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PROBLEM OF SERVICE ROBOTS SYSTEMOLOGY, APPROACH TO APPLICATIONS

1. INTRODUCTION

Practical analysis of international reviews on recent robots applications suggests, that: robotic means are recently valuable and in many areas inevitable part of automation of production and non-production processes, that. except keeping „tempo“ in the „classical" application areas, the „tempo“ of application in non-industrial areas increases.

Social request remarkably orients the robot application towards automation of manipulative works mainly in the dangerous environment and the environment harmful to human health. These new areas for robotic means application are systematically structured to areas of so – called service activities , which can be classified into categories of technologic performances, non-technologic performances and support performances character activities, Fig.1..

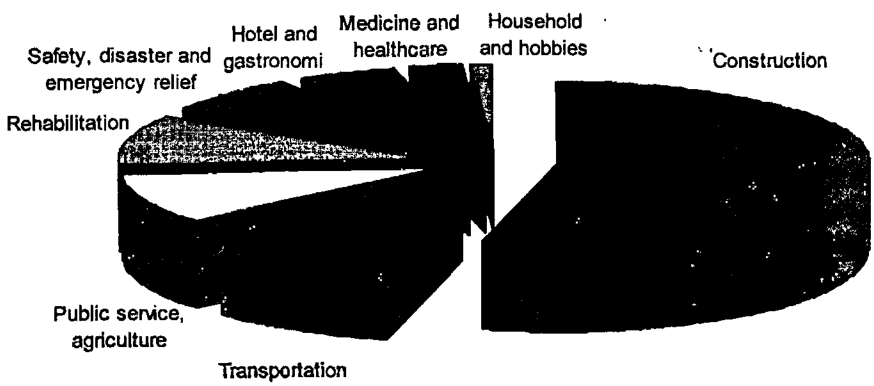


Fig.1

The potential of robots needs for these activities, i.e „servis robots“ (SR), could be bordered by the application environment for the area of unnatural , dangerous , public , domestic and privat environment. Both the potential and needs of this environment formulate innovatively new requests on robots, Fig.2.

The paper gives the knowledge and experience obtained in working out the problem of SR, mainly in the part of completion of the systemology and completion of the approaches to the construction and application of this category of robots.

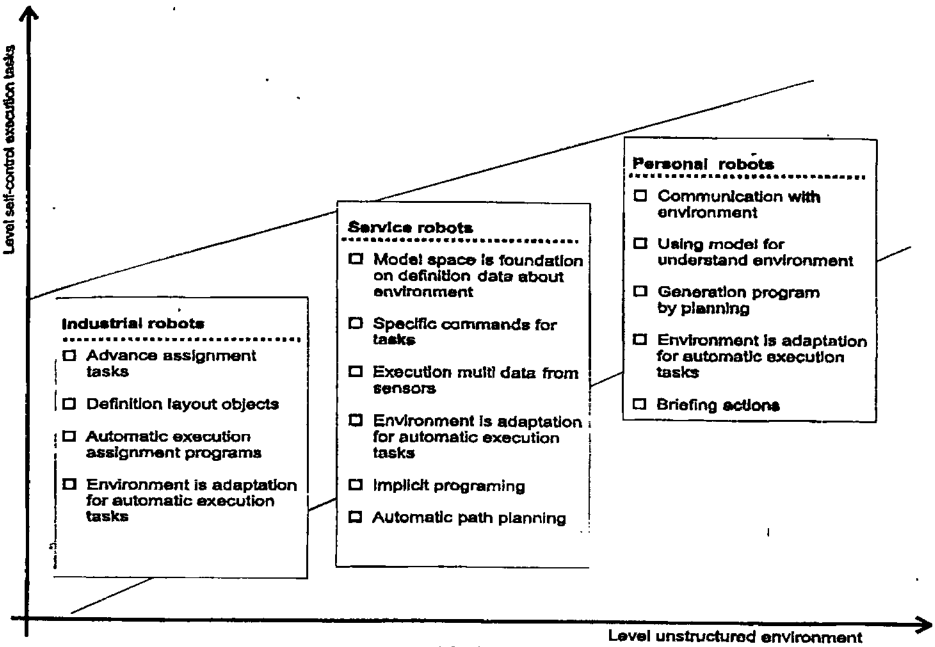


Fig.2

2. SERVICE ROBOT, SYSTEM MARKS

The application of the classical robots in the service activities is very limited, mainly from the reason of extreme requests that are connected with a range and division of the needs formulated by their wide application area. These requests are structured as a problem:

- technological (technological output, autonomy of the output, interaction operator – robot – technology, intelligence of the working tip and so on)
- control – navigation (movement in non-structured environment, adaptivity, intelligence of behaviour, etc.)
- economical – operative (initiative investment, operation working costs, responsibility for the investment in operation area, etc.)

Generally accepted definition of servis robot: freely programmative kinematic device that performs services partly or fully automatically. Services are tasks that do not contribute to industrial production of goods, but they contribute to work useful for people and technology equipment.

2.1. System model of servis robot

Recent solution of SR, as well as the analysis of the requests on SR allow to design „system model of SR" (formal structure, model of conception SR(M), model of system characteristic SR(CH)), structured to the set of functionally tied subsystems, Fig. 3: subsystem of mobility (freely programative „transport" and „positioning" of SR in the action area, „stabilization" of the working position), subsystem of output part (freely programative „positioning" and „movement" of the working effector in the working environment), subsystem of working effector (working interaction with worked subjcet, technology, working environment), subsystem of internal sensors (verification of all sensoric functions tied to SR subsystem function and management), subsystem of outer sensors (verification of all sensoric functions tied to SR activity with the working and outer environments), managing susbsytem (intelligent managing, program verification, control-block systems), subsystem of energy supply (energy supply of all subsystems, supply reliability, back supply), subsystem of operator (interaction operator – SR – technology – environment

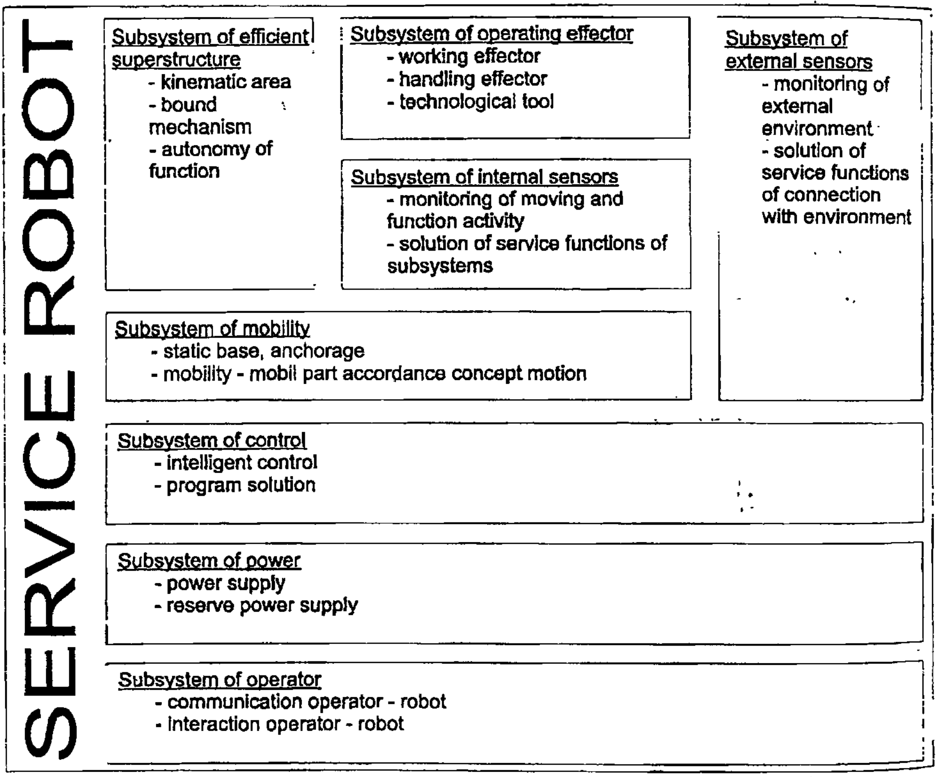


Fig.3

Model of conception is charasteristic (symbol registration)

$$SR(M) = < O_c, T_h, P_o >$$

where O_c – object-robot cooperation, T_h – operating head, P_o – operating step. Model of system characteristic is (symbol registration)

$$SR(CH) = < C_{ht}, F_r, S_r >$$

where C_{ht} – handling (technology) task, F_r – systém behaviour, S_r – robot structur (coupling).

2.2. SR system model interpretation

SR system model connected with priority requested characteristics can be interpreted according to

- movement characteristics – static (portable, statically firmly tied to one working place), mobile (moving, considerable variant)

▪ function architecture – mechanic part (machineware, mecahnics, serice drives, internal sensor system), managing part (managing systém, external sensor systems, operator interaction part), software (systém, users' program, intelligence grade), working effector (technological, manipulation, special)

▪ level of autonomy and behavior intelligence (behavior intelligence, working output intelligence, decision intelligence)

The problem of recent technical variations of SR is that it clashes with the inability of preparation of competent basis (mainly higher generation level) that would create a possibility for variant (modular) solutions originated in the given system model of SR.

3. APPROACH TO APPLICATIONS

Application due to variance of needs and requests can be set on the principles of general rules, which form them through technology problems, control – navigation problems and economic – working problems. This approach represents „open and non-structure" service actities.

Practical approach follows the characteristics of so – called „service scenario" and the methods of its analysis, Fig.4.

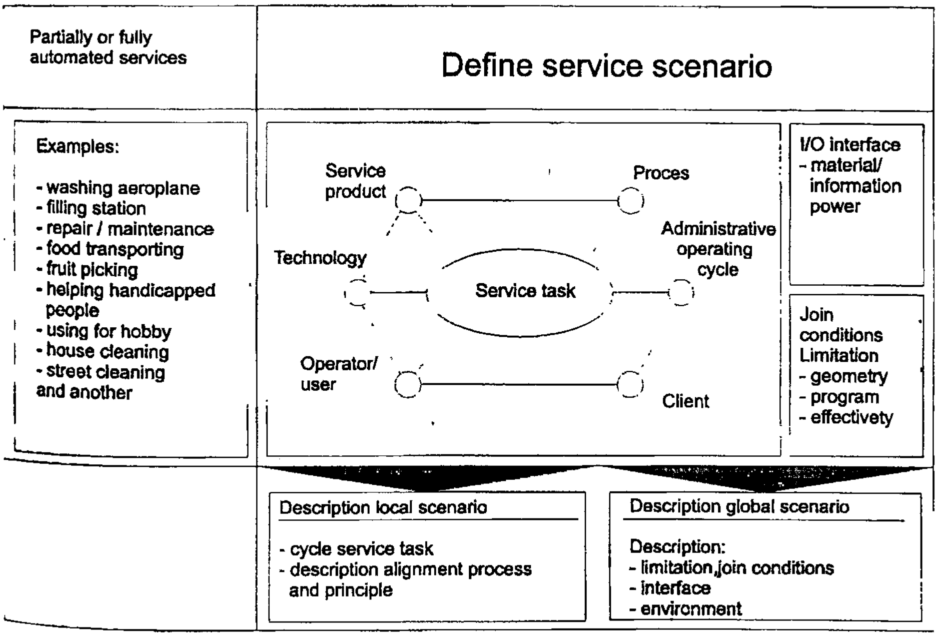


Fig.4

Analysis methodology of service scenario, with the help of object oriented databases, help to suggest the realisation and way of fulfillment of service task, from which the formation of requests on SR and solution of service robotic system follous, Fig.5.

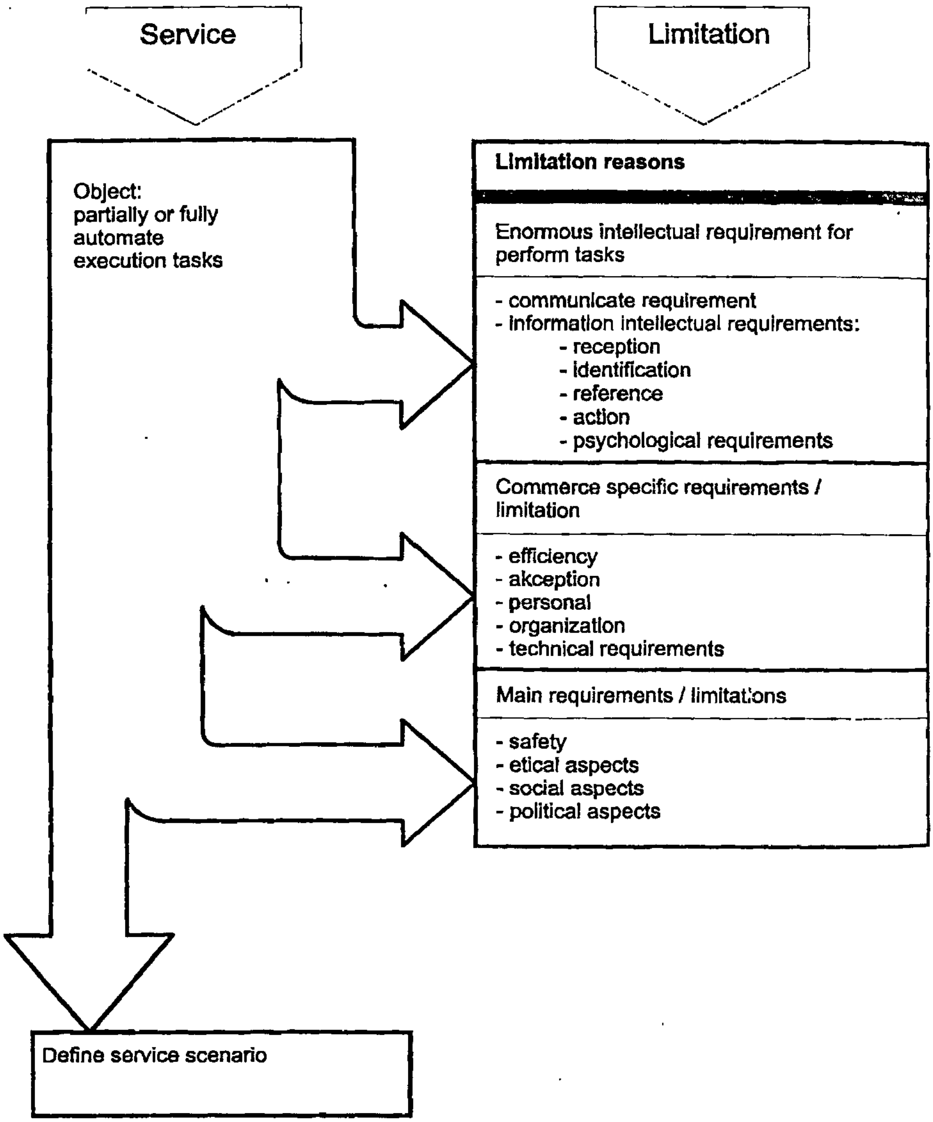
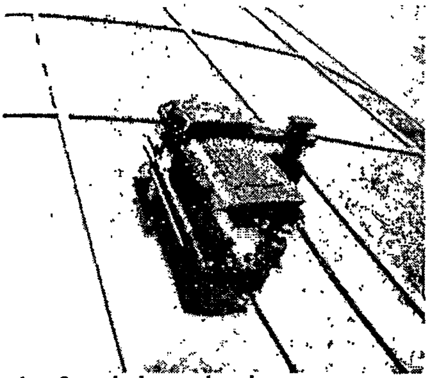


Fig.5

4. EXAMPLES OF SERVICE ROBOTS SOLUTIONS

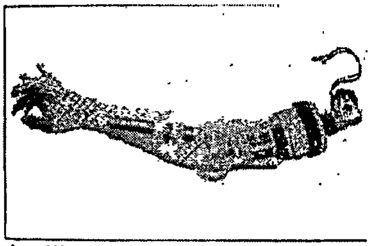
The widht of the application area and the construction principles and solutions of SR resulting of it càn be documentated at the choice of concrete solutions and applications.

- area of unnatural environment
- area of dangerous environment
- area of public environment
- area of domestic environment
- area of personal life



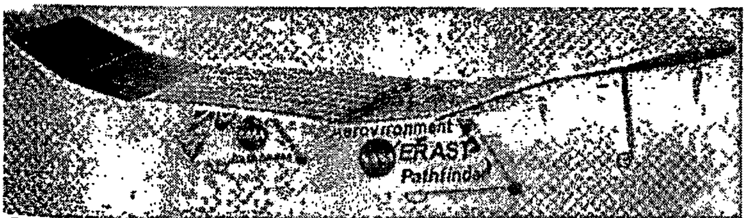
robot for windows cleaning

robot for exploring in nuclear plant

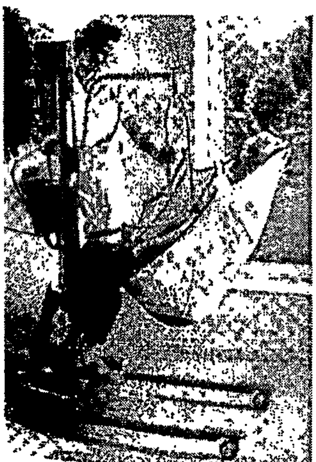


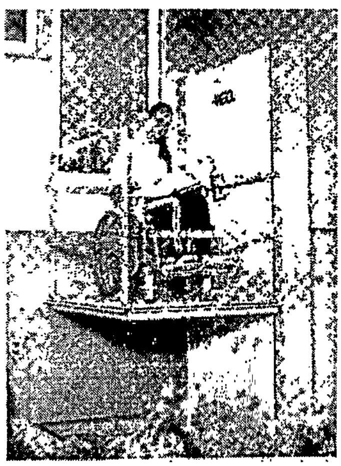
intelligent replacement

robot for house cleaning



flying robot for use in air space





equipment for handicapped persons helping

5. CONCLUSION

The first world experience of SR application confirm their functional, technical, practical and economic need. They confirm their considerable amandment to economization and humanization of service operations, solution of the lack of human capacities in ceratin sort of service activities and also decreasing the price of labor in these activities.

The influence on the process and speed of SR implementation has its general openess to new technologies for service activities, also inability of expert capacities for securing service activities at quantitatively new level. As service activities are principally close to the activities of a man in his working and living environment, SR development will soon have its cultural and social background.

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Acknowledgements

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