Week 1 Update

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0.1 Survey of different motion capture technique using Kinect Camera

0.1.1 Adding Collision object for Human Body in Augmented Reality using Kinect

Research Paper: Aitpayev, K.; Gaber, J., "Collision Avatar (CA): Adding collision objects for human body in augmented reality using Kinect," Application of Information and Communication Technologies (AICT), 2012 6th International Conference on, vol., no., pp.1,4, 17-19 Oct. 2012.

Pros and Cons

- Easy to implement
- System not accurate enough
- problem with measurements of bone

Illustrations

0.1.2 Skeleton Animation motion data based on Kinect

Research Paper: Xiaolong Tong; Pin Xu; Xing Yan, "Research on Skeleton Animation Motion Data Based on Kinect, "Computational Intelligence and Design (ISCID), 2012 Fifth International Symposium on , vol.2, no., pp.347,350, 28-29 Oct. 2012.

Pros and Cons

- Creation of standard motion data files in real time
- reduces funding of implementation
- jitter present in data achieved for foot
- lack in optimization of motion data

Illustrations

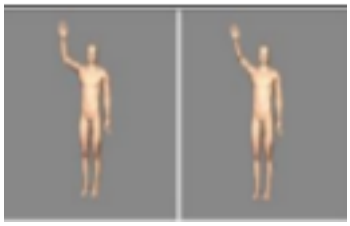
0.1.3 Motion Capture and Reconstruction based on depth info using Kinect

Research Paper: Ming Zeng; Zhengcun Liu; Qinghao Meng; Zhengbiao Bai; Haiyan Jia, "Motion capture and reconstruction based on depth information using Kinect," Image and Signal Processing (CISP), 2012 5th International Congress on , vol., no., pp.1381,1385, 16-18 Oct. 2012.

Pros and Cons

- Fairly accurate reuslts obtained for real time 3D human body movements.
- Good fidelity and low latency of system
- no support for occlusion handling

Illustrations



0.1.4 Animation of 3D characters from single depth camera

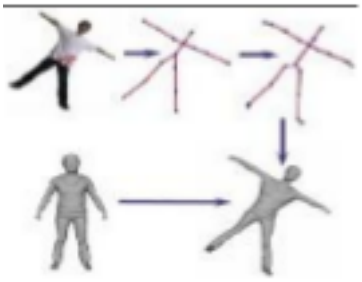
Research Paper: Mian Ma; Feng Xu; Yebin Liu, "Animation of 3D characters from single depth camera," 3D Imaging (IC3D), 2011 International Conference on, vol., no., pp.1,4, 7-8 Dec. 2011.

Pros and Cons

- Noise and errors with joints position are removed
- Due to removal of noise good results are obtained

- The deformation models pose in not that similar to captured cahracter
- Skinning is not done properly

Illustrations



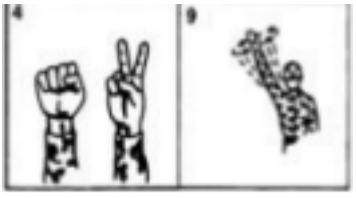
0.1.5 Multiple user motion capture and system engineering

Research Paper: Colvin, C.E.; Babcock, J.H.; Forrest, J.H.; Stuart, C.M.; Tonnemacher, M.J.; Wen-Shin Wang, "Multiple user motion capture and systems engineering," Systems and Information Engineering Design Symposium (SIEDS), 2011 IEEE , vol., no., pp.137,140, 29-29 April 2011.

Pros and Cons

- Support for mapping hand gestures
- Reduces funding if implementation
- arm gestures not supported

Illustrations



0.1.6 Augmented Mirror: interactive AR system based on kinect

Research Paper: Vera, Lucía, et al. "Augmented mirror: interactive augmented reality system based on kinect." Human-Computer Interaction–INTERACT 2011. Springer Berlin Heidelberg, 483-486. 2011.

Pros and Cons

- Head orientaion, lip movements, facial expressions, and automatic gestures are handled
- Occlusion is handled
- Finger tracking is not supported
- use of too many devices makes system difficult to implement

Illustrations

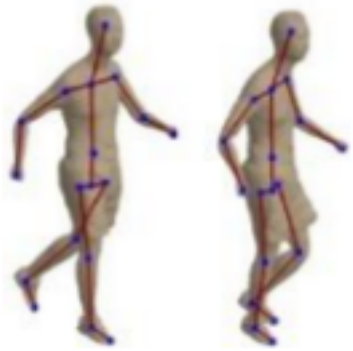
0.1.7 Scanning 3D full human bodies using kinect

Research Paper: Tong, Jing, et al. "Scanning 3d full human bodies using kinects." Visualization and Computer Graphics, IEEE Transactions on 18.4 (2012): 643-650.

Pros and Cons

- inference phenomenon is handled using multiplekinect.
- complex occlusions are handled
- reduces funding of implementation
- algorithm is memory efficient
- quality of reconstructed model is still poor.
- misalignments still occur
- unnatural bending in arm areas

Illustrations



0.1.8 Skeleton Tracking using kinect sensor and displaying in 3d virtual scene

Research Paper: Chanjira Sinthanayothin, Nonlapas Wongwaen, Wisarut Bholsithi. Skeleton Tracking using Kinect Sensor Displaying in 3D Virtual Scene. International Journal of Advancements in Computing Technology. IJACT: International Journal of Advancements in Computing Technology, Vol. 4, No.11, pp. 213 - 223, 2012.

Pros and Cons

- Bone joint movements are detected in real time with correct position tracking
- No support for occlusion

Illustrations

0.1.9 Motion Capture by Kinect

Research Paper: Karina Hadad de Souza, Rosilane Ribeiro da Mota. Motion Capture by inect. SBC - roceedings of SB ames, X SB ames – Bras lia – DF – Brazil, November 2nd - 4th, 2012.

Pros and Cons

- Multiple kinect support for motion capture
- increase in precision of system
- occlusion handled with use of multiple kinect
- not good enough performance
- with use of multiple kinect data processing increase

Illustrations

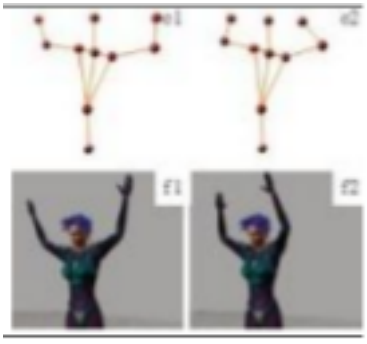
0.1.10 Unsupervised Skeleton extraction and Motion Capture from Kinect video via 3D deformable matching

Research Paper: Zhang, Quanshi, et al. "Unsupervised skeleton extraction and motion capture from 3D deformable matching." Neurocomputing 100 (2013): 170-182.

Pros and Cons

- more robust approach than others
- good performance
- no support for occlusion in case when a person folds his hands together

Illustrations



0.1.11 Real time Physical modeling of character movements with microsoft kinect

Research Paper: Shum, Hubert, and Edmond SL Ho. "Real-time physical modelling of character movements with microsoft kinect." Proceedings of the 18th ACM symposium on Virtual reality software and technology. ACM, 2012.

Pros and Cons

- proposed algorithm is computationally efficient and can be applied to wide variety of interactive VR applications
- no support for occlusions and noise handling

Illustrations

0.2 Survey of body and skeleton tracking techniques

0.2.1 Optical Motion Capture

Research Paper: Fern'ndez-Baena, Adso, Antonio Susin, and Xavier Lligadas. "Biomechanical validation of upper-body and lower-body joint movements of kinect motion capture data for rehabilitation treatments." Intelligent Networking and Collaborative Systems (INCoS), 2012 4th International Conference on.IEEE, 2012.

Applications

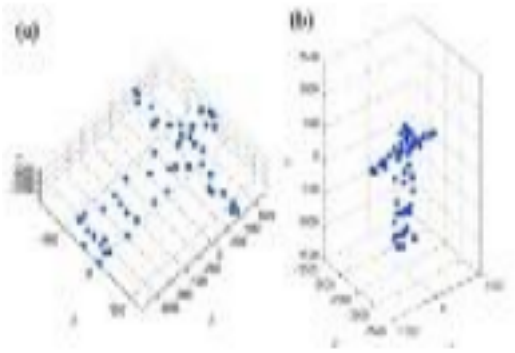
Biomechanical validation of upper body and lower body joint movements of kinect motion capture data for rehabilitation treatments

Pros and Cons

- Reducing funding of implementation
- Comparison of Kinect motion capture with optical motion capture
- gives fairly good results

- lack of precision in system
- approximation of joints and bones not done

Illustrations



0.2.2 Randomized decision forests

Research Paper: J. Shotton, A. Fitzgibbon, M. Cook, T. Sharp, M. Finocchio, R. Moore, A. Kipman, and A. Blake. Real-time human pose recognition in parts from single depth images. In Computer Vision and Pattern Recognition (CVPR), 2011 IEEE Conference on, pages 1297 –1304, june 2011.

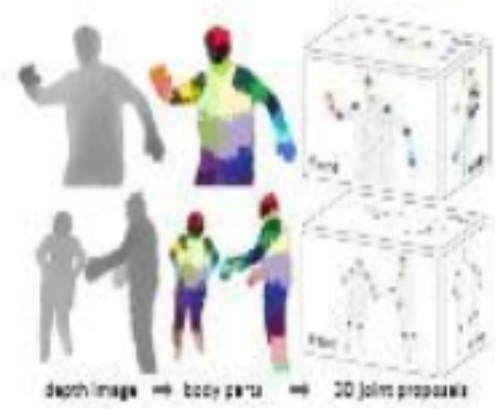
Applications

Real time human pose recognition in parts from single depth camera

Pros and Cons

- quickly and accurately predicts 3D positions of body joints from single depth image, using no temporal information
- ability to run the classifier in parallel on each pixel on a GPU to increase the speed.
- using large and highly varied training dataset to estimate body parts invariants to pose, body shape, clothing, etc. to pose the relation between two adjacent parts.

Illustrations



0.2.3 Decentralized articulated object tracking. heirarchial articulated object tracking

Research Paper: Qu, Wei, and Dan Schonfeld. "Real-time decentralized articulated motion analysis and object tracking from videos." Image Processing, IEEE Transactions on 16.8 (2007): 2129-2138.

Applications

Real time decentralized articulated motion analysis and object tracking from videos

Pros and Cons

- fast and easy to implement
- results are not shown in case of self-occlusion due to the fact that it cannot pose relation between two adjacent parts.

Illustrations

0.2.4 position tracking based on a kalman filter, multiple particle-filter tracking based on 2D articulated motion

Research Paper: del Rincón, Jesús Martínez, et al. "Tracking human position and lower body parts using Kalman and particle filters constrained by human biomechanics." Systems, Man, and Cybernetics, Part B: Cybernetics, IEEE Transactions on 41.1 (2011): 26-37.

Applications

Tracking human position and lower body parts using kalman and particle filter constrained by human biomechanics.

Pros and Cons

- bipedal motion is handled without any constraints
- occlusion is seen in case of pivot joints.

Illustrations

0.2.5 Gaussian process annealed particle filter

Research Paper: Raskin, Leonid, Michael Rudzsky, and Ehud Rivlin. "Dimensionality reduction using a Gaussian Process Annealed Particle Filter for tracking and classification of articulated body motions." Computer Vision and Image Understanding 115.4 (2011): 503-519.

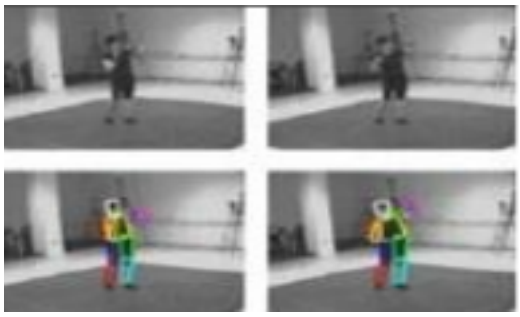
Applications

Gaussian process annealed particle filter for tracking and classification of articulated body motions.

Pros and Cons

- robust than heirarchial annealed particle filter.
- less errors
- in case of hugging motion classification fails.
- cross validation is needed to classify ambiguous types of motion

Illustrations



0.2.6 Recursive Bayesian Tracking for articulated objects

Research Paper: Bernier, Olivier, Pascal Cheung-Mon-Chan, and Arnaud Bouguet. "Fast nonparametric belief propagation for real-time stereo articulated body tracking." Computer Vision and Image Understanding 113.1 (2009): 29-47.

Applications

fast non parametric belief propogation for real-time the tri axis internal/ magnetic sensors package

Pros and Cons

- good results shown arm movements to various human positions
- slow processing rates.

Illustrations

0.2.7 Kalman based fusion algorithm

Research Paper: Zhu, Rong, and Zhaoying Zhou. "A real-time articulated human motion tracking using tri-axis inertial/magnetic sensors package." Neural

Systems and Rehabilitation Engineering, IEEE Transactions on 12.2 (2004): 295-302.

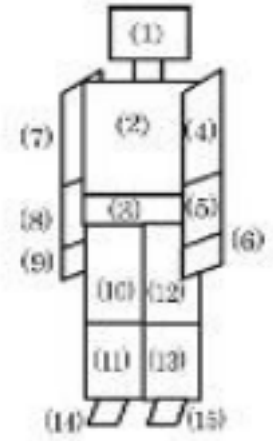
Applications

Real time decentralized articulated motion analysis and object tracking from videos

Pros and Cons

- accurate tracking is achieved by use of kalan filter to eliminate
- time lag is generated du to kalman filter.

Illustrations



0.2.8 Grid based belief propogation algorithm, data-driven markov chain monte carlo

Research Paper: Lee, Mun Wai, and Ramakant Nevatia. "Human pose tracking in monocular sequence using multilevel structured models." Pattern Analysis and Machine Intelligence, IEEE Transactions on 31.1 (2009): 27-38.

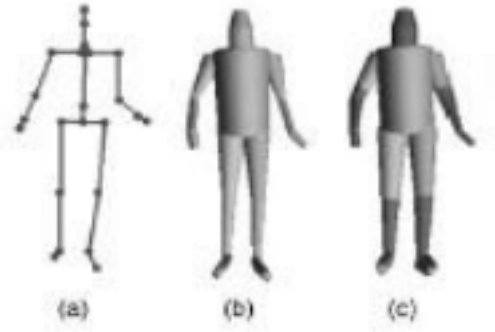
Applications

human pose tracking in monocular sequence using multilevel structured models

Pros and Cons

- less position error due to full pose inference
- longer processing time for rendering hence not suitable for real time application

Illustrations



0.2.9 Annealed Particle Filter, particle filter, factored-state heirarchial hidden markov model

Research Paper: Peursum, Patrick, Svetha Venkatesh, and Geoff West. "A study on smoothing for particle-filtered 3d human body tracking." International Journal of Computer Vision 87.1-2 (2010): 53-74.

Applications

Smoothing for particle filtered 3d human body tracking

Pros and Cons

- smoothed inference techniques are implemented
- occlusion and poor segmentation is handled by heirarchial hidden markov model
- tracking results are not so accurate
- smoothing does not improve body tracking accuracy
- processing time is increased due to smoothing

Illustrations

0.2.10 Variable length markov models, monte-carlo bayesian frame-work

Research Paper: Caillette, Fabrice, Aphrodite Galata, and Toby Howard. "Real-time 3-D human body tracking using learnt models of behaviour." Computer Vision and Image Understanding 109.2 (2008): 112-125.

Applications

real time 3d human body tracking using learnt models of behavior

Pros and Cons

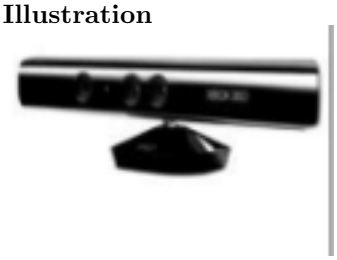
- capable of handling fast and complex motions in real time
- body movements are captured while elimination jitters
- algorithm is robust and efficient
- simultaneously tracking of multiple subjects has not yet been fully investigated
- dimensionality reduction is needed on learning cluster

Illustrations

0.3 Survey of different depth cameras with their specifications

Kinect Camera

Illustration



Viewing Angle 43°vertical by 57°horizontal
Device Range Minimum 0.8 meter to maximum 4 meter
Frame Rate 12 and 30 frames per second
Rsolution 1280 x 9960 resolution
IR Camera Yes
Microphone array Yes
OS Support Windows
Comments

- widely used for gaming and application development
- drivers are made available from Microsoft as well as third party drivers are also available

Sony Playstation Eye

Illustration

Viewing Angle 56˚to 75˚field of view
Device Range Minimum 0.3 meter
Frame Rate 75 and 187 frames per second
Rsolution 380 x 240 resolution at 12 FPS or a 640 x 480 resolution at 75 FPS
IR Camera No
Microphone array Yes
OS Support Windows, Mac OS, Linux
Comments

- drivers are still not available from Sony
- play station playing experience is enhanced

Prime Sense Sensor

Illustration

Viewing Angle 57.5˚to 45˚field of view
Device Range Minimum 0.8 meter to maximum 3.5 meter
Frame Rate 60 frames per second (FPS)
Rsolution 640 x 480 resolution
IR Camera Yes
Microphone array Yes
OS Support Windows, Linux
Comments

- best depth performance
- low power consumption
- OpenNI compatible

Intel's Creative Camera

Illustration

Viewing Angle 73˚field of view (diagonal)
Device Range Minimum 0.15 meter to maximum 0.99 meter
Frame Rate 30 frames per second (FPS)
Rsolution 1280 x 720 resolution
IR Camera Yes
Microphone array Yes
OS Support Windows
Comments

- very limited range
- portable camera with HD support
- drivers are made availablem from Intel

0.4 Comparison of Natural User Interfaces(NUI) libraries

0.4.1 Microsoft Kinect SDK

Pros

- Easy to install, fairly widespread
- new version supports skeleton tracking
- able to grab full 1280x960 resolution of camera
- predictive tracking of joints
- skeleton recognition is done very fast
- joint occlusions handled
- description of sdk architecture and documentation for the APIs

Cons

- support for windows only
- limited language support, only for c/c++ and c
- higher processing power

0.4.2 OpenNI/Nite

Pros

- very poppular, ready to use methods
- supports skeleton tracking
- available for most languages
- any OS compatible

Cons

- difficult to install
- calibration pose is reqiored
- no predictive tracking
- joint occlusion not handled properly
- gets confused with very fast movements

0.4.3 Libfreenect

Pros

- Support for several applications
- any OS compatible
- available for most languages

Cons

- difficult to install
- no skeleton tracking

0.4.4 CL NUI

Pros

- can capture wide range of body movements
- camera noise can be filtered

Cons

- cannot perform motion prediction
- no support for occlusion handling

0.4.5 Evoluce SDK

Pros

- supports various gesture recognition methods
- easy to install
- supports skeleton tracking

Cons

- only for windows 7
- calibration pose is required
- limited language support, only for C/C++ and C.

0.4.6 Delicode NImate

Pros

- quite fast
- supports skeleton tracking
- does not require camera calibration

Cons

- skeleton tracking not done properly
- only for windows