***1) Shared-space collaboration***

*How do the robot and humans communicate with each other in order to be transparent about their states, plans, or beliefs?*

The system the robot is connected to uses non-invasive electromyography (EMG) sensors on the users arm to detect changes in muscle activity. The software then uses this information to detect changes in arm level and exertion. The system is also capable of reading hand signals that allow finer control of position. The robot aims to mimic the users movements and respond to commands given by the user. The system can be monitored by a number of parameters, including real time plots for EMG sensor signal and analysis of the processed data.

***2) Challenges of real-world HRI deployment***

*How does the robot ensure that people are safe around it and people feel safe around it?*

The robot does not move very quickly which allows it to minimise risk of colliding with obstacles without human intervention. Additionally the arm disengages when the user relaxes their arm, allowing the user to control when the robot is active or not. The arm also has a screen mounted on it, with either signal and processed data, or a friendly face.

***3) Human-centered design***

*• What media does the robot use to communicate with the human?*

The majority of feedback given from the robot to the human operator is in the form of sympathetic movement. The arm only moves as the human moves their arm, with the aim being to make the arm ‘an extension of yourself’. Primarily this comes from an EMG sensor attached to the bicep and triceps.

*• What does, or should, the robot do if the human does not understand its communication?*

If the robot were to misunderstand a gesture command, the robot would ignore it and remain at the same position. The robot is approximately 70% accurate in identifying hand gestures, this will happen sometimes but the risk of misunderstood commands is minimal. There is significant noise in the signal coming from the EMG, and insufficient data processing could result in the robot drifting or not responding to commands. The RoboRaise team uses a neural network trained on data from previous users to more accurately read the signal.