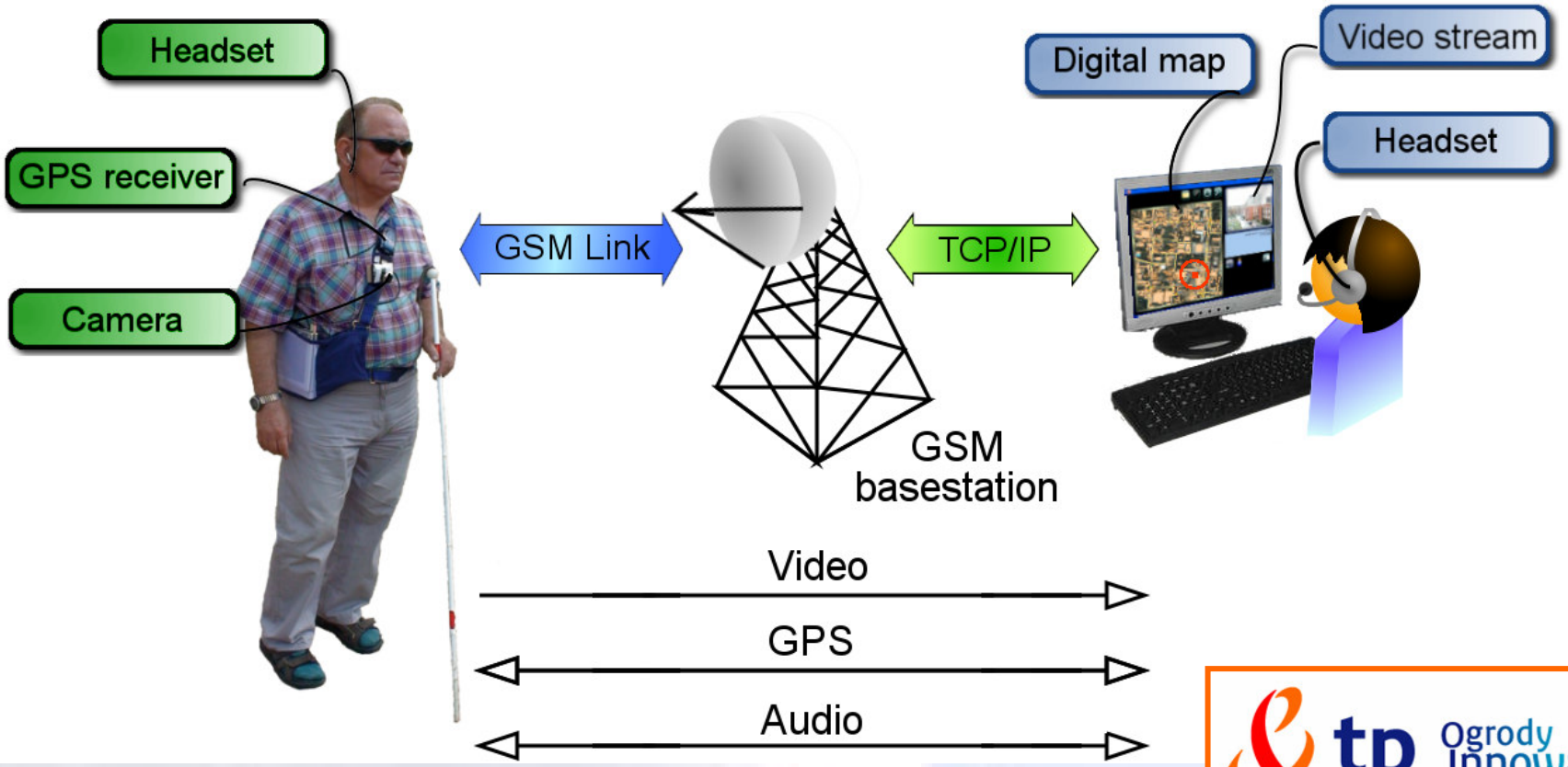
System hardware



Navigating the blind



Remote navigation system



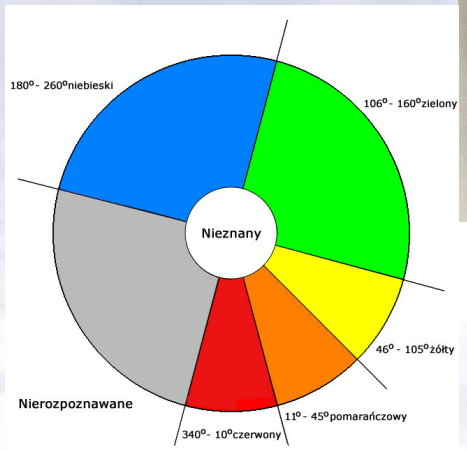
System trial

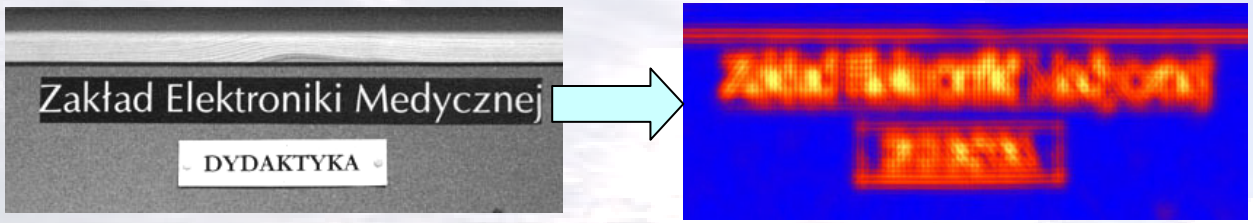
Operator's terminal

Smartphone with speech synthesis

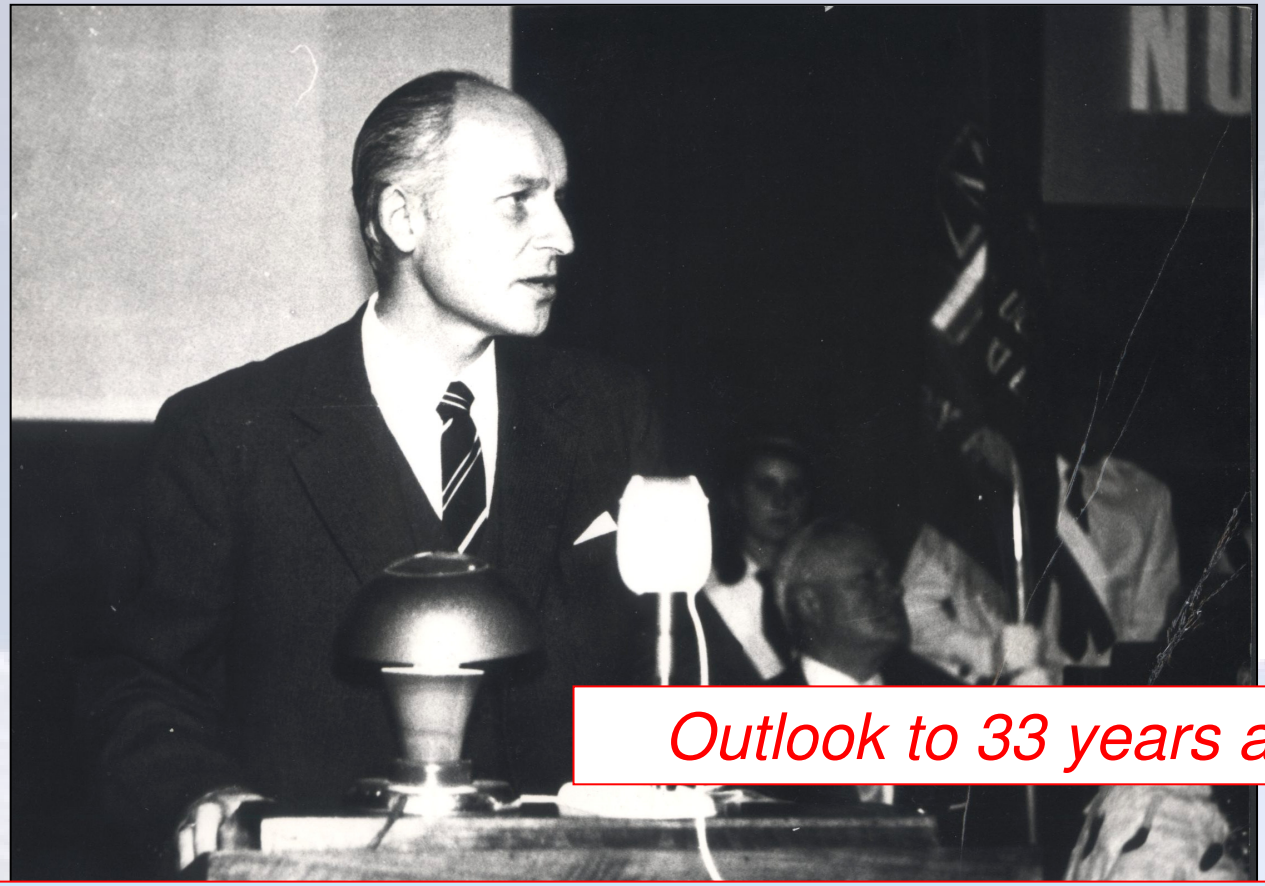
Symbian smartphone assisting the blind:

- *phone functions*
- *speech synthesis*
- *GPS navigation*





prof. Korzec inaugural lecture



Outlook to 33 years ahead?

Inaugural lecture given by prof. Korzec in 1975.

Engineering's Grand Challenges

Make solar energy economical

Provide energy from fusion

Develop carbon sequestration methods

Manage the nitrogen cycle

Provide access to clean water

Restore and improve urban infrastructure

Advance health informatics

Engineer better medicines

Reverse-engineer the brain

Prevent nuclear terror

Secure cyberspace

Enhance virtual reality

Advance personalized learning

Engineer the tools of scientific discovery

Acknowledgments

The blind volunteers taking part is the studies

Polish Blind Union, Lodz Region

Colleagues and PhD students
from the Medial Electronics Division

Ministry of Science and Higher Education