

## RESEARCH AND DEVELOPMENT IN AUTOMATION OF BUILDING IN ISRAEL

by  
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### INTRODUCTION

Research and Development in automation of the building processes in Israel comprises these programs:

- a. Development of interior finishing robot.
- b. Automation of crane.
- c. Development of floor finishing robot.
- d. Automated building design and planning processes.

Most of the research projects on these subjects are being carried out at the National Building Research Institute of the Technion, I.I.T. They will be briefly reviewed here.

### DEVELOPMENT OF INTERIOR FINISHING ROBOT

The objective of this multistage program was to develop a mobile robot with an ability to execute various finishing works such as painting, plastering, tiling, building and others, in residential and similar buildings. The robot represents the generic class 1 of construction robots as defined in [12].

The schematic outline of the program is shown in fig. 1. It includes the following modules:

- 1) Performance specifications and preliminary design of the robot and its components - the arm, the carriage, the sensors, the effectors and the control system. The findings are described in [14].
- 2) Adaptation of building technologies to robotic constraints. The main works which have been adapted in this context were partitions building, plastering, floor finishing. Several additional works are also being adapted to robotic requirements. The project is described in [3].
- 3) Analysis of optimal configuration in terms of the robot productivity, cost, and ease of operation. The preferred solution has been determined with the aid of computer simulation and measurement of performance of various configuration alternatives. The study is described in [12].
- 4) Planning of robotized work. Within the context of this study a computerized procedure has been developed for analysis of the feasibility of robot employment to different types of buildings. The study is described in [2].
- 5) Testing of physical performance of automated tasks with a small robot (Scorbot of Eshed Robotec, arm reach of 0.60m and payload of 1.0 kg) adapted to building works. The robot could perform several finishing tasks - painting, building, jointing and similar works, and employed two types of sensors. The study is described in [1].

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- 6) Testing of physical performance of automated tasks with a full scale robot (S-700 of GMF, reach of 1.50m and payload of 30 kg) adapted to building works. The robot can perform various finishing tasks - painting, plastering, tile setting, partitions, building and others. It will employ several types of sensors - for avoidance of obstacles, for materials handling, for mapping and navigation and for identification of openings. The robot is described in [8], and [12].
- 7) Autonomous control system for the interior finishing robot. The system will allow the robot to sense and map an unknown environment, and plan its work in that environment. The study is described in [11].

### AUTOMATION OF CRANE

The purpose of this program is to automate the control system of a regular construction crane. The objective of automation is to improve the productivity and accuracy of material handling operations on the construction site. The parts of the program, which have been completed to date, include a feasibility study and a design of the control system. The study is described in [7]. A gantry crane will be automated in the next stage of the program, and a tower crane will be automated in its final stage.

### DEVELOPMENT OF FLOOR FINISHING ROBOT

The floor finishing robot represents the third generic class of the construction robots as defined in [14]. Its purpose is to process - level, smooth, grind, joint, paint, cover, etc., large horizontal floor surfaces inside and outside of buildings.

The program will be performed in three stages:

- a. a feasibility study of the system.
- b. a detailed design of the robot.
- c. development - production of a prototype, operation and follow up.

Another version of the robot will be used as an automated materials moving device on building sites and prefabrication plants.

The robot will be developed on the basis of an automatically guided vehicle which had been built at the Technion robotic center, and is described in [4].

### AUTOMATED BUILDING DESIGN

The purpose of this program is to automate the design process of an industrialized building. The process includes the following stages:

- a. Preparation of brief.
- b. Generation of preliminary design.
- c. Performance evaluation of preliminary design.
- d. Adaptation of the design to industrialization.
- e. Construction planning.

Several projects have been completed and are in progress on subjects c,d,e. They are as follows:

Performance evaluation of preliminary design - an expert system which evaluates the thermal acoustic and fire resisting performance of a given building design. The system is described in [15].

Adaptation of design to industrialization - an expert system which generates a detailed design and cost estimate of prefabricated elements on the basis of preliminary conventional design of a building. The system is described in [6].

Construction planning - two expert systems have been developed for this purpose. One of them - CONSCHED described in [10] - generates a list of activities necessary to complete a given building, the resources required for the completion and a work progress schedule. The other, described in [5], assists in selection and location of cranes on a building site.

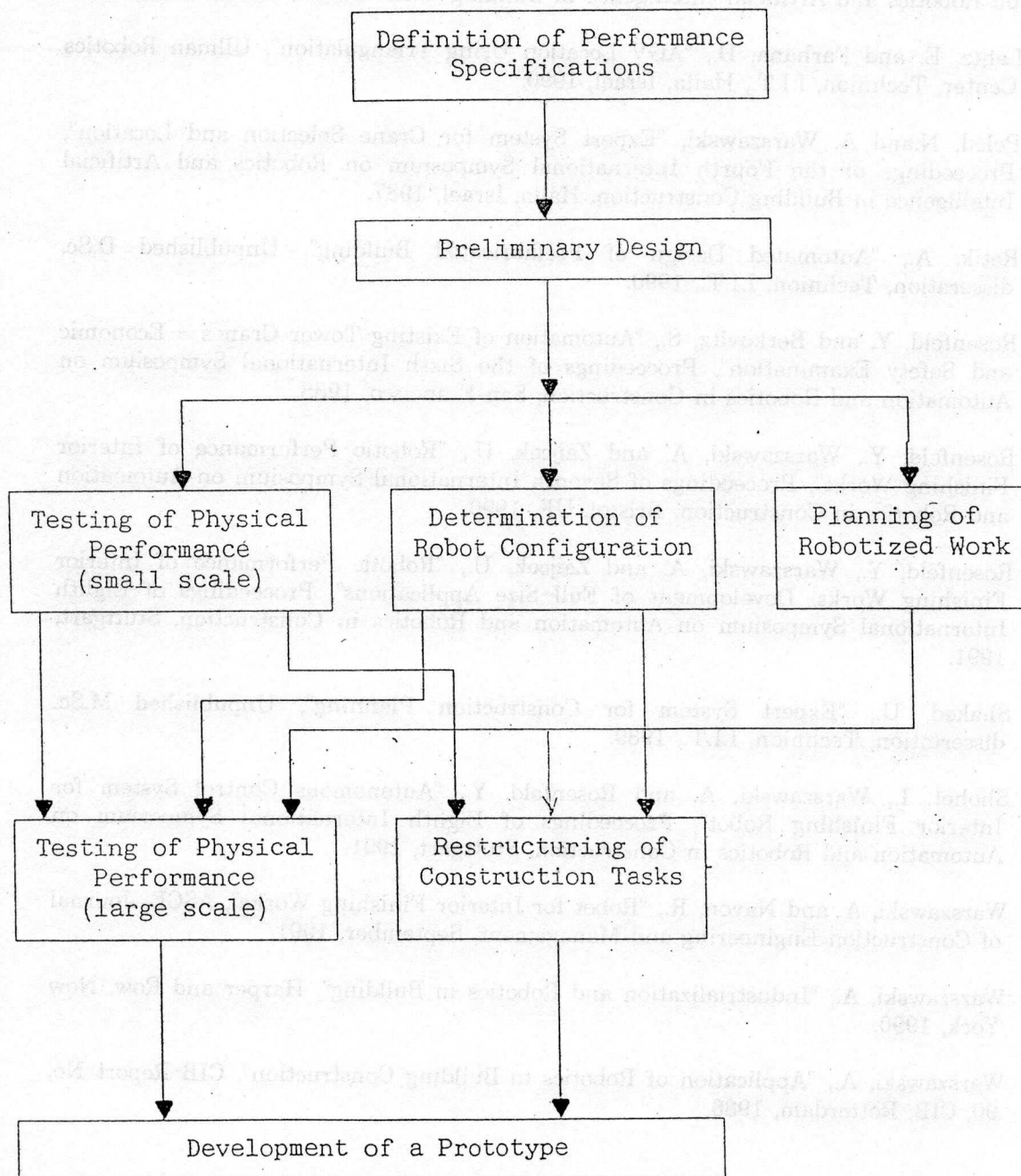


Figure 1 - Development Program of Interior Finishing Robot



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