Blind dogs need guides too: towards technological support for blind dog caregiving

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Blind or visually impaired pet dogs have additional challenges to overcome in their daily life in environments typically built for sighted humans, as do their caregivers in supporting them. From simple activities like finding their food in a hopefully stable home environment, to more complex activities like navigating an ever changing outdoor environment safely. While some support exists for blind and visually impaired dogs, frequently in the form of physical safety products and veterinary guidelines for care giving, little interactive technology yet exists to inform and complement caregivers' abilities. In this paper, we present the results of an interview-based study with caregivers of blind and visually impaired dogs, using thematic analysis to construct core themes of support needed, and translated these into a prototype app. Our findings show that, while caregivers can adapt quickly to coping with a blind or visually impaired pet dog in their own environment, a gap exists in coping with (ever changing) outdoor environments, in particular identifying safe and suitable outdoor walking routes. We show an initial design of a mobile app for this purpose, and discuss to what extent software for informed caregiving of visually impaired pet dogs could benefit from further work.

CCS Concepts: • **Human-centered computing → HCI theory, concepts and models**.

Additional Key Words and Phrases: animal-computer interaction, dog, visual impairment, blind, prototype

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1 INTRODUCTION

Blind pet dogs are very adaptable creatures and are very much able to still have a great quality of life. From personal experience of giving care to visually impaired pet dogs we understand there are challenges, while there are clear steps that caregivers can take, ranging from adapting home environments to visually impaired dogs, and managing walks in outdoor environments. Yet, little technological support exists to do so, let alone support caregivers of visually impaired dogs as of yet. This short paper presents an initial step towards this aim by carrying out an interview-driven study to understand the challenges that caregivers face and identifying where support may be needed. Practically, we contribute:

(1) **A systematic understanding of the challenges caregivers of visually impaired dogs face** through analysis of literature focused on caregiving and technology available for visually impaired dogs; and
(2) **discussing what relatively straightforward technology could provide** by briefly discussing what functionality technology would need and how it could look like.

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2 BACKGROUND–WHAT DO WE KNOW ABOUT VISUALLY IMPAIRED DOGS?

2.1 Caregiving

The etymology of caregiving defined by the Oxford English Dictionary states that caregiving is characterised by attention to the needs of others, especially those unable to look after themselves adequately. The impact of a pet's disease does not only affect the patient, but also can affect the quality of life of the pet's owner [16]. This was initially investigated in a previous study, where questionnaires were sent to nineteen owners of disabled dogs to judge the quality of pet and owner lifestyle [8]. Furthermore, the study gives appreciation to the long term financial and emotional commitment in which an owner makes for their disabled pet. Among the study's findings, 79% of owners agreed that they expected an increased amount of work would be required to maintain their disabled dog. However, in regards to the owner's perception of their pet's quality of life, 95% disagreed strongly that their pet was leading a poor quality of life [8]. Therefore, it can be suggested that disabled animals are not defined by their disabilities and can still lead good quality lives with the right assistance from their owners.

In addition to this, another study on the evaluation of the impact of epilepsy in dogs on their caregivers [10] provides another insight into the challenges these caregivers might come across. An online survey of 225 participants took place, with the majority conveying a positive response when focusing on the overall quality of life for their epileptic dog. However, others responded negatively expressing financial burden due to veterinary bills and medical related adverse effects. This study also highlighted the need of educating these owners on long term management caregiving of the dog population with epilepsy to improve their views on the overall quality of life for their epileptic dog. It is required to provide that extra support to these caregivers.

In addition, it is often assumed that blind dogs exhibit behavioural troubles and that blind dogs have poorer communication capabilities than dogs with no sensory impairments, in particular with their human caregivers [14]. However, this is not always the case as there is a lot of helpful veterinary advice for owners of blind dogs available online. Orton provides detailed advice around commands, the home environment, gardens, walks, play, training, socialisation, merchandise, other impairments, support, and rehoming [12]. Orton's work is of particular relevance to this paper as she shares this advice based on her own experiences with her own blind pet dog, Peaches, as well as her own veterinary expertise. Orton's work highlights the initial worries from owners when they are told that their pet dog will become blind, some owners even considering euthanasia for their pets. She encourages these owners that dogs are adaptable and can continue life with only very minor adjustments.

Savel and Sombé's work [14] asks the question, are dogs with congenital hearing and/or vision impairments so different from sensory normal dogs? The results of their study found that sensory impaired dogs, such as blind pet dogs, may be just as capable as sensory normal dogs. Blind dogs can still achieve good levels of competence in the activities in which their owners engage them in. To achieve this level of competence, an interesting adjustment for a blind pet dog based on veterinary advice is the use of commands. Orton states, 'Owners may find their dogs are much more receptive to oral cues than sighted dogs.' [12] This could be assumed that a blind dog focuses more on their other senses such as smell and sound. More veterinary advice [6] tells us that dogs rely less on their vision and more on their sound and smell, although this varies between breeds. Adult dogs are very capable of rapidly learning the significance of human gestures and with formalised training, this ability can be further enhanced [13]. Furthermore, Orton's veterinary advice [12] also informs us that there are infinite commands that a blind dog can learn. The use of commands is also encouraged in training techniques with blind dogs, capturing and rewarding a behaviour and

attaching a corresponding command. Focusing on Hedges' veterinary advice [6], the advice lists the different uses of commands for blind dogs to aid navigation.

Another adjustment is focused on keeping the furniture in the home environment in the same place. This allows blind dogs to get to know the area and gain the confidence to move around without bumping into things. However, as dogs are very adaptable to new environments and can map them quickly, it's not to say furniture can't ever be moved. Research has provided evidence that a dog can fast map [7]. To assist the mapping of an environment, dogs have senses in place to help them navigate their environment in low levels of light [3] and part of this adaptation, depending on the dog, could include use of their whiskers. Dogs can navigate a dark space without bumping into walls, whiskers can sense air currents, assisting the dog in navigating the dark even if they have limited vision [11] Similarly, gardens cannot be forgotten. Orton offers advice on how owners can prevent their blind pet dogs from bumping into obstacles in the garden such as trees, bushes, fences and washing line poles. These include the use of textural changes such as grass to bark chips or have foam cladding around objects. Large, flat grassy areas can encourage blind dogs to feel confident and secure to run and play at speed. Toys that incorporate sound or scent are perfect for blind dogs [12]. Orton also discusses the assistive technologies available on the market but does not believe that they are of any benefit. Some of these technologies will be discussed within the next section 2.2, focusing on whether these technologies prevent the blind dog from developing their own adaptive mechanisms?

2.2 Assistive technologies

The following section will investigate the use of tech and gadgets for blind pet dogs. Although assistive technology for pet dogs with impairments seem limited to 3D Imaging Sonar emitters for dogs, harnesses, tracking collars, and pet safe drinking fountains, there is still vital research surfacing. Below some of these technologies are discussed in more detail. The constantly changing technology has enabled a lot of our communication to be carried out electronically rather than verbally, enabling us to cut across distance and language barriers [5]. Similarly, we can use communication technology with dogs to accomplish tasks, to be more specific, we can use technology on blind pet dogs.

2.2.1 Blindsight and Muffin's Halo devices. The purpose of the BlindSight devices is to carry out echolocation by using sound-echoes to work out location information about the environment (cf. [15]) that can be attached to a collar or harness. There are lots of animals who do use echolocation such as birds, dolphins and bats. The use of BlindSight allows blind dogs to use echolocation to determine the direction of and the distance of objects using the reflected sound.

In a recent study [1] commercially available visual aid devices were tested on twelve blind dogs from the University of Georgia ophthalmology service. The purpose of this study was to demonstrate how useful these devices were in assisting blind dogs with their navigation and to help veterinarians provide advice to owners of blind dogs upon purchasing these devices. The two assistive devices tested were the BlindSight 3D Imaging Sonar emitters devices and Muffins Halo physical barrier. The Muffins Halo's purpose is to prevent the animal from bumping into stationary objects and injuring the head, neck, or shoulders, via a detachable cushion and wire rim. The study undertook thorough testing as each dog completed five different obstacle-avoidance mazes, which in return provided promising results on the navigational ability of the blind dogs with assistance of these devices. The results found that the assistive device that led to the least collisions in the blind dogs through the completion of the maze was varied and relied on the dog itself. This is because the findings depended on the size of the dog. Smaller dogs performed better with halo and bigger dogs performed better with BlindSight devices in regards to less collisions in the mazes. Therefore, before an owner of a blind dog was to purchase one of these devices, the size of the dog should be taken into consideration. It could be

argued, though, that this physical barrier could prevent a blind dog from being able to map out new environments, as it never collided with objects to begin with to know that the object was there. The merchandise available, such as the 'plastic hoops' are difficult for dogs to get used to and may prevent the dog from developing their own adaptive mechanisms [12].

The VibroTactile Vest (VTV) is an effective piece of technology as it provides an artificial sense of touch, as though users have contact with a real environment. This vibrating vest device can deliver information to the user information to the user by changing the vibration parameters, such as location, frequency, amplitude, waveform and duration. The VTV for dogs itself is an off the shelf dog harness equipped with communication gear and four vibrating motors. Another study of incorporating training through VTV for hunting dogs, carried out further research on solutions for navigation to assist disabled dogs [9]. The experiment highlighted that although blindness and deafness is common in older dogs and their mobility may not be the best, these dogs still need to exercise to keep their joints healthy. Therefore, the VTV could be a possible solution for blind dogs navigating through different environments. The wearable vibrotactile could assist with interaction between a blind dog and their handler at a distance or remotely. This is important as veterinary advice explains that caregivers must ensure environments are safe for their blind pet to navigate, such as keeping furniture in the same area etc [12]. The use of VTV could be pivotal in the future for blind dogs, allowing caregivers to care for their blind dog from a distance while still providing a safe environment for them to explore.

3 EMPIRICAL STUDY

We conducted an interview driven study with owners of blind dogs, owners of dogs who had a sight impairment and individuals who have cared for blind dogs in the past. The interview driven study both elicited rich data on participant's day to day experiences of giving care to visually impaired dogs. We obtained ethical approval from Northumbria University's IRB (ref. 40774) before conducting any interviews.

3.1 Participants

Seven UK-based individuals who owned dogs with sight impairments were recruited through UK-focused social media networks such as Facebook, and Instagram. All seven participants volunteered and received no compensation for their participation.

3.2 Materials

We used the following interview guide for the semi-structured interviews.

Icebreaker question and about routines

- Tell me about your dog, what's their name, how long have you lived together?
- Talk me through your daily routine with your dog

Understanding challenges

- Tell me about your dog's sight impairment?
- Follow-up questions: how long have they been blind?
- Is there anything your dog struggles within its day-to-day life and why do you think this is?
- Do you believe you can still 'communicate' with your dog as well with its sight loss? For example, asking your dog to come for a walk, or behavioural things you might have trained before like giving a paw.

- Are there any examples you can give?
- How do you think your blind dog feels since its sight loss? E.g., Depressed, normal, coping well, not coping well?
- Caregiver Burden Questions – Have you experienced any changes in your own mood, social life, work etc with looking after your blind dog? Do you feel your health has suffered because of your involvement with your blind pet?

Exploring solutions

- Do you already have these minor adjustments in place for your blind pet dog?
  Keeping furniture in the same place to help with your dog's navigation
  Commands such as, careful, up & down
  Your garden at home, different textures e.g., grassy flat areas
- Are you aware of these techniques and do they think it would assist you in caregiving for their blind pet dog? (Katy Orton's advice)
- Do you think there could be more support for your blind dog?
- Have you ever heard about these technologies/gadgets for your dog? - Muffins Halo, BlindSight, PetSafe drinking fountains, vibrotactile vest or tracking collar?
- If there was an app to help you look after your blind dog, would you use it?
- Are there any other things you would like to add?

3.3 Analysis

We conducted a thematic analysis, which is a method analysing qualitative data that entails searching across a data set to identify, analyse, and report repeated patterns [2]. Ultimately these themes we construct will be the foundation for gathering the requirements for the interactive prototype to assist in the caregiving for blind pet dogs.

4 INTERVIEW FINDINGS

Across 18 pages of interview transcript, we generated 53 distinct codes. Each segment of data that was related to the research question or data that was interesting was captured in a code. We then reviewed all codes to construct themes. An initial thematic map was created, displaying 6 initial themes, 'Adjustments & Routine', 'Lack of Support', 'Commands', 'Impact on Owner', 'Technology' and 'Struggles', which following discussions and reflection we refined to a final thematic map with four key themes as shown in Figure 1: 'Impact on Owner', 'Adjustments,' 'Impact on Dog' and 'Technology/Gadgets'.

4.1 Theme 1: Impact on Owner

A sight impairment in a pet dog not only affects the dog's quality of life but it also affects the quality of life of the pet's owner [16]. This was evident for most participants throughout the transcript. Participants expressed their own personal anxieties when caring for their blind pet dog, more specifically, stating, "*It was a bit daunting and scary at the start*" (**P2**) and "*I am really nervous about leaving *dog's name**" (**P6**). These changes of health in a pet dog can have a resulting impact on the existing human–dog relationship, causing sadness and frustration for the owner [4]. This sadness and frustration were dominant throughout the interview with **P2**, where they stated "*I struggled a lot*" and "*It did impact me a lot*". Additionally, one of the interview questions asked if the participant's dog's sight impairment has

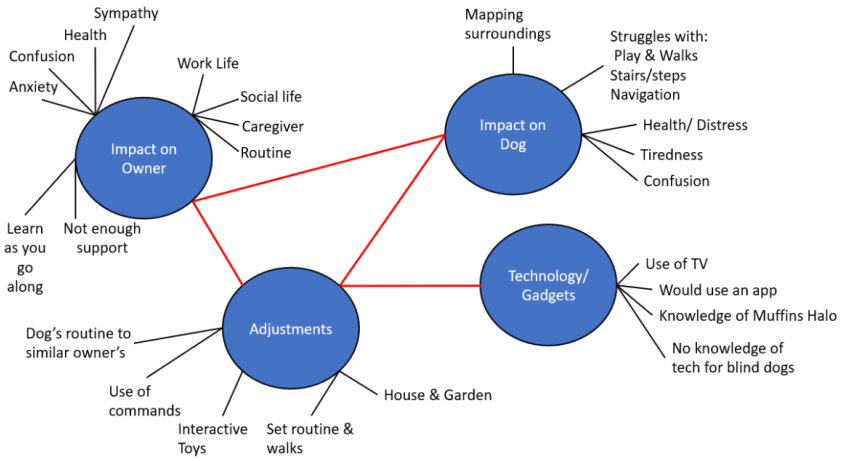

Fig. 1. Themes constructed during the analysis of interview data

any direct impact on the participant's own mental health, social life, and work life. Participants 2, 3, and 6 discussed that their dogs health has had a knock-on effect in their own life. The participants voiced that their dog's health had "*a big impact on my social life*" (**P3**), "*a lot of my time was spent looking after *dog's name**" (**P2**) and "*it definitely impacted my social life*" (**P6**). Furthermore, participant 2 highlights how much time has been dedicated to caring for their blind dog stating, "*If I did work full-time, I wouldn't be able to look after *dog's name**" (**P2**). In relation to the dogs' health, a lot of different conditions some dogs suffered from were discussed such as diabetes, cataracts, ulcers, eye infections and nystagmus, resulting in the participants acting as their pet dog's caregiver. This was evident throughout the discussion of participants (**P2**, **P3**, and **P6**) disclosing respectively, "**dog's name* is my priority*", "*you have to carry *dog's name* to the garden*", "*you were constantly watching out for *dog's name* to make sure they were okay*" and their dog "*will have 12 units of insulin administered via subcut injection*". Furthermore, throughout the transcript, there is a pattern of sympathetic language from the participants towards their pet dogs. This is shown through participants (**P1, P4**, and **P7**) stating respectively "*I do feel bad for *dog's name**", "*I felt a bit bad for *dog's name**" and "*I do think *dog's name* lost a little quality of life.*" Participants displayed pity for their pet dog's misfortune, suggesting that this may consequently impact their views and feelings towards their pet dog. Overall, there is no doubt that all participant's, some more than others, were directly impacted by their dog's sight impairment.

4.2 Theme 2: Adjustments

There are many adjustments in which owners can make for their blind pet dog. Orton encourages owners to focus on the few positive changes they can implement rather than dwell on worry and pity [12]. During the interviews, all participants were asked if they had any minor adjustments in place for their blind pet dog. All the participants responded with descriptions of house, garden, commands, walks and routine adjustments. Minor adjustments are crucial in assisting a blind pet dog with navigation and ensuring they have a good quality of life. All seven participants spoke of their house adjustments, stating, "*furniture stays in the same place*" (**P1**), "*we keep the doors open* (**P4**) and "*we kept all the furniture in the same place as a precaution"* (**P5**)). Similarly, **P3** went further to say that "*all plant pots were removed from the garden so that there is no risk of *dog's name* hurting themself.*" These adjustments may seem obvious in the

house and garden; however, pet dogs will be able to build up confidence in moving around areas they know well [12]. Additionally, throughout the transcript there was a dominant pattern of a daily routine for the blind dogs. Participants expressed this, voicing, they had a "*daily walk route*" (**P3**), they "*had a set routine*" (**P4**), they "*took the same route on every walk, so *dog's name* was familiar with their surroundings*" (**P5**) and they had "*quite a particular routine.*" (**P6**) One participant went further to say that their dog "*does not like the daily route to be changed… *dog's name* will drop to the floor and cry*" (**P3**). Veterinary advice does state that it is helpful to walk similar routes in the initial stages of blindness but as soon as the dog is confident, there is no reason to stick to the same walks and routes [12]. It could also be suggested that this may depend on the dog's own adaptive mechanisms and characteristics. As dogs are highly adaptive creatures, many participants mention that they have been able to teach their blind dog commands. Participant **P1** revealed that they taught their blind dog the word 'up' at the curb on walks so that their dog knows to "*jump up the curb.*" Participant **P3** also revealed the use of 'touch training' and that their dog knows the word 'careful'. Orton highlights that the careful command is essential, as the blind dog will know that they need to slow down and take more care in their environment as there is an obstacle or danger ahead [12]. Another impressive command, shared by **P6** is the use of the lead to assist in steering their blind dog in the right direction, stating "*we have amazingly taught 'this way' so *dog's name* follows our voices*" and then we "*gently pull the lead as we say, 'this way' and *dog's name* follows.*"

4.3 Theme 3: Impact on dog

Sight loss can have initial impacts on a pet dog from their navigation, mapping of surroundings, playtime, and approach to different environments. Throughout the transcripts, there was a mix between participants expressing that their blind pet dog was coping well and had full active lives, and participants who explained their blind pet dogs did not adjust to their sight loss very well. As some participants explained, "*I don't think *dog's name* coped well […] I think *dog's name* was depressed*" (**P2**) and "*I think *dog's name* lost a lot of liberty and a lot of autonomy..*" (**P7**) Diving deeper into participant 2's interview, their blind dog refused to walk and 'would panic' when they were on the lead. Based on this interview it can be suggested that this blind dog is struggling with their sight transition. Furthermore, this struggle reinforces the importance owners can play in their pet dog's life by being patient and making the minor adjustments previously mentioned. Similarly, another participant expressed that the sight loss "*was a bit traumatising for the dog*" (**P4**), also confirming that their blind dog struggled to go on walks. Orton has stated that large, flat grassy areas can encourage blind dogs to feel confident and secure enough to run and play at speed [12]. This was the case in the transcripts, with some participants stating "*we also let *dog's name* off the lead when there is a park that is enclosed, and *dog's name*absolutely loves it*" (**P6**) and if we "*let *dog's name* off the lead in a big field *dog's name* would run around no problem*" (**P7**). There was also a common pattern of the participants 'blind dogs that "*still bumped into furniture*" (**P2**), "*banged...head off a lot of things*" (**P7**) and "*has got conjunctivitis as a result of bumping into things.*" (**P6**) Another struggle for the blind dogs was loud noises. Participants expressed how their dog reacts negatively to loud noises such as cars or fireworks, stating their dog "*becomes very overwhelmed with loud noises*" (**P3**), has "*bad anxiety over loud sounds such as fireworks and car exhausts*" (**P6**) and "*if *dog's name* heard a car driving around in the street *dog's name* would just belly flop.*" (**P7**) Although there have been struggles, participants 3 and 6 believe their dog has a full active life, revealing that their dog "*enjoys playing with my parent's dog*" (**P3**), "*gets along fairly well*" and "*walks with ease and navigates new surroundings amazingly.*" (**P6**) How well a dog adjusts to the loss will depend on the speed of onset, the severity of the loss and the individual temperament of the dog [6].

4.4 Theme 4: Gadgets/technology

There are a variety of gadgets on the market for individuals to purchase and assist their blind pet dog through day-to-day tasks. However, Orton has been asked to trial many of these items and never found any significant benefit [12]. Throughout the interviews, the seven participants were asked if they have heard of Muffins Halo, BlindSight, PetSafe drinking fountains, vibrotactile vest or tracking collar. It was discovered that most of the participants had previous knowledge of Muffins Halo. However, there was mainly negative opinions and views on the gadget, with participants stating, "*Muffin's halo sounds a bit much*" (**P1**), "*I don't think *dog's name* would have liked it*" (**P2**), "*Muffins Halo ... made *dog's name* anxious*" (**P3**), "*I don't think muffins halo would have helped*" (**P4**) and "*we are thinking of investing in a Muffins halo but they are just so expensive.*" (**P6**) Although there was mainly negative feedback on the gadget, another participant did express they wish they would have tested the product on their pet dog, but they still did hold their reservations, expressing, "**dog's name* might have made an active effort to take it off.*" (**P7**) Regarding the other gadgets, most of the participants did not have any knowledge of the assistive gadgets out there, explaining, "*no I'm not aware of these technologies.*" (**P5**) Furthermore, some participants held positive views on the other gadgets mentioned, stating, "*they sound like good gadgets*" (**P2**) and "*the vest sounds good...I think it would be a help.*" (**P4**) Overall, there is a lack of awareness on what assistive gadgets are available to support owners and their blind pet dogs. Additionally, tech in the house can be used to assist blind dogs, such as radios or TVs for sound orientation. Veterinary advice confirms this, having a tv or radio on in the same place within a room can help blind dogs to orient themselves indoors [12]. Some participants recognised this and revealed, "*we left the TV on in the room*" (**P2**) and "*I'd put the TV on for *dog's name* in the background.*" (**P7**) There is also beneficial use of a labelled harness, this can alert strangers that a dog is blind and hopefully prevent unmanaged physical interactions [12]. This is shown in one interview: "*we have a Julius K9 Harness, and we have an IM BLIND attachment stuck to it which really comes in handy.*" (**P6**) Throughout the transcripts there was a consistent opinion of that there could have been more support in place for their blind pet dog. Other participants believed that "*the vet could have gave a lot more aftercare*" (**P2**) and "*vets could give more advice about this.*" (**P3**) In addition to this, participants felt that there should be a platform for an "*app with forum boards*" (**P6**) , an app with a "*sense of a support community on it like a forum*" (**P7**) and an app with "*training tips or how to walk the dog.*" (**P4**) In regards to an app, all participants believed they would find an app useful and would download and use such software.

5 CONCLUDING OUTLOOK: TOWARDS TECHNOLOGICAL SUPPORT FOR VISUALLY IMPAIRED DOG CAREGIVING

Based on the thematic analysis, we argue that a technological platform that supports caregivers of visually impaired dogs could support all the typical aspects one would expect: providing a community to seek advice, centralized tips and guidance, linking to available technologies, as also explicitly found in Theme 4 (Sec. 4.4). What is most interesting from an interactive technology perspective, perhaps, is the potential for software that helps in planning safe walks for visually impaired dogs – a concern for many interviewed as discussed in Theme 2 (Sec. 4.2).

Our interview driven studies discovered that there was a pattern of individuals who did struggle with their blind pet dogs occasionally on walks. This involved their pet dog displaying signs of distress due to the sound of car exhausts, busy roads and changes in the route of the walk. Individuals also explained how their sight impaired dogs prefer large flat grassy areas in parks. A technology, for example in the form of a basic mobile app, could thus support caregivers by allowing them to plan walks, pick a location to visit based on location and other relevant meta-data such as noise levels, environmental stressors, and other factors that may affect a visually impaired dog's ability and enjoyment of such

Fig. 2. Example wireframes of a prototype developed to address the interview findings

outdoor spaces. That said, we did bias participants to some extent towards a software-driven support solution here by the interviews explicitly asking what kind of app support would be welcome, which means additional work should also explore other potential technological support without biasing participants towards software-driven solutions.

To conceptualize this more concretely, we designed an interactive prototype (see Fig. 2) which showcased such functionality, covering the functionality that we identified in Theme 4, serving as a single point of entry for veterinary advice, social environments and a sense of community support with tips and training. Given the fear and apprehension displayed by some participants in interviews to walking their dog, and the challenge of finding new walks the dog would accept we also designed a functionality to assist caregivers in planning walks. The GPS functionality within the 'Plan my Walk' would allow for the user to search within their current location for parks. This allows for the user to discover more information on nearby areas and make decisions based on the relevant information provided. This feature will then allow users to pick a park to visit based on location. The app will also provide information on noise levels, opening times, if it is close by to any main roads, if the park is a dog park and if the park has large flat grassy areas. Such a mobile app could be both a support for caregivers of visually impaired dogs and provide relatively simple support in planning walks that avoid unnecessary stressors. Based on the interview study we conducted we recommend that as a next step further research efforts in blind dog caregiving are undertaken into assistive technologies for dogs, including more in-depth interviews to understand e.g., why physical assistive technology does not seem appealing to caregivers, and detailed user studies with such potential prototypes to assess what kind of functionality caregivers would actually use most in reality, rather than think what functionality they think they would use.

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