

What can a Personal Robot do for you?

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Abstract. This is a report on the expectations of future users of personal robots based on a survey of 358 respondents with a median age of 22 years. A questionnaire was designed using a “text open ended” approach. The questions along with an introduction and sketch of a humanoid robot in a home were used to “paint the picture” of the respondents having a robot assistant at home. Respondent were then asked what they would ask the robot to do at various times of the day, at weekends and while away on holiday. The task category of “Housework” was the most popular, with 39% of the overall answers. “Food Preparation” and “Personal Service” were the second and third most popular categories with 16% and 14% respectively. Although many of such tasks can also be done by humans, there are potential qualitative benefits in using robots. These results suggest that research should provide solutions for cooking meals, tidying up, general cleaning and the preparation of drinks.

Keywords: Personal robots, Service robot, User expectations, Survey, User survey, Household tasks, Robot tasks.

1 Introduction

The robotic market has been predicted to boom in the near future, especially in the personal and service sectors [1]. For this boom to actually happen, robot engineers need to develop useful application and corresponding robot skills. The present research was undertaken with the aim to quantify the user’s expectations and inform on potential applications.

Previous surveys have involved a limited selection of tasks. In one survey [2], respondents were asked to select from a list of 6 applications (Household (vacuuming etc.), Gardening, Guarding the house/family, Looking after children, Entertainment, and an open category “Other”. The five named applications appeared to be the users’ preferred tasks. In another survey [3], respondents had to select tasks from a list of 28 tasks that the literature usually assigns to assistant robots. Both studies produced results strongly biased by the initial selection of tasks. In contrast, this study uses an open question format where respondent can mention any task. It is however biased by the humanoid robot shape suggested to the respondents, the pre-defined situations, e.g. time of the day, described in the questionnaire.

In the next two sections, the survey method and process is explained, followed by an explanation of how the open-ended answers are quantified and categorized. The results are presented in section 4, including the frequency of individual task requests and the relative importance of categories such as household work, cooking, etc. In section 5, features of the requested tasks and survey method are discussed. Implications for research and market are proposed.

2 Survey Design

Surveys can be carried out using a variety of methods. Here we need to discover uses of a “really new“ product that is not an evolution of an existing product. In such a case, “information acceleration” methods are generally used, bringing the future to the respondent, or projecting the respondent into the future [4]. For that purpose, an in-depth questionnaire (figure 1) was designed to induce the respondent to imagine life with a robot and “day dream” interactions with the robot, and the working day of his or her robot. The design benefited from the advice of specialists in social and market research.

Three data collection methods were used for this questionnaire, personal interviews, paper questionnaires and internet survey. In total 358 respondents completed the questionnaire. 260 aged 11 to 17, 87 aged 18 to 60 and 11 aged 61 or above. 11 to 17 year olds were children attending secondary school. 18 to 60 year olds were considered adults and 61 years or above were considered as Retired/Elderly. The data for 15 respondents were collected using the personal interview methods and all fell under the adult and elderly age groups. Data for 21 respondents were collected using the Internet survey method and all were adults. The remaining 322 respondents were asked to fill out a paper questionnaire. The respondents had a median age of 22 years.

The introduction to the questionnaire included a short sentence to describe how the subject has been given a robot and that it is theirs for a year. In addition a sketch of a humanoid robot in a domestic setting was supplied to enhance the subjects “mental picture” before answering the questions. A humanoid shape was selected to avoid suggesting any functional limitation that may bias the answers.

The questions were of type “text open ended” [5], giving the respondent freedom of expression and allowing for multiple answers per question. The level of detail gathered in each question was decided by the respondent himself. Additional multiple-choice questions were used to gather information on the respondent’s age, sex and if they have any help from helpers, nannies, cleaners or gardeners.

Personal robot user expectation survey

You have been given a robot as part of a trial program. It is yours to live with for one year.



1. You get up and get ready for your day, what will you ask your robot to do today?
2. The evening comes, what will you ask your robot to do during the evening?
3. You are going to bed, what will you ask your robot to do before you go to sleep?
4. It is Sunday morning. What will you ask your robot to do?
5. You have booked two weeks holiday and plan to go away. What will you ask your robot to do while you are gone?
6. You can “upgrade” your robot by teaching it new activities. 6 months have passed since you got your robot. Have you upgraded your robot by teaching it anything?
7. Instead of a robot you have been given a trial of an intelligent appliance. Which appliance would you choose and how would it be intelligent?

Sex: Male Female

Age: 18 – 20 21 – 30 31 – 40 41 – 50 50 and over

Nationality: _____

Do you have any of the following?

Cleaner Helper Nanny Gardener

Fig. 1. The questionnaire form.

3 Results Analysis

Due to using the open-ended question method it was important to find the right approach to analysing the results. Here we focus on the overall level of interest for various robot tasks. All tasks mentioned by respondents were recorded and the number of references to that task was counted. When a respondent mentioned the same task several times, e.g. in the responses to different questions, each mention was counted separately and added to the total. This was to reflect the higher interest for such a task. The answers to question 6 on “what task would you teach your robot” were amalgamated with the answers to the other questions on “what tasks would you ask a robot to do”, as both answer groups reveal tasks of interest to the user. The answers to question 7 “what kind of intelligent appliance would you like instead of a robot” are only briefly summarized in this paper.

The number of responses was normalized to 100 respondents in each age group, so that the presented results can easily be evaluated by the reader. No further normalisation took place. Note that the small number (11) of respondents in the age group above 60 makes their results statistically less reliable than those of the other groups, but they are still informative. The results presented in a bar chart (figure 2) show the cumulated answers of 3 populations of 100 respondents in three age classes. The pie chart (figure 3) reflects the raw number of answers in each category. This approach should therefore give a clear indication of how popular tasks were.

4 Results

Figure 2 shows the normalized quantitative data recorded from the survey. It contains data from questions 1 to 6 from the three age groups. The chart shows the most popular tasks and the number of times they were mentioned in the survey by respondents in each age group. General cleaning for example was mentioned 63 times by the normalized population of 100 adult respondents (18-60 years old). As mentioned in section 3, this does not necessary mean that 63 separate respondents mentioned general cleaning. Some respondents could have mentioned the tasks more than once in their questionnaire. The bar chart in Figure 2 gives a clear indication of the most popular requested tasks: general cleaning, tidying, prepare tea, (this also means “prepare supper” in the UK), and guard the house.

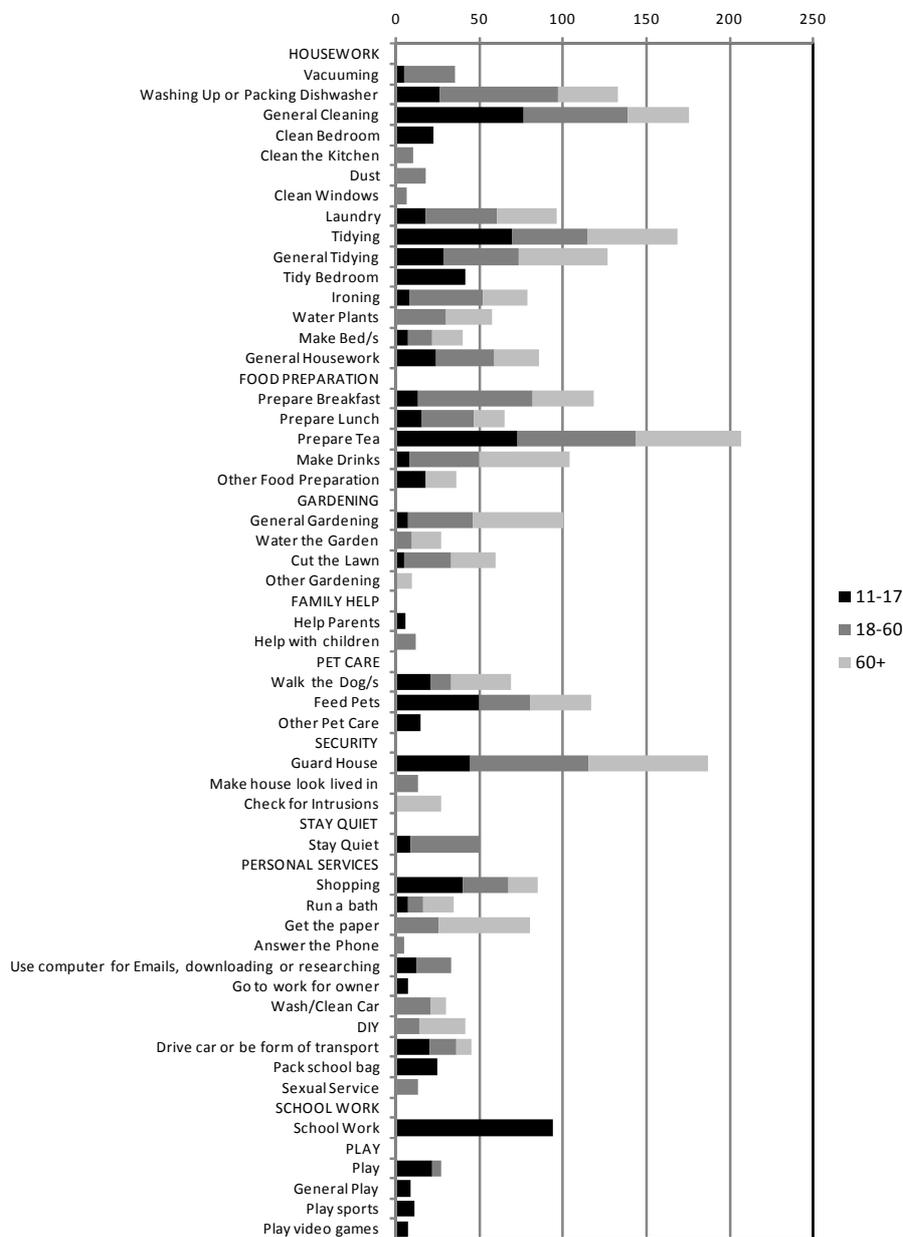


Fig. 2: Quantitative results. Number of requests of the indicated tasks normalized to 100 respondents in three age groups: 11-17, 18-60 and 61 or more. Only tasks mentioned more than 4 times are shown. Task categories are indicated by labels with zero counts, e.g. HOUSEWORK.

The tasks included in the chart are varied. We grouped them into categories to give an overview of the areas in which the robot would be asked to perform tasks. The tasks were grouped into the following categories; Housework, Food Preparation, Gardening, Family Help, Pet Care, Security, Stay Quiet, Personal Service, School Work and Play. These categories were derived from the collected data and were not pre-decided at the start of the research. Table 1 below shows which tasks came under which category.

Table 1. Tasks Categories and corresponding tasks.

Housework
Vacuuming, washing up or packing dishwasher, general cleaning, clean bedroom, clean the kitchen, clean the bathroom, dust, clean windows, laundry, tidying, ironing, water plants, make bed/s general housework, other housework.
Food Preparation
Prepare breakfast, prepare lunch, prepare tea, make drinks, other food preparation
Gardening
General gardening, water the garden, cut the lawn, other gardening
Family Help
Help parents, help with children, help elderly
Pet Care
Walk the dog/s, feed pets, other pet care
Security
Guard house, make the house look lived in, check for intrusions, protect against fire
Stay Quiet
Stay quiet, stay out of my way
Personal Service
Shopping, run a bath, get the paper, answer the phone, use computer for emails, downloading or research, got to work for owner, wash/clean car, DIY, drive car or be form of transport, pack school bag, Sexual Service
School Work
School work
Play
General play, play sports, play games or with toys, play video games, acrobatics

The popularity of each task category is represented in figure 3 with a pie chart showing the fraction of the actual number of mentions over all 358 respondents. Housework had the largest number of answers with 39%. Food preparation and personal services also had relatively high portions with 16% and 14% respectively. Finally, Pet care, Security and School Work appeared in 7-8% of the requests.

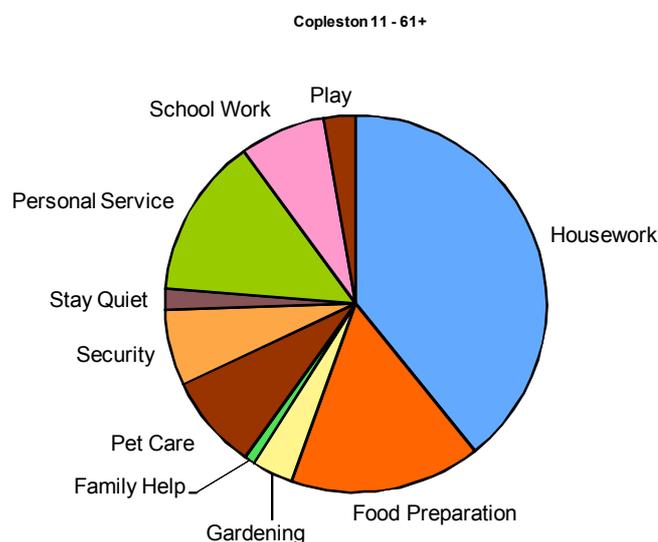


Fig. 3. Popularity of task categories.

Question 7, concerning the interest for intelligent appliances, was only posed to adults and elderly in its form of figure 1. The replies cover almost all current appliances, with the most mentioned being Hoover/cleaner, iron, cooker, television, fridge/freezer and food preparation devices. The latter are an exception in that they do not cover existing appliances. How would appliances be intelligent? Typically, a Hoover should be capable of regular daily cleaning, sensing of dirt or spills, opening of doors automatically, emptying itself and to differentiate between types of dirt. An iron should iron cloth, fold and put away the clothes after ironing, the iron should detect fabric types and automatically adjust its temperature. A cooker should detect when food is burning or boiling over, automatically cook a meal for a specific time and create an entire meal from scratch including preparation and cooking. A television should sense when the user is in the room so that it only switches on when the user is present, fast forwarding through advertisements without prompting and operate by voice control. A fridge should keep an inventory of what is inside it, defrost meat in time for cooking, give the user suggestions of recipes based on its contents, dispose of spoiled food or even be able to prepare meals itself. General food preparation devices were varied and included appliances which would provide healthy meals to the user, tell the user what is in their cupboards and what they need to replenish (all based on a specified budget), a steamer which would wash, peel, cut and steam vegetables and a drinks maker that can be sent text messages from a mobile phone to create drinks.

5 Discussion

5.1 Attitude towards robots

The results show that people have an overall positive attitude towards living with robots. Although there was no question to ask if the respondents would accept the robot into their homes, it is clear that they were all willing to give answers when asked what they would ask a robot to do for them. A previous survey conducted at a robotics exhibition in Switzerland backs up this view [6]. In that survey of 2000 people, 71% of them answered “yes” to the question “could you imagine to live on a daily basis with robots which relieve you from certain tasks that are too laborious for you?”

The robot in our survey was considered as a servant. It should be noted that the questions never said that the robot was there to do work for you. People just assumed that this is its purpose. This conforms to a distinctly western view on robotics suggested by [7]: If a robot does not do specific tasks, it is not useful. However, tasks mentioned in our survey were not always “work”.

5.2 Task types

There seems to be two types of tasks the robot could do for the owner. Tasks which remove labour from the owner and tasks which enhance the owner’s life. Housework, gardening or food preparation all relieve work from the owner whereas playing adds to the person’s life through entertainment. Security tasks ‘enhance’ the user by duplicating his/her presence. The DIY task also represents an enhancement, as not everyone has the required skills. The same probably applies to cooking. Curiously, respondents did not mention collaborative tasks, e.g. help in moving a piece of furniture.

The popularity of the housework category appears to indicate that people are looking for solutions to the “laborious” jobs around the home. Another survey into the top ten most dreaded household chores highlights cleaning the kitchen, cleaning the bathroom and washing the dishes as the three most dreaded chores [8]. In the results in figure 2 cleaning and dish washing are also the task most asked of the robot under the housework category. General cleaning was often mentioned but respondents were not specific to exactly what object or what rooms they wanted cleaning. Some respondents did state that they wanted the kitchen or bathroom to be cleaned however this represented a very small number of replies compared to general cleaning. It is unclear whether the respondents had bathrooms or kitchens in mind when answering “do the cleaning”. However, in our list of tasks that a household robot should be able to do, cleaning is of a high priority. The results of our survey seem to back up the attitudes to certain chores. However, preparing tea and preparing breakfast were very popular tasks, while cooking only ranked 9th out of the ten most dreaded chores. There seems to be a contradiction here, as food preparation is a high priority task for household robots even though it is not as dreaded as others. People may not dislike cooking meals, but would nevertheless be happy letting the robot prepare their evening meal. We can speculate that robots will have better cooking skills than the average person, and will be able offer a greater variety of meals. Meal preparation

also appears in the replies to the question on intelligent appliances. To highlight another difference between our and the dreaded chores surveys, tidying was not included in the top ten list but appears prominently in the housework category. People do not seem to dread this task very much but would still pass it off onto their robot.

The significant number of responses in the “food preparation” category is one of the interesting findings of this survey. This is an application where robots could make a valuable contribution to the quality of life of the user, especially in view of the limited cooking skills of the general population.

Among other tasks, it is noteworthy that schoolwork was the third most popular tasks overall. This task was only requested by children up to the age of 17. Therefore unlike the majority of tasks, it is not an answer distributed over all of the respondents. It is not surprising that children want to receive help with schoolwork or in fact to have it done for them. These results could be highlighting a need for children to have more support when doing their schoolwork. The form of this support needs further investigation.

There were a few mentions of sexual services by adult respondents. Whether respondents were serious or not, the fact is sex was seen in the results. Sexual robots have already been seen in Hollywood, e.g. in the 2001 film “AI” by S. Spielberg, and it might just be a matter of time before robots made for sex become a reality. There are several mentions on the internet of developments in that area.

Playing with the robot was also seen in the results. Among younger respondents, males were the ones who wished to play sports and video games. Females answered to generally play with the robot or to play games or with toys. Among older respondents, card games were mentioned. Thus, not all the tasks required from the robot were “work”.

There were clear differences between age groups in the categories of Homework, Play and Gardening (figure 2). However, there is very little difference in the other categories, reflecting similar needs for services at home.

The survey does not reveal “new” tasks that were not known before, or that could only be realized with or by a robot. Such tasks may have emerged if respondents had the use of a real robot.

5.3 Methodology

It is very likely that the results of the survey were influenced by the introduction and sketch. These were deemed necessary to put the respondent in the “mind set” of having a robot at home. To help respondents imagine their life with the robot, the questions were designed to guide the respondent through their day and during a weekend and holiday.

The use of an image of humanoid robot of human size had the expected effect that no task was limited by the assumption that the robot had limited cognitive capabilities or dexterity. However, it has probably eliminated tasks where superhuman physical or cognitive robot capabilities could be exploited.

There was a definite relationship between the time of day and the tasks answered (data not shown here). Obviously food preparation was already governed by the time of day however other tasks like gardening or washing up were answered in the questions corresponding to periods when the respondent themselves would perform

these tasks. For example, gardening was mentioned most often in the weekend question. A robot could perform these tasks at any time but the respondents chose to ask the robot when they would normally do them. This trend could simply be a bias introduced by the way the questions were worded and the questionnaire design but may also reveal an attitude of the respondents towards cohabitation with robots. It may be significant that several respondent wanted the robot to “be quiet” during the night.

A different introduction would most likely have led to different results. For instance, a picture of a robot with two wheels and no manipulators would have reduced the range of tasks requested. This could be confirmed by a future survey to investigate how different introductions and sketches lead to different results. For this survey however, the introduction served its purpose and very few respondents questioned the robot being in their home or its functionality.

Different data collection methods were used. It is unclear if this has affected the response pattern. If it had, this would mainly have affected data for the 61+ age group. As there also is a small number of respondents in that group, its results are only indicative. A follow study would be required for more refined results.

Quantifying the results proved challenging for the open-ended questions used here, as task categories had to be determined after the survey. The use of multiple-choice questions may have been simpler, but it was considered more important not to influence the respondent by giving them answers to choose from. Various normalization schemes could have been implemented, e.g. to mimic a flat distribution of ages, but there was no strong reason for doing so. The current results in figure 3 thus reflect the views of a rather young population. However, figure 2 has shown that in most categories, there is little differences between age classes.

It is a question for future work of whether a more imaginative list of tasks could have been generated with a different questionnaire design. This survey probably reflects correctly what users would ask from their robot after taking delivery. However, they are likely to start inventing new tasks soon after, which may point to the need for user-programmable robots.

5.4 Market considerations

The demands of respondents were in great majority for tasks that they could do themselves, raising the question of whether the main benefit of personal robots is additional free time. In many cases the robot could theoretically do a task better than its user, e.g. cleaning, DIY and cooking. Thus, personal robots could not only provide free time to the user, but add value through better execution of tasks. This however requires advanced robots.

Certain tasks are services that users cannot provide themselves, such as entertainment, home security while absent and feeding the pets. These benefits could probably also be provided by simpler non-humanoid robots.

Overall, no single task identified in this survey has the flavour of a life-changing “killer application”. It is tempting to speculate however that, if robots were flexible enough, user would find new applications of their robot, e.g. to expand the user’s sensing and action capabilities, or to reduce life’s uncertainties, etc.

Regarding the commercialization of early versions of personal robots of the humanoid type considered here, it is anticipated that these will be very expensive, with a price probably similar to that of a luxury sport car. Thus the initial market appears limited, with only the very rich being able to afford a robot. Such users can also afford human servants who can probably provide a higher quality of services than early robots. One of the added benefits of robots, however, would be a greater privacy. Another possible market is the assistance of the elderly, where a support organization could bear the costs of the robot and supply it as and when required. Recent robots for this market, however, have not been well received [9].

One big limitation to market growth is the lack of user-centred applications. Users expect robots to work, and much research and development is still needed to develop the required robot skills. The development of assistant robots requires applied research in areas such as handling of fabric, cloth and bed sheets, preparing food and drinks, and cleaning surfaces and awkward places. The specification of corresponding research problems would require a more detailed analysis of the demands of the users. For instance, what do respondents actually mean by “tidying” or “cleaning”? Other tasks such as “prepare tea” or “feed the pet” probably pose more clear challenges. The implementation of these tasks could benefit from decomposition into more elementary operations in defined domestic environments¹. This decomposition is likely to reveal gaps in the knowledge needed for the development of specific applications.

Another issue is the certification and development of safety standards [10], as personal robots will operate in close proximity of children, elderly and pets. Once the questions of functionality and safety are resolved, more social aspects of robot behaviour will gain importance.

6 Conclusion

This research has produced unique quantitative data on peoples’ expectations from robots in the home. The study focused on humanoid robots but also inquired about future intelligent appliances.

The robot was seen mainly as a servant and, to a lesser extent, a play partner for children. People expect robots to take care of the usual chore, and provide services in the area of homework and security. There are strong demands in the categories of housework (mainly cleaning), food and drink preparation, and in a range of personal services, e.g. shopping. Although many of such tasks can also be done by humans, there are potential qualitative benefits in using robots.

These results suggest that research should provide solutions for cooking meals, tidying up, general cleaning and the preparation of drinks. Adaptable designs would enable users to develop their own applications.

¹ You can see and contribute to analyses examples at vrpersonalrobotics.org

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