

operator's VIGILANCE monitoring

The logo for 'Jazz' is stylized, with the 'J' and 'a' connected, and the 'z' having a unique, angular design. A small copyright symbol is to the right.

by Ober Consulting Poland

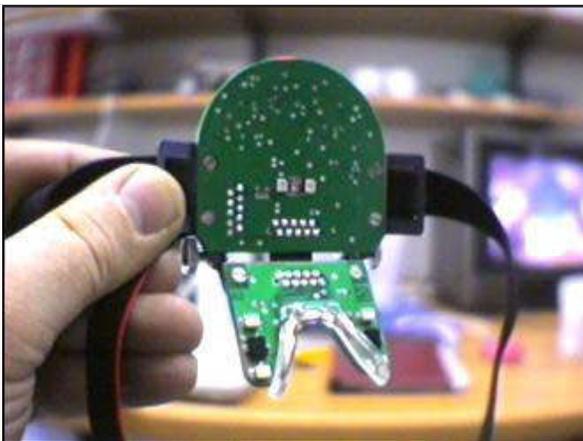


Simultaneous monitoring of:

- ocular motility
- head movements
- heart rate
- blood oxygenation
- light environment
- operator's speech
- audio background

Features:

- minimal intrusiveness
- zero setting time
- subject can wear his own spectacles
- lightweight (35g)
- galvanic isolation
- battery powered controller unit



Options:

- wireless transmission
- head- mounted scene camera
- possibility of monitoring two operators at the same time

the European Collaborative Project

Visual INTERaction and
Human Effectiveness in
the Cockpit, part II



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DESIGN PHILOSOPHY

The key functions of the Jazz system are aimed for monitoring the visual attention processes, which reflects the management of the operator's conscious attention. From the point of view of the overall operator's performance it allows to detect the anomalies in attention management like being in the exclusive planning mode, accompanied by the visual inattention. It results in blocking of the information exchange between the supervised environment and the operator's conscious brain (the day-dreaming eyes condition), called also the absent mind. The operator's mind instead of being in the control room or in the airliner cockpit is somewhere else. No one is taking care of the course of events.

PHYSIOLOGICAL REQUIREMENTS / TECHNICAL SPECIFICATION

• Eye movements:

Sampling rate: 1 kHz
Resolution: 12 bit plus 12 bit automatic signal offset cancellation
Range: X axis ± 45 degrees; Y axis ± 25 degrees

Sampling rate of 1 kHz allows high reliability of saccades detection. It provides also one millisecond resolution of fixation duration measurement. It allows distinguishing the origin of the saccade - its triggering site. It can be the conscious brain - longer fixation (220 ms and longer), or the preconscious brain (200 ms and less).

Vertical measurement accuracy is limited due to the visco-elastic properties of the upper lid (tissue strain relaxation and tissue flow). The vertical eye movement measurement serves mainly the purpose of reliable detection of movement artefacts (displacement of the sensor in relation to the eyes, caused by raising the brows and mimics), as well as blinks.

• Total haemoglobin and oxyhaemoglobin plethysmography:

Sampling rate: 250 Hz
Resolution: 12 bit plus 12 bit automatic signal offset cancellation

The gain of the system is adjusted to allow the displacements of the baseline of the plethysmography signal to accommodate the differences of the DC signal component caused by changes of the hemodynamic outflow from the heart. It can result from the decreased or increased pressure in the chest, being the result of the Valsalva manoeuvre.

It allows for example to monitor the appropriateness of anti-G training. It makes also possible to observe the vaso-motor compensatory responses, accompanying the hyperaemia (vasodilation). The AC component of the signal is approximately 1/5 of the allowed baseline displacement.

• Head accelerations along the horizontal and vertical axis:

Sampling rate: 250 Hz
Resolution: 12 bit
Range: $\pm 2g$ (in X and Y-axis) Attached software for data presentation displays the acceleration changes within $\pm 1g$. The head movements accompanying the redirecting of the gaze usually don't exceed the acceleration of $1g$.

The accelerometer is measuring the acceleration due to the dynamic head movements, as well as the static position of the head in relation to the gravity vector. The head movements stimulate the compensatory eye movements - the VOR's (vestibulo oculomotor responses). They stabilise the image projected on the retina to allow the sharp vision. Possessing the information about the head movements simplifies the analysis of the eye movements (VOR-components). In addition the overall head motility and the static position of the head carries the information about the operator's vigilance (nodding the head when falling asleep).

• Environmental illumination:

Sampling rate: 250 Hz
Resolution: 12 bit
Range: 0 - 100 lx

The gain of the system is adjusted for usual working place illumination. The measuring channel is DC coupled and allows identifying the level of illumination (DC component) as well as the light flickering present only in the artificial illumination (flicker frequency is twice the AC power line frequency: Europe - 100 Hz; US, Canada - 120 Hz). For the free moving operator, it allows to identify roughly the orientation of the subject in the room.

• Microphone:

Sampling rate: 8 kHz
Resolution: 8 bit

The gain of the audio channel is adjusted for clear speech recording of the operator's voice when he communicates with the other members in the control room, as well as when he talks to himself (usually with the low voice).

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