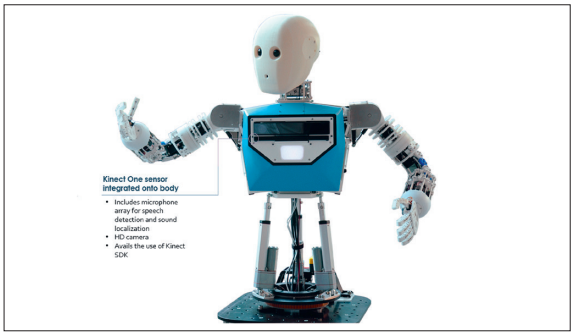
Benjamin Eggimann

Martin Kleiner

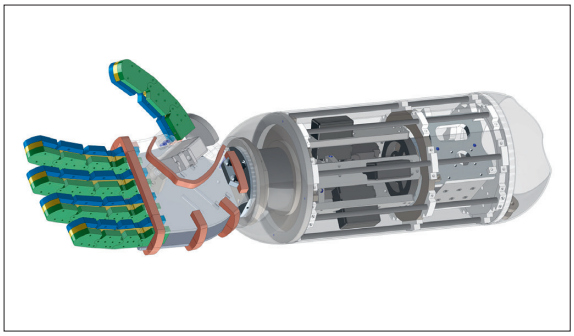
Graduate Candidates	Benjamin Eggimann, Martin Kleiner
Examiner	Prof. Dr. Hanspeter Gysin
Co-Examiner	Prof. Dr. Hans Gut, MAN Diesel & Turbo Schweiz AG, Zürich, ZH
Subject Area	Automation & Robotik
Project Partner	Nanyang Technological University NTU; School of Mechanical & Aerospace Engineering; Robotics Research Centre, Singapur

EDGAR's hand

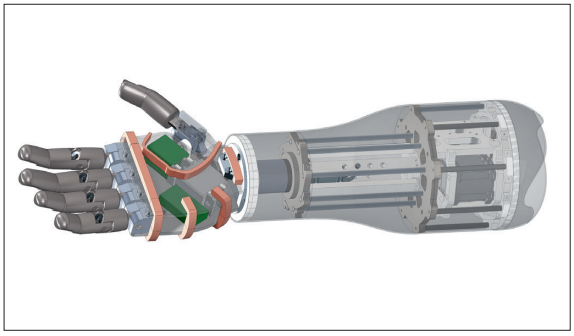
Designing a new hand concept for the «Expression Display & Gesturing Avatar Robot-E.D.G.A.R»



Initial version of EDGAR-2 (NTU)



Existing hand and forearm of EDGAR-2



New hand and forearm concept

Introduction: In the year 2012, Nanyang Technological University (NTU), Singapore, decided to take on an immense challenge of creating artificial intelligence and started the project called «Expression Display & Gesturing Avatar Robot-E.D.G.A.R». The main aim of this project was to develop an avatar that has the ability to interact with people all over the world, even at the comfort of their own home with the use of a Microsoft Kinect camera. The identified area of application was for the use in teleconferences or other social interactions around the world without the need of a real presence of the interlocutors. Therefore, the avatar is a replication of a human upper body and can assume the face of its user. The media presentation was a success and NTU decided to proceed with EDGAR-2. If the Robot could recognize the voice of the person speaking with the use of voice recognition softwares such as «Siri», an autonomic interaction would be possible. Such a robot would be useful in shopping malls or as a receptionist to answer questions or animate people. At the end of 2015, EDGAR-2 was born. Equipped with a Microsoft Kinect camera and the ability of locating the speaker by its voice, EDGAR-2 is able to locate anyone in a room and have humanlike interactions.

Objective: There is still a lot of work to be done even though EDGAR was materialized. Several problems were identified and these include a bulky and heavy lower arm. Therefore, this project aims to simplify EDGAR's hand and forearm, reducing the numbers of parts and its weight. Furthermore, if a usecase with human interactions comes into question, a handshake ability must be considered. This would require major changes to its structure while implementing flexibility and overload protections.

Result: A new arm concept was developed where the finger actuators have been moved directly into the joint to minimize power loss during force transmission. Therefore, downsizing and simplification of the forearm were viable. The new finger is now driven by an electromagnetic coil and a worm gearbox motor. Using 3D-printing technology allowed integral structures, reducing the number of parts and for this reason the assembly time was substantially reduced. In order to implement a handshake ability, several flexible elements were designed and a wrist flexibility is now implemented. Furthermore, using a bus communication system, the electrical wiring is hassle-free and allows further modifications and modularity.