

Job Identification and Analysis for Vocational Robotics Applications

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ABSTRACT

An analysis was carried out in an effort to identify specific jobs that may be made accessible through a robotic accommodation. The approach was to examine expanded job opportunities that resulted from raising an individual's level of manipulation ability slightly. The search was facilitated by using commercial software.

INTRODUCTION

Valpar's System 2000 [1] software is being used to identify jobs that may be made accessible through the use of an assistive robot. System 2000 is a general vocational analysis tool that consists of several software modules, one of which is a data base containing the basic job analysis as defined in the US Department of Labor's Dictionary of Occupational Titles (DOT)[2].

System 2000 software cross references the DOT job title and descriptions with factors related to job requirements, as defined by the Revised Handbook for Analyzing Jobs (RHAJ)[3]. These factors include education, physical demands, training, and environmental conditions. Through evaluation of these data bases, it is expected that job areas will be identified that have not been previously made accessible, but are potentially suitable job opportunities for people with manipulation disabilities.

APPROACH

The RHAJ organizes the different categories of jobs as defined in the DOT into seven categories, General Educational Development (GED), Aptitudes, Worker Functions, Environmental Conditions,

Specific Vocational Preparation, Temperaments, and Physical Demands. In this analysis, GED's and Physical Demands are examined because they most reflect qualities of a human robot system.

The GED category is organized into three categories: Reasoning, Mathematics, and Language. The categories are rated on a scale from one to six where six is the highest GED level. The numbers correspond to a scale based on level of schooling as well as general vocational experience and do not relate directly to a grade level.

The Physical Demands category describes the amount of physical activity required to perform a particular job in areas such as Strength, Climbing, and Reaching. All of the areas, except Strength, are rated on a Never, Occasionally, Frequently, and Constantly scale. Strength is rated on a Sedentary, Light, Medium, Heavy, and very Heavy Scale.

The approach taken in this analysis [4,5] was to define four fictitious client profiles using the RHAJ categories relating to Physical Demands in such a way that the profiles were representative of an individual with a manipulation disability. A search of the DOT data base was carried out and the number and types of jobs were identified and recorded.

An assumption was then made that the introduction of a robotic accommodation would effectively augment modestly the ability of the client in the areas of strength, reaching, handling, and fingering. The fictitious profiles were changed to reflect an increase in ability in these areas and a search of the DOT data base was performed again. The difference in the results of the searches is considered to be an indication of the jobs

that may potentially be made available through the introduction of a robotic accommodation.

The effect of GED level on potential job opportunities was further considered by carrying out the DOT search for each client profile at each of the six GED levels raising the Reasoning, Mathematics, and Language categories at the same time.

The approach described above is consistent with the recommendations of Valpar for use of System 2000 in identifying job training and education that may be prescribed for a client in order to access a job. We have extended it to evaluate the impact of increasing physical capabilities through the use of a robot.

CLIENT PROFILES

A summary of the client profiles is contained in Table 1. The four main profiles are organized into two pairs. For each pair the strength category is defined as Sedentary for the first profile and Light for the second profile, while the rating for Reaching, Handling, and Fingering remains the same.

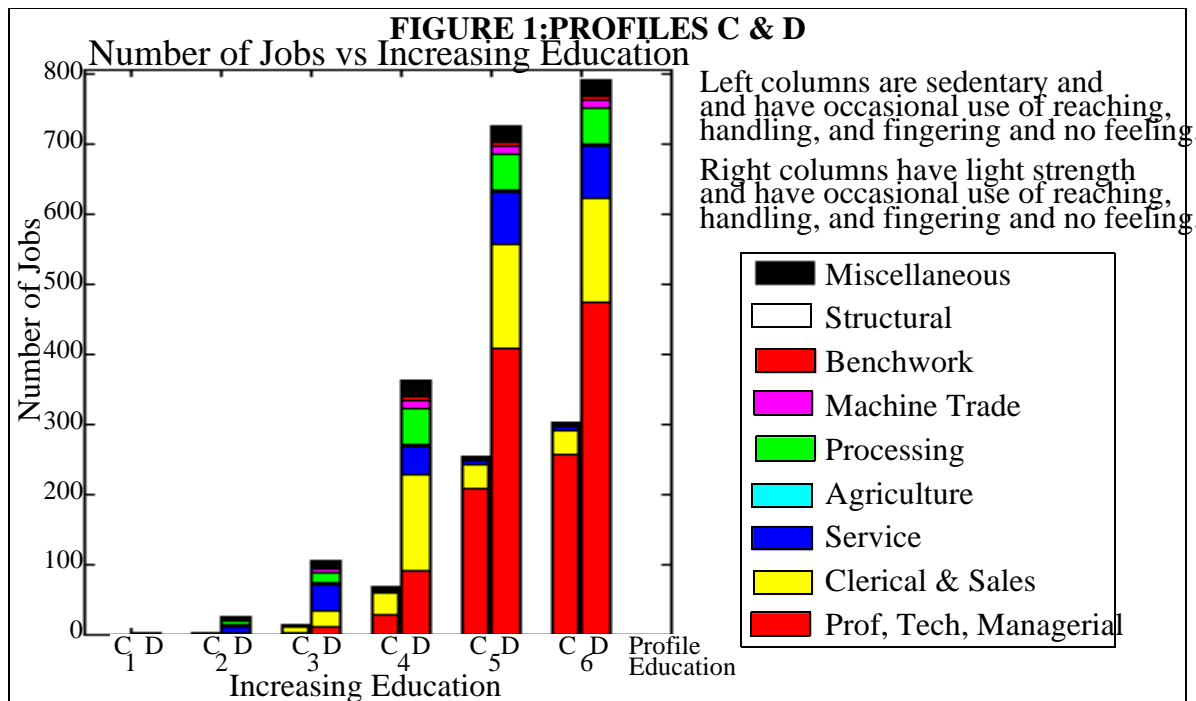
In all profiles, it was assumed that the introduction of the robotic arm would not improve sensory ability. Therefore, the Feeling category was defined as Never. It was also assumed for each profile that the individual possessed mobility constraints, and therefore the Climb, Balance, Stoop, Kneel, Crouch, or Crawl categories were also defined as Never.

Table 1: Physical Demands Defined for All Profiles

Profile	Strength	Reach	Handle	Finger
A	Sedentary	Never	Never	Never
B	Light	Never	Never	Never
C	Sedentary	Occasional	Occasional	Occasional
D	Light	Occasional	Occasional	Occasional

RESULTS

Figure 1 shows the number and types of jobs identified for profiles C and D, which represent the high range of manipulation ability for the profile pairs. As the level of required education increases, so do the opportunities in all of the job fields with a



large increase in the professional, technical, and managerial fields from level 4 to 5. The majority of the jobs that were appropriate were professional, technical and managerial, clerical and sales, service, and processing jobs. It is apparent that only a slight increase in manipulation ability results in a substantial increase in the number of jobs for which an individual may be eligible

Table 2 contains the maximum numbers of jobs available in each of the DOT job categories. Table 3 shows only Profile C and how the number of jobs varies with education level and within each of the job categories. For this analysis, the jobs that were obtained in level five were included in the number six category. The number six category were not exclusive to the highest education category.

Table 2: Number of Jobs by Profile

Profile	A	B	C	D
Professional	38	69	253	447
Clerical	0	0	33	141
Service	2	11	5	61
Agricultural	0	0	0	2
Processing	0	2	0	24
Machinery	0	0	1	10
Benchwork	0	0	1	5
Structural	0	0	0	2
MISC.	0	0	2	14

Table 3: Profile C Distribution with Respect to Education Level

Education Level	1	2	3	4	5	6
Professional	0	0	1	26	206	253
Clerical	0	0	7	32	33	33
Service	0	0	1	3	5	5

Table 3: Profile C Distribution with Respect to Education Level

Education Level	1	2	3	4	5	6
Agricultural	0	0	0	0	0	0
Processing	0	0	0	0	0	0
Machinery	0	1	1	1	1	1
Benchwork	0	0	1	1	1	1
Structural	0	0	0	0	0	0
MISC.	0	0	0	1	2	2
Total	0	1	11	64	248	295

DISCUSSION

Figure 1 shows the number of different jobs within each category that theoretically could be accessible to someone with a manipulation disability. It demonstrates that as education level increases, so do the number of jobs. This is most apparent in the professional field. Generally, professional jobs are more sedentary and require high levels of education. Also, quite noticeable is that as strength is increased one level the number of jobs at least doubled.

The next part of the search focused on the job definitions themselves to determine what sub categories were most appropriate for this type of accommodation. From Table 2 it is obvious that the most jobs available are in the Professional category. For Profile C, these numbers are shown in Table 3 with respect to education level. From this chart, the first job that is available is in the Machinery category with an education level of 2. When this job is look at more closely, its title is a Matrix Inspector. From the description in the DOT this position involves visual inspection of metal dies.

When education level 3 is examined, several jobs in the Clerical category are possibilities for the user to perform. Three of the seven

jobs are in the Information and Message Distribution category. Examples of this are an operator or a traffic manager.

At education level 4, the clerical category is still the dominant category. All but one of the service jobs are opportunities for an individual with this education level. Most of the jobs are in the Information and Message Distribution and the Miscellaneous Clerical Category.

At levels 5 and 6 most of the jobs are in the Professional Category. Within the Professional category, 82 are within the Manager subcategory mostly within the transportation, communication, finance, and public administration categories. In addition to the professional category, there are 5 service jobs available. These mostly deal with desk police jobs and surveillance camera viewing.

CONCLUSIONS

The above described approach utilizes standard practice in vocational counseling to prescribe training and services, to identify the potential effort of providing a vocational robotic accommodation. The outcome of this analysis supports the basic notion that robotic accommodation's represent a viable option for expanding employment opportunities, as well as identifies a range of job types to be considered. Continued work is necessary in this area to introduce robotic accommodation into the service delivery process in order to reach its potential.

REFERENCES

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