









**Figure 4:** The server uses a *Kinect* to continuously track the users' skeletons and calculate their aiming direction.

### Conclusion and Future Work

We have shown a novel way to allow users to take control of networked devices located in a smart environment. The known *Point&Click* paradigm was extended to move all services needed for intuitive interaction to a server in the same space. In future work we plan to overcome some of the usability limitations that we could identify in first evaluations. One of them is the explicit registration step required before the interaction. Through the use of accelerometer data, it should be possible to correlate smartphone movement and *Kinect* data in a more intuitive way. The sensors could also be used to enable more natural gesture based interaction with the controlled appliances. The second issue is the (re-)localization of appliances in the smart space. We are currently experimenting to use the same *Point&Click* interaction to infer device locations. In theory the user should be able to specify the position of a new or moved device by targeting

it from two to three different places, even if it is not in the *Kinect*'s field of view. Other possible technical improvements of the system are porting the application to a platform-independent implementation relying on *HTML5* and adding support for other control modalities, such as IR or Bluetooth, through the server. Lastly, employing multiple *Kinects* would allow for a larger coverage of the smart environment, reducing blind spots.

### References

- [1] Beigl, M. Point & Click – Interaction in Smart Environments. In *Proc. HUC*, Springer (1999).
- [2] Bernardos, A. M., Casar, J. R., Cano, J., and Bergesio, L. Enhancing Interaction With Smart Objects Through Mobile Devices. In *Proc. MobiWac* (2011).
- [3] Fleer, D., and Leichsenring, C. MISO: A Context-Sensitive Multimodal Interface for Smart Objects Based on Hand Gestures and Finger Snaps. In *Adj. proc. UIST*, ACM (2012), 93–94.
- [4] Ringwald, M. UbiControl: Providing New and Easy Ways to Interact With Various Consumer Devices. In *Adj. Proc. Ubicomp* (2002), 81.
- [5] Roduner, C., Langheinrich, M., Floerkemeier, C., and Schwarzentrub, B. Operating Appliances with Mobile Phones - Strengths and Limits of a Universal Interaction Device. In *Proc. PERVASIVE* (2007).
- [6] Schmidt, D., Molyneaux, D., and Cao, X. PIControl: Using a Handheld Projector for Direct Control of Physical Devices Through Visible Light. In *Proc. UIST*, ACM (2012), 379–388.
- [7] Wu, J., Pan, G., Zhang, D., Li, S., and Wu, Z. MagicPhone: Pointing & Interacting. In *Adj. proc. Ubicomp*, ACM (2010).
- [8] Zimmermann, G., Vanderheiden, G., and Gilman, A. Prototype Implementations for a Universal Remote Console Specification. In *CHI EA '02*, ACM (2002).