SonoSens® Monitor is a mobile monitoring and diagnostic system for tracking and recording of human body movements.

For physicians, medical scientists and developers SonoSens® represents the mobile solution for objective measuring and evaluating of mobility:

- It gives clearer understanding in treatment of diseases and enhancement of processes concerning the human muscle and skeleton system.
Introduction: Examples for Problems that SonoSens® aims to solve:

- **Physicians** want to examine and therefore measure the status of patients' flexibility before and after a treatment; several problems require a measurement under real every-day conditions.

- **Scientific researchers** in the fields of sports want to enhance sportive performance by studying and adapting movement sequences in training and competition.

- **Industrial researchers and developers** want to measure and confirm product properties objectively under defined, but real conditions, (e.g. comfort of a seat).

- **Industrial medicine** wants to enhance processes by investigating common movement-patterns by measuring and analyzing.
Introduction: State of the Art

Recent methods for recording and analysing of human body movements and flexibility are:

- Classical method: Anamnesis
- Static or dynamic visualizing methods:
  - X-ray examinations
  - CT
  - Video motion capture

They are **no mobile systems**!
SonoSens® is the worldwide solely mobile solution for recording and analysing of body movement usable under everyday conditions:

- It offers full mobility without constraining the freedom of movement
- It is easy to applicate, lightweighting and comfortable to wear

Therefore SonoSens® uses a special physical method and realizes a robust medical principle
SonoSens® Monitor is based on the Schober-Ott principle a medical method for evaluating the flexibility of the human spine (Paul Schober 1865-1943, Victor Rudolf Ott 1914-1986).

- The Schober-test is a functional test of the flexibility of the lumbar region of the spine. In standing position a point above the acantha of vertebra S1 and a point 10cm (3.94 inches) above S1 (cranial) is marked (e.g. with a pen).

- The Ott-test is a functional test of the flexibility of the thoracic spine. In standing position a point above the acantha of vertebra C7 and a point 30cm (11.81 inches) below C7 (cranial) is marked (e.g. with a pen).
Method: Medical / Orthopaedic Background

- Changes of the distances between these measured under flexions
- In patients with acampsia of the spine the flexibility especially in these regions is reduced and hence the change of the distances is smaller in comparison to defaults of healthy humans
Method: Technical Principle

For the technical realization SonoSens® uses the method of sonometry, a non-invasive method, absolutely free of pain and without electromagnetic emissions influencing the human body:

- By measuring the transition-time of repeated ultrasonic impulses between ultrasonic transducers (transmitter / receiver), applied on the body surface, it is possible to determine the prolongation / elongation of tissue and thereby the body posture under movement.

By combining the technical principle of sonometry with the medical Schober-Ott-principle analysing of body posture and movement patterns is feasible.
SonoSens® Monitor 8 is equipped with 8 ultrasonic transducers:

- 4 transmitters L1, R1, L3, R3 (left, right)
- 4 Receivers L2, R2, L4, R4
- A pair of 1 transmitter & 1 receiver represents one logical measurement-channel (A..L)
- Up to 12 channels are possible

The high number of channels enables SonoSens® to measure not only frontal flexibility but also sagittal flexibility and torsions.
Main application scenarios are:

a) standard back  
b) knee & lumbar spine
**Operation: Procedure**

For motion/posture capture the SonoSens® System consists of:

- **SonoSens® Monitor** device for measuring
- **SonoSens® Analyzer** software for analyzing and reporting.

A measuring session consists of 5 steps:

1. Sensor application depending on the problem
2. Calibration procedure
3. Measurement (e.g. an outdoor walk)
4. Data transmission
5. Data analysis and interpretation
In standard application on the back SonoSens® measures 12 channels:

- **8 sensors** symmetrically to the spine
- **3 segments**: lumbar-, thoracic-, cervical spine
- **6 straight channels**: A..F detecting frontal / sagittal flexions/ extensions (front, back, left, right)
  - **frontal flexion**: channels lengthen
  - **frontal extension**: channels shorten
  - **sagittal flexion**: one side shorten, opponent side lengthen
- **6 cross channels**: G..L detecting transversal torsion (left, right)
In knee application SonoSens® is measuring 6 channels:

- **2 segments**: knee & lumbar-spine
- **2 straight channels**: E+F in the lumbar region, detecting flexion
- **2 cross channels**: K+L in the lumbar region, detecting torsion
- **2 knee channels**: A+B (left, right) detecting proportion of knee flexion (90° to 180°)
Operation: Calibration Sequence

A calibration has to be accomplished after application of the sensors on the body:

- SonoSens® records the calibration measurement
- Calibration consists of multiple intervals/steps:

  **Scenario Standard back:**
  - starting the calibration measurement
  - patient stands upright for 30 seconds
  - test of maximum flexibility in all planes:
    - **frontal:** 10s flexion, 10s extension
    - **sagittal:** flexion 10s left/ 10s right
    - **transversal:** torsion 10s left/ 10s right

  The pelvis has to be fixed, only the upper body may do these exercises.
Scenario knee & lumbar spine:
- starting the calibration measurement
- patient stands upright for 30 seconds, knee-angle at 180°
- patient is sitting with knee-angle of 90° between lower and upper leg
Operation: Measurement

Measurement can occur under every-day conditions:

- Multiple measurement intervals can be recorded
- One interval for one exercise (e.g. climbing stairs, running, driving, sitting, outdoor-walk)
- Shortterm intervals of 10 min
- Longterm intervals of 24h
**Operation: Data Transfer**

When the measurement session is stopped, the data can be transferred to a PC with the SonoSens® Analyzer software:

- SonoSens® features an infrared data interface (IrDA)
- Transfer occurs without any data cable
- SonoSens® has only to be in the sight of the infrared-interface of the PC
- One click for initiating data transfer
- The software SonoSens® Analyzer controls the data transfer
- After importing the measurement is stored in the SonoSens® Analyzer database (by patient ID & name)
Operation: Analysis and Reporting

After the data transfer the data is analyzed automatically by the SonoSens® Analyzer; Reports were generated:

- Data will be analyzed automatically
- A preview report is presented
- You can choose a special report due to your examination
  - First examination
  - Follow up examination
  - 3D visualizing
  - Knee measurement

We can assist you on configuring the data connection.
At first after data transfer a 2sided preview is presented as an extract:

**Side 1 – straight channels:**

- **Linegraphs:**
  - Cervical spine
  - Thoracic spine
  - Lumbar spine

- **Parameters:**
  - Measuring frequency
  - Number of intervals
  - Starting lengths in spine segments

- **Range of motion:**
  - Range of parameter in spine segments
Reports: Preview / Standard Report

Side 2 – cross channels:

- **Linegraphs:**
  - Cervical spine
  - Thoracic spine
  - Lumbar spine

- **Parameters:**
  - Starting lengths across spine segments

- **Range of motion:**
  - Range of parameter in spine segments
A gait analysis usually consists of an *initial examination* and several *follow-up examinations*.

The *initial examination* determines the status of the patient before intervention.

*Follow-up examinations* determine the status of the patient under or after a treatment.

For the evaluation of a treatment results will be presented in a comparable 2-sided report:
**Side 1 – calibration results:**

- **Parameters:**
  - Measuring frequency, Number of intervals
  - Starting lengths

- **Range of motion:**
  - Histograms and values of maximum Flexibility test in spine segments

- **Short description:**
  - Problem and/or treatment
Side 2 – examination results:
(same for initial / follow up examination)

- **Parameters:**
  - Measuring frequency, Number of intervals
  - Starting lengths

- **Range of motion:**
  - Histograms and values of maximum flexibility test in spine segments

- **Short description:**
  - Problem and/or treatment
The 3D presentation shows the analyzing results of the first versus the follow-up examination:

- It allows an enhanced and more comprehensive view of the analysis results.
- Arrows indicating atypical posture in spine segments.
SonoSens® improves the multidisciplinarity communication for cooperations on base of objective measuring results:

- Orthodontia / Dentistry
- Ophthalmology / Optometry
- Surgery and Orthopaedy
- Physiotherapy
- Rehabilitational medicine
- Industrial medicine
  - Sports medicine
  - Medical expertise
- Otolaryngology
Applications: Orthopaedys

- Holistic medicine check of the muscle and skeleton system
- Identification and presentation of causalities at chronic pain ("chronical pain is lying")
- Visual presentation of deficiencies of posture- and movement in a timeline
- Visualizing promotes the patients understanding and acceptance for therapy
- Visualizing permits proof of the therapies effectivity and therapeutic tools (glasses, insoles)
- Deduction of preventive interventions
- Basis for behavioral training
- Individualized adaptation of therapy or training
Applications: Industrial medicine / workplace planning

- Measuring, recording, documenting, quantizing of typical stress- and risk factors of the muscle and skeleton system in the working area
- Optimization and planning of work places/ working processes
- Economical aspects: - optimization of processes and economic efficency accompanied by increasing of product quality
- Humanitarian aspects: - minimization of stress and risk factors - individualized work place planning - reducing of health issues
- Risk analysis from ergonomic point of view
- Test for realizeable construction planning (menschengerecht)
Applications: Rehabilitational- & Sports medicine

Rehabilitational medicine:
- Indirect control of rehabilitational results in optimization of sensomotoric capacity by objective measuring
- Optimization and individualized adaption of therapy
- Follow up control of treatment results under every day conditions
- Validation of novel therapeutic concepts
- Quality control, audit and confirmation tool

Sports medicine:
- Motion- and performance diagnostics under training conditions
- Power rating of the muscle and skeleton system
- Measuring and minimizing of stress and risk factors
Applications: Physiotherapy, Dentistry, Medical Expertises

Physiotherapy:
- Control of treatment process
- Craniosacral therapy
- Feet-muscle-training
- Propriceptive training
- Provisioning of sensomotoric insoles

Dentistry:
- Temporomandibular joint disorder (TMJD / TMD, IDC10: K07.6)
- Prescription and control of a mouthguard
Applications: Physiotherapy, Dentistry, Medical Expertises

Medical expertises:
- Occupational incapacity

Ophthalmology:
- Provisioning with eyeglasses
Summary: Profits from SonoSens®

SonoSens® completes the palette of motion monitoring systems:

- **First fully mobile motion capture and analysis system**
- Helps analyzing and documenting disorders that cause negative changes in motion behavior
- Examination under daily life conditions
- Method is not invasive, free of pain, free of radiation
- Harmless even to pregnant and children
Summary: Profits from SonoSens®

SonoSens® completes the palette of motion monitoring systems:

- Longterm measuring of posture and motion up to 24h
- Easy to apply, comfortable to use
- Several applicable scenarios (back and knee)
- Cable free data transfer
- Automated analysis and report generation with easy to read diagrams and visualizations
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