How to achieve the huggable behavior of the social robot Probo? A reflection on the actuators

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A B S T R A C T
Most robots have a mechanical look or are covered with plastic or metallic shells. Their actuators are stiff which gives them not only an unnatural look, but also an unnatural touch. The goal of the huggable robot Probo is to serve as a robotic research platform for human–robot interaction (HRI) studies with a special focus on children. Since not only cognitive interaction, but also physical interaction is targeted a new mechatronic design must be developed. To achieve Probo a huggable and safe behavior a new set of actuators is developed together with a triple layered protection cover which is presented in this paper. Probo’s soft touch is introduced, on the one side by use of novel passive compliant actuators, Compliant Bowden Cable Driven Actuators (CBCDAs), and on the other side by combining custom made servo motors, Non Back Drivable Servos (NBDSs), with flexible components and materials such as springs, silicon and foam. The working principle of the novel CBIDA is extensively described, together with experiments in order to determine its level of compliance and its bandwidth.

1. Introduction

The overall trend in robotics is that robots will work more frequently with humans. For a good collaboration a good communication between the robot and human is necessary. To communicate in a proper manner the robots can be equipped with some human-like traits, for instance, facial expressions and gestures. According to Mehrabian\textsuperscript{[1]}, most of our communication goes over non-verbal means, like facial expression and gestures. When a robot has these capabilities as well, one can speak of social robots. The face is the most important element to express social cues. For Probo’s face, as well, some compliance is needed.

Most robots have a mechanical look or are covered with plastic or metallic shells. Their actuators are stiff which gives them not only an unnatural look, but also an unnatural touch. The goal of the huggable robot Probo is to serve as a robotic research platform for human–robot interaction (HRI) studies with a special focus on children. Since not only cognitive interaction, but also physical interaction is targeted a new mechatronic design must be developed. To achieve Probo a huggable and safe behavior a new set of actuators is developed together with a triple layered protection cover which is presented in this paper. Probo’s soft touch is introduced, on the one side by use of novel passive compliant actuators, Compliant Bowden Cable Driven Actuators (CBCDAs), and on the other side by combining custom made servo motors, Non Back Drivable Servos (NBDSs), with flexible components and materials such as springs, silicon and foam. The working principle of the novel CBIDA is extensively described, together with experiments in order to determine its level of compliance and its bandwidth.

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