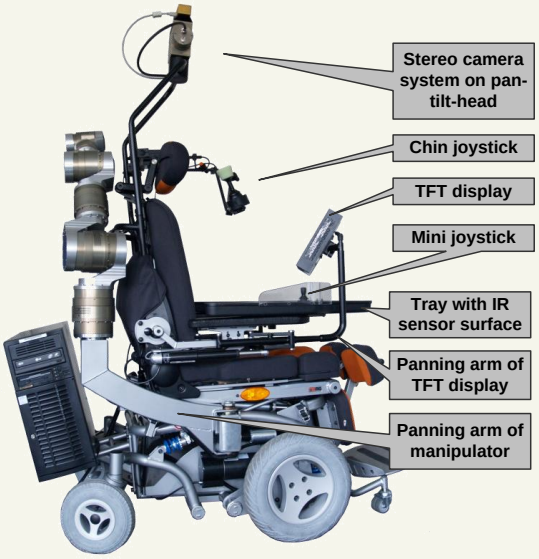
Camera Calibration for Reliable Object Manipulation in Care-Providing Robot FRIEND

Institute of Automation



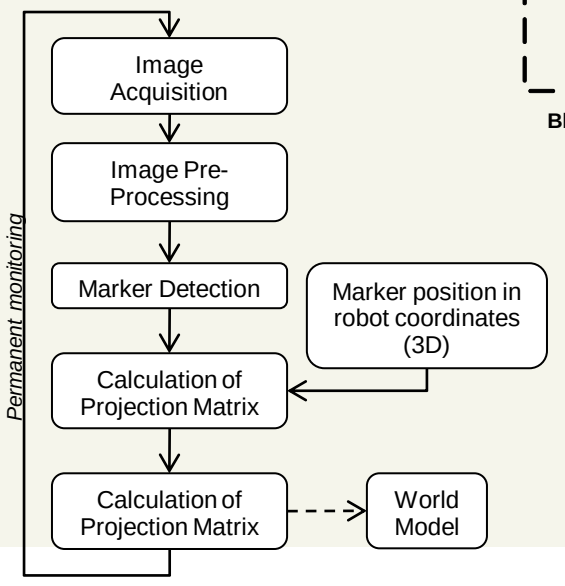
Care-Providing Robot FRIEND

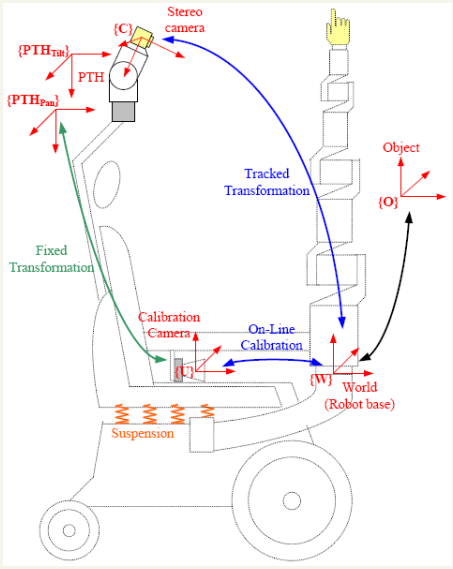
The System

_ Wheelchair system fitted with suspension
_ Precalibrated stereo camera system mounted on a 2 DoF (degree of freedom) pan-tilt head unit (PTH)
_ 7 DoF manipulator/robot arm with computer-based control
_ Intelligent tray

Stereo Camera Calibration

_ Camera calibration fixed requirement for 3D vision systems for precise objects of interest recognition for robot grasping and manipulation
_ Calculation of camera's pose w.r.t. a reference coordinate system
_ Marker-based calibration with ARToolKit
_ Image pre-processing for good and precise marker recognition

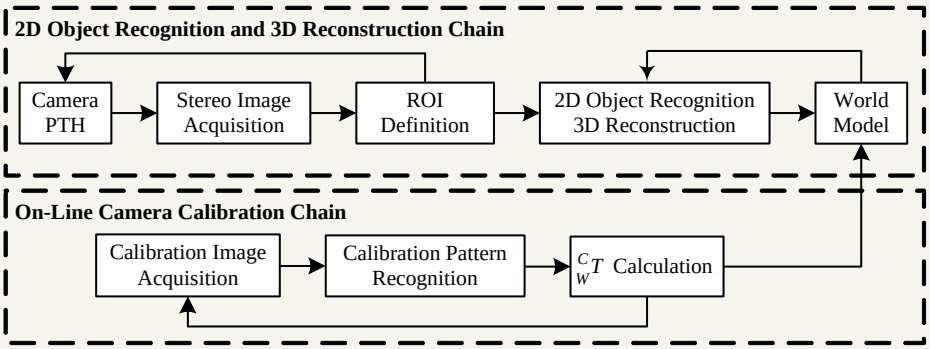




Structure and coordinate transformations in Care-Providing Robot FRIEND

Calibration with Respect to external Influences

_ Problem: suspension of the wheelchair influences the projection between robot and stereo camera which have to be
_ Solution: Additional camera mounted to *observe* changing in suspension
_ On-line calibration to cope the influence of the suspension



Block diagram of the FRIEND vision system with on-line camera calibration support.

Gaze-Control

_ Camera gaze orientation used for global scene understanding
_ Pan-tilt head (PTH) unit used in changing the camera viewing angle since projection matrices changes
_ Define fixed angles for pan and tilt for initial calibration
_ Recalculating projection matrices from the current angles of the PTH
_ Recalibration of global stereo camera

Aim

_ Development of a robust camera calibration concept for the Care-Providing Robot FRIEND for reliable object grasping and manipulation

Research

_ Marker-based camera calibration with ARToolKit

_ Image processing methods for precise marker detection

_ Precise marker detection for exact calculation of transformation matrices, in order to estimate the position of objects of interest for robot grasping and manipulation in the environment

_ High rate necessary to cope the influence of the suspension

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