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ÚSTAV AUTOMATIZACE A INFORMATIKY

COMMUNICATION BETWEEN HUMANS AND ROBOTS

KOMUNIKACE MEZI LIDMI A ROBOTY

BACHELOR'S THESIS
BAKALÁŘSKÁ PRÁCE

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ABSTRACT

This work written at the Faculty of Mechanical Engineering, Brno University of Technology, Institute of Automation and Computer Science, deals with the problem of communication between men and robots from nontraditional aspects. It is tried to analyse and divide the ways of the communication, find the problems that are related to this and on their basis analyse possible solutions. It was endeavoured to show some real solutions to these mentioned problems.

ABSTRAKT

Tato práce, která byla psána na Strojní fakultě Vysokého učení technického v Brně, Ústav automatizace a informatiky, se zabývá problémem komunikace mezi lidmi a roboty z netradičního hlediska. Snahou bylo vyhodnotit a rozdělila způsoby této komunikace, najít problémy, které se této oblasti týkají a na jejich základě analyzovat jejich možná řešení. Cílem bylo poukázat na některá reálná řešení zmíněných problémů.

Key words

Robot, Communication, Humans, Man, Machine

Klíčová slova

Robot, komunikace, lidé, člověk, stroj

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Contents:

The List of Used Symbols

ABB ....Asea Brown Boveri s.r.o
RIA ....Robotics Institute of America
APT ....Automatic Programming Tool
ICAM .... Integrated Computer Aided Manufacturing
MCL .... Manufacturing Control Language
VAL ....Versatile Assembly Language
NC ....Machines Computer Numerical Control Machines
XML ....Extended Markup Language
HRI ....Human-Robot Interface
RTOS .... Real-Time Operating System
TMC ....Toyota Motor Corporation
NC ....Numerical Control
JIRA ....Japanese Industrial Robot Association
PC ....Personal Computer
ATT ....Audio Transcription Toolkit
R.U.R. .... Rossum's Universal Robots
ISO ....International Standards Organization

1 Introduction

1.1 The Goal of the Bachelor Thesis

When we hear the word ROBOT what is usually on our mind, is the Czech origin and international use. It was used by Karel Čapek, for the first time, in his drama R.U.R., which means Rossum's Universal Robots. The robots are presented by Čapek as those who speak like people and think like people. Only some things are different from people, for example, they cannot feel. But this is only a vision of Čapek and it is unrealistic. [1]

There are also other authors that focused on the problem of communication between men and robots in their work. They show the upbringing of the robot and the making use of artificial intelligence, but they warn that if no one devotes enough to the importance of talking about this subject, the misuse of robots can bring a big problem for humankind. One of the authors, a professor of an English university, Warwick, whose publication even appeared in Czech translation and who visited VUT in Brno, personally presented his opinions in a speech in the year 2004. [2] The other author is an employee of VUT in Brno at the Faculty of Electrical Engineering and Communication at the Department of Control and Instrumentation. [3]

The number of robots is constantly increasing. The future expects constant growth of the use of robots. It appears that the incapability to use the robot is something that slows down this growth.

For example, if you visit the web side http://www.jobpartner.cz/poradna/trendy-v-poptavce-po-pracovnich-silach:20070809?cat_id=8 , you can find that the Programmer of CNC Machines is at a deficiency in the Czech Republic.

There is a possibility that there will be an increase of the machines needing people that know how to use them, but at the same time, there will not be enough capable people who can communicate with these robots and machines. This looks like a big problem to solve. It is at the same time, the main reason why I have chosen to write my Bachelor thesis about the communication between humans and robots.

1.2 The Actuality of Communication Between Humans And Robots

The main goals of this thesis are derived out of the submission that was given to me:

1) To analyse the relationship problem between humans and robots from the point of mutual communication.
2) To bring together the summary of different approaches for solving the question of the communication between robotic systems and human services.

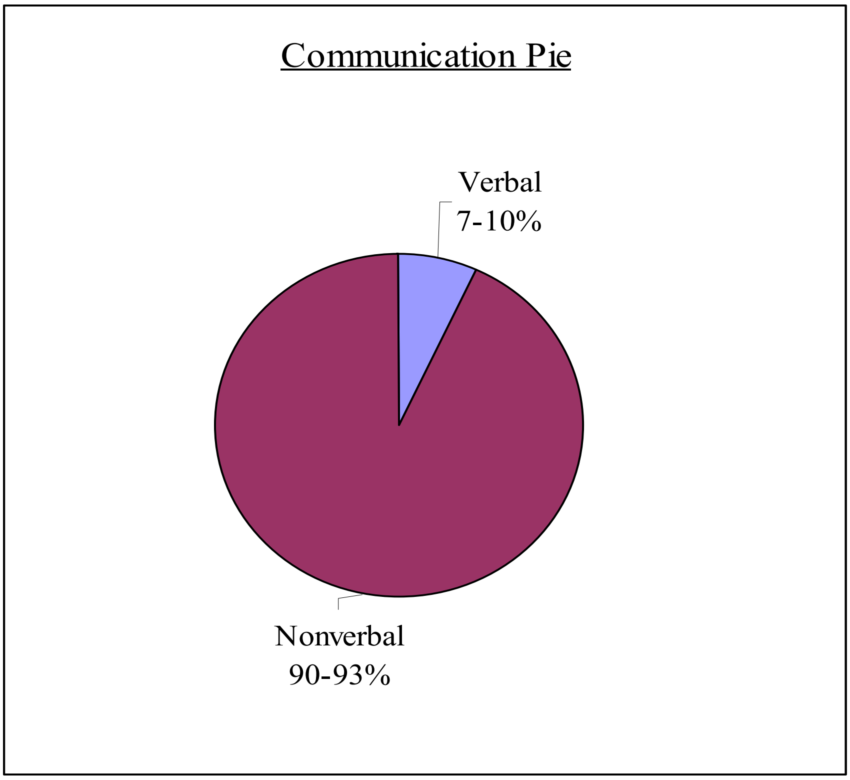
According to one study of the World Robotics 2003, between 770,000 and 1,050,000 pieces of industrial robots were operated all together worldwide. The exact number of robots is very difficult to determine because it is not recorded anywhere. The minimum number is taken from the assumption that takes as the approximate life of a robot, 12 years. On the other side, the maximum number is taken from the approximate life of robot as 15 years. For example, Japan and South Korea (statistics of these countries take together all classes of robots and we cannot compare that with other countries) suggested that there were 375,000 multi-functional robots worldwide by the end of the year 2002. This means that there was an increase of 6% since the year 2001. Out of this number, 233,000 pieces are in the UE and 104,000 pieces are in the USA. [8]

2 Analysis of The Problem

2.1 Communication in General

The communication is defined as a process that allows organisms to exchange information by several methods. [4] Forms of interpersonal communication are dealt out in 2 major groups:

1. Verbal communication – using language as an auditory means by speaking, singing and tone of voice. [4]
2. Nonverbal communication - using physical means, such as body language, sign language, paralanguage, touch, eye contact, or the use of writing. [4]



Picture no.1 – Communication pie, compares how much we use nonverbal communication. [5]

When we briefly talk about the ways of communication that are mainly used while communicating with robots, we would very possibly talk about touch and writing. If we want to program a robot, we need to know the language of the robot.

2.2 Definition of The Word ‚Robot' and Classification of Robots

When we want to talk about communication between humans and robots, we need to understand fully the meaning of the word, robot, as it is used these days and also differentiate the robots we have around us. As I was looking for the diversification, I found several interesting points I would like to bring out.

First of all, we have to clarify the meaning of the word. The English version of Wikipedia explains: „A robot is a mechanical or virtual, artificial agent. It is usually an electromechanical system, which, by its appearance or movements, conveys a sense that it has intent or agency of its own. The word robot can refer to both physical robots and virtual software agents, but the latter are usually referred to as *bots* to differentiate. While there is still discussion about which machines qualify as robots, a typical robot will have several, though not necessarily all of the following properties:

- is not 'natural' i.e. artificially created
- can sense its environment, and manipulate or interact with things in it
- has some degree of intelligence or ability to make choices based on the environment, often using automatic control or a preprogrammed sequence
- is programmable
- moves with one or more axes of rotation or translation
- makes dexterous coordinated movements
- appears to have intent or agency." [6]

After reading this, we may feel that it is quite easy to specify the classes of robots we can see. But the problem is when we see the different classifications. For example, the Robotics Institute of America (RIA) recognizes 4 classes of robots:

- „A: Handling devices with manual control
- B: Automated handling devices with predetermined cycles
- C: Programmable, servo-controlled robots with continuous of point-to-point trajectories
- D: Robots capable of Type C specifications which also acquire information from the environment for intelligent motion.

The contrast is the Japanese Industrial Robot Association (JIRA), which recognizes as many as 6 classes of robots:

- 1: Manual - Handling Devices actuated by an operator
- 2: Fixed Sequence Robot
- 3: Variable-Sequence Robot with easily modified sequence of control
- 4: Playback Robot, which can record a motion for later playback
- 5: Numerical Control Robots with a movement program to teach it tasks manually
- 6: Intelligent robot: that can understand its environment and able to complete the task despite changes in the operation conditions"[6]

Such variation makes it difficult to compare the exact numbers of robots in different countries. For this reason, the International Standards Organization gives a single definition to be used when counting the number of robots in each country. International standard ISO 8373 defines a robot as "an automatically controlled, reprogrammable, multipurpose, manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications." [6]

As we live in the Czech Republic, we are mainly concerned with the classification of the Czech Republic. According to the Czech version of Wikipedia, we can find the following classes of robots:

- 1: Manipulator – a machine without self-intelligence, needing to be conducted
- 2: Kitchen Robot – combination of mixers and other kitchen devices
- 3: Droid – whatever intelligent and self-acting robot
- 4: Andriod – a robot that looks like a human being - we usually expect biological structure. This kind of robot was used in Čapek's R.U.R.
- 5: Humanoid – a robot like a human being, mainly by physique and motion
- 6: Cybernetic organism – a living creature enriched by mechanical or electronic pieces. [7]

After these clear ideas and classifications, I need to specify my goal. I will be talking mainly about humanoid robots.

Presently, the main control member of a robot is (and will be for a long time) a computer. It is important to realize the communication problems with computers.

2.3 The Way of Communication With Humans And Robots

There is a dialogue with a computer – question and answer - and a conversation with a computer. While we discuss the conversation, it is very difficult to identify mistakenly made sentences. Now I will show the conversation more closely using a table:

The ways of communication with a robot

The way	**A Human – The Source of Information**	**Canal**	**A Robot – The Receptor of information**
1	Human delivering by mouth and gestures	Surrounding air and good vision	Looking at the human‘s display by hearing and vision
2	Saying word by mouth	Surrounding air	Reception of the spoken words – Digitalization of language
3	Text of natural language		
3.1	Fingers on the keyboard	Alphanumeric keyboard	The flow of alphanumeric symbols
3.2	Handwritten	Optic detector (digitizer, detector OCR)	The flow of alphanumeric symbols
4	Sounds and noises (tones, whistles, applause, screaming)	Surrounding air	Detector with A/D converter –Electrical signal
5	Sign language	Visible (transparent) environment	Optical exploring
6	Colorful signals (colored hues, Morse signals)	Environment transmitting certain light rays	Detector of certain light rays
7	Limbs (meaning by the body)		
7.1	Handling control members (joystick, track ball, mouse, glove, button, switch…)	Certain control device	Electric signal – numerical or continuous
7.2	Control of PC	Computer boundary	Numerical signal
8	Through nerve impulse	Special detector	Analogical electric signal

Note:
Special robotic language – language for robots.
Long distance transmission through data transmission.

2.4 ROBOCOMM

There was a conference about the communication. It was the First Conference on Robot Communication and Coordination and was called ROBOCOMM. It was held in Athens, Greece, from October 15 to 17, 2007.

The Technical Program Committee was mainly represented by technical universities from the USA, on the second place there were universities from Japan. Europe was represented by these countries: Sweden, Switzerland, Italy, Greece, Portugal, Germany and France.

Robotics is an interdisciplinary field that includes the following key competencies: mechanics, control theory, electronics and communications. The first three areas dominated in their roles. However, in the last two decades we have witnessed the unprecedented growth of wireless communication technologies with networks.

Networked robotics pose significant challenges, requiring the integration of communication theory, software engineering, distributed sensing and control into a common framework. Robots are also unique in that their motion and tasking control systems are co-located with the communications mechanisms.

The main goal of ROBOCOMM was to get the ideas of prominent researchers and to gather and merge different ideas into a common framework that will enable new applications based on large scale networks of mobile robots.

We can quote the list of themes that have something in common with this thesis:

- Robotic interactions with sensors
- Communication protocols for tele-operated and tele-reflexive robots
- Intra-sensor communications within individual robots
- Communication protocols for flocks and warnings for networked robots
- Biologically inspired or biomimetic robot communication
- Exploiting the interactions between communication and autonomy
- Localization and tracking using robotic communications

ROBOCOMM was discussing these themes, stressing more wireless networking aspects for robots. [8]

Even though I tried to contact and get some results of this conference I did not get any response. I wanted to quote this conference to stress the importance of communication with robots and also to show that the technical universities are aware of this issue.

3 Examples of Used Solutions

Currently, the biggest amount of robots, are presented by the industrial robots. This is the result of communication problems between humans and robots. For consideration, I have chosen some specific examples of the artificial languages that are derived from the companies' applications of the industrial robots and other robots.

3.1 Solution of ABB – Rapid Language

The Robotics Department of the ABB Corporate Research Center in China stresses the importance of an easy robot programming application. RAPID hides the complexity of ABB robot programming language by an intuitive graphical programming approach. They did a customer test demonstrating the simplification and speed increase of the process of programming ABB robot. [10]

There is another possibility of robot control languages. Numerous machine languages exist for the control of semi-automated machine tools. These include APT (automatic programming tool) and ICAM (integrated computer aided manufacturing).
McDonnell Douglas Aircraft Company has recently extended APT to MCL (manufacturing control language) in order to program a Cincinnati Milacron T3 robot to rivet sheet metal. Higher-level robot control languages, obvious requirements for advanced automated space systems, include VAL (versatile assembly language) for the Puma robot and "HELP" for the Pragmac robot (Donata and Camera, 1980). The problem of extending high-level languages from comparatively simple machine tools to more sophisticated multi-axis integrated robot systems, which may be found in future automated space factories, must be viewed as a top priority research item.

These specific languages come from the field of CNC machines and industrial robots and were initiated by the distributors of these machines.

On the other side, there are primarily developed languages with the focus on controlling robots, e.g. RoboML.

These specialized languages are derived from the field of the operating of CNC machines and industrial robots and are sponsored by the manufacturers of these devices.

On the other hand, there rise languages that are primarily developed for controlling robots, e.g. RoboML. [20]

3.2 Human-Robot Interaction: City University of Hong Kong

Starting from the early work on Internet-based HRI [human-robot interface], there is a number of successful implementations of tele-operation interfaces via the Internet. Weak quality-of-service guarantees over the Internet, however, limit the applications of Internet-based tele-robotics and suggest using more complex interface models. The need for simplification of robot programming has led to a number of dedicated national projects, e. g. in Japan and in Germany. One way to simplify programming is through utilization of graphical interfaces, e. g. Roboglyph, Robot Programming Simplification Project, Onika. An alternative (and complimentary) strategy is to simplify the underlying data representation so that its interpretation and editing with the help of relatively simple software or directly by a human, is possible.

Our goal is to propose a language for the purposes of Internet-based HRI applications that would unify the languages of the three categories considered above while being transparent for a human with minimal training. Namely, the language should:

• be powerful enough to express everything that can be expressed by the mentioned languages for robotic programming, agent communication and knowledge representation;

• allow its manipulation via relatively simple software or directly by a human; and

• be suitable for cross-platform applications.

In order to satisfy these requirements we utilize Extensible Markup Language (XML) to develop the specification of RoboML - a markup language for robotic applications.

'Robotic Markup Language (RoboML)' means standardized representation of robotics-Related data. On February 02, 2001, Maxim Makatchev, from the Department of Manufacturing Engineering and Engineering Management at the City University of Hong Kong lead a development effort to create a 'Robotic Markup Language (RoboML)' for standardized representation of robotics-related data. The specification would support communication language between human-robot interface agents, as well as between robot-hosted processes and interface processes, and also provide a format for archived data used by human-robot interface agents.

Our goal is to develop a single Internet-oriented language to account for the major needs of the agent-based HRI. We have chosen to use XML as a base for the specification of RoboML, the markup language for robotics. In view of the requirements of the choice to build the language using XML, it is based on the following considerations:

• *Suitability to express what can be expressed by the known languages for robotic programming, agent communication and knowledge representation.* XML has proved to be convenient to describe various types of structured data, as demonstrated by a growing number of XML-based languages for a wide range of domains. The availability of the specifications of XML-based languages for many engineering and scientific domains makes it possible to utilize their studies of ontology and syntactic models and to reduce the work on the design of a new language.

• *Convenience for manipulating by a human by means of simple software or directly.* Despite the fact that XML allows to specify languages with high complexity, understanding the concepts of domain oriented implementations is usually within the capability of non-experts. XML-compliant code is easy to parse and generate by software. The ability to manipulate the language code with the help of relatively simple software and its transparency for the user can be particularly important for service and entertainment robotics. A native support of XML is becoming a de facto standard for web-browsers.

• *Suitability for cross-platform applications.* As a consequence of the adoption of XML as a standard for the WWW and its support by browsers, it is effectively cross-platform. Parsers, translators, browser plug-ins and other types of software components for XML are available for many applications and popular computer platforms. [14]

The conclusions of the University are the following: In order to use the Internet as a communication medium for the human-robot interface, it is required to address a number of specific problems: communication between real-time systems via the channel with low quality-of service guarantees, limited or uncertain computational resources available for the interface client and the embedded software, compliance with the Internet standards, and compatibility with available software. The proxy-mediated HRI model aims at reducing the communication and computational load of embedded and user interface agents and provides means for asynchronous data exchange, accounting for the real-time nature of the embedded agent and, possibly, of the user interface agent. The available data schema and subscribed data schema, expressed in XML Schema definition language, are supported by the proxy agent for each of the data streams to facilitate cross-agent translation and to reduce inter-agent traffic. The XML-based markup language for robotic applications, RoboML, is intended to be used in conjunction with other Internet standards, including other XML-based languages for specific domains.

While the proposed methodologies are being successfully tested, we recognize that much more work needs to be done to refine the formal specifications of the proxy-mediated HRI architecture and RoboML. This work is closely related to the development of the parent Internet standards of XML-based languages and protocols, as well as to the progress in HRI, agent communication, knowledge representation, and robot programming. Possible further directions of work on RoboML include (a) specification of studies of ontology for robot control architectures, multimodal user interfaces, and robot programming, and (b) development of the RoboML application support via applets and browser plug-ins. [14]

3.3 Siemens Handling and Robotics

Siemens presents its solution for handling and robotics by using a device called SINUMERIK. SINUMERIK fuses together NC, handling and robotics. It is a fully digital and easy to operate tool. Different controllers and programming devices were required because the functionality of traditional machine tool controls were insufficient for handling.

It has an especially ergonomically designed handheld terminal that combines the functions of an operator panel and a machine control in a single unit. It allows complete operation and monitoring of a machine and you can use its Teach-in and Programming functions to write user programs easily.

All operation states, messages and actual values are shown on the large pixel-graphic display. The operator prompting helps to modify machine and user data and to program. It is also possible to carry out program corrections and tests, or to read data and programs in or out.

The “Extend operator interface” function makes customized extension of the operator interface possible from the PC or direct via the HT 6 with no additional aids of any kind. Thus you can customize and individualize your SINUMERIK HT 6 with your own dialog boxes, soft keys, texts, graphics and functions.

The global, field-proven SINUMERIK control system offers you the optimal platform for maintaining your competitive edge. By combining NC and handling/robotics, you can use the full functionality of a machine control, a handling controller and a robot controller on a single digital level. So if you want to solve a robotics task at the same time as your machine tool or handling task, you can do it quite simply with one and the same controller – at low cost and in one operation. Drives and controllers are without a doubt, the core of your automation solution. [12]

Picture no. 2 - SINUMERIK 810D SINUMERIK is the perfect automation system for machine tools taken from the website of the Siemens company . [25]

3.4 Robot Linux and The Problem That Exists There

Microsoft doesn’t have a generalized platform of Microsoft Windows for directing applications in real time. This requires a careful consideration of some alternative solutions. The following text that was taken from the online Linux magazine, Linuxexpres, which shows that this kind of platform could be the operating environment Linux,

“Robots in our society have been getting domesticated for many years. It would not surprise anyone to see an intelligent washing machine that is able to wash by itself, and beyond that, kindly talks, a wash station automat that tirelessly washes one car after another, or a humanoid creature that shakes hands with politicians, while conversing wittily.

In recent years, there has been a boom in so-called intelligent robots that are not unmovable, but that need to be able to cope with the traps of the real environment. They may become common consumption electronics as the computers became.

There is an example in Japan, where with the increase of retired people, childless couples and jobless people, expect that the robotic industry will overcome the production of the PCs. There will be a need of helpers that would take care of the retired ones, patients, and children or watch over the house.

Another possible use of robots is as the function of protector so-called ‘smart dust’ – miniature scanner (of temperature, humidity, light, etc.) connected with a wireless network. These robots can then accept information of the ‘dust’ and transmit it and use it for relaying possible future situations.

In recent years there is a recognizable tendency for creating a norm for robotics analogous to classical PCs. We can see the endeavour of big producers to create certain packages for advanced designers to be able to build their own robots and concentrate on the real problems.

The standardization is not going around the field of robotics. It looks that there are some absent unitary factors. This way there are many independent projects that are trying to define the norms for different fields of robotics. There are developed language concepts (mainly on the basis of XML) for communication between robots, e.g. RoboML or SensorML.

At this moment, Linux is becoming useful. It has many advantages for its being open-minded as the advance designers can adjust what they need depending on their wishes. It is also unfailing and very well supplied by different sensors even for networks. One important advantage is its low cost in comparison with its competitions’.

If the robot needs to compete, it must react fast and exactly. The so-called real-time operating system (RTOS) takes care of that. Linux cannot react in itself in real time but is able to react by tacking a special extra core RTLinut." [11]

The final solution depends on the situation of how the platform shown above will extend in practice and how we can see from this material that many applications were produced (e.g. PetrolBot, Velociped ROB-1, TagBots, Isamu). This platform also solves the problems of standardization of communication.

Picture no.3 - Isamu stands 1,346 mm tall, weighs 54,9 kg, and walks at over 1,6 km per hour. Not only that, Isamu climbs up and down stairs, carries 1,8 kg objects in its hand-like grippers, and even recognizes human faces via its dual-camera stereo vision system. [15]

3.5 Robot Toyota

Toyota Motor Corporation (TMC) puts together new technologies for mobility and production that combines with development of new things. They develop robots called „Toyota Partner“ that support humans in everyday life and help to make a future community look forward to health and comfort. Toyota Partner robots were already introduced at the Toyota Group pavilion during a world fair in Aichi in 2005. In the meantime, TMC was intensively improving and directing four areas where they could be the most useful to humans: help with chores, taking care of patients and healthcare, help in the field of production and help for personal short-distance transport. TMC wanted to use for other improvements and the progress of their robots the new developments obtained, by using a robot-guide at the fair vestibule in Toyota Kaikan. [26]

Robot-guide Toyota: basic information	
Type	Prototype with wheels
Main fields of use	Guiding visitors and explaining the exhibits
Characteristics	- Independent motion, allowing the robot to move toward the goal and self-dependently avoiding barriers.
	- Fingers with joints, allowing the robot to give autographs.
	- Verbal communication, allowing the robot to communicate with visitors.
	- Identifying pictures, allowing the robot to read visitors' tags and accordingly give a competent comment.
Height (mm)	1 200 mm
Weight	60 kg

Picture no.4 - Robot-Guide Toyota. [26]

3.6 Robot DaVinci

This kind of robot is present at a hospital in Brno - St. Ann's University Hospital Brno. The supervisor of my bachelor thesis had the opportunity to visit one of the real surgeries using the robot, DaVinci. Let me describe first his experience and then tell more about the robot.

One morning, sometime in February 2008, Doc. Lacko went to see the surgery. When he arrived to the hospital, he was asked to take all his clothes off, clean up, and put a special surgical dress on. It was a little shocking for him, but he followed the instructions without saying anything. Then he was allowed to the operating theatre. There was a patient on an operation table and in a corner there was DaVinci. Of course, it has two parts, one is for the surgeon, he sits at a special desk and by touch he guides the robot. The other part is the robot that is actually doing the surgery on a patient.

The thing that interested Doc. Lacko, was that even though this robot is very big and hard to manipulate, it doesn't have something to direct it to the place of surgery. So a person needs to push it around. I feel this part really not cooperating with the high technology that this robot brings, as I know that the price is very high and it would not make it any more expensive to have a joystick.

Picture no.5 - How DaVinci works - the surgeon sits from a distance and guides DaVinci to do the precise surgery. [16]

Picture no.6 - We can see where is the surgeon looking into, the daVinci surgeon has two cameras that show the inside of the patient and the human surgeon is using his hands to guide the hands of the daVinci surgeon to do the precise work. [16]

Picture no.7 - How the hand of DaVinci surgeon is following the motion of a human surgeon. It is very accurate. [16]

This robot helps to improve the surgeries and also to benefit the hospital by its productivity and efficiency. It also improves the maximising efficiencies, like decreased length of stay, complications, blood transfusions, nursing staff ratios, post-op pain management. The utilization for the surgeries, especially for application across multiple surgical specialties, cardiac, urology and general surgery, e.g. surgery of eyes, needs to be very precise. [16]

Another positive aspect of this robot is that DaVinci is following the hand of a human surgeon but is not shaken by its pulsation. We cannot say this if we use a laser beam for surgeries. So it makes a surgeon's work even more precise, as it grasps only the exact motion.

4 Conclusions

4.1 Risks of Not Being Able To Manage The Communication With Robots

Robots made at the companies, make it difficult when used to simplify the production; it slows down the progress. There is also another aspect of this risk – we as humans don't have such a high population growth and we have many elderly people that need someone to take care of them. We also need to start to use personal robots for disabled ones, or as vacuum cleaners. But we still have the risk that all these people for whom the robots are made, don't know how to communicate with them and how to use them. So this 'help' is useless. As an example, the latest survey has shown that 80% of users of video-cassette players are unable to program by themselves the functions that are offered. It shows that, one of the reasons is the absence of the operation instructions. And other times the instructions and functions are too complicated to understand.

The field of controlling robots should have respect for the experiences from the use of complicated automated control systems. The communication between the operator and control system is very complicated in these systems. To be able to manage this communication process effectively, a specific interface (boundary) has been created that is taking care of this problem. It is called SCADA/HMI. [18]

These are the main reasons why the communication between the users and robots require special attention.

4.2 The Need of Education For Future Users

An important aspect is the education. Of course, we can start with education of seniors, but the question is if it makes any sense. We need to learn out of today's experience to motivate children so they want to know how to program computers and use personal robots. The motivation is very important, as children have a lot of schooling ahead of them. The stress should be also on using PCs at schools as a teaching tool.

I have found one really interesting article I would like to share as a possible motivating education for children. In an issue of ABC, many articles are about robots. The motivating topic was called "Robots expect their day". There we find the following information: A Humanoid Robot Riding a Bike, which is a short article about Murata Boy, a humanoid robot made in Japan. This robot is 50cm, weighs 5kg and is able to move 60cm/min. The magazine also talks about the origin of the word "robot". It has also many pictures with short information mainly of humanoid robots, which are toy-robots that are able to do many specific things. This issue is very tempting for kids to have a chance to know more about robots and to be motivated to know how to use these interesting things that are able to cooperate, play, etc. [17]

If the kids find fun using robots as little ones, it will be easier to teach them the language of a robot and then they will feel drawn to the programming. What we really need are the robotic toys for them.

The other possible way how to motivate kids is by using their favorite toy, better said the Lego. It is an international word for children. Every child imagines small pieces and out of them you can build what you feel like. But I am here talking about a particular name of Lego. It is Lego NXT Mindstorms. Just by reading the name, it doesn't sound very easy. Basic instruction helps you to build a vehicle, Tribot, or a Roboarm, or a scorpion or a humanoid, Alpha Rex. The designers of this Lego have created a really tempting toy for children. It is very simple to program. It communicates directly via BlueTooth so you can control the behavior of it easily. [19]

You can look at the website of Lego to find more information on their robotic products for children. [27] It has very nice pictures and information.

I have found another example of controlling mobile robots used by Ján Pavlovkin from the Faculty of Natural Sciences at the University of Matej Bela in Banska Bystrica. I quote three of his works where he describes the support of toy-robots for students. [21], [22], [23]

4.3 Final Evaluation of Achieved Results and Contribution

I have created a taxonomic tablet that I haven't found anywhere. I have described different cases of communication from the side of system approach. The main reason of this thesis was to stress the importance of this topic, because I have found that it is very important. No one till now cares about this topic of serious concern. I have tried to determine some trends in this area, e.g. Technical Weekly Magazine.

The Technical University of Liberec, the Faculty of Mechatronics has created a new system of transcription of spoken language. It is called ATT (Audio Transcription Toolkit). It is able to transcript the Czech language spoken by whatever person. It is able to adjust to different pronunciation. The accuracy of this system is between 85 and 95 per cent. So it is very accurate. This program will be used mainly for the work of judges and for disabled people. [24]

Every company describes the language they create, so they take only one aspect and don't cover it by any complex explanation. We need to complete it. Another aspect of this problem is not only with the wide context, but also in the cooperation between the robots.

The main reason of this thesis is to stress the importance of education. Of course, we cannot expect that by fast education everyone will be able to program a robot that he needs to use. We have to take into account that the importance of education is gradual and needs to be systematic - with all its structures. It should also be done orderly – step by step - to get the desired solution.

4.4 Recommendation

The topic about communication between men and robots is very wide. As I was unable to cover the subject fully, I recommend further research in this field.

In my bachelor thesis I have shown that the issues of communication between men and robots are necessary to take by a systematic approach (to see the interosculation in between elements). Otherwise we cannot get to the root of the problem and see all of its connections.

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