K9 SEARCH & RESCUE

HANDLER AND K9 COMMUNICATION EFFICIENCY

RESEARCH REPORT

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ABSTRACT

Canine SAR teams play a vital role in saving lives. However, the efficiency of these missions is often hindered by communication challenges and health concerns for the K9s. This report explores the critical issues of handler-canine communication and K9 health and safety in SAR missions found in academic literature and through data from people within the SAR industry. It delves into the unique communication challenges faced by SAR teams operating in mountain and wilderness terrains. By identifying these challenges, this report aims to provide insights into opportunities for improving SAR operations for better communication during missions, increased efficiency, and decreased search times.

TABLE OF CONTENTS

INTRODUCTION

The use of search and rescue dogs (SAR) originated in the 1800s when they were known as Ambulance and Red Cross dogs. These dogs were trained to locate wounded individuals and deliver medical supplies during World War I (1). Today, SAR teams worldwide employ specially trained canines and their handlers for various purposes, including human detection, evidence seeking, and cadaver searches in emergency and search operations (3). These SAR teams are typically composed of volunteers who are dedicated to saving lives and providing assistance in critical situations. SAR dogs are classified by the type of terrain they work in and the specific search methods they are trained to execute. These include:

TERRAIN

- Wilderness search and rescue
- Alpine search and rescue
- Urban search and rescue
- Combat search and rescue for military use

SEARCHING METHOD

- Air scent
- Trailing/tracking
- Cadaver/human remain detection.
- Water search

In canine search and rescue missions, time emerges as the most critical element. Canine SAR teams are continuously working to increase efficiency and accuracy in their search and rescue missions to decrease search times (3). SAR dogs often navigate terrains that pose significant challenges for human searchers, covering ground at speeds far surpassing human capability. Currently, K9 units operate with relatively limited technological support, placing a heavy reliance on effective canine handler communication (2). Notably, as these canines frequently operate in terrains where they may be positioned over 500 meters away from their handlers, the significance of communication is accentuated in the quest to elevate mission efficiency. However, an exploration through both primary and secondary research reveals that communication stands out as the most problematic aspect of SAR missions.

AIM

This report aims to explore a key factors influencing efficiency in SAR (Search and Rescue) missions, canine handler communication (1) (4). The primary objective is to identify and offer an understanding of the points of inefficacies between handler. It also aims to identify opportunities for optimizing handler-K9 communication. The report will specifically focus on air-scent SAR canines working in mountain/wilderness terrains, as these are the most commonly used canines for SAR, especially in Australia, thus offering more opportunities for primary and secondary research.

PROJECT STRUCTURE

1

SCOPE THE PROJECT

Identify aim and purpose of the research

2

SENDARY RESRCH

Analise available literature to draw findings on the area of research

3

CONDUCT PRIMARY RESRCH

Gain further understanding on themes from literature review and address research gaps.

4

DISCUSSION

Draw common findings from both forms of research.

5

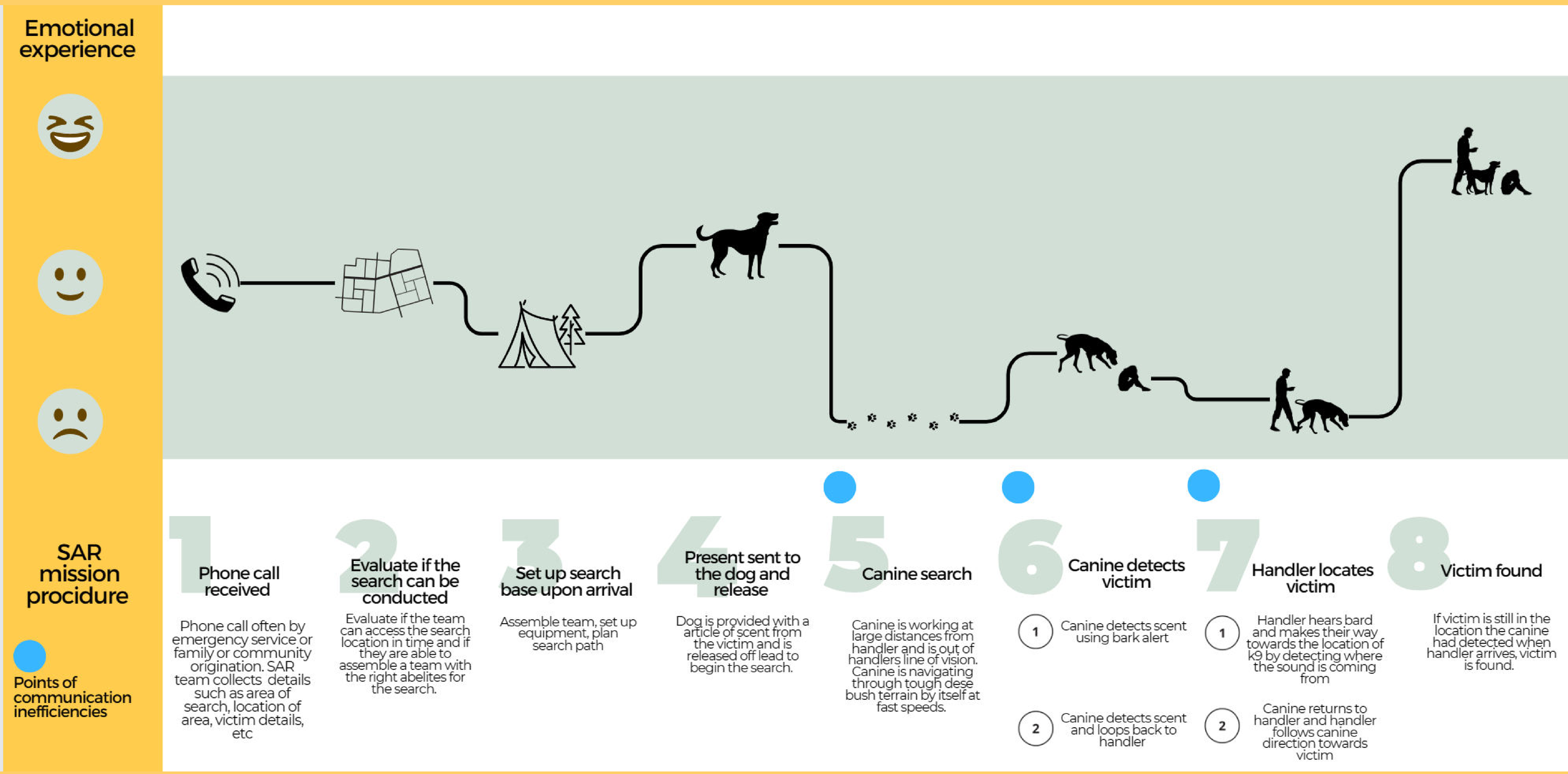
DESIGN IMPLICATIONS

Identify opportunity design intervention and develop design criteria.

LITERATURE REVIEW

The following literature review will focus on creating an in-depth understand of the current communication between SAR dog and handler and identify communication challenges they are affecting efficiency of the SAR mission.

THE AIR SCENT WILDERNESS SAR MISSION PROCEDURE



CANINE AND HANDLER DISTANCE CHALLENGES

During a search mission, SAR canines operate off-lead, covering areas ranging from 1-100 acres (13) and ranging beyond 500 meters from their handlers (2). SAR canines predominantly operate out of their handler's visual range, thus communication between handler and canine during a mission heavily relies on auditory cues (5). With such large ranging distances, the audibility of K9 bark alerts to the handler is compromised (2). It's observed that the handler struggles to hear the K9's bark alert, and while distance plays a central role in this issue, dense terrains and ambient sounds in the surroundings further exacerbate the challenge (2). In these situations, there are two crucial consequences if using the bark alert as the alerting method. Firstly, search times extend as handlers delay initiating Stage 7, 'locating the victim,' until they are within audible range of the canine (2).

In some instances, particularly with lower-ability dogs, canines may exceed the instructed range, leaving handlers without accurate knowledge of the dog's work area (6). This extended range can lead to the canine missing search areas or conducting incomplete searches, thereby compromising search accuracy (6). Moreover, venturing too far increases the likelihood of the canine moving out of audible range. If the dog has already located a victim and initiated the bark alert, the handler may struggle to determine the dog's direction, thus reducing mission efficiency (6). To manage canine range, certain SAR teams are adopting GPS tracking collars. How-

ever, these collars are unsuitable for use in dense terrains, where they pose the risk of entanglement or getting the dog stuck (7). SAR handlers prefer to keep equipment to a minimum, as equipment such as harnesses and vests currently available have the risk of getting stuck in the terrain, causing injury to the canine (14). These also increase the risk of overheating, especially with harnesses that provide high coverage (14).

When a dog picks up a scent and follows a direct trajectory, it's essential for handlers to adjust their search path accordingly (7). Handlers who do not utilize GPS tracking primarily rely on visual cues like changes in direction and the canine's body language. These handlers often set shorter ranging distances for dogs, fearing the risks of wide-ranging (7). However, setting a lower range can significantly limit a dog's ability to pick up scents and can lead to a more time-consuming search process. Handlers are required to increase the length of the search path, consequently extending procedure times (7).

CANINE HEALTH STATUS COMMUNICATION ISSUES

SAR missions are physically demanding, often leading to health issues for SAR dogs, which can have both short-term and long-term consequences (8). According to a research article on SAR dog and handler collaboration, a standard SAR K9 shift typically ranges from 4 to 8 hours, during which the dog should work without distractions (4). A study during SAR deployments in Oso, Washington, highlighted dehydration as a prevalent health issue, with 40% of the dogs in the study showing signs of dehydration post-search missions (8). Dehydration is a common concern in SAR missions (9), exacerbated by limited handler-canine contact, making it difficult to detect these issues (12). Recognizing dehydration in canines is challenging, with symptoms including a dry nose, dry gums, decreased skin elasticity, vomiting, and excessive panting (9). Dehydration hampers a dog's scent detection ability, reducing search efficiency (1) and diminishing energy levels, resulting in a slower search pace (11).

In the wilderness, SAR canines face various environmental risks, including contaminated water sources, deceased animals, and potentially hazardous plants and creatures (8). Canines working in such environments are at risk of ingesting or encountering these hazards (8). Dietary indiscretion emerged as the second most common health issue in the SAR deployment study in Oso (8). Since canines often work off-lead and out of sight, handlers have limited control and knowledge of what their canines consume or contact in the area (8). If a canine consumes contaminated water or animal remains, the primary implications are vomiting and/or diarrhea (8). However, these symptoms can also indicate toxin exposure in dogs. Therefore, it's crucial for handlers to identify the source of ingestion or contact to provide appropriate care (1).
Wilderness searches can also result in exposure to unique toxins for SAR canines (1). Animals such as snakes, spiders, scorpions, bees, and others can envenomate, which can be highly fatal to dogs, even resulting in death (1). If canines have been envenomated, it is commonly identified during a post-search shift medical checkup. However, sometimes this can be too late, depending on the toxicity of the venom (1). Veterinarians state that identifying the specific toxic plants consumed or animals the dog was in contact with is crucial for antivenin success for the canine (10). Currently, as dogs work out of sight, thus not having visuals of the matter consumed or the animal in contact with the canine, creates the risk of not understanding the severity of the dog’s condition and not being able to get the appropriate treatment, which can have fatal implications for the dog’s health (1).

In more severe cases canine might show signs on the search by displaying the following symptoms (9,15,17):

1 Paralysis **2** Swelling **3** Shivering **4** Frothing mouth **5** Drooling mouth

With some of these severe symptoms, the canine might struggle to navigate back to the handler (9). In these situations, there is no method of communicating that the canine is unwell or indicating the location of the canine to the handler (9). It can take time before the handler realizes that the canine is missing, depending on the checking frequency and the range distance of the canine (8). In other instances where the canine is showing physical signs of the symptoms, the handler can only notice the condition of the canine upon visual contact with the canine, which again can take time, depending on the canine's search pattern (8). With symptoms not physically seen in canines, the handler only becomes aware of the situation post-mission during a medical checkup of the canine (8). With increased time between the point of canine intoxication and the point of handler identification, the risk to the canine increases, making the situation more severe (1). Exposure of a dog to these risks can affect the dog's overall health and lower its ability to perform on the mission, reducing the efficiency of the mission (1). From this data, it is evident that there are shortcomings in the timely communication of canine health status and canine exposure to risks to the handler during a SAR mission.

CANINE SAFETY STATUS COMMUNICATION

Wilderness SAR canines frequently encounter challenging terrains, increasing the risk of canine injuries (1). Most injuries sustained during wilderness searches are minor in nature (16). Common injuries include abrasions and wounds, such as cuts, scrapes, and split or cracked paw pads (16). Among these, foot abrasions are the most prevalent, occurring at a rate of 5 events per 1000 hours (16). In cases of more severe injuries, canines may need to be sidelined for days or even weeks (18). Delayed identification and treatment of paw injuries can lead to increased severity and raise the risk of infections, necessitating further medical attention (18,16). Detecting these injuries promptly is vital for handlers to provide appropriate care and rest to their canines (18). Research indicates that canines perform better after receiving treatment for injuries (21). Hence, early identification and treatment of injuries increase the likelihood of enhanced canine productivity and mission efficiency. Given the limited visual contact with canines during missions, handlers may struggle to identify injuries unless they are severe (21). The heightened adrenaline levels in canines during searches often mask signs of injury (18), further underscoring the importance of prompt injury communication to enable timely treatment and optimal canine performance.

CANINE RE-FIND CHALLENGES

The re-find alerting technique presents challenges of potentially losing victim location (4). Once the victim is located, the canine needs to return to the handler (4). The duration of the return depends on how far the canine has ranged to find the victim, thus increasing mission time (10). Although during this stage the victim is located, the SAR team is still unaware of the victim's location until the handler follows the canine back to the identified spot (10). The alerting method creates a time gap between the detection of the victim by the canine and the location of the victim by the handler (4). With this time gap, SAR teams are presented with a risk of victim relocation (7). When the handler arrives at the location, the dog is pinned, and there is no victim present; there is also a risk of false identification of the victim; however, the occurrence of this cannot be identified by the handler (4). This alerting process takes longer durations compared to bark alerting; however, it is easier to communicate canine location to the handler (10).

VICTIM INTERACTION CHALLENGES

During a SAR mission, the canine is the first point of contact with the victim (4). Depending on the age and state of the victim, the canine's actions are not always clear to the victim (4). In some situations, such as with child victims or mentally challenged victims, it may not be clear that the canine belongs to a SAR team (4). Victims are often in a highly stressed state (19). In these situations, especially when using bark alerts, the victim can express fear towards the canine, increasing their stress levels and potentially leading to them moving to different locations (4). When the canine locates the victim, there is no means of communication between the SAR team and the victim to provide reassurance, and there is no understanding of the victim's condition and health until the handler arrives (4).

GAPS IN LITRATURE

Currently there were certain areas literature that have limited insight. Although literature identify these areas of concern, there is limited insight on these topics.These gaps include:

1. There is limited literature on **how victims interact or react to canine** during mission.
2. There is limited literature on actual **data regarding the accuracy of SAR dogs' obedience and behavioral challenges** and inefficiencies during a mission.
3. Limited literature on **most time-consuming procedures and incidents** during a mission.
4. **Limited knowledge on equipment used for SAR and its efficient** on mission efficiency and accuracy.

There is potential to develop further insight into these gaps through conducting primary research. Through the next stage of research, primary research, the findings from the literature review can be tested and further understanding in these gaps in literature can be obtained.

RESEARCH

This section of the report outlines the methodology for conducting primary research to further our understanding of canine handler communication. The research aims to provide deeper insights into the gaps identified in the literature review regarding communication inefficiencies. While qualitative research will be the primary approach, certain aspects of the survey will incorporate quantitative research methods.

STUDY ONE: SURVEYS

Survey 1 (Appendix 1)
Topic: SAR Communication and safety study
Participants: 8
Survey form: Online Google Forms
Duration: 15-20 minutes
Questions: 18

Survey 2 (Appendix 2)
Topic: Communication with your k9
Participants: 22
Survey form: Online Google Forms
Duration: 10-25 minutes
Questions: 9

Survey 1

The survey had several objectives: to establish a comprehensive understanding of canine handler communication within missions, assess its integration into canine training, and enhance insight into the communication of canine health and safety from the perspective of SAR handlers. These objectives were aligned with the findings outlined in the literature review for comparative analysis. As this was the initial stage of research, the survey questions covered a broad scope of topics but were presented briefly. The questions were designed to address these three areas of research sequentially. The survey included a combination of short-answer and multiple-choice questions for ease of engagement. Multiple-choice questions provided numerical data for quantitative analysis, while short-answer questions aimed to gain a deeper insight into the situation. The survey was distributed to SAR organizations via email and was also shared with various SAR handlers on social media platforms such as Facebook and Instagram, resulting in a higher response rate than email for obtaining highly relevant insights. As there were only five identifiable and contactable SAR canine wilderness search organizations in Australia, the research expanded to a global scale by sending the survey to organizations in the United States and the Netherlands, where SAR teams are more prevalent.

Limitations

Participants were given the opportunity to provide additional details for their multiple-choice answers to gain a better insight into the topic; however, there was limited engagement with these options. The survey was sent to 14 SAR organizations via email, and 31 organizations, handlers, and trainers were contacted through social media. However, only 8 responses were received. Due to the limited sample size, data accuracy was reduced. Nevertheless, the sources of data were reliable, as all participants were either handlers or trainers for SAR canines.

Survey 2

Due to the low participation rate in the initial survey and the limited number of organizations to contact, a new survey was created to explore communication between domestic dogs and their owners. The purpose of this survey was to understand how dogs communicate with their owners, identify which forms of communication are more effective, and pinpoint the communication challenges. This survey received higher participation rates because it focused on general dog owners, resulting in a more diverse range of practices. Consequently, a larger sample size was employed for this survey. The sample used was a convenience sample, consisting of pet owners I had access to through social media or my personal contacts. The survey was posted on Facebook and WhatsApp to reach a broader audience within my contacts. Additionally, it was distributed via direct messages on social media platforms and through text messages to dog owners I knew personally, specifically targeting participants to boost the response rate. Similar to the previous survey, this one also included multiple-choice and short-answer questions.

Limitations

While there was better engagement and a larger sample size, the data collected is not specific to working SAR dogs and provides a general insight into communication with canines.

STUDY TWO: INTERVIEWS

Participants: 1

Interview form: Semi-structured, phone and zoom.

Duration: 20- 30 minutes

Questions: 17-20

A semi-structured interview was creating to gain understanding of the following domains:

1. Communication training (literature gap)
2. Communication on track challenges and befits. (Validating and expanding literature)
3. Points of inefficiency on tracks (literature gap)
4. Safety and risk communication (validating and expanding literature)

All questions were initially written in a Word document and were read aloud during the interviews. Any new questions added during the interviews were noted down in the document as the interviews progressed. Both interviews were recorded using the Voice Memo app on an iPad for transcription purposes after the interviews. Notes were not taken during the interviews to avoid distraction and potential time constraints. Recording commenced only after participants verbally consented to being recorded.Participants who engaged in the interviews displayed a high level of interest in the study and continued to provide additional data that they deemed relevant to the study via email and text messages. The interviews took on a conversational approach, allowing the conversation to flow into different topics and providing a deeper understanding. Participants in the interviews offered more detailed insights on these topics, and there was a better understanding of the questions compared to the survey responses. This was because the interview setting allowed participants to seek clarification on questions, and the interviewer could prompt for more in-depth responses.

1st Interview

Phone The first participant was a wilderness search canine handler who operates with two air scent canines in South Australia. The participant was contacted via social media and preferred to conduct the interview by phone.

2nd Interview

Zoom The second interviewee was a SAR supervisor and SAR canine handler based in Finland. However, the organization the participant worked for deployed SAR teams internationally. Currently, there were no SAR teams present in the QLD area through this organization or any other, making an observation study at this time impossible. This participant was contacted via email.

Limitation:

Gathering participants for the interview was challenge as there was low lever engagement with request for interviews. 18 emails, 4 calls specially requesting interviews were sent however only 2 responses were received. Although these interviews provided a great insight, a larger sample size would be beneficial for accuracy.

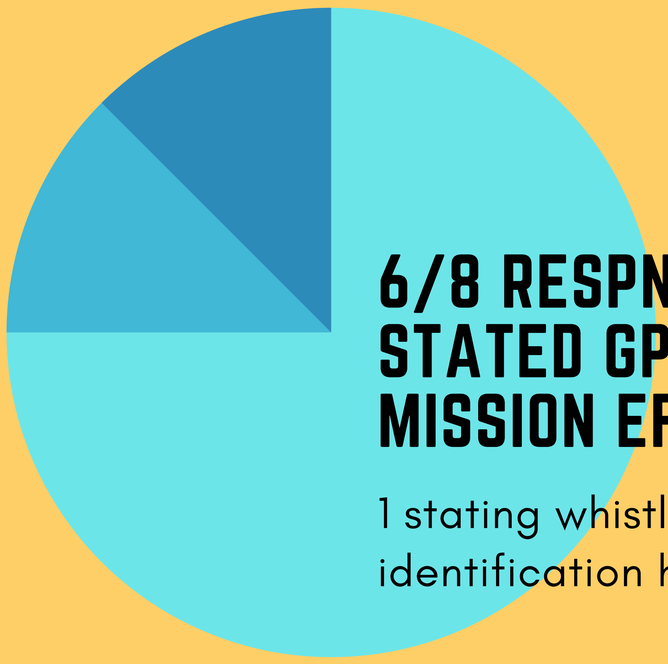
ANALYSIS & FINDINGS

After surveys and interviews were conducted, data were analyzed to draw insights. For the interviews, thematic analysis was conducted by extracting themes from the transcripts and the codes within them. From the surveys, themes were drawn from short-answer responses, and quantitative analysis was performed for the multiple-choice answers.

LOCATIONAL AWARENESS

The importance of locational awareness for handlers was recognized, with all 75% respondents stating that GPS was an essential tool for effectiveness in SAR missions. Both interviews included comments indicating that GPS was essential for efficacy and a very useful tool for multiple purposes:

1. Provided understanding of canine exposure to risky areas
2. Identifies areas canine has missed during search
3. Displays behaviour change in canine indicate sent detection.
4. Locate canine when out of audible range



6/8 RESPNDATES STATED GPS INCRSES MISSION EFFICIENCY

1 stating whistle and 1 stating identification harness

Reduced safety risk to canine and aids identification of canine injury

When operating in high-risk environments, canines tend to work closer to their handlers due to the inherent dangers (as mentioned in Transcripts 1 and 2). In these situations, handlers place significant importance on maintaining locational awareness of their canine partners. The use of GPS trackers is highly valued, as it serves as a valuable resource. These devices provide real-time location data for the canine. Handlers can utilize this information not only for general tracking but also in case of emergencies. It allows handlers to assess if the canine is avoiding high-risk areas or if there are changes in the dog's movement behavior that might indicate injury (as highlighted in Transcripts 1 and survey responses). This technology enhances safety and operational efficiency in such challenging environments.

Increased search accuracy

Participants pointed out that in SAR missions, there are occasions when canines may not effectively cover an area. They might either miss certain spots (as observed in Transcripts 1 and 2 and confirmed by survey findings) or move too swiftly through the area (as noted in Transcript 2). In addressing this challenge, GPS trackers have proven to be valuable tools. These devices can help identify if any areas were overlooked during the search, ultimately improving the overall accuracy of the mission (as discussed in Transcript 1 and supported by survey findings).

Aids identification of canine scent pickup

When a canine picks up a scent, it tends to accelerate its pace and alter its search direction based on the scent's source, often resulting in a considerable distance between the canine and its handler (as described in Transcript 2). Survey participants mentioned that recognizing this behavior change can be challenging, depending on the terrain's visibility (Transcript 1) and the dog's working distance from the handler (Transcripts 1 and 2). In such situations, handlers often lose visual contact with the canine for a period, requiring a high level of trust in the canine's abilities (Transcript 2). However, calling the dog back during this state can be detrimental to the mission, as the canine might lose the scent trail, leaving the handler without locational awareness of the dog (Transcript 2). An interview participant who used GPS tracking devices reported that handlers felt more confident and reassured when equipped with GPS trackers, as they provided additional information about the canine's success rate in scent detection (Transcript 1).

Improves communication when out of audible range

When the canine is beyond audible range and initiates a bark alert, it often goes unnoticed by the handler (Transcripts 1 and 2 and the survey responses). The dog might continue barking for extended periods before the handler becomes aware of the situation, necessitating the handler to find the dog, a scenario where GPS assistance proves valuable (Transcript 1). Conversely, the canine is unable to hear verbal commands or whistles from the handler in situations where a recall or an emergency stop is needed (Transcripts 1 and 2). GPS trackers are helpful for locating the canine when there is no response to recall (Transcript 1).

7/8

SAR HANDLER RESPONDENTS

STATE DOG BEING **OUT OF AUDIBLE RANGE** IS AN ISSUE WHEN DOG WORKS AT DISTANCES

AUDIBILITY BETWEEN CANINE AND HANDLER ISSUES

500M TO 2KM

AVERAGE MAX RANGING DISTANCE FOUND BITWEEN HANDLERS

The number one communication issue identified in the survey was ability to hear canine bark alert (Transcript 1, 2 and survey). Canines are frequently operating at distances of 500 m to 2 km away from their handlers in expansive search areas, which often places them beyond audible range (Transcript 1 and 2).Presently, there are no tools available to address this issue, and the only way to mitigate it is by limiting the dog's search range, which, in turn, extends the duration of the search mission (Transcripts 1 and 2).

SITUATIONAL AWARENESS

The significance of situational awareness for canines was emphasized due to the heightened concerns about distractions, potential encounters with risks, and the overall performance of the canine on the track. All survey and interview participants reported having limited situational awareness of their canines. 2 key negative implication of low situational awareness are found:

1. Unable to identify if canine has **encountered risk**
2. Unable to identify if canine **has been distracted**

Health and illness identification issue

Participants emphasized that low situational awareness is less of an issue for physical injuries, as these are relatively rare. Instead, they stressed that the more critical concern is the limited awareness of what the canine has consumed or whether it has encountered dangerous animals, as these situations demand early detection and identification. This is particularly crucial in countries like Australia and regions where pests are prevalent, as bait in search areas, often found in forest and bush terrains, is a significant cause for concern among handlers.

Distraction issues

Throughout all the studies, animals were identified as significant distractions for canines during SAR missions. In Australian SAR missions, kangaroos and rabbits were noted as common distractions that canines frequently encounter (Transcript 1). Handlers reported that the presence of animals such as rabbits, birds, or rodents along the search path often leads to dogs deviating from the scent trail, resulting in a loss of the scent and decreased mission efficiency. Once a canine loses the scent, it becomes challenging to reacquire it, as the animal may need to widen its search area, thereby prolonging the mission duration (Transcript 1 and 2). Distractions were also observed in other forms, including pedestrians, foods on track and animal sounds.

100%

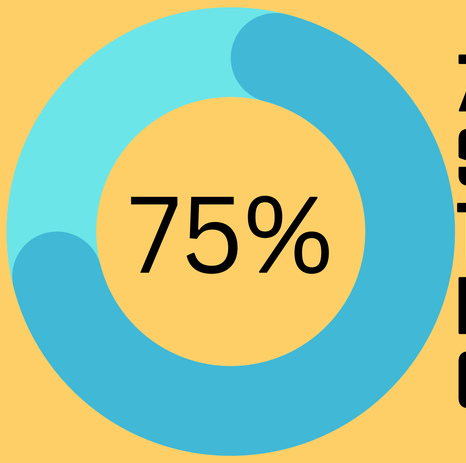
RESPONDENTS BOTH BOTH SURVEYS STATE ANIMIALS/ WILDLIFE ARE THE NO 1 RESON OF DISTRACTION FOR CANINE

TRANINING SAR

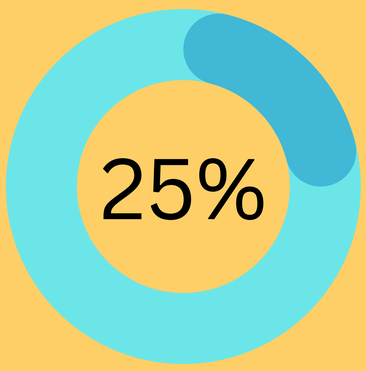
Training directional communication

The research findings highlighted consistent themes that underscore the importance of locational and situational awareness in SAR missions. Improved locational awareness and situational awareness between canines and handlers significantly enhance canine safety and mission efficiency, leading to shorter search times. Audibility between canines and humans emerged as a critical issue affecting mission duration. While the primary cause of these challenges is the distance between canines and handlers, training canines to operate effectively at such distances presents its unique set of challenges.

Training working out of sight



75% RESPONDENTS SAID DISTANCE TRAINING WAS THE MOST CHALLGING COMMAND TO TRAIN



25 %SAID IT WAS ALERTING

Obedience when working at a distance is the number one most challenging area of training for canine handlers (Transcript 1,2 survey). It is highly important to train canines to perform a thorough search when working alone away from handler (Transcript 2). Canine handlers struggle to observe and evaluate canine behaviours when out of sight of handler during training(Transcript 2).

100%

RESPONDENTS SAID THEIR DOGS **OFTEN** WORK OUT OF SIGHT

OUT OF WHICH...

87.5%

SAID THERE WERE ISSUES RELATED TO THIS

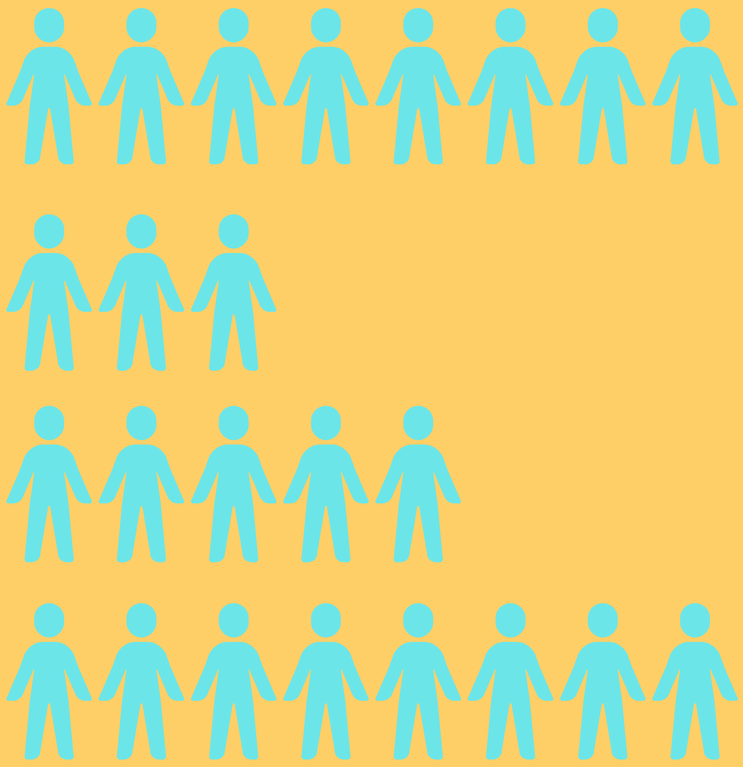
CURRENTLY CANINE HANDLERS ARE ENGAGING IN THE FOLLOWINGTO ENSURE THE SAFETY AND WELL-BEING OF CANINE:

REGULAR HEALTH CHECKS

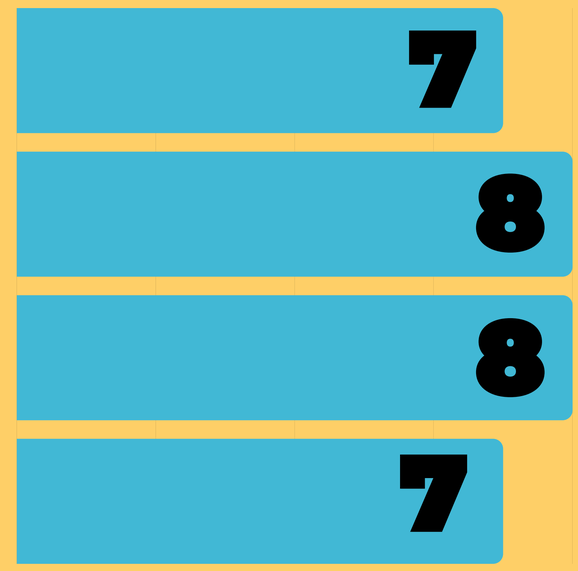
PROTECTIVE GEAR (VESTS, BOOTS) PROVIDE EXAMPLES

HYDRATION AND NUTRITION PLANNING

REST PERIODS



CURRENTLY HANDLERS FACE THESE FOLLWING CHALLENGES OR OBSTACLES WHEN WORKING WITH CANINE



METHODS HANDLERS USE TO COMMUNICATE WITH CANINEON THE TRACK

VERBAL

HAND GESTURES

WHISTLE

BODY LAUNGUAGE

SUMMERISING ANALYSIS

The research findings highlighted consistent themes that underscore the importance of locational and situational awareness in SAR missions. Improved locational awareness and situational awareness between canines and handlers significantly enhance canine safety and mission efficiency, leading to shorter search times. Audibility between canines and humans emerged as a critical issue affecting mission duration. While the primary cause of these challenges is the distance between canines and handlers, training canines to operate effectively at such distances presents its unique set of challenges.

DISCUSSION

The data obtained from the literature review and the conducted research demonstrated a strong correlation, with minimal or no significant discrepancies in the insights gained. The literature review aimed to establish an understanding of the primary challenges contributing to inefficiencies in communication between canines and handlers, while the conducted research was used to validate these identified challenges, gain deeper insights into their significance, and address any existing research gaps. It was found in both methods of research that communication issues arise from an increased distance between the handler and the canine, reducing visibility and audibility between the two. Comparing findings from both the literature and the research conducted, five common key areas of inefficiencies in communication between handler and canine during a SAR mission were identified:

1 COMMUNICATION OF SAFETY AND HEALTH

Currently, there is poor communication regarding injuries or health risks to the canine. Handlers are not being informed of these incidents in a timely manner and often lack understanding of the occurrence. Addressing these issues late or not addressing them at all can have severe health implications for the canine and, in some cases, be fatal. The occurrence of these incidents is also found to negatively impact canine performance due to the deterioration of their health and abilities. Delayed detection further exacerbates negative health implications, reducing the dogs' ability to perform and lowering mission efficiency.

2 COMMUNICATION OF CANINE PERFORMANCE

Currently, canine performance can be hindered by environmental distractions, causing the canine to either lose scent completely or miss search areas. While missing search areas is not a common occurrence, it can happen during searches. Communication to the handler regarding the canine's current performance during the search is minimal. In instances where these issues occur, the accuracy of the search can be compromised, and search times can be prolonged as the dog is required to re-search these areas.

3 COMMUNICATION OF COMMAND

Currently, during SAR missions, command control over long-ranging distances and in dense or loud environments is limited. With a reduced ability to communicate commands to canines, search times increase as the handler needs to either relocate or wait for the canine to relocate to the handler.

4 COMMUNICATION OF VICTIM LOCATION

Currently, due to the low audibility of the canine's alert, more time is required to identify that the canine has made a find, as the handler may take time to come within audible range. This results in inefficiency in the search, leading to increased search times even after the victim has been located

5 COMMUNICATION WITH VICTIM

Currently, there is inadequate communication between the SAR team and the victim at the initial point of contact when the canine makes contact with the victim. At this stage, there is also insufficient communication of the victim's situation and health to the human SAR team

Currently, there is very limited equipment available to address these issues as equipment of canine can cause safety issues of getting stuck and trapped. Although there are GPS trackers and camera harnesses available, they can only be used in certain terrain with risk of getting stuck is low.

DESIGN IMPLICATIONS

With the identification of the five key points of communication inefficacy and a comprehensive understanding of their causes and implications in the following research, the foundation for designing criteria begins to take shape. For SAR canine teams, there is an opportunity to enhance search efficiency and reduce search durations through a design intervention that specifically addresses the five identified problem areas.

Currently, there is an opportunity to improve the situational and locational awareness of canines to handlers, enhance the situational awareness of handlers to victims, and improve the audibility between canines and handlers, as well as between handlers and canines. The design intervention can potentially target a single point of inefficiency or multiple areas simultaneously.

This presents an opportunity for the implementation of technologies or tools that aid in real-time tracking and communication between handlers and canines, ensuring effective relay of information on safety, health, performance, and commands. Additionally, enhancing communication between SAR teams and victims during the initial contact with the canine could improve the overall effectiveness of these missions. Such design interventions have the potential to significantly enhance the efficiency and safety of SAR operations, benefiting both canines and human responders. While there are equipment options available in the market aimed at enhancing canine location and situational awareness, such as GPS trackers and harness cameras, these are not applicable for canines as found in the literature and research, as they lack design considerations specific to SAR dogs and the terrain in which they operate. This can create safety risks, such as getting stuck, and health risks, like overheating, for these canines.

THE DESIGN INTERVENTION CAN CHOOSE TO TARGET ONE OR MULTIPLE OF THE FOLLOWING CRITERIA AS THE FOCUS OF THE DESIGN INTERVENTION.

To better understand what is required from the design intervention, a brief criterion of design is identified:

MUST:

MUST IMPROVE CHOSEN CRITERIA OF FOCUS

MUST TAKE INTO CONSIDERATION TERRAIN CANINE WORKS IN

MUST TAKE INTO CONSIDERATION CANINE MOVEMENT

MUST PRIORITISE CONSIDERATION CANINE SAFETY AND WELLBEING

MUST BE EASY TO USE

MUST BE DURABLE

MUST INCREASE EFFICIENCY OF THE SEARCH

SHOULD:

SHOULD BE USER-FRIENDLY

SHOULD BE ADAPTABLE FOR USE ON MISSIONS AND FOR TRAINING

SHOULD IMPROVE MANAGEMENT OF SAFETY RISKS AND INJURY

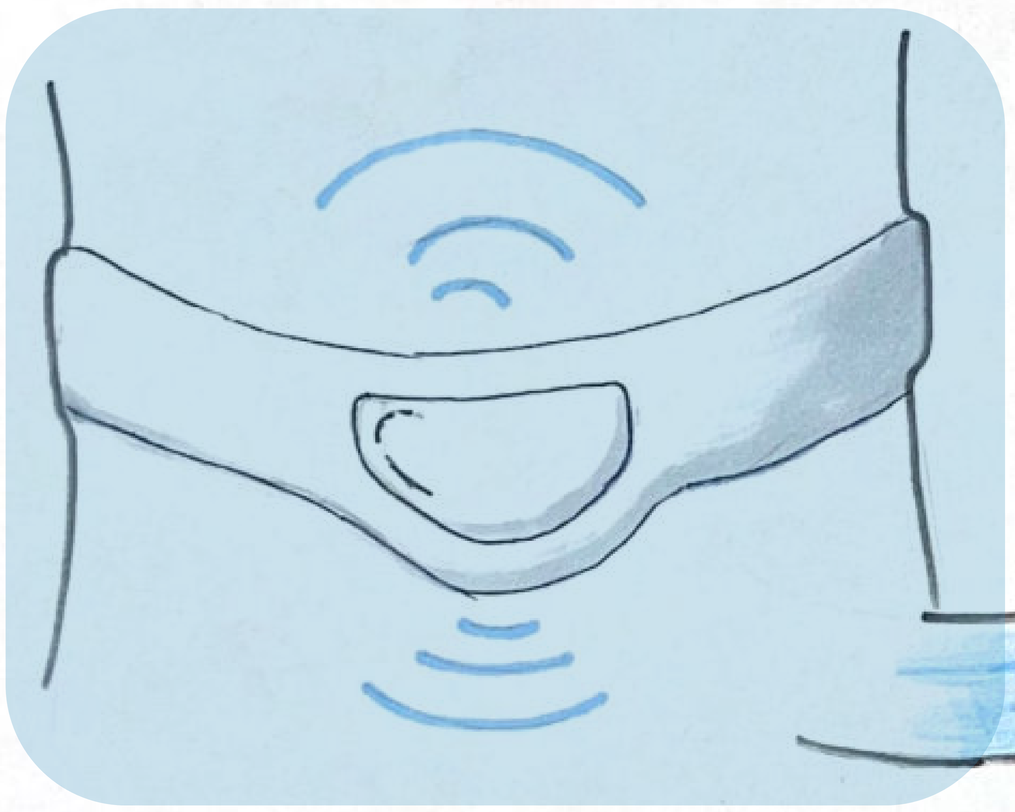
SHOULD BE ADAPTABLE FOR DIFFERENT WILDERNESS TERRAINS

SHOULD SEAMLESSLY INTEGRATE WITH SAR MISSION PROCEDURE

DECREASE SEARCH TIMES

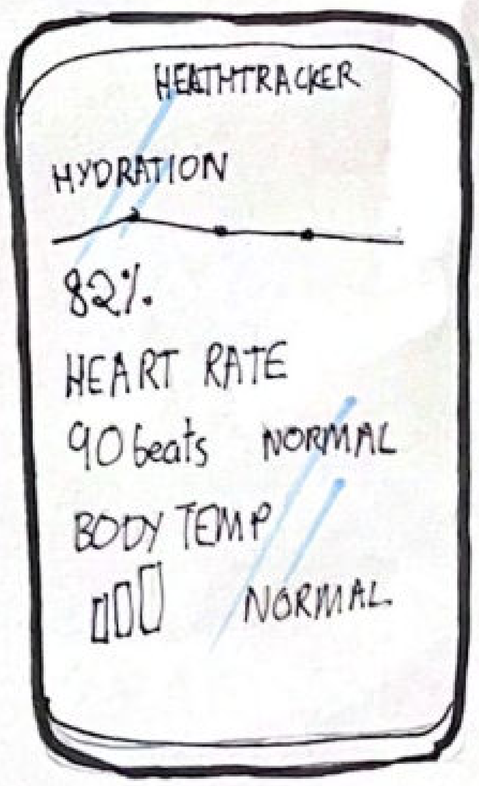
CONCEPT 1: K9 HEALTH TRACKER

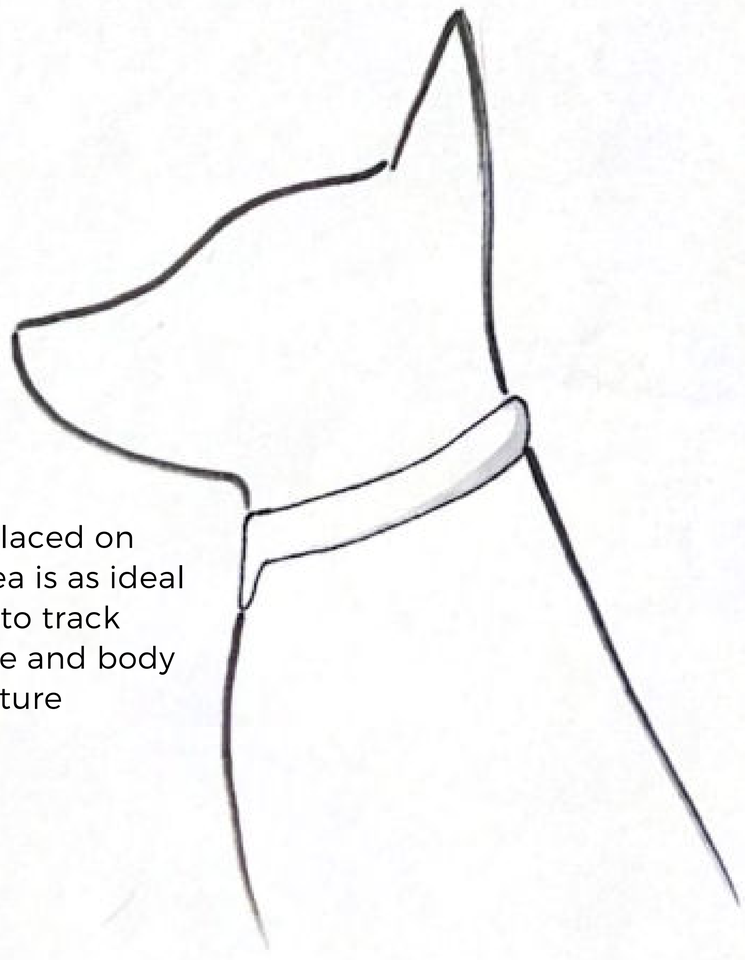
The K9 Health Tracker is a wearable monitor collar equipped with heath monitoring sensors. The collar is able to track dogs' vital signs such as hydration levels, heart rate, body temperature and activity levels. The information recorded by the collar can be accessible to the handler through the k9 Health tracker app in real-time. In the cause of abnormal heart rate, low hydration levels, overheating and exertion handler will be sent an alert through the app allowing prompt action in the case of such issues. This improves the communication of health and safety of the canine to handler.



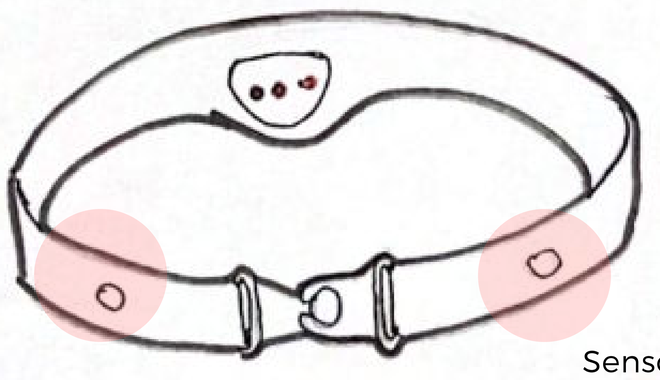
Built in sensor in collar

Health tracking on the app





Sensor placed on chest area is as ideal location to track heart rate and body temperature



Sensors on neck area are ideal for hydration tracking

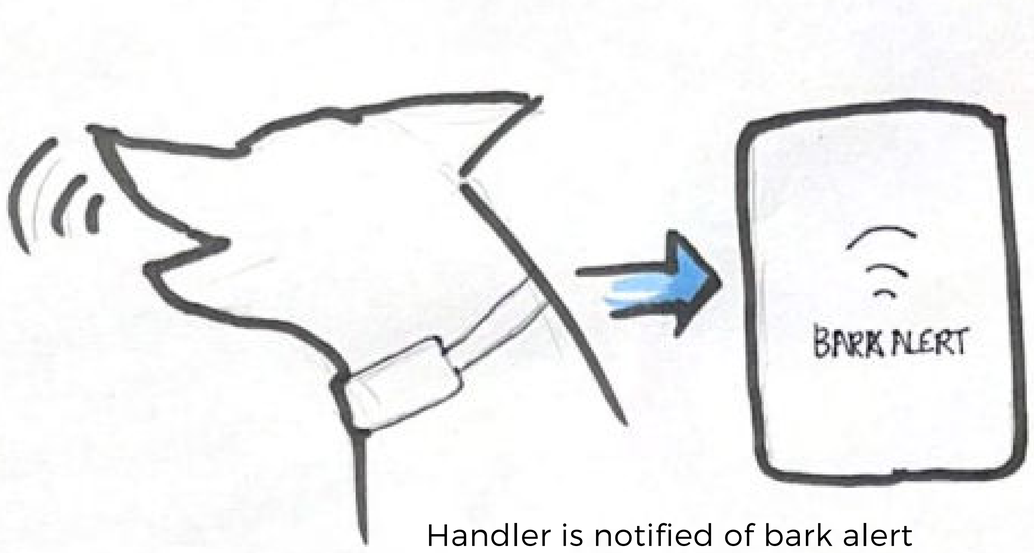
Break-away collar magnesium used for safety. The collar is released with pulling pressure.

FUTURE DEVELOPMENT:

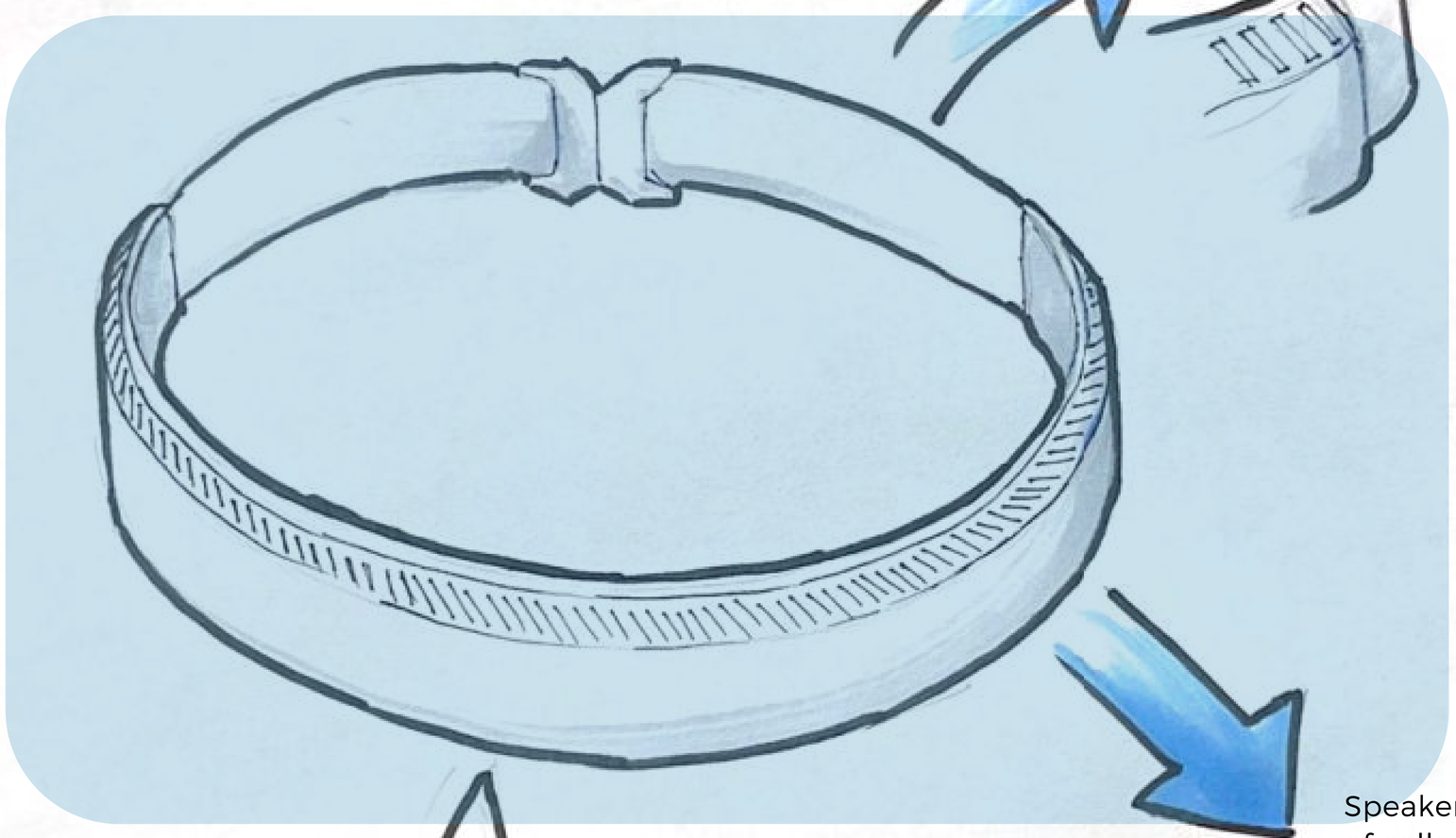
- Material
- Adjustment method

CONCEPT 2: AUDIO COLLAR

The Audio Collar is designed to facilitate two-way audio communication between the canine and handler. When working at a distance, the handler can give verbal commands to the canine, such as a recall command. Furthermore, the handler can alternatively hear the bard alert when canine is out of audible distance. The audio collar allows increased distance between canine and handler on an operation increasing search efficiency. In scenarios where the canine has made contact with a victim, the handler can also engage in verbal communication with the victim to gain a better understanding of the situation before the rest of the team arrives. This design solution thus enhances situational awareness, improves communication between the victim and handler, and enhance audibility between the canine and handler allowing more distance between canine and handler.



Handler is notified of bark alert through device



Clip magnesium for attachment

Flexible band for comfort and adjustability

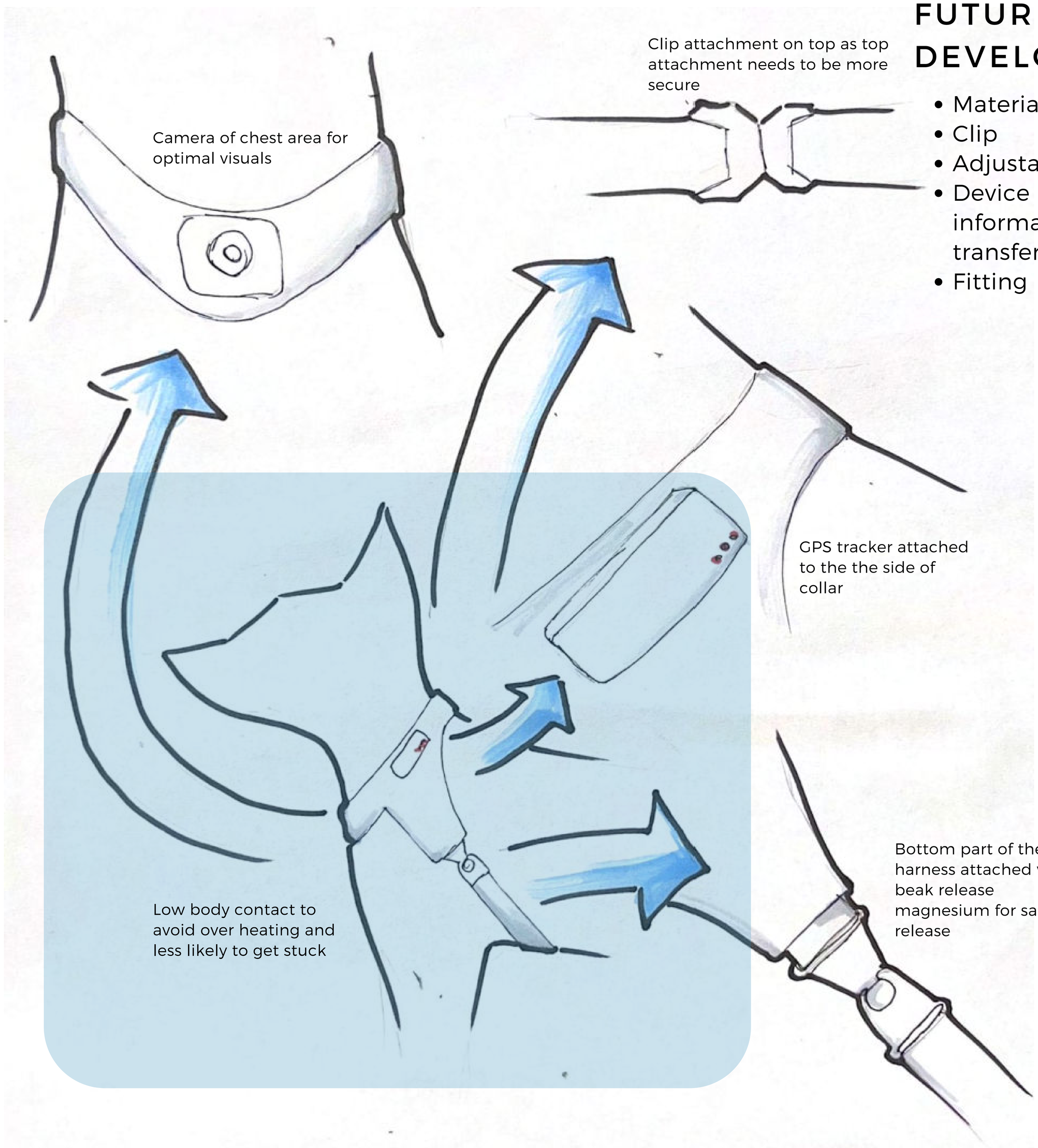
Speaker and microphone on top of collar for better audibility

FUTURE DEVELOPMENT:

- Material
- Clip
- Adjustability
- Device information transfer

CONCEPT 3: SMART HARNESS

The smart harness is harness mounted with a lightweight camera and GPS tracker. The handler is able to watch canine visual or location on their devices on the app. The camera provides better situational awareness for handler whereas the GPS provides better locational awareness to handler. If canine comes in contact with any dangerous environmental factors, the camera will be aiding the handler identify what the animal or plant the dog was in contact with. With a mounted camera, better victim situational understanding is created for the SAR team before arrival. With the GPS tracker, the handler is able to identify any areas of the track the canine missed or if the canine has gone off track. This concept can also be a solution to improve canine distance work training as it provides as record of what the canine is doing allowing handers to evaluate its behaviour and performance when canine is working alone.

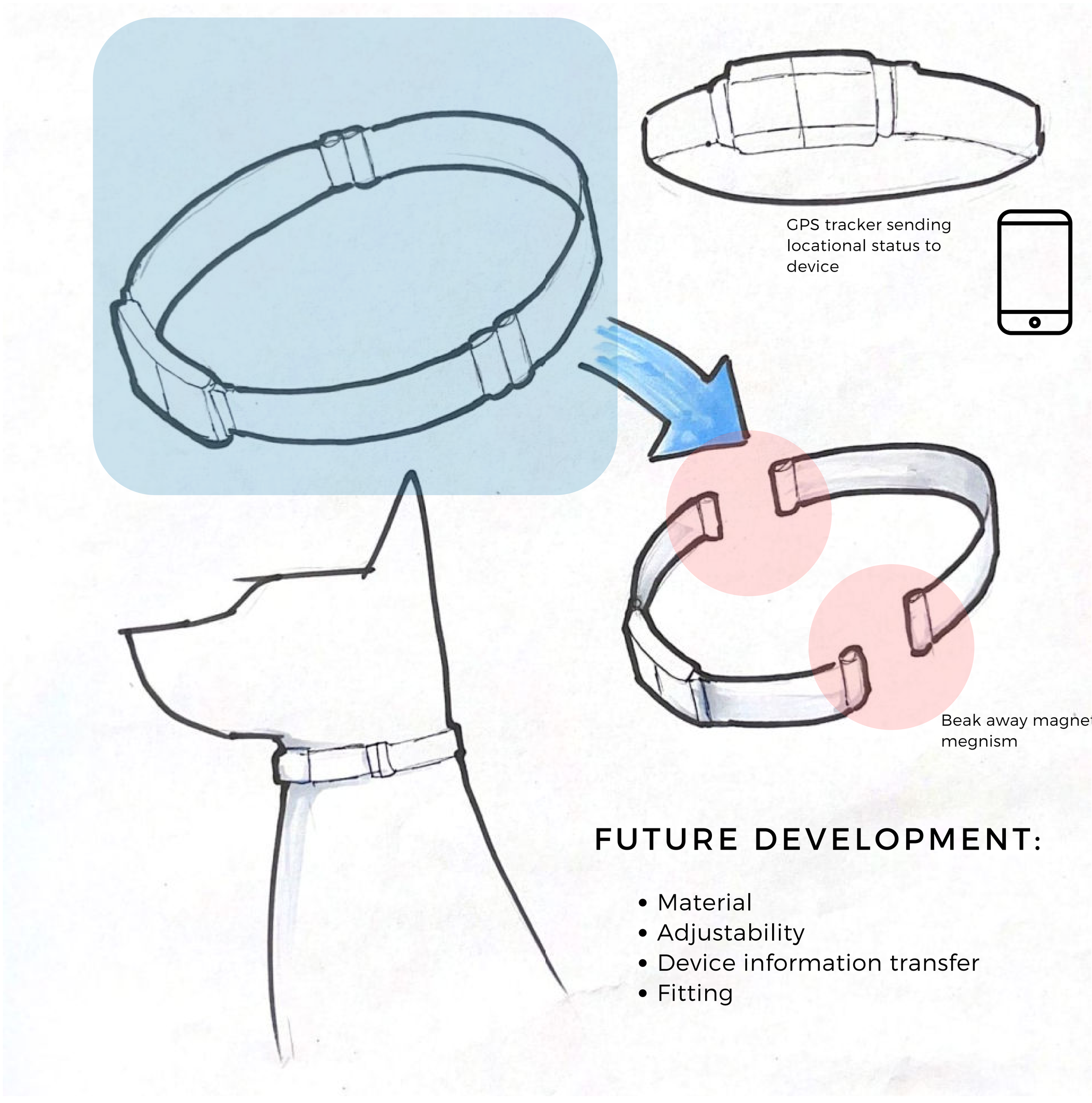


FUTURE DEVELOPMENT:

- Material
- Clip
- Adjustability
- Device information transfer
- Fitting

CONCEPT 4: MAGNETIC RELEASE GPS COLLAR

The Magnetic Release GPS collar is designed for SAR missions where there is high level of obstacles and risks in the terrain. These terrines are based in environments with high level of obstacles where there is a high risk of the canine getting trapped, handler not being able to physically navigate through areas and extremely low visibility, or audibility. In these terrains there is high importance for situational awareness and implementation of GPS, however, currently GPS collars are unable to be used in these situations as there is a higher risk of them getting stuck. The magnetic release collars is attached to the canine using three magnetic attachments. If collar gets stuck on the tack, lower level of force is required to release magnets and free dog from stuck situation. The magnets strength will be enough to stay connected during typical SAR mission canning activity however will also be weak enough to be released by strength of dog.



FUTURE DEVELOPMENT:

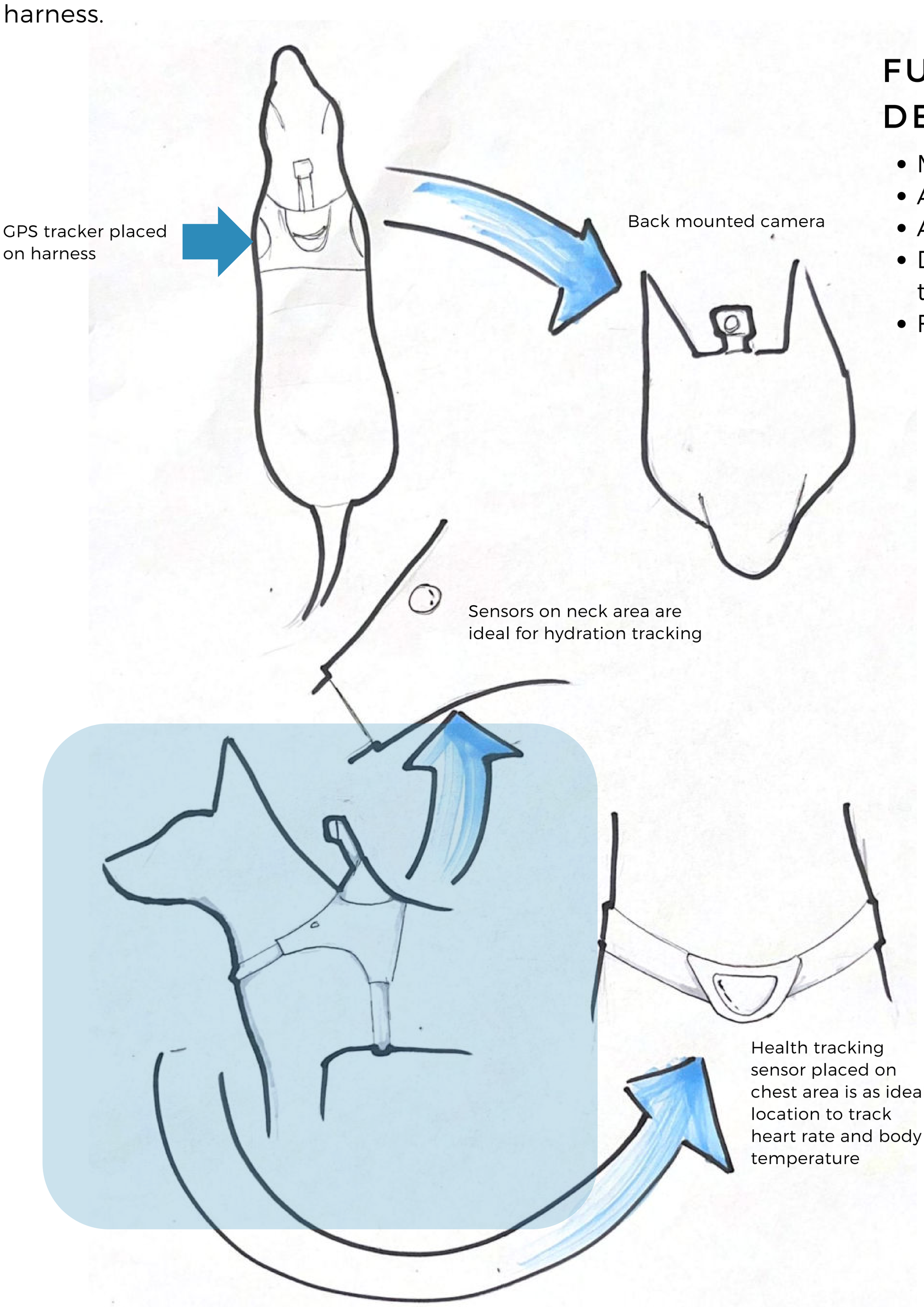
- Material
- Adjustability
- Device information transfer
- Fitting

CONCEPT 5: SAR HARNESS

The SAR harness is a combination of concepts 1,2,3 and 4. The smart harness includes the following elements for the following purposes:

- GPS for locational awareness
- Camera for situational awareness
- 2-way audio for better verbal communication, alert communication, and victim communication
- Heath tracker for better understanding of canines health on track

The handler can track all these elements through the SAR harness app on their phones. In the case canine movement stops or there are health concerns detected, the app will present this information to the handler in the form of an alert. In the case canine gets stuck, the pressure release clip magnesium will release canine allowing it to be free of the harness.



FUTURE DEVELOPMENT:

- Material
- Adjustability
- Attachment points
- Device information transfer
- Fitting

CONCLUSION

For SAR missions, time is a crucial element, and communication between canines and handlers plays a pivotal role. Through in-depth primary and secondary research on the subject, key points of inefficiency and problem areas in communication have been identified. The objective of the literature review was to identify and understand these key challenges contributing to communication inefficiencies. The primary research conducted subsequently was used to validate these identified challenges, delve deeper into their significance, and address research gaps.Throughout these investigations, a recurrent theme has emerged, emphasizing that communication obstacles primarily arise from the distance between canines and handlers, resulting in compromised visibility and audibility. This presents an opportunity to optimize SAR mission efficiency and effectiveness by addressing these communication issues. Five areas of inefficiency in communication between handlers and canines during SAR missions were identified: Communication of Safety and Health, Communication of Canine Performance, Communication of Commands, Communication of Victim Location, and Communication with Victims. These points of inefficiency translated into design criteria for potential design interventions to improve canine-handler communication. This design criteria aided the creation of five potential design solutions that can work to enhance this communication. The next stahe of the project will select one design to develop.

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Authenticity Statement

This is to certify that to the best of my knowledge, the content of this report is my own work. This report has not been submitted for any subject or for other purposes. I certify that the intellectual content of this report is the product of my own work and that all the assistance received in preparing this report and sources have been acknowledged.

Your name: Aantra Shinde
Student number: n10769340
Date: 10/09/2023

AI Use Statement

I have utilised Generative AI in this report (ChapGPT, Dalle, Bard, or similar) to assist in various ways. The way I have used Generative AI includes better working, spelling and grammar.

Your name: Aantra Shinde
Student number: n10769340
Date: 10/09/2023

APPENDIX

Appendix 1: Survey 1

Communication with your k9

A study on SAR canines

* Indicates required question

Are you over the age of 18? *

- Yes
- No

How do you typically communicate with your domestic dog to convey commands or cues?

- Verbal commands (e.g., "Sit," "Stay," "Come")
- Hand signals or gestures
- Treats or food rewards
- Clicker training
- Whistle commands
- Leash guidance or corrections
- Body language and posture
- Toys or playtime rewards
- Electronic training collar (e-collar)
- Other (please specify)
- Other:

Are you able to interpret your domestic dog's non-verbal signals and cues effectively?

- Option 1

How important do you believe body language communication is in your relationship with your dog?

1 2 3 4 5

Have you encountered challenges in training your dog to respond to your cues? If so, please describe.

Your answer

How does your dog communicate to you if it is injured?

Your answer

How does the dog communicate to you if it is unwell?

Your answer

Most successful method of communication with dog? (what is your dog more likely to listed to)

- Verbal commands (e.g., "Sit," "Stay," "Come")
- Hand signals or gestures
- Treats or food rewards
- Clicker training
- Whistle commands
- Leash guidance or corrections
- Body language and posture
- Toys or playtime rewards
- Electronic training collar (e-collar)
- Other (please specify)

What command is hardest to communicate to the dog?

Your answer

Have you used any training techniques or methods to enhance communication with your domestic dog?

Your answer

Appendix 2: Survey 2

K9 Search & Rescue team system

As a part of QUT industrial design project.

* Indicates required question

Are you over the age of 18? *

- Yes
- No

Outline the steps and procedure of a search and rescue mission?

Your answer

Main issues you face during the training process?

Your answer

Methods of reinforcement you use?

- Treats
- Toys
- Verbal Praise
- Clicker Training

Feel free to add detail for the above answer here

Your answer

Have you encountered any challenges or obstacles when working with your search and rescue dog? (Select all that apply)

- Environmental Factors (Terrain, Weather)
- Training Difficulties
- Communication Issues
- Equipment Limitations
- Physical Stamina of the Dog
- Other:

Feel free to add detail for the above answer here

Your answer

Are there specific tools or equipment (aside from a harness) that you find essential for your dog's effectiveness in search and rescue tasks? Any potential tools or technology you would find useful?

Your answer

How often is the dog out of sight?

- Often
- Sometimes
- Rarely
- Never

If yes, is this ever an issue and why?

Your answer

Most common injuries for k9's?

Your answer

How do you ensure the safety and well-being of your search and rescue dog during operations?

- Regular Health Checks
- Protective Gear (Vests, Boots) provide examples
- Hydration and Nutrition Planning
- Rest Periods

Are there any unique considerations you take into account when selecting gear or equipment for your dog's participation in search and rescue tasks?

Your answer

Are safety features such as emergency release mechanisms or secure fasteners important to you in search and rescue equipment?

- Yes
- No

What methods do you use to communicate commands and signals to your dog during search and rescue missions? (Select all that apply)

- Verbal cues
- Hand signals
- Whistles
- Clicker training
- Body language
- Other:

Does canine behaviour change when scent trail is identified?

- Yes
- No

If yes, what behavioural changes witnessed are most significant?

- Body launguage
- Direction
- Speed
- Focus
- Other:

Any additional information you would like to provide for this research?

Your answer

Appendix 3: Themes identification process from interview 1 trancription (First 2 pages)

Locational awareness

Situational awareness

Audibility

Safety and health status awareness

Obedience

Distraction

Time and efficiency

Aantra: Good afternoon, …, thanks for taking part in my study.

Interviewee: No worries I am glad I could help.

Aantra: The interview will take about 20-30 minutes and will provide you with questions in sequential order. The first set of questions will be about the training process, the second about communication and the third about safety. I would like to first begin my asking you what the steps of procedure are during an SAR mission.

Interviewee: From the duty phone call?

Aantra: Yes, that would be perfect

Interviewee: first, we get a call on the duty phone we have set questions that are asked. This phone call is called request to assist. If it is a request assist come in through emergency service it will still come through the duty phone. for emergency services, the questions are more tailored to words them. these questions depend on factors such as distance and type of the incident whether or not we can or can't respond and on the evidence log that comes in. If it is a request by a family member or a community organization we try and get some basic contact details. And then, depending on the amount of time, it takes to get to the location the travel time of deployment available resources are contacted. We will ring which ever Dog teams are closest or who we can get out there first. When they arrive, we set up base camp. Here we expect for the dog in its hand, love, and support team to arrive. If it is emergency services, we only deploy what emergency services ask us if it is in a remote area. We have to set up a remote base which is more complicated as it requires more equipment and it's a very time-consuming process. Now if there is a cent article available, we provide the dog with the scent. This is done before we release the dog. The dog then goes to the direction indicated using directional control commands. The dog is then out of sight working the search path. Once the victim is found, a bark alert is conducted by the dog. In this situation, I will start navigating myself towards the dog. I use a Garman GPS collar, so I know where the dog is. Upon search completion, we have a bit of a hot debrief on how the SAR our mission went. Often they could be multiple types of S an are dogs search scent, dogs, Trail, dogs etc at a singular site. Human remains detection dogs off and on a time restriction like SAR dogs. For SAR dogs time is a crucial element. We are aways identifies ways we can improve search times I our debriefs. We also try and identify what points of the mission took a lot of time. There is also a second debrief in the second week where we go more in depth about this.

Aantra: perfect thank you. Ok so next question. What is the most important command your dog needs to know?

Interviewee: Recall. There is recall and then there is emergency stop they are both equally important. The dog is normally at a distance when an emergency stop is called so there needs to be a lot of trust in the dog to give up the search. Often when I am training canines they cant see me from a so they may not choose to comply in these situation. It is also really important for the dog to obey when the handler is out of sight. Training dogs, when the dog that are out of line of sight more obedience problems arise. When working with Labradors, a common problem is that they consume things on the track without handler correcting behavior which can be really dangerous working in rubble and some wilderness areas. (Also)

Aantra: What needs consistent training?

Interviewee: Everything needs consistent training. We train 3 times a week on the track and of course there is daily training as well. We see the SAR team a couple of times a month. Obedience and directional control for me is always done together. We also do a log deployment where we do a pretend test search mission where we practice setting up and conduct a mission. We compare search efficncy and search times after each of these practice missions.

Aantra: Perfect. What are some key issues you face during training?

Interviewee: With us in SA I find during training the key issues are getting dogs to obey from a distance and stay within search range. It takes a while for dogs to learn how far they are able to search from handler. During training especially when the dog is younger or new, he is highly distracted and once distracted may wonder off search path without us knowing (also).

Aantra: Is there any other training issues with the terrain or communication?

Interviewee: An issue that teams with canines using bark alert face is I can be 500 m away, down in a pit, in some solid terrain or on different levels and I will still not hear the bark alert. So we use our Garmin tracking collars so we can better know where the dog are (also)but also max where they have been so we know if they have missed any areas etc. There is also be every noisy environments where I could struggle to hear canine. For a SAR mission voice communication for commands is also crutial. So if radio collage existed that would also be good.

Aantra: That takes me onto the next question, do you work with your dog off lead?

Interviewee: Yes when I work with my air-scent dog. This is most commonly wide area search. If there is any danger in the area like a cliff, we will stay clear of the area or put the dogs on leads

Aantra: Is there a max distance between you and the dog?

Interviewee: It depends, we want them to range but not too far. We can see on the Garmin collars they can go up to 1.5 to2 km away. We tend not to do that too much but if it is a wide search area that an open area.

Aantra: How do you control this distance

Interviewee: After a lot of training they will eventual naturally pick up nd get used to a distance. They will learn to check up on you and maintain this distance. They tend to work 500m ish ranging wise.

Aantra: Is this distance ever an issue?

Interviewee: Yes it is, if you cant hear the alert or if you don't have a Garmin collar that tracks where they are then obviously the dog will be waiting at the person upon but they wait there until you find

Appendix 4: Themes identification process from interview 2 trancription (First 2 pages)

Locational awareness

Situational awareness

Audibility

Safety and health status awareness

Obedience

Distraction

Time and efficiency

Trust

Aantra: Are you working with air scent dogs at the moment

Interviewee: yes 2

Aantra: On a regular SAR mission what are the steps and procedures?

Interviewee: When we go to a SAR mission, we first do an assessment of the area and landscapes to identify the dangers and efforts we have and our main tasks.

Aantra: What countries do you work in?

Interviewee: Predominantly Australia but I am an international team leader for SAR so I work abroad as well.

Aantra: What is the most important command your dog needs to know?

Interviewee: The most important thing for the canine to know is functional obedience. This includes what means right, left go on go forward and stop. Directional control. These are the main commands we are using.

Aantra: Is recall one of these?

Interviewee: Yes, but it is not commonly used as normally we don't see the dog on the track and if the caning has caught a scent, it would be a shame to recall the dog as then it would loose the sent which can take a long time to find again. The dog at the moment is searching for the human scent and also he is analyzing the scent of the specific individual. If recalled the dog things that specific person cent it has picked up is not a person for it to search for.

Aantra: What are some key issues you face in training? For example commands or terrains you work in.

Interviewee: The main issue to make the dog understand he has work to do independently without the handler by its side. The dog needs its own drive. We are not trying to influence the dog at all during training.

Aantra: Does your dog ever work off lead?

Interviewee: yes

Aantra: Ok so what is the max distance between you and your dog?

Interviewee: That is hard to say it really depends on how much trust there is between handler and dog. The communication between handler and dog is highly dependent on trust. The dog handler has to have a lot of trust in the dog that the dog is doing the right thing and not distracted. Dog needs to trust hadler that there is no actions that are harming for the dogs on the track.

Aantra: So the max distance depends on each dog and handler?

Interviewee: Yes. So each dog is different. Everybody needs to understand what perfect communication between dog and handler is.

Aantra: Are these dogs ever out of sight?

Interviewee: Most of the search the dog is out of sight. Especially when we are looking for victims in the forest, the dog will start 500m away so you wont see the dog most of the search (Also). The dog has to know how far I should go and when I should return independently.

Aantra: Is this ever an issue when the dog is out of sight?

Interviewee: Yes this is the biggest issue. You never know what is happening there would be many animals. Are there deer, rabbits or something like that. Are there cars, snakes, or any other dangers. (Also). First you would of course have a look at the map and environment and see what could be harmful for the canine within the area they are searching in. There is also a danger the dog could be hurt.

Aantra: Because of these risks do you ever have to put PPE on the dog?

Interviewee: No cause if you put a collar or harness on dog it is very likely they can get stuck especially in rubble. In wilderness searches they can get caught or hung on a branch and they are unable to release themselves.

Aantra: Is the dog ever out of audible range?

Interviewee: Yes sometimes this issue can occur that I cant head the dogs bark alert but with a whistle or something they can always hear me.

Aantra: How do you control the distance between you and the dog?

Interviewee: In training we get them used to the distance. We start with short distances and the distances between training get longer and longer up to 500m. We don't commonly exceed 500 m.

Aantra: What sort of communication methods do you use on track?

Interviewee: The voice of course and the whistle. Different dogs are used to whistle. We are now tring to have a tracker on the dog it is very useful especially in the after-track review. Because if you have a tracker you can see the track the dog took so you can see if it was everywhere or if there were spots that were missed.

Aantra: Do you or any other people in the field face any communication issues with the dog?

Interviewee: Yes of course it is very common. It may happen that the dog is away and nobody know where the dog is and we have to wait until the dog is back thus distance can really be an issue. (Also) Or if the dog is distracted by a rabbit or deer or something that can be an issue.

Appendix 5: Interview Questions

1. SAR mission steps and procedure?
2. What are some key commands or behaviours you are teaching your dog? are there any specify ones that are highly important?

functional obedience

1. What needs consistent training?
2. What issues do you face during training? Think about commands, training environment etc.

1. Does your dog work off lead? If so what is the max distance he works from you?
2. IF YES In this satiation is the dog out of sight? is this ever an issue? is the do ever out of an audible range?
3. IF YES How do you control the distance?
4. IF YES Do you always know the location of k9?
5. What are the methods of communication you use with the dog while on the track? which one do you use the most?
6. Do you or other people you know face any communication challenges with the k9?
7. Main pinpoints during the mission? Consider what takes most time, any unnecessary tasks, any common k9 issues?

1. What sort of terrain do you work in?
2. What is the most common found terrain and what is the toughest terrain to work with?
3. Common k9 injuries and hazards?
4. Does the k9 undergo heath checks more frequently or different health cheeks then a non working dog? If so specify?
5. Do they wear an PPE?
6. Is there any hydration and nutation planning that is involved specifically for SAR dogs?
7. Is the physical stamina of the dog ever an issue?
8. Are there any limitations in the equipment and technology you use.
9. Are there specific tools or equipment (aside from a harness) that you find essential or useful for your dog's effectiveness in search and rescue tasks?
10. Are there any unique considerations you take into account when selecting gear or equipment for your dog?
11. Are safety features such as emergency release mechanisms or secure fasteners important to you in search and rescue equipment?