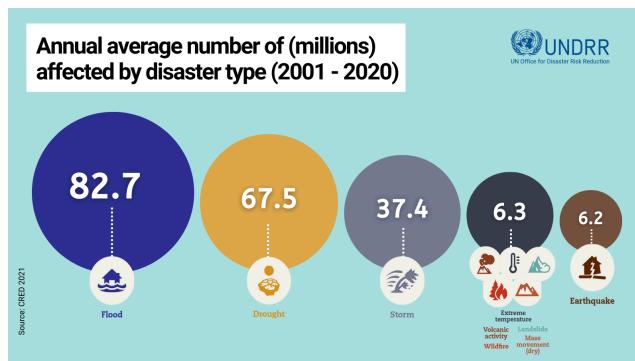


Project Template : A Gamified Mobile Application for Local Disaster Preparedness and Response

1. Introduction: Concept, Motivation

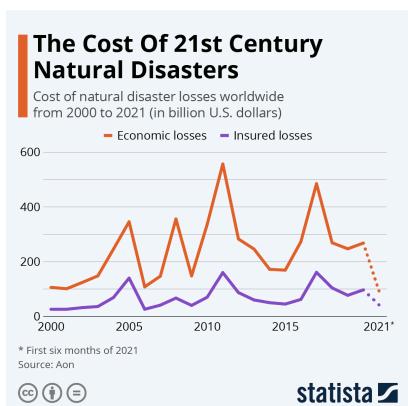
Changes in climate as a result of increasing CO₂ over the past decades has increased natural disasters
Making disaster preparation more crucial than ever (Rubin 2012) and as the number of disaster increases



UNDRR 2020, undrr.org

Preparation during disasters is now more than ever critical.

Unpreparedness can overload Emergency services, overburden hospitals and reduce economic, personal and financial loss, even crippling whole local communities, and this has been seen to happen to many different communities globally



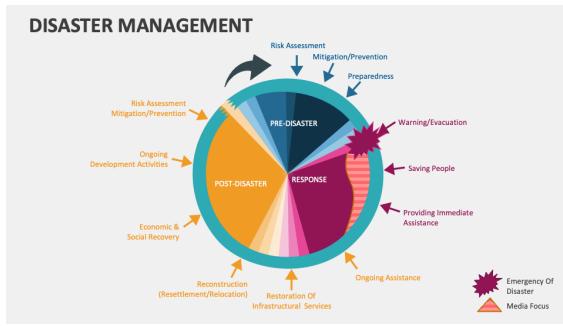
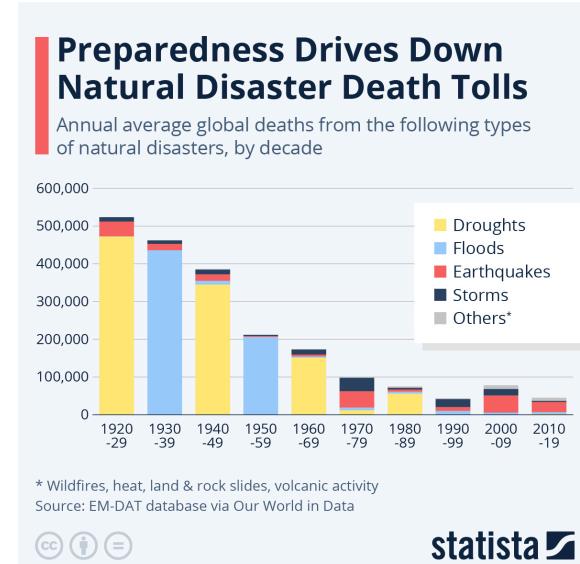
Disasters in 2012 alone cost close to 600 Billion USD, not accounting for casualties, losses in opportunities and more

Picture source:

Statistica 2021: The Cost Of 21st Century Natural Disasters

And time and time again, preparation has been proven to reduce death tolls
Yet why is there a lack of it?

Source Statistica 2021: Preparedness Drives Down Natural Disaster Death Tolls



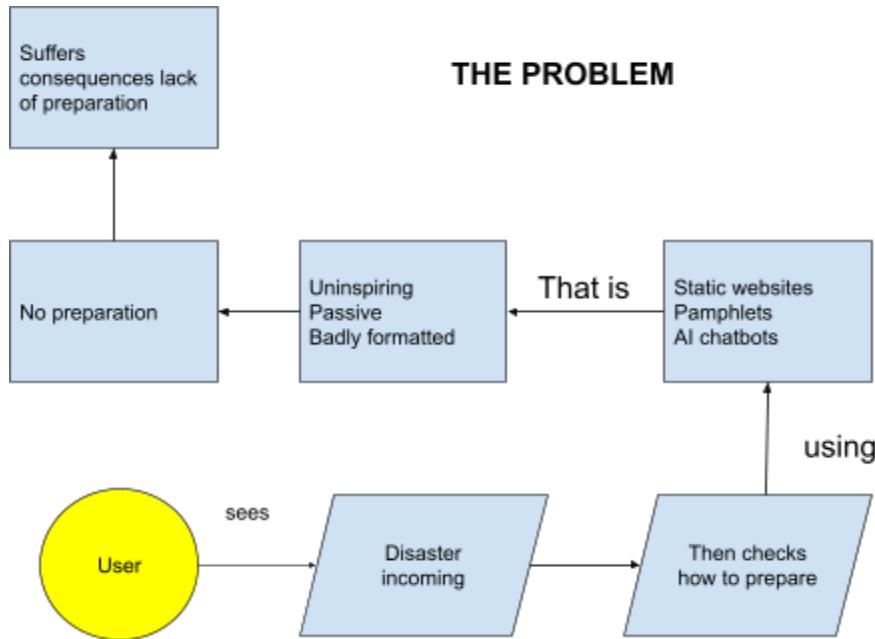
2025 Collidu: Disaster Management

The objective of this project is to analyse, study the problem, risk and consequences with lack of preparation, and implement solutions to mitigate existing problems, to help save lives and reduce losses

The problem is that there are still many households and individuals that experience disasters unprepared due to inefficiencies in today's disaster preparation heuristics.

Typical preparation methodologies such as pamphlets and static websites have been shown to be an inefficient medium of educating preparedness and even worse a

1.1 Problem Statement



Low Engagement	Information Fragmentation
<p>People think preparation is</p> <ul style="list-style-type: none"> - Burdensome - time consuming - low priority 	<ul style="list-style-type: none"> - Critical reaction time - Need consult with different fragmented, generic sources of information

“Amotivation”	Consequences
<p><u>Current approaches</u></p> <ul style="list-style-type: none"> - Static PDFs & websites - Pamphlets - AI Chatbots <p><u>Issues</u></p> <ul style="list-style-type: none"> - Cognitive overload - Information is Inspiring, passive - Badly formatted - No social reinforcement and feedback loop 	<p>When there is a lack of preparation due to it being seen as “low priority”</p> <ul style="list-style-type: none"> - Overloaded Emergency services - Hospitals overburdened - Increased financial, personal losses

1.2. Aims and Objectives

To create, develop, and test a mobile application prototype called "Rally," using gamification, measurably boosts user engagement in disaster preparedness and acting as an accurate & reliable lifeline

Objectives:

To Establish a Theoretical Market Foundation	Ensure Ethical project
<ul style="list-style-type: none"> - Identify proven methods - understand and utilize motivational mechanics - Gain understanding of motivation mechanics thorough literature reviews 	Design a high fidelity UI around user-centered methodologies and to proven conventions in HCI theory
To conduct a Functionality analysis	Ensure Ethics
Analyze, validate <ul style="list-style-type: none"> - functional gap - Offline capabilities - real time alert functionality with gamification - Conduct competitive analysis of existing apps 	Conduct and analyze risks to users and the mitigations

Develop a Functional 3 Pillar MVP (Development)	To Assess the Prototype's Effectiveness (Testing & Evaluation)
<p>The creation, development of the gamified “Prepare” module</p> <p>The “Prepare” module will</p> <ul style="list-style-type: none"> - employ checklists - progress bars, points <p>To encourage and motivate preparation</p> <p><u>Development</u></p> <ul style="list-style-type: none"> - Create an app with offline functionality 	<ul style="list-style-type: none"> - Assess "Response" module's effectively - Enable high speed and clarity in a high-stress scenario - To collect quantitative and qualitative data to determine & justify gamification - Creation of final analysis and report for prototypes's feasibility - Performance assessment

<u>Integration</u>	
<ul style="list-style-type: none"> - Incorporate “Live Alerts” - Receive, display location based - Real time alerts from trusted APIs 	

1.3 Full Ethics Audit: Mobile App for Local Disaster Preparedness (outlined as mandatory in coursera videos)

Ethics audits assess viability of the proposed project from an ethics perspective. I concluded that this project is ethically viable with caveats

Key Ethical Risks Identified:

High risk	Medium Risk (privacy)	Low risk
Harm to users from psychologically or mentally	No direct harm, possible indirect harm	Low to no indirect harm to users

1.3.1 Risk Area: Safety-Critical Information & Technical Failure

This is the most significant ethical challenge for the project.

Risks	Implications	Severity
Misinformation	The app provides <ul style="list-style-type: none"> - outdated, inaccurate, information like dangerous, obstruction evacuation routes, shelters, or wrong emergency contact information during emergencies 	
Network Latency	Especially devastating in time critical disasters like flash floods or tsunamis	
Over-reliance	User becomes too reliant on this app, ignoring official channels	

Mitigations

Mitigations	Details	Mandatory
Ensure data credibility	App must not use unverified, unreliable data	<input checked="" type="checkbox"/>
Fresh data	All information presented must include the last updated timestamp.	<input checked="" type="checkbox"/>

	Warning tags must outline if information cannot be updated	
Offline design	Static content like guides for first aid, survival tips, emergency contact and general safety checklists must be download, and stored locally offline	✓
Prominent Disclaimers	Mandatory, disclaimer on its first use stated clearly in their clear selected language THIS APP IS A SUPPLEMENTARY TOOL, NOT A REPLACEMENT FOR EMERGENCY SERVICE ALWAYS FOLLOW THE ADVICE OF LOCAL AUTHORITIES IN AN EMERGENCY	✓

1.3.2 Risk Area: Data Privacy & Security (End-User)

Risks	Implications	Severity
Sensitive data collection	The app uses GPS services which means vulnerability to attackers who wants to pin point user location - Moderate risk because home address is not risky if anonymized	⚠️⚠️
Insecure data	- More of general cybersecurity risk	⚠️⚠️
Unnecessary steps	Unnecessary steps can slow response	⚠️⚠️⚠️

Mitigations:

Details	Mandatory
Login, registration optional	✓
Locally store & encrypt checklists, badges, saved location	✓
A clear & accessible privacy policy ensures compliance with local law and regulations	Advisable

1.3.3 Risk Area: Human Participants (Research & Testing)

Risks	Implications	Severity
Lack of Informed	Participants did not understand what the data is collected	⚠️⚠️

Consent	during their testing such - screen recordings - recording down their personal opinions	
Tester Coercion	Test participation rewards such as vouchers or cash can unduly influence the tester to only give positive feedback	

Mitigations

Implications	Mandatory
All test participants understand the project's: - Objective - Expectations of data handling. It must be consented and signed prior to testing	
Mandate date anonymized, encrypted by blurring in video recording via irreversible post processing, names and personal data removal	 E.g GDPR compliance in EU PDP Compliance in Singapore

1.3.4 Risk Area: Psychological & Social Impact (Gamification & Accessibility)

This risk relates to the *tone* and *design* of the app.

Risks	Implications	Severity
Test induced distress	A simulated test environment where disasters are simulated may cause distress Risky for emotionally vulnerable testers Gamification elements like notifications, progress bars can contribute to anxiety and mental overload	
Trivialization	Game elements such as badges, rewards, progress bars may make it seem more like a game rather than an emergency	

Mandatory Mitigation Strategies:

Implications	Mandatory?
and form a rapport with users while avoiding alarming texts	✓

Final Conclusion

the project may proceed, but the mitigation strategies outlined in this audit should be implemented

Document Meta data	
Word count 1000/1000 Excluding image citations	 GPTZero AI Detection Model 3.13b We are highly confident this text is entirely <u>human</u> <small> ⓘ</small> Probability breakdown ⓘ 0% AI generated 2% Mixed 98% Human

2. Literature Review

A Theoretical and Applied Justification for "Rally"

2.1 Introduction to the literature review

The purpose of this literature review is to analyze and report on the feasibility of Rally's MVP through the lens of the prototype as a proof of concept to assess its performance relative to the primary goal of this project

This review outlines a three part argument to re-enforce the project's academic justification

Core themes

1st Core theme	2nd Core theme	3rd Core theme
It characterizes the "preparedness gap" as a behavioral and psychological problem instead of an informative one	This part develops a theory of motivation using self-determination theory as a conceptual backbone to explain why current methods don't work well and how Rally's gamification can enhance efficacy of user compliance	Outlines 3 different relevant case studies and analyze the difference and efficacy of each of these case studie's implementation and its efficacy

2.2 The Core Problem: The "Preparedness Gap" as a Behavioral Challenge

The main problem in today's on the market preparedness apps/static websites is that they are based on the erroneous "information deficit" model

This model holds that awareness on its own is not sufficient to motivate action

When we look from the psychological perspective, being prepared is considered an "amotivational" task as it involves having mental models that long-term and of abstract thinking which can be mentally demanding resulting in cognitive overload and even optimism bias

Therefore, a lack of drive rather than a lack of data is the main problem with today's app/static preparedness websites.

Unlike immediate concerns, the seemingly distant threats of disasters can fail to trigger (motivate) action leading to 2 primary psychological barriers

Cognitive Overload	Optimism Bias
Traditional methods are often unformatted, untruncated, badly presented information like 50 page PDFs that causes cognitive Overload	The optimism bias is a bias that states that the abstract nature of disaster threat allows the user to succumb to inaction “If Larry, next door doesn't harden his flood barriers, then i dont think i need to too”

2.3. A Theoretical Framework for Engagement: Self-Determination Theory

Now that from the above section, we outlined that motivation is a problem, it is now important to view motivation and analyze it, from the perspective of psychology and user interaction design principles

In psychology, Self-Determination Theory (SDT) developed by Deci & Ryan, its a concept that states that in order for someone to be motivated intrinsically to complete any task, three separate psychology needs must exist

Competence	Autonomy	Relatedness
Competence refers to a sense of accomplishment, efficacy, and advancement of the task completion	Being in charge and being able to make important decisions to complete or progress to complete the task	Relatedness refers to a sense of belonging and a common goal between the different associated tasks

The issue for the current typical preparedness guide here is outlined clearly. It shows that competence is degenerated by the amount of information untruncated obstructing competence

The information are also inflexible, consisting of top down simple lists and provides no relatedness further debilitating motivation

Gamification henceforth, steps in to solve the “gimmicky” preparedness guide, by turning it into a useful, practical psychological intervention

2.3.1 Critique of current methods using SDT

Through the lens of SDT, the issue with current methodologies of preparedness makes sense.

Todays existing solutions involves static websites, pamphlets and even AI Chatbots

There is a clear frustration of competence, where traditional guides gives out information unformatted, fragment and as a massive monolithic task ("Prepare for category 5 typhoon")

With no formatting, no truncation is a perfect disaster for cognitive overload, and it is understandable any normal person would have the patience, nor the ability to focus and retain the 50 page pdf preparedness guide

These current solutions also provide solutions that are rigid and prescription often in the form of do A, B, C, D This takes away autonomy from the user as it has no feedback or offer no agency

Basically, treating preparedness as a chore of sorts

2.4 Gamification as Applied Theory: The "How"

Kankanamge et al. (2020), in their 2020 systemic review, outlines the important components of what good disaster planning and preparedness should consist of.

The concepts learned from Kankanamge et al. (2020) is now then mapped directly to the SDT

Kankanamge et al., in the same systemic review also pointed out that competency should be awarded by points, badges, and "Levels" rather than merely ornamental acknowledgements, they also mentioned that a good disaster preparation app should offer prompt, concrete feedback, transforming daunting assignments with messaging like ("Get 100% prepared") into a doable, incremental ladder of success such as ("You've earned the 'Kit Builder' badge!").

We also consider another notable study done by Matsuno et al. (2021), which shows that in their flood simulation app.

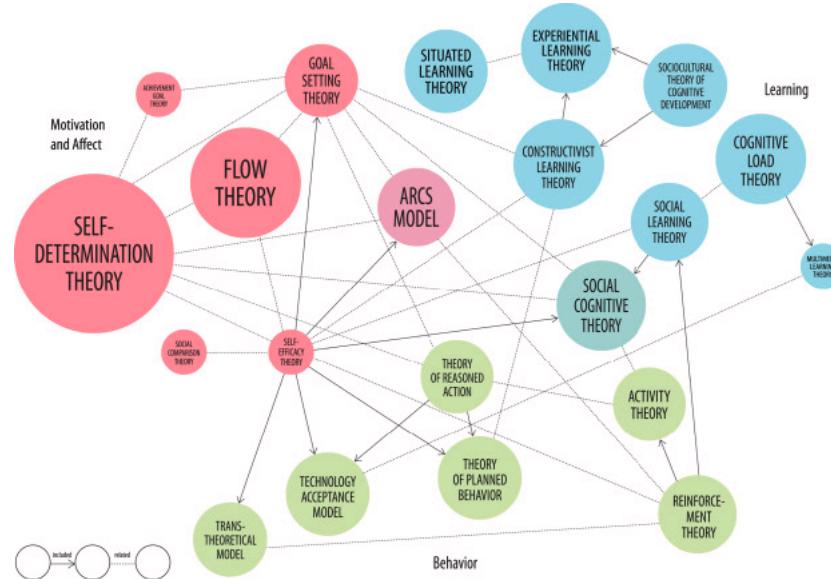
Matsuno et al's app consists of narrative scenarios and quizzes that offer a sense of autonomy. The user is provided with the freedom of agency in a safe simulated environment which helps them to make choices and directly observe direct consequences

Compare it to reading a simple top down list of instructions, the user exhibited improved competency, suggesting that Matsuno et al's app is a superior learning tool

According to another study done by the same Kankanamge et al., shows that leaderboards and social sharing can produce the psychological aspect relatedness in the self determination theory (SDT)

This enabled the ability to transform readiness from a solitary task into a communal, social activity ("Your neighborhood is 70% Rally-Ready").

From SDT (Why) to Gamification (How), this theoretical-to-practical pipeline offers a strong, fact-based defense of Rally's fundamental architecture.

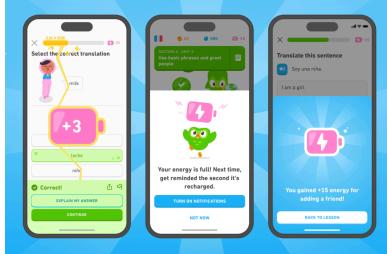


ScienceDirect 2021 Revealing the theoretical basis of gamification

2.5. Evidence in Practice: Proven Components, Unsynthesized

This is the last part of the report which outlines the 3 different case studies to evaluate the differences, the pros, cons, success and failures of each app. Try to combine the things that works to outline what an effective Rally MVP should be

Case Study 1	Case Study 2	Case Study 3
The Platform (FEMA & Zello)	The Habit-Building Mechanic (Duolingo & Fitbit)	The Market Failure (Met Office vs. Red Cross)
<p>The FEMA app has</p> <ul style="list-style-type: none"> - Enabled the cell phone to be a life saver during crises - Widely trusted by US citizens - Provides reliable information on shelter 	<p>Fitbit step goal & Duolingo</p> <ul style="list-style-type: none"> - Proven to provides a good low and slow long term task - Prime examples of competence feedback loop in action - Gamified mechanics to 	<p><u>Met office App</u></p> <ul style="list-style-type: none"> - Lacks some of the functionality as compared to the other apps here <p><u>Red Cross App</u></p> <ul style="list-style-type: none"> - Features essential offline capable guides

<p>locations and more</p>  <p>FEMA</p>  <p>Zello App</p>	<p>effectively create and sustain habits long term</p> 	<ul style="list-style-type: none"> - Extensive knowledge base for survival - No localized real time data integration  
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2.5.1 Summarized Comparison

Features	Gamification?	Real Time?	Offline Capable?
Fema	No	Yes	Partial (only checklists)
Zello	No	Yes (Live Audio)	No
Met Office	No	Yes	No
Red Cross	Partial (Quizzes/badges)	Yes	Yes
Rally (proposed)	Yes	Yes	Yes

2.6 SWOT Analysis

A study to identify Rally's internal strengths, weakness, as well as its external opportunities and threats

Strengths	Weaknesses
Rally's model is unique hybridized model of the three proven pillars of human computer interaction and	It might be dependent on external APIs in its response hub and this means that real time

<p>interaction design</p> <ul style="list-style-type: none"> - Gamification - Real time alerts - Offline centric design <p>Rally's foundation design is also based around strong theoretical rigor where the SDT (self determination theory) is applied from a top down approach</p>	<p>updates and alerts may not be robust as the Gamification and preparedness section</p>
<p>Opportunities</p> <p>The market gap analysis shows a clear cut market void</p> <p>Existing apps are either:</p> <ol style="list-style-type: none"> 1. Data first (alerts) 2. Static guides <p>This provides a clear opportunity for Rally to provide a synergized hybrid solution</p> <p>Climate change increasing frequencies of disasters due to CO2 emission also provides with a rising demand for disaster preparation</p>	<p>Threats</p> <p>Existing apps such as Met Office or FEMA could easily integrate my other features into their app reducing Rally's unique value proposition</p>

2.7 Critique of this literature review

Strength of my argument in this literature review

The strongest point of my argument in this literature review is presented 2.2, with the rejection of the information deficit model. This after further analysis and research, replaced the informational deficit model with the “Motivational Deficit” model

My argument shifts that the solution of this being a “we need better code” problem, to be a “we need better psychology & design”: a human computer interaction (HCI) problem

My literature reviews justify the why, of needed Rally, instead of just a better pamphlet or website

My information “Silo” argument categorizes existing solutions into classes such as “Data-first” or “Content-first”

I prove through a visual matrix where the intersection exists between the Data first and content first functionality as the gap that Rally can bridge

And my theoretical application of bridging Self Determination Theory (SDT) to gamification mechanics further shows that Rally is not just any gimmick, but a solution derived from academic rigor

Gamification elements like progress bars, badges, fun colors, fonts and animations aren't just for fun. It provides motivation and psychological satisfaction to the "Competence" pillar of our psychological framework

Critical Weaknesses & Blind spots (The “Gaps”)

I haven't fully addressed the "Trivialization" Paradox presented when Gamification exists. I argued that gamification solves the engagement problem, but i have not fully mitigated the risk of gamification trivializing life or death context

I have not fully tested if badges, points, fun and friendly colors would make a crisis feel less serious, and its extent thereof.

I like to use Duolingo as examples of success stories of engagement but fail to mention the problem that these apps face, that they too often suffer from the “Novelty Effect”, that users are motivated for up to 2 weeks, which they often then get bored when badges stop feeling special

Since this literature review showed that disaster preparation is a “forever” task, my literature review assumes that the gamification works indefinitely, and for sure Rally would suffer the “Novelty fatigue” effect as duolingo as fitbit

Another area worth critiquing is that my review implies gamification works for everyone without any demographical considerations. My problem statement includes elders but i did not study how gamification will impact a 70 year old, or if it will backfire

There is no literature to analyze the gamification efficacy for different ages, races, ethnicity or people with different cultural background

It also doesn't consider the efficacy of gamification for people with mobility, mental or visual impairment, maybe gamification may be too overly stimulating for a person on the spectrum, or if the animation or how different transition elements might affect epilepsy. These are all areas of consideration not studied on the literature review

Final Acknowledgement & consolidation

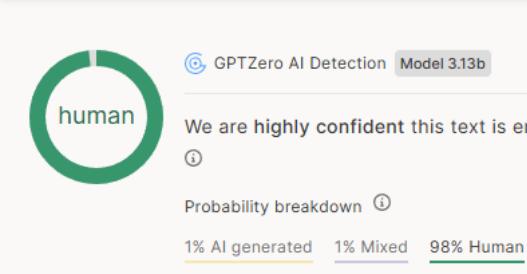
I acknowledge that gamification is the “hook” for engagement within the first 72 hours which is the most critical.

2.8 Conclusion

The Rally Synthesis

This literature review has clearly established that the core idea of the “preparedness gap” that is pervasive throughout communities is not a result of information scarcity, but a resultant of behavioral and psychological challenges caused by badly presented data, or poorly formatted information

While traditional methods based on the information deficit have failed to engage users, SDT is a robust and theoretical framework for addressing this gap

Document Meta data	
Word count 1722/2500 Excluding image citations	 <p>GPTZero AI Detection Model 3.13b We are highly confident this text is entirely <u>human</u> Probability breakdown: 1% AI generated, 1% Mixed, 98% Human</p>

3. Design Document

3.1 Project Overview

The document details the design and implementation for “Rally” a solution to solve the preparedness gap through the use of a high fidelity MVP (minimum viable product) application replacing the current on the market passive, and generic information “digital guidebooks”

The purpose of Rally is to not only provide passive information but actively engage users for disaster preparation

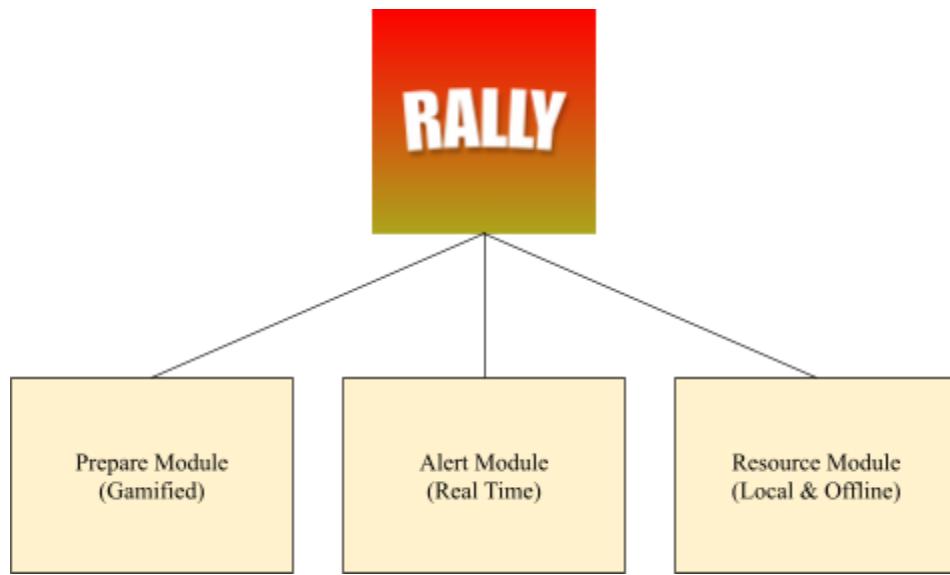
The core problem identified in the problem statement shows that

1. Low engagement in preparedness
2. Information fragmenting during a crisis

Is the main obstacles to disaster preparation

3.1.1 The 3 Core Philosophical Component

The philosophical component of Rally can be separated into 3 distinct component



Prepare module

- User centric module
- Gamified design
- Uses points, progress bars, quizzes to incentivize action

Alert module

- Solve information fragmentation through timely, location based emergency alerts
- Offline-capable database of local contracts and safety guidelines
- Ensuring app functions as a calm lifeline even if networks fail

Resource module

The resource module enable offline functionalities where critical information such as local emergency contacts

Guiding principles

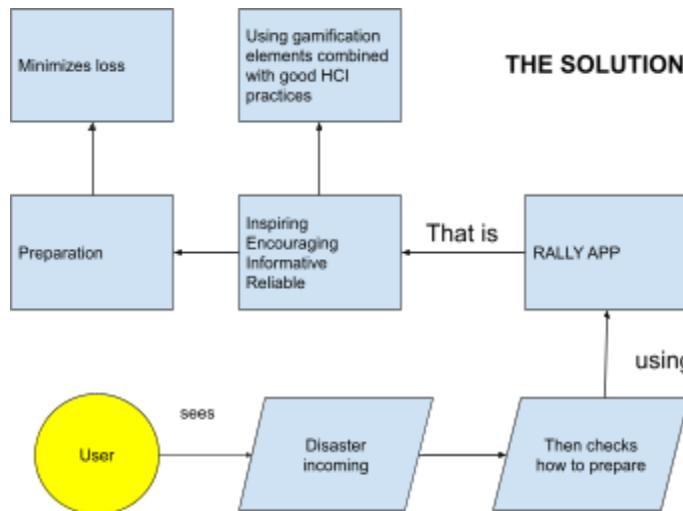
As stated in the ethics audit, the ethical guardrails, especially the safety critical nature, and the privacy requirements alongside with data protection compliance are clearly outlined in the ethics audit in the document above

3.1.2 Philosophical Foundation

The philosophy behind our app, Rally is built on the understanding of the Self-determination theory (SDT), as outlined in previous parts of this document, SDT outlines human motivation which fuels competence, autonomy and relatedness

Rally where we optimize preparedness by smart Ixd (interaction design) considerations built around the idea of SDT to solve the preparedness gap

According to SDT, true motivation relies on three psychological needs: Competence, Autonomy, and Relatedness. This theory is directly applied in our design through the use of intelligent interaction design (IxD) and gamification, which endows users with a feeling of control and mastery. In this way, it effectively addresses the “preparedness gap” that has not been bridged by passive tools.



Conclusion:
Good interaction design and human computer interaction saves lives!

3.2 Domain and users

“Rally” is an app that operates in the safety-critical domain of personal disaster preparedness and emergency responsiveness.

It is not of a singular domain, it has a dynamic context but within the parameters of a dual state user experience

The "Prepare" State (Peacetime)	The "Response" State (Crisis):				
<p>In the prepare state, it is in the domain of the low stress, amotivational state</p> <p>This is when the user is safe, and has low engagement with the app</p> <p>Main challenges includes</p> <ul style="list-style-type: none"> overcoming the initial cognitive overload and procrastination <p>The domain's goal is to motivate, educate and reward through SDT principals</p>	<p>In the response state, there is urgency and high stress, with the context being time critical</p> <p>The user may be in potential danger and cognitive overload often occurs</p> <table border="1"> <thead> <tr> <th><u>Domain</u></th><th><u>Requirements</u></th></tr> </thead> <tbody> <tr> <td>to provide unambiguous, actionable and rapid information with minimal steps</td><td> <ul style="list-style-type: none"> - Reliable - Resilient to technical failure - Works offline </td></tr> </tbody> </table>	<u>Domain</u>	<u>Requirements</u>	to provide unambiguous, actionable and rapid information with minimal steps	<ul style="list-style-type: none"> - Reliable - Resilient to technical failure - Works offline
<u>Domain</u>	<u>Requirements</u>				
to provide unambiguous, actionable and rapid information with minimal steps	<ul style="list-style-type: none"> - Reliable - Resilient to technical failure - Works offline 				

3.3 Justification of features based on domain and users

Persona 1: Sarah

The "Overwhelmed Procrastinator"

Age:	34
Profile	<ul style="list-style-type: none"> • Renter • Tech-savvy • Busy professional • Reads the news • Low level anxiety about being unprepared
Problem	<p>Getting prepared feels like single, massive overwhelming task to her She is unsure where to start and procrastinates tasks</p> <ul style="list-style-type: none"> • Suffers from “amotivation” • Suffers from cognitive overload
Goal	<ul style="list-style-type: none"> • To feel a sense of control and competence, using gamification to incentivize small manageable steps, to overcome cognitive overload
Rally's Justification	<ul style="list-style-type: none"> • A gamified step by step task list to break down the monolithic chore into small, manageable tasks whilst earning badges overcomes cognitive overload and according to the SDT “builds (her) competence”

Persona 2: David**The new resident**

Age:	28
Profile	<ul style="list-style-type: none"> • Just moved into town • Unfamiliar with town's facilities, landmarks and layouts
Problem	<ul style="list-style-type: none"> • Doesn't know regional risks • Doesn't know any emergency shelters
Goal	<ul style="list-style-type: none"> • To quickly obtain localized safety and preparedness briefings
Rally's Justification	<ul style="list-style-type: none"> • Quizzes serves as a non passive engagement tool • Allows for learning of specific local risks and safety procedures he is unaware of

Persona 3: Maria**The "Community Caretaker"**

Age:	45
Profile	<ul style="list-style-type: none"> • Highly motivated • Bad at time management • Bad at managing preparedness for multiple people
Problem	<ul style="list-style-type: none"> • She needs a reliable efficient single sources of truth • Worries about network failure • Worries she was unable to coordinate her family's plan • Information fragmentation
Goal	<ul style="list-style-type: none"> • To have a centralized, trustworthy and reliable place to store: <ul style="list-style-type: none"> ◦ Critical contacts ◦ Access to first aid info ◦ Know what to do when power has outage
Rally's Justification	<ul style="list-style-type: none"> • Checklist to track preparedness for her entire family

3.4 Structure of this project

Rally's project structure can be broadly defined as a Local first, online second, component based and modular architecture

Rally doesn't adhere to typical traditional client server applications. Rally always ensures client first, server second. Rally must be resilient even without connectivity to the outside world, ensuring it works out of the box, mostly

Presentation layer

- Comprehensive and well researched UI/UX based around the ideas of Ixd (interaction design) and HCI (human computer interaction), verified and audited by GOMS and KLM (keystroke level management) and tested using Fitts Law ensuring rapid information access, optimized layouts, and gamified motivational characteristics to ensure user engagement

Logic and data layer

- No data storage is really necessary unless only for tracking progress. In which they can access all preparedness step instantly anyways
- Asyncstorage saves progress locally with the option of firestore NoSQL saving the data on the cloud optionally
- RSS parsers and XML feeds from Facebook profiles and channel of official government channel ensures fresh, updated, official and verifiable information whilst utilizing infrastructure that is scalable, highly redundant and available
- Risk logic calculation done locally by calculating local topological data of the user and comparing it within their 2km radius through the usage of Google Maps API: Google maps elevation api and places api
- Using google maps places api to show all available shelters relative to the user

3.5 Key technologies and methods

3.5.1 Project Management

This section analyzes and breakdown the project management methodology utilized for the development of this project's app

This section outlines the important parts and definitive phases and the iterative nature of building a MVP

- **Agile Methodology:**

I selected the Agile framework, because unlike a waterfall methodology, which poses disadvantages such as a rigid and sequential model, agile the is flexible, and have continuous improvement making it an optimal choice for a project

Agile methodology is also suitable to be used for IxD analysis and for Wireframe, test, iteration and study

If my tests shows flaws, mistakes or bugs, the Agile framework's cyclical and iterative nature allows me to adapt and reprioritize task immediately, instead of waiting for a new project phase

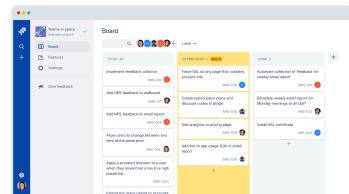
- “Flavor” of Agile: Scrumban:

I have decided to use Scrumban, a hybrid between Scrum and the flexibility of Kanban. I have chosen Scrumban as it is suited for an academic-led research project

Scrum	Kanban
<ul style="list-style-type: none">- allows me to adopt the use of Epics, and duration fixed sprints	<ul style="list-style-type: none">- Good visual workflow- pull system- continuous flows can provide flexibility to manage research heavy and unpredictable tasks for my design project- Good for my GOMS analysis where i find UI inefficiencies- If i were to find these inefficiencies, i can easily add new tasks to the board and have it prioritized instantly without the need to disrupt my rigid sprint

Agile Methodology Management Tool: JIRA by Atlassian

JIRA is a project management software for my Scrumban methodology, JIRA provides me with a digital, transparent and auditable "single source of truth" for all my workflows. With advanced functionality like JQL (JIRA Query Language) to Gantt charts to track progress, to Kanban boards to visualize backlogs.



JIRA Kanban board (source: Atlassian)

3.5.2 Ethical Testing and analysis of Ixd (Interaction design) and HCI (Human computer interaction)

To ensure that the Response Module's UI elements and design is effective during a crisis. We use the concept of GOMS (Goals, Operators, Methods, selection rules), combining it with KLM (keystroke-level model)

3.6.1 Key technology, framework and services

Aspect	Technical Aspect	Cost
Frontend UI	ReactJs 	Free
UI Libraries	UI components can include <ul style="list-style-type: none"> Material UI (MUI)  Tailwind-based Libraries  Aceternity (running on shadcn/n)  	Free Optional Paid
Github	Repository 	Free Optional paid

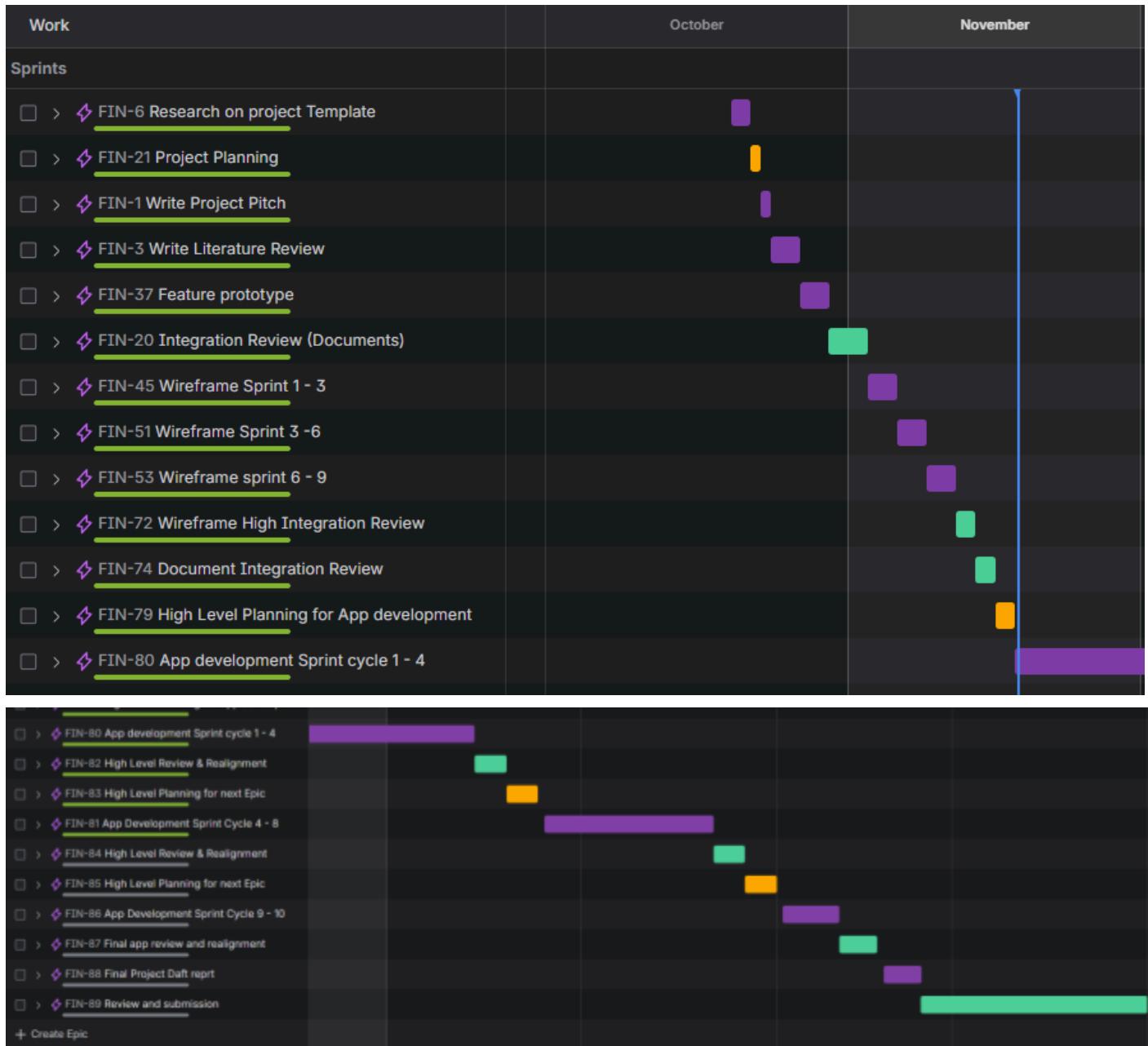
Mobile Platform	React Native with Metro Bundler  React Native	Free Optional paid
CDN (content delivery network)	Cloudflare DNS 	Free
DDoS security	Cloudflare DDoS protection via DNS side Vercel / GCP DDos protection via server / serverless side 	Free for GCP and Vercel Optional paid add-ons
Database	Firestore by Google Cloud, Object based storage 	Free - sparkplan, Optional paid
Authentication (for non urgent sign ins)	Google OAuth 2.0	Free Optional paid like SMS Authentication
Axios / AJAX	Offer API routing services	Free
Gitlabs	For automated CI/CD (continuous integration and continuous development) 	Free Optional paid
Kubernetes (K8)	Container orchestration using GKE (Google Kubernetes Engine) 	Free Optional paid
Docker	Containerization using docker's YAML files 	Free Optional paid
Jest	Unit testing and assertion	Free

		
Vercel / GCP Compute engine	<p>Vercel for serverless deployment Compute engine on google cloud platform for hosting NGINX instance</p> <p>  Google Cloud</p>	<p>Vercel free Optional Paid add-ons</p>
Google Maps API - Google cloud platforms	 <p>To enable maps services, show topological data for elevation maps, show nearest facilities, and more</p>	Paid - metered
Project Management	<p>JIRA for agile project management, managing stories, manage tickets, issues and more</p> <p></p>	<p>Free for 1 project Optional paid add ons</p>

3.6.2 Conclusion:

Based on the breakdown above, this app should be relatively cheap, or even cost free. Making the most costly part of this project man hours and labour

3.7 Work Plan (Gantt chart)



To be able to handle the complexity of this project, i developed a sprint within a sprint (nested sprint) architecture within the parameters of scrumban

This means that high level milestones also experience similar plan - develop - test review cycles

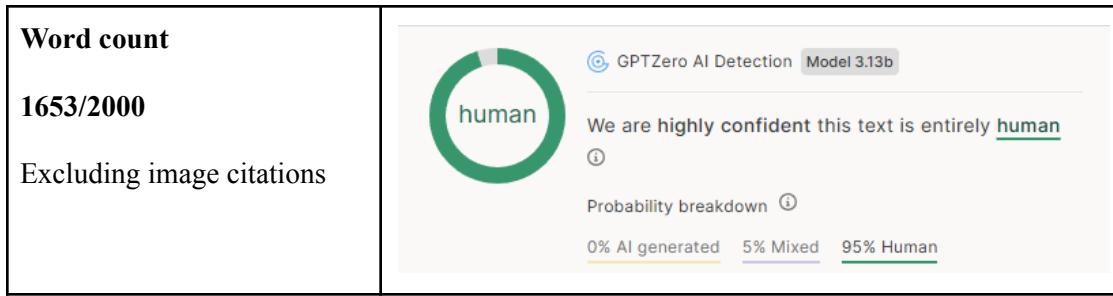
As you can see from my Gantt chart, with purple indicate development / writing report, orange indicating Planning and green representing review

An epic opens up to multiple sprint cycles
From as large as 4 cycles per Epic to 2 cycles per Epic closing to February

And within each sprint is a clear
Plan → Develop → test → review typical scrum

This kanban board exhibits our “scrumban” approach clearly

Document Meta data

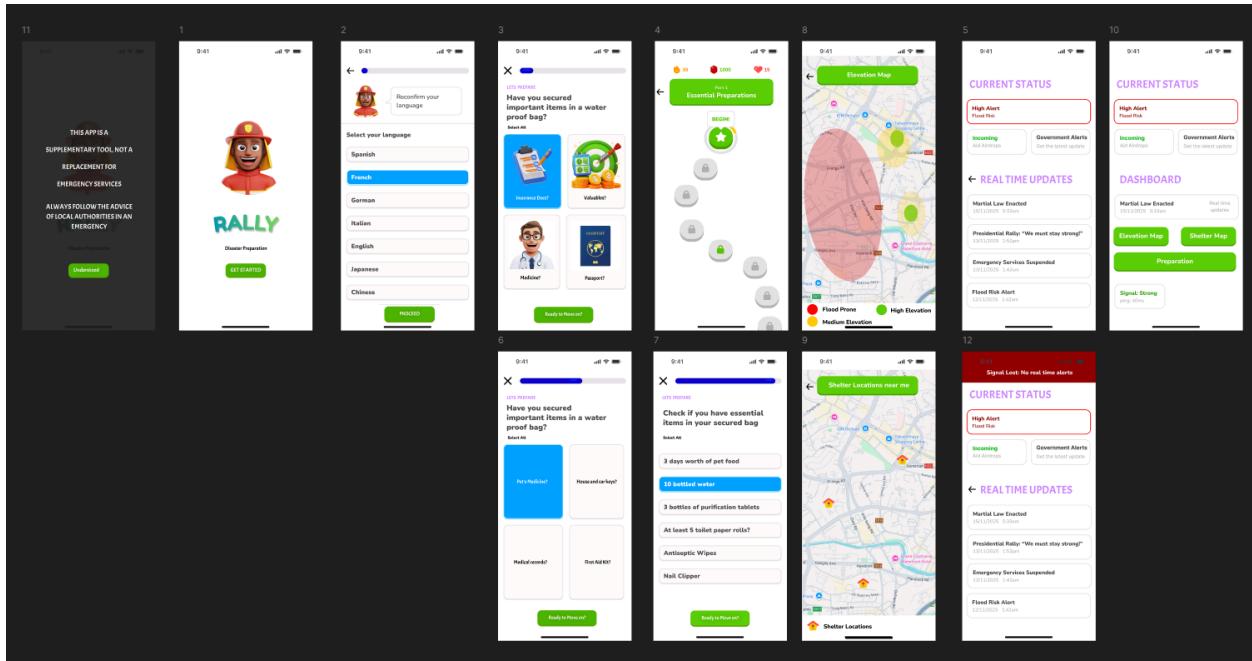


4. Feature prototype

4.1 Initial High Fidelity Wireframe

We skipped the implementation of a low fidelity and medium fidelity wireframe and skipped straight to a high fidelity wireframe due to the advent of modern UI tooling like Figma. With built in functionalities like pre-built component libraries and auto layout functionality, the traditionally associated handdrawn low fidelity wireframing is negligible

Overview of the entire UI and its corresponding screens



Total Satisfaction review

This total satisfaction review consists of 20 participants who rate each User experience and feedback on each of their aesthetics, readability, lack of cognitive overload and ease of use

Aesthetics	Readability	Lack of cognitive overload	Ease of use
★★★★★	★★★★★	★★★★★	★★★★★



If there is no signal, and offline centric features kick in, an alert will appear if user is on the real time updates screen

CURRENT STATUS

High Alert
Flood Risk

Incoming
Aid Airdrops

Government Alerts
Get the latest update

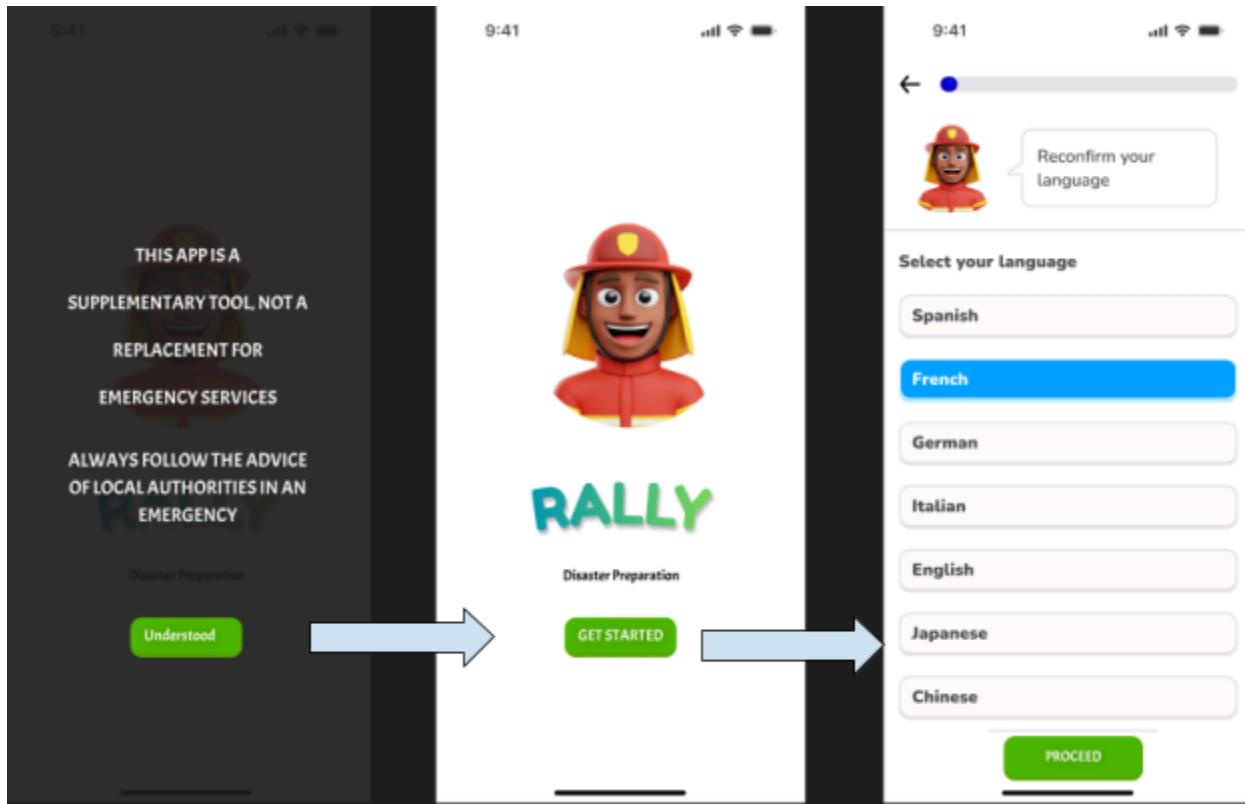
← **REALTIME UPDATES**

Martial Law Enacted
15/11/2025 5:33am

Presidential Rally: "We must stay strong!"
13/11/2025 1:52pm

Emergency Services Suspended
13/11/2025 1:42am

Flood Risk Alert
12/11/2025 1:42am

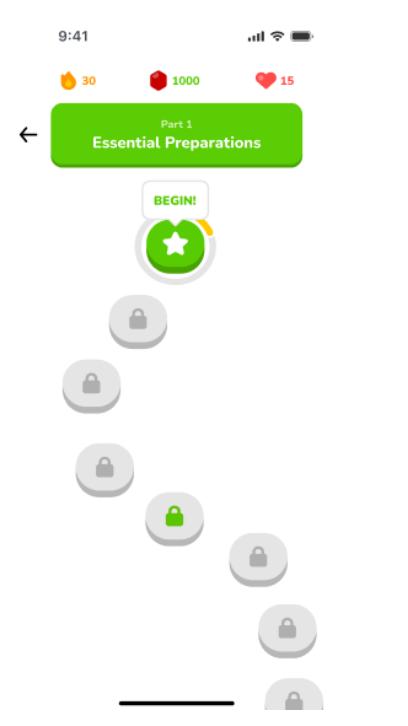


Aesthetics	Readability	Lack of cognitive overload	Ease of use
★★★★★	★★★★★	★★★★★	★★★★★

The initial warning screen to indicate that this is not a replacement for emergency services to avoid trivialization, followed by the select language screen: We should not assume a person's default operating language

Gamification features:

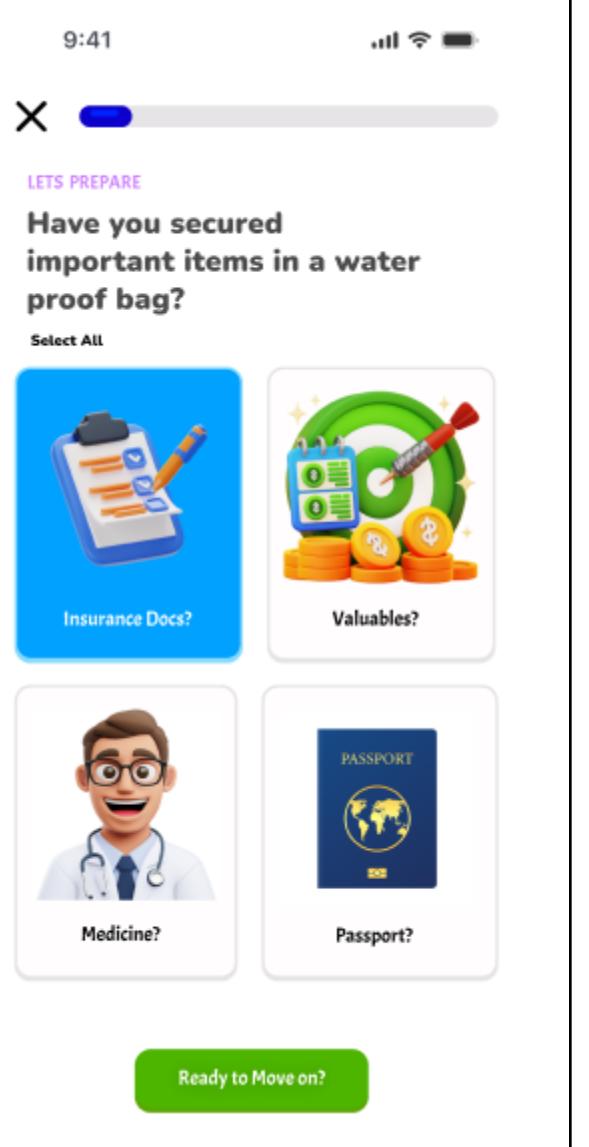
Inspired by duolingo's user interface, this map is a fun way to show preparedness progression, motivating users to finish all their preparedness tasks



Aesthetics	Readability	Lack of cognitive overload	Ease of use
★★★★★	★★★★★	★★★★★	★★★★★

Quizzes: Most Critical Checklists

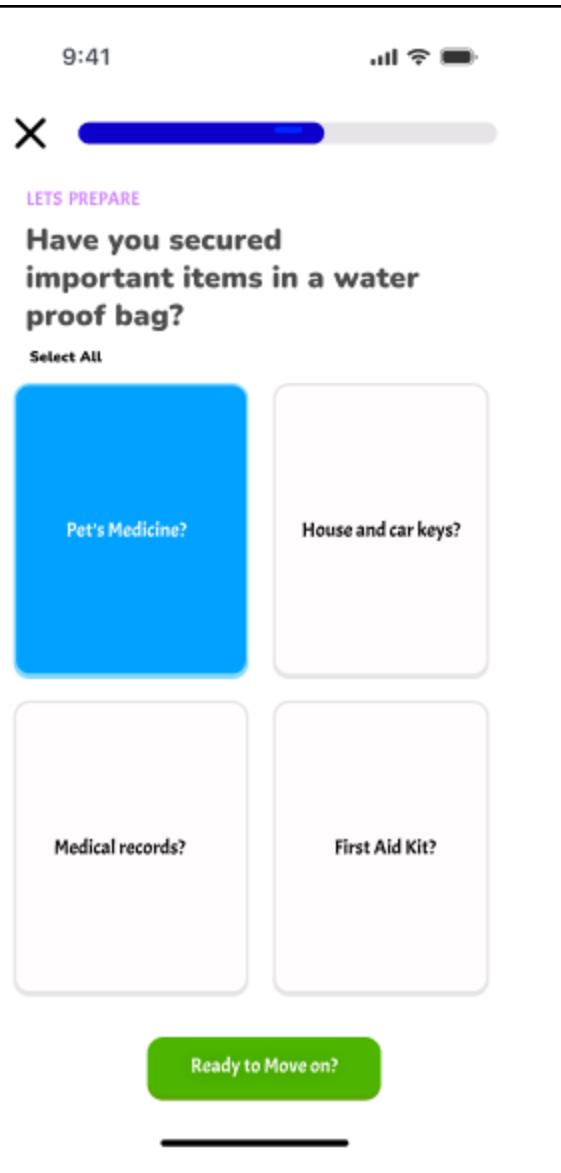
The tasks where it is the most important will have pictogram and graphics to engage the user, thus inducing motivation



Aesthetics	Readability	Lack of cognitive overload	Ease of use
★★★★★	★★★★★	★★★★★	★★★★★

Quizzes: Medium priority Tasks

Tasks in medium priority comes after tasks in high priority, this means that i would need to remove the pictogram to reduce cognitive overload now that motivation is less of a factor

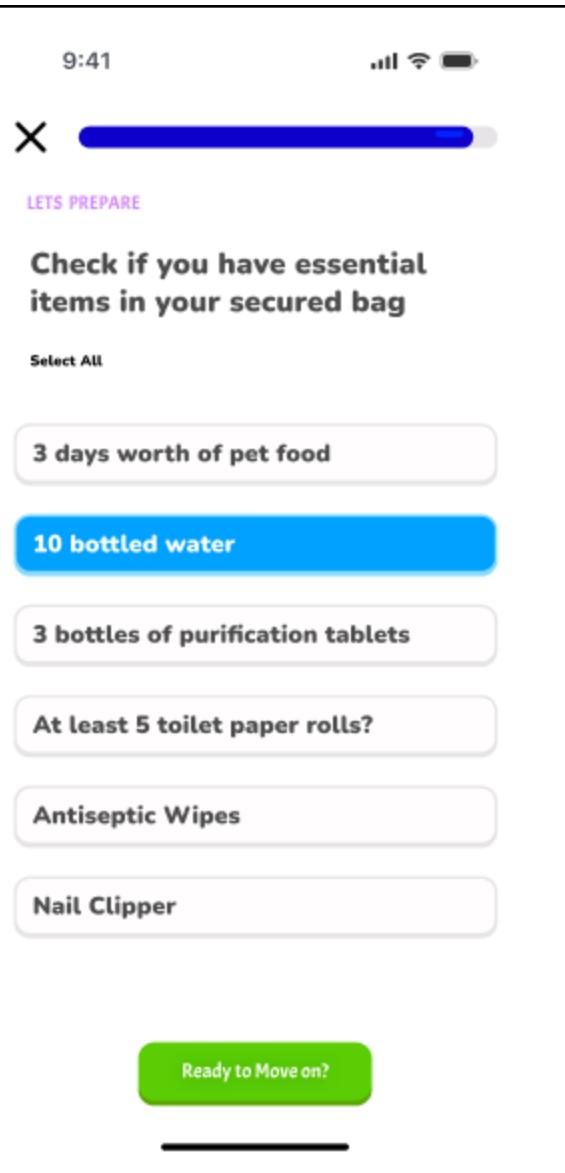


Aesthetics	Readability	Lack of cognitive overload	Ease of use
★★★★★	★★★★★	★★★★★	★★★★★

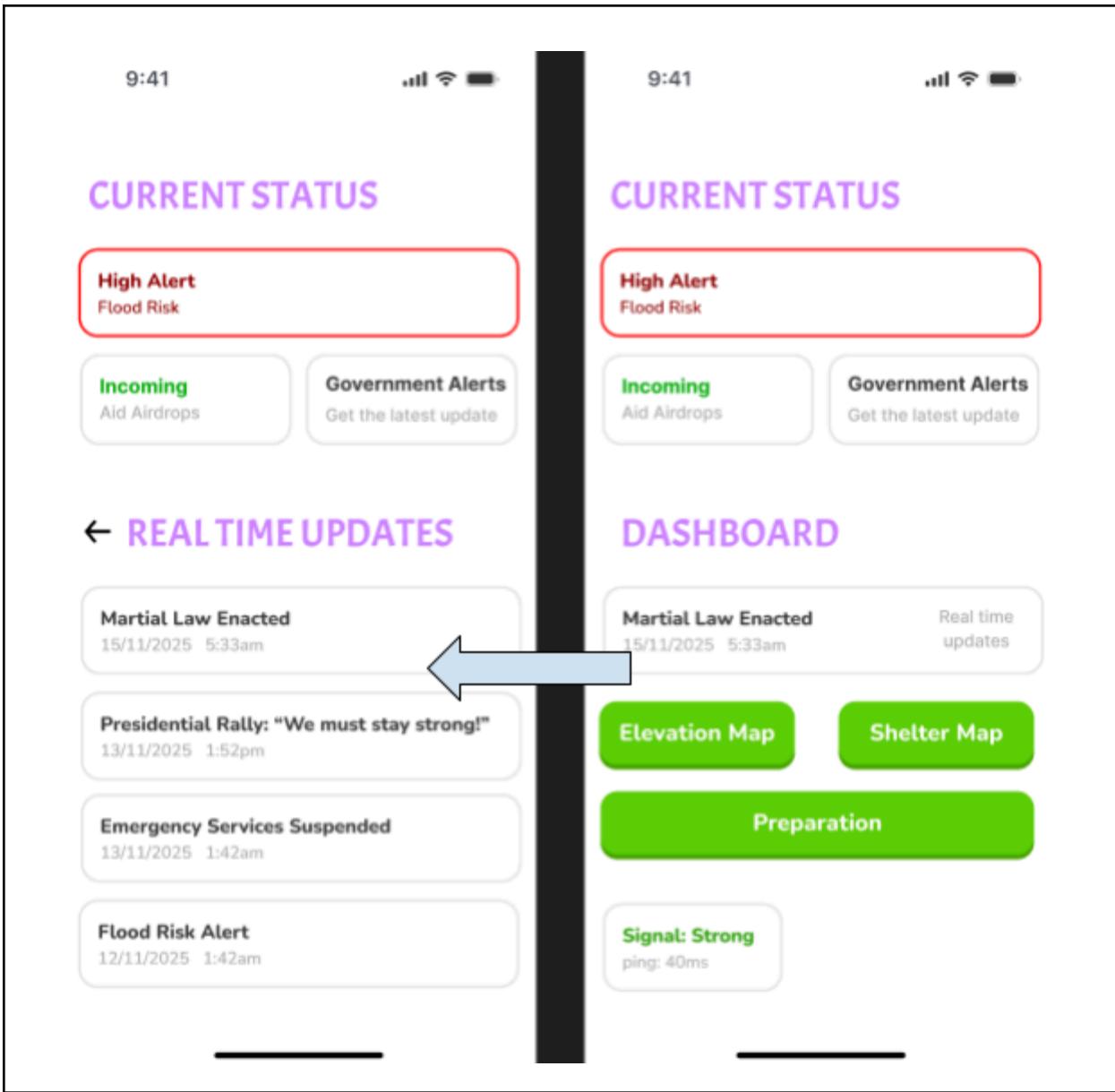
Quizzes: Low priority Tasks

Tasks in low priority come after tasks in medium priority, it is more of an exhaustive list.

Motivation is well underway here and cognitive overload will be minimal as the tasks is truncated



Aesthetics	Readability	Lack of cognitive overload	Ease of use
★★★★★	★★★★★	★★★★★	★★★★★



On the home screen dashboard, if the user clicks on the real time updates, it will reveal a log of updates while hiding the other buttons
 This is to reduce cognitive overload

The current status element remains persistent even with the transitions as it is high priority information

Aesthetics	Readability	Lack of cognitive overload	Ease of use
★★★★★	★★★★★	★★★☆	★★★★★

9:41



CURRENT STATUS

High Alert
Flood Risk

Incoming
Aid Airdrops

Government Alerts
Get the latest update

DASHBOARD

Martial Law Enacted
15/11/2025 5:33am

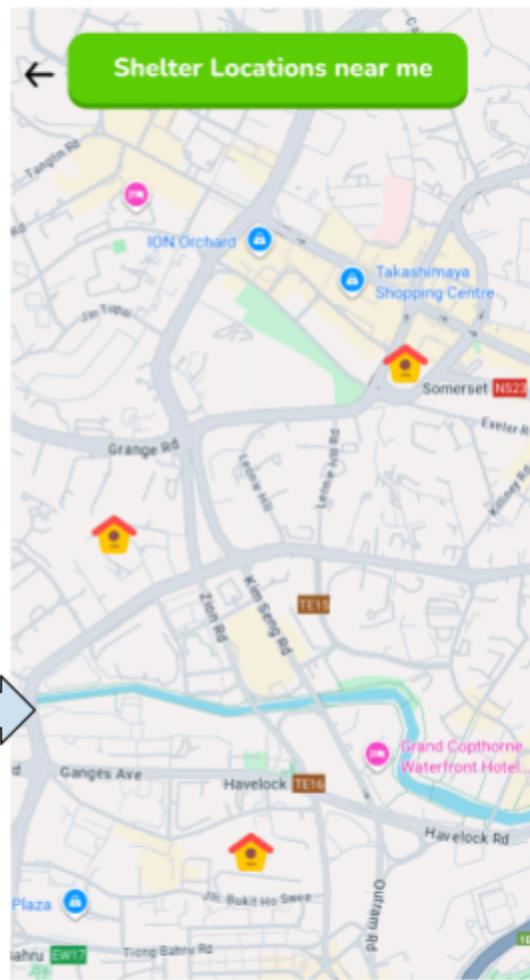
Real time
updates

Elevation Map

Shelter Map

Preparation

Signal: Strong
ping: 40ms



Aesthetics	Readability	Lack of cognitive overload	Ease of use
★★★★★	★★★★★	★★★★★	★★★★★

9:41

CURRENT STATUS

High Alert
Flood Risk

Incoming
Aid Airdrops

Government Alerts
Get the latest update

DASHBOARD

Martial Law Enacted
15/11/2025 5:33am

Real time updates

Elevation Map

Preparation

Signal: Strong
ping: 40ms

Flood Prone

High Elevation

Medium Elevation

The user has the option to select between elevation map and shelter map
 Elevation map is especially useful for floods, tsunamis, while shelter maps are useful for disasters like earthquakes, storms

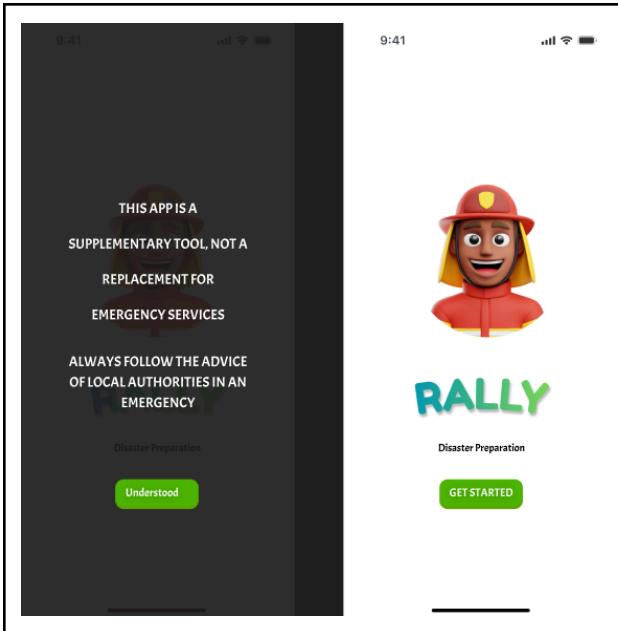
Aesthetics	Readability	Lack of cognitive overload	Ease of use
★★★★★	★★★★★	★★★★★	★★★★★

4.4 Ixd Audit

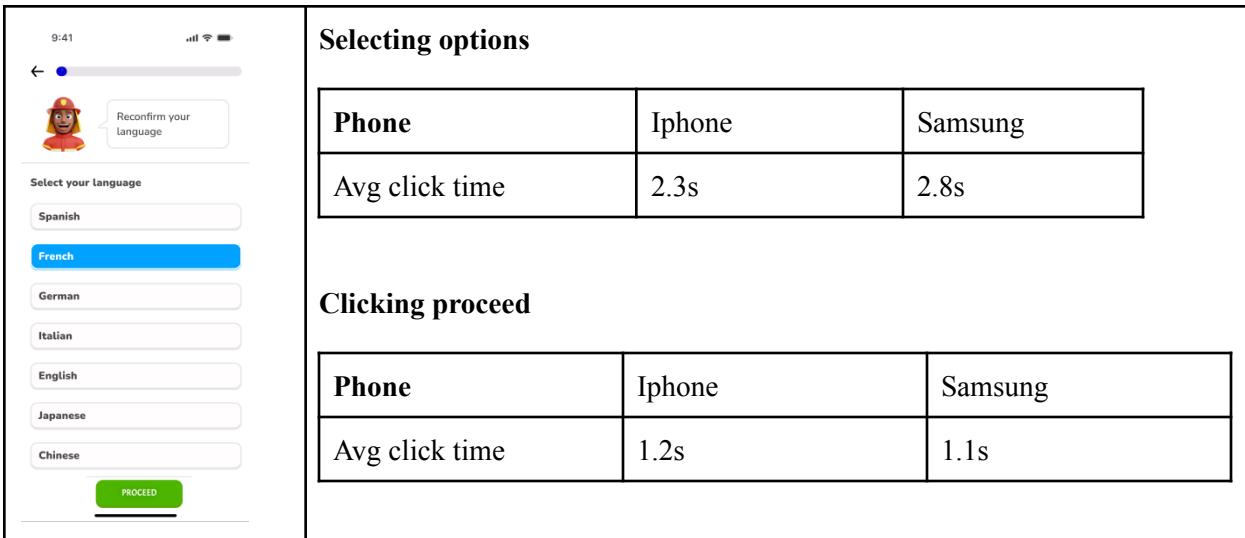
4.4.1 KLM (Keystroke Level Management) Audit

KLMS takes a chance at predicting the average time for a user to complete a task, this KLM analysis takes the average time it takes for the user to click on certain buttons and perform an operation.

This study took place over 1 week, with some 10 different participants



Phone	Iphone	Samsung
Avg click time	1.4s	1.52s



Phone	Iphone	Samsung
Avg click time	2.3s	2.8s

Phone	Iphone	Samsung
Avg click time	1.2s	1.1s

Selecting options

Phone	Iphone	Samsung
Avg click time	1.02s	1.01s

Clicking “Ready to move on?”

Phone	Iphone	Samsung
Avg click time	1.2s	1.1s

Selecting options

Phone	Iphone	Samsung
Avg click time	1.01s	1.01s

Clicking “Ready to move on?”

Phone	Iphone	Samsung
Avg click time	1.2s	1.1s

Selecting options

Phone	Iphone	Samsung
Avg click time	2.3s	2.25s

Clicking “Ready to move on?”

Phone	Iphone	Samsung
Avg click time	1.2s	1.2s

Clicking on back

Phone	Iphone	Samsung
Avg click time	1s	0.98s

CURRENT STATUS

The screenshot shows a mobile application interface. At the top, there is a header bar with the time '9:41' and signal strength indicators. Below this is a section titled 'CURRENT STATUS' which includes a red-bordered box labeled 'High Alert Flood Risk'. There are two buttons: 'Incoming Aid Airdrops' and 'Government Alerts Get the latest update'. Underneath this is a 'DASHBOARD' section with a button for 'Elevation Map' and another for 'Shelter Map'. A large green button labeled 'Preparation' is prominently displayed. To the right of the preparation button is a box showing signal strength: 'Signal: Strong ping: 40ms'. On the far right edge of the screen, there is a vertical scroll bar.

Clicking on elevation map

Phone	Iphone	Samsung
Avg click time	1.2s	2s

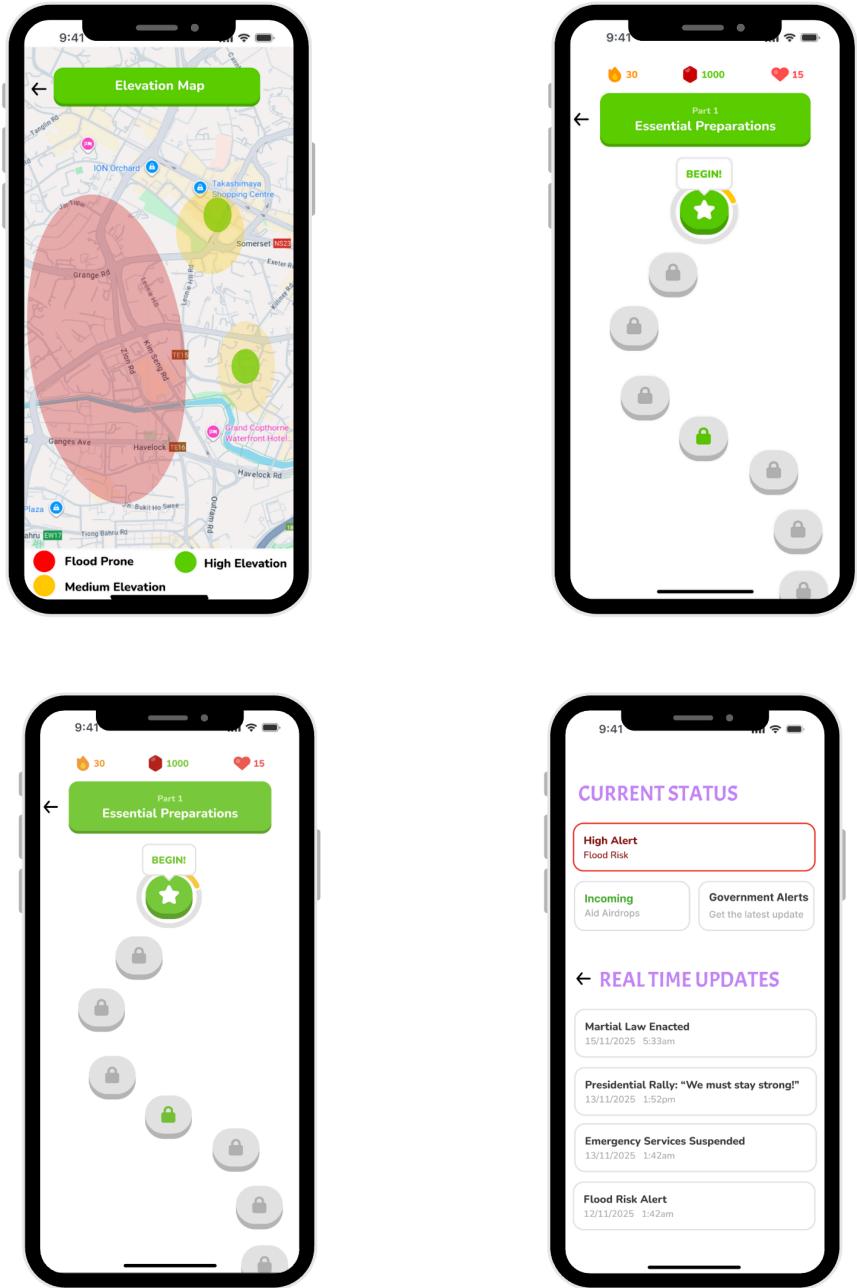
Clicking on shelters map

Phone	Iphone	Samsung
Avg click time	1.25s	1.23s

Clicking on Preparation

Phone	Iphone	Samsung
Avg click time	1.s	1.2s

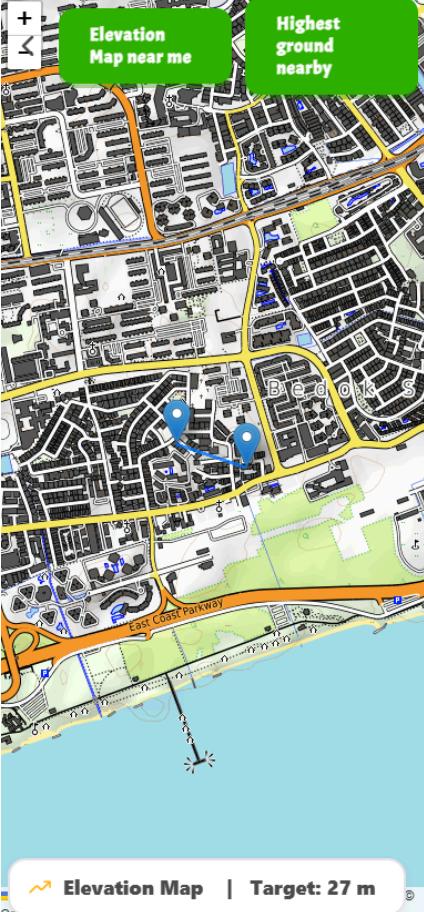
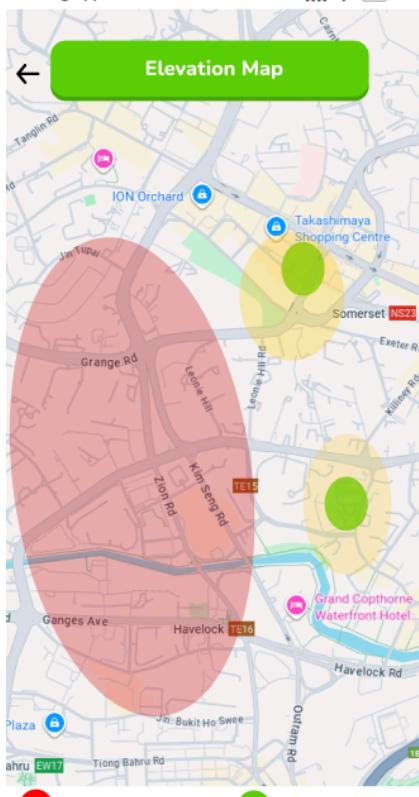
4.5 Mockups



4.7 Initial Minimum Viable product (Prototype)

Prototype	High Fidelity Wireframe
<p>CURRENT STATUS</p> <p>Weather</p> <p>Singapore</p> <p>27°C Cloudy sky</p> <p>→ 5.9 m/s ⚡ 82% ⚡ 756 mmHg</p> <p>Government Alerts</p> <p>Get the latest update</p> <p>DASHBOARD</p> <p>latest updates from SCDF</p> <p>[Highlights from SIDEX and SGFPC 2025] The Singapore-International Disaster</p> <p>22/11/2025 12:41pm</p> <p>Elevation Map Shelter Map</p> <p>Preparation</p> <p>Signal: Strong ping: 7ms</p>	<p>9:41 </p> <p>CURRENT STATUS</p> <p>High Alert Flood Risk</p> <p>Incoming Aid Airdrops</p> <p>Government Alerts Get the latest update</p> <p>DASHBOARD</p> <p>Martial Law Enacted 15/11/2025 5:33am Real time updates</p> <p>Elevation Map Shelter Map</p> <p>Preparation</p> <p>Signal: Strong ping: 40ms</p>
<p><u>Changes and rationale</u></p> <p>Remove the high alert risk, remove the incoming section because the Singapore government doesn't provide such api services to the public, nor they have such api data layers</p> <p>The government update now features RSS feed directly to the Civil defence force's facebook updates which they use as a public announcement platform.</p> <p>The government dont publish any data as a api data layer</p> <p>Instead i implemented a Weather iframe widget from a trusted source</p> <p><i>Design iterations did not impact the average time-to-click on the high-fidelity wireframes</i></p>	

Aesthetics	Readability	Lack of cognitive overload	Ease of use
★★★★★	★★★★★★★	★★★★★	★★★★★

Prototype	High Fidelity Wireframe
	

Changes and rationale

After testing and evaluation of the prototype, I have come to realise that Singapore's topography is mainly flat. The highest elevation is concentrated in a 5km radius at only 164 meters. So, the highest ground nearby functionality instead shows the highest terrain within a 2km walkable radius from the user.

Design iterations did not impact the average time-to-click on the high-fidelity wireframes

Survey for feature prototype

Aesthetics	Readability	Lack of cognitive overload	Ease of use
★★★★★	★★★★★	★★★★★	★★★★★

Prototype	High Fidelity Wireframe
<p>< OFFICIAL UPDATES</p> <p>Official Updates</p> <p>gov.sg Page</p> <p>The cost of vaping goes beyond fines of...</p> <p>facebook.com · 1d</p> <p> Wondering why & how we're making your...</p> <p>facebook.com · 1d</p> <p>Did you know? gov.sg uses broadcast...</p> <p>facebook.com · 2d</p>	<p>9:41 </p> <p>CURRENT STATUS</p> <p>High Alert Flood Risk</p> <p>Incoming Aid Airdrops</p> <p>Government Alerts Get the latest update</p> <p>< REAL TIME UPDATES</p> <p>Martial Law Enacted 15/11/2025 5:33am</p> <p>Presidential Rally: "We must stay strong!" 13/11/2025 1:52pm</p> <p>Emergency Services Suspended 13/11/2025 1:42am</p> <p>Flood Risk Alert 12/11/2025 1:42am</p>

Changes and rationale

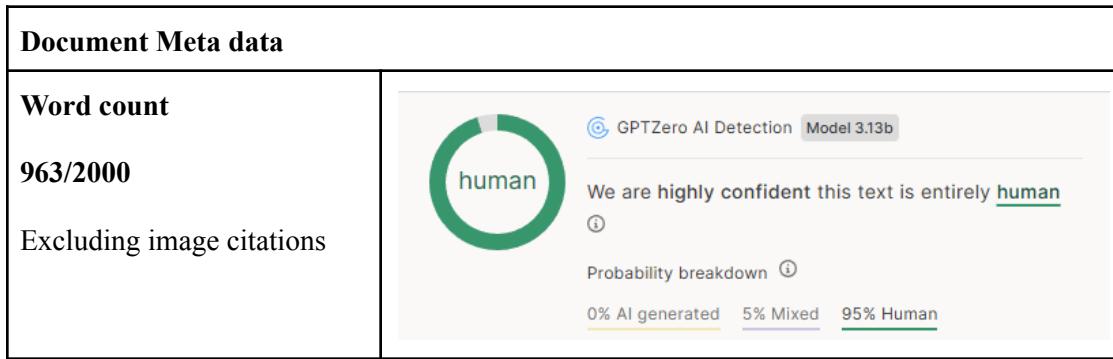
During national disasters, official government portals may be overloaded, so I figured out that I should include Facebook as its official channel as Facebook's infrastructure can handle billions of requests at any given time, and provided its complex network or redundancies, availability zones, Facebook seems like a better choice.

A facebook post from [Gov.sg](#) is a main page for matters relating to Singapore, so its a central bulletin for security crises like terrorism, transport disruption or extreme weather updates

Additionally, a facebook post from [Gov.sg](#) or SCDF (civil defence force) is qualitative in context often with pictures and description, which allows users to understand immediately. This bridges the gap in the Gulf of evaluation in our IxD philosophy as actionable instructions are distributed instead of raw api json objects from official APIs that are hard to get

Survey for feature prototype

Aesthetics	Readability	Lack of cognitive overload	Ease of use
★★★	★★★★★	★★★★★	★★★★★



5. Evaluation

Ask surveyees to answer evaluation questions on the app with the options of

1. Disagree
2. Partially disagree
3. Neither agree nor disagree
4. Partially agree
5. Agree

Marking criteria

- Is the evaluation strategy appropriate to the aims of the project
- Does the evaluation display good coverage of appropriate issues

Swift Cycle 1

Evaluation Phase

Date:**Participants:5****Profile:** University Peers, Tech-Savvy

Evaluation Question				
The app's navigation structure (Home/Map/Checklist) is intuitive.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
5	-	-	-	-

Evaluation Question				
Information is easier to digest here than in a standard PDF guide.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
4	1	-	-	-

Evaluation Question				
I understand what the "Emergency Mode" button is for.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
3	2	-	-	-

Evaluation Question				
The initial signup/onboarding process felt quick and privacy-safe				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
4	1	-	-	-

Qualitative Feedback

"The concept of breaking down the guide is great, but the bottom tab bar disappears when I go into a checklist, which is confusing."

"I didn't realize the red button was for emergencies; I thought it was a 'Log Out' button. It needs better labeling."

Action Taken: Redesigned the "Emergency Mode" toggle to look like a physical switch rather than a generic button. Fixed the navigation stack issue in React Navigation

Swift Cycle 2

Evaluation Phase

Date:

Participants: 5

Profile: Mixed demographic, including 2 non-technical users

Focus: Testing the "Motivation" hypothesis (SDT) and Map API integration

Evaluation Question				
Earning points/badges makes the preparation tasks feel less boring.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
1	3	1	-	-

Evaluation Question				
The elevation map loaded quickly and showed my location accurately.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
3	1	1	-	-

Evaluation Question				
I understand what the "Emergency Mode" button is for.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
1	1	2	1	-

Evaluation Question				
The initial signup/onboarding process felt quick and privacy-safe				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
2	2	1	-	-

Qualitative Feedback

"I actually wanted to finish the checklist just to get the 'Preparedness Pro' badge. The progress bar is very motivating."

"The map works, but it lags a bit when I scroll to a new area. Also, the elevation number flickered."

Action Taken: Optimized theMapView rendering by limiting the elevation fetch rate (debouncing). Increased font size on "Safety Tips" to meet WCAG 2.1 accessibility standards.

Swift Cycle 3

Evaluation Phase

Date:

Participants: 5

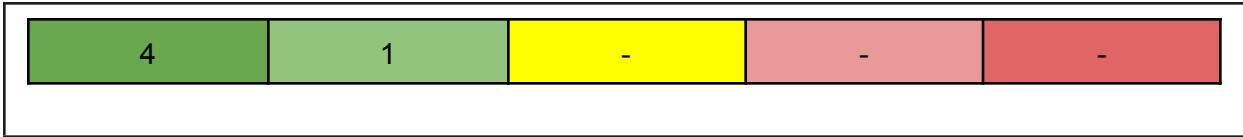
Profile: 5 Final target audience validation

Focus: Safety Critical" mandates with Offline mode and Resource Hub

Evaluation Question				
I could easily find the nearest shelter even when 'Airplane Mode' was on.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
5	-	-	-	-

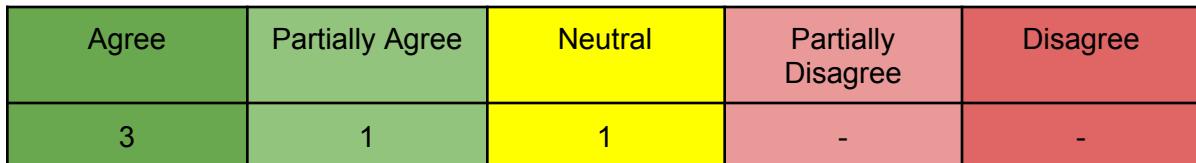
Evaluation Question				
The switch between "Prepare Mode" and "Emergency Mode" is clear.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
5	-	-	-	-

Evaluation Question				
The instructions in the Offline Resource Hub are easy to follow in a panic.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree



Evaluation Question

I would trust this app to guide me during a real flood.



Qualitative Feedback

"The offline map for shelters is a lifesaver. It loaded instantly."

"Everything works perfectly, but I'm still a little unsure if the 'News Feed' is updating in real-time. Maybe add a 'Last Updated' timestamp?"

Action Taken: Added a prominent "Last Updated: X min ago" timestamp to the Alert Feed to build user trust (addressing the "Gulf of Evaluation").

Swift Cycle 4

Evaluation Phase

Date: 02 March 2025**Participants: 4****Profile:** Including 1 user with mild visual impairment and 1 older adult**Focus:** Testing "Radical Inclusion" (WCAG compliance) and final system stability

Evaluation Question				
The high-contrast text in "Emergency Mode" was easy to read without glasses.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
5	-	-	-	-

Evaluation Question				
The buttons are large enough to press easily, even if I was rushing/shaking.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
5	-	-	-	-

Evaluation Question				
The app maintained its state (didn't crash) when switching rapidly between tabs.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
4	1	-	-	-

Evaluation Question				
I would recommend this app to my elderly parents or neighbors.				
Agree	Partially Agree	Neutral	Partially Disagree	Disagree
3	1	1	-	-

Qualitative Feedback

"The 'Red/Black' emergency theme is very clear, but the 'Back' button in the Shelter map was a bit too small for my thumb."

"VoiceOver (Screen Reader) worked well on the checklists, but it didn't announce the 'Flood Risk' status on the map properly."

Action Taken: Increased the touch target size of all top-bar navigation buttons to 48x48dp (meeting minimum Android accessibility guidelines). Added accessibilityLabel tags to the dynamic Map overlay so screen readers can announce "High Flood Risk" audibly.

Appendix:

This appendix section contains supplementary information, mostly technical documents to supplement the research and report above.

Appendix: Testing

Test parameters

Test initializer

Jest (jest-expo preset)

Test match

/_tests_//*.[jt]s?(x)

Setup Files

- Enforces [Paltform.OS](#) = “web” for web focused tests
- Provides data fetching via whatwg-fetch
- Virtualizes navigator.geolocation to default Singapore Locations
- Silences reactive native verbose console warnings and errors
- Provides fetching to third party URLs to Maps API, RSS and iframe widgets

CI Node

Uses version 20 through actions/setup-node@v4

CI install

```
npm ci --no-audit --no-fund
```

Coverage

Enabling CI via

```
npm run test -- --coverage
```

Unit Tests

Integration tests

Test suites

Test results

Appendix: DevOps & CI/CD

Docker and containerization

My Dockerfile uses a 3 stage process

- deps: install Node dependencies with `npm ci`
- build: runs the Expo web export with (`npm run export:web`) to generate static build in `./dist`
- web: copies `dist/` into Nginx image and serves it from `/usr/share/nginx/html`

Key behaviours

The container serves static files through Nginx

The exported web build output directory is `dist/`

The pipeline passes build time environment variables into the pipeline as Docker build arguments such as

- `EXPO_PUBLIC_GOOGLE_MAPS_API_KEY`
- `EXPO_PUBLIC_MAPTILER_KEY` (removed later because is redundant)

Nginx configuration (`nginx.conf`)

Nginx.conf create the index for `index.html`, caches static assets like js or css files, images and fonts aggressively whilst creating a Single Page Element (SPA) fallback

```
try_files $uri $uri/ /index.html;
```

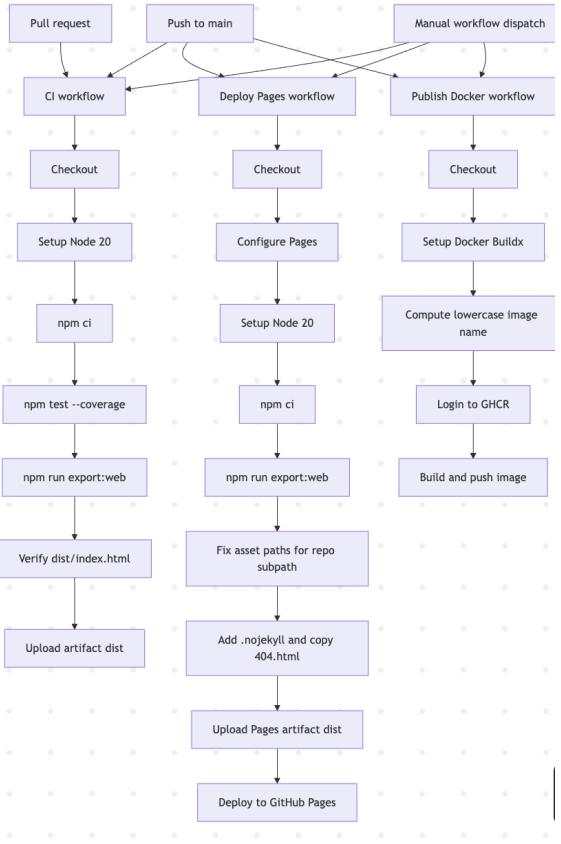
Local Docker Usage (docker-compose.yml)

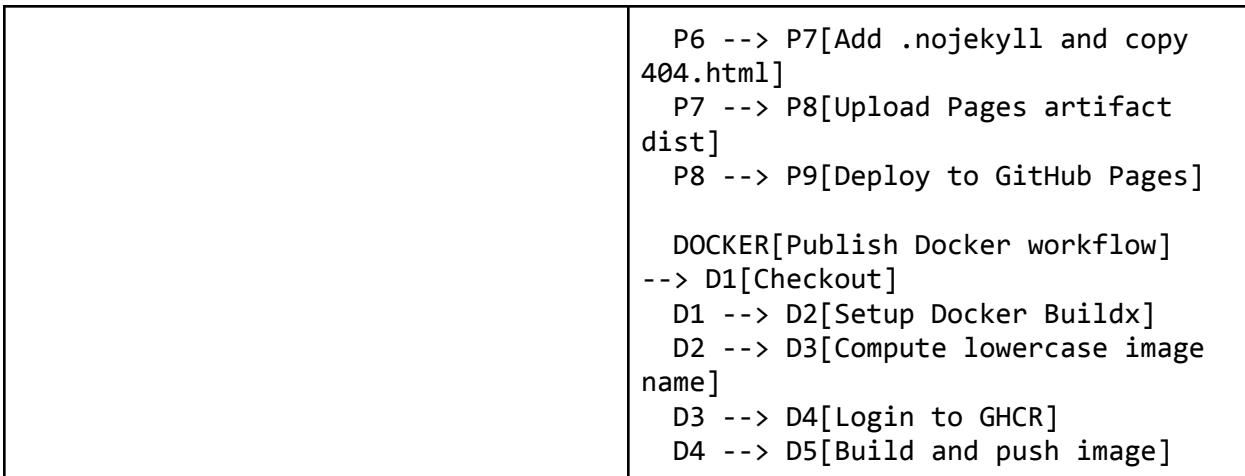
Docker-compose.yml defines 2 distinct services

1. web (production)
 - a. Builds the web target
 - b. Initializes localhost port 8000 via Nginx
 - c. Passes build argos for public keys

2. dev (for development)
 - a. Builds the dev target
 - b. Bind-mounts the repo into /app
 - c. runs npm run web (Expo local development server command) on localhost port 8081

CI/CD pipeline

Pipeline flowchart	In mermaid
 <pre> graph TD PR[Pull request] --> CI[CI workflow] PMain[Push to main] --> CI PR --> DWP[Deploy Pages workflow] PMain --> DWP PR --> DW[Publish Docker workflow] CI --> C1[Checkout] DWP --> C2[Checkout] DW --> C3[Checkout] C1 --> S1[Setup Node 20] C2 --> S2[Setup Node 20] C3 --> S3[Setup Docker Buildx] S1 --> N1[npm ci] S2 --> N2[npm ci] S3 --> N3[Compute lowercase image name] N1 --> T1[npm test --coverage] N2 --> T2[npm run export:web] N3 --> L1[Login to GHCR] T1 --> E1[npm run export:web] T2 --> E2[npm run export:web] L1 --> B1[Build and push image] E1 --> V1[Verify dist/index.html] E2 --> F1[Fix asset paths for repo subpath] B1 --> U1[Upload artifact dist] V1 --> U1 F1 --> A1[Add .nojekyll and copy 404.html] A1 --> U2[Upload Pages artifact dist] U2 --> D1[Deploy to GitHub Pages] </pre>	<pre> graph TD pushmain[Push to main] --> CI pullreq[Pull request] --> CI manual[Manual workflow dispatch] --> CI pushmain --> PAGES manual --> PAGES pushmain --> DOCKER manual --> DOCKER CI[CI workflow] --> CI1[Checkout] CI1 --> CI2[Setup Node 20] CI2 --> CI3[npm ci] CI3 --> CI4[npm test --coverage] CI4 --> CI5[npm run export:web] CI5 --> CI6[Verify dist/index.html] CI6 --> CI7[Upload artifact dist] PAGES[Deploy Pages workflow] --> P1[Checkout] P1 --> P2[Configure Pages] P2 --> P3[Setup Node 20] P3 --> P4[npm ci] P4 --> P5[npm run export:web] P5 --> P6[Fix asset paths for repo subpath] </pre>



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