RemoTouch: human avatar for tactile perception

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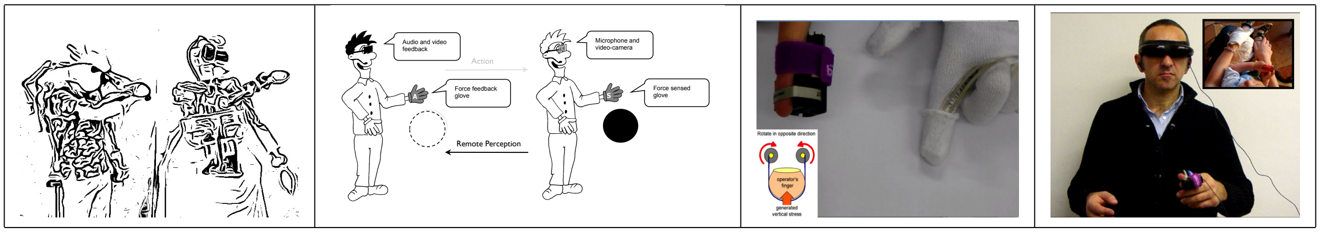

Figure 1: *Robotic teleoperation (1.1). The scheme of RemoTouch (1.2). The tactile and sensor devices (1.3). Touching the baby (1.4).*

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Humans have always attempted to extend their perception abilities to enlarge the *workspace* of the human body. Consider for instance the role played by mobile phones in audio modality. If one thinks about technology for the recording and playback of audio and video, portable devices come to mind. This is not true anymore for *touch* modality. Technology for touching remote objects has typically been used in robotics for teleoperation and the devices used are very far from being portable. In Fig. 1.1, a teleoperation system is represented: a robot is used as slave in the remote scenario and an exoskeleton allows the feedback of contact forces, which are sent to the human operator. Technology for teleoperation is very advanced but it is not portable, cheap or widely used in everyday life.

The RemoTouch Idea

An alternative solution for remote tactile perception is presented in Fig. 1.2 and consists of

- substituting the slave robot with a human operator and
- substituting the exoskeleton, or other cumbersome interfaces, with a simple and wearable tactile device.

The device in charge of recording tactile perception is not a robot, as it is for teleoperation, but instead, a *human avatar*. It is able to collect tactile signals, along with audio and video signals, used as feedback which is sent to the remote user. This is what we refer to as remote perception in Fig. 1.2. In the experimental demonstrations, conventional techniques have been used to synchronize these different typologies of signals. The human avatar puts on a glove equipped with commercial piezoresistive force sensors, model FlexiForce A201 (Fig. 1.3).

Regarding the user, the force feedback recorded by the human avatar is presented to the user using a simple and wearable tactile display shown in Fig. 1.3, developed in [Minamizawa et al. 2007] and adapted to RemoTouch. It consists of two motors and a belt able to deform the fingertip according to the contact force measured by the remote instrumented glove. Note that the force feedback is only tactile and the kinesthetic feedback is missed. Recently, results have been presented in robotics literature, explaining to what extent the kinesthetic feedback can be substituted with just tactile feedback [Minamizawa et al. 2010]. Practical experiments have shown that this lack of feedback in force is well compensated by the presence of other modalities like video and audio feedback, which are extensively used in our experimental demonstrations.

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Demonstrations and Discussion

Two demonstrations are presented in the video: the first shows RemoTouch performing the task of touching a baby: the father, far from home, shares the same tactile experience with the mother while she is touching their child. The context is very important here: having a tactile interaction with their own child is extremely immersive thus compensating for the lack of kinesthetic feedback and other lacking factors of realism. Note that the context is so important in this case that the father naturally tends to assume almost the same posture as his wife, in the arms and hands. The second experience deals with music playing and listening: another very involving experience in everyday life. The user plays the piano and records the tactile experience, with the instrumented glove, to be played back to another remote user at a different time.

The demo session will consist of the on–line touch experience with human avatars.

An important feature of RemoTouch is that the involved technology is low–cost and low–energy consumption. Of course this is a consequence of choosing a human avatar which is not a secondary point, but the main point of our project. We believe that new interaction paradigms can be developed with human avatars based on the RemoTouch project.

The main criticism to this work is that the performance of the overall system has been sacrificed in exchange for the portability and wear-ability of the devices. Again, we believe that the prototype proposed in this work will stimulate the birth of new ideas and paradigms for applications in telepresence and teleoperation. Regarding teleoperation, note that RemoTouch deals only with the remote perception while the action needed to control the remote avatar (Fig. 1.2) is an open and very interesting issue, and will be the object of future investigations

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