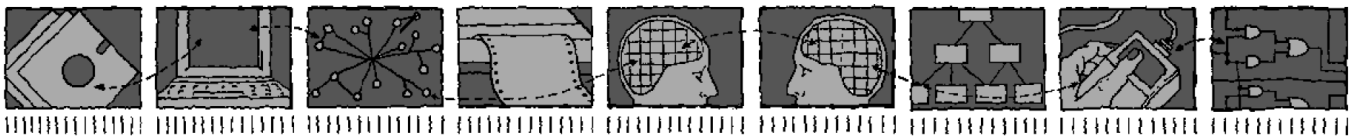
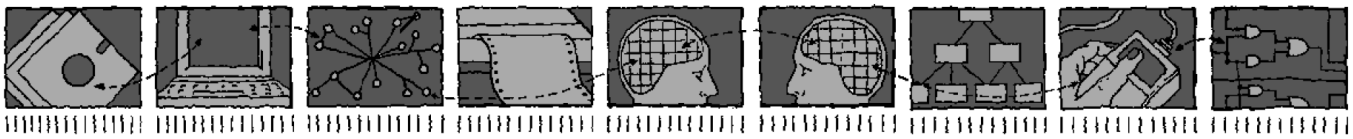


Department of Computing Science and Mathematics
University of Stirling



How do People want to Control their Home?

Claire Maternaghan

Technical Report CSM-185

ISSN 1460-9673

April 2011

Department of Computing Science and Mathematics
University of Stirling

How do People want to Control their Home?

Claire Maternaghan

Department of Computing Science and Mathematics
University of Stirling
Stirling FK9 4LA, Scotland

Telephone +44 1786 467 421, Facsimile +44 1786 464 551
Email cma@cs..

Technical Report CSM-185

ISSN 1460-9673

April 2011

Abstract

There are a large number of home automation companies which offer consumers tailored solutions to meet their needs. At installation time users are asked how they would like their home to behave so as the companies engineers can program the solution for their client. Once programmed, the users must contact the company and, in many cases, pay for these rules to be altered in any way. This is mostly due to the rigid design of the software architecture used by these companies. In most cases the user is very unlikely to know how they would like their home to behave until they have lived with the technology for some time. Even then, their requirements may change on a daily basis.

The author proposes that consumers need home systems that they are able to program, and re-program, easily. In order to gain a deeper understanding of how people could see themselves using such a control mechanism of their home an online survey was carried out. There were 150 participants ranging in age, gender, sex, technical ability and experience. This report describes the survey and user group, and then explores the data received from the survey: evaluating the author's eight hypotheses and describing any trends on the qualitative data gathered.

Acknowledgments

Claire Maternaghan is supported by the Scottish Informatics and Computer Science Alliance, the University of Stirling, and the MATCH project (Scottish Funding Council, grant HR04016). The author is grateful to her colleagues on the MATCH project and Kate Howie for their advice and support. Thanks also goes to all those who participated in the survey.

1 Introduction

Home automation is a concept that has been dreamed about for decades. Walt Disney's original plans for his Experimental Prototype Community of Tomorrow (EPCOT) outlined a utopian laboratory for domestic technology, where families would live, work, and play in an integrated environment [10]. Disney, like many of his contemporaries, imagined homes that would attend to their inhabitants' every need. He regarded the home as a site of unending technological progress. The understanding of the American home was altered thanks to the fixation on 'space age' technology and its promise of domestic bliss. As the decades roll by, slowly but surely home automation is creeping into the developed world's homes.

The first home automation products appeared on the market in the late 1970s [8] yet home automation has barely left the ground. Helen Heneveld, a leading home automation industry consultant [11], describes two main markets for home automation solutions: the mass market and the "ultra-high-end" market. Many of today's products and solutions fall into the high-end category, giving the illusion that all home automation must be expensive and rare. Unfortunately, to a large extent, this is true. For the average home occupant to install a home system of any nature they either need to have a technical background and understanding of the technology they are installing or have to rely on specialised companies to install the system for them. For the most part the latter is the only option, keeping prices high and consumers reliant.

Ideally consumers should be able to go to their local hardware store, buy some home hardware (e.g. some X10 modules for controlling mains devices, a door lock for remotely locking the front door or a burglar alarm which supports SMS, email reporting and remote control) and install it into their current home system independently and with ease. From there, they should also be able to integrate this new hardware, and the services it offers, into the existing rule set for the home. For example, say the owner wanted to turn off the lights when they lock the front door. They later add a burglar alarm system to their home (and to the home system) and would like to amend their original rule to now turn off the lights and turn on the burglar alarm when they lock the front door. At the moment, this is not possible with existing home automation systems on the market.

As part of the author's research into developing a home system, further understanding was required of how users would imagine themselves interacting and controlling such a system. A survey was designed to help with this understanding. There have been a few surveys into how users (including families, couples, parents and the older generations) live within their home and how, or if, technology could be used to enhance it, including: [1, 2, 3, 4, 5, 6, 9, 15, 17, 20]. Also how these groups of people react to various academic projects, including: aCAPpella [7], Accord [16], CAMP [18, 19], Papier-Mâché [13] and others [12, 21]. However, to the author's best knowledge there has not yet been a survey carried out asking the user for basic information about controlling their homes and the locations and technologies associated with that. Therefore not only is this survey necessary, it is also extremely valuable.

Section 2 describes the survey and the respondents who took part are described in section 3. Section 4 reviews the results of the survey, looking at both the quantitative and qualitative data, and using the quantitative data to evaluate various hypotheses. Finally the report concludes with a summary of the findings in section 5.

2 The Survey

The Google Form service was used to create the online survey, which is shown in Appendix A and available to view at [14].

2.1 Format

The survey was designed to take between 5 and 10 minutes to fill in. This had the advantage of encouraging more people to take part due to the small time commitment required, but meant that the questions had to be condensed and kept to a minimum without jeopardising the quality and range of information which was required.

2.2 Demographic Questions

The first four questions were to obtain some basic demographic information about the respondent, including gender, age, status and home owner. This information both helped ensure that we were obtaining data from a representative sample of the demographic and offered insight into trends based on this information. Some additional information more specific to technology was also gathered to provide the author with a further understanding of the type of user. Due to the nature of the topic it was important to ensure that results from a good mix of technical backgrounds were obtained.

2.3 Introductory Question

The introductory question asked "How likely are you to want to be able to control your home?", with the possible answers: 'Very Likely', 'Likely', 'Unlikely', 'Very Unlikely' and 'Unsure' which are based on the Likert scale.

2.4 Core Questions

There were three main categories of core questions for the respondent:

- The preferred devices to control the home with.
- The preferred locations to control the home from.
- The preferred methods to control the home with.

These questions all have the exact same format, where the question was asked then a few possibilities were offered. The user had to rate the likelihood of each possibility using the Likert scale. There was also a text box at the end of each question which allowed the user to list any other possibilities that were not mentioned in the question.

Finally, to end the survey the user was given a large text box introduced with 'If you have any comments/suggestions/ideas please leave them here'.

2.5 Review

The survey was reviewed by experienced academics to ensure both the technical correctness of the survey format and style.

2.6 Pilot

A pilot was carried out with three respondents who varied in age, technical experience, and familiarity with this field of research to confirm that the survey was suitable for the wide range of respondents which it was aimed at. The comments were all taken into account and some of the questions and technical words had to be reworded to remove any ambiguity in the questions.

When testing the survey out one of the respondents answered 'Very Unlikely' when asked how likely they would be to want to control their home, and justified this by saying that they would not like the hassle and stress of trying to choose, buy, install, manage and use such a system. They described how they fear that such a system would break or be unreliable and therefore not worth the hassle nor money involved in owning a home system. This was interesting as the user was applying their personal experience and reservations about computers and technology to the notion of a potential home system that the survey is asking about. The author decided to add the following statement: "From now on assume that you could have the perfect system for controlling your home..." and then ask the question again: "Now how likely are you to want to be able to control your home?", with the same five possible answers as before.

Before the survey was sent out the author wrote eight hypotheses which are described and proven (either true or false) in section 4.

3 The Respondents

Since a wide demographic user set was required it was important to propagate the survey to as many different people as possible, and ideally people that the author did not know. This was achieved by using snowball sampling -whereby the author sent the survey to friends, family and colleagues and asking them to send it on to others. This resulted in 150 people filling in the survey over the duration of two weeks. The author then closed the survey to begin analysis of the data. Results were received for each representative demographic and shown in tables 1 to 5.

	Male	Female	Totals
< 20	14	6	20
21 - 30	46	9	55
31 - 40	13	14	27
41 - 50	14	11	25
51 - 60	3	9	12
61 +	6	5	11
Totals	96	54	150

Table 1: Age and Gender Crosstabulation

	Student	Employed	Unemployed	Retired	Homemaker	Rather not say	Totals
< 20	18	1	1	0	0	0	20
21 - 30	28	22	3	0	1	1	55
31 - 40	5	20	2	0	0	0	27
41 - 50	1	23	0	0	1	0	25
51 - 60	0	11	0	0	1	0	12
61 +	0	2	0	9	0	0	11
Totals	52	78	6	9	3	1	150

Table 2: Age and Status Crosstabulation

	No	Yes	Totals
Female	16	38	54
Male	58	38	96
Totals	74	76	150

Table 3: Gender and Home Owner Crosstabulation

	Poor	Competent	Good	Expert	Totals
Female	6	14	25	9	54
Male	0	4	34	58	96
Totals	6	18	59	67	150

Table 4: Gender and Technical Ability Crosstabulation

	No	Yes	Totals
Female	8	46	54
Male	4	92	96
Totals	12	138	150

Table 5: Gender and Enjoyment of Using Technology Crosstabulation

4 Results

The results collected were rich in both quantitative and qualitative data. The quantitative data was kept in the spreadsheet which Google Forms auto populates from the surveys filled in, and the qualitative data was moved into its own document. This allowed the hypotheses to be evaluated using the quantitative data from the spreadsheet, and the comments and feedback to be analysed separately. H_0

4.1 Hypotheses

4.1.1 Older people do not enjoy using technology

It was predicted that as age increases the percent of users who do not enjoy using technology will increase. It was believed to be true as the younger generations have grown up with technology playing a large role in their life, whereas for older generations technology can still seem scary and difficult. Also, younger generations are generally more willing to spend higher amounts of money and time on technology as it has been the way they were brought up, whereas the older generation are not used to the expense of technology, often having traditions and reluctance to change or move on. Many older people can be afraid of technology, unsure of how to use it and afraid of breaking it in some way, whereas younger generations have a much higher degree of confidence around technology.

Because nobody in the under 20 age category and only one person in the 31-40 age category chose the answer 'no' when asked if they like using technology there is not enough data to significantly prove the relationship. However, the graph shown in Figure 1 portrays a strong relationship between age and percentage of people not liking technology. So although we can not statistically prove this hypothesis, the data does encourage us to conclude that there is indeed a relationship between age and disliking technology.

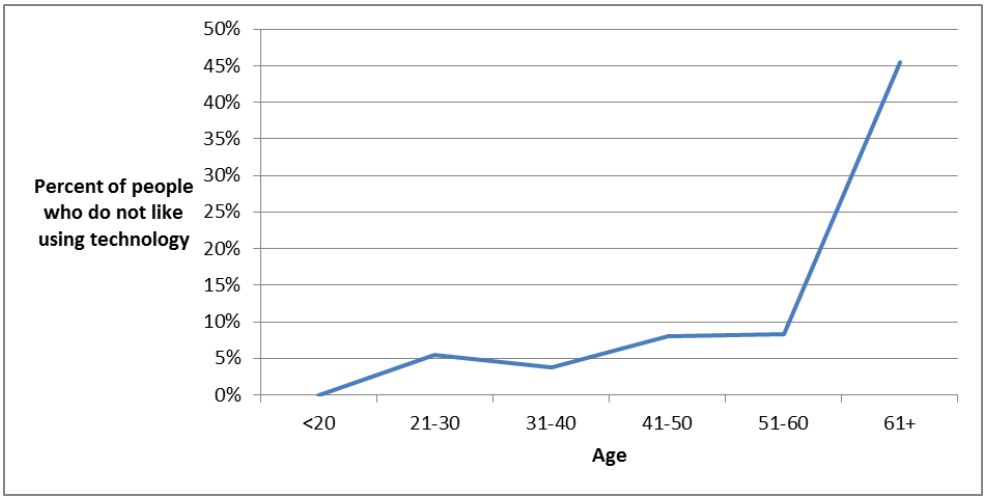


Figure 1: Effect on disliking technology as age increases

4.1.2 As age increases, technical ability decreases

Similar to hypothesis 4.1.1, and for similar reasons, the author believed that the average technical ability of users will decrease as age increases.

H_0*: There is no relationship between age and technical ability.*

H_1*: There is a relationship between age and technical ability.*

A chi-squared test was used to calculate if there was significant difference between under 40s and over 40s when rating technical ability. P is less than 0.0005, therefore at a 1% level of significance we can reject H_0 in favour of H_1 to conclude that there is a relationship so that as age increases, technical ability decreases.

4.1.3 People would like to control their home if offered their 'perfect' solution

The author believed that if users were offered "the perfect system for controlling their home" that the vast majority of them would be highly likely to want it.

80% of people answered 'likely' or 'very likely' when asked if they would like to control their home. This rose to 93.33% when they were offered the 'perfect system' and asked the same question again.

H_0*: There is no relationship between the likelihood of wanting a home system before and after being offered a 'perfect system'.*

H_1*: There is a relationship between the likelihood of wanting a home system before and after being offered a 'perfect system'.*

A chi-squared test was carried out against the likelihood of wanting a home system before being offered a 'perfect system' and after. This resulted in a p value of 0.001, so at a 1% level of significance we can reject H_0 in favour of H_1, concluding that there is a relationship between the likelihood of wanting a home system and the likelihood of wanting a 'perfect' home system. From the data we can see that this relationship is an increase in likelihood from a home system to a 'perfect' home system.

4.1.4 People would prefer using their PDA, laptop/PC and tablet over their TV or games console

As a means of controlling their home the author believed that most people would much prefer to use either a PDA, laptop, PC or tablet PC than their TV or games console.

H_0*: There is no relationship between the likelihood of wanting to control the home using either a PDA, laptop/PC or tablet more than through a TV or games console.*

H_1*: There is a relationship between the likelihood of wanting to control the home using either a PDA, laptop/PC or tablet more than through a TV or games console.*

Using a chi-square test, the p values between each relationship are:

	TV	**Games Console**
Laptop/PC	< 0.001	< 0.001
PDA	< 0.001	< 0.001
Tablet	0.362	< 0.001

Table 6: P-Values of likelihood between means of control

At a 1% significance level we would not be able to reject H_0in favour of H_1, due to the large p-value between TV and tablet. This would force the conclusion that there is no relationship between wanting to control the home using either a PDA, laptop/PC or tablet more than through a TV or games console. However, if we remove the tablet from the hypothesis to result in:

H_0*: There is no relationship between the likeliness of wanting to control the home using either a PD or laptop/PC more than through a TV or games console.*

H_1*: There is a relationship between the likeliness of wanting to control the home using either a PD or laptop/PC more than through a TV or games console.*

At a 1% significant level we would reject H_0. Therefore the second amended hypothesis is true and we can conclude that people would prefer to control their home using their PDA or laptop/PC rather than using their TV or games console. Figure 2 visually represents this notion.

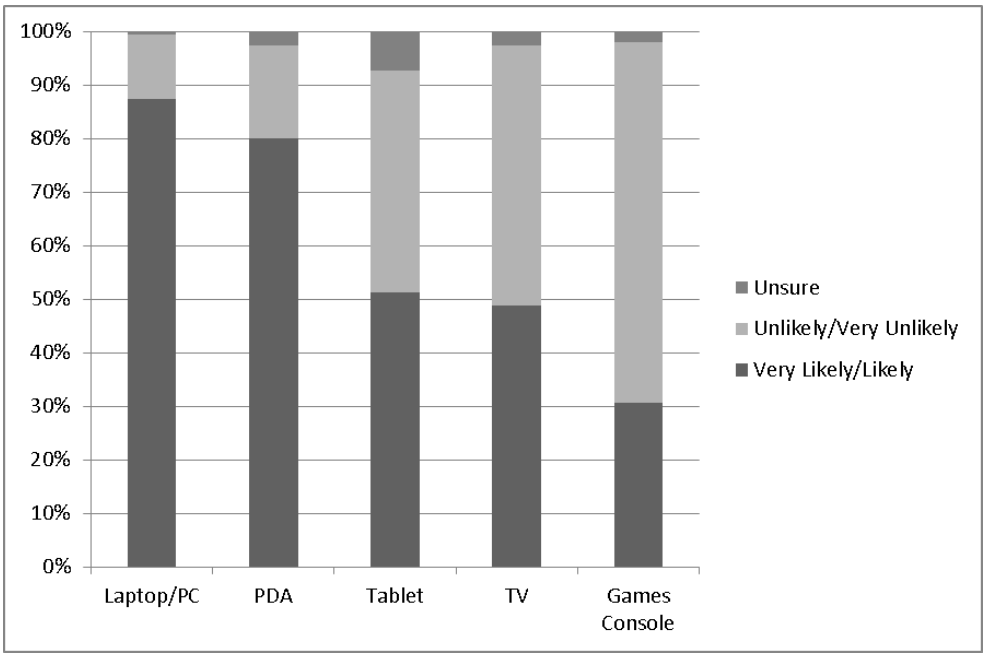


Figure 2: Likelihood of using particular devices to control the home.

4.1.5 Older people would be more likely to control their home from the hall

The author believed that older generations do not appreciate the full freedom that technology can offer, and can end up in the mindset that computers are found in the study or in the office, and find it difficult to imagine much else in between. I believe that older generations think that the hall within the home is a place for controlling many aspects of the home such as the burglar alarm and thermostat for their central heating. In the same way they could associate the notion of controlling their home from this same location. Younger generations, in contrast, can imagine and would prefer that the whole control of their home (burglar alarm, thermostats or other features) be carried out from wherever they are at that point in time. They do not share the same imagined restrictions and traditions that older generations do.

H_0*: There is no relationship between the likelihood of wanting to control the home from the hall and age.*

H_1*: There is a relationship between the likelihood of wanting to control the home from the hall and age.*

Using a chi-squared test we get a p value of 0.125 when comparing under 40s and over 40s with their likelihood for controlling their home from their hall. Using a 5% significance level we reject H_1 in favour of H_0. Therefore there is no relationship between age and wanting to control the home from the hall. The graph shown in figure 3 demonstrates this statistic and visually shows that there is no relationship.

4.1.6 People would not be likely to program their home from their kitchens or bedrooms

The author believed that, on the whole, people would rather not program their home from inside their kitchens or bedrooms, as these rooms already have strongly associated functions of cooking/eating and sleeping respectively. Therefore people are far more likely to want to program when relaxing in the lounge or at their PC in their study.

H_0*: There is a relationship between the likelihood of controlling the home from the kitchen or bedroom and not controlling the home from the kitchen and bedroom.*

H_1*: There is no relationship between the likelihood of controlling the home from the kitchen or bedroom and not controlling the home from the kitchen and bedroom.*

Using a chi-squared goodness of fit test with the following summarised tables:

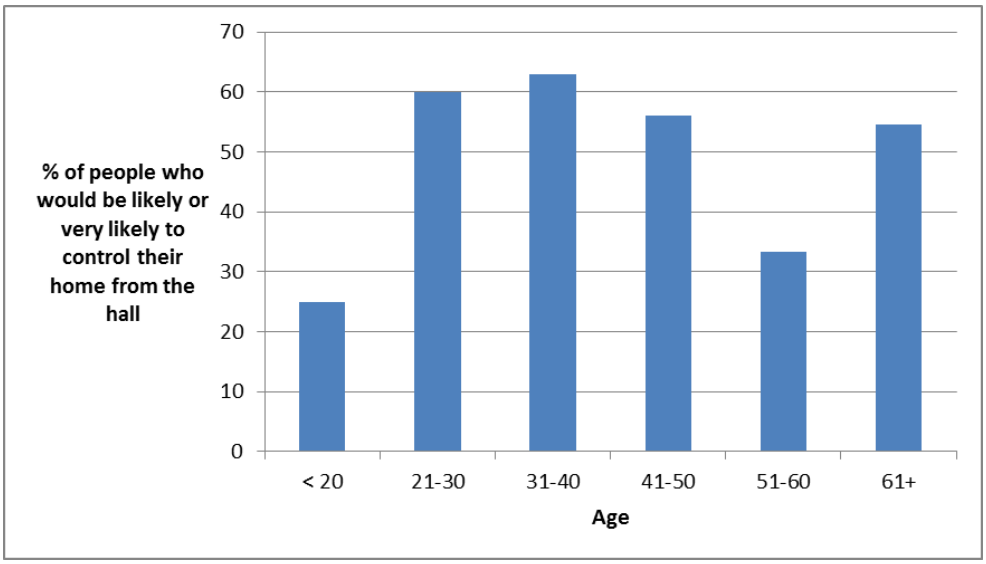


Figure 3: People who would be likely or very likely to control their home from the hall.

	Observed	Expected
Likely/Very Likely	115	74
Unlikely/Very Unlikely	33	74

Table 7: Bedroom counts

	Observed	Expected
Likely/Very Likely	110	73.5
Unlikely/Very Unlikely	37	73.5

Table 8: Kitchen counts

This results in chi-square values of 45.432 and 36.252 respectively. Using a 5% confidence level we cannot reject H_0 in both cases, therefore we must reject H_1 to conclude that there is a relationship between the likelihood of controlling the home from within the kitchen and bedroom and not controlling the home from within the kitchen or bedroom. The data shows us that the relationship swings to the positive side rather than the negative, so in actual fact people are likely to program their home from their kitchens or bedrooms. Figure 4 visually demonstrates this fact.

4.1.7 People would not want to program their home through voice or gesture control

The author believed that on the whole people would rather not program their home through voice or gestures.

H_0*: There is a relationship between the likelihood of controlling the home using voice or gesture control and not controlling the home using voice or gesture control.*

H_1*: There is no relationship between the likelihood of controlling the home using voice or gesture control and not controlling the home using voice or gesture control.*

Using a chi-squared goodness of fit test with the following summarised tables:

	Observed	Expected
Likely/Very Likely	83	74
Unlikely/Very Unlikely	64	74

Table 9: Voice Control counts

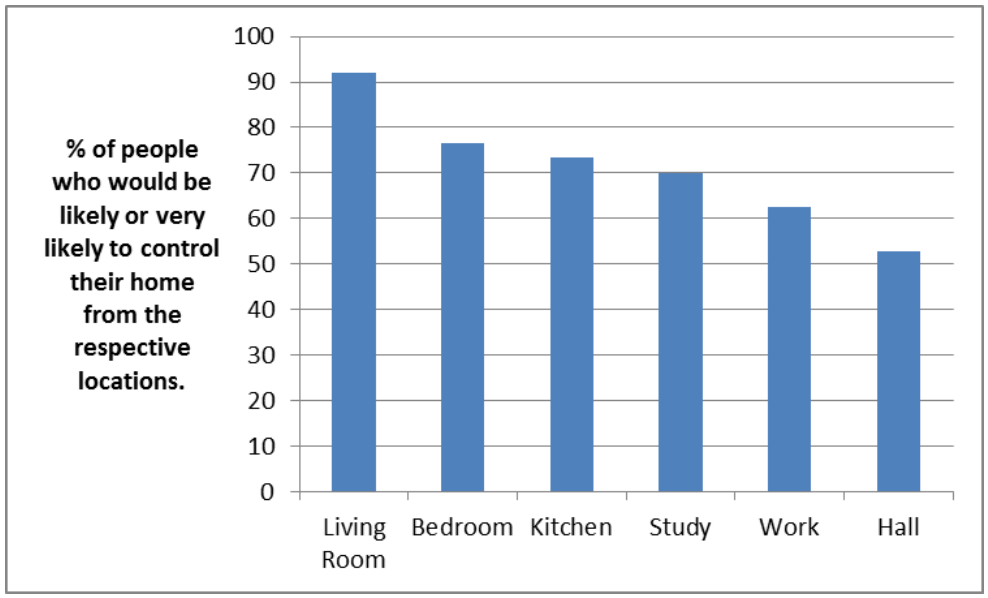


Figure 4: How likely or very likely people would be to control their home from different locations

	Observed	Expected
Likely/Very Likely	30	73
Unlikely/Very Unlikely	116	73

Table 10: Gesture Control counts

This results in chi-square values of 2.456 and 50.658 respectively, both with DF 1. Using a 5% confidence level we can reject H_0 in favour of H for voice control, but we cannot for gesture control.

Voice Control We reject H_0 for voice control in favour of H_1 which means that there is no statistical relationship between the likelihood of controlling the home using voice control and not controlling the home using voice control.

Gesture Control Since we cannot reject H_0 for gesture control we must reject H_1 to conclude that there is a relationship between the likelihood of controlling the home using gesture control and not controlling the home using gesture control. The data tells us that this swing is in the negative direction, where more people voted 'unlikely' or 'very unlikely' than 'likely' or 'very likely'. Therefore we can conclude that the data shows that more people would prefer not to program their home through gesture control.

Once again these statistics are represented visually. This time figure 5 demonstrates the likelihood of the varying methods of home control.

4.1.8 People would most prefer to program using a touch interface

The author believed that on the whole people would prefer to program their home using a touch interface more than they would prefer to use voice, gesture or remote controls.

H_0*: No relationship between method and likelihood of use.*

H_1*: Relationship exists between method and likelihood of use.*

Using three chi-squared tests between touch control and each of the other methods of control, the p-value was <0.001 with voice and gesture control and 0.002 with remote control. These values allow us to reject H_0 in favour of H_1at a 1% significance level. Therefore concluding that people would prefer to use a touch interface rather than the other methods of control offered. The graph shown in figure 5 visually portrays this information, with 98.66% of people answering 'very likely' or 'likely' (61.33% and

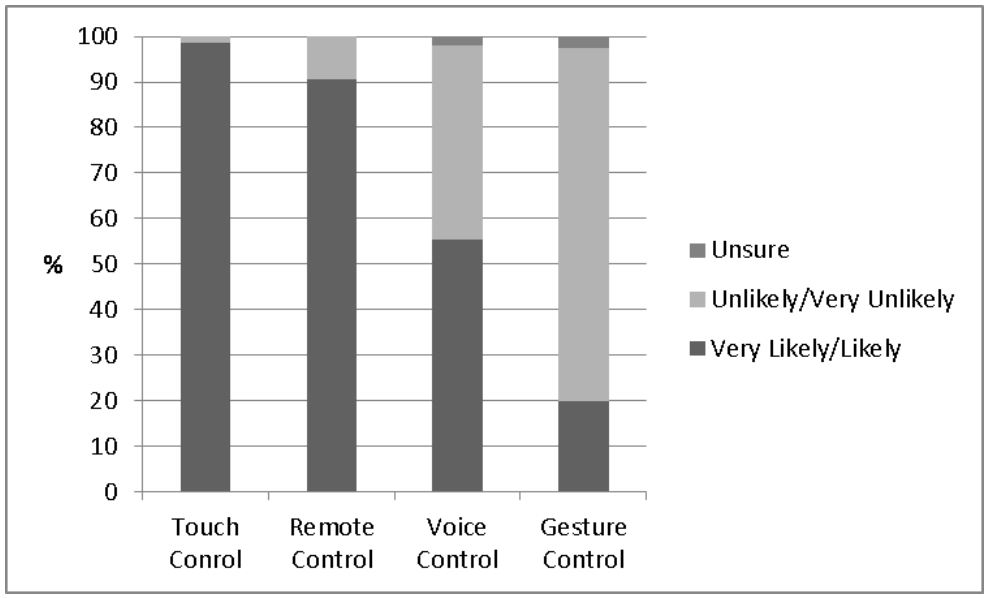


Figure 5: The likelihood of using various methods to control the home

37.33% respectively) when asked how likely they would be to use touch control when controlling the home.

4.2 Qualitative Results

For each of the main questions asked the users were given the opportunity to make suggestions. There was also a large suggestion box at the end of the survey. In some cases the user would make suggestions at the end rather than in the respective text fields for each question. In those cases the answers have been moved into their respective question. A wide range of feedback was received that is now summarised and reviewed in turn:

4.2.1 Other Devices

There were many different suggestions made when asked if there were any other devices that users could see themselves controlling their home with. These have all been collated into table 6, along with their respective counts.

Devices	Requests
Wall Panel(s)/'house console'/'control panel'	8
Remote Control	7
'Normal' mobile phone/mobile device	7
Microphone/voice	3
RFID/RFID Fob	2
Wearable/portable devices (like a watch or credit card)	2
Full VR helmet and gloves	1
Arduino (open-source electronics platform for hobbyists)	1
Chumby (small portable electonic device which displays custom Internet feeds)	1
Portable Games Console	1
Telephone (landline/mobile) call	1
In-Car System	1
RobCo Pip-Boy (a handheld electronic device from the Fallout PC Games)	1
MP3 Player	1

Table 11: Devices suggested by users and their respective counts.

By far the most popular suggestion was a wall panel:

- "Wall panel interface, e.g. for heating"
- "House console, bit like the alarm control device near entrances to the dwelling"
- "Dedicated multi-room control panels situated around the house or in the kitchen"
- "Dedicated controller (similar to central heating controller)".

It became clear that there was a general divide in the suggestions: those who liked the idea of the fixed wall panel ("like an iPad, but fixed e.g. to the fridge"), and those who wanted quite the opposite ("a device that could be worn on the wrist, e.g. watch" or "multiple devices depending on location").

Another clear divide was among those who suggested devices within their comfort zone ("a remote control" or " 'normal' mobile phone") and those who suggested technology that they had maybe no personal experience of ("Chumby?", "voice activation", or even a "RobCo Pip-Boy").

4.2.2 Other Methods

Users offered some interesting ideas for possible methods to control their homes. Table 7 summarises these suggestions and shows their respective counts

Methods	Requests
Saving and creating different house modes for reuse	5
Different interface options available for the one system	4
Autonomous control with ability to override	4
Voice	3
Motion	3
'Web interface'	3
Preset timers	2
Mind control	1
Automatic settings chosen dependent on the person involved (profiling)	1
Hybrid of voice and touch	1
Clapper (e.g. the house being able to respond to someone clapping their hands)	1
Placement of physical items (phones, dedicated 'tiles', etc.) to represent different things ("Placement of physical items in ways the house could recognise (glyphs, RFID or feature extraction), for example putting phone down means forward mobile calls to house phone, or using tiles to represent games/movies/music to play")	1
Iris control (for example gaining access to your house by using eye technology verification)	1

Table 12: Methods suggested by users and their respective counts.

Interestingly a few people mentioned the concept of programming their home:

- "Option of programming different options and/or storing them for reuse might be useful"
- "Preset programs"
- "It could send commands based upon rules such as when leaving work turn on heating, start filling bath, defrost dinner."

Only one person mentioned the automation of the home, yet made the point that they would still like to be able to override it:

- "Autonomous control but with the ability to override it – i.e. house making its own predictions on what is required based on external data (e.g. weather forecast / data) and past behaviour (e.g. person always out on Thursday night until 9pm so switch on heating later)."

These results are reassuring, showing that users want control over their home rather than a fully automated solution, and in some cases are volunteering to program their home.

4.2.3 Other Places

Locations were mentioned by people throughout all their written answers, so these are collated and shown in table 8.

Locations	Requests
Anywhere	15
Car	9
Bathroom	8
Garage	6
Sport locations (hiking, gym, cinema, ice rink)	5
Garden	5
Holiday	5
Commute	3
Friend or familys' house	2
Shopping	2
Restaurant	1
Every room	1
Dedicated room	1
A command centre	1

Table 13: Locations suggested by users and their respective counts.

More than half of the locations mentioned are away from the home, showing how important it is for people to be able to remotely monitor and control their home from anywhere.

4.2.4 General Comments

A wide range of comments were left by users at the end of the survey. These included activities that they would like to be controlled within their own home, names of various technologies and devices they would like to use, and the means of controlling their home. The highlights of the comments are summarised below:

Flexibility It was mentioned that the system should be able to offer the user various means of controlling both the home system and the home:

> "I would want to be able to change the methods of input and output depending on various things such as the type of thing I am controlling, my location, my mood....what other things are on around me, etc."

Profiling A few users mentioned the notion of home occupants (and potentially visitors) having profiles which could be used to determine the home, or room, environment settings:

> "I would like to see smart homes implement a profile system for whoever is in the room at any one time. By making use of personal networks (i.e. hardware attached to the body), perhaps a small credit card style device, each person might require different heating & lighting levels etc. If more than one person is in a room then a neutral profile would be used."

Programming Again, users took the opportunity to mention their desire to program their home:

> "Programming options. For example, select room/light from a list, select on-time and off-time plus days that applies to. So can for example save holiday setting which you can then easily recall next time."

Location Based Behaviour The house reacting to your location was mentioned by a few users:

- "Input from PIR sensors around house to determine location and alter some services accordingly."
- "I would like a sensor to turn the lights on a room when I am there (no mater if I move or not) and turn off when I leave."
- "One thing not on the list is just being physically in the room, like the light would come on to your default preset, music could follow you from room to room, light your path at night, etc."

Home Security As the author discovered in a previous user study, home security is an important issue to people. This was confirmed again in this study:

- "I'd love to have a home surveillance that I could view from work to check that the house is OK. Also, to be able to switch on lights for example if I am coming home later than expected."
- "Safety features would be useful addition, e.g. – if hot water tank leaks switch off water heating and turn off more water going in to tank. Could inform homeowner by SMS."

System Security There was a surprising lack of comments made about the reliability and security issues of a home system, however this could be due to the comment made in the survey which asked the user to answer the questions as if a 'perfect' home system was available.

- "Security – if you were able to make commands for changes in your house while you are outside of it - can someone unwanted do it? It would be good to have things like baths run for coming home from cold football matches – get the heating turned on/off if the weather changes quickly (as it does here) but I wouldn't like a stranger running a bath and flooding the house or turning on the heating when you are away for a month in high summer."
- "Street / Public places (e.g. Bar, Train etc.) – but only if trust was gained that system worked correctly!"

Accessibility Most likely due to the type of user filling in the survey there was very little mentioned about accessibility issues, nor telecare. One user did make the following point:

> "I hope this could include some accessible solutions in one system, e.g. to allow disabled people to control all environmental aspects such as windows, curtains, door openers, TV, media systems, page turners, bed control, water and shower temperature, automated on/off taps/showers/washing machines etc. etc. etc. And that the system could be adapted to allow varied accessible manner...for some this would be touch, others could be voice activated, others by additional larger switches with automated scanning through options, some others can use head pointers etc. etc.!"

Feedback Only one user mentioned system feedback for reassurance purposes:

> "A remote control device with buttons specific to the task – perhaps with pictures would be easy to use, followed by a message to say that the task had been completed so that you knew the task you had just asked to be done had actually been completed."

5 Conclusion

This survey has been incredibly valuable in learning how people want to control their homes. This information has allowed hypotheses about users and the home to be proven true, or in some cases false, and for trends to be observed in both the quantitative and qualitative data. The key information learnt was the types of devices, methods and locations in which people would use to control their home and One user summarised the key aspects of home control: "Multiple points of access, ease of control and reliability are key issues."

The quantitative data has allowed us to evaluate a number of hypothesis. The data confirms that older people do not enjoy using technology and are not as technically capable as younger generations. Users demonstrated a very strong desire to control their home, especially when offered 'the perfect system'. On the whole PDAs, laptops, PCs and tablet PCs were preferred as means of controlling the home over games consoles. Finally, touch and remote control were strongly preferred as means of controlling the home than voice or gesture control. The author's two hypotheses about controlling the home from certain locations were both proven false, showing that actually there is no trend between age and controlling the home from the hall, and that actually people on the whole do not have much preference where they control their home from.

The author can make use of the statistics and observations learnt from the survey to help ensure that her work is both suitable and appropriate for potential end users. Having learnt that 98.7% of the users from the survey said that they would be likely or very likely to control their home using a touch interface, and the strong desire for people to want to control their home from 'anywhere', an Apple iPad has been chosen as the main means of controlling the author's existing home system work. An iPad is a slimline tablet PC which offers a very high standard of simplicity, form factor and enjoyment for any user and was considered the most suitable device available on the market. Care and attention over other issues raised by users will be given, such as security and flexibility of both the home system and the means of controlling the home system.

References

[1] Sarah Beech, Erik Geelhoed, Rachel Murphy, Julie Parker, Abigail Sellen, and Kate Shaw. The Lifestyles of Working Parents : Implications and Opportunities for New Technologies. *HP Tech report*, (HPL-2003-88), 2004.

[2] J Coughlin, L A D'Ambrosio, B Reimer, and M R Pratt. Older adult perceptions of smart home technologies: implications for research, policy and market innovations in healthcare. *Conference proceedings : ... Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Conference*, 2007:1810–5, January 2007.

[3] Andy Crabtree, Tom Rodden, Terry Hemmings, and Steve Benford. Finding a Place for UbiComp in the Home. *UbiComp*, 2864(LNCS):208–226, 2003.

[4] Charles N Darrah. Family Models , Model Families. In *Revisiting the American Dream: How US Families Cope with Work and Family Life, American Anthropological Association Annual Conference, Chicago, IL*, 2003.

[5] CN Darrah, J. English-Lueck, and J. Freeman. Families at work: An ethnography of dual career families. *Report for the Sloane Foundation*, pages 98—-6, 2001.

[6] Scott Davidoff, Min Kyung Lee, John Zimmerman, and Anind Dey. Socially-Aware Requirements for a Smart Home. *International Symposium on Intelligent Environments*, pages 41–44, 2006.

[7] A K Dey, R Hamid, C Beckmann, I Li, and D Hsu. a CAPpella: programming by demonstration of context-aware applications. *Proceedings of the SIGCHI conference on Human factors in computing systems*, page 40, 2004.

[8] Edward B. Driscoll. A Timeline for Home Automation. 2002.

[9] Rebecca E Grinter, W Keith Edwards, Mark W Newman, and Nicolas Ducheneaut. The Work to Make a Home Network Work. In *ECSCW*, number September, pages 469–488, Paris, France, 2005.

[10] Davin Heckman. *A Small World: Smart Houses and the Dream of the Perfect Day*. Duke University Press, 2008.

[11] Helen Heneveld. Background of Helen Heneveld. `www.hheneveld.com/about`, 2009.

[12] Clare-Marie Karat, John Karat, Carolyn Brodie, and Jinjuan Feng. Evaluating interfaces for privacy policy rule authoring. *Proceedings of the SIGCHI conference on Human Factors in computing systems - CHI '06*, page 83, 2006.

[13] Scott R. Klemmer, Jack Li, James Lin, and James A. Landay. *Papier-Mache*. ACM Press, New York, New York, USA, 2004.

[14] Claire Maternaghan. Controlling the Home Survey, 2010.

[15] Jon O'Brien, Tom Rodden, Mark Rouncefield, and John Hughes. At home with the technology: an ethnographic study of a set-top-box trial. *ACM Transactions on Computer-Human Interaction*, 6(3):282–308, September 1999.

[16] T Rodden, A Crabtree, T Hemmings, B Koleva, J Humble, K P RA kesson, and P HANSSON. Configuring the Ubiquitous Home. *Cooperative Systems Design: Scenario-Based Design of Collaborative Systems*, page 215, 2004.

[17] Jennifer A Rode, U C Irvine, Eleanor F Toye, and Alan F Blackwell. The Domestic Economy : a Broader Unit of Analysis for End User Programming. In *CHI*, pages 1757–1760, 2005.

[18] K. Truong, G. Abowd, and J. Brotherton. *Who, what, when, where, how: Design issues of capture and access applications*, pages 209 – 224. Springer, 2001.

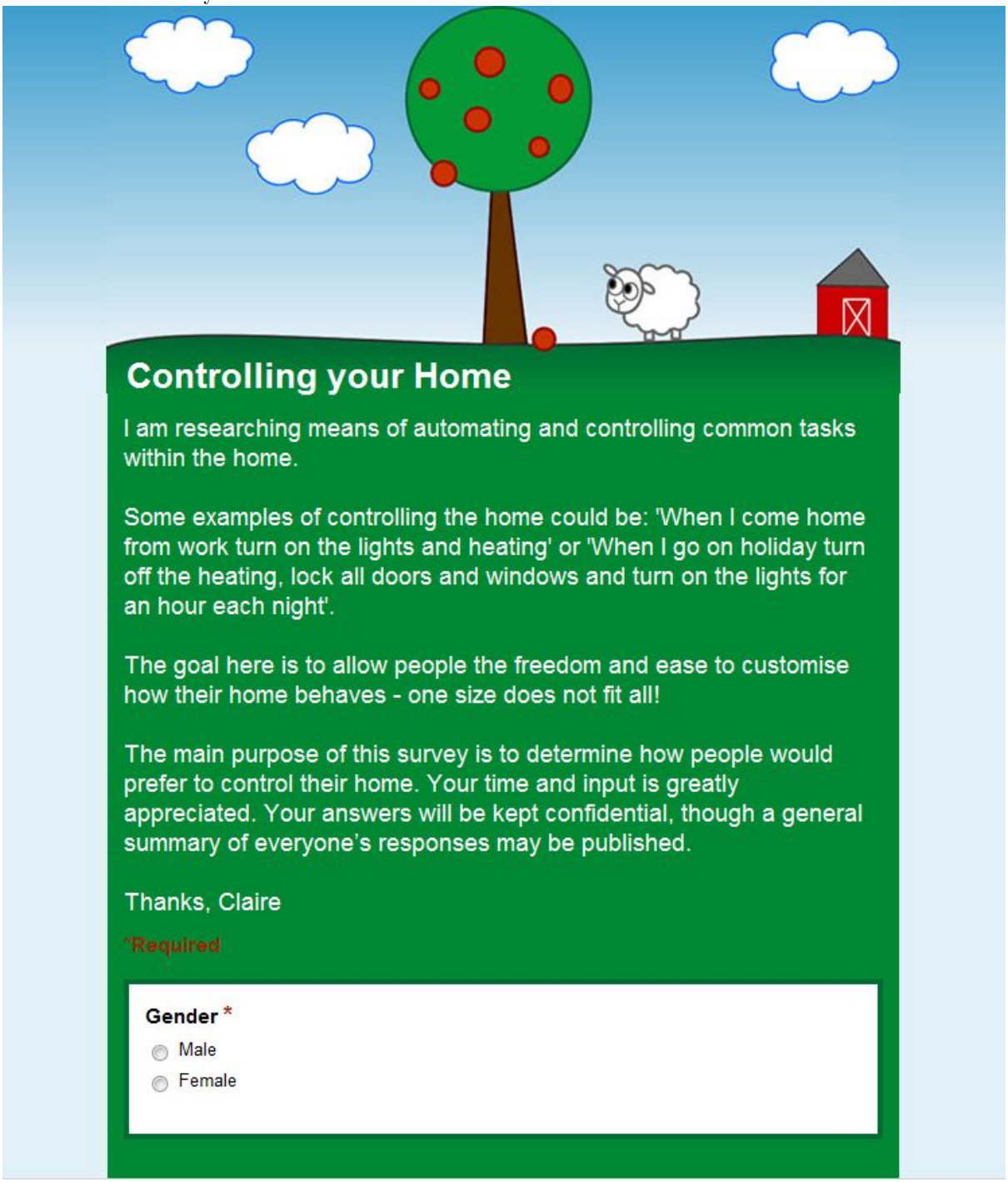
[19] K. Truong, E.M. Huang, and G.D. Abowd. CAMP: A magnetic poetry interface for end-user programming of capture applications for the home. *UbiComp 2004: Ubiquitous Computing*, pages 143–160, 2004.

[20] Alladi Venkatesh, Æ Erik Kruse, and ÆEric Chuan-fong Shih. The networked home : an analysis of current developments and future trends. *October*, pages 23–32, 2003.

[21] B Zhang, PLP Rau, and G Salvendy. Design and evaluation of smart home user interface: effects of age, tasks and .... *Behaviour and Information ...*, 2009.

Appendix A

Screenshots of the survey:



Age *

- < 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 +

Status *

- Student (inc. PhD students)
- Employed (/ Self Employed)
- Unemployed
- Retired
- Homemaker
- Rather not say

Are you a home owner? *

- Yes
- No

Do you enjoy using technology? *

e.g. computers, mobile phones, digital cameras, mp3 players etc etc...

- Yes
- No

How would you rate your technical ability? *

- Expert
- Good
- Competent
- Poor

How likely are you to want to be able to control your home? *

- Very Likely
- Likely
- Unlikely
- Very Unlikely
- Not Sure

From now on assume that you could have the perfect system for controlling your home...

Now how likely are you to want to be able to control your home? *

- Very Likely
- Likely
- Unlikely
- Very Unlikely
- Not Sure

How likely would you be to use the following devices to control your home: *

	Very Likely	Likely	Unlikely	Very Unlikely	Unsure
PDA (e.g. an iPhone or Android Phone)					
Tablet PC (e.g. an iPad)					
TV					
Laptop/PC					
Games Console (e.g. an Xbox or Playstation)					

Are there any other devices you could see yourself using?

How likely would you be to control your home from the following places: *

	Very Likely	Likely	Unlikely	Very Unlikely	Unsure
Living Room					
Study					
Kitchen					
Bedroom					
Hall					
Work					

Are there any other places you could see yourself controlling your home from?

How likely would you be to use the following methods to control your home: *

	Very Likely	Likely	Unlikely	Very Unlikely	Unsure
Voice Control (e.g. say a command)					
Touch Control (e.g. touch panel in the hall)					
Gesture Control (e.g. shake mobile phone for 'no')					
Remote Control (e.g. pressing an actual button)					

Are there any other methods of controlling the home you could see yourself using?

If you have any comments/suggestions/ideas please leave them here: