Assistive Technologies to Support Distance Learning for Students with Disabilities

Davide Mulfari
University of Messina
University of Pisa
Italy

Salvatore Mulfari
University of Messina
Italy

ABSTRACT

Nowadays, the videoconferencing technology can meet the demands of university students who are unable to attend lectures held in a classroom. However, persons with disabilities, especially those with severe motor impairments, may face difficulties in controlling many video conference devices, like motorized Internet Protocol (IP) cameras. In order to address these issues, we propose an initial study regarding the usage of assistive technology systems aimed at simplifying access and control of such kind of networked cameras. In particular, by using low cost sensors and existing assistive technologies, a personalized human computer interface has been prototyped to better support the interaction between the remote student with a disability and the academic environment The paper describes the first design of the system and its initial implementation.

CCS CONCEPTS

• **Human-centered computing** → **Accessibility**; *Accessibility systems and tools*;

KEYWORDS

Assistive Technology; Students; Video Conferencing; Camera; Pan Tilt; Sensors

ACM Reference Format:
Davide Mulfari and Salvatore Mulfari. 2018. Assistive Technologies to Support Distance Learning for Students with Disabilities. In *International Conference on Smart Objects and Technologies for Social Good (Goodtechs '18), November 28–30, 2018, Bologna, Italy.* ACM, New York, NY, USA, 2 pages. https://doi.org/10.1145/3284869.3284927

INTRODUCTION

In the field of Information and Communication Technology (ICT), video conferencing allows two or more users in different locations to hold live, face-to-face meetings without having to move to a single location together [2]. Regarding an academic scenario, this technology offers many opportunities to share, in real time, frontal teaching activities with students who are away from an university classroom [3] due to several reasons. In these conditions, typically the remote student can rely on a video conference based on a popular software solutions (e.g., Microsoft's Skype or Google's Hangout) using a fixed webcam connected to a computer placed in the classroom. However, in such a way, the remote student may not benefit from a more advanced video conference systems based on motorized cameras that improves the interaction between the remote student and the class.

Furthermore conducting a video conference may represent a technical resource in order to connect a traditional classroom setting with students with disabilities who are based a considerable distance from the university headquarters [1]. By considering the potential demands of these users, ICT - based Assistive Technology (AT) solutions can be used to simplify access and control of the video conference system for the remote person with a disability [4]. In this paper, the core component of our video conferencing platform is a motorized Pan Tilt Zoom (PTZ) Internet Protocol (IP) camera, which is located in an university classroom and it is intended to stream live academic lectures over the Internet. To support the interaction between the remote student and the academic environment, we propose the design of a personalized human computer interface (HCI) to control the main functionalities of the camera, such as pan tilt movements and zooming. In the depicted applications, our target users are remote students with severe motor impairments, who are unable to access computer-based system by using traditional input devices. As an alternative human computer interface, the designed HCI system takes input from a set of sensors (or assistive technology devices) and converts these digital signals into discrete commands for the motorized system. The rest of the paper presents an early implementation of an alternative HCI platform to control the remote camera interface, according to a one-to-one interaction model.

1 HUMAN COMPUTER INTERFACE DESCRIPTION

The term *PTZ IP camera* refers to a kind of networked camera allowing end user to control the movement and position of the lens from a remote location using controls on an Internet browser or software application for computers and mobiles. In particular, regarding the displacement, panning refers to horizontal movement of the lens where tilting describes vertical movement. The remote control of a motorized PTZ IP camera requires a discrete set of input commands typically available on a web browser interface for personal computers

Goodtechs '18, November 28–30, 2018, Bologna, Italy

ACM ISBN 978-1-4503-6581-9/18/11.
https://doi.org/10.1145/3284869.3284927

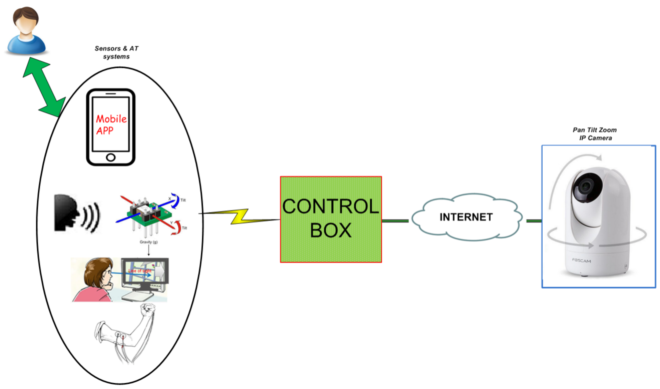

Figure 1: Reference scenario. The control box as an interface between sensors and PTZ IP camera.

or a mobile application for smart phones. However, many users with disabilities, especially those with severe motor impairments (e.g., spastic quadriplegia), face difficulties in using such pieces of software for managing cameras by means of traditional input devices, such as mouse, keyboard or touchpad. In order to address these issue, we propose the combination between sensors and existing AT systems to achieve an accessible control of network camera's functions, including pan / tilt movements and zoom control. Additionally, the chosen IP camera supports a Real Time Streaming Protocol (RTSP) connection to transmit both audio and video signal in real time: in particular, the audio signal may be captured from a wireless microphone and sent over the net; therefore the remote user, e.g., the student, uses any device equipped with a RTSP software client (such a desktop computer, tablet or smart phone) to get the live video and audio. Moreover, the usage of a moving camera may be an useful aid for a student who wishes to produce notes during the lectures: indeed, he can use dedicated camera's functionalities for taking pictures or recording video stream.

With reference to Figure 1, we focus on the development of the *Control Box* component: it acts as a piece of interface between external sensors (or already customized AT tools) and the PTZ IP camera. In the proposed scenario, external sensors and AT solutions may include: mobile applications for mobiles (smart phones, smart watches and tablets), speech recognition software, inertial motion units, eye tracking system or electromyography sensor. These devices provide discrete output signals, which can be related with network commands for the remote motorized camera. For these reasons, the control box functions may be implemented via a pure software (for example, an app for smart phones interacting with the on-board sensors) or may require a combination between pieces of software and specialized hardware components. To provide an initial implementation of the Control Box system, a mobile application for Android smart phones has been prototyped. Here, the mobile device acts as Control Box while it is highly coupled with its onboard sensors. Several software features can be summarized as follows:

- **Speech recognition.** By using the mobile 's microphone, it mainly allows users to associate a set of personalized vocal commands with IP camera's pan tilt movements and actions, like zooming or taking pictures.
- **Motion sensors.** This function uses mobile's motion sensors to detect body controlled movements which may be translated into pan / tilt movements for the camera. Additionally, in a separate configuration, the inertial motion unit is enclosed within a wearable platform and it is not invasive for its user; the reduced size allows us to place it on several body locations, so we can appreciate a wide range of well controlled body movements.

2 CONCLUSION AND FUTURE WORKS

Nowadays, supporting the education of persons with disabilities represents a challenge in an academic context: if the student is unable to attend lectures held in an university classroom, it is critical to provide him with the ability of using video conference tools over the Internet. Additionally, ICT-based assistive technologies may simplify the access and the remote control of a video conferencing component, such as a motorized pan tilt IP camera. In this paper, we have considered the demands of remote students with severe motor impairments and we move an initial step toward the design of a personalized HCI system. As an alternative human computer interface, the designed HCI system takes input from a set of sensors (or assistive technology devices) and converts these digital signals into discrete commands for the motorized network camera.

Future research directions will investigate a concrete implementation of the proposed prototype with the aim of conducting remote teaching activities with individuals with disabilities. Additionally, in future work we plan to evaluate the system and to prove its usability in collaboration with many disabled students attending the University of Messina, Italy.

3 ACKNOWLEDGEMENTS

The authors wish to thank Fiammetta Conforto and Giacomo Fiumara for their support and helpful discussions.

REFERENCES

[1] Sheryl Burgstahler, Bill Corrigan, and Joan McCarter. 2004. Making distance learning courses accessible to students and instructors with disabilities: A case study. *The Internet and higher education* 7, 3 (2004), 233–246.
[2] Mehmet Reha Civanlar, Alexandros Eleftheriadis, Danny Hong, and Ofer Shapiro. 2016. System and method for scalable and low-delay videoconferencing using scalable video coding. (Aug. 23 2016). US Patent 9,426,499.
[3] Christopher D Howes. 2018. Creative Collaboration in Higher Education: A Guide for Distance Learning Technologies. (2018).
[4] Stacie L Robertson. 2018. The Role of Technology in Service Delivery for People with Disabilities in Rural Communities. In *Disability and Vocational Rehabilitation in Rural Settings*. Springer, 59–76.