



Blue eye technology

(blue eyes –
Human operator
monitoring system
)

BY

Agenda

- Motivation
- What is **BlueEye** technology ?
- What is **BlueEyes** ?
- System designing
- System overview
- DAU
- CSU
- Data security
- IBM research
- Conclusion

Motivation

- Human error - a frequent reason of catastrophes and ecological disasters
 - temporal indisposition
 - weariness
 - oversight
- Monitoring of conscious brain involvement
- Lack of complex solution exploiting wireless link technology, database systems and AI algorithms

What is blue eye technology ?

- **The BLUE EYES technology aims at creating computational machines that have perceptual and sensory ability like those of human beings.**

How can we make computers “see” and “feel” ...

- Blue eyes uses sensing technology to identify a user's actions and to extract key information.
- Information is then analyzed to determine the user's physical ,emotional ,or informational state.

What is Blue Eyes ?

- The complex solution for human-operator monitoring:
 - Visual attention monitoring
 - Physiological condition
 - Operator's position detection
 - Wireless data acquisition using bluetooth

What is BlueEyes not?

- Doesn't predict nor interfere with operator's thoughts
- Cannot force directly the operator to work

IBM research

- BLUE EYE – EMOTIONAL MOUSE

sensors in the mouse ,sense the physiological attributes which are correlated to emotions using correlation model

-by simply touching the mouse ,the computer will be able to determine a person's emotional state.

- BLUE EYE enabled TELEVISION – could become active when the user makes an eye contact.

Physiological foundations

Human brain

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graph TD; A[Human brain] --> B[Preconscious brain]; A --> C[Conscious brain];
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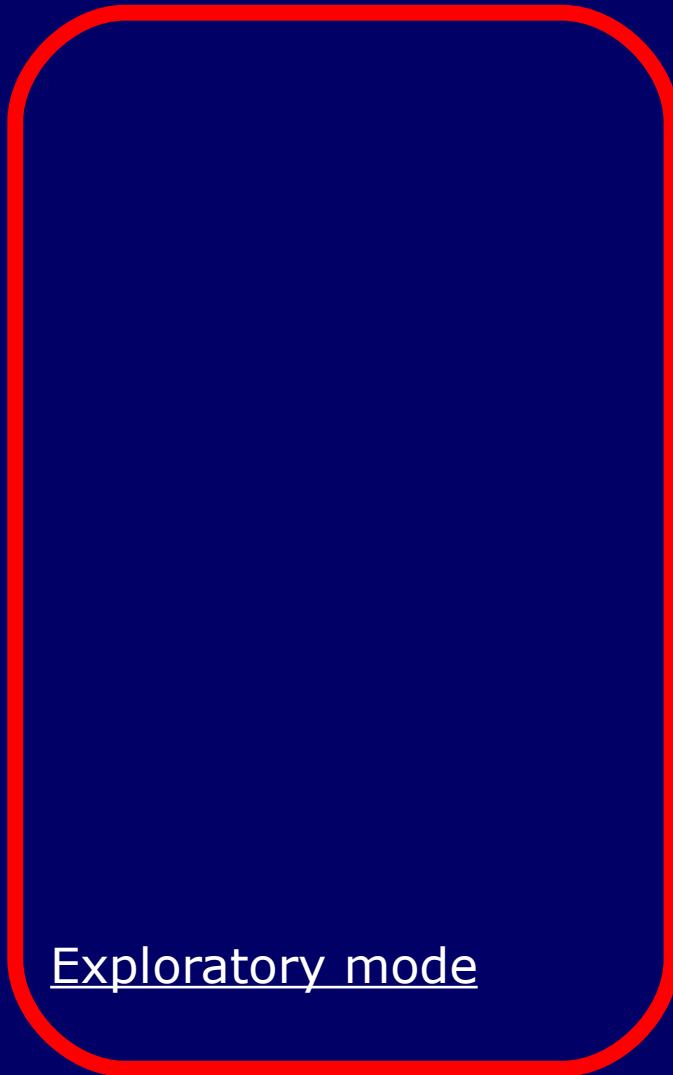
Preconscious brain

- alogical
- „automatic“

Conscious brain

- manages the knowledge
- logical reasoning
- makes decisions

Conscious brain - operation



Exploratory mode

Planning mode

The eye movement sensor

- Off-shelf eye movement sensor – Jazz multisensor
- Supplies raw digital data regarding
 - Eye position
 - Level of blood oxygenation
 - Acceleration along horizontal and vertical axes
 - Ambient light intensity

Eye movements

- Retina - central vision (macula)
- Central vision and the conscious brain

Saccade - a rapid eye jump to a new location assigned by the conscious attention process.

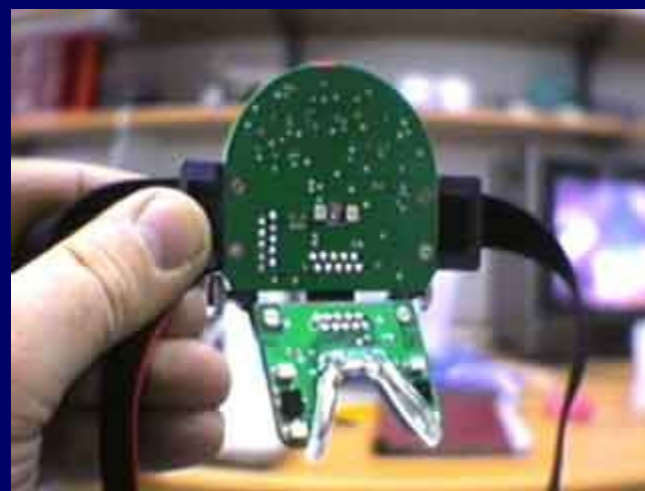
Saccades presence

Exploratory mode

Jazz multisensor

Jazz Multisensor

Jazz



Design objectives

- A mobile data acquisition device
 - A reliable real-time buffering, processing and recording
 - A clear visualization interface
 - Mechanisms for creating custom data analyzers
 - To ensure a possibility of distributing the processing among a number of computers

Implementation and engineering

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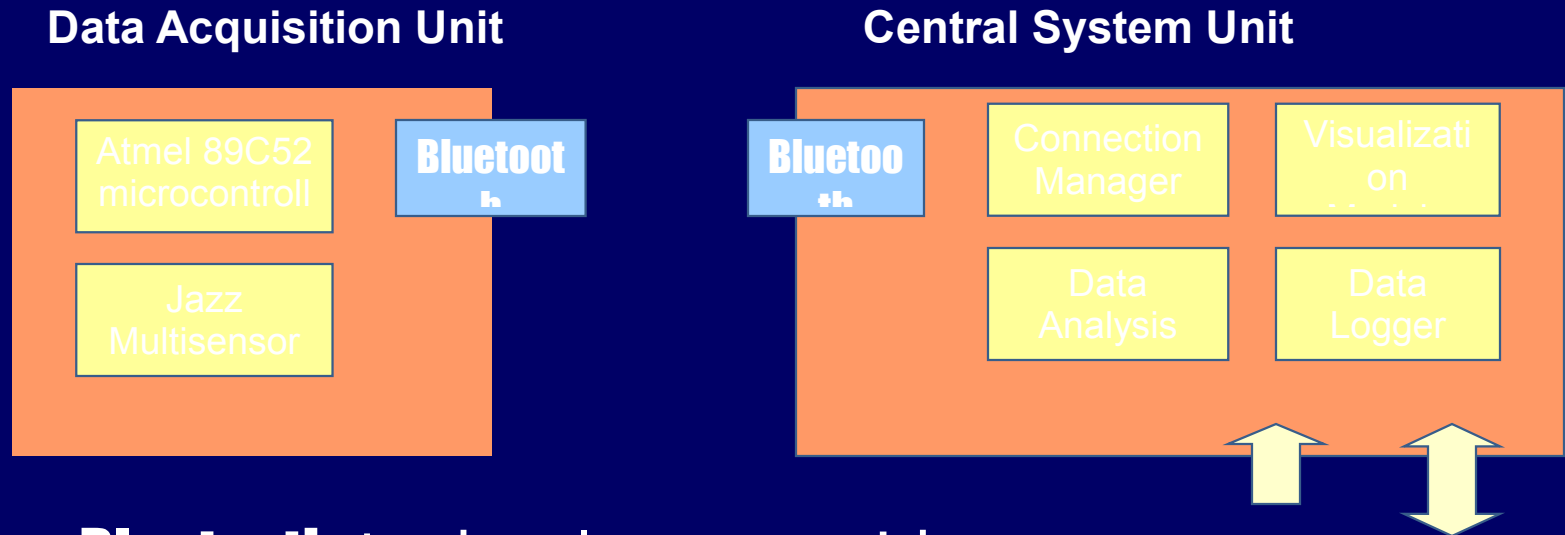
-THREE groups of users

- OPERATOR -a person whose physiological parameters are supervised
 - authorization in the system
 - receiving alerts
- SUPERVISOR – a person responsible for analyzing operator's condition and performance.
- SYSTEM ADMINISTRATORS- maintains the system deliver tools for adding
 - new operator's to the database
 - defining alarm conditions
 - configuring logging tools
 - creating new analyzer modules

Designing

- A personal area network for linking all the operators and the supervising system
- Two major units
 - DAU (data acquisition unit)
 - CSU (central system unit)

System overview



Bluetooth technology provides means for creating a Personal Area Network linking the operators and the central system.

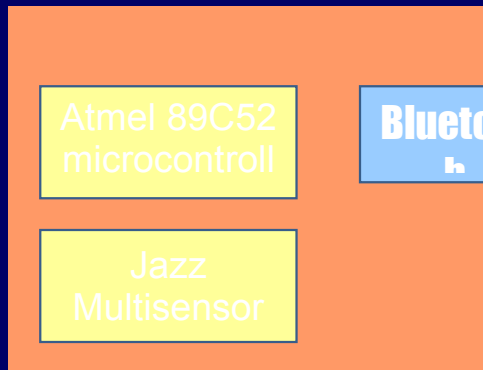
DAU

The DAU consists of the following components

- ATMEL 8952 microcontroller
- BLUE TOOTH MODULE – supports synchronous voice data transmission
- PCM CODEC –used to transmit operator's voice and central system sound feedback
- UART –communication between bluetooth module and microcontroller (115200 bps)
- MAX232 –level shifter
- ALPHAUNUMERIC LCD display
- LED indicators
- ID CARD interface

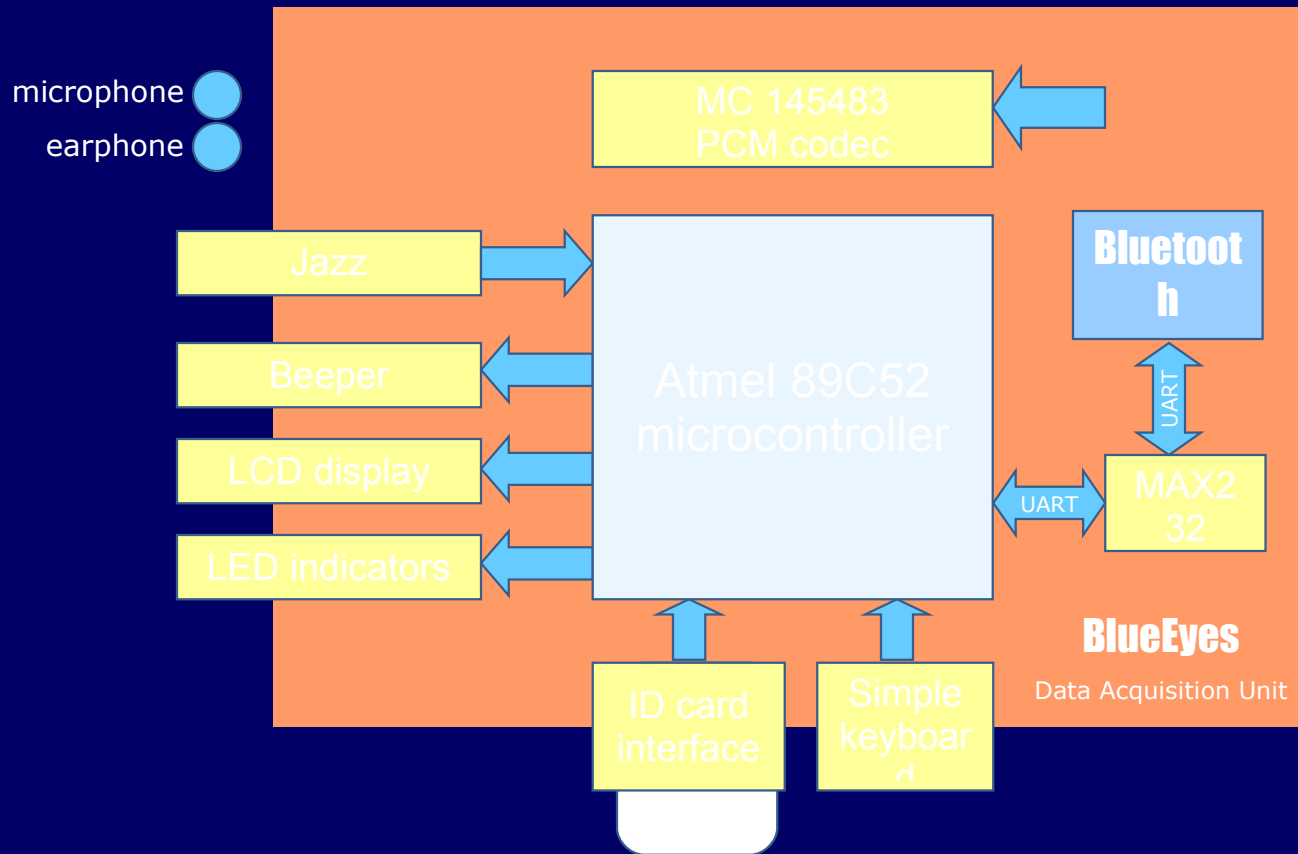
DAU - features

Data Acquisition Unit

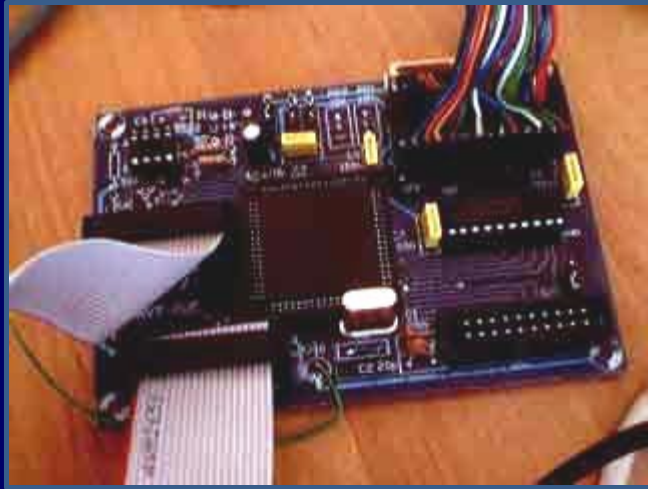


- Lightweight
- Runs on batteries - low power consumption
- Easy to use - does not disturb the operator working
- ID cards for operator authorization

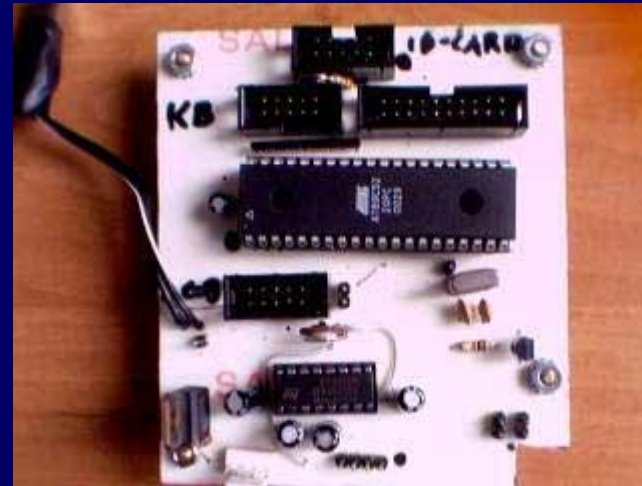
DAU - components



Microcontroller & blue tooth module



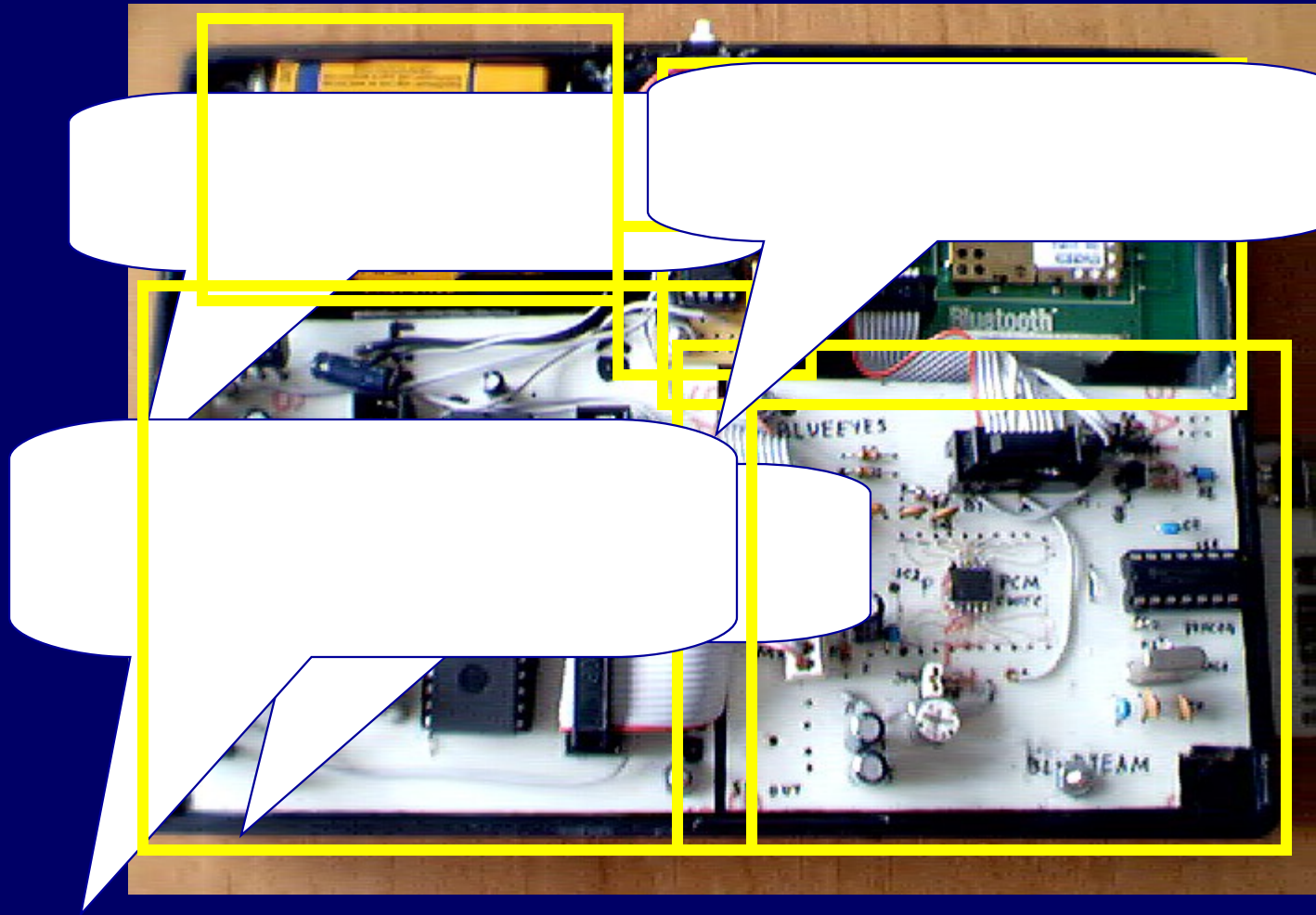
EEPROMS & the PCB



Implementation - DAU

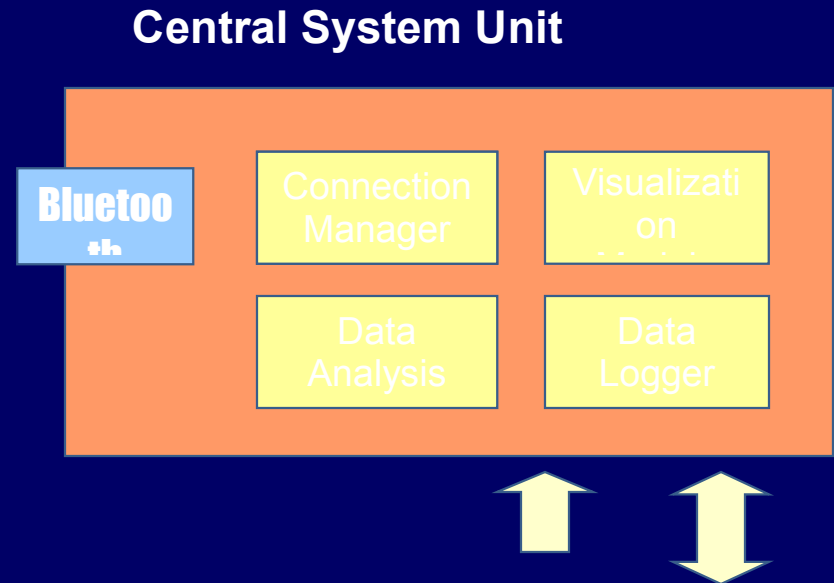
- Made from scratch by the team
- Bluetooth module inside
- Jazz sensor interface
- Microphone and earphone sockets
- 5-key keyboard
- Two lines, 8 characters LCD
- Powered from 6 AA batteries

Implementation - DAU



CSU - features

- Connection management
- Data processing
- Visualization
- Data recording
- Access verification
- System maintenance

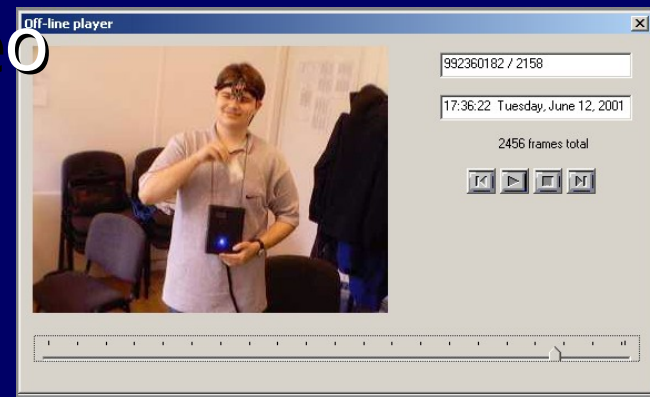
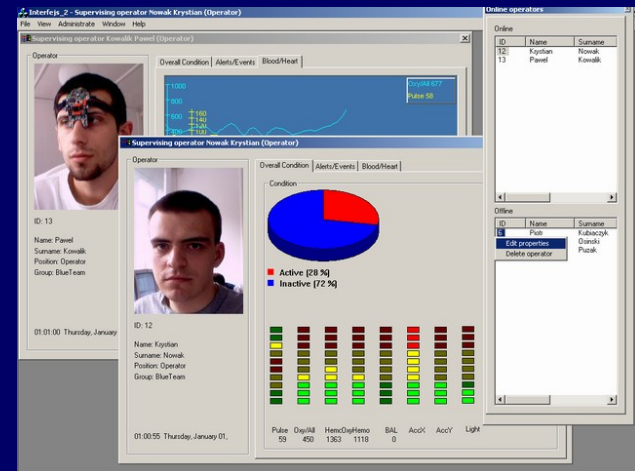


CSU – components

- CONNECTION MANAGER – main task to perform low-level blue tooth communication
- DATA ANALYSIS MODULE – performs the analysis of the raw sensor data in order to obtain information about operator's physiological condition
- DATA LOGGER MODULE – provides support for storing the monitored data.
- VISUALIZATION MODULE – provides user interface for the supervisors

CSU - Visualization Module

- Raw and processed data visualization using:
 - VU-meters
 - pie-charts
 - time series
- audio and video data playback

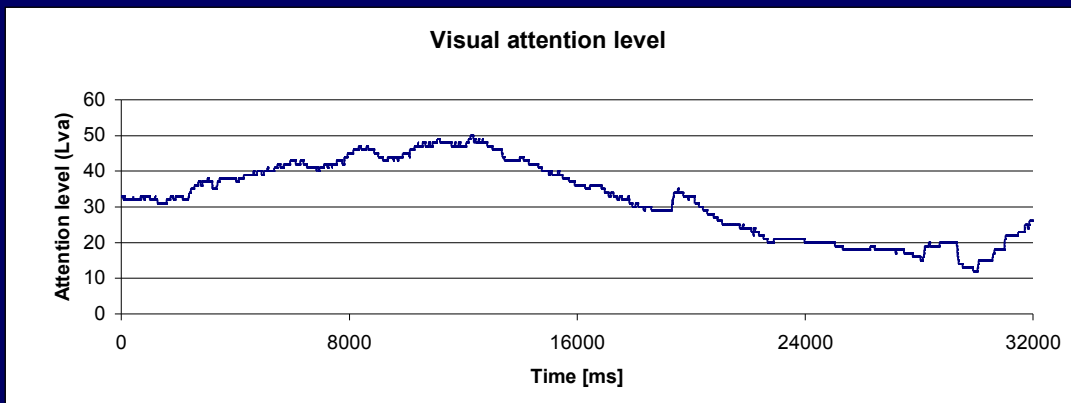
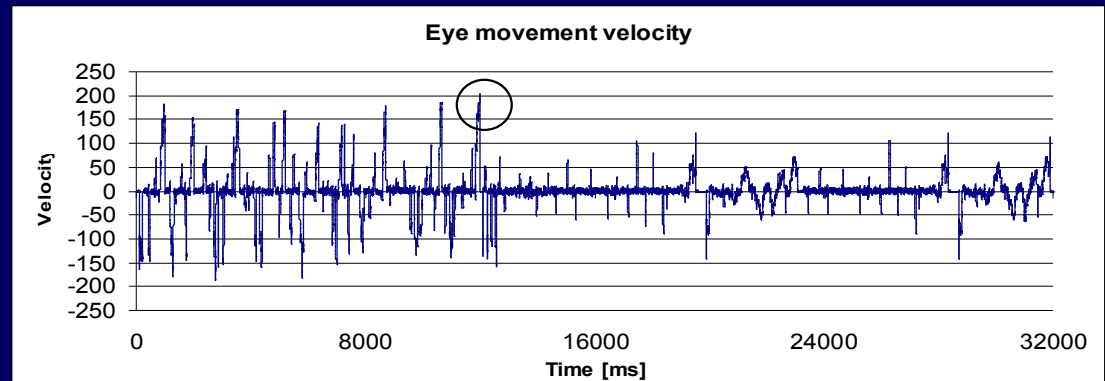


CSU - saccade detector

- Saccade detector and conscious brain involvement level calculation

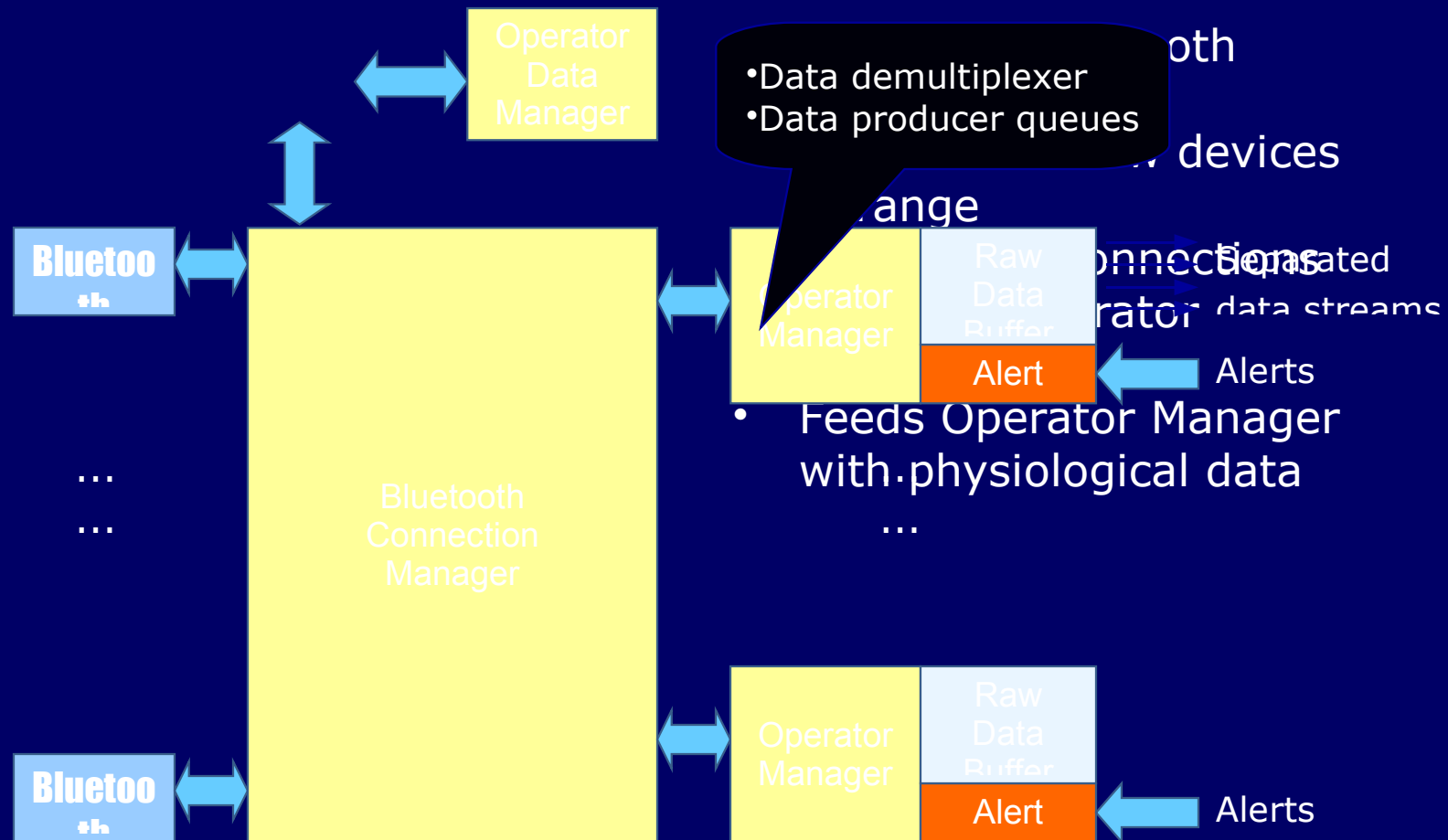


Differentiation



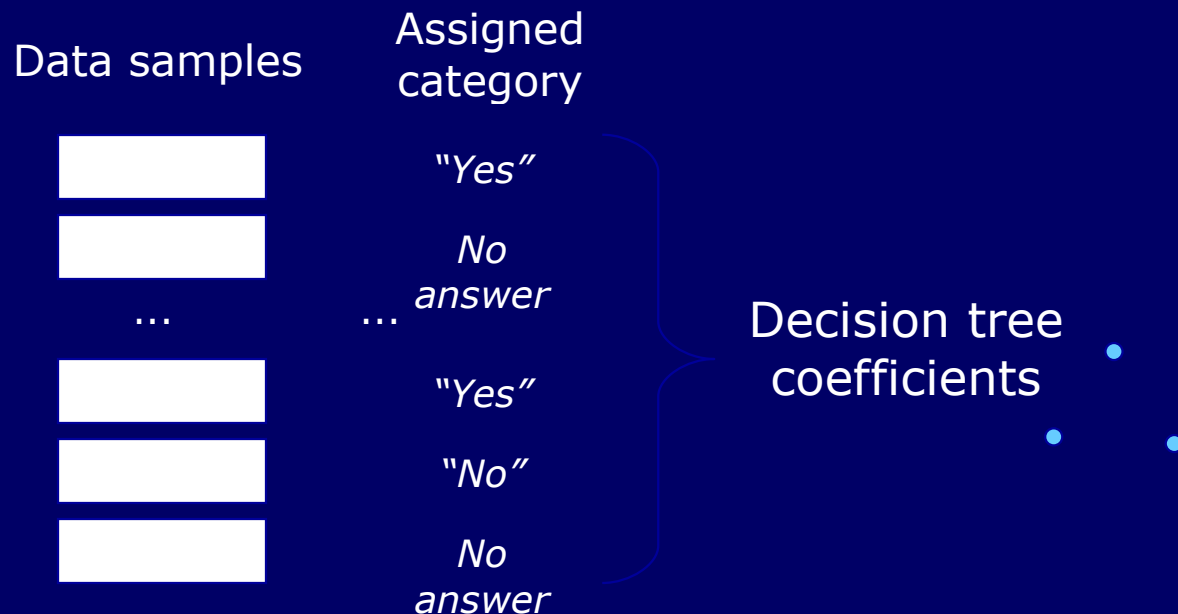
Conscious
brain
involvement
level

CSU - Connection Manager



CSU - Data Analysis

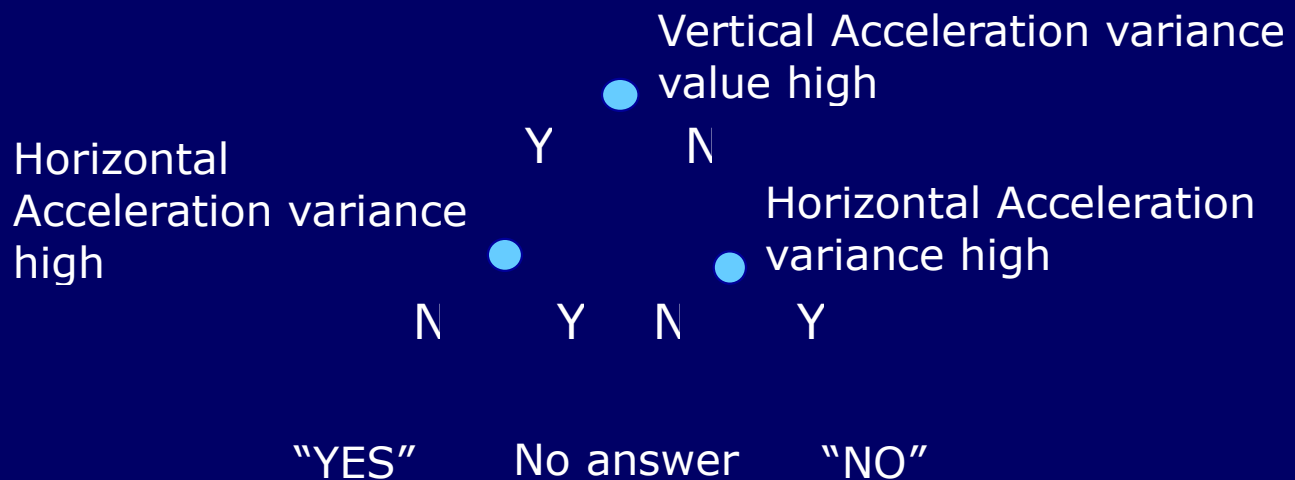
- Custom data analyzers - decision tree based classifiers
- Automatic decision tree coefficients generation - C4.5 based algorithm



CSU - Data Analysis

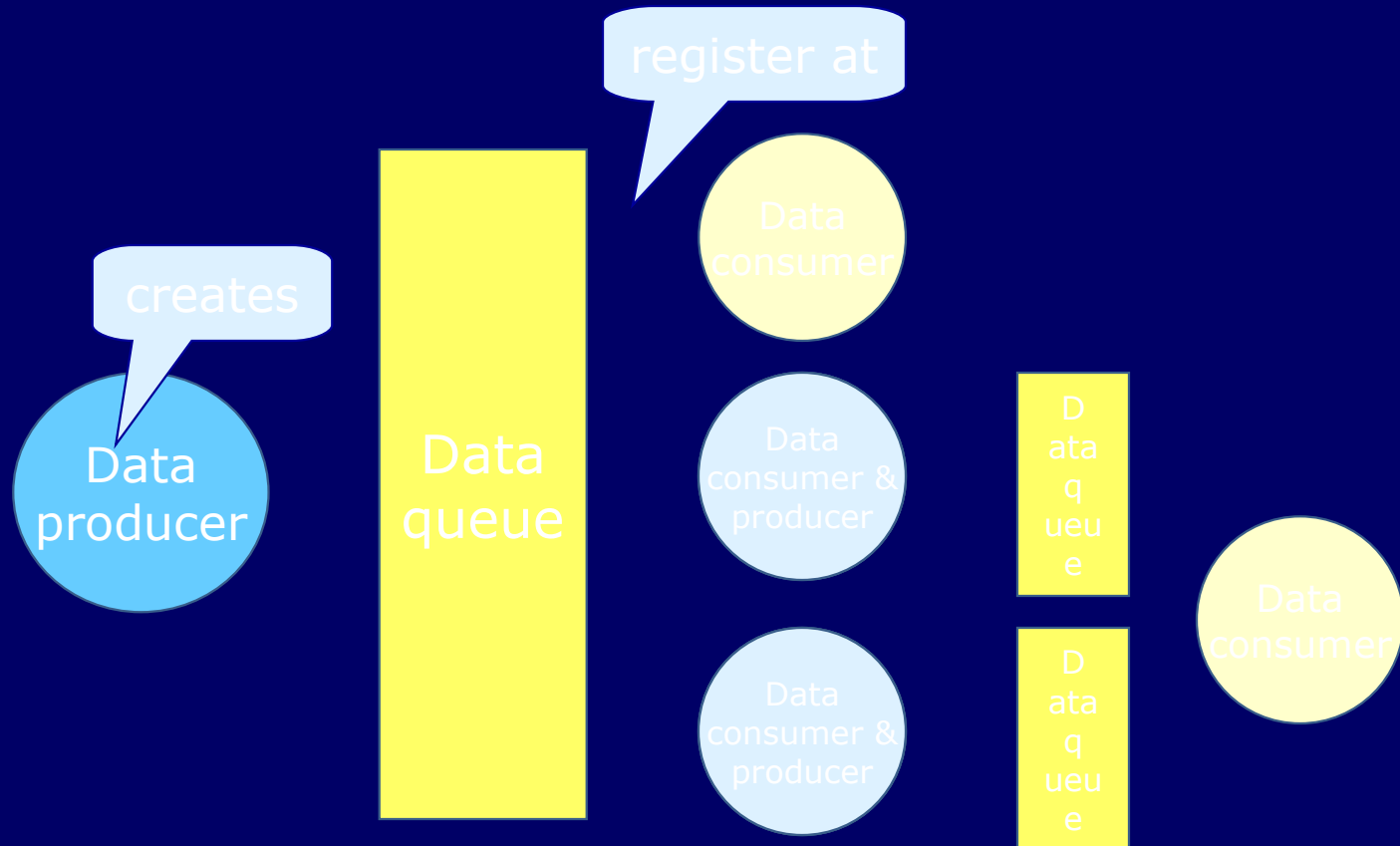
- Custom data analyzers - decision tree based classifiers

Example: Operator gesture recognition
(simplified)

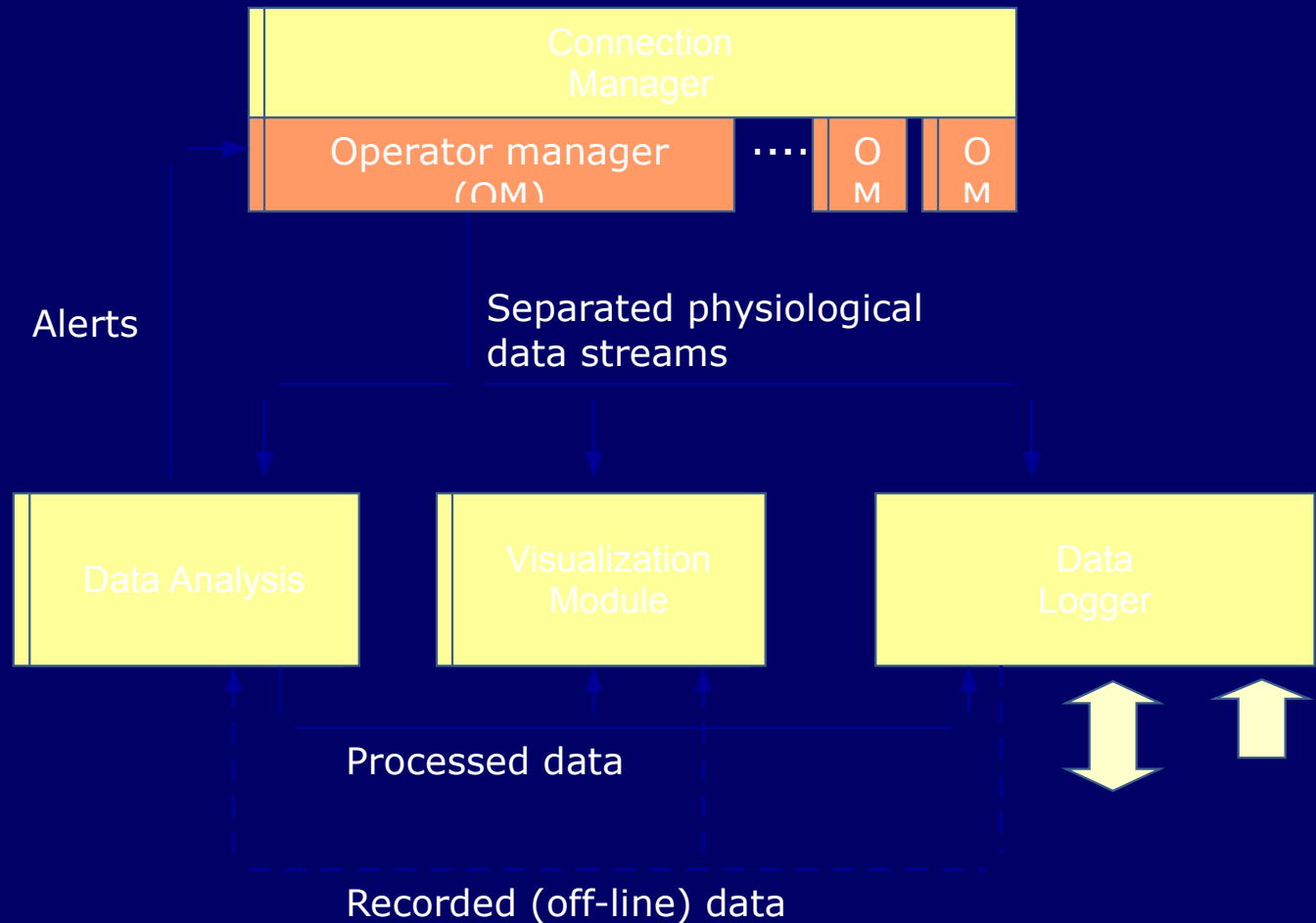


CSU - intermodule communication

- Uses buffered thread-safe queues and producer-consumer scheme

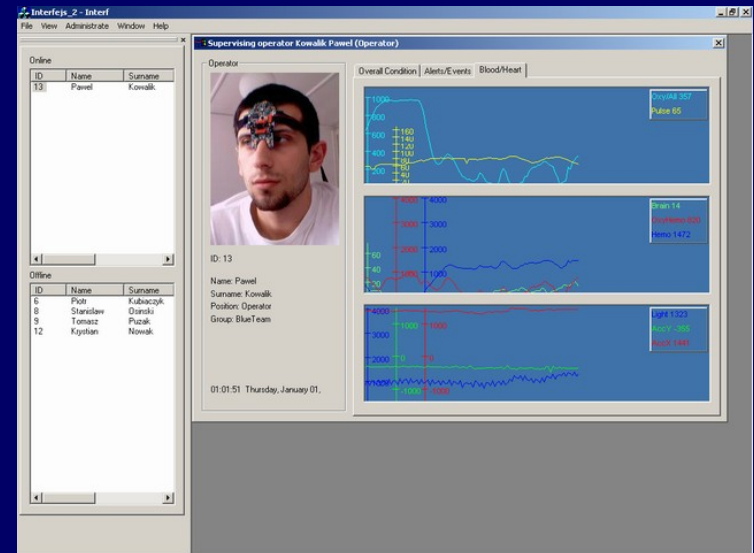


CSU - intermodule communication



Implementation - CSU

- Standard MDI user interface
- Custom-built Bluetooth communication routines
- Intel USB camera
- ID card programmer
- Developed using Visual C++ 6.0
- Deployment environment: Windows 2000, MS SQL Server



Future improvements

DAU

- small CMOS camera to monitor the operator's point of gaze
- single PCB (SMD technology)
- low voltage ICs - LiIO batteries
- power

CSU

- data mining algorithms
- advanced database encryption using e.g. AES algorithm

Data security

- Only registered mobile devices can connect to the system
- Bluetooth connection authentication
- Bluetooth connection encryption
- Access rights restrictions
- Personal and physiological data encryption

Applications of Blue Eyes

- Generic control rooms

(System can be applied in every working environment

requiring permanent operator's attention)

- Power station
- Captain bridge
- Flight control centers
- Operating theatres – anesthesiologists

Blue Eyes - benefits

- Prevention from dangerous incidents
- Minimization of
 - ecological consequences
 - financial loss
 - a threat to a human life
- The reconstruction of the course of operator's work

References

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Conclusion

- In the near future ,ordinary household devices- such as television , refrigerators ,ovens may be able to do their jobs when we look at them and speak to them.
- Future applications of blue eye technology is limitless

**Thank
you**