PROJECT PHANTOM: OPTIMIZING THE MISSING PERSON SEARCH PROCESS IN RUSSIA

An Interactive Qualifying Project Report:
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Abstract

Finding missing people is a big challenge for any country and Russia could benefit by improved search strategies. The goal of our project, sponsored by Russia-based Foton Bank, was to construct a detailed block diagram for a search protocol with sensitivity to time and to different types of missing persons (children, elderly, etc.) to be implemented in a mobile application. This application will expedite and streamline search operations for missing persons in Russia and will integrate the multiple services and networks of databases currently in place.

Authorship

Ty Bugdin, Adam Sochacki, Robert Belmonte, Garrett Smith, Daria Shalina, Alina Muradyan, Denis Grachev, Anton Antonyan, and Vladlena Smirnova all contributed to the research and writing of this report. The following is a breakdown of how the report was written for this project.

Ty Bugdin contributed to this report by writing the last section of the background - "The Use of Technology in Finding Missing Persons." The List of Figures, Acknowledgements, and this Authorship page were constructed by Ty. Ty also gave a contribution to the Executive Summary. The block diagram prototype was partially constructed by Ty.

Adam Sochacki contributed to this report by writing the third section of the background - "Why Are People Going Missing?" Other contributions include the construction of the preliminary block diagram, report revisions, and organization of interviews.

Robert Belmonte contributed to this report by writing the first section of the background - "Missing Person Information." The Abstract and the Executive Summary were also constructed by Robert. Robert also wrote the Introduction, Results, and Conclusion sections.

Garrett Smith contributed to this report by writing the second section of the background - "Who is Searching." The final draft of the Abstract was constructed by Garrett and he also played a role in the construction of the block diagram prototype. Garrett also gave a contribution to the Executive Summary.

Daria Shalina contributed to this report by gathering the statistics and data concerning cases of missing persons in Russia published by the police and Liza Alert and constructing the

block diagrams representing the search processes and strategies applied and conducted by the Russian official bodies and volunteer organizations.

Alina Muradyan collected information concerning the process of searching, translated the documents from different government agencies and ministries, collected the information about main types of missing people and the reasons, and made phone calls to EMERCOM to find the statistics.

Anton Antonyan collected information concerning specific actions and details needed to be taken into consideration whilst searching for elderly people.

Denis Grachev contributed to this report by collecting statistics and interviewing Liza Alert. Information analytics and charting assistance were elements of Denis's contributions.

Vladlena Smirnova, together with the team, collected information from all the possible resources and reviewed the statistics available. Also, Vladlena analyzed cultural and national peculiarities between Russian cases and American cases.

All of our team members contributed to the methodology to make a coherent chapter that met the desired outcomes of our sponsor Andrey Pashkevich from Foton Bank and Professor Svetlana Nikitina from Worcester Polytechnic Institute.

Executive Summary

Approximately 100,000 Russian citizens disappear every year and of those cases 25% are never found. The issue of persons disappearing has a profound impact on Russian society as a whole. Russia has yet to truly recover from the events of the 20th century. The Second World War, the collapse of the Soviet Union and the gulag system resulted in a huge demographic imbalance. One of the largest contributing factors to the disproportionate gender ratio in Russia, is the fact that a large portion of Russian men were killed during World War II, and the Russian population has yet to fully recover. Geography and topography also contribute to how and why people go missing. The availability and advancement of different technologies has a large contributing role in locating missing persons in both rural and urban environments. Rural environments typically have less access to resources and infrastructure compared to urban environments that could assist search and rescue teams in locating missing persons. The topography of a particular region also has a significant role when search and rescue teams have to develop protocols that can be used to locate a missing person. Different topographical regions such as forests and mountains are often difficult to navigate and traverse, hindering a search and rescue team's ability to locate a missing person. The vastness of Russia with regions so remote and inaccessible can make it impossible to search in some cases. By looking at how the United States handles cases in similar regions, our developed model can provide insight into different organizations and methods that can be utilized for increased search efficiency.

There are typically many organizations in any country that assist in locating missing persons, both governmental and non-profit. After the advent of DNA analysis technologies, the

United States government, for example, established a task force to utilize biometric information in detecting missing people and matching them to unidentified people. In 2009, the publicly available NamUs database was created for this purpose. Other United States organizations include AMBER Alert and Silver Alert. AMBER Alert specifically assists in locating missing children. AMBER Alert spreads information through a broadcasting system over mobile phones, radio and television. Silver Alert assists in locating elderly people with different types of neurological diseases who may have wandered and gotten lost. Silver Alert uses radio broadcasting and is not as well implemented in various states as AMBER alert is. In Russia, Liza Alert is a non-profit organization that works to locate people that have gone missing. Liza Alert uses a system that divides possible missing person locations into sectors and assigns these sectors to volunteers. Volunteers include divers, balloonists, ATV technicians and trackers. What Russia seems to be lacking is an integration of these systems.

As with any modern day issue, there are technologies to accompany how missing persons are found. The list of those discussed in this report includes dogs, GPS, drones, internet, and telephone. A dog's sense of smell is known to be incredibly strong, and it is used throughout the world to find people missing after natural disasters, kidnappings, prison escapes, as well as drug and bomb sniffing. A Global Positioning Satellite (GPS) often helps civilians find a certain store, but it may have an important role in finding missing persons. GPS SmartSole is a company which is implementing tracking devices in the shoes of patients with neurological diseases like Dementia or Alzheimer's. Drones are often useful in the process when searching over large areas. Drones can have operational ranges over a few miles, at speeds twice that of humans, can survive harsh weather conditions, and will often carry infrared or thermal imaging cameras to

help locate the heat signature given off by a missing person. Lastly, the internet and telephone have given the population extraordinary access to information. They can easily call their local law enforcement in order to place a tip. A tip is information which the searching party may find useful in conducting a successful search. Without these technologies, many more missing people would stay missing forever.

The goal of our project was to establish a detailed protocol of actions ready for digital implementation in order to locate missing persons. These methods included researching trends in missing persons data for both the United States and Russia, conducting interviews in both the United States and Russia, and developing a prototype block diagram that would serve as the backbone for the development of the application. Simultaneously, our team's Russian members accomplished very similar tasks. By having the perspective of Russian-specific missing person trends, interview and online research, and their missing person search diagrams, our team was provided with incredibly valuable insight into the missing person search process. The Russian team focused on creating age-group specific diagrams that went through the search process for people from each group. These diagrams were then combined with our team's full-length prototype block diagram to increase the number of paths the algorithm could take, the specificity of organizations and protocols to use, and many other factors among other sections of the search process we looked into and modeled.This final prototype block diagram was then sent to Foton Bank's web development team for use as a foundation for their application to help find missing people. By modeling the search process for a missing person in high detail and with information from both research in Russia and the United States, the prototype block diagram should help the

application streamline the search process and increase overall success and efficiency for any search parties using the application.

Acknowledgements

We would like to acknowledge Mr. Andrey Pashkevich for sponsoring this project, Professor Svetlana Nikitina for advising this project, and Professor John Zeugner for assisting with writing this report.

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Introduction

Every eight minutes someone goes missing in Russia. The issue of missing persons is commonplace in Russia and remains a prevalent issue in modern society. With roughly 100,000 individuals going missing every year and 25,000 remaining lost forever, Russia has a striking issue with finding missing persons (Geodakyan, 2018). The harsh environment and rough terrain make searching for missing persons especially difficult for law enforcement and search parties. With such a vast expanse of rural terrain and a lack of infrastructure in terms of databases and tools for finding missing people, Russia is in a very difficult situation in terms of trying to find missing persons. In the United States, over 600,000 individuals are reported missing every year but, only 80,000 cases remain unresolved within a year (NCIC, 2018). There are a multitude of factors that cause this disparity in statistics, including differences in infrastructure, environments, societal norms, and search procedures.

Effective search practices for missing people and recognition of unidentified bodies have been revolutionized by recent technologies such as DNA analysis, fingerprinting and information systems (NamUs, n.d.). In 2005, the United States formed the National Missing Persons Task Force to implement these new technologies in identifying and locating missing people. In 2009, a database was created to make automatic case comparisons using biometric information. The modern search practice of U.S. police is to conduct a search and report to a central database if necessary. In contrast, the Russian government has only created an unidentified persons database in Moscow, and has not yet implemented a fingerprinting system they authorized. These systems are not exclusive to the search for missing persons. The work of the Russian Ministry of

Emergencies has been criticized by the nonprofit Liza Alert for inefficient search practices, which is the reason for the founding of Liza Alert (Liza Alert n.d.). The effectiveness of independent Russian organizations raises the question of how to best implement search systems. Our sponsor wants to streamline the search process for finding missing people with as much efficiency and accuracy as possible. In order to accomplish this, we needed to look into every detail in the search process and how everything connected together to make a thoroughly modeled system. By getting multiple different perspectives on different parts of search procedures from both the United States and Russia, this model can encompass many different variables and features of the real world.

Our team in the United States worked directly with a team of students from the Financial University in Moscow, Russia. We all simultaneously looked directly into search procedures and what different methods, search algorithms, and technologies both countries use. Both teams looked into the search procedures and methods used in their respective countries while trying to document as much detail as possible to model a thorough search process. After comparing both models, our collective team then used the best possible combination of methods and procedures to create a framework for a phone application that would use advanced algorithms to create recommendations for search party actions. This framework is in the form of a multi-layered block diagram prototype that would be utilized by the computer science team of LightNet Systems to help create this phone application.

Both teams took different approaches to the same problem which resulted in varying perspectives. Our team in the United States planned on using acquired interview data and online research to create a full-length block diagram that would follow the possible logic paths of a

missing person search algorithm. The Russian team similarly conducted interviews, researched online, and made diagrams but, they had separate diagrams for each age group that they looked into. These diagrams then were combined and overlapped to make a comprehensive full-length block diagram prototype. Both teams focused on having as much detail in their diagrams as possible with the end goal of having time estimates between each step of the search process. By keeping consistent communication with the Russian team members and combining our respective block diagrams, our project team successfully created a prototype for the LightNet Systems computer science team to use as a baseline in order to strengthen and enhance our sponsor's phone application.

Background

Disappearances of persons happen all over the world on a regular basis, although the number of people who go missing varies greatly depending on the country of origin. Many countries have databases, processes, and procedures to locate missing persons. Geographic and demographic data can be used by law enforcement to predict why a person went missing. This data can then be used to estimate where the person is most likely to be and the best method to find them.

First, we briefly overviewed the issue of missing persons. The overview included legal definitions, geographic statistical data, and demographics with reference to data from the United States and Russia. Second, we identified parties particularly interested in finding missing people including government agencies, families, and volunteer groups such as Liza in Russia and AMBER Alert in the United States and where they could use help with optimizing their search process (AMBER Alert, n.d.). Third, we discussed the reasons people go missing. Reasons for disappearance included psychological stresses, neurological diseases, criminal activity, and reported deaths. The section ended with a comparison of missing person statistics and cultural reasons between the United States and Russia. Finally, our group looked into the technologies involved with searching for missing people with a focus on modern techniques such as animal guidance, drones, and GPS tracking. All of these sections contributed to the research and development of our block diagram prototype in order to streamline and integrate all incoming data, provide a detailed sequence of logical steps, and accurately model the search process for a missing person.

I. Types of Information Collected on Missing Persons

A. Definitions of a Missing Person in the U.S. and Russia

US Legal is an organization that specializes in giving legal assistance and providing legal information to small organizations in the United States. According to US Legal, the legal definition of a missing person in the United States is an adult 18 years or older whose disappearance is not voluntary or a child whose location is unknown to that child's legal custodian (US Legal, Inc. n.d.). Multiple U.S. agencies and local police forces work to find people who are legally missing. One such agency that exists on the federal level is the National Crime Information Center (NCIC), which aggregates missing persons reports nationally. Secondly, many states have the AMBER Alert system in place, which is used to locate children who are missing and may be in danger. (Missing person law and legal definition. n.d.). In general, there are very strict criteria that many law enforcement agencies use to classify missing people as well as specific strategies that can be used to find those people. Both the United States and Russia are vastly different from a cultural perspective and so cultural considerations must be taken into account to develop specific strategies for locating missing persons. Due to these cultural differences, there are many different reasons that people go missing in both the United States and Russia that are explored further.

B. Demographics of Russia and the United States

The country of Russia had a total population of about 144 million people as of the year 2018. There is a significant gender disproportion in the Russian population. In 2018, the World

Bank determined that the Russian population is about 46% male and 54% female (The World

Bank, 2019). In addition, Russia's population has been stagnating. One of the largest factors

contributing to Russia's most recent loss in population is its fertility rate. In order for a

population to increase, the fertility rate in the country must be at least 2.1 children per woman.

The current fertility rate in Russia is approximately 1.6 children per woman, which is

significantly less than the fertility rate needed for an increasing population. (The World Bank,

2019)
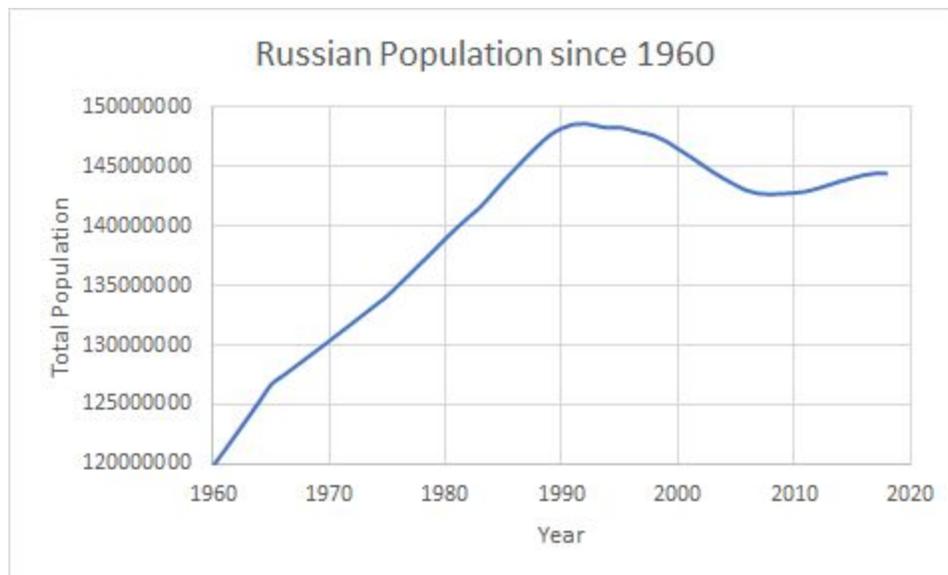
Figure 1: Total Russian Population since 1960

The figure above shows the total population in Russia since 1960. In general, the graph shows a

rapid increase in Russia's total population until the year 1990, then slightly decreasing without

fully recovering. (The World Bank, 2019).

Adults comprise a larger percentage of the Russian population compared to children and

proportionately more adults go missing every year compared to children. According to the

Agency of Strategic Initiatives Director General Svetlana Chupsheva, as many as 70,000 to

100,000 people go missing in Russia every year and 25% of them are never found. Of the 25% of

people that are never found, approximately half are children. One factor contributing to the

disappearance of children is their vulnerability, making them easier targets for abductions.

Approximately 300 total abductions occur in Russia in a given year, making abductions a small

cause for disappearances. (TASS, 10 Jul, 2018). Throughout much of Russian history, women

were the most common victims of abductions that resulted in their disappearance. (Muravyeva,

2016). Many women disappeared due to being forced to get married to men against their own

will. This practice was mostly apparent in Siberia. While the practice of abducting women to get

married against their own will was quite common during the early era of the Russian Empire,

these abductions were deemed barbaric and backwards when the monarchy in Russia was

established and through the modern period. (Muravyeva, 2016).

Our research found that statistically, missing person cases are decreasing in the United

States compared to an increase in cases in Russia. The following graphics and data explain

several possible reasons for these trends.

Figure 2: Missing Person files in the United States from 1990-2019

The Crime Control Act of 1990 paved the way for many new federal policies which had a significant impact on the ability for law enforcement agencies to more effectively locate missing persons. One of the more significant laws that was a part of this act was the National Child Search Assistance Act, which allowed for local, state, and federal agencies to more efficiently input key identifying characteristics about missing children into databases. The law also removed any sort of waiting period that prevented immediate input of key identifying characteristics about missing children into key databases such as the National Crime Information Center (NCIC) database. The effect that these federal policies had on the amount of missing person cases that were filed, was a large spike that occurred soon after these bills became federal law in the late 1990s. One of the contributing factors for this spike was not that more people were going missing, but instead more cases could be filed due to the increased efficiency and resources that

law enforcement agencies now had as a result of the signing of the aforementioned bills (Statista Research Department, 2019).

After the turn of the century, the amount of missing person files in the United States steadily decreased. One of the contributing factors to this was the events surrounding 9/11, where many Americans felt less secure and social trust decreased. As a result, parents were more inclined to keep track of the location of their children, causing the amount of missing person cases to decrease. Due to increased resources made available to state and local law enforcement agencies, as well as the rise of organizations such as AMBER Alert, missing persons could be found more efficiently and more quickly (Boss, P. 2004).

Since the year 2000, the amount of missing person cases in the United States steadily decreased. In the year 2000, there were 876,213 missing person cases that were filed. This decreasing trend continued throughout the decade where in 2005, a total of 834,536 missing person cases were filed and in 2010, a total of 692,944 missing person cases were filed. The decreasing trend continued in the following decade where in 2015, a total of 634,908 missing person cases were filed and in 2019, a total of 609,275 missing person cases were filed (Statista Research Department, 2019). These trends and causes allow our team to consider the role government and organizations play into the process of searching for missing persons. The services in the United States appear to have established a more effective model of recovery upon which our team emulated our constructed model in order to enrich the Russian practice.
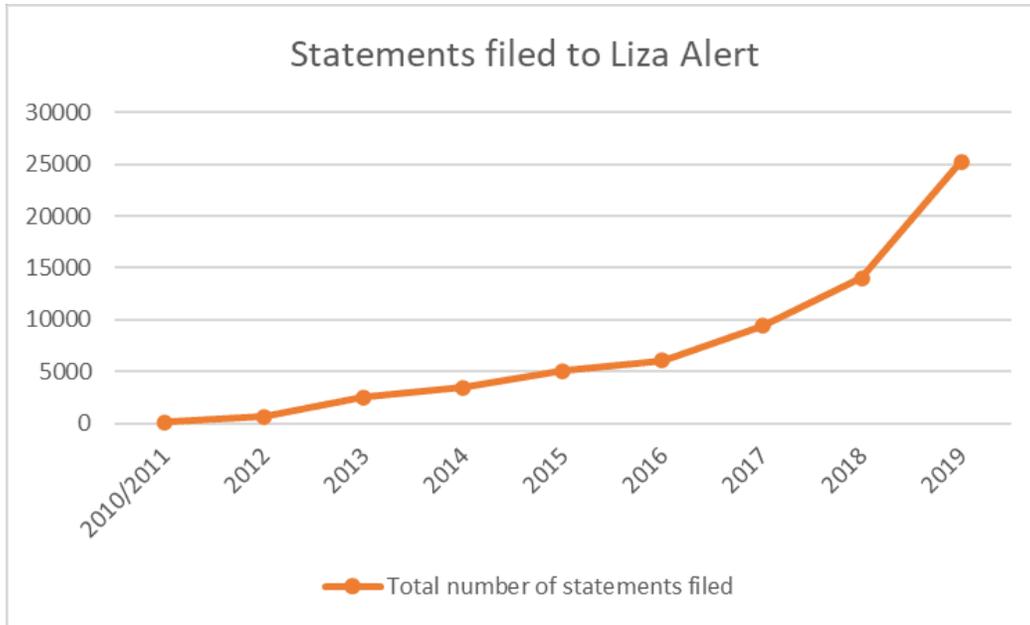
*Figure 3: Statements filed to Liza Alert*
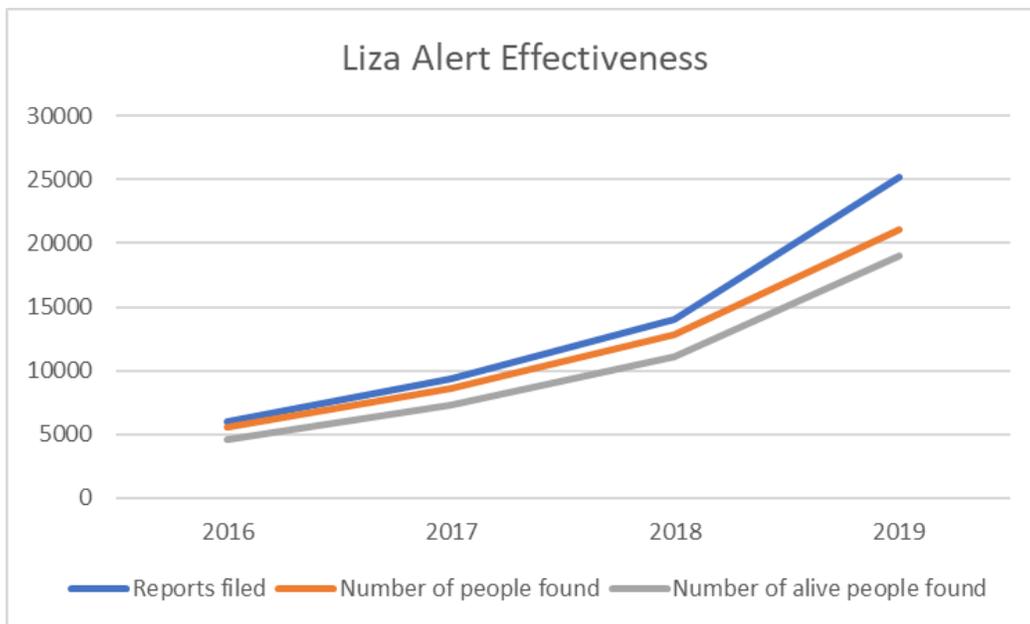
Figure 4: Liza Alert Effectiveness

Throughout the duration of the project, five Russian students from the Financial

University assisted in the project, finding reputable and relevant data pertaining to Russian

databases for missing persons. Specifically, one of the organizations that the Russian students had collected data from was Liza Alert. Some of the data they found related to how Liza Alert categorizes missing persons, as well as numerical data outlining various trends observed by Liza Alert. Based on their research, there is comparable overlap between Russian and American organizations pertaining to categorizing missing persons. Some of these categories include people with no specific place of residence, mentally disabled, drug addicts, tourists, mushroom pickers, orphans, runaways due to family or financial reasons, missing due to a natural disaster or war, and victims of domestic violence. The Russian students also found that age plays a significant role in how missing persons are categorized. Children and teenagers are often categorized differently when missing compared to elderly people, due to significant differences in the causes of their disappearance (Liza Alert, 2019).

The Russian students also located numerical statistics relating to missing persons in Russia from the Liza Alert database. They found that every day, approximately 300 people go missing in Russia. Of the people that go missing, approximately 80% are found by search and rescue organizations as well as law enforcement. Based on the results from the Liza Alert database, there is an increasing trend for the amount of people that go missing on an annual basis, as the number of missing persons increases 10-12% every year. For missing children, approximately 90% are found. Liza Alert also reported that up to 17% of missing persons are unable to be found. The Russian students also found in the Liza Alert database that during the years 2018-2019, more people had disappeared in urban areas compared to rural areas. Liza Alert had also separated these particular cases into four categories: visitors, property owners, children, and businessmen. Lastly, the Russian students had found that the fastest growing category of

missing persons was runaways, specifically teenagers who have their families or have ran away from school. (Liza Alert, 2019)

Russia's vast territory and harsh climate in winter make it a nightmare for search parties. Out of the roughly 3 percent of people who are never found by Liza Alert, many are believed to have drowned in lakes, or have been covered in snow and ice during Russia's harsh winters. The other seasons present dangers too. Every year, Liza Alert sees a peak in missing persons reports during the summer and "mushroom season," from June to September, when Russians traditionally go out into the woods to pick mushrooms and berries. (Liza, Alert 2019).

The research gathered by the Russian students from the LIZA Alert database, allowed our team to consider multiple different factors and variables to keep in mind when creating our block diagram model. By pursuing this type of cross-cultural demographic analysis, our team was able to hold multiple perspectives on the same problem and as such, we were able to observe and fill in any gaps in our research by accounting for significant cultural differences when constructing the block diagram.

C. Geographical Influences & Factors in the Missing Search Process

People going missing has been a major issue for law enforcement in societies all around the globe for centuries. Geography plays an important role in determining the procedures, priority, and scope of a missing person search. The environment that people can go missing is not limited to one particular setting; people from urban or rural areas commonly go missing for example. According to a journal entitled Forensic Ontology, most people that go missing voluntarily do so in areas that are disconnected from urban society. Many people that go missing

do so in rural environments where the likelihood of them being found is slim. (Fancher &

Hampl, 2018). Geography is also a major factor in cases of people that go missing involuntarily.

In cases of abduction and kidnapping, the perpetrators are more likely to abduct a person in an

area where they have the least possible chance of getting caught. In many cases, people are more

likely to go missing in areas that are less likely to have the resources and infrastructure that

would assist in finding missing people. (Fancher & Hampl, 2018).

The topography of an environment can also heavily influence where people are more

likely to go missing as well as influence the difficulty in finding them. For example, the national

parks in the United States such as Yosemite and Yellowstone are vastly different in terms of

topography compared to the rest of the United States. The national parks have various

topographical regions including mountains, forests and large bodies of water that allow for

people to go missing and make them harder to locate. A study performed by Yosemite national

park determined that the majority of people that go missing within the park, do so in regions that

are difficult to traverse or navigate such as mountains and forests. (Hung & Townes, 2007). Over

a ten year period from January 1990 to December 1999, Yosemite national park performed 1912

search and rescue missions and assisted 2327 individuals. (Hung & Townes, 2007). Their

analysis also showed that there were 112 fatalities recorded from failed search and rescue

missions, leading to a fatality rate of approximately 4.8%. (Hung & Townes, 2007). The search

and rescue missions that required the most time, money and manpower were performed in areas

that were difficult to traverse like mountains and forests. They found that people who went

missing within forests in particular comprised the majority of targets in search and rescue

missions. (Hung & Townes, 2007). This research into terrain related searches influenced our

model to include geographic factors such as mountains and forests limiting searches to local organizations and requiring specific technologies. While Russia has much more land mass and more extreme geographic regions than the United States, this research is still applicable to Russia. They also rely on local organizations for missing person searches - a topic we explored further in this report - but, this connection to local wildlife groups and local authorities was key for our team's block diagram prototype applicability for Russia.

II. Parties Involved in Missing Person Search Operations

There are certain groups with a vested interest in finding missing people; commercial entities such as banks searching for debtors, governments in search of wanted persons, humanitarian non-profits such as Liza alert whose mission is to find the missing, and the missing's family and friends. Due to the decline in public confidence of the Russian government's search process, volunteer groups are becoming more involved in missing persons cases (Liza alert.2019). The Liza Alert search organization has processed up to 23% of these cases along with the police. The U.S. does not have any organization near this prominence.

A. U.S. and Russian Governments

In 2005, the United States formed the National Missing Persons Task Force. The National Missing and Unidentified Persons System, NamUs, was created to help the task force in identifying and locating missing people. In 2007, a database for unidentified people was created and hosted on NamUs. In 2008, a database for missing people was created for NamUs and the next year both were merged in order to make automatic case comparisons using biometric information (NamUs, n.d.). Criminologists and trusted law enforcement professionals use the

NamUs database for solving missing persons cases. Russia does not have a missing person search database as of August 2016, 8 years after the United States created one. The International Centre for Missing and Exploited Children stated Russia would have a database by 2017, but the current status is unknown (Global missing children research initiative.2016).

B. Families

According to the police, the best time for locating a missing person is in the first twenty-four hours. However, families are sometimes hesitant to report a missing person. If a loved one goes missing, the family often searches with the police during the initial stages. After the police search to no avail, some families will continue to search for years (Parr, Stevenson, & Woolnough, 2016). Research shows that in many cases search intensity will gradually lessen. Until a loved one is found, a majority express an incapability of accepting the loss (Parr, Stevenson, & Woolnough, 2016). We could not find information detailing if these sentiments are different in Russia but, it is believed these feelings are universal.

C. Organizations

There are large organizations dedicated to the humanitarian purpose of locating missing people and delivering them to safety. The United States AMBER Alert and Silver Alert programs and the Russian Liza Alert are the main groups. In contrast to AMBER Alert, Liza Alert does not have government backing.

Founded in 2010, Liza alert is a humanitarian group based in Russia that employs crowdsourcing to find missing people (Evgeny Voropay, 2012). They have an online system that displays "sectors" and marks whether they have been fully searched or not. They also have

specialized volunteers such as balloonists, dog handlers, ATV drivers and divers. Their primary

focus is on finding missing children and they were formed due to the chaotic search for a missing

child, Liza Fomkina, who was found one day after her death. The disorganized search that

indirectly resulted in her death was blamed on the government's incompetence. The Russian

government and Liza Alert have made public criticisms of each other (Lenta.ru, 2013).

Silver Alert is a United States organization whose intent is to implement a broadcast

system that relays information about missing people, in particular, seniors who have Alzheimers

or a similar disease (Wikipedia, 2019). Silver Alert uses roadway messages, radio and tv stations,

and other emergency notification systems to find missing seniors. The goal listed on their

website is to advocate legislation on the state level to implement their alert system (American

Silver Alert Coalition).

AMBER Alert is a United States government program formed after the kidnapping and

murder of a child named AMBER. The system began in Texas in 1996 when news broadcasters

and local police worked together to create an early warning system for child abductions. The

system has since then spread to other states and localities (AMBER Alert, n.d.)

Both countries have public systems in place for a way to account for and publicize

missing people across large populations and areas. While the United States has their main

organization dependent on the government, Russia primarily uses the public and volunteer

efforts to maintain a similar system. This shows that in our search model, our team needed to

highlight both civilian and government involvement in search processes.

III. Social Causes for the Disappearance of Missing Persons

To understand why people are going missing, our team researched several major causation factors including runaways, neurological diseases, kidnappings, and deceased individuals. Each category has several key factors that are further explored in depth, resulting in an expansive understanding of the underlying issues behind why people go missing. By looking at both the United States and Russia for underlying social causes, our team could better understand and identify the logic within a search for a missing person. Our prototype block diagram follows the entire process of finding a missing person but, it also breaks down profiling into sections by age - such as children, young adults, and the elderly. The causes our team looked into in the following sections influenced some of the actions taken by the application to best fit the most commonly seen cases from each age group - such as wandering for Dementia patients directly affecting elderly groups the most for example. There are a wide array of societal influences that impact missing persons of which our team looked into for both countries.

A. Running Away

The main informational points in the following section come from "Geographies of Missing People", published in 2013 by the University of Glasgow and written by Olivia Stevenson, Hester Parr, Penny Woolnough and Nick Fyfe - experienced researchers in missing person analysis. These researchers used a major study conducted in the United Kingdom between 2009 and 2011 with over 300,000 missing person reports from a population of over 60 million as a baseline database with forty-five adults interviewed for deeper psychological analysis (Stevenson, et al. 2013). Among those interviewed, there was approximately a 50:50 split

between male and female, over ninety percent were between 22 and 59 years old, there was an even split between employment status, and a high proportion of interviewees had either diagnosed or undiagnosed mental health issues (Stevenson, et al. 2013). One issue in the study is sample size but, it was meant more so to analyze the psychological reasons behind why missing persons run away. The findings from these studies should be applicable to most large and developed societies - although cultural differences, language barriers, and other factors may impede the generalization of these findings on a global scale. For example, Russia which has almost double the population of the United Kingdom, is roughly 70 times larger in land mass, and has an entirely different language and set of societal norms. The Journal of International Business Studies explained that for a single-country study to be sufficient internationally - applicable to other countries around the world - it must compare and contrast different methods across multiple involved countries (Rosalie Tung & Arjen Witteloostuijn, 2008). The statistics from the United Kingdom study are most likely not directly translatable to any one country - such as Russia - but, it gives a baseline for future studies in Russia that can then be further compared. These cases with psychological or mental disorders causing people to go missing gave our team insight into the logical paths search teams should take when a missing person is identified to demonstrate these conditions or similar tendencies.

Multiple statistical points can be made in determining the psychological causes of why individuals run away based on the findings of this study. From some of the main takeaways, several underlying drivers can be identified including mental health crisis, drug and alcohol issues, relationship breakdowns, domestic abuse, debt, and other traumatic stressors (Stevenson, et al. 2013). The majority of missing people travel by foot with cars and buses being the next

most popular mode of transportation. Among those interviewed, almost everyone feared the police, avoided public places, and areas with CCTV but, several revealed themselves to significant others or close friends. Both small and large parks were popular locations for resting places as well as beaches, cliffsides, and seashores. Twenty-two percent of the missing adults used local hotels and bed and breakfasts for hiding and sleeping, often checking in under false names and paying in cash. Most of the interviewed individuals identified rough sleeping as being a critically low emotional and physical point, driving them to take risks and seek improved shelters. Most of these individuals reported strong positive emotions to start but then strong feelings of isolation, guilt, shame, and embarrassment as time progressed. Many individuals feel anger and apprehension upon being labeled as 'missing persons', many struggle to come to terms with their return, and many deal with trauma for months and years afterwards.

Researchers also offered several recommendations for how to help prevent, protect, and find missing people (Stevenson, et al. 2013). One suggestion that stood out to our group was a recommendation for awareness campaigns. These campaigns would include several items such as training mental health services and hospitals to be more aware of warning signs and risk of a person becoming missing. The campaign would also involve informing the public on support services available, regular check-ins with people who have returned to society after being missing, and regular broadcasts to raise public awareness of missing people issues and to combat the current stigma against missing people. Researchers also recommended that major transport hubs and food distribution centers should carry advertisements for missing people that relay information on where they can get help and their confidentiality rights.

One study done solely in Russia confirms many of the findings above but, with several additional factors. The article "Social and lifestyle determinants of depression, anxiety, sleeping disorders and self-evaluated quality of life in Russia" published in 2005 by Soc Psychiat Epidemiol and written by Maria Averina and other psychologists offered some research for our group. Averina links the majority of the mental disorders and stressors that the Russian population suffers primarily to socioeconomic status, poor nutrition, alcohol use, and smoking (Averina, 2005). With a dramatic shift in the economic, political, and societal structures with the collapse of the Soviet Union, many of these changes have had a negative mental impact on the Russian population across multiple generations. This shows that the causes for missing people stemming from mental and psychological disorders are similar across multiple countries, which was taken into account during our team's modeling process. It is clear that psychological effects play a strong role in determining why a person goes missing and how they are affected by it throughout their experience.

Children make up a noticeably large portion of those who are reported missing in any given population. Although statistics vary based on location, there are several sources that can give further insight into the breakdown of missing person statistics. The National Crime Information Center (NCIC) as of December 31, 2018 reported 34.8% of their 85,459 active records are juveniles under the age of 18 with 45.1% being under 21 (NCIC, 2018). Some further analysis was taken from the article "Runaway Youth: Caring for the Nation's Largest Segment of Missing Children" published in January, 2020 by Theresia Gambon and Janna Gewirtz-O'Brien. Both authors have Master's Degrees in Gewirtz-O'Brien is on the Committee on Psychosocial Aspects of Child and Family Health. The article highlights that "The largest segment of missing

children in the United States includes abstract runaways, children who run away from home, and throwaways - children who are told to leave or stay away from home by a household adult. Although estimates vary, as many as 1 in 20 youth run away from home annually" (Gambon and Gewirtz-O'Brien, 2020). The article has very current information on missing children and missing person statistics and information on emotional repercussions, so our group used it to have an estimate on current events and missing population estimates.

There is a scarcity of data on political and economic refugees within individual countries, but there is some general global data that our team looked at. From the UN Refugee Agency (UNHCR), there are an estimated 70.8 million forcibly displaced individuals around the world currently. Among those forcibly displaced, 25.9 million are refugees and 3.5 million are asylum-seekers. The UNHCR collects and displays various types of data on refugee statistics including where they come from and what countries host them. Our team used the UNHCR site to also double check the figures for missing children, adults, and any other groups we look at. With about 16,800 employees as of May of 2019, their organization has plenty of manpower in updating statistics, tracking reports, and further developing refugee analysis. There is also a UNHCR Statistics Database that our team looked at for further analysis of global refugees. Our team recognized that there are significant differences between refugees and missing persons due to political, economic, and societal factors but, there is some overlap between the two groups that was taken into account in our analysis.

B. Neurological Diseases as Causes for Disappearance

Another significant cause of missing people includes people affected by Dementia, Alzheimer's, and other neurological diseases. The Russian Alzheimer's Association states that

over 1.5 million people are living with dementia in Russia (Alzheimer's Association, 2020). In "The Role of Attention and Memory in Search for Missing Persons" published in 2019 by Kara Moore of Knox College and James Lampinen of the University of Arkansas, the role of memory in missing person cases was discussed. Using a study with observed participants, researchers were able to gauge how well an average person's memory handled missing person information. Our team used the results of the study to determine how to best handle eyewitness data in missing person cases among other important case characteristics. In "Missing Incidents in Community-Dwelling People with Dementia" published in 2012 by Meridith Rowe, Catherine Greenblum, and Rita D'Aoust, the concept of Dementia causing missing person incidents is explored. Our group used their research in defining missing person statistics due to Dementia. A similar breakdown can be made for Alzheimer's which was looked at through the "Role of Attention" source among other medical accounts. This research shows that our model needed to take neurological diseases into consideration when accounting for missing persons who could be suffering from conditions such as Dementia. A similar case can be made for the elderly populations of Russia who get lost in remote locations and have trouble remembering their relative location.

C. Kidnappings

Another source of missing people involves abductions and kidnappings. The Global Economy states that as of 2017, for every 100,000 people, Russia has an average of 0.2 kidnappings - meaning roughly 300 abductions throughout their whole population of 145 million. The abduction rate per 100,000 people has decreased from 0.8 in 2004 (1200 abductions) to 0.2 in 2017 (300 abductions) (The Global Economy, 2017). The United States

added Russia to a list of several dozen countries globally that are believed to have a high risk of

kidnappings occuring (O'Connor, 2019). From one source titled "Kidnapped children make

headlines, but abduction is rare in the U.S." by Scott Malone and Daniel Wallis in 2019, fewer

than 350 people under 21 are abducted per year since 2010. When these incidents occur, they

usually make local, state, and sometimes national headlines - attracting a lot of attention.

Although abductions account for a small percentage of missing persons, our group looked into

how officials deal with these cases and what trends are observed. Malone and Wallis state that

hundreds of thousands of juveniles are reported missing every year, but only several hundred of

those cases reported are confirmed abductions by strangers. The rate of abductions will vary

based on geography and location around the world but for our model, we focused specifically on

the statistical disparity between the United States and Russia.

D. Death as Cause for Disappearance

Another smaller but still viable source of missing people are those that are missing people

who are actually deceased. From the Civil Code of the Russian Federation, a person is

considered deceased or *'In Absentia'* if they are missing for over five years, missing for over six

months after an accident, or two years if the person was involved in a military conflict (Russian

Press Ministry, 2018). There is a Wikipedia database titled "Formerly missing people found

dead" with currently hundreds of total entries. Public online sources along with other databases

were looked at by our group in determining how officials determine where their data is collected

from. Similarly to abductions, the reported numbers will most likely vary by country and

geography, but our group looked into the difference between these accounts and the reasons

behind them. One Russian news article, "Where Do the Children Go" written by Ivan Petrov in

2006, explains the Russian perspective on missing persons. The article reports that, according to police estimates, about 95 percent of missing children are those who run away and the majority of those cases result in a successful recovery (Petrov, 2006). On the other hand, the Moscow Criminal Investigations Department (MUR) reports dangerous trends of both missing children and adults meeting fatal ends due to factors such as freezing conditions, vehicle accidents, abductions, and murders (Petrov, 2006). Although deaths constitute only a small percentage of the total missing cases around Moscow, it shows the potentially fatal side to missing person cases and the high risk involved with the environment the missing persons are traversing. By looking at possible deaths to be the result of a missing person search, our team added in contact with morgues along with DNA and dental record departments as points of contact for finding information in our prototype block diagram.

E. Cultural Differences in Russia

The statistics of missing people are still covered by a veil of mystery. There are many mysterious and unsolved cases around the disappearance of people all over the world. An analysis and review of reports show that the number of cases has significantly increased over the last few decades. In Russia each year over 100,000 people are put on the missing list, where a quarter of the missing are minors. Every year, more than 65,000 people are found. The main risk groups usually include the elderly, sick people, as well as teenagers and children.

According to statistics in 2018, 13,683 statements were received about missing children and in the first half of 2019 there were 8,383. "The number of cases of missing children in the Russian Federation increased by 7% in 2019, which, of course, causes concern," as was reported

by the Investigative Committee of Russia. The main reasons for the disappearance of children and teenagers often involve family conflicts, asocial behavior of parents, child abuse, and adverse living conditions.

According to the "Novaya Gazeta" research, over 80 % of crimes against children are committed by family members or relatives and half of them are made in a state of alcoholic or drug intoxication (Dolinina, 2019). In Russia, the regulation system of family relations, in particular the regulation of child abuse, is not yet fully developed. So, for example, for 40% of the accused who beat or killed their child, the court recognized the pregnancy or the presence of other children as extenuating circumstances. Also, if the child was not killed or his or her health was not seriously harmed, even when the torture lasted for years, the defendants in most cases received suspended sentences or corrective work. Moreover, in order to avoid liability for the crime, it is often enough for the accused to make peace with the victim. Reconciliation of the parties is not prohibited by law in Russia, and some judges are simply too lazy to deal with cases in-depth as it is easier to write a resolution on reconciliation than a sentence. The question here is not even whether the person was forgiven or not, but that the accused is evading punishment. In addition, the court can dismiss the criminal case, even if, due to age, the decision on reconciliation for the child was made by his representative. It is also worth noting that it is usually quite difficult to prove torture being made by parents, and many people, including sometimes judges, perceive beating of children not as deliberate torture, but as a parenting process.

Given the above, it is not surprising to see the increasing number of children and teenagers leaving their home because of ill-treatment. As a result, they are in a risk group of

missing people in Russia. The next major tendency often seen among the cases with missing people is the so called "mushroom season". Liza Alert chairman Grigory Sergeev said in one of his interviews: "We do not like mushroom summer. We know from the experience: in 2018 there were no mushrooms, and people disappeared much less. In 2019 we are waiting for the warm summer and mushrooms and an increase in the number of lost people" (Emelianenko, 2019). To prove the point, this is exactly what happened in summer of 2019 when for the entire summer Liza Alert received almost twice as many reports for missing people in the forest than in the summer of 2018: 8320 applications against 4392 (Yarila, 2019).

In the mushroom season of 2019 Liza Alert during a day received the same number of applications as it did earlier during a week. First, this was due to a favorable summer, so there were a lot of mushrooms in the forests. Everyone wants to go to the forest to gather them, and the result is obvious. In each region, the season begins at different times: in the southern regions, the peak of activity begins much earlier than in the middle lane. In general, the main season falls on all the summer months and September.

According to Liza Alert statistics, every 12th missing person dies in the forest (Chepovskaya, 2019). This is a lot. There are several factors that affect this. Firstly, inexperienced mushroom pickers or those who went to collect in an unknown forest lose track of the terrain and get lost. Or by contrast, people are lost as a result of their extreme self-confidence. Often people overestimate their strengths and do not take into account the fact that in the forest they can feel bad. As a rule, people are not properly prepared when going to the forest, as they do not plan to be lost there. That is why, almost all those who were missing had no

water, they did not wear bright clothes, lacked matches and a lighter. Many even do not have a mobile phone with them. Unfortunately, the result of that often turns out deplorable.

Another peculiar feature of searching for missing people in Russia concerns the Orthodox religion and its traditions. Monasticism, or monkhood, the practice of devoting oneself to spiritual work by leaving the ordinary life behind is quite popular in Russia, and more people tend to go away to live in monasteries than in other countries. This is something which is common knowledge in Russia. The Church accepts any person who comes there and allows them to change their name and identity and break any contact with the outer world, which creates additional challenges for anyone looking for a missing individual.

In addition, there is a particular delay in initiating the police's procedure of searching for missing people in the Russian society that significantly hinders the effectiveness of the search. The majority of Russian people believe that in the case of an individual going missing their family has to wait for 3 days before reporting it to the police in spite of the fact that there is no legal act that requires this "waiting period". In reality, the police can accept reports as soon as a person goes missing, and the sooner they are reported to officials, the higher the likelihood of finding them is. Thus, by waiting for 3 days people substantially decrease the chances of finding a missing person.

Summing up, as we see, there are many reasons why people go missing. In general, they are often common in all countries, but still there are certain peculiarities at the national level. Nevertheless, this worldwide problem can be overcome only when people unite and carry out the research and rescue work together. Only then, we are able to successfully find those missing and

bring them home and to their family. By taking into account these cultural differences between countries, we may more effectively solve missing person cases around the world.

F. US-Russia Missing Person Statistics Comparison

By specifically looking at the difference between the United States and Russia in terms of missing person statistics, our group better understood the key factors in both causes and solutions of missing persons. The Russian News Agency reported that up to 100,000 individuals go missing every year (Geodakyan, 2018) with about half of the missing persons being children. The BEARR Trust - a non-profit organization in Russia - supports the same claim along with several other articles. These sources also claim that about 25% of missing persons never get found. There seems to be more thorough data on missing persons in the United States even though the number of reported missing people is much higher than in Russia. According to an article by WALB News 10, around 600,000 people are reported missing in the United States every year (WALB, 2019). The claim is supported by the NCIC - an organization under the FBI - that reported 612,846 missing person cases in 2018 (NCIC, 2018). The database also reported that out of that total, 424,066 were juveniles under the age of 18 - putting the total at about 69% of total missing cases being children. The highly contrasting statistical point here is that in 2018, there were 527,387 cases resolved - meaning that only 14% of missing persons are not found within a year's span compared to Russia's value of 25% of missing people never being found. The statistics show that Russia is less efficient at successfully resolving missing person cases. With the salient geographical features such as expansive mountains and forests, the location and retrieval of missing persons in Russia can be incredibly difficult. The following graphics

breakdown the comparison between the United States and Russia in terms of missing person statistics.
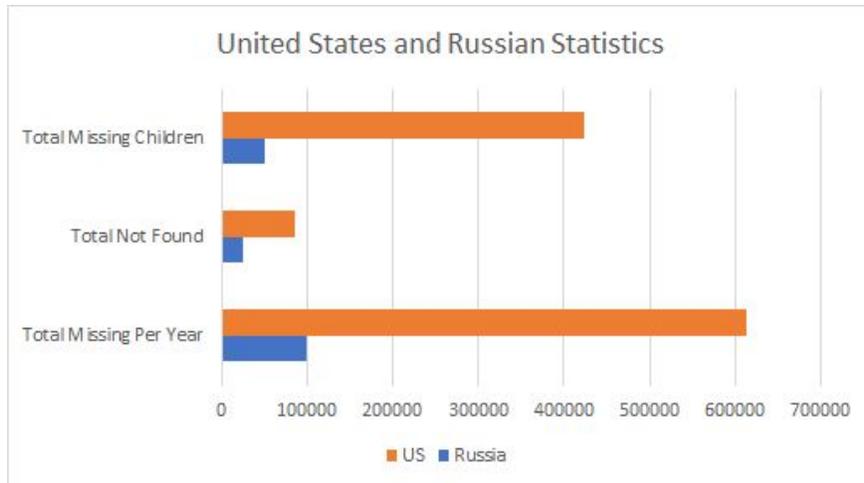

*Figure 5: Missing Person Statistic Breakdown*
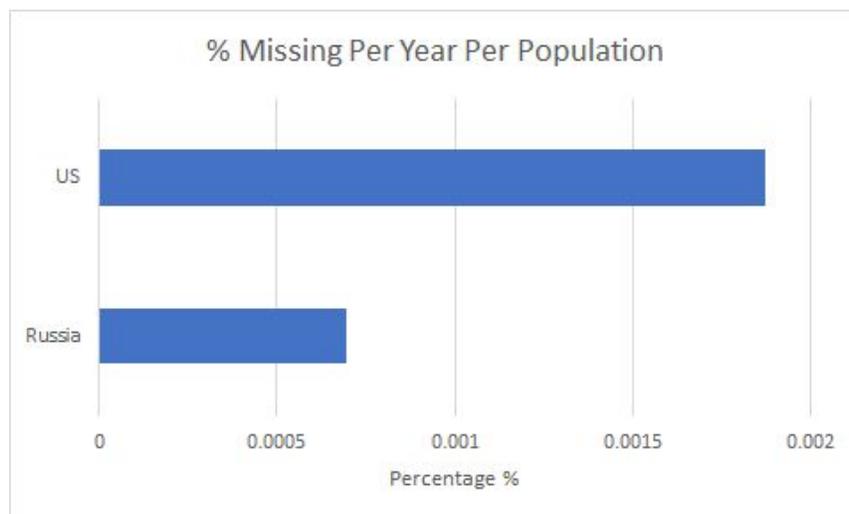
Figure 6:Missing Persons Compared to Populations
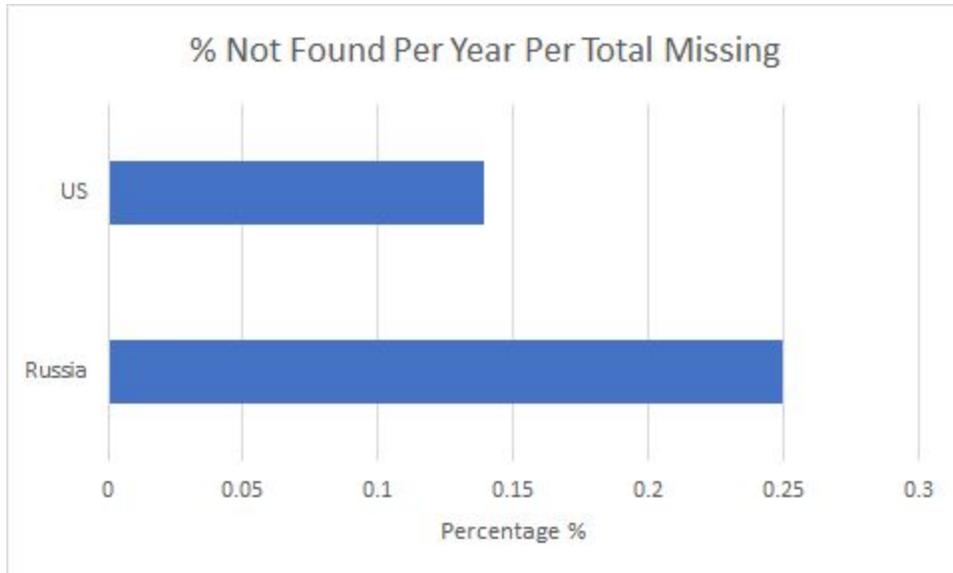
*Figure 7: Comparison of Missing Persons Not Found Compared to Total Missing
(Note: Russian number is those never found, US is those not found within a year)*
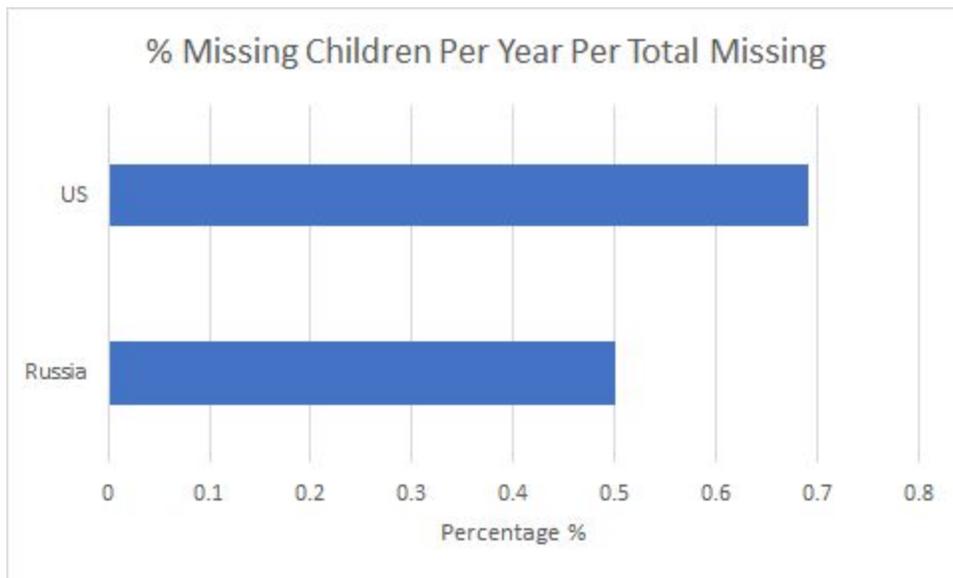
Figure 8: Comparison of Missing Children Compared to Total Missing

For the previous four graphs, data was collected from the previously discussed articles and databases (WALB, 2019), (Geodakyan, 2018), (NCIC, 2018).

From the graphs, the base level conclusion is that the United States has more missing people, children, and those that are not found. If you look at the percentages though in relation to each population, the United States resolves more cases even though it still has more missing people per population and more missing children per total missing. This means that statistically, the United States is more efficient at successfully finding missing persons. The difference in open case completion rates between countries shows that it was important to further look into how the United States handles finding missing people and what systems they have in place to then make a comparative analysis with what Russia has in place and then propose improvements. Some factors that might play into these discrepancies may be variables such as land mass, terrain difficulties, and harsh conditions which are specific to each country. By having both sets of data in our analysis, our team was able to create a better bigger picture as to what discrepancies can be observed between systems and which sections of the search process should be highlighted and examined further.

IV. The Use of Technology in Finding Missing Persons

A. Use of Animals in Search Operations

The technologies associated with finding missing persons are quite varied. From high tech solutions such as machine learning and GPS tracking to neolithic methods, many different techniques have been used. Dogs have a very keen sense of smell, and their innate skill has been used by law enforcement around the world. Cases of hunters going missing have been settled

with the use of dogs with only a scent to follow through the woods. Another example of dogs finding people took place in Haiti in 2010 after their massive 7.0 earthquake. After 17 days trapped, a victim laid their eyes upon the golden retriever who discovered them (Wildesen, 2011). Another case, particularly involving criminal activity took place in Salt Lake City in 1994 when a rottweiler led police 40 miles to a child who was abducted (Wildesen, 2011). Dogs have been and will continue to be a successful method of locating missing persons.

B. GPS & Machine Learning

With recent advancements in GPS and machine learning, humanity is able to adopt technology into various facets of human life to vastly increase accuracy and efficiency. A drawback to GPS tracking, however, is the range at which animal tracking is effective in comparison. If a person must be tracked throughout an entire country or even the world, a pursuer would require a larger range. Individualized patterns of movement can be tracked with a compilation of data from global positioning satellites (GPS) in tandem with machine learning and could be "used to predict typical locations of individuals with dementia and detect movements that do not follow these patterns and may correspond to wandering" (Wojtusiak & Mogharab Nia, 2019). In Wojtusiak and Mogharab Nia's research, machine learning was used to identify where a person would most likely be and if the person was not in that location would calculate where the person may be going based on known movement patterns (Wojtusiak & Mogharab Nia, 2019). The basis of tracking, logging, and predicting a person's future movements seems to be an invasion of privacy, but there are other solutions.

Mentioned in Wojtusiak and Mogharab Nia's research is the use of a company which manufactured tracking devices which are placed in the soles of a person's shoes. The device is

linked to satellites via a cellular signal and is primarily used to track neurologically diseased patients, high-profile individuals, and young adults/teens (GTX Corp., 2020) . The program is a service, and as such is paid through a subscription like a cellular data plan. However, the program provides a noninvasive way to track a person's loved ones if there exists a fear of wandering. Issues with the device are a maximum battery life of two days, and the possibility of the victim being lost without their shoes (GTX Corp., 2020). Our group was primarily interested in streamlining the search process for missing people. By exploring these possibilities of GPS and machine learning, our group better understood the modern implementations of our model and therefore could gear the creation of the model in a way that can be easily understood by computer science specialists. This also included highlighting inefficiencies in systems currently in place that could be replaced by automation, GPS, or other technological advancements.

C. Drones

"A search and rescue drone is an unmanned aircraft used by emergency services...ideal for searching over vast areas for missing persons and crime victims in need of rescue" (AltiGator Unmanned Solutions, 2014). The article shows how an image can be taken from an aerial view with thermal imaging of a body. Without the use of thermal technology, the body may go overlooked and the search would continue on the ground. Additionally, because of their remote operation, drones may be able to fly into dangerous situations to find missing persons such as into a fire or in the vast areas of isolated tundra. The versatility of a drone can also vary depending on the size and load capacity. For example, a smaller drone may not be able to carry a camera capable of picking out a person from an altitude of 1000 feet but it is able to fly below the tree line to search. A large drone, on the other hand, could have a large load capacity and be

able to carry equipment such as a thermal imager, an infrared imager, or even just a camera with a very advanced lens so that it may search the most area in a given time. Our model directly included this technology in the process of finding missing persons in various geographic settings. By researching the various uses of drones, our model was able to more accurately predict what types of drones would be used in specific situations.

D. The Telephone and Internet

Commonly overlooked since its use is so common is the use of the internet and phones. According to an article from History.com, Alexander Graham Bell invented the telephone in the year 1847 (History.com, 2019). Since the 19th century, the telephone has become such an integral piece of human society that we often overlook how important it really is. Likewise, the world wide web was invented in 1990 by Tim Berners-Lee and revolutionized the world although the date has been disputed (Andrews, 2019). Now people could send in tips via telephone or internet to services which look for missing persons such as the National Park Service (NPS). On the NPS's website, one can find out how to submit a tip via phone call or text, email, an online form, or by calling the emergency line 9-1-1 (National Park Service, 2019). One of the most important forms of gathering information on missing persons is the initial call to police or search organizations. This is true in both the United States and in Russia. By looking into the various forms and uses of the telephone and internet, our model was able to better capture the realistic capabilities and logical decisions of everyone involved in the search process.

Methodology

The purpose of our project was to design a missing person search process for our sponsor organization. Our process was provided as a block diagram for the sponsor organization. The process suggested actions and functionality to be supported and carried out by the mobile application, databases, and employees.

We had three primary tasks to achieve this goal. These tasks included researching demographic data and trends in the United States, conducting interviews and researching sources pertaining to effective search practices, and creating a full-length block diagram to visualize the entire search process and have it ready for digitization and application development. While all of these were taking place simultaneously, our team was in communication with the Russian team members who were engaged in the same tasks in Russia. The demographic data was used to create a better understanding of the historical differences between the United States and Russia in terms of missing person search statistics and capabilities. The interviews and online research provided us with real-world data to update and expand our block diagram as it was developed and elaborated. The block diagram provided a visualization of the entire search process and took into account as many search scenarios and procedures as possible.

The Russian team did its own independent research on missing persons in Russia through interviews and online sources. This was used to create individual diagrams for separate sections of the search process that were stand-alone processes. These diagrams followed the possible steps taken to find a missing person from their respective age group and they were independent of each other. These diagrams were used during and at the end of our diagram construction to fill in any gaps in the models. This information visualization was invaluable for our team in the

United States - who used everything collected to make a final product. Each task of this project worked interchangeably to create a full-length and detailed prototype that had both data and research from the United States and Russia for a missing person search model.

I.   Communication with Russian Partners

This project began as a collaborative international effort between two universities to create the best possible model to find a missing person. After being unable to continue our project work in Russia due to the world-wide onset of the COVID-19 virus, remote work and online communication became vital to the success of our project. Through recommendations by our school, professor, and sponsor, it was decided that the Zoom application would be used for online meetings, WhatsApp would be used for faster communication, and Google Drive would be used to share and work on documents collectively. The following sections break down how our team handled the communication with our Russian partners and our sponsor.

First communication with the Russian students was made via Skype in order to exchange information. We received their phone numbers and created a WhatsApp group chat so that quick, organizational information could be spread such as meeting times. The WhatsApp group chat also functioned as an initial method to get to know each other.

Our next step was to integrate the Russian students with the Google Drive folder created at the very beginning of the project. The folder housed all documents from sources, data, charts and everything in between. Once the Russian students were given access, they were able to forward sources and write-ups to the American students for a deeper understanding and for proofreading. Zoom is a video application which was used often to explain documents and

processes in more detail than a text message would allow. Discussion about the flow map, interviews, and report were all done on Zoom.

The composition of this team (half American, half Russian) helped to flesh out intricacies in the issue such as cultural differences which are discussed in the Background section of this report. The Russian students could find information pertaining specifically to Russian processes and this information could then be compared to the American processes found by the American half of the team. This yielded a full picture view of the problem and the solution. Supporting block diagrams drawn up by the Russian students based on their research aided in the completion of the block diagram prototype.

II.   Demographics and Trend Research and Analysis

In our initial conversation with our sponsor, Mr. Pashkevich, we were tasked with doing additional research on the trends in missing person statistics and the reasons behind any noticeable changes in the data. We then researched different sources for missing person statistics in the United States to create detailed explanations for demographic trends dating back to 1990. The following sections break down each step in the process of accomplishing this task.

A. Visualize missing person data in the United States
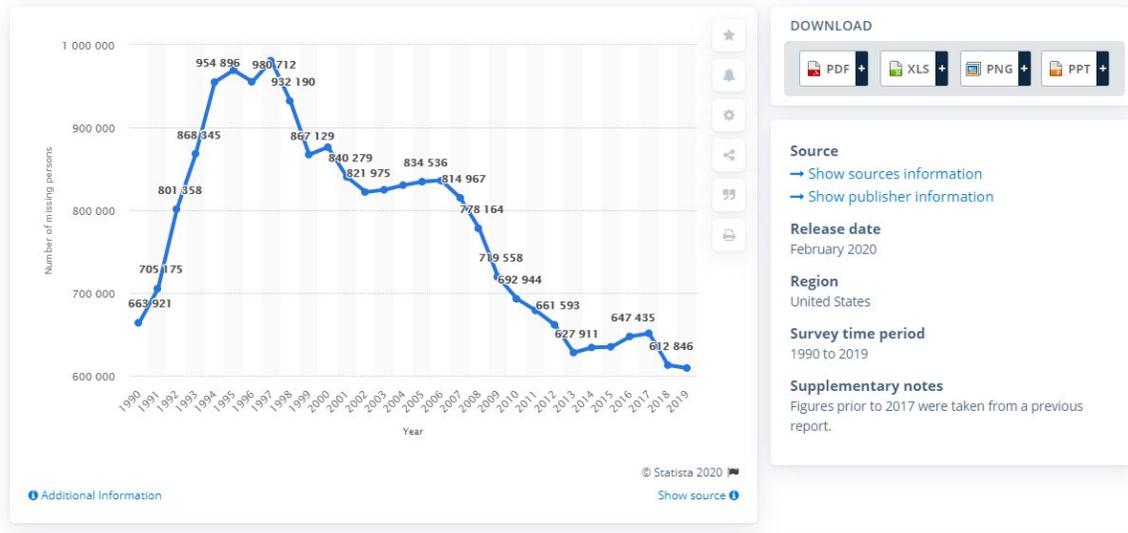

Figure 9. Graph of Missing Person Cases 1990-2019

This graphic was sourced from the National Crime Information Center (NCIC) database. This showed what trends were present in missing person statistics in the United States and allowed our team to look further into the reasons behind certain trends. A similar set of data located in Background section I.A. details the amount of missing person cases in Russia. However, the data may be biased on the account that the data was collected only from Liza Alert which was founded in 2010. It shows an increase in cases reported from zero in 2010 to about 25,000 in 2019 and this could be attributed to the popularity of the organization instead of the frequency of people going missing.

B. Research events and causes for spikes or drops.

By looking into various online sources for certain time periods and years, our team was able to determine the explanations behind the notable trends in the missing person data. The specifics are detailed further in our Background Chapter but research tools such as Google Scholar and other databases were used to gather this information.

C. Collect data into a presentable report explaining critical years that establish trends

After conducting extensive research and overlaying that information with the graphic above, our team was able to create a report on the observed trends in missing person statistics - which can be found in our Background Chapter. This information was then delivered to our sponsor, Mr. Pashkevich. As stated earlier, this information was similarly gathered by our Russian team members in a similar fashion. That data was also delivered to Mr. Pashkevich who then compared the two sets of data and trends. By having the historical data for both the United States and Russia, our entire team was able to understand the scope of the issue of missing people on a global scale and therefore could further understand the model construction process. This allowed the teams to take any country-specific factors into account like government intervention for missing person searches in the United States or the contribution of volunteer organizations to missing person searches in Russia.

III.   Interviews and Data Collection

This task was meant to be the main source of information gathering for the advancement and expansion of the block diagram prototype. The goal with these interviews was to get a variety of information from areas with varying geographies in order to get as much of a conclusive search process for any situation. Before the end of our preparatory term, our team conducted an in-person interview with a member of the Worcester Polytechnic Institute police force, Sergeant Carpenter. The original plan was to conduct similar in-person interviews in Russia but that became impossible. Therefore, we transitioned to attempting to conduct interviews through online video and phone calls. Due to the unprecedented nature of the situation affecting everyone around the world with the COVID-19 pandemic, it became close to impossible to contact emergency services like police stations and hospitals for our team and for the Russian team members. This resulted in yet another shift in data collection strategy. Both teams ended up collecting as much information as they could from online sources such as police reports and recorded search procedures. This proved to be the most accurate and accessible means to both of our groups. While interviews would have been ideal for getting real-world data in terms of identifying search procedures, online sources were our team's next best source of information. Both this newly acquired data and any data from previous interviews was used to dictate the steps in the block diagram as well as any estimates for times between steps.

Below were the steps taken to collect real-world data on search processes for missing people:

      A. Contact various individuals and organizations to develop a better understanding of search processes and procedures.

(Interview questions can be found in Appendix A)

- Police Stations
    a) Sergeant Carpenter - Worcester Polytechnic Institute Police
    b) Worcester, MA - Police Investigation Unit
    c) Webster, MA - Detective Bureau
    d) Pittsfield, MA - Detective Bureau
- AMBER Alert
    a) amberalert@usdoj.gov - general contact email
    b) Massachusetts AMBER Alert contact
- Volunteer Search Groups
    a) Heather Belusky - North American Missing Persons Network
    b) Missing Person Advocacy Network
    c) Patrick Sargent - This Week In Worcester, Missing Person Articles
- Private Investigators
    a) Linda Higgins - Contact from Professor Nikitina
    b) Michael Clements - Mr. and Mrs. Detective Agency

The above individuals and organizations were contacted in our preliminary outreach efforts. The data our group actually used in the block diagrams came from the Sergeant Carpenter interview. The Russian team conducted several similar interviews with local police.

B. From online research, obtain as much accurate and applicable data to

inform the block diagram on logical steps taken between search

procedures

Our team took information mainly from online public transcripts and public police

records. The main organization we researched in the United States was AMBER alert due to their

abundance of public information. From the Russian students, we were able to get more valuable

information from the Management of the Ministry of Internal Affairs of Russia in the Kamchatsk

Region as well as the Main Directorate of the Ministry of Emergencies of Russia for the Moscow

Region. These sources were who we conducted research into in order to develop an

understanding on the written procedures and protocols involved in a search for a missing person.

The Russian team simultaneously looked into sources such as public records from LIZA Alert

and public police records. Both the interviews and online research were done to get as much

accurate data on what happens in a real search for a missing person. By looking at multiple

sources, organizations, and perspectives from both the United States and Russia, we were able to

develop an in-depth block diagram prototype modeling the search process.

C. Russian Data Collection

The statistics gathering process in Russia was hindered by the fact that the official

information was not in public domain, and figures from different Internet sources varied

significantly. The requests were filed to the Federal State Statistic Service and the official police

analytical center. The latter provided the number of reports of missing persons filed to the police

throughout the period of 2017 to 2019. The earlier data could not be provided as the police

collects and saves data reports for a period of last 3 years. Liza Alert (the largest volunteer search organization in Russia) was also contacted via their official VKontakte group and provided their own statistics for the period of 2010-2019.

The whole process of obtaining and analyzing data was difficult due to the closed nature of information sources. There were also two attempts to connect with Liza Alert service. Only one was successful and provided our team with the necessary information on the basis of which the schedule was drawn up.

Russian police officers were reluctant to conduct interviews with the Russian research team due to the quarantine regime in the country. Another reason for such behavior could have been connected with the fact that some particular procedures and peculiarities of search are considered a state secret that could not be publicly revealed. In order to fill in the lack of information, the team analyzed the legal acts describing search procedures in accordance to which the official bodies are to act. In addition, Liza Alert provided their info brochure where their stages of search are explained.

To sum up, similar to the WPI team, the Russian team studied the official websites of the Ministry of Emergency Situations, the Ministry of Internal Affairs, the special forum of Liza Alert and provided analysis and translation of key information to inform the subsequent development of block diagrams.

IV.   Block Diagram Prototype

A. Planning and Process Development

Our final deliverable to Mr. Pashkevich, the sponsor of Project Phantom, was a block

diagram prototype detailing a search process to be performed by the organization. For ease of

implementation, our diagram had to be justifiable, implementable and comprehensive. We then

asked, how can we defend each choice? How can we be certain our product is useful and covers

what is necessary to the organization? To justify our process, we created a document called

"search process diagram explanations" which linked the various resources used to develop the

block diagram. On our map, we cited the reasoning for specific steps with an identifier, for

example [4.a], to state that the fourth organization on the list under document "a" has

information that justifies the step. We did this because the complexity of the diagram made it

difficult to track the wide array of sources steps were derived from, and observers can easily see

justifications for them. In the example below, it is evident how the logic behind each step was

clearly defined.
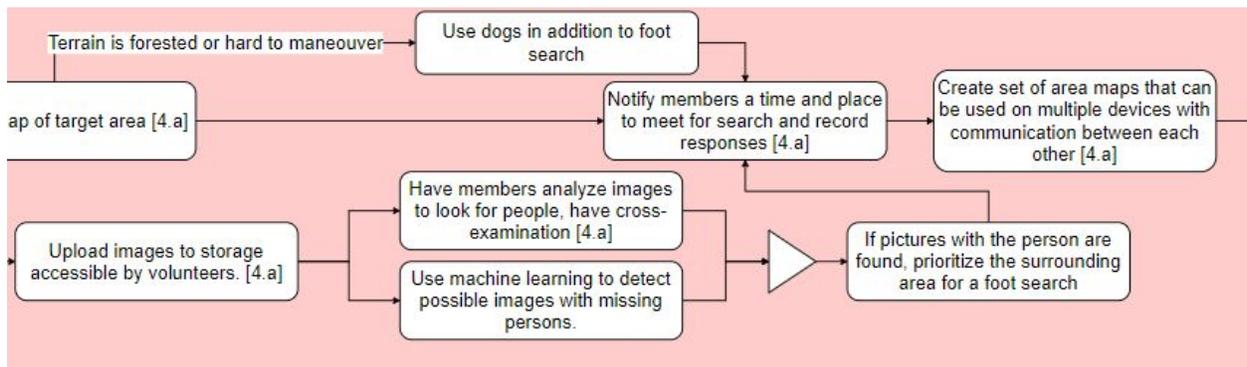
Figure 10: Example Cut-Out From Action Section in Block Diagram

For our block diagram, we drew primarily from two types of sources; publications by nonprofit organizations and police procedures learned from interviews and research. We drew greatly from the nonprofit Russian Liza Alert service because of their effectiveness in Russia, informative publications, and streamlined procedures. We extracted search process steps from our research into our sources in the United States and added them to our process. There were some organizational limitations that changed the specifics of these steps, since Project Phantom is neither a government-affiliated nor a non-profit. While taking into account best international practices with sensitivity to the Russian context, our group used the United States (rather than Russian) police procedures to determine other steps in the search process. This was mainly due to limited available information because of issues with interviews and data collection mentioned earlier. By not having the entire perspective of the police from both the United States and Russia, our model could be missing out on specific factors not covered by publicly accessible information from one or both countries. Our joint Russian team worked on seperate block diagrams drawn mainly from Russian processes so that we could contrast them and incorporate the superior aspects of each. We chose this comparative method to identify the reasons why more missing persons cases are resolved per capita in the United States than Russia.

B. Block Diagram - Visual/Structural Design

Since we intended to make our block diagram cover a wide range of circumstances under which people go missing, there was a danger that growing complexity could make our map less coherent. We had to balance readability with thoroughness. We also decided to use a block diagram structural design that dictated how we produced steps from our aggregated data. By

having clear steps between every part of the process, the visualization was both clear and thorough while it also applied the gathered data from our research.

Our map followed a four-stage structure that was run through in a series of iterations. Before entering the process, it is first determined whether the case should be accepted - if it is legitimate and the circumstances call for investigation, the case is accepted and enters the first iteration of the process. The first stage is information gathering, preliminary information is gathered from known contacts and additional information is gained from what steps have been taken and their results. The second stage is profiling - identifying the likely type of missing person case. Based on this information, what is most likely to have happened with this missing person? This profile is then used to generate a basic recommendation, such as searching an area or contacting hospitals. The recommendation is based on time expenditure as well as likelihood of success. The final stage of implementation is the specifics regarding a recommendation - how exactly to carry it out and how to issue instructions to an organization's workers. This design is visualized below. We chose this design because a stage process adds clarity by having an overarching structure for the diagram. Each section of this diagram was broken down into further depth which can be seen in Appendix B.
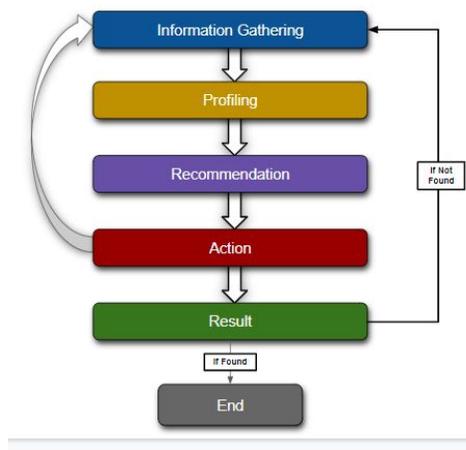
Figure 11: Original Overview Flow Map of Block Diagram

For the development of our block diagram we chose to use the design application "diagrams.net" because our members were most familiar with it and it permitted simultaneous work. We converted the conceptual outline of the block diagram into a structured diagram where we drew from resources previously mentioned to create steps for the search process. Below is our completed prototype block diagram. It used the four-stage process described above. For readability, we added stages as backdrops for the individual steps that were most closely related to them. A more detailed view of each section can be found in Appendix C.
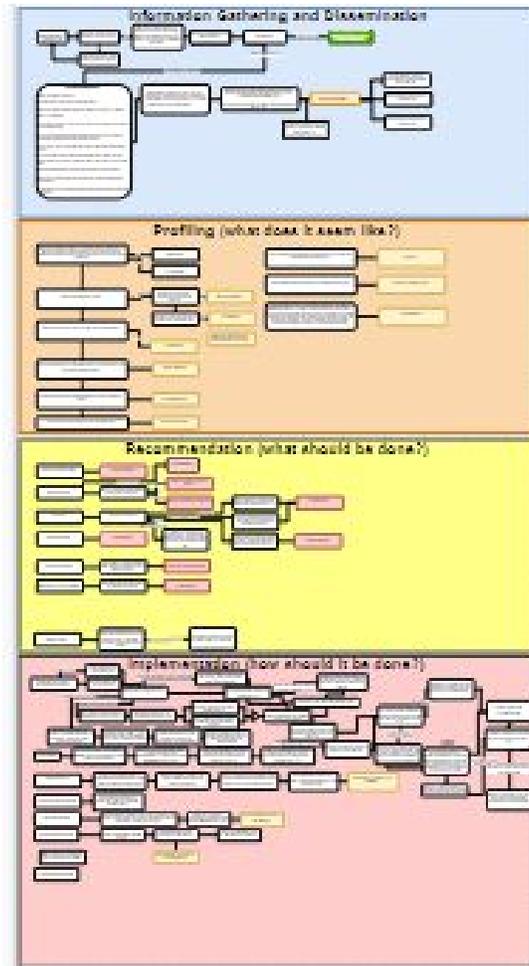
Figure 12: Full-Length View of Prototype Block Diagram

When adding steps, it was first considered what stage the missing person is a part of, then they are incorporated as fits with the existing model. There were some limitations in this due to the fact that some steps overlapped and may not follow from one stage to the one directly after it. This adds complexity that reduces readability but ensures a full-length cycle for each case.

The construction of this block diagram was a highly iterative process that required following through each path to make sure every section was logical and thorough. Whenever our team was unable to complete a path, we looked to the diagrams and research from the Russian team. Along with this filling in, our team also compared each section from the Russian team to

the respective path within our full-length diagram to fill in any gaps or inconsistencies. With our current collected information and research from both the Russian and United States team members, this was the most thorough and comprehensive diagram that we could make. Each path can be followed from start to finish with either a result found or a connection to another logical path, following through the entire search process. This prototype is ready for the Russian application development team and should be able to provide them with a developer-ready framework for further advancing their web application. With insight from both our sponsor, professor, and fellow team members in both the United States and Russia, this prototype pulled resources from a wide variety of sources and perspectives giving it extensive usability. Someone with a missing person to report could follow the paths given with an expansive set of options that could be applicable for their situation so this prototype is highly personable. The downside of this is that with so much detail and so many paths, it may be difficult for an end user to exactly follow where to go next in their processing. Since this diagram addressed the process for all facets of a missing person search organization and categories of subjects, some of it may not be pertinent to the application developers. The developers will have to determine what steps can and should be implemented into an application.

The following supporting block diagrams below were constructed by the Russian team members. By taking a look at individual categories of missing people, they were able to create a more narrative visualization following a person based on age group. The majority of their information was sourced from public Russian police records and other online sources. The detail and logic within these block diagrams were critical in our team's construction of the final prototype block diagram.
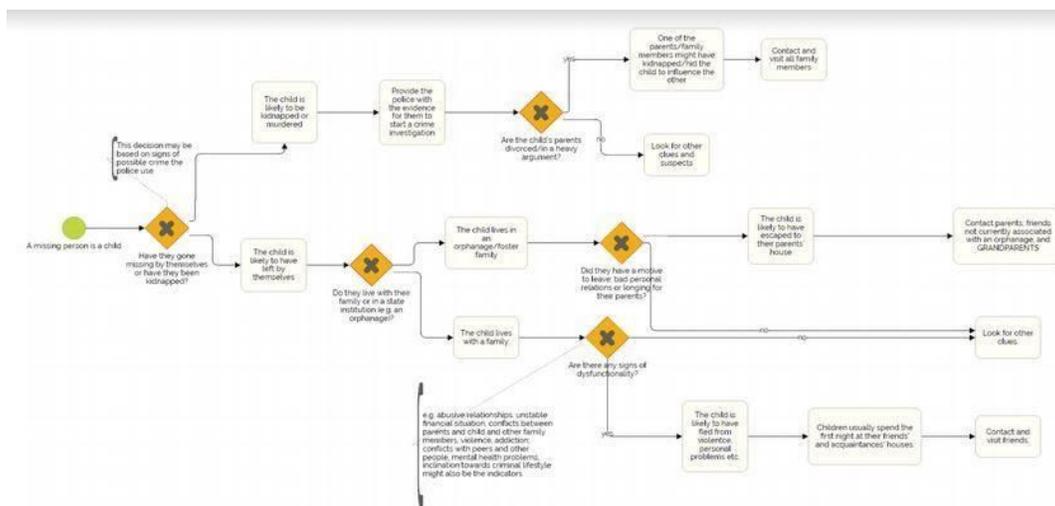
*Figure 13: Supporting Block Diagram of How to Find Missing Children*
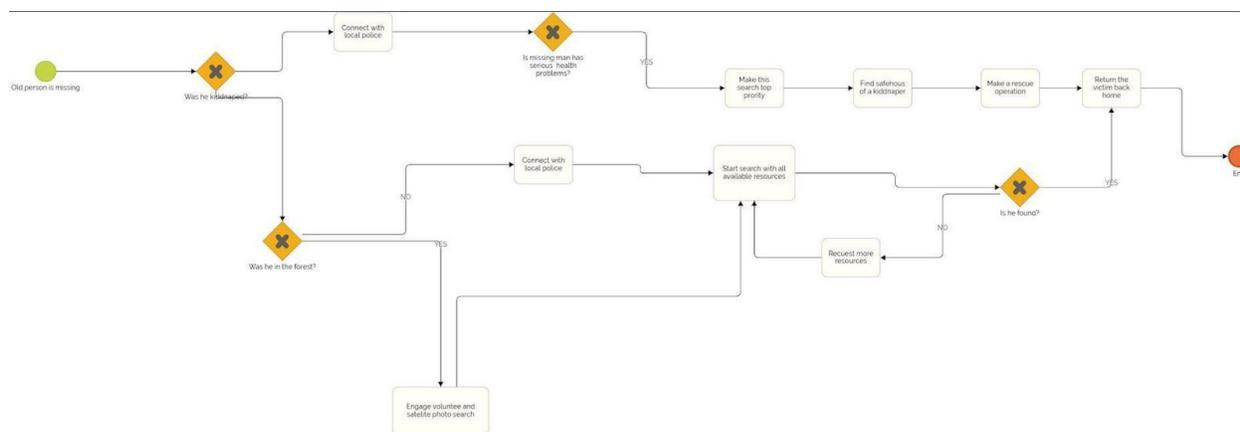
*Figure 14: Supporting Block Diagram of How To Find Missing Elderly*
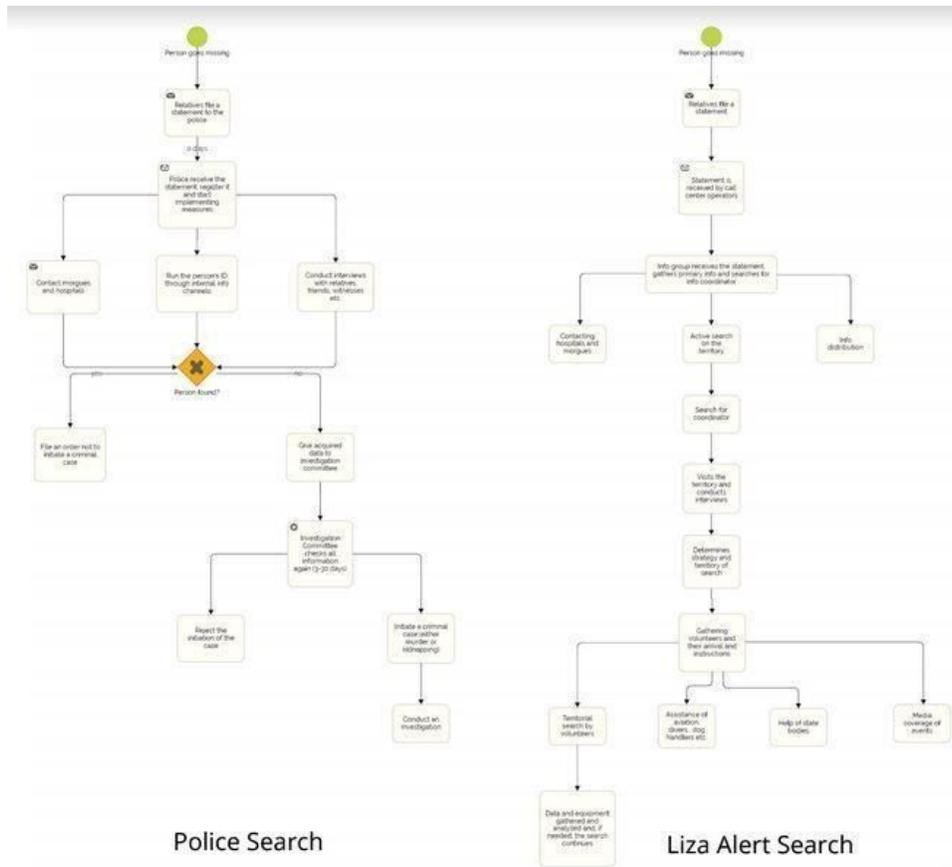
Figure 15: Supporting Block Diagrams Comparing Search Processes of Police and Liza Alert

Findings

By analyzing the results gathered from the interview conducted with the WPI police chief as well as collaboration with our Russian partners, our team was able to construct a thorough prototype block diagram that will provide our sponsor with accurate information to locate missing persons in Russia. The information gathered from the interview with the WPI police chief was valuable in guiding our efforts on the creation of the block diagram. The police chief provided us with a rough procedure that his task force follows in order to gather useful information to find the missing person. Different cases can be prioritized based on how long it has been since the person was last seen as well as the profile of the missing person. For example, a missing person who has poor mental health or would be considered suicidal would receive a higher priority.

The Russian students from the Financial University were also an extremely valuable resource for gathering information from Russian organizations such as LIZA alert. Due to the nature of accessible information in Russia, it was difficult for our team to gather data about LIZA Alert here in the United States. The Russian students provided us with information relating to the amount of cases handled by LIZA alert on an annual basis, as well as a breakdown of how each case was categorized. Based on the information collected in the interview with the WPI police and the information that the Russian students collected from LIZA Alert, block diagrams were created for each respective country. These block diagrams highlighted the search process that would be undertaken by law enforcement agencies and volunteer organizations to locate a missing person. These steps included information gathering, profiling, recommendations and implementation. Gathering information pertaining to the missing person is essential, as it can be

imported into a database to establish a file of the missing person. A profile can then be created to

allow law enforcement professionals to develop an effective strategy for locating the missing

person. Key categories by which profiles diverge the greatest were age based. Child (age 0-10),

adolescent (age 11-20), adult (age 21-60) and elderly (age 60+) each had their own peculiarities

which would help to identify why they went missing and how best to find them. Based on the

key details of the missing person's case, different types of technology or strategies can be

recommended and used to locate the missing person. Those recommendations can then be

implemented into a form of action that allows for search parties to most effectively and

efficiently locate the missing person.

Conclusions and Recommendations

In summary, data gathered from the interview conducted with the WPI police, along with the collaborative efforts from the Russian team, helped to provide our team with a thorough understanding of the process of creating block diagrams that outlined potential paths a search organization could take to locate a missing person.

Limitations:

Due to the nature of the COVID-19 pandemic which prevented our team from going to Russia to carry out field work for the project, most of the data gathering was performed online remotely. Communication with team members, the project sponsor and Russian partners was carried out via Zoom rather than in person due to the COVID-19 pandemic as well. Since most of the communication was carried out remotely via Zoom, meetings were less frequent and had to be balanced around everyone's schedules. Time zones were also a major factor that impacted communication since Moscow is seven hours ahead of the east coast of the United States and therefore ten hours ahead of the west coast of the United States. Another one of the major limitations that our project team encountered was the lack of desired data in the form of interviews. Our hope was to conduct additional interviews in Russia, alongside our Russian partners. However, due to the nature of the pandemic, many of the places that we contacted were unresponsive when asked to be interviewed. Many of our Russian partners who collaborated with us for the project also encountered a similar dilemma, where they also struggled to schedule interviews. Due to the COVID-19 pandemic, some of the Russian students were unable to

continue participating in the project. Out of the eight original members of the Russian team, only five continued their participation with the project. This limited what we could do in terms of contacting various Russian agencies to collect important data relating to missing persons as well as scheduling interviews.

Recommendations:

Due to the nature of the COVID-19 pandemic, there is a lot of room for additional research that could be conducted in the future. This research could be in the form of additional interviews with law enforcement agencies or other search organizations, to help guide and pinpoint our team's understanding when creating the block diagram. Additional pathways could be created in both the Russian and United States block diagrams as new information could be gathered from the additional interviews. Our team found that the recommendation and implementation sections of the block diagram were the most difficult to complete due to the complexity and specificity of the different paths in the block diagram. Therefore, additional pathways in both sections could be added in future updates to the block diagram as different questions are pondered and new procedures are inquired about through additional research. Since the block diagrams will serve as the framework for a future application created by the sponsor and his team, future recommendations and specific improvements can be gathered from the app development team as well. The app development team would be responsible for transferring all of the information located from both the Russian and United States block diagrams into a user friendly app that search parties could use to locate a missing person.

All in all, optimizing the search process in which missing persons in Russia tackles a significant issue that deeply affects the Rusian society. As mentioned earlier, Russia is largely inefficient when locating missing persons when compared to the United States. As such, our team constructed a block diagram, which can serve as a map that various Russian law enforcement agencies and volunteer organizations can use to more efficiently locate missing persons. The block diagram itself would serve as a set of pathways that can be followed by these Russian organizations, and the diagram is broad enough to cover many different missing person profiles. While the block diagram that our group created mostly took into account Russian cultural differences, future research could be conducted to allow for the block diagram to be broadened and used for other countries with different cultures. Hopefully, the increased efficiency from the block diagram would allow for more missing persons to be located so that they can return to their normal lives. Overall, this project experience was very enlightening, since it allowed for our project team to collaborate with students of a different culture, and work towards a unique and fascinating goal in a cross-cultural setting.

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AltiGator Unmanned Solutions. (2014). Drones for search & rescue missions. Retrieved from

https://altigator.com/drones-for-search-rescue-missions/

A search and rescue drone is an unmanned aircraft used by emergency services, such as police

officers, firefighters or volunteer rescue teams, ideal for searching over vast areas for missing

persons.

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Andrews, E. (2019). Who invented the internet? Retrieved from

https://www.history.com/news/who-invented-the-internet

As you might expect for a technology so expansive and ever-changing, it is impossible to

credit the invention of the internet to a single person.

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anxiety, sleeping disorders and self-evaluated quality of life in Russia . Soc Psychiat Epidemiol

40, 511–518. https://doi-org.ezpxy-web-p-u01.wpi.edu/10.1007/s00127-005-0918-x

Chepovskaya, A. (2019). Nearly 600 mushroom pickers disappeared in the forests in a week, far

from all lost volunteers manage to save

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and killing children in families and why the guilty are often simply released.

https://novayagazeta.ru/articles/2019/09/23/82057-ya-tebya-i-ubyu

Emelianenko, V. (2019). Fear of mushroom summer.

https://rg.ru/2019/05/23/pochemu-v-rossii-propadaiut-do-300-chelovek-v-den.html

Evgeny Voropay. (2012). Liza alert - search for missing children. Retrieved from

https://te-st.ru/entries/liza-alert/

Liza Alert is a crowdsourcing project to find missing children. Liza Alert is a community of

people who managed to collect and bring offline active Internet users offline. Squad Liza Alert

not only joins the search for children, but also initiates them, acts as a leader and coordinator.

Fancher, J. P., & Hampl, P. (2018). In David T. J., Lewis J. M.(Eds.), *Chapter 6 - missing and

unidentified persons* Academic Press.

doi:https://doi.org/10.1016/B978-0-12-805198-6.00006-2

The problem of missing persons and unidentified human remains in the United States and

around the world has existed for a very long time. It is essentially the largest ongoing mass

fatality disaster. Although significant progress has been made in recent years in some

geographic regions, missing and unidentified persons are a persistent global problem. The

phenomenon of missing and unidentified persons places a major strain on law enforcement

resources, and it is complex and not well understood. This chapter will discuss the forensic

odontology principles and practice in identifying missing and unidentified persons. "

GTX Corp. (2020, February). GPS SmartSole®. Retrieved from

https://gpssmartsole.com/gpssmartsole/

GPS SmartSole® is a smartphone hidden and sealed within a water-resistant, trimmable shoe

insert. It uses GPS and 2G cellular technology, is charged about every day, and requires

service plan – all just like a smartphone. Test to ensure 2G cellular coverage in your area, then

the SmartSole will automatically update its location. THE KEY ADVANTAGE: GPS

SmartSole® is discreet and your loved one won't forget to bring it with them! Track your

loved one for a fraction of the cost of a "lock down" memory care facility. Safety and

independence made affordable – now that is peace of mind!

History.com. (2019). Alexander graham bell. Retrieved from

https://www.history.com/topics/inventions/alexander-graham-bell

Hung, E. K., & Townes, D. A. (2007). *Search and rescue in yosemite national park: A 10-year*

review doi:https://doi.org/10.1580/06-WEME-OR-022R1.1

Objective To describe the general characteristics and epidemiology of search and rescue (SAR)

in Yosemite National Park (YNP) and identify possible areas for intervention directed at

reduction in use of these services. Methods Yosemite Search and Rescue (YOSAR) personnel

record every search and rescue mission on a Search and Rescue Incident Report. The

information contained in these reports was used to perform a retrospective review of all SAR

missions within YNP during the 10-year study period between January 1990 and December

1999. Results YOSAR performed 1912 SAR missions, assisting 2327 individuals and

recording 2077 injuries and illnesses. Popular trails in and around Yosemite Valley collectively

accounted for 25% of all individuals needing SAR services. Lower extremity injuries and

dehydration/hypovolemia/hunger were commonly identified reasons to need SAR services.

The duration of SAR missions averaged 5hours, used 12 SAR personnel, and cost $4400.

Helicopter was the primary mode of transport in 28% of SAR incidents. There were 112

fatalities, yielding a SAR case fatality rate of 4.8%. The majority of fatalities occurred while

hiking/snowshoeing, with falling the most common mechanism of lethal injury. Conclusions

Day-hikers in and around Yosemite Valley use a large portion of SAR services, with lower extremity injuries and dehydration/hypovolemia/hunger the most common reasons. It seems reasonable to direct future intervention to prevention of these commonly identified problems in this particular population of Park visitors. "

Global missing children research initiative. (2016). Retrieved from

https://www.icmec.org/wp-content/uploads/2017/05/Russia-August-2016.pdf

Liza alert statistics. (2019). Retrieved from

https://lizaalert.org/forum/viewtopic.php?f=102&t=30844

Missing person law and legal definition. (n.d.). Retrieved from

https://definitions.uslegal.com/m/missing-person/

The source above describes the legal definition on what defines a missing person in the United States, as well as how various law enforcement agencies classify missing persons.

Muravyeva, M. (2016). Abduction of women in early modern russia; modernizing the empire. *Russian History, 43*(3-4), 338-372. doi:10.2307/26549590

The abduction of women is closely connected with traditional or primitive societies. Anthropologists tie it with alternative marriage arrangements, characteristic of those systems where marriages are arranged by parents; historians tend to view the abduction of women as part of early history of developed nations, mostly the Middle Ages. In Russia, recent historiographical discussion of abductions always starts with descriptions of customary practices in Siberia to highlight the steppe and frontier experiences in the framework of colonization and underline 'savage' or 'backwardness' of Siberian populations. However, scholars almost never talk about the abduction of women within the European part. In this

article, female abductions are analyzed within the framework of citizenship and modernization of the Russian Empire in the seventeenth and eighteenth centuries. It focuses on the notion of consent and how it contributed to the founding of a new social unit, that is the family, in which women and men acquired their rights and duties in relation to outside society and wider polity. The lack of consent jeopardized the legitimacy of such a union and compromised the citizenship status of its members. On its way to build the country as a modern empire, Russian authorities localized the abduction of women as a 'customary' practice of 'backwards' people to preserve the modern European core of the Empire.

NamUs. (n.d.). About NamUs. Retrieved from https://www.namus.gov/

Information about how the United States implemented a missing persons database, and for what reasons. Brief history of the organization and motivations.

National Park Service. (2019). Cold cases - investigative services (U.S. national park service). Retrieved from https://www.nps.gov/orgs/1563/cold-cases.htm

A list of missing persons from American state parks. The list includes the person's name, where they went missing, when they went missing, a description of the person and any relevant information about the case. The oldest case dates back to 1969 and the most recent dates to 2017.

NCIC. (2018). 2018 NCIC Missing Person and Unidentified Person Statistics. Retrieved from https://www.fbi.gov/file-repository/2018-ncic-missing-person-and-unidentified-person-s tatistics.pdf/view

Stevenson. (2013). Geographies of Missing People: Processes, Experiences, Responses. Retrieved from https://explore.openaire.eu/search/publication?articleId=core_ac

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The World Bank. (2019). Population, total - russian federation | data. Retrieved from

  https://data.worldbank.org/indicator/SP.POP.TOTL?locations=RU

Wikipedia. (2019). *Silver alert* Retrieved from

  https://en.wikipedia.org/w/index.php?title=Silver_Alert&oldid=930353498

A Silver Alert is a public notification system in the United States to broadcast information

about missing persons – especially senior citizens with Alzheimer's disease, dementia, or other

mental disabilities – in order to aid in locating them.

Silver Alerts use a wide array of media outlets – such as commercial radio stations, television

stations, and cable television – to broadcast information about missing persons. In some states

(specifically Arizona, Florida, New Jersey, California, Maryland, Texas, and Wisconsin),

Silver Alerts also use variable-message signs on roadways to alert motorists to be on the

lookout for missing seniors. In cases in which a missing person is believed to be missing on

foot, Silver Alerts have used Reverse 911 or other emergency notification systems to notify

nearby residents of the neighborhood surrounding the missing person's last known location.

Silver alerts can also be used for children who are missing without being in danger or

abducted.

Supporters of Silver Alert point to the U.S.A's growing elderly population as a reason to

support new programs to locate missing seniors. Approximately six in ten dementia victims

will wander off at least once. If not found within 24 hours, up to half of

wandering seniors with dementia suffer serious injury or death.

Wildesen, A. (2011). How does A dog track A missing person? Retrieved from

https://thecaninetrainingcenter.com/how-does-a-dog-track-a-missing-person/

Wojtusiak, J., & Mogharab Nia, R. (2019). Location prediction using GPS trackers: Can machine

learning help locate the missing people with dementia? *Internet of Things,* , 100035.

doi:10.1016/j.iot.2019.01.002

Significant number of people with dementia are at risk of wandering and getting lost. These

individuals may get hurt, cause distress to families and caregivers, and require costly search

parties. This study explores the possibility of using machine learning methods applied to data

from GPS trackers to create individualized models that describe patterns of movement. These

patterns can be used to predict typical locations of individuals with dementia, and to detect

movements that do not follow these patterns and may correspond to wandering. Data from a

sample of 337 GPS trackers were used. After preprocessing, the data is used for iterative

clustering, followed by classification learning. The number of clusters ranged between one

(devices that always stayed "home") and nine for devices with maximum mobility. The

average number of clusters was 2.62. Models for predicting location achieved varying

accuracy, depending on the regularity of the wearer's schedule. The achieved average Area

under ROC (AUC) is 0.778, with accuracy 0.631, precision 0.662, and recall 0.604. Unusual

locations that potentially correspond to wandering incidents were identified by applying a

secondary classification learning after filtering out data corresponding to normal movement.

Yarila, Y. (2019). Statistics of the Liza Alert squad for August 2019.

https://www.yaplakal.com/forum3/topic2004582.html

Appendices

Appendix A: Interview Questions for Police Stations

Consent Script:

We are an IQP team from WPI working to optimize an application to find missing persons in Russia. We are Adam Sochacki and Ty Bugdin. We would like to interview you to collect information to build the app. The interview will take about one hour. We may put your title in our report, but we will not use your name. We may quote you directly. The information we will be gathering will be kept confidential so far as permitted by law. This interview is completely voluntary, and you need not answer all of the questions. If you feel you have further questions you may reach out to us at projectphantomd20@wpi.edu.

Questions:

1. What is your rank and what division are you a part of?

2. How long have you been a police officer?

3. What training would someone need to be a part of the search process?

4. What is your specific procedure for finding a missing person?

5. What happens after you receive a call/tip about a missing person?

6. How might this procedure be different if your station was located in a rural area/mountainous area/other?

7. How do you prioritize missing person cases?

8. How do you determine where to start looking for a missing person?

9. What tools would you use to look for a missing person? Such as drones, dogs, or satellites.

10. How do you identify a case as such:

    a. Runaway

    b. Kidnapping

    c. Neurological Disease

    d. Presumed Dead

11. How do you handle communication with different search parties?

12. What are your personal suggestions to improve the search process?

13. Could you recommend any other police stations we should interview in order to get a wider sample of information?

Appendix B: Initial Block Diagram Proposal
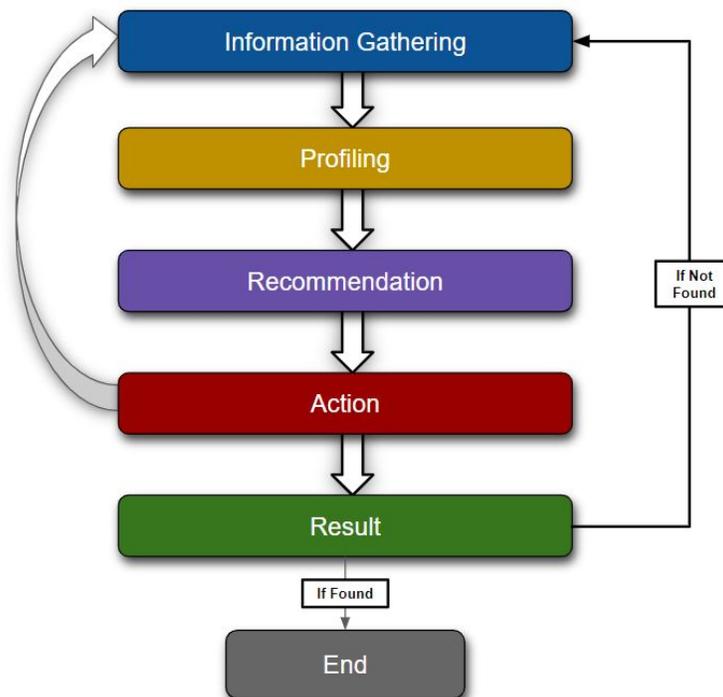
Figure 16: Overview of Each Category Within Search Cycle
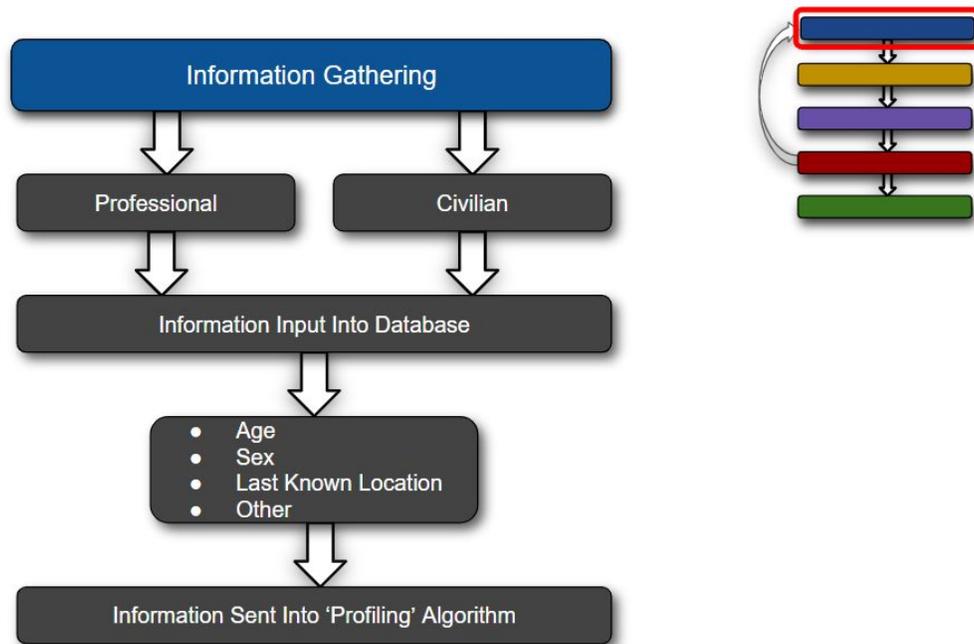
Figure 17: Information Gathering Breakdown
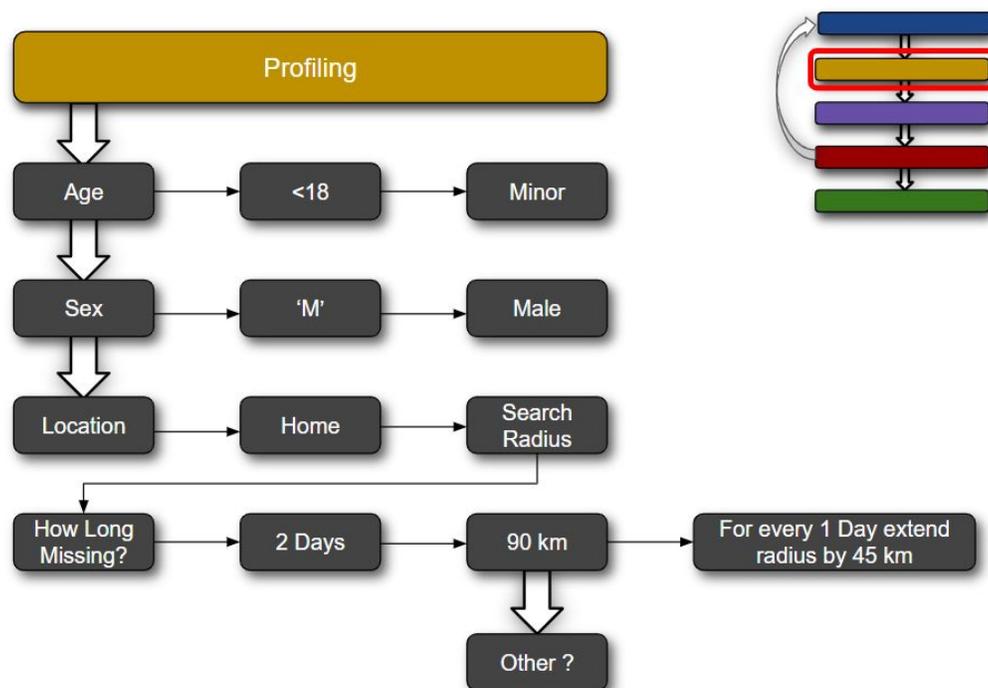
Figure 18: Profiling Breakdown
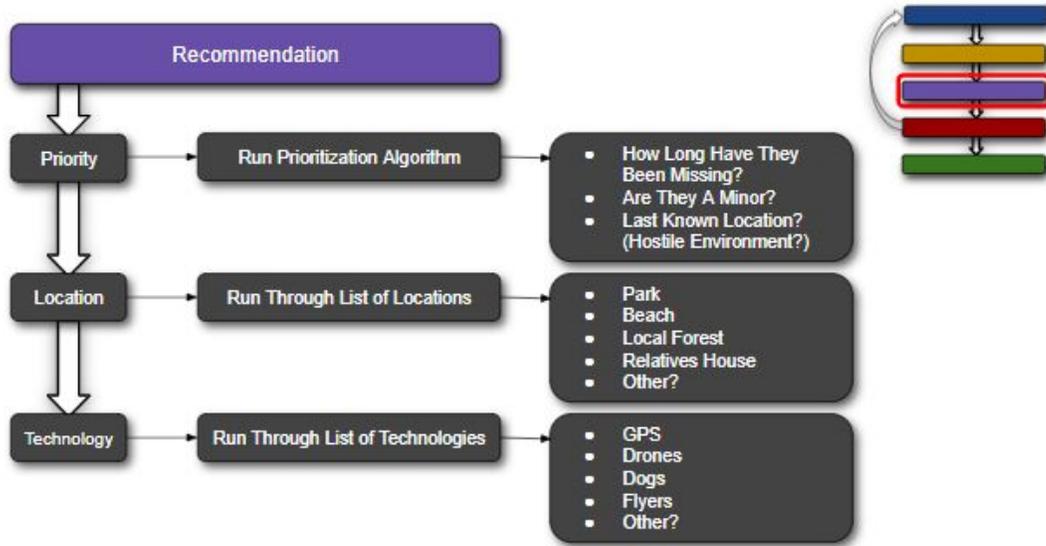
Figure 19: Recommendation Breakdown
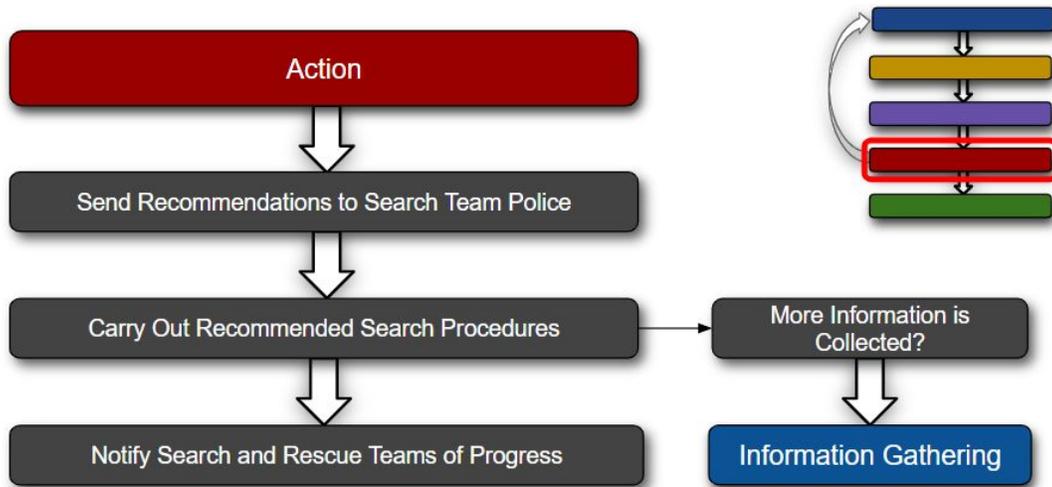
Figure 20: Action Breakdown
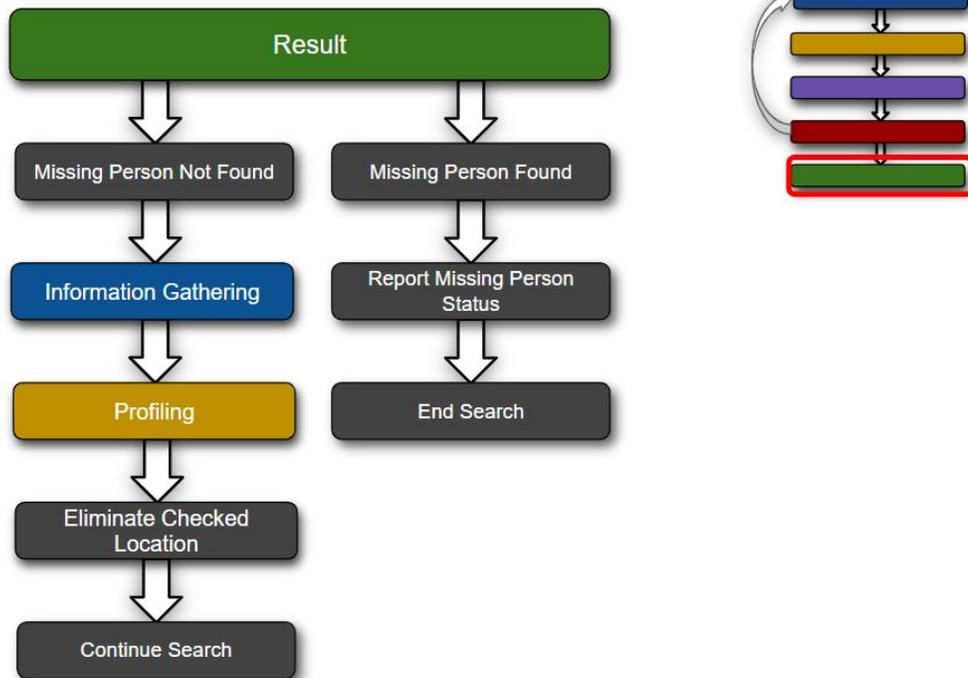
Figure 21: Result Breakdown

Appendix C: Final Prototype Block Diagram
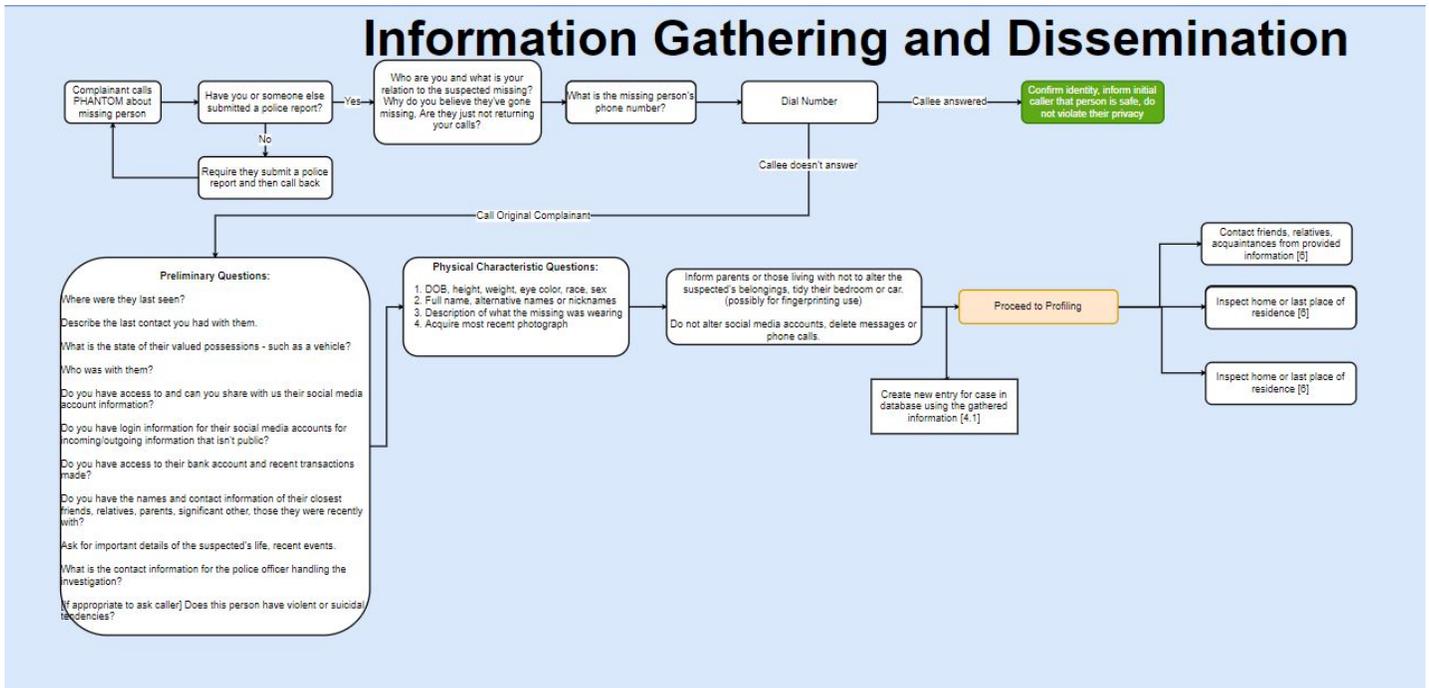
*Figure 22: Information Gathering and Dissemination Section*
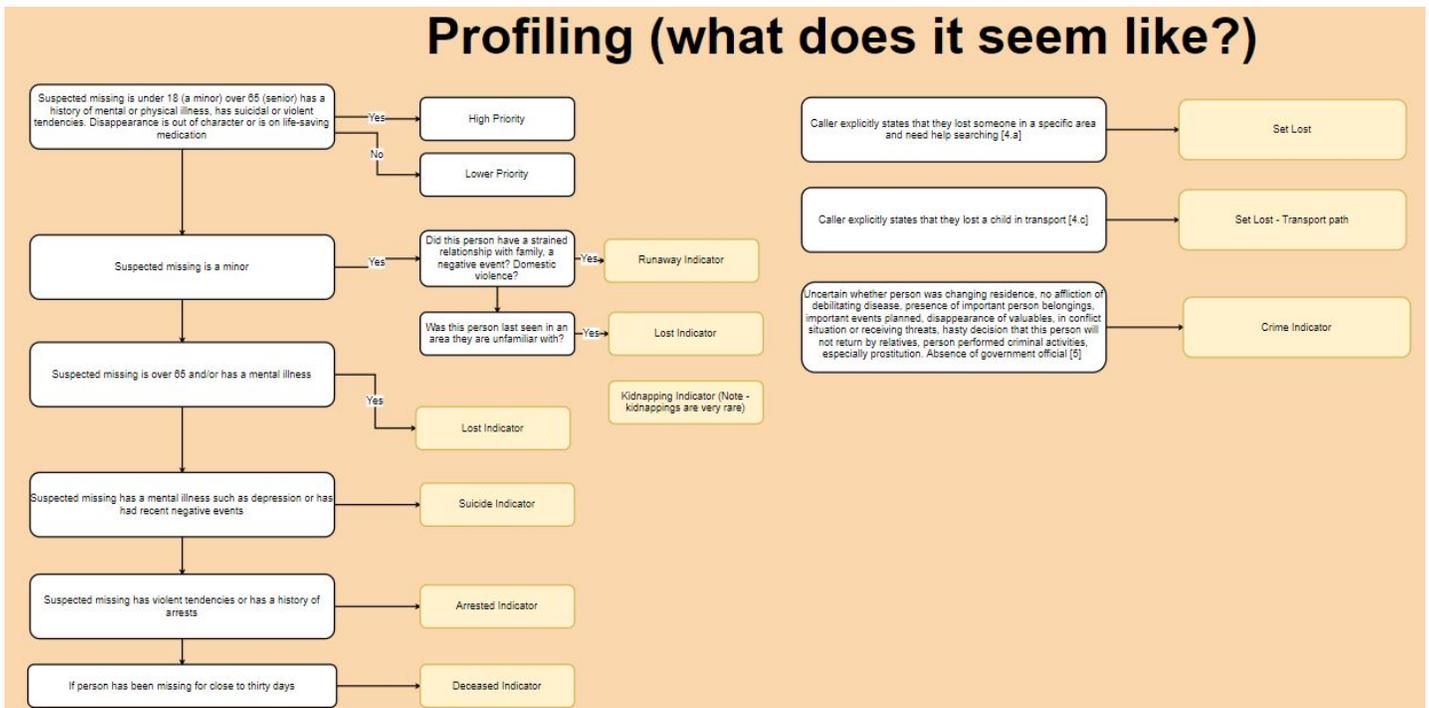
*Figure 23: Profiling Section*
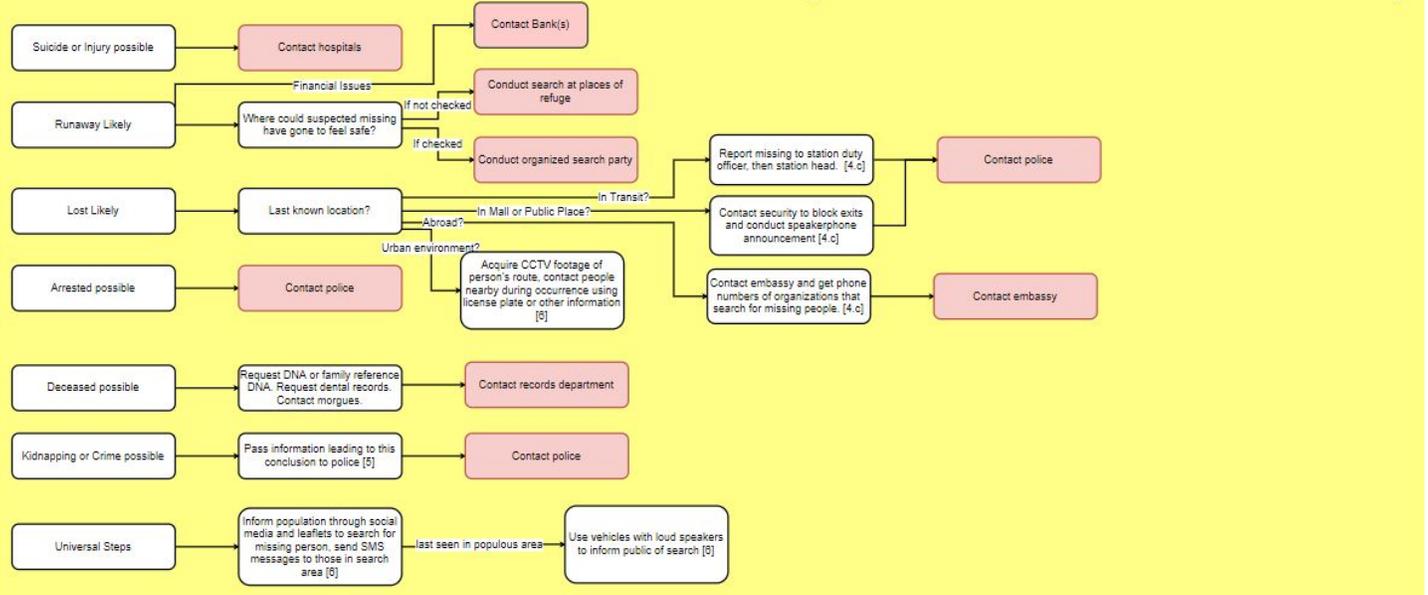
Figure 24: Recommendation Section
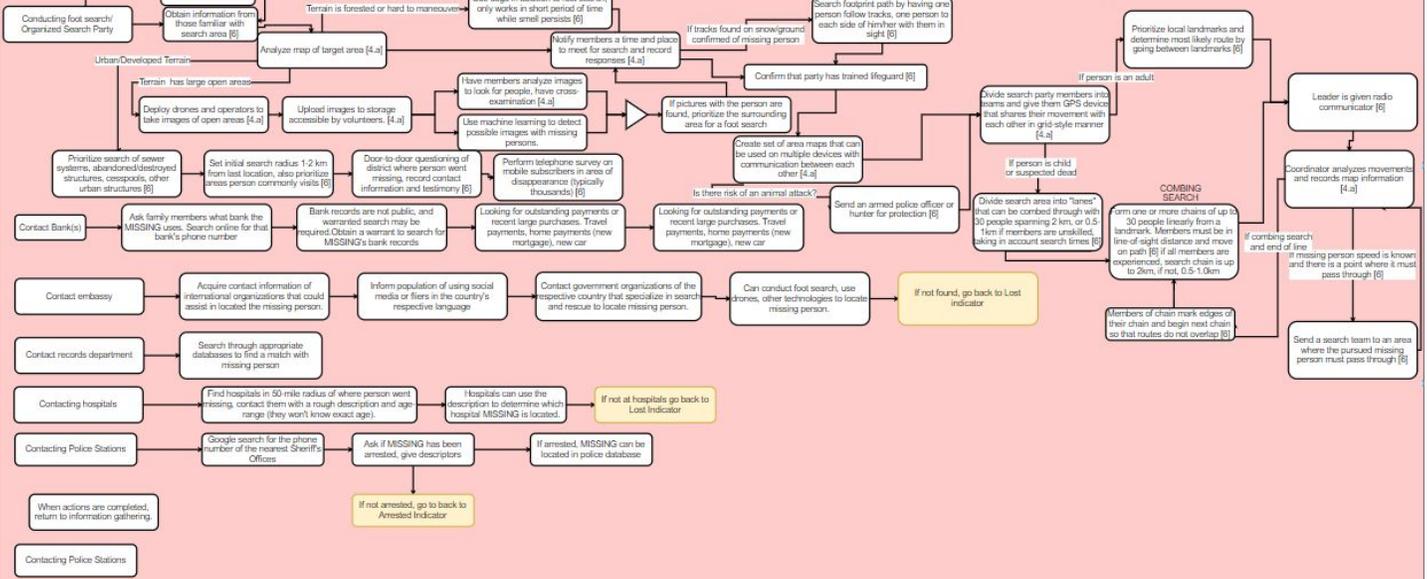
Figure 25: Implementation Section