Online Robot Teaching with Natural Human-Robot Interaction

Human-Robot Interaction
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Outline of the presentation

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Introduction

With the development of new industries robots can

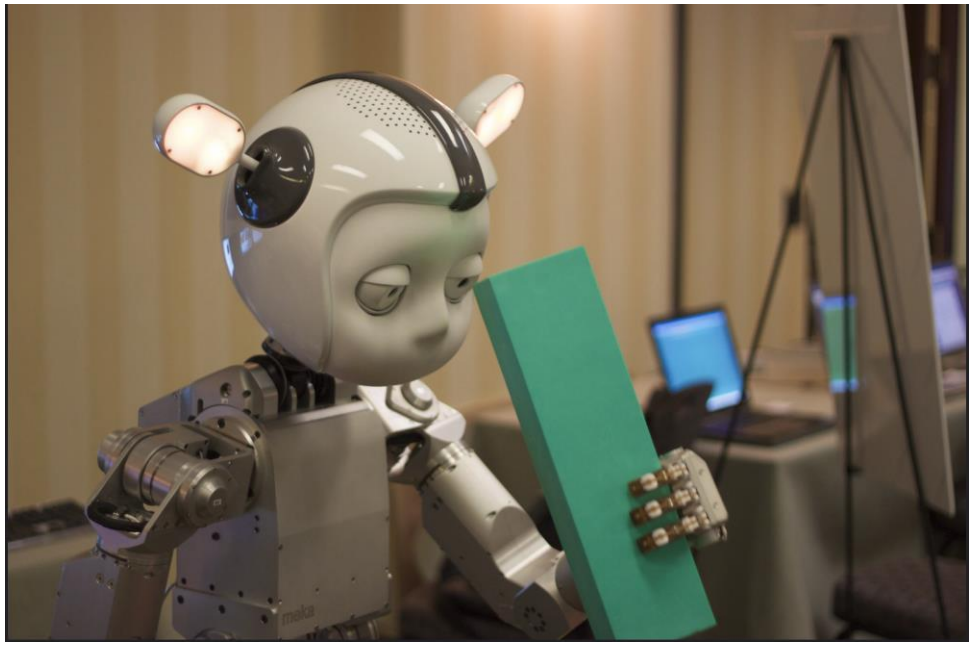
work **collaboratively with humans** in a common area

There are several teaching-playback technologies but operators must be skilled and we want a more **natural interaction**

Online teaching

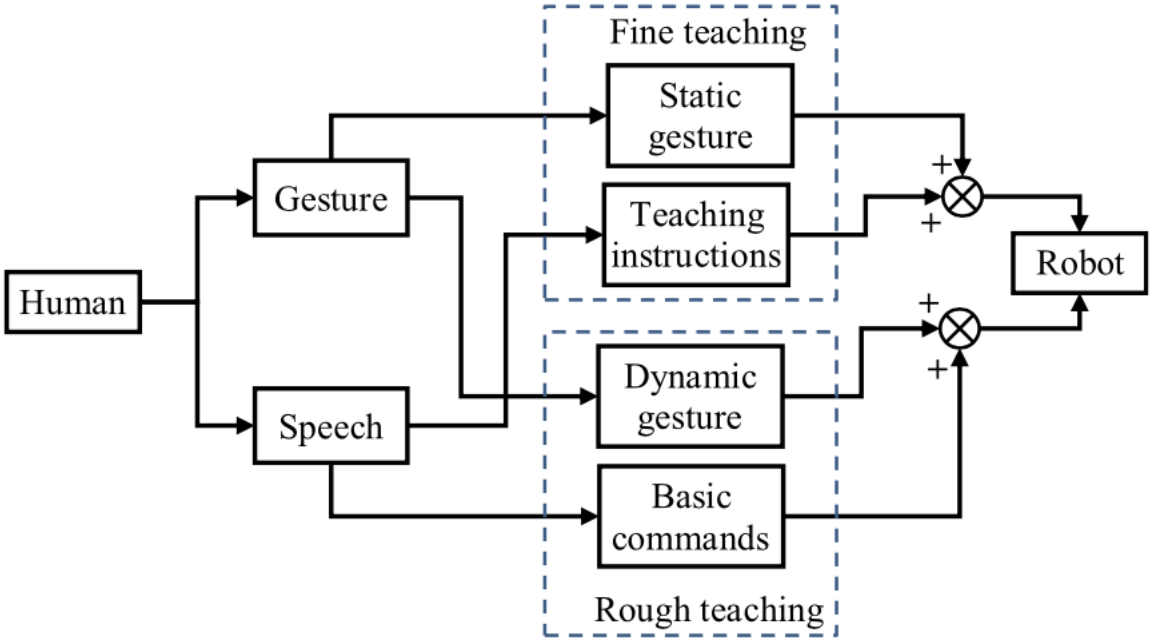
Most of the communication between humans is done through speech and gesture. Robots need to perform a multimodal interaction.
The teaching method proposed by the paper will be focused on:

- **Speech recognition**
- **Motion-sensor technology**
- **Data conversion and fusion**



Online teaching

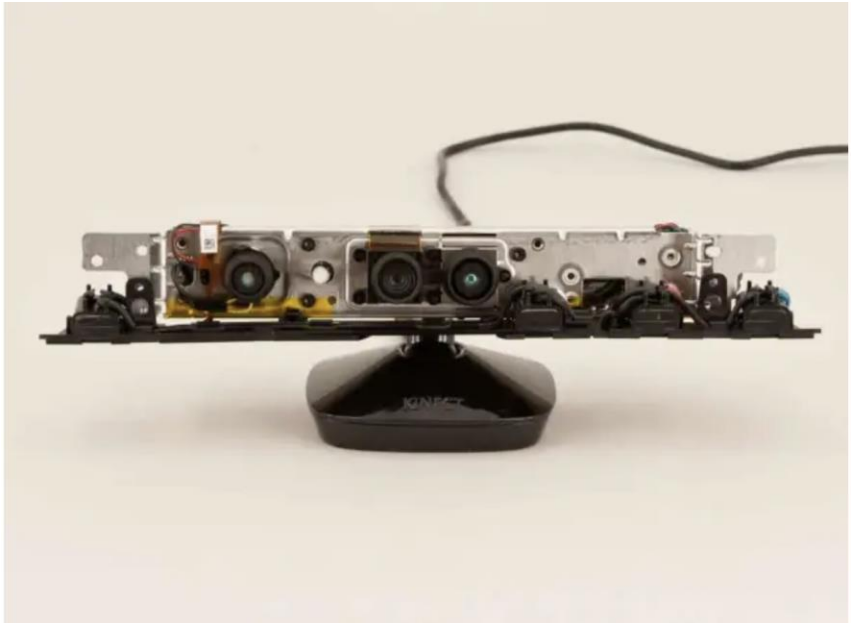
This method is based on the **conversion** of speech data and gesture into **description text**

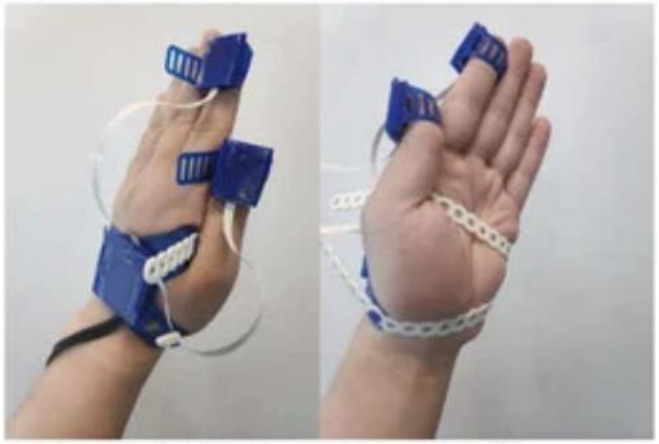


Recognition of hand motion

In order to locate and measure the orientation of the hand of human operator the system uses:

- Kinect Camera
- IMU





Position estimation is performed with a Kalman filter and orientation estimation with an IPF

Text Understanding

First, we need to establish a thorough text control command corpus. Second, we designed a set of effective robot control commands. Third, how to transform the intentions of the user's natural language text into the corresponding robot control commands was considered

The framework consists in 3 layes:

- Input layer: obtain user information
- Interaction layer: text fusion and intention understanding
- Output layer: transform robot control commands into corresponding motion

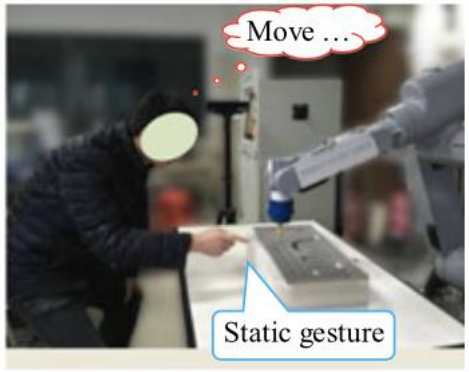
➢Training process
➢Testing process

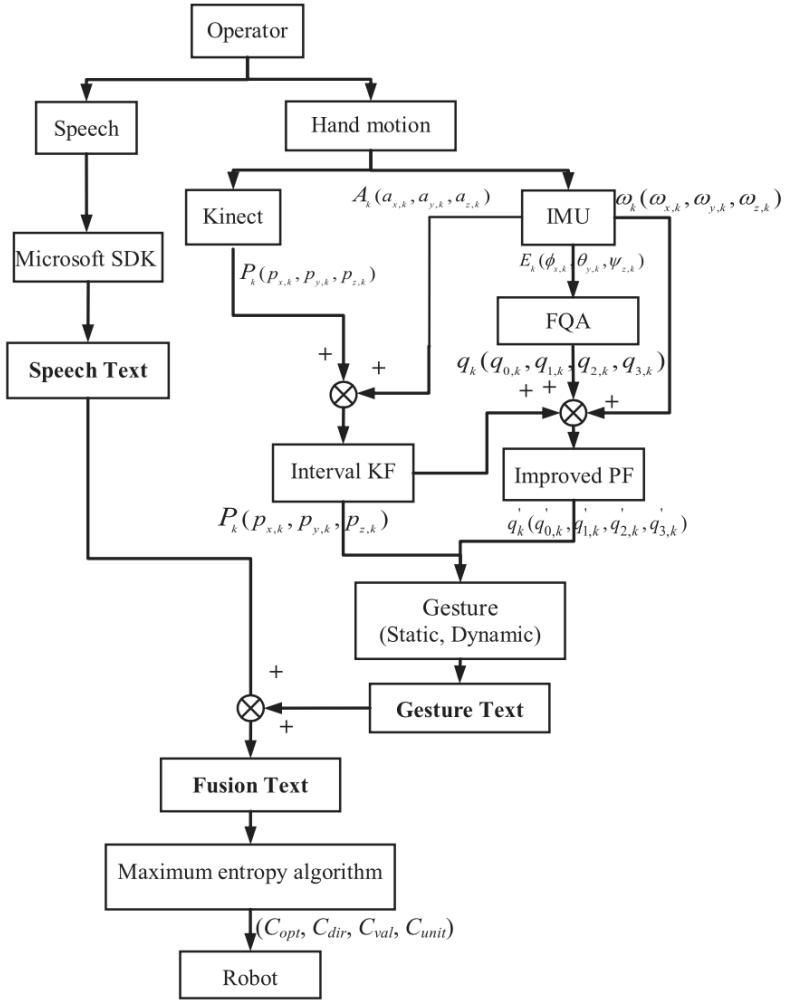
Realization of robot teaching using AVFT

We can capture 2 different gestures:

- Dynamic

- Static





Maximum entropy algorithm extract robot control commands

Experiments and Results

The robot used for the experiment is KUKA KR 6 R700.
A steel plate waas placed in the experiment platform.

EXPERIMENTS

1. The operator needed to guide the robot near the hole and put the peg into the hole. Since the guidance process did not require high accuracy, dynamic gesture was used to complete the guidance process.
2. The operator moved along the trajectory with hand, and then the robot EE repeats the same movement according to the motion data collected by the sensor

RESULTS

The results are based on the idea that the higher the naturalness of the human–robot interaction method, the less time it takes for a new operator to control or use the robot. Comparing it with another method we can see a significant improvement.

Holes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Our method	28.2	27.2	27.5	26.7	27.3	25.3	27.4	27.6	25.6	26.7	26.5	27.4	19.6	20.2	19.5	19.8
Method [9]	44.6	42.3	40.8	42.3	39.8	38.9	39.7	40.6	41.2	44.3	42.1	43.2	33.2	30.5	31.8	31.7
Method [13]	--	--	--	--	47.9	--	--	--	48.8	--	--	--	41.4	46.8	42.3	39.8

Personal Considerations

The Online teaching could prove to be particularly interesting not only in the industrial field but also to be combined with different tasks.

The topic as discussed in the paper has many limitations, especially as regards the accuracy of the method and uncertainty. To increase accuracy, the robot must be equipped with very expensive sensors that estimate continuous movement.

A possible future project could be to use the method also on educational robots. In situations where he is flanked by a person, the teachers themselves can show the robot how to move and gesture to look more human.

References

- Guanglong Du , Mingxuan Chen, Caibing Liu, Bo Zhang, and Ping Zhang
  "Online Robot Teaching With Natural Human–Robot Interaction"