University of Toronto
Faculty of Applied Science and Engineering
APS111 & APS113
Conceptual Design Specification (CDS)

Team #	5	Date	November 1st, 2019

Project Title	Conceptual Design Specification
Client Name	Visitors and residents of Toronto Islands
Client Contact	Mike French
Tutorial Section	30
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Please check off which components you are submitting for your assignment:

✔ CDS in one Google document (file) with a PDF copy submitted to Quercus with the following components:

✔ Cover Page
✔ Executive Summary
✔ Introduction
✔ Problem Statement
✔ Detailed Requirements
✔ Service Environment
✔ Stakeholders
✔ Alternative Designs
✔ Proposed Conceptual Design
✔ Measure of Success
✔ Conclusion
✔ Reference List
✔ Appendices (Optional)

✔ Include a link (with "can edit" access) to your Google document in the Comments section of your Quercus submission.

If any of the above components are missing, your assignment is considered incomplete. It will accrue standard late penalties until completed.

Attribution table with ALL team members' signatures must be emailed to your TA by the same deadline as the CDS. An incomplete or missing attribution table will result in zero on the assignment for the team.

Executive summary

In 2017 and 2019, Lake Ontario water levels peaked at 76m, causing severe flooding in the Toronto Islands (TI) and $8M in damage to homes and businesses. Residents were inadequately informed of the situation and unprepared to mobilize action in flood mitigation measures. On behalf of TI residents, the client Mr. Mike French is requesting us to design an emergency communication system to better facilitate flood preparation and response.

Currently, the Toronto Regional Conservation Authority (TRCA) monitors flood water levels that it publishes on its website and sends through wireless public alerts (WPA) such as AlertReady Ontario. However, this requires internet and LTE+ smartphone access respectively, which a lot of seniors at TI do not use. The design needs to develop an emergency communication pathway between the TRCA and TI residents that do not use the internet/smartphones.

Essentially this results in 2 secondary functions: sending key information about flood water levels and emergency contacts from TRCA to residents, including a feedback response to acknowledge alert receipts. To effectively target the elderly, the design should send alerts that are easy to interpret, allowing them to respond quickly. After the site survey to TI, the team noted the lack of central community areas and the relative isolation of houses within neighbourhoods, prompting us to narrow the design space into a technological device/system to target individuals as opposed to public displays/announcements.

After executing structured and free brainstorming sessions, graphical decision method, and the pugh method, the team had 3 alternative designs: an intercom system installed in residents' homes; a portable adhesive personal ringer; and an alert dissemination system compatible with regular GSM cellular networks/landlines. Since all 3 were interpretable and responsive, we compared their costs as a deciding factor, as it was a major client need and one of the objectives. Both the intercom and the personal ringer have high upfront costs associated with manufacturing, which is not ideal for the small TI budget of $76,000 especially as they will not be in use between September to May. In this regard, the Alert Dissemination system stands out as a low-cost solution as it solely relies on using existing devices of residents, and an automated system to send alerts and receive notifications. Residents can choose their preferred method of communication, and receive alerts if flooding occurs. Moreover, these alerts can be portable, whereas the intercom would be at home and personal devices can be left out by residents.

In the next steps, the team has to collaborate with TRCA to set-up a system that can automatically receive live updates from their monitoring and then send alert messages to residents' preferred channels at different critical water levels. By late January, all residents should be surveyed to pinpoint the target group and have them specify their primary and secondary preferred modes of communication. By mid-April, the system should be designed, and by late June, be tested and improved so that it can be potentially implemented from July-August during flood season.

1.0 Introduction

Due to their low elevation, the Toronto Islands (TI) are prone to severe flooding and recently experienced two such extreme floods in 2017 and 2019 [1]. TI's representative, Mike French, has expressed the need for a more efficient, systematic emergency communication protocol to minimize damage to the community as scoped and addressed below.

2.0 Problem Statement

The TRCA (Toronto Regional Conservation Authority) monitors flood water levels, publishes them on their website, and sends them through wireless public alerts (such as AlertReady Ontario), requiring internet and LTE + smartphone access respectively [2][3][4]. Statistics show that only 18% of Canadians over 75 own a smartphone [5] and 39% of Canadian seniors (65+) only use landlines [6] making it difficult for the elderly to receive urgent flood warnings using existing methods [7][8]. Mr. French needs a method that can deliver "accurate and timely" emergency information to all residents and a way to record acknowledgment of alerts from residents. Currently, residents use yahoo messenger groups and a buddy system which are disorganized. The gap is the lack of quick, two-way communication between TRCA and TI residents [1]. Therefore, the scope will focus on using smartphones and internet-free technologies to deliver emergency information and record acknowledgment of the alert.

3.0 Service Environment

The service environment covers Ward's, Centre and Algonquin Islands as they are the most populous. Large-scale flooding generally occurs in the months of May-August; the physical environment has elements that may affect the design's structural/electrical stability outdoors as well as the signal reception. The layout and details of specific neighborhoods that influence the choice/effectiveness of communication methods have been included below.

3.1 Physical Environment

The outdoor elements below will provide an extremes-inclusive range that will encompass indoor attributes, so the design can function in either environment.

Table 1: Physical elements with justification regarding impact.

Element	**Data**				**Justification**
	May	**June**	**July**	**August**	
Average rainfall(mm)	75.0	62.7	65.0	84.3	May affect physical/ electrical functionality [10]
Average temperature range(°C)	8.1−16.6	13.2−22.2	16.7−25.5	16.8−24.5	Fluctuations may affect electrical components [10]
Average wind speed 2019	17.9	17.9	16.7	17.5	May affect structural stability

<table>
<tr><td>(km/h)</td><td></td><td></td><td></td><td></td><td>[11]</td></tr>
<tr><td>Relative Humidity (%)</td><td>72</td><td>64</td><td>66</td><td>65</td><td>May affect electrical components [12]</td></tr>
<tr><td>Elevation level (m)</td><td colspan="4">

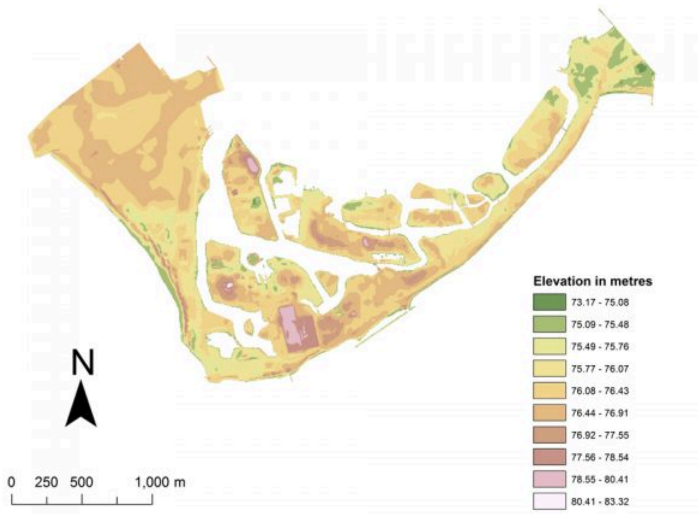


Figure 1. TI elevation map in meters above sea level [8]

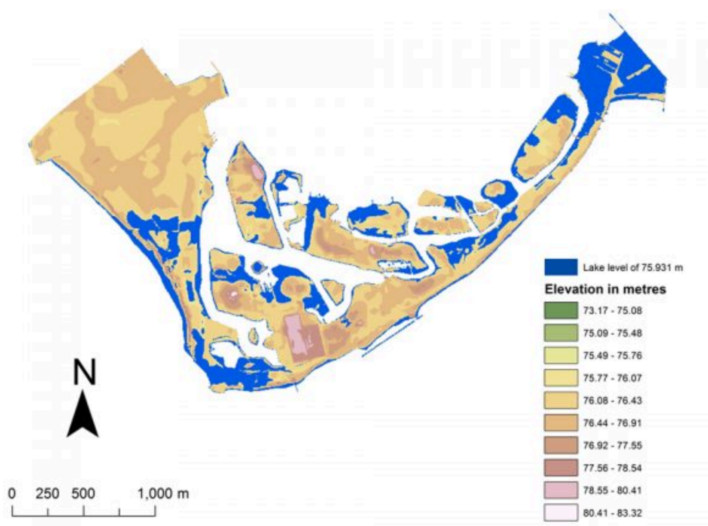


Figure 2. TI elevation map in meters above sea level and likely flooded areas in May 2017 [8]

</td><td>Affects what areas may need priority in being informed [12]</td></tr>
</table>

Table 2: Rough observations of TI (figures taken Oct. 13, 2019)

<table>
<tr><th>Element</th><th>Observations</th><th>Justification</th></tr>
<tr><td>Path widths in residential areas</td><td>
Figure 3. Arm span in comparison to path widths in Ward's Island residential area; houses ~1.75m across from each other.

Figure 4. Houses on Algonquin Island around 5-10m apart (measured with steps).</td><td>House proximity may be useful if broadcasting messages in neighborhoods</td></tr>
</table>

More rough observations in Appendix A.

3.2 Living things

The design is meant to account for the technological/social disparities on TI, thus population demographics must be considered in order to effectively transmit information to residents. Impact on other organisms is negligible.

Table 3: Living things with justification regarding impacts.

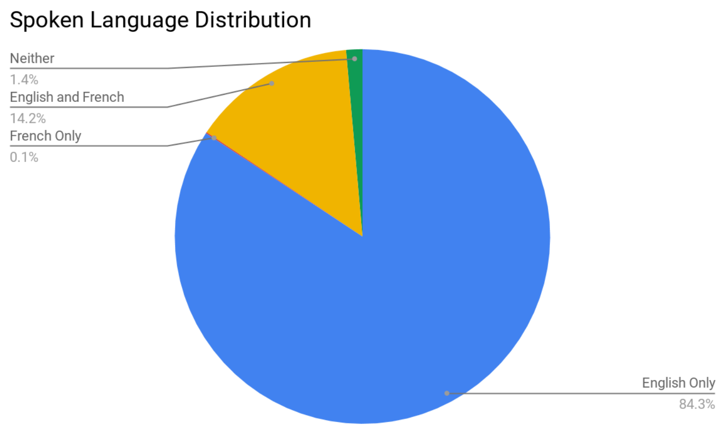
<table>
<tr><th>Living Things</th><th>Description</th><th>Justification</th></tr>
<tr><td rowspan="2">Humans</td><td>

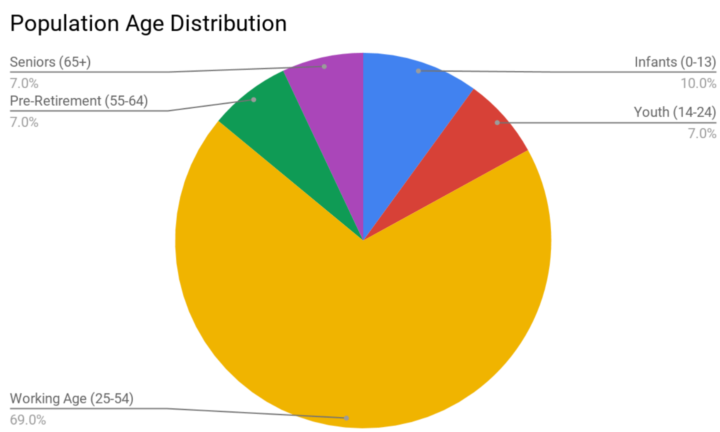
Figure 5. Spoken Language Distribution of TI residents</td><td rowspan="2">Characteristics of people using the design [13]</td></tr>
<tr><td>

Figure 6. TI Population Age Distribution</td></tr>
</table>

3.2 Virtual environment

The following table accommodates for the established technological mediums on TI, specifically regarding smartphones/internet access amongst the elderly.

Table 4: Virtual Environment surrounding TI.

Items	**Description**
4G	Global standard in wireless network technology for various internet services [14] Carriers that cover all of TI: Bell, Rogers, Telus [15]
GSM (Global System for Mobile Communication)	Global standard for voice and text for cell-phones. Carriers that cover all of TI: Bell, Rogers, Telus, WIND, etc. [16]
PSTN (Public Switched Telephone Network)	Traditional landline network (global)  Figure 7. Telephone lines on TI
CBC Radio One 99.1FM ICI Musique 90.3FM ICI Radio-Canada Première 860AM	Radio/TV channels operating on TI [17]. (CBC); can potentially broadcast signals on behalf of TRCA. Alternatively, a separate radio signal is used in the design, needs to choose different frequencies.
HAM Radio	Range of 10+ miles on a flat ground; can reach halfway across the country with a repeater [18]
Wi-Fi IEEE 802.11	Used by most smart devices in Toronto on the 2.4GHz and 5GHz frequencies [19] Provided by carriers listed under 4G

4.0 Stakeholders

The following stakeholders are based on cost and legality considerations involving authorities using similar situations in global flooding incidents.

Table 5: Stakeholders and their impact

Stakeholders	**Impact of Design**
Government of Ontario	Meets Emergency Management Doctrine criteria [20]
Toronto Fire Services	Reduce dispatches and increase efficiency
City of Toronto	Cost unknown; municipal government may be inclined to fund design [21]
Toronto Islands Community Association (TICA)	Can better organize responses and updates to residents during flooding [22]
TRCA	Flood alerts efficiently sent out and received by residents [23]

5.0 Detailed Requirements

The primary aim is to facilitate two-way emergency communication between authorities and residents to send alerts and capture response; accessibility and safety are two characteristics prioritized target the elderly.

5.1 Functions

The essence of two-way communication between authorities and residents is broken down below:

Table 6: Primary and secondary functions

Primary Function	Secondary Functions
Conduct two-way communication between authorities (TRCA, TI Flood Leadership committee) and TI residents	• Notify residents of flood severity and relevant emergency contacts/information • Confirm residents' awareness/safety with feedback to the authorities

5.2 Objectives

The following objectives are primarily derived from the target population and client needs; we want the elderly to receive and understand the information quickly, and be able to respond easily.

Table 7: Objectives with respective metrics/goals in descending importance

Objectives	Metrics	Goals
Easy Interpretation	Flesch-Kincaid reading ease	Score of 100-90 (understood by age 11+) [24]

Ease of response for residents	Number of steps the process takes	One Based on UX design principles [25]
Inexpensive	Under TI community budget	<$76,000 [26]
Information Reception Speed	Time (in minutes)	<5 [27]

5.3 Constraints

The design encompasses TI, therefore it must consider the health and safety of its population and ecosystem to minimize harm.

Regulation Compliance requires at least two public tests annually as stated in Telecom Decision CRTC 2019-239 requirement [28].

Frequency should be between 4-12kHz or 450-10000Hz ⅓ octave band as stated in ISO 7240-25:2010. This is above birds' hearing threshold, in order to not injure their ears, and within the minimum human hearing threshold [29].

Volume should be below 80-130dB measured by a decibel meter, as per stated in some regulations, ISO standards. It is below ear pain threshold, within the elderly hearing range [30].

The duration of the alarm should be a three-pulse temporal pattern consists of an "on" phase lasting 0 to 5 seconds + 10% and shall be no less than 180 seconds, as stated in ISO 8201:2017, measured by stopwatch. The reasoning is this prevents citizens from confusing it with other alerts [31].

Flashing lights cannot be between 3-65 flashes per second, following ISO 9241-391:2016. This prevents epileptic reactions from citizens arising from light [32].

6.0 Alternative Design

As seen in appendices F-N, idea decomposition and free brainstorming were used to generate ideas that utilize sight, touch, smell, and hearing and considered less prevalent methods of communication such as radio. After free brainstorming, we used SCAMPER to modify and distribute ideas into four categories; screen-based, speaker, vibrations, and lights. Following feasibility checks, multi-voting and graphical design charts, we settled on four designs that best fit objectives #1 and #2 and compared them with all objectives using the Pugh method before picking three. Below are the design specifications. For reception and cost result calculations see Appendix B-D.

6.1 Intercom:

The master station, within 1.5km radius of the intercoms (substations)(Fig.10), will control all input and output data [33]. A "technical team" modifies flood alerts received from TRCA into messages and sends them to the master stations(Fig. 9). Each device has a screen, speaker, indication light and buttons(Fig. 8): when the signal is sent from the master stations to the substation, the screen lights up and displays the message while the LED light flashes and the speaker announces the message. This continues until residents respond by pressing either the green or red buttons, labeled “OK” and “Help” in Braille respectively; green sends a response signal back through the channel whereas red directs residents to a Help screen with automated instructions. The device is inactive from September to May (non-flood season), requires wiring into buildings’ power systems and residents’ continued presence at home.

Design specifications:

- Screen dimension based on UX design principles for elderly users [34]
- Font, Size: Sans serif, 12-pt [34]
- Light, Color: LED JC bulb, G4 bi-pin, Red, wavelength (740nm) [35]
- Message on buttons: Braille on the two buttons that spells “Help” and “OK”
- Message beneath buttons: Instructions on how to use the intercom: “Please press the “Respond” button to indicate you are safe and do not require assistance during the flood.”
- Body specifications: Noryl plastic [36]
- Button: Black Stainless Satin Steel [37]
- Radius of Buttons: 20mm
- Speaker: loudspeakers, BP9080x. 16-40,000 Hz [38]
- Amplifier: Class D [39]

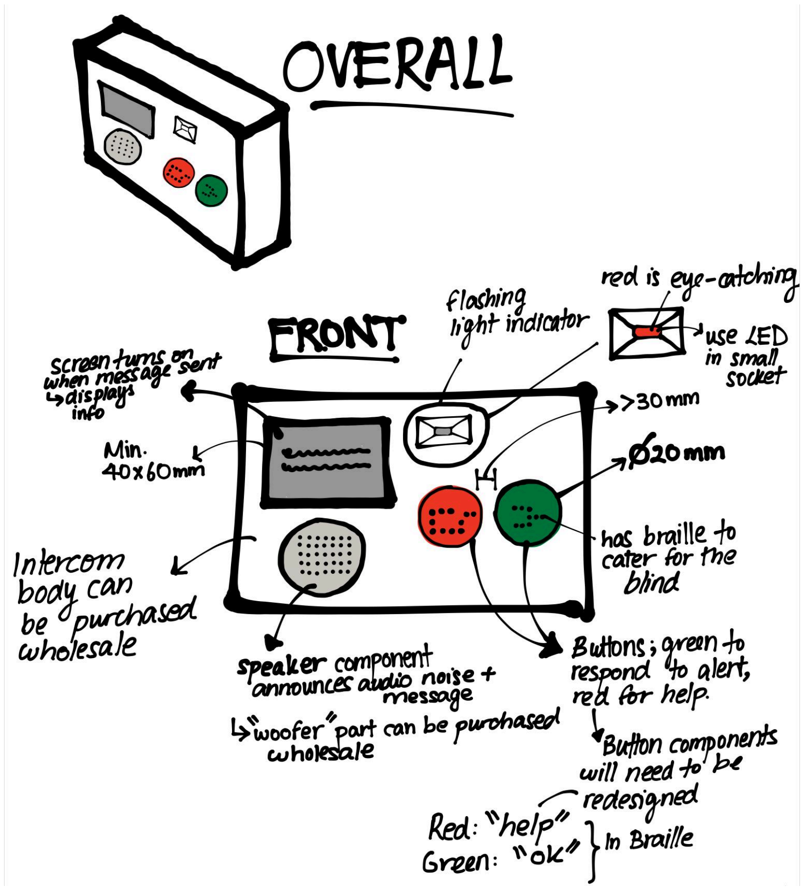


Figure 8. Intercom diagram

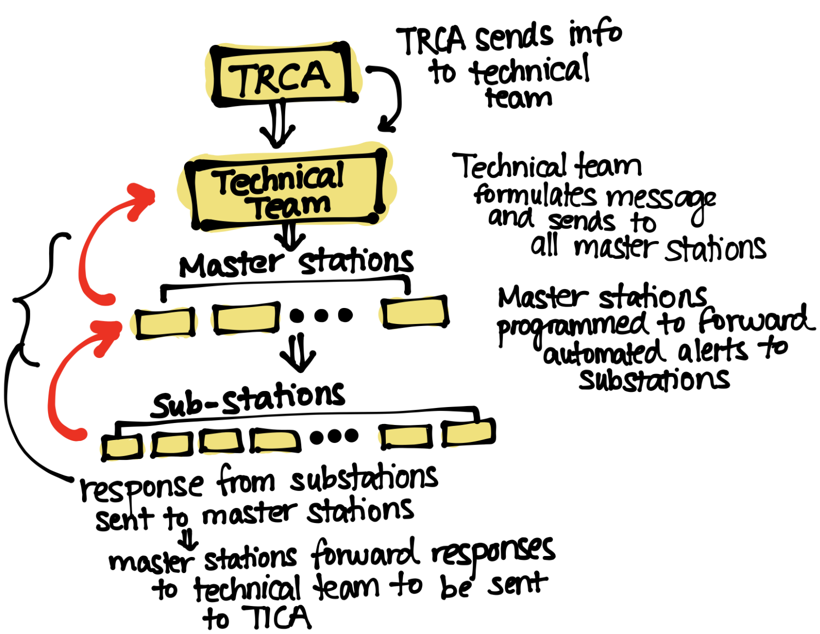


Figure 9. Intercom information pathways

Figure 10. Master station distribution [40]

Table 8: Intercom Objective Goal Fulfillment

Goal	Result
Reading ease score: 100-90	100-90 (construct understandable message)
Steps: 1	1 (press green button)
Cost: <$76,000	>$212,00 (manufacture + installation + labour) [41]
Reception: <5min	~1.26×10^{-6}min (radio waves)

6.2 Personal Ringer:

A small portable device is attached to the user's item of choice. It features a screen, buzzer, indicator light, button on the front, and an adhesive strip on the back(Fig.11). When the device receives the signal from TRCA, the device vibrates, the light flashes, the buzzer beeps at a fixed volume and the screen displays a small message. This continues until the user presses the button (labeled in text and braille), sending a response signal back to TRCA. The device is only active during flood season. There may be difficulty in maintenance.

Design Specifications:

- Font, Size: Sans Serif, 14-pt [34]
- Light, Color: LED, Red (740nm wavelength)
- Message: “Click Button to Respond”
- Braille on Button: “Response”
- Body specifications: ABS Plastic [42]
- Adhesive: Uline Fast Tack Spray Adhesive on Adhesive Strip [43]
- Button: Black Stainless Satin Steel [44]
- Vibration: Micro-DC Motor in alternating magnetic field [43]
- Speaker: Piezo buzzer, PS1240 [45]
- Sound: 2-10kHz

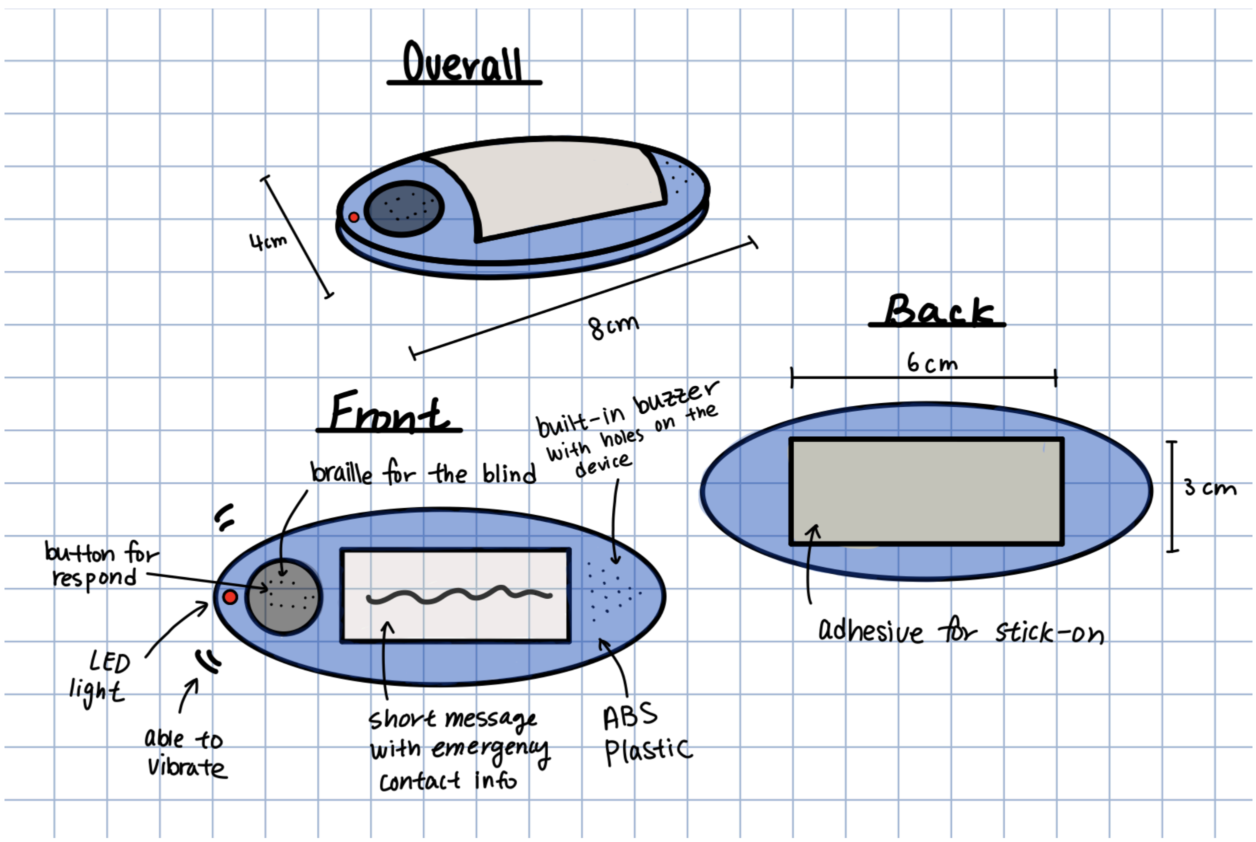


Figure 11. Ringer diagram

Table 9: Ringer Objective Goal Fulfillment

Goal	Result
Reading ease score: 100-90	100-90 (construct understandable message)
Steps: 1	1
Cost: <$76,000	~$279,000 (manufacture + distribution, undetermined between device

	purchased privately by residents or subsidized by the government)
Reception: <5min	~$1.26x10^{-6}$min (radio waves)

6.3 Alert Dissemination

This design consists of a multi-medium alert system that sends automated messages to all residents through texts or phone calls on cell-phones/landline, depending on preference(Fig.12-13). Pre-flood season, residents submit their preferred and secondary methods of communication. TRCA then sends the alert to residents in collaboration with major telecom companies, such as Bell . Residents respond to the alert through given instructions specific to the preferred medium, during which residents can either acknowledge the alerts or request a clarification, also automated. The previous information will be logged and available for residents to refer back to. The alert will be re-sent every four hours until response is submitted. After 24 hours, the alert will also be sent through the secondary method of communication.

Design Specifications:

- Cell-phones: GSM networks
- Landlines: Digital PSTN network

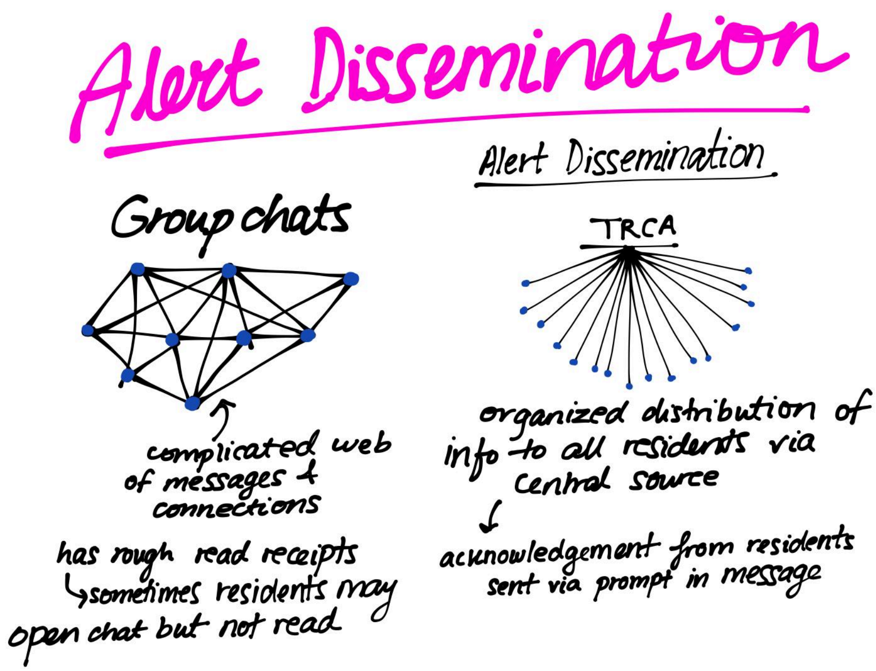


Figure 12. Comparison between abstract representations of current communications system and alert dissemination design

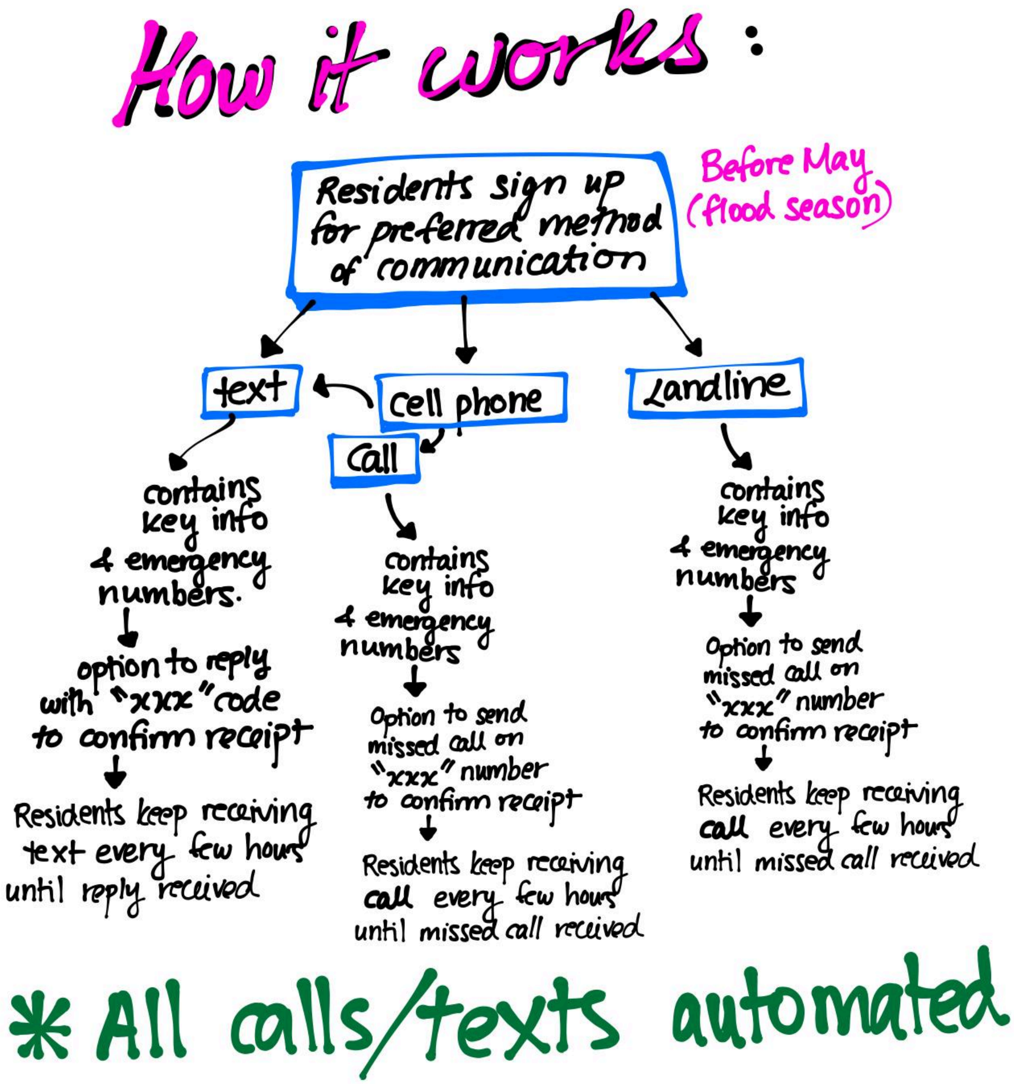


Figure 13. Flowchart of potential information pathways

Table 10: Alert Dissemination Objective Goal Fulfillment

Goal	Result
Reading ease score: 100-90	100-90 (construct understandable message)
Steps: 1	~1-2 (call/text)
Cost: <$76,000	~$60,000 (software development, platform integration, collaboration with companies [46] [47])
Reception: <5min	~1.26×10^{-6}min (radio waves)

7.0 Proposed Conceptual Design - Alert Dissemination

The Alert Dissemination communication system delivers concise messages to TI residents, allowing residents to understand the alert in under five minutes and provide a confirmation of acknowledgment to TRCA via call/text. As only 18% of Canadians over 75 own a smartphone [5] and about 39% of Canadian seniors (65+) use a landline [6], this design can send alerts to residents who have no smartphones. Between September and May, residents will be asked to state their primary and secondary means of contact through which TRCA, in partnership with Canadian telecommunication companies, will send alerts to TI community. As described in Figure 14, residents will need to take one step to send an acknowledgment of the alerts regardless of how they receive alerts. This system meets the gap imposed by the limitations of current solutions- fast, accurate, and two-way communication.

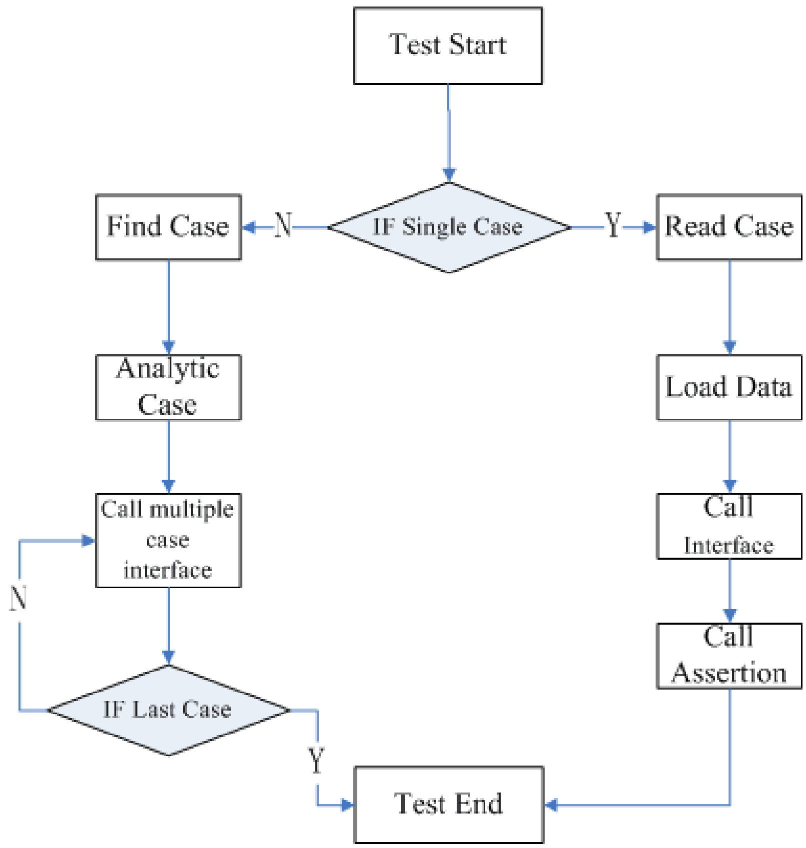


Figure 14. Generic Flowchart used for programming automated message delivery system [48]. See Appendix E for thorough explanations of the flowchart shown

To comply with Objective 1, Alert Dissemination system will implement the Federal Communication Commission's updated rule of max 360 character alerts [49]. The messages will be written in English in compliance with the Flesch-Kincaid test, yielding a value about 100-90. Ease of interpretation of the alert directly corresponds with the speed of reception of information by the user as outlined in Objective 2. The time gap between when an alert is received and when the user takes action is called the protective action initiation (PAI) time, influenced by milling [49]. Milling is characterized by a recipient thoroughly understanding an alert without emotional attachment [49], therefore, increasing the ease of understanding of a message will decrease PAI time. The programming language C++ will be used to code the automated system as it has the fastest execution time among widely used languages [50]. Based on UX design principles, it is optimal to have one step for the user to indicate receipt of alert, also supported by Figure 14 [25]. Most of the coding for Alert Dissemination can be executed without overhead costs for software [51]; therefore, the majority of the costs associated will be for labour (software and telecommunication engineers) during installation and maintenance, amounting to about $30/hour and $50/hour for software and telecommunication engineers, respectively [52].

8.0 Measures of Success:

The design will grant residents without smartphone the ability to receive TRCA alerts and to confirm the reception of said message. Each objective has a test; the total performance of the design will measure its success.

8.1 Methods for Measuring Time Efficiency (Speed):

Time efficiency of the alert message will be tested using the command `time` in the code of the message, determining the time the CPU takes to run the commands and informing the user of the task's completion [52]. This result will be compared to existing solutions such as Tsunami Warning Systems, which needs 15 minutes to inform the public of incoming floods. If the codes takes below 15 minutes to run, the design will be deemed effective [53].

8.2 Methods for Measuring Easy Interpretation:

Easy Interpretation will be assessed using the Flesch-Kincaid test, measuring the reading and listening ease of a specific text. The message will be put in the test and see whether it achieves a desired score of 100-90, catering to users with low English-language proficiency [54].

8.3 Methods for Measuring Ease of Response:

Ease of response is measured through SEQ: "How difficult or easy did you find the task?". SEQ uses a Likert Scale-style response from points 1 to 7, meaning "Very Difficult" to "Very Easy" respectively. The test requires participants to complete tasks varying in complexity or length. After each task, participants are asked to take SEQ [55].

8.4 Methods for Measuring Costs:

Measurement for whether the design is inexpensive is done through the Engineering Estimate method, estimating the total cost of production for individual parts. Then, we draw a Venn Diagram with two categories: "Falling under budget" and "Cheaper than Existing Designs" [56].

8.5 Demonstration of Feasibility:

In order to show the alert is a feasible design in terms of the specified scope, the following items will be included:

- Results of tests included in Methods of Success:
    - Faults and possible improvements
    - Further work
- Detailed layout of code:
    - All commands along with timings for each

    - Explanation of each command
- Complete image/sound of the message on email, text and landline form.
    - Visuals for email and text
    - Message for sound
- Comparison with existing designs
    - Improvements to the design
    - Improvements for other designs
    - Similarities
    - Differences
- Complete list of effects on stakeholders
    - Effect on TI Community, GTA, Toronto Government, Fire Services, TRCA

9.0 Conclusion

Mr. French needs an accurate early warning communication system with user acknowledgment capabilities. As about 14% of TI are elderly with limited smartphone usage, the scope provides this niche population with the tool that alerts them of a crisis via smartphone/internet/LTE free technology. Alert Dissemination has been chosen as the recommended design that best complies with the design criteria, scope, and client need.

The next steps for the client are to make a list of primary and secondary communication method for each TI resident within the next two months (late January); each person's preferred method of communication will be updated in Alert Dissemination Network. Although optional, the client and residents will benefit from a community meeting outlining the implementation and benefits of Alert Dissemination during times of crisis.

Estimated Timeline:

- January: consolidated list of primary and secondary means of contact for each resident
- April: telecommunication engineers work with TRCA and major phone providers to develop Alert Dissemination framework
- April - May: implementation of framework and testing
- June: Bugs fixes and maintenance procedures finalized
- July-August: Alert Dissemination released

10.0 Reference List

[1] M. French, Client Statement, “Immediate Flood Preparation, response, recovery and mitigation on Toronto Islands”. Toronto, Canada: University of Toronto. [Online] Available: https://q.utoronto.ca/courses/119774/pages/documents-and-resources. [Accessed: 25- Oct- 2019].

[2] D. Boyd, F. Kenny, B. Smith and B. Keene, *Delivery of Ontario's Flood Forecasting and Warning Program*. Mississauga, Ontario: Canadian Dam Association, 2015.

[3] "Campaign - Alert Ready Emergency Alert System - Pelmorex Corp.", *Alert Ready Emergency Alert System - Pelmorex Corp.*. [Online]. Available: https://www.alertready.ca/wireless/#carriers. [Accessed: 25- Oct- 2019].

[4] Toronto and Region Conservation Authority (TRCA). (2019). Flood Forecasting & Warning -Toronto and Region Conservation Authority (TRCA). [online] Available at: https://trca.ca/conservation/flood-risk-management/flood-forecasting-warnings/ [Accessed 25 Oct. 2019].

[5] Lagerquist, J. (2019). Internet usage growing fastest among older Canadians: StatsCan. [online] CTVNews. Available at: https://www.ctvnews.ca/sci-tech/internet-usage-growing-fastest-among-older-canadians-statscan-1.3676986 [Accessed 29 Nov. 2019].

[6] thestar.com. (2019). Canadian seniors slow to pick up smartphones | The Star. [online] Available: https://www.thestar.com/business/tech_news/2014/01/23/canadian_seniors_slow_to_pick_up_smartphones.html [Accessed 29 Nov. 2019].

[7] "Seniors' smartphone uptake low among Canadians", *CBC News*, 2014. [Online]. Available: https://www.cbc.ca/news/technology/seniors-smartphone-usage-low-among-canadians-1.250494. [Accessed: 25- Oct- 2019].

[8] J. Jacobson, C. Lin and R. McEwen, "Aging with Technology: Seniors and Mobile Connections",Cjc-online.ca, 2017. [Online]. Available: https://www.cjc-online.ca/index.php/journal/article/view/3221/3362. [Accessed: 25- Oct-2019].

[9] Government of Canada. “Causes of Flooding”, 2013. Available: https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/causes-of-flooding.html [Accessed: 25-Oct-2019]

[10] Yu Media Group d.o.o., "Toronto Islands, Canada - Detailed climate information and monthly weather forecast | Weather Atlas", Weather Atlas, 2019. [Online]. Available: https://www.weather-ca.com/en/canada/toronto-islands-climate. [Accessed: 12- Oct- 2019].

[11] "Toronto Historical Wind Speed", Amateur Weather Statistics for Toronto, Ontario, 2019. [Online]. Available: https://toronto.weatherstats.ca/metrics/wind_speed.html. [Accessed: 12- Oct-2019].

[12] Steenberg, J. and Steenberg, J. (2019). Mapping the flood vulnerability of the Toronto Islands - Spacing Toronto. [online] Spacing Toronto. Available at: http://spacing.ca/toronto/2017/07/12/mapping-flooding-toronto-islands/ [Accessed 29 Nov. 2019].

[13] Toronto.ca. (2019). [online] Available at: https://www.toronto.ca/ext/sdfa/Neighbourhood%20Profiles/pdf/2016/pdf1/cpa77.pdf [Accessed 29 Nov. 2019].

[14] "Rogers Canada 4G & LTE Wireless Network Coverage Maps -", *Compare Cellular*, 2019.[Online]. Available: https://www.comparecellular.ca/rogers-coverage-maps/. [Accessed: 11- Oct-2019].

[15] Whistleout.ca. (2019). Best Cell Phone Coverage In Toronto. [online] Available at: https://www.whistleout.ca/CellPhones/Guides/Best-coverage-In-Toronto [Accessed 29 Nov. 2019].

[16] Whistleout.ca. (2019). A guide to SIM-only cell phone plans. [online] Available at: https://www.whistleout.ca/CellPhones/Guides/a-guide-to-sim-only-cell-phone-plans [Accessed 29 Nov. 2019].

[17] "What is the radio frequency in my area?", *CBC Help Centre*, 2019. [Online]. Available:https://cbchelp.cbc.ca/hc/en-ca/articles/217731807-What-is-the-radio-frequency-in-my-area-. [Accessed: 11- Oct- 2019].

[18] A. C, "4 Ways To Communicate During A Disaster - Off The Grid News", Off The Grid News, 2019. [Online]. Available: https://www.offthegridnews.com/extreme-survival/4-ways-to-communicate-during-a-disaster/. [Accessed: 11- Oct- 2019].

[19] Electronics-notes. (n.d.). “Wi-Fi Channels, Frequency Bands & Bandwidth.” [online] Available at: https://www.electronics-notes.com/articles/connectivity/wifi-ieee-802-11/channels-frequencies-bands-bandwidth.php [Accessed 11 Oct. 2019].

[20] Ontario Ministry of the Solicitor General. (2019). “Legislation and Regulation | Emergency Management Ontario.” [online] Available at: https://www.emergencymanagementontario.ca/english/insideemo/legislationandregulation/emergency_management_doctrine.html?fbclid=IwAR2ubFd_gmpRscMVKqicA-DRlaqrz6KJ3X59AER5QSHEV1P5LsMYLkqjL7k [Accessed 11 Oct. 2019].

[21] Shiomi, K. and Izumi, D. (2019). “Lack of local-level funds slows proliferation of J-Alert system.” [online] The Japan Times. Available at: https://www.japantimes.co.jp/news/2008/07/17/national/lack-of-local-level-funds-slows-proliferation-of-j-alert-system/#.XZo7XkZKhPY [Accessed 11 Oct. 2019].

[22] Toronto and Region Conservation Authority (TRCA). (2019). Flood Forecasting & Warning -Toronto

and Region Conservation Authority (TRCA). [online] Available at: https://trca.ca/conservation/flood-risk-management/flood-forecasting-warnings/ [Accessed 11Oct. 2019].

[23] Naowski, N. (2019). Lessons learned: Ward's Island residents get ready for possible flooding |CBC News. [online] CBC. Available at: https://www.cbc.ca/news/canada/toronto/flooding-toronto-torontoisland-wards-lakeontario-1.5134628 [Accessed 11 Oct. 2019].

[24] *"Flesch reading ease score in Yoast SEO • Yoast"*, *Yoast*, 2019. [Online]. Available: https://yoast.com/flesch-reading-ease-score/. [Accessed: 25- Oct- 2019].

[25] N. Babich, "Mobile UX Design: Key Principles", Medium, 2019. [Online]. Available: https://uxplanet.org/mobile-ux-design-key-principles-dee1a632f9e6. [Accessed: 29- Nov- 2019].

[26] Torontoisland.org, 2019. [Online]. Available: http://torontoisland.org/Portals/3/TICA/newsletters/newsletter%20Nov%202016.pdf?ver=2016-12-08-102507-127. [Accessed: 25- Oct- 2019]

[27] I. ProTexting.com, "Instant Mobile Keyword and Short Code", ProTexting.com, Inc., 2019. [Online]. Available: https://www.protexting.com/7/27/learning-center.html. [Accessed: 29- Nov- 2019].

[28] Government of Canada, "Telecom Decision CRTC 2019-239 | CRTC", Crtc.gc.ca, 2019. [Online]. Available: https://crtc.gc.ca/eng/archive/2019/2019-239.htm. [Accessed: 26- Oct-2019].

[29] R. Beason, "What can birds hear?", *Proceedings of the Vertebrate Pest Conference*, vol. 21, 2004. [Online]. Available: https://escholarship.org/uc/item/1kp2r437. [Accessed 26 October 2019].

[30] "Hearing loss and deafness: Normal hearing and impaired hearing", *InformedHealth.org*, 2017. [Online]. Available: https://www.ncbi.nlm.nih.gov/books/NBK390300/. [Accessed: 26- Oct-2019].

[31] *Acoustics — Audible and other emergency evacuation signals,* ISO 8201:2017, 2019

[32] *Ergonomics of human-system interaction - Part 391: Requirements, analysis and compliance test methods for the reduction of photosensitive seizures,* ISO 9241-391:2016, 2019

[33] "Intercom System :: Two-wire Stations :: N-8020MS Industrial-Use Master Station", Toacanada.com, 2019. [Online]. Available: http://www.toacanada.com/shop/intercom-system/two-wire-stations/n-8020ms-industrial-use-master-station.html. [Accessed: 29- Nov- 2019].

[34] J. Six, "Redirect Notice", Google.com, 2019. [Online]. Available:

https://www.google.com/url?q=https://www.uxmatters.com/mt/archives/2010/05/designing-for-senior-citizens-organizing-your-work-schedule.php&sa=D&ust=1575000426930000&usg=AFQjCNE8ckef3LvIlq1ugmCFX8ebGWpRUw. [Accessed: 29- Nov- 2019].

[35] I.pinimg.com, 2019. [Online]. Available: https://i.pinimg.com/736x/75/8c/2c/758c2cb6b859dc479277d5d488f69520--home-lighting-lighting-design.jpg. [Accessed: 29- Nov- 2019].

[36] "Browsers and Using Curbell Plastics Website", Curbellplastics.com, 2019. [Online]. Available: https://www.curbellplastics.com/Research-Solutions/Materials/Noryl. [Accessed: 29- Nov- 2019].

[37] "Push buttons: ASP, RCI and more from www.thebuilderssupply.com", Thebuilderssupply.com, 2019. [Online]. Available: https://thebuilderssupply.com/Push-buttons-and-much-more_b_14.html. [Accessed: 29- Nov- 2019].

[38] "BP9080x", Definitive Technology, 2019. [Online]. Available: https://www.definitivetechnology.com/products/bp9080x. [Accessed: 29- Nov- 2019].

[39] T. Nicolakis, "Definitive Technology BP9080x, BP9060, CS9060 Dolby Atmos Speakers Review", Audioholics Home Theater, HDTV, Receivers, Speakers, Blu-ray Reviews and News, 2019. [Online]. Available: https://www.audioholics.com/surround-sound-reviews/definitive-bp9080x-bp9060-cs9060-dolby-atmos-review. [Accessed: 29- Nov- 2019].

[40] Torontoisland.com, 2019. [Online]. Available: https://www.torontoisland.com/images/toronto_island_map.pdf. [Accessed: 29- Nov- 2019].

[41] "Intercom System :: Two-wire Stations :: N-8000MS Multifunctional Master Station", Toacanada.com, 2019. [Online]. Available: http://www.toacanada.com/shop/intercom-system/two-wire-stations/n-8000ms-multifunctional-master-station.html. [Accessed: 29- Nov- 2019].

[42] T. Rogers, "Everything You Need to Know About ABS Plastic", Creativemechanisms.com, 2019. [Online]. Available: https://www.creativemechanisms.com/blog/everything-you-need-to-know-about-abs-plastic. [Accessed: 29- Nov- 2019].

[43] "ULINE - Shipping Boxes, Shipping Supplies, Packaging Materials, Packing Supplies", Uline.ca, 2019. [Online]. Available: https://www.uline.ca/Product/Detail/S-13379/Aerosols/Uline-Fast-Tack-Spray-Adhesive-115-oz?pricode=YG032&gadtype=pla&id=S-13379&gclid=CjwKCAiA_f3uBRAmEiwAzPuaMwLCegf

wX0QSTLbUKLnMOAH84YzAw1Un84asuJoMNowqVjAJDwLEjRoCSZkQAvD_BwE&gclsrc=aw.ds. [Accessed: 29- Nov- 2019].

[44] Thebuilderssupply.com. (2019). Push buttons: ASP, RCI and more from www.thebuilderssupply.com. [online] Available at: https://thebuilderssupply.com/Push-buttons-and-much-more_b_14.html [Accessed 29 Nov. 2019].

[45] Industries, A. (2019). Piezo Buzzer. [online] Adafruit.com. Available at: https://www.adafruit.com/product/160 [Accessed 29 Nov. 2019].

[46] SOLTECH. (2019). How Much Does Custom Software Cost? - SOLTECH. [online] Available at: https://soltech.net/how-much-does-custom-software-cost/ [Accessed 29 Nov. 2019].

[47] O, K. (2019). Software Development Costs and Factors Affecting Its Price. [online] Cleveroad Inc. - Web and App development company. Available at: https://www.cleveroad.com/blog/software-development-costs [Accessed 29 Nov. 2019].

[48] Anon, (2019). [online] Available at: https://www.researchgate.net/figure/Interface-automation-test-flow-chart_fig2_317554105 [Accessed 29 Nov. 2019].

[49] National Academies of Sciences, Engineering, and Medicine, *Emergency Alert and Warning Systems: Current Knowledge and Future Research Directions*. Washington DC: The National Academies Press, 2018, pp. 18-44 [Online]. Available: https://www.nap.edu/read/24935/chapter/3. [Accessed: 30- Nov- 2019]

[50] "C++ g++ vs Python 3 - Which programs are fastest? | Computer Language Benchmarks Game", *Benchmarksgame-team.pages.debian.net*, 2019. [Online]. Available: https://benchmarksgame-team.pages.debian.net/benchmarksgame/fastest/gpp-python3.html. [Accessed: 30- Nov- 2019].

[51] Spiceworks, I. (2019). C++ SMS source code on how to send SMS text messages using HTTP-Script Center - Spiceworks. [online] Community.spiceworks.com. Available at: https://community.spiceworks.com/scripts/show/2979-c-sms-source-code-on-how-to-send-sms-text-messages-using-http [Accessed 29 Nov. 2019].

[52] Payscale.com. (2019). Software Engineer Salary in Canada | PayScale. [online] Available at: https://www.payscale.com/research/CA/Job=Software_Engineer/Salary [Accessed 29 Nov. 2019].

[53] van Engelen, R. (2019). Performance Analysis. [online] Available at: https://www.cs.fsu.edu/~engelen/courses/HPC/Performance.pdf [Accessed 29 Nov. 2019].

[54] Readable. (2019). The Flesch Reading Ease and Flesch-Kincaid Grade Level. [online] Available at: https://readable.com/blog/the-flesch-reading-ease-and-flesch-kincaid-grade-level/ [Accessed 29 Nov. 2019].

[55] TryMyUI Blog. (2019). Measuring task usability: The Single Ease Question - TryMyUI Blog. [online] Available at: https://www.trymyui.com/blog/2015/03/04/measuring-task-usability-the-single-ease-question/ [Accessed 29 Nov. 2019].

[56] AcqNotes. (2019). Cost Estimating Methods - AcqNotes. [online] Available at: http://acqnotes.com/acqnote/tasks/cost-estimating-methodscostestimating [Accessed 29 Nov. 2019].

[57] Intercom, I. (2019). Installation Cost for a Video Intercom. [online] DTV Installations. Available at: https://www.dtv-installations.com/blog/intercom-system/installation-cost-video-intercom [Accessed 30 Nov. 2019].

[58] Google. "Area of Ward Island." Google Maps. [online] Available: https://www.google.ca/maps/place/Ward's+Island,+Toronto,+ON/@43.6314973,-79.3587839,16.36z/data=!4m5!3m4!1s0x89d4cae72ec2ff13:0x924d8542dc554ef0!8m2!3d43.6320265!4d-79.3554029?hl=en. [Accessed 29 Nov. 2019].

[59] Google. "Area of Algonquin Island." Google Maps. [online] Available: https://www.google.ca/maps/place/Ward's+Island,+Toronto,+ON/@43.6270462,-79.3643374,15.98z/data=!4m5!3m4!1s0x89d4cae72ec2ff13:0x924d8542dc554ef0!8m2!3d43.6320265!4d-79.3554029?hl=en. [Accessed 29 Nov. 2019].

[60] Google. "Area of Centre Island." Google Maps. [online] Available: https://www.google.ca/maps/place/Ward's+Island,+Toronto,+ON/@43.6155396,-79.3810551,15.75z/data=!4m5!3m4!1s0x89d4cae72ec2ff13:0x924d8542dc554ef0!8m2!3d43.6320265!4d-79.3554029?hl=en. [Accessed 29 Nov. 2019].

[61] Beatty, L. (2019). Ward's and Algonquin Islands, Toronto Harbour. [online] Nationalgeographic.com. Available at: https://www.nationalgeographic.com/travel/canada/wards-and-algonquin-islands-toronto-harbour-ontario/ [Accessed 30 Nov. 2019].

[62] Google. "Distance between TRCA headquarters and Toronto Islands." Google Maps. [online] Available: https://www.google.ca/maps/place/Toronto+and+Region+Conservation+Authority+(TRCA)/@43.6857663,-79.6297124,10.56z/data=!4m5!3m4!1s0x882b2e2c97504421:0x7843e7d4d4ba8eff!8m2!3d43.786351!4d-79.532578?hl=en. [Accessed 29 Nov. 2019].

[63] CostHelper. (2019). How Much Does a Pager Cost? - CostHelper.com. [online] Available at: https://electronics.costhelper.com/pager.html [Accessed 30 Nov. 2019].

Appendices

Appendix A
Service Environment - site survey to Toronto Islands

Central community areas:

Figure 15. Algonquin Island Association

Figure 16. Montessori/Community Centre on Algonquin Island

Figure 17. Sunshine Centre for Seniors, Ward's Islands

Locations of central meeting points may be important in conducting communication.

Linear settlement	 Figure 18. Houses are linearly built along roads in neighborhoods, with vegetation on the other side. Taken Oct. 13 2019.	Settlement pattern useful in determining central communication points (eg. public broadcasting).
Sound Levels	Around 10-30 dB (measured on NIOSH Sound Level Meter)	Ambient sound levels useful when considering emergency noises.

Appendix B

Intercom cost calculations

1 video intercom system, 4 substations (5 parts): ~$4000 + installation [57] = ~$800/part

Area of Ward Island: ~56000m^2 = 0.056km^2 [58]

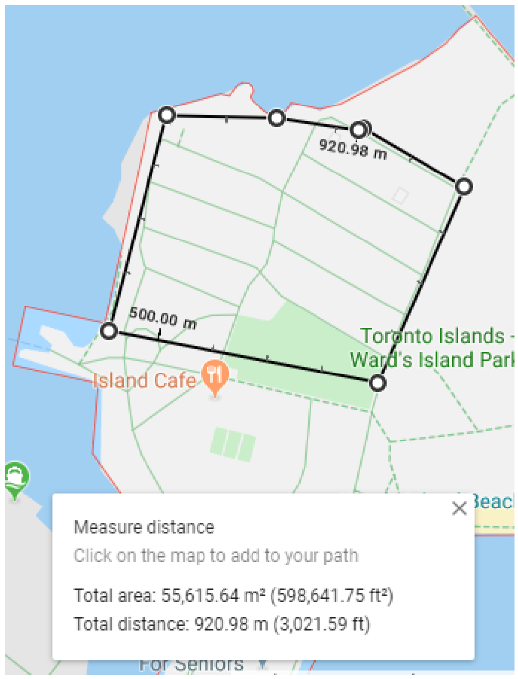


Figure 19. Area of Ward Island [58]

Area of Algonquin Island: ~77000m^2 = 0.077km^2 [59]

Figure 20. Area of Algonquin Island [59]

Area of Centre Island: ~157000m^2 = 0.157km^2 [60]

Figure 21. Area of Centre Island [60]

Number of houses from residential areas: 262 [61]

Master stations: 1/1.5km^2 → 1x3 areas = 3 master stations

Substations(intercoms): 1/house → 1x262 houses = 262 intercoms

Total Parts = 3 + 262 = 265

Total Cost = 265x$800 = $212000 + installation

Appendix C

Intercom, ringer and alert dissemination reception speed calculations

$v_{light} = 3 \times 10^8 m/s = 1.8 \times 10^7 km/min$

Distance between TRCA headquarters and Toronto Islands: $d \cong 22.6$km [62]

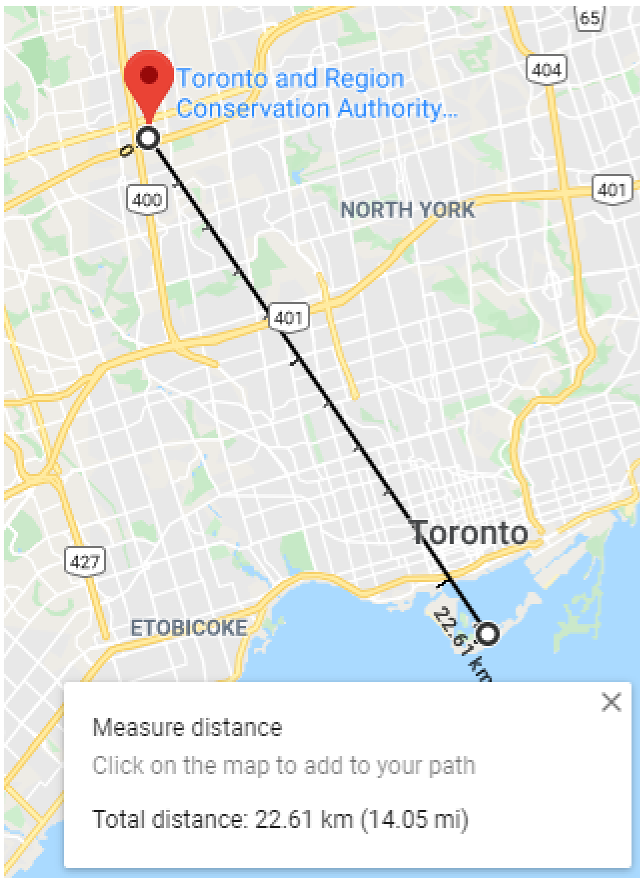


Figure 22. Distance between TRCA headquarters and Toronto Islands [62]

$t_{reception} = \frac{d}{v_{light}} \approx \frac{22.6km}{1.8 \times 10^7 km/min} = 1.26 \times 10^{-6} min$

Appendix D

<u>Ringer cost calculations</u>

Number of elderly on TI: ~4614 [13] → round up to 4650 potential users

Cost of device: ~$60 (device analogous to pagers) [63]

Total Cost: ~5000x$60 = $279,000

Appendix E

The automated message delivery flowchart begins with an *if statement* that presents a case about whether a warning should be issued. If the answer is yes, then the code will continue working down the right side of chart beginning at the *read case*. The *read case* outlines an executable statement that will read a *print statement* that will encompass the warning message. The *call interface* is another block of code that generalizes the functions of a call and it *implemented* in the *parent class*, which represents the decision workflow in the flow chart. The *print statement* is executed, the *if statement* ends, and the *test ends.* In the case where a warning is not needed, the *if statement* directs the code to the left side of the flow chart. There can be many options for an *analytic case*, one is catching an error by implementing a *warningMessageErrorException*. If the exception is called, then the warning message was supposed to be called but was not and an engineer will need to debug the code and manually issue an alert. The *multiple case interface* is another general code block that outlines the various cases that handle various exceptions. This interface is *implemented* by the *parent class* (flow chart). If no exception is called, there really should not be an alert issued and the code ends.

Appendix F
Rough Solutions List from free and structured brainstorming:

1. Standard for communication
2. Town-speaker for citizens
3. Linked transmission (eg. Amber) but without smartphones
4. People going door-to-door
5. Telecom in every home
6. Alarm (like fire)
7. Microphone inserted in “non-smartphones” and radios → make them speakers
8. Flyers
9. Posters
10. Letters delivered to doorstep
11. Telegram
12. Phone calls made to every resident
13. Morse code
14. Newsletters

15. Information on sandbags/trees
16. Submission boxes for residents
17. WPA with test back to confirm
18. Electronic billboards
19. Smoke signal in air
20. Smell signal → sulfur release in house
21. Mini patrol robot
22. Flashing lights
23. Flashing lights - Specific light colour from flash of screen placed in house + QR code
24. Flashing lights - Mini projectors switch on inside houses
25. Flashing lights - Fire torches outside houses (creates domino effect along neighborhoods)
26. Flashing lights - Red lights on trees
27. Flashing lights - Paint trees' bark with paint that glows when signal sent
28. Flashing lights - Street lights flashing
29. Vibrations with devices
30. Vibrations with wristbands
31. Implant microchips that send electric shock
32. Implant brain chip that alerts them
33. TV
    a. Announcements start playing → interrupt all programs
34. Water sprinklers
35. Personal Ringer for Citizens
36. Mailman for Floods
37. Tracker for Citizens (attached to them)
38. Boat Blasting Horns
39. Trigger Smell
40. Morse Code Machines
41. Online Flyer
42. House Speakers
43. Cuckoo clocks that make sounds when signal sent
44. All doors automatically open when signal sent
45. Water changes colour when signal sent (eg. food colouring)
46. Bird Messengers
47. Animal Indicators (trained animals)
48. Drums
49. Loud irritating music
50. Fire torch domino effect (one house lights torch, then others follow)
51. Paint Coat for House Color Changing
52. "Bat Signal"
53. Sulfur/or any triggering scent release in house (smell alert)
54. Power Outage to alert
55. Power surge
56. "Doppler" in Speakers

57. Lighthouse beam shone all over island
58. AlertMonroe-Type Alerts (email, sms/text, email, home phone, cell phone calls)

Appendix G

Feasible solutions:

1. Town-speaker for citizens
2. Linked transmission (eg. Amber) but without smartphones
3. Telecom in every home
4. Alarm (like fire)
5. Microphone inserted in "non-smartphones" and radios → make them speakers
6. Flyers handed out to residents from their community centres, sent in mail and at public spaces to give projected information on flooding. Combine with another solution to give a more urgent alert.
7. Put up posters with key information (eg. emergency contacts) on trees/billboards and supplement that with another solution to give urgent alerts.
8. Send letters to residents' mailboxes in advance, and combine with a more urgent alert.
9. Dial a certain number that will refer you to an automated call giving information about next steps (updated timely, can keep pressing numbers to view past steps)
10. Phone vibrates in Morse code
11. Newsletters delivered to residents.
12. Information on pole signs posted along every neighborhood, combine with another solution to alert residents.
13. Information printed on sandbags, as they will be used and prevalent to residents already
14. WPA (Wireless Public Alerting) but not on smartphones/LTE/Internet with feedback to confirm received acknowledgement
15. Electronic billboards displaying emergency information.
16. Flashing lights - Red lights on trees
17. Flashing lights - Paint trees' bark with paint that glows when signal sent
18. Flashing lights - Street lights flashing
19. External hardware source placed on trees/poles/buildings that sends waves to activate unique vibrations in ALL phones to signal danger
20. Vibrations with wristbands that are worn by residents, combine with another solution to prompt residents to reach information elsewhere.
21. TV announcements start playing → interrupt all programs
22. Water sprinklers in house going off when signal sent, and combine with another solution to prompt residents to reach information elsewhere.
23. Personal Ringer for Citizens (automated calls sent to them)
24. Boat Blasting Horns as sign of emergency, combine with another solution to prompt residents to reach information elsewhere.
25. Trigger Smell → electric signal triggers release of sulfur from sealed container.
26. Flyers delivered via email/text
27. Speakers in house give announcement
28. Fly small/compact drones to drop letters/packets consisting of information

29. Fly small/compact drones to announce warning
30. Support dogs for elderly people → dogs wear collars that play specific sound/display light when signal sent, and they are trained to notify their owners to check emergency information from other sources.
31. Community Centres/Public areas have people play loud drums to draw people out
32. TV/speakers in house/Loudspeakers in community centres or public spaces start playing loud irritating music (and then gives information)
33. Feature of intercom/device that sends message to each person and shows them the response of their neighbours, which prompts them to respond (provide feedback) due to social pressure.
34. Paint a wall of house with luminescent paint with a mini-projector opposite that displays information during floods.
35. Firecrackers released.
36. Specific item/device in house turns on/off, temporarily, ~10 min, repeats. Residents notified prior to that what it means.
37. Make certain appliances turn on/ glow brighter. Maybe implement a device in houses?
38. Frequency Set-Up in Speakers, change in frequency based on location (leads people to info source?)
39. Lighthouse beam shone all over island → if not visible for the entire island, enact mini light poles in sync with the lighthouse, which could be like a main light
40. AlertMonroe-Type Alerts (email, sms/text, email, home phone, cell phone calls)

Appendix H
REFINED LIST AFTER 2 MULTIVOTING ROUNDS

1. Town-speaker for citizens
    a. O1**:** Residents will have to be trained to respond to message prior and it will take them several steps
2. Intercom in every home + feature of intercom/device that sends message to each person and shows them the response of their neighbours, which prompts them to respond (provide feedback) due to social pressure.
    a. Feedback system is not reliable/need to fix
3. Dial a certain number that will refer you to an automated call giving information about next steps (updated timely, can keep pressing numbers to view past steps)
    a. doesn't comply with objective 4 (mandatory), will not select after this stage
4. WPA (Wireless Public Alerting) but not on smartphones/LTE/Internet with feedback to confirm received acknowledgement
    a. Will not plot→ same as AlertMonroe; will eliminate
5. TV announcements start playing → interrupt all programs
    a. Restriction/Assume: TV must be on
    b. Restriction: Viewer is actually watching/listening TV
6. Personal Ringer for Citizens (unique pattern of vibration(s))
    a. separate device that person can stick on anything (phone, wallet, backpack, hang on keychain), will vibrate/light up and user will have to press button/tap to send feedback

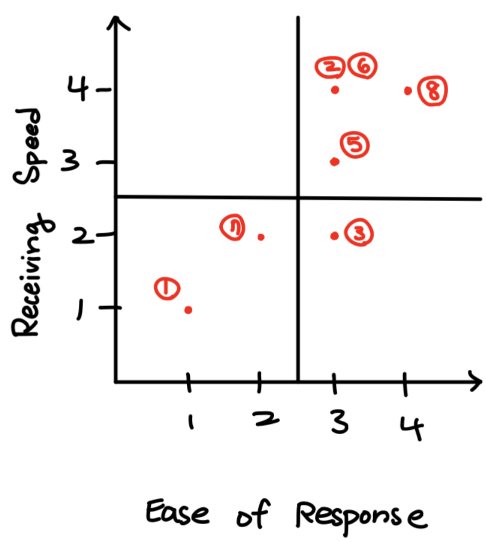
7. Specific item/device in house turns on/off, temporarily, ~10 min, repeats. Residents notified prior to that what it means.
8. Alert Monroe-Type Alerts (email, sms/text, email, home phone, cell phone calls)

Appendix I

Feasibility check: Using Graphical Design Chart

Objective #1: Ease of response
1→ Residents don't know how to indicate response to warning.
2→ Residents take >10 mins and/or 5+ steps to figure out to how indicate response.
3→ Between 5~10 mins and/or 2~5 steps taken to indicate response.
4→ <5 mins and/or < 2 steps to indicate response.

Objective #2: Information Reception speed
1→ 20+ min to receive info
2→ 10~20min to receive info
3→ 5~10min to receive info
4→ <5 min to receive info



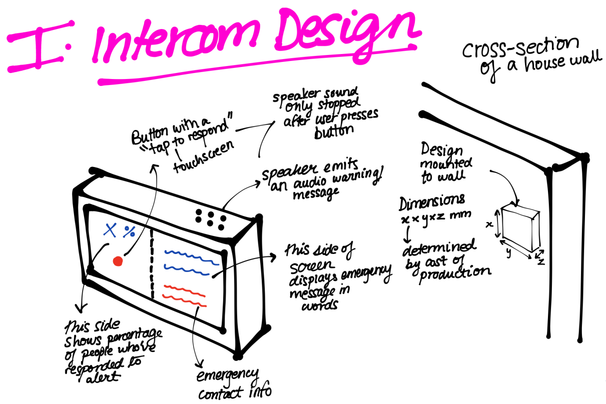
Chosen 4 ideas to design:

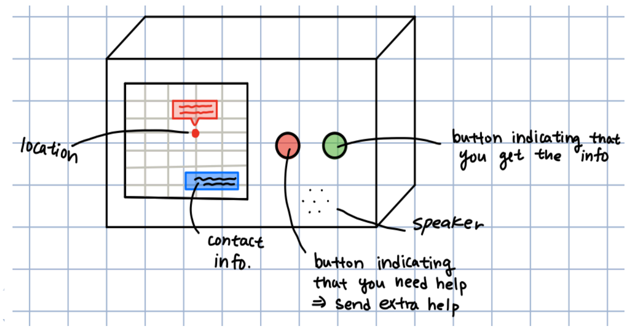
- Intercom
- TV interruptions
- Personal Ringer
- Alert Monroe-type Dissemination

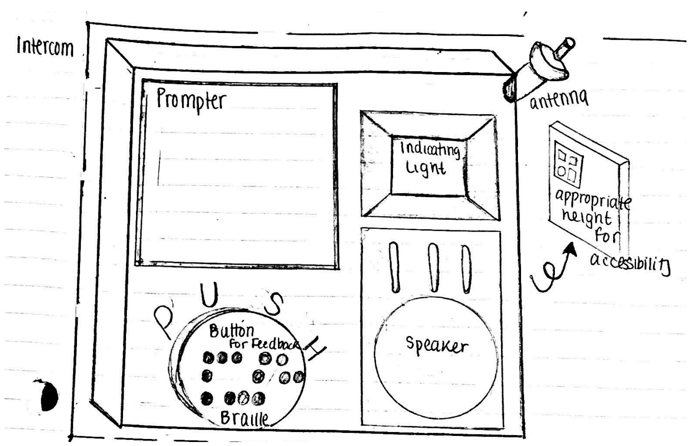
Appendix J

General evaluations of each design

- **Intercom**







Pros:

- ❖ Screen, audio, and button capabilities are optimal for elderly (our target market)
- ❖ People are prompted to respond
- ❖ Two buttons available – one to indicate feedback and another for extra help.
- ❖ Button is accessible for blindness - has braille. Indicating light and speakers will comply with constraints for epilepsy and deafness. Mounted on wall at a height that is easy to reach.
- ❖ Universal sound that triggers response

Cons

- ❖ Extra bulky box that residents may refuse to buy/put in their house as it will be useless from September to May
- ❖ Will require batteries or cord? - batteries will need to be resupplied after each non-use period / or people will plug it out from Sept. to May and maybe forget about it once flooding season comes around
- ❖ Common problem: Other technology electromagnetic waves are interfering, causing a mild or loud humming. https://www.doityourself.com/stry/how-to-add-a-lock-to-your-bedroom-nightstand

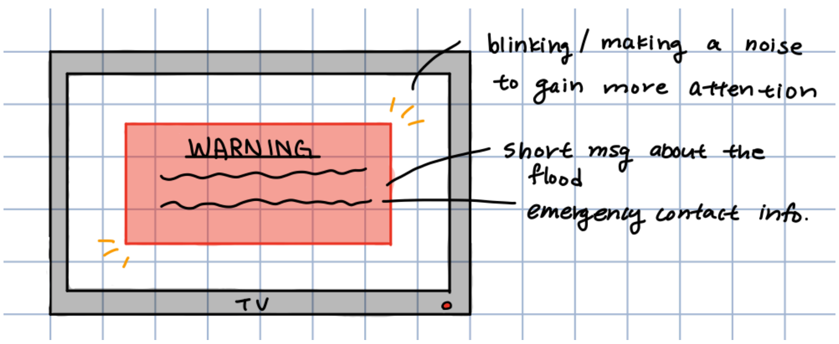
- ❖ Volume: what if some people are deaf? Deteriorated hearing?
- ❖ Works on the basis of Master system and subsystems → can be wired or wireless. Adding the infrastructure of the master system will be costly and complicated to install.

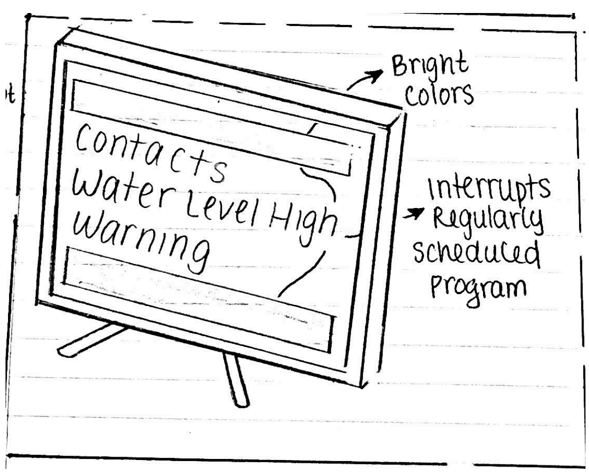
Combined Design (Telecom):

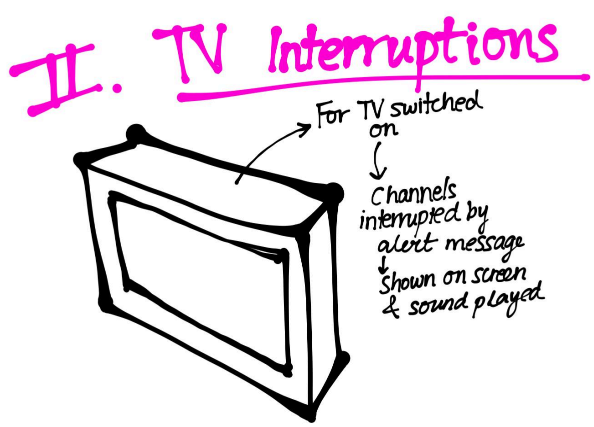
- Two buttons: ok and help
- A speaker that emits a warning message
- Braille on buttons
- Warning indicator light

Appendix K

- **TV alert**







Pros:

- ❖ Bright color, progressive image enlargement and sound capabilities are beneficial
- ❖ Bright colors following Epileptic ISO
- ❖ Information

Cons:

- ❖ TV usage may decrease significantly during summer months as people may start to spend time outside → may miss alerts
- ❖ How are we overcoming the concern of muted TV?
- ❖ Flooding can during the night, early morning, and any other odd time that TV will not be on

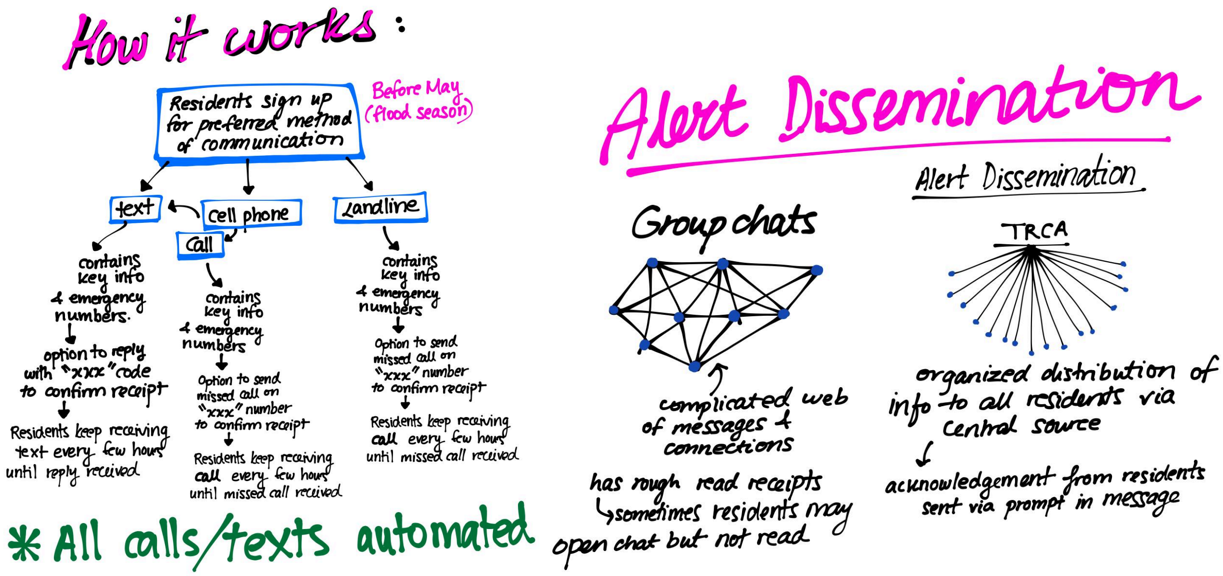
- ❖ No receipt of alert function?
- ❖ No distinct feature to notify authority/others if someone needs extra help
- ❖ Assume that demographic frequently watches TV
- ❖ No uniformed manner of response - may have to use external number to dial? https://peasi.com/2018/04/10/pros-and-cons-of-massintrusive-based-alerting-systems/

Suggestions:

- ➔ Take up the whole screen
- ➔ Less Technical Message Emphasis and more on raw language
- ➔ Implement a two-way feedback system on the TV itself

Appendix L

- **Alert Monroe**



Pros:

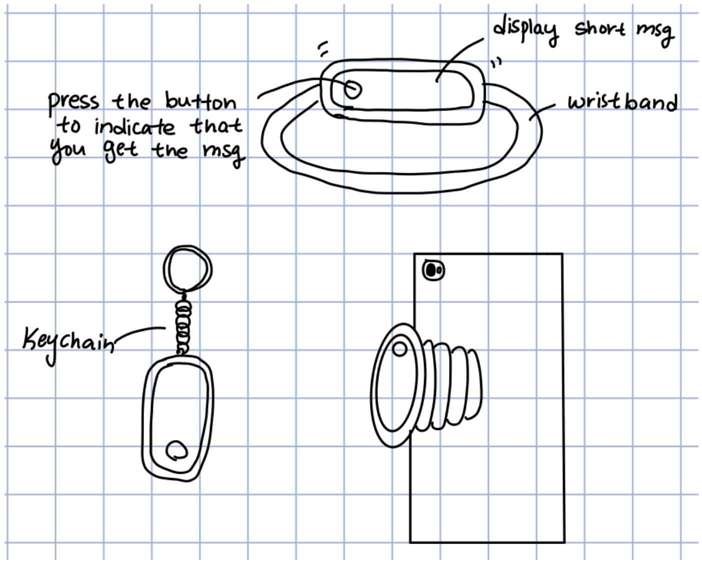
- Resident can be alerted at any time of day
- No need to be "actively pursuing an alert"
- Can redial, text, email the source to repeat the emergency procedure or alert in case someone missed it/misunderstood it
- Possibly add number to "calling" list and residents receive call either on landlines or cell phones → works with devices that they already have
- Convenient acknowledgement function
- Allows for follow up
- TV capabilities
- Residents can choose their preferred method of solution

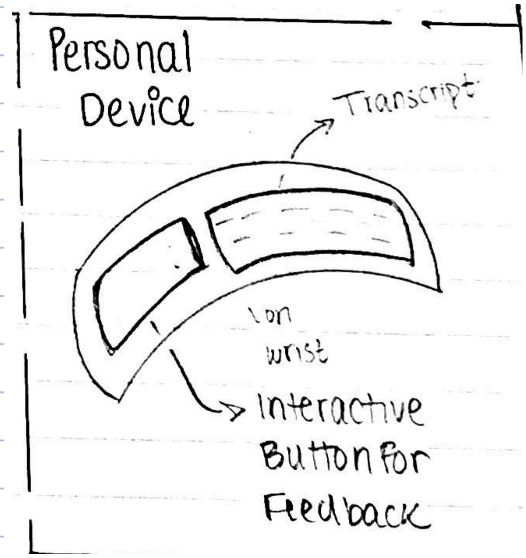
Cons:

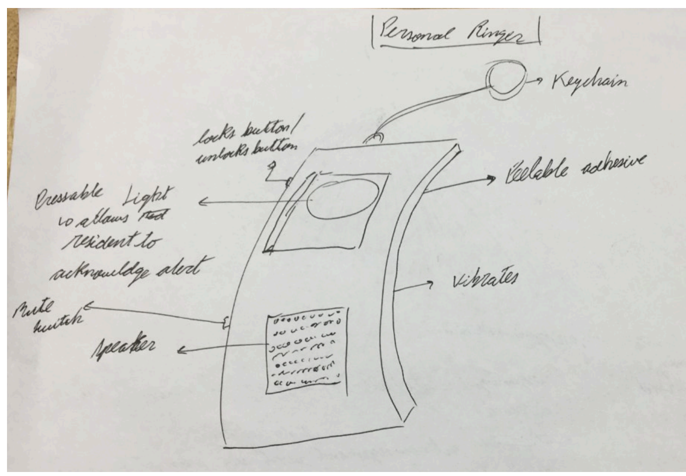
- No distinct feature to notify authority/others if someone needs extra help

Appendix M

- **Personal Ringer**







Pros:

- ❖ Can be carried anywhere
- ❖ Attached to anything without being a nuisance
- ❖ Accommodates for visual and hearing impaired people
- ❖ Caters to deaf, blind residents
- ❖ Residents cannot turn it off or adjust volume

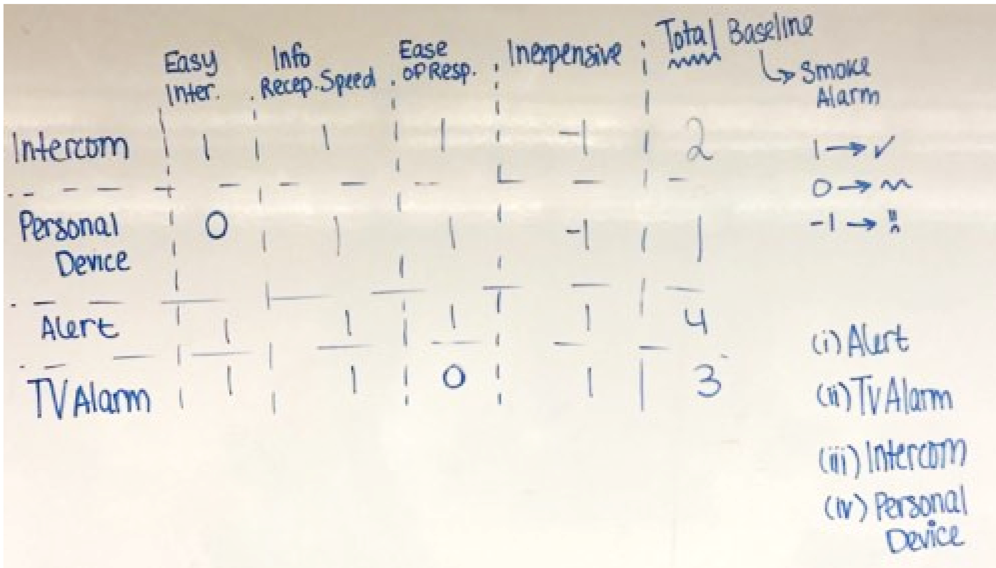
Cons:

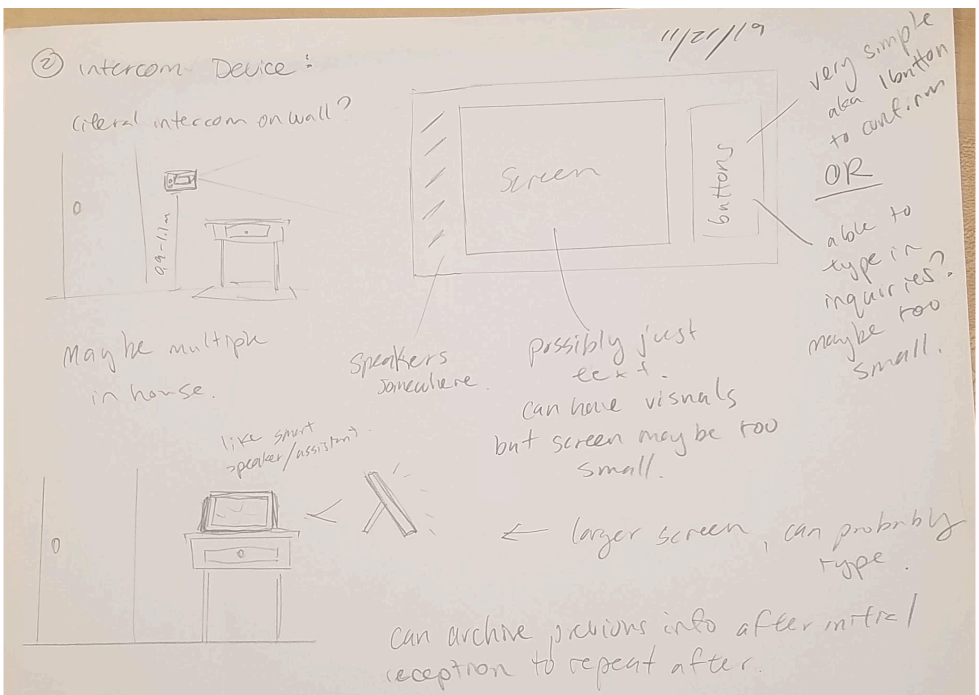
- ❖ Small device can be lost easily
- ❖ Small screen for those who can't see well without glasses
- ❖ Difficult to remember how to respond and what the signal means
- ❖ Will be irrelevant during most of the year
- ❖ Charging problem? What's the lifetime of battery?
- ❖ Difficult to conduct tests to check operations

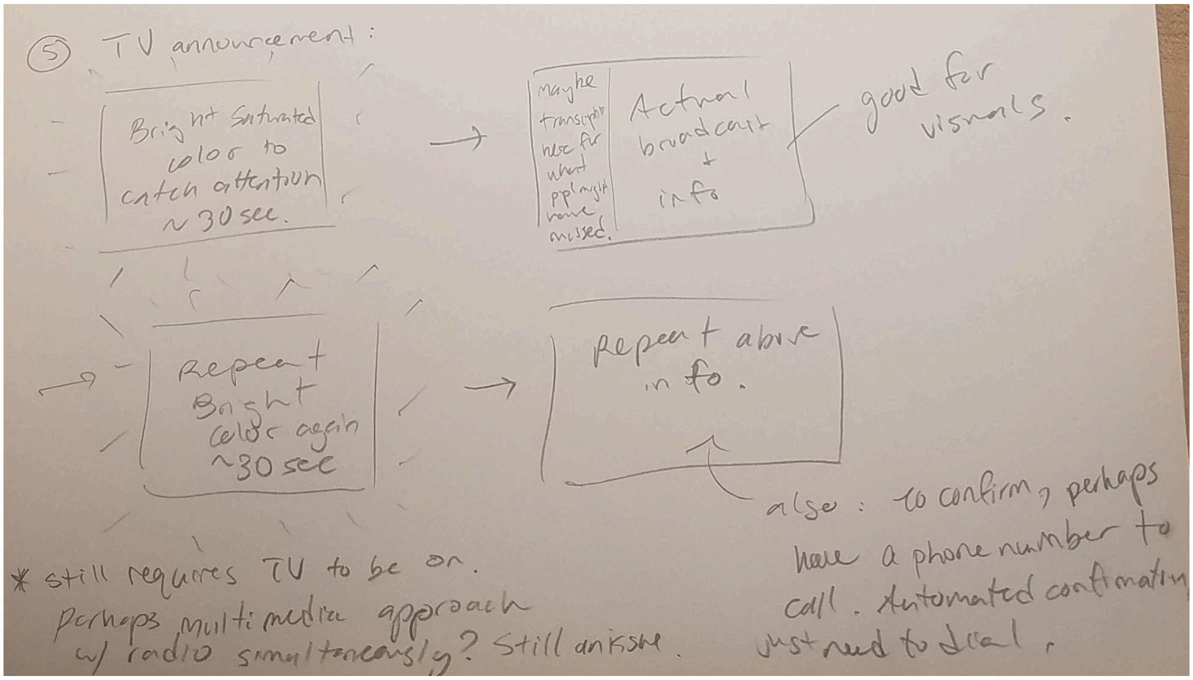
❖ Budget might be a problem

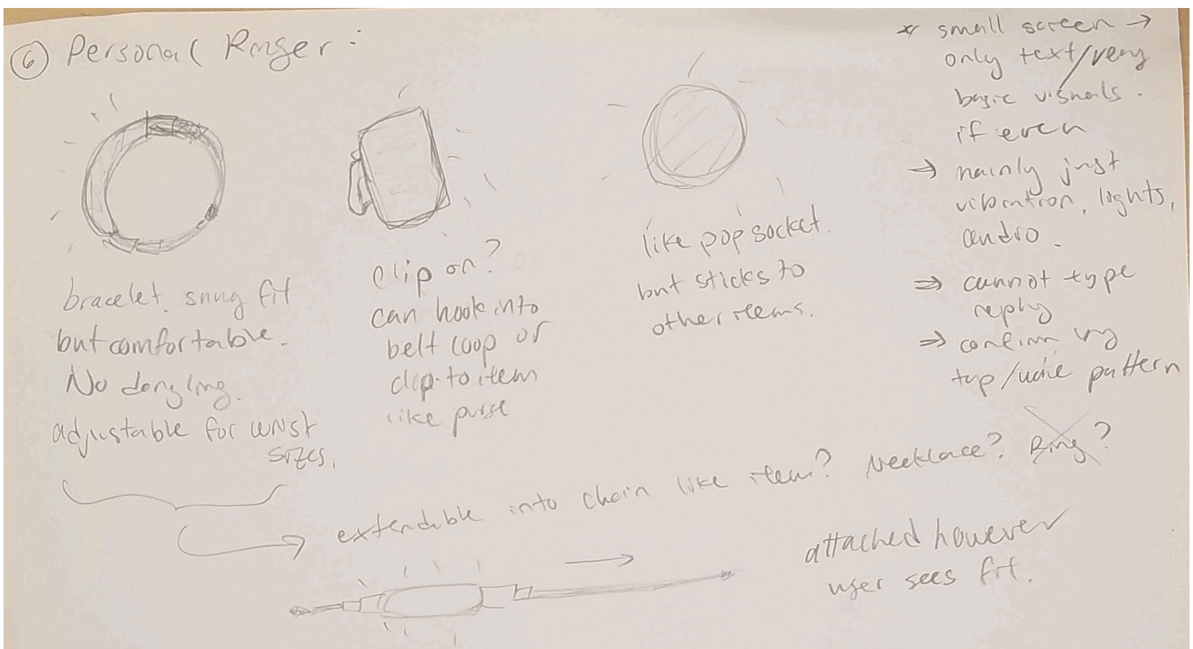
Appendix N

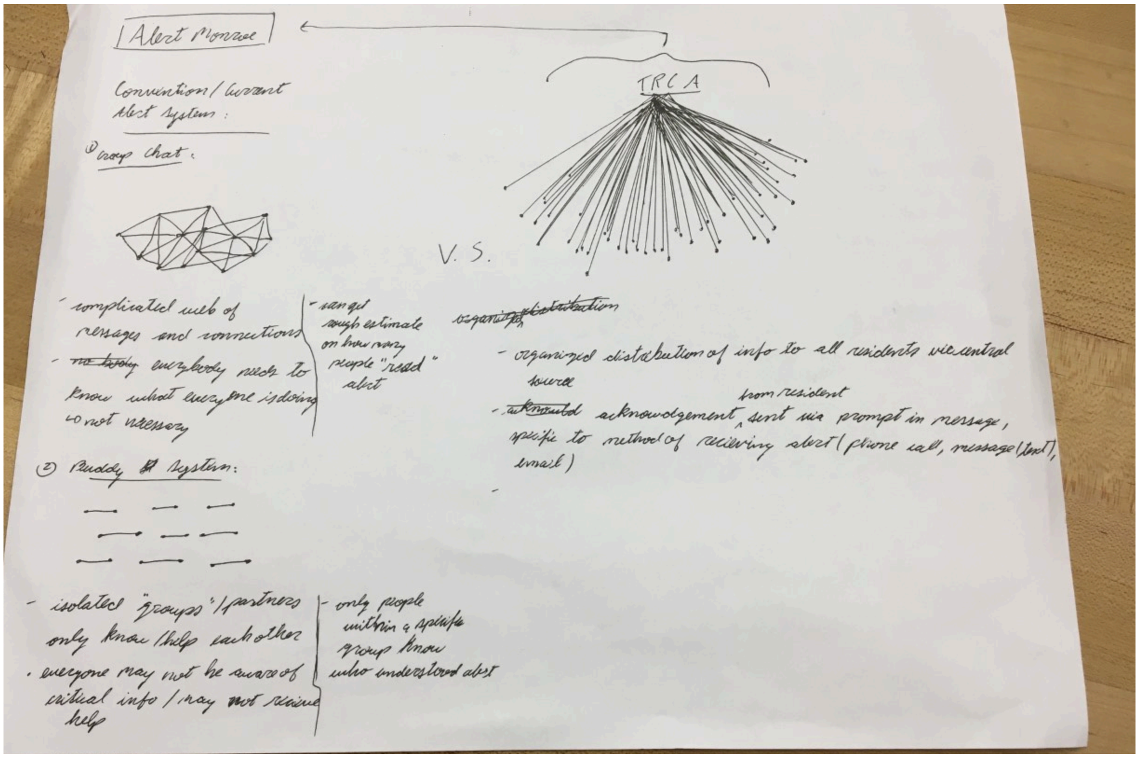
Choosing 3 Alternative Design Ideas using Pugh Method Matrix:
(Baseline solution is a smoke alarm)

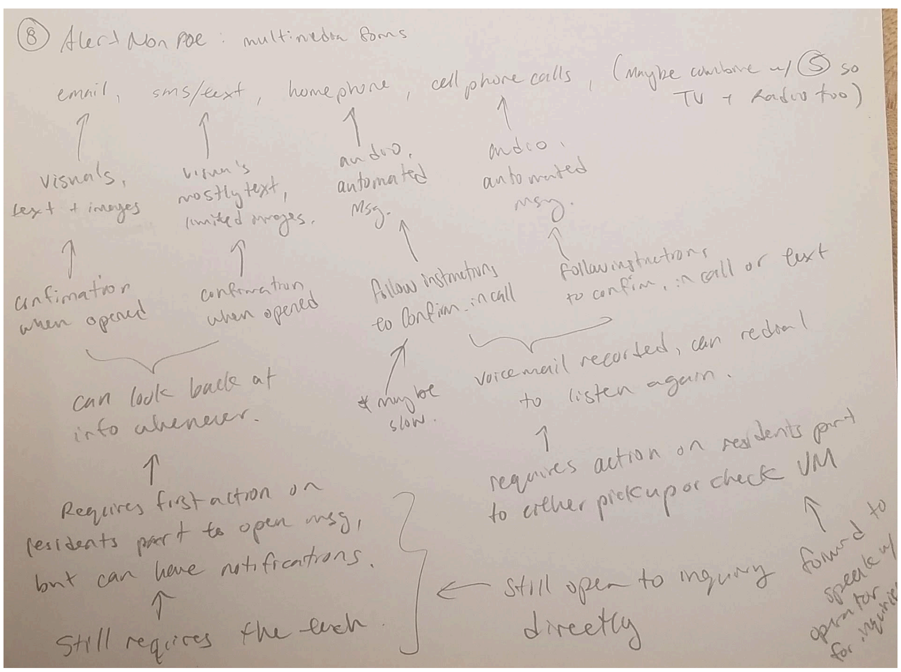





5 TV announcement:
Bright Saturated color to catch attention ~30 sec.
maybe transcript here for what ppl might have missed.
Actual broadcast + info
good for visuals.
Repeat Bright color again ~30 sec
Repeat above info.
also: to confirm, perhaps have a phone number to call. Automated confirmation just need to dial.
* still requires TV to be on.
perhaps multimedia approach w/ radio simultaneously? Still unsure.


6 Personal Ringer:
* small screen → only text/very basic visuals. if even
→ mainly just vibration, lights, audio.
⇒ cannot type reply
⇒ confirm w/ tap/wide pattern
bracelet. snug fit but comfortable. No dangling. adjustable for wrist sizes.
clip on? can hook into belt loop or clip to item like purse
like pop socket but sticks to other items.
extendable into chain like item? Necklace? Ring?
attached however user sees fit.


Alert Manage
Convention / Current Alert System:
① Group Chat:
TRCA
V.S.
- complicated web of messages and connections
- everybody needs to know what everyone is doing
- organized distribution of info to all residents via central source
- acknowledgement from resident sent via prompt in message, specific to method of receiving alert (phone call, message (text), email)
② Buddy System:
- isolated "groups"/partners only know/help each other
- everyone may not be aware of critical info / may not receive help
- only people within a specific group know who understood alert


⑧ Alert Manage: multimedia forms
email, sms/text, home phone, cell phone calls, (maybe combine w/ ⑤ so TV + Radio too)
visuals, text + images
visuals, mostly text, limited images.
audio, automated msg.
audio, automated msg.
confirmation when opened
confirmation when opened
follow instructions to confirm in call
follow instructions to confirm, in call or text
can look back at info whenever.
voicemail recorded, can redial to listen again.
requires action on residents part to either pickup or check VM
Requires first action on residents part to open msg, but can have notifications.
Still requires the tech.
still open to inquiry directly