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The view to the current state of robotics

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Abstract. Article examines some of the areas of robotics development. The introduction summarizes the development to present, which stresses the strong emergence of service robots and humanoids. The next section of contribution is devoted to the development of industrial robots. Particularly is emphasized the direction of drives development and are referred to its fundamental properties, which have current industrial robots.

Keywords: service robot, humanoids, development

1. Introduction

Major manufacturers of robots in a period of decline deployment of industrial robots to industry mainly to the automotive industry started to invest more in to the development of robotics for service field, service activities and today also to personal robots. Recent experience shows that these areas open up a wide array of applications. This trend is technically supported by the development of control and communication technology, sensors and drives. The focus is on mobile robots with different handling, respectively technological extension. Their use is almost in every sector of industrial and non industrial sectors. Service robots are developed for many applications, are able to refuel the fuel for cars, airplanes, clean the windows on tall buildings, penetrate to work under the water, and are an invaluable aid in various disasters for firefighters, police and army. They assist to the doctors and know to operate. The emerging new category of robots is called personal robots for fun, sport, and disabled people and so on.

2. The development of robotics

The father of robotics I.F.Engelberger on 26th Symposium ISIR (International Symposium on Industrial Robots) said password „Robotics the Bright Future“. Today, it confirms the development of robotics. Both mobile and service robotics is dynamically developing, but new approaches are also in the improvement of industrial robots. Trend in robotics and emerging category of robotics characterizes Fig. 1. A new category of robots become the service robots, to which ascribed is broad perspective and significant dynamic development. Characteristic feature of the service robots is their mobility and autonomy. Their priority functions are related to the secondary activities, i.e. such, which are not directly involved in the technology process, but conduct the „facilitating“or servicing activities. The service robots differ principally from the industrial robots not only in their construction but also in the set of their utility properties. Difference is mainly in the fact that the service robots are fully autonomous devices, which do not have their activity programmed in details in advance as industrial robots. They conduct their activity step by step and according to the situation development at their working scene and related surroundings. Information needed for such devices are obtained from various types of sensors, for examples for the working area monitoring exploited are the ultrasonic sensors, laser scanners and camera systems.

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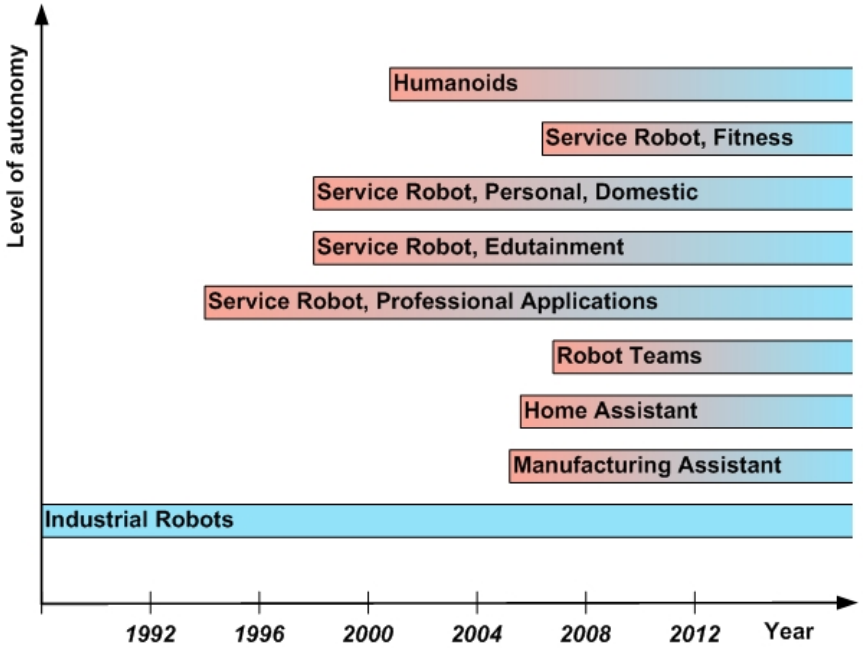

Fig. 1: Roadmap of service robot systems

Significant results were obtained in the development of the humanoid robotics. Humanoid robotics integrates the knowledge and constructions of the industrial and service robots with latest knowledge in the field of cognitive science. The result is the robot with high similarity to human.

New field of the development, along with the construction solutions of the humanoid robots, is their interaction with the human. Recently, in the spotlight of the researcher and experiments, is in the achievement of the movements similar as human.

We can see two directions in the development of the humanoid robots. The first is, to make it to serve as the personal assistant to human – robot partner, and the second – to replace him in many activities.

The field of the Personal Robots application is shown in Fig. 2.

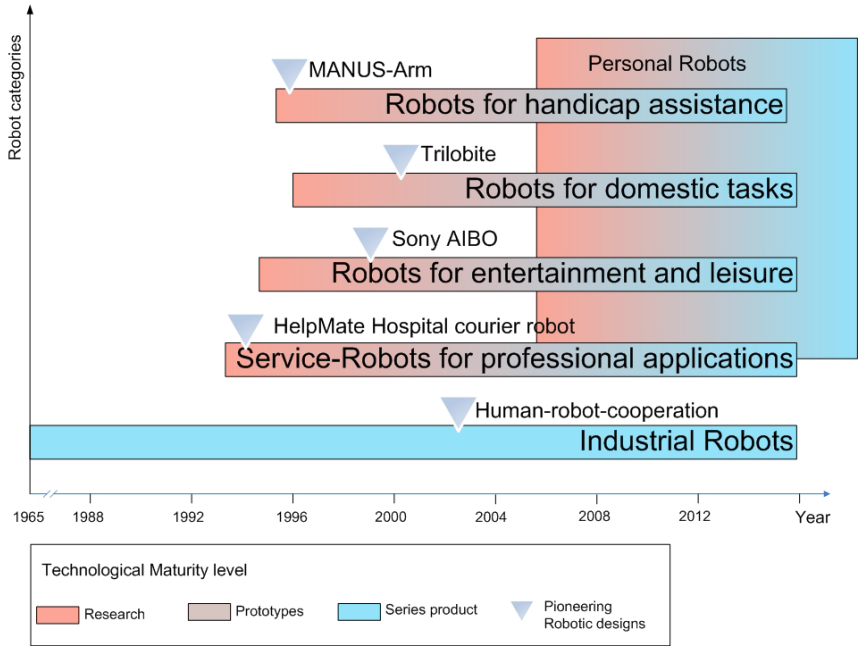

Fig. 2: A roadmap to personal robots

Differences between service and industrial robots in particular are, these:

- construction – architecture and modular structure

- mobility - function of motion in workspace
- control – navigate to reach an aim
- solution of collision situations – detection of obstacles and objects in workspace, method to their avoid
- sensor equipment – incorporation a sensor functions vision, touch
- security – reference in interface human – machine, reference in own security, relation between objects in zone of action

2.1. Developments of industrial robots

The construction of industrial robots is realized with relation on kinematics structure base in two types. First type is a conception with so called opened kinematics chain. Second types are parallel robots. The first type uses a rotational and translational kinematics' pair. This one is most common. Number of independent DoF (degrees of freedom) are five or six in these robots. Main motion system is formed by three movements. Wrist has two to three, usually rotational movement.

The main trends in robot construction of these robots are design of new drives with the aim to reduce a weight, accuracy and performance. These drives are built as intelligent mechatronics systems with direct integration in joint of robot, Fig.3.

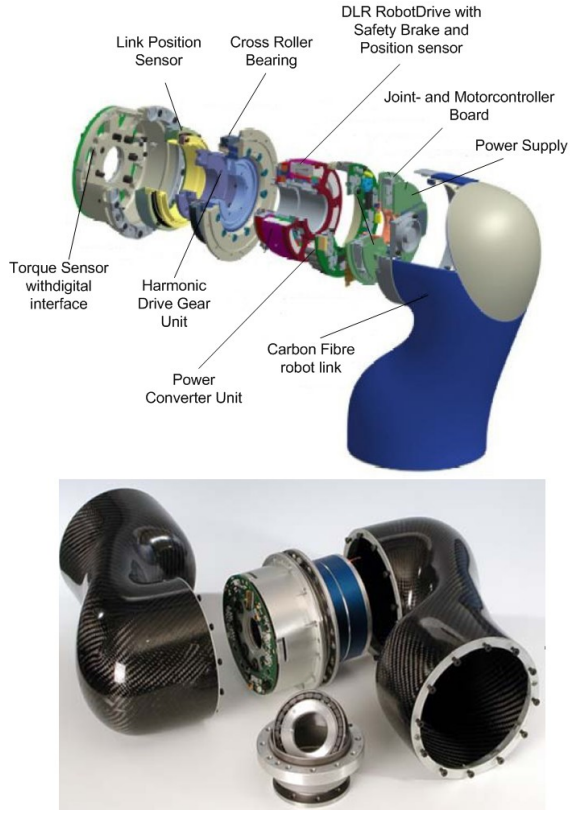

Fig. 3: Intelligent mechatronics systems

Interesting solution of compact integrated two- axis joint was introduced by company Schunk GmbH. This note drive module has two orthogonal location of axis with simultaneous movement in range ± 170o for one axis. A next trend in development of industrial robots is to equip with two arms, so called DUO robots, Fig.4.

Fig. 4: DUO robot

This robots construction copied function of human arms, it has 15- teen and more DoF. They are predetermined for complicated assembly and manipulating operations. For the increasing demands on accuracy, movement speed, but also for reliability, these concepts are no longer able to move its technical capabilities and the respond is the introduce of robots based on the concept of parallel kinematic structures, Fig. 5 (tripod, hexapod,...).

Fig. 5: Tripod and hexapod kinematic structures

Advantages of this robots approach include, for example accuracy to 0.0025 mm, greater speed (up to three times) at high accelerations, the ratio of load to tare is 1:1.7 (in traditional articulated robots is the ratio 1:10) and so on.

Robots with parallel structures, due to its stiffness are conceptually enforced as a "machine", where instead of the grip head bearing the technology unit. Prognosis of their application is directed to the general assembly tasks and tasks requiring high accuracy, e.g. for surgical procedures in medicine. The last decade was mainly characterized by the development of control, sensors applications, communications and information technology, computer intelligence, which alter the existing structure to structure multi-agent. Deployment of robots groups, due to the information link, in an automated process acting as a team of robots Fig. 6, where a failure of one robot does not stop the line, but other robots take over his role, eventually split the role, including the exchange and administration of the instruments.

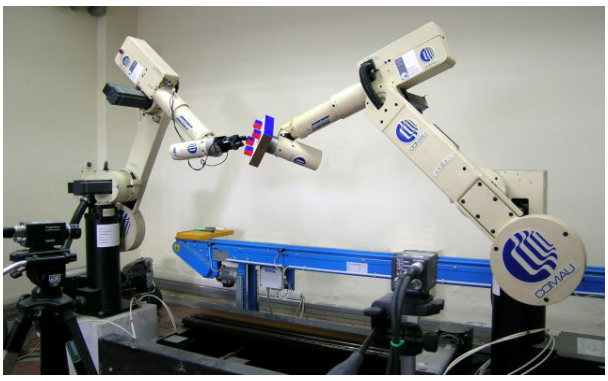

Fig. 6: Robot team acting

Advantages of current industrial robots are in Fig. 7.

Advantages of industrial robots	
*favorable ratio price / performance	* autonomy
* favorable ratio handling area / built up area	* intelligence
* low operating costs	* communicability
* high reliability	* multifunctionality
* immediate installation	* use of virtual reality for off-line programming

Fig. 7: Advantages of current industrial robots

3. Conclusion

Robotics today is one of the most dynamic areas. The robot is a product that incorporates the widest area of research but also the applications. The robot is a product that already appears not only as a "worker" when operating the machine but like as a "surgeon", "chairman", "nurse", "actor", "footballer", "mason", "toy", and "live animal". Although these robots are today still far from actual reality, the development technologies relentlessly reduce this gap.

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