CEF 440 TASK 2

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FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF COMPUTER ENGINEERING

CEF440: Internet Programming and Mobile Programming

Design and Implementation of Mobile-Based Archival and Retrieval of Missing Objects Application using Image Matching

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Introduction

The evolution of mobile computations and wireless communications technologies has embedded itself in our lives due to its rapid development. Ubiquitous wireless devices used in daily tasks have led to the revolution of Mobile Government (m-Government) systems aiming to deliver services and information anywhere and anytime to citizens through the utilization of mobile technologies and applications. However, only the performance of the delivered services establishes its usefulness with many undiscovered applications to such innovations, especially since this is a desired area for further development with relation to smart cities. One such application is the lost and found items retrieval utility. The loss or misplacement of personal belongings is a common occurrence that can cause inconvenience and distress to individuals. Traditional methods of searching for missing objects, such as posting flyers or contacting lost and found services, are often time-consuming and ineffective. To address this issue, this project proposes the development of a Mobile-Based Archival and Retrieval of Missing Objects Application using Image Matching. This project aims to leverage mobile technology and image matching algorithms to create a robust and user-friendly platform for archiving and retrieving missing objects. The mobile application will allow users to capture images of lost items, store them in a centralized database, and perform real-time image matching to identify potential matches.

1. REQUIRMENT GATHERING TECHNIQUES

These are simply the various ways and methods used to have as much as requirements from the users. This stage can also be known as the **UX RESEARCH Stage,** where a group of **user researchers** use on or two techniques to have some of the requirements that the app need to have.
There are two types of UX research, namely; Quantitative and Qualitative research.

a) Quantitative research

In short, it means collecting and analyzing numerical data to describe characteristics, find corrections; or test hypotheses. As a class of requirement gathering, Quantitative analysis mostly deals with collecting data from a very large population. Below are some of the techniques used to carry out Quantitative Research?

1) Survey

A survey is a *method of gathering information using relevant questions from a sample of people with the aim of understanding population as a whole.* Offering a survey or questionnaire allows you to collect information from many people in a relatively short amount of time, particularly helpful for interacting with people in different geographic locations and also good for budget savings and time constraints. When preparing your survey, consider these tips:

- ✔ Keep them shorter versus longer so people are more likely to complete them
- ✔ Focus on a feature or topic, rather than many at once
- ✔ Use ratings to generate data analysis responses, like "strongly agree," "agree" or "disagree"
- ✔ Have some open-ended questions to allow free-form responses to get detailed input
- ✔ Use the six question words to structure your survey: who, what, when, where, why and how, like "How does the user login," or "Where are the results shown in the program?"

Moreover, the question could be multiple choice, multi-select, text entering, ranking and rating order, and slide-by-slide.

Also, there are two types of survey;

- **Online Survey**

  This is the use of softwares to carry out our survey. The best tool we can use here is GOOGLE FORM, which does not only allow us to do form our questionnairs and share using a link, but to gather and arrange responses from users in an organised manner making use of graphs and various charts diagram.
  Below is the link to create an online survey on google, **online survey tool**:

https://docs.google.com/forms/u/0/?tgif=d&ec=asw-forms-hero-goto&pli=1

- **Onsite Survey**

  This is the sharing of physical questionnaires to a group of people and collecting their responds after some period of time. You just have to printout a number of questionnaires, select a research area (a school, hospital, institution) and distribute the questionnaires there.

2) Requirement workshop

Firstly, a Workshop is a collaborative session where stakeholders and business analysts or users work together to elicit, validate, and prioritize requirements for a project or a product.

Generally, researchers will ask participants to attempt a series of assigned tasks, and then observe and record how well they can accomplish those tasks. Their ability to do the things you want them to do informs your next steps—namely, whether to make changes to your design or product or not, and which changes to make.

After the test is done, you'll gather and analyze data, and then make choices about the best next-steps.

b . QUANTITATIVE ANALYSIS

Quantitative analysis is a process of naturalistic inquiry that seeks an in-depth understanding of social phenomena within their natural setting. It focuses on the "why" rather than the "what" of social phenomena and relies on the direct experiences of human beings as meaning-making agents in their everyday lives.

Six common types of qualitative research are **phenomenological, ethnographic, grounded theory, historical, case study, and action research**.

2.1 Ethnographic Research

Ethnographic research is an approach to data collection and analysis that aims at evaluating and categorizing human experiences through the lens of the participants' cultural and ethnic backgrounds. Ethnographers observe life as it happens instead of trying to manipulate it in a lab. Because of the unpredictability of life, ethnographers often find is challenging to nail down their projects in a protocol for the Board to review. Nevertheless, the Board needs a good explanation of a study in order to approve it. Helping the Board to understand the parameters of the study, the situations in which the participants will be contacted and will participate, and the risks involved will allow them to approve studies where some flexibility is needed.

Ethnographic research can be further divided into

2.2 Phenomenological studies

Phenomenological studies, for their part, place major emphasis on the unique experiences of individuals. Phenomenological research focuses primarily on discovering personal thoughts and experience.

There are various methods on collecting data or requirements in Phenomenological research, some of these include;

- **Participant observation**

  Observing the preferences and action of the subject or the individual and interacting with them.

- **P-to P Interview**

  Here, the interviewer organise a meet up with the user where questions will be asked to the user. The interview will be registered and analysed. Certain parameters such as the user's first response and the corporal attitudes will be taken into consideration.

2.3 Grounded Theory Research

Grounded theory is a systematic qualitative research method that collects empirical data first, and then creates a theory 'grounded' in the results. Grounded research is different from experimental research or scientific inquiry as it does not need a hypothesis theory at the start to verify. Instead, the evolving theory is based on facts and evidence discovered during each stage. Also, grounded research also doesn't have a preconceived understanding of events or happenings before the qualitative research commences.

Below are the steps involved in grounded theory research;

- ✔ Data Planning: The researcher decides what area they're interested in. In this stage, you'll also want to create your open-ended initial research questions.
- ✔ Data collection and analysis: The researcher collects qualitative data by asking open-ended questions in interviews and surveys, studying historical or archival data, or observing participants and interpreting what is seen. This collected data is transferred into transcripts.
- ✔ Data analysis is turned into a final theory: The researcher takes the core categories and themes that they have gathered and integrates them into one central idea (a new theory) using selective code. This final grounded theory concludes the research

  - **Contextual Interviews**

    Following the subjects and observing them doing their regular activities while also interacting with them.

  - **Archival Research**

    The researcher digs down existing documents and past research for understanding the requirements. There is no physical contact with the subjects in the case of archival research.

Passive Observation Following the subjects and observing them doing their regular activities without making an interaction. The researcher may take notes, click photographs, or record videos to draw observational inferences.

2.4 DOCUMENTAL ANALYSIS

Document analysis includes reviewing the existing system's documentation, like user manuals and instructions. It is helpful particularly for any changeover risk mitigation and you can glean important information that pushes the boundary of establishing new requirements or validating existing ones. It is helpful to have multiple people review the documents and hold a meeting afterwards to compile your insights to make sure nothing gets missed.

2. WHAT TO DO AFTER REQUIRMENT GATHERING

Once you are done collecting or gathering the requirement proposed by users, stakeholders, and the business team, you need to document your results and confirm the understanding of the requirement collected.

2.1 Documenting requirements

- Once you've gathered your project requirements, you need to document them in a concise and well-organized document.
- Requirements of any kind influence the analysis, design, implementation, and test phases directly and indirectly. Requirements documents may also support the change management activities. When requirements change, the requirements document can serve as the basis to analyze the extent to which other parts of the system are influenced. The change effort can thus be estimated.
- Additionally, requirements documents like BRDs or FRDs can be the basis for legal contracts and other type of agreements with vendors and other stakeholders.
- Documenting the requirements can help to quickly overcome legal conflicts between two or more parties.

2.2 **Confirming understanding of requirements**

Once your project requirements are documented, don't assume that everybody has a shared understanding. Always remember that each person considers the project from his or her individual perspective. You must understand these different perspectives and gather the different requirements to build a complete picture of what the project should achieve.

Also, share those documented requirements with all of the project's stakeholders to ensure everybody is on the same page before the project begins. If anything was skipped or misunderstood, it's better to know now.

- **USECASE DIAGRAM:**

    - A use case diagram is a UML Diagram which help us to organise all the functional requirement of an app after collecting the various requirements from users.
    - You can make used of the use case diagram where all the functional requirements are highlighted for the stakeholders and the business team to clearly understand.
    - A tool used to design UML DIAGRAMS (use case diagram) is **STARUML.** https://staruml.io/download/ Here is the link to download the software

- **BUILD A PROTOTYPE**
    - A prototype is simply the first preliminary output of a project
    - You can do a prototype after the collection of data and present it to the various stakeholders for feedback.
    - Tool: figma prototypying, use this link to get there https://www.figma.com/files/recent?fuid=1183258788115296337

- **UI DESIGN**
    - Once you are done with requirement gathering, you can present or propose a low and high fidelity design to the stakeholders. Once these design are validated, you can now come out with the User Interface Design.
    - Tool: fluid AI, adobe xb.

II PRACTICE

A. TOPIC:

Archival and retrieval of missing objects using image matching algorithm and advanced machine vision.

B. PROBLEM STATEMENT

The loss or misplacement of personal belongings is a common occurrence that can cause inconvenience and distress to individuals. Traditional methods of searching for missing objects, such as posting flyers or contacting lost and found services, are often time-consuming and ineffective. To address this issue, there is a need to develop a mobile application that leverages mobile technology and image matching algorithms to create a user-friendly platform for archiving and retrieving missing objects efficiently.

- **GOAL**: The goal is to provide a solution that streamlines the process of locating lost items, enhances accuracy in matching, and promotes community engagement to improve the effectiveness of the search process.

C. REQUIREMENT GATHERING

Our presentation will be divided into 3 parts

i. IDENTIFYING THE STAKEHOLDERS

- **Definition**: Firstly, a stakeholder are people who brainstorm, analyze, approve or deny project updates. The stakeholders could be end-users, stakeholders, sponsors, managers, developers, testers, regulators, and any other parties who have a stake in the software outcome.

- **How do we identify stakeholders**: the most user technique to identify stakeholders is through **stakeholder analysis?** This is the process of collecting information about any person that will be impacted by (or can impact) your project

- **Our various stakeholders:** our project is going to have 3 stakeholders, who are

    - End-users
    - The developers
    - The testers
    - administrator

Requirement gathering techniques used in our projects:

we used 3 requirement gathering techniques throughout this project

I. Interviews:

we carried out a P-To-P (person to person) research technique. We were able to interview 4 different individuals by the help of a prearranged questionnaire made up of 9 questions as follows

Pre-prepared questions from the Interview

- Have you ever misplace an important item? Being it a document or and a personal identity? What was the item?
- If yes, in what circumstance?
- What type of personal belonging do you usually misplace?
- How do you do after realising you misplaced the object? How do you describe the object (what are some of the criteria you emphasize on why describing your objects)
- What are some of the methods do you use to recover the missing property? Are they easy?
- What if you could use your mobile device to recover your missing item?
- What are some of the features you would like to have or see in that app?
- Will you be comfortable uploading the image of your missing item to give the chance to other people to help you look for your stuff?
- Can we keep your contact in other to keep you updated on the evolution of the app?

REPORT ON THE SURVEY CARRIED OUT ON SUNDAY 28 APRIL 2024

This interview was done at

- Mile 17 buea. Over 2 "moto boys" , 8 bus drivers and 10 taxi drivers were interviewed .
- Two workers from Camtel office were also interviewed

QUESTIONS ASKED :

- How often do u loose your lost document (ID card , birth certifcate , death certificate and others) ?
- If yes. what do you usually do to find the said lost document ?
- Where do you often or occasionally do you recover lost document ?
- What measures do you take after recovering the documents to make sure they are returned back to the owner ?

RESULTS :

- MILE 17:

QUESTION 1 :
Out of the 20 people,

- 19 of them reported they have never lost their documents .
- 1 of them, their document was stolen from their car . They reported they were extremely causios with their documents as they are being frequently asked by the police. The one person whose document was stolen was because he left his car unlocked out of tiredness

QUESTION 2 :

- The one person whose document was stolen reported it to the police for further investigation

QUESTION 3 :
Out of the 20 people,

- 14 of these persons typically find missing documents in their vehicle (more than 5 times)
- 3 of them have rarely found missing documents in their vehicle (< 2 times)
- 1 of them have never seen or picked any missing documents

QUESTION 4 :

- 7 of these people return the lost document to the "Taxi Union"
- 8 of the bus drivers return the missing document to the nearest bus stop

- 3 of them tried to personally contact the owners due to the numerous "taxi union" locations making them pay a fine before seraching for their missing documents

❖ CAMTEL OFFICE :

QUESTION 1 :

- 2 of them reported they have never lost their documents. They reported they are always carefuly when handling their documents (especially ID card) as it has become a second nature to them

QUESTION 3 :

- 2 of them mostly found missing documents on waiting chairs or on the floor

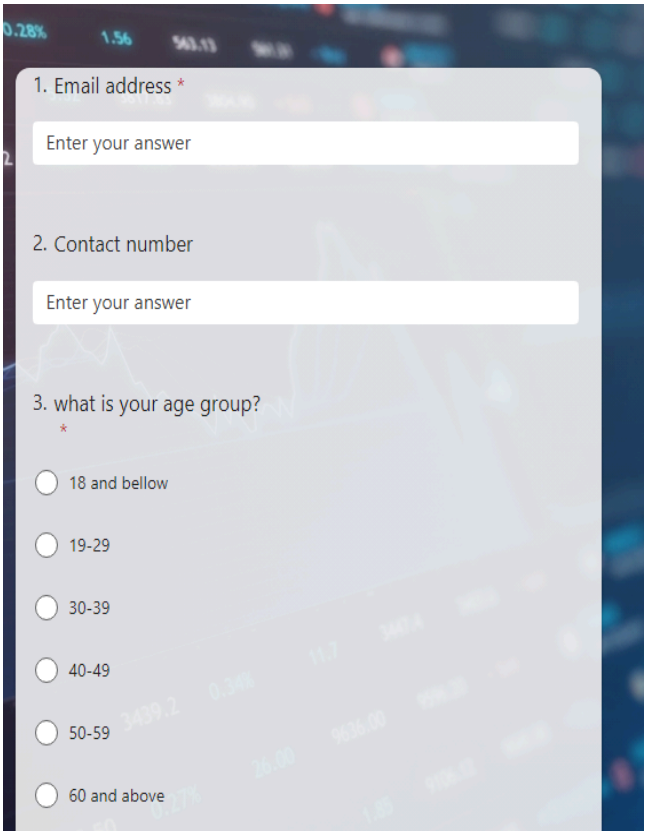
QUESTION 4 :

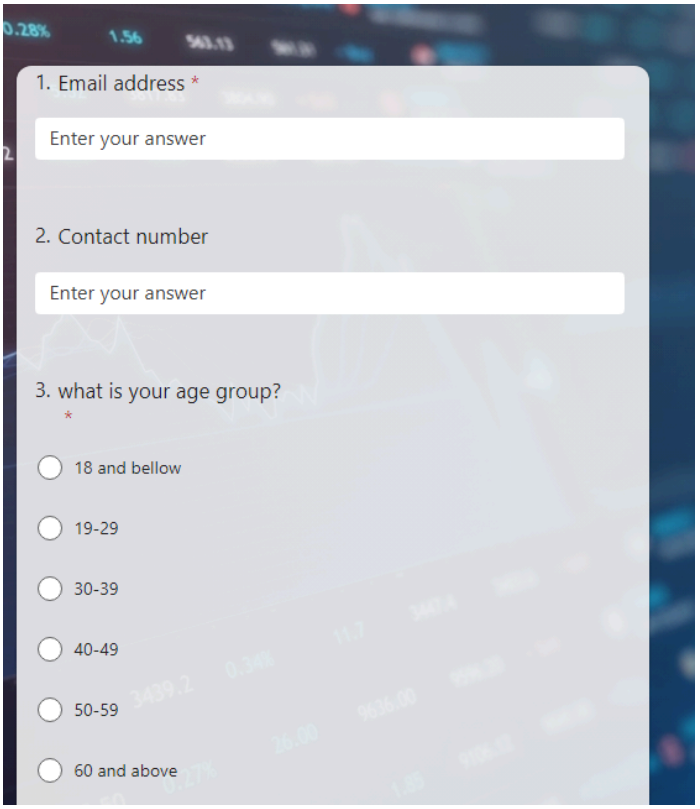
- They reported they usually placed the missing document on the front of the desk visible to everyone coming in incase some people are looking for it . They do so because they said most of the time they were too busy to make futher inquiries to find the owners of the missing documents

II. Survey:

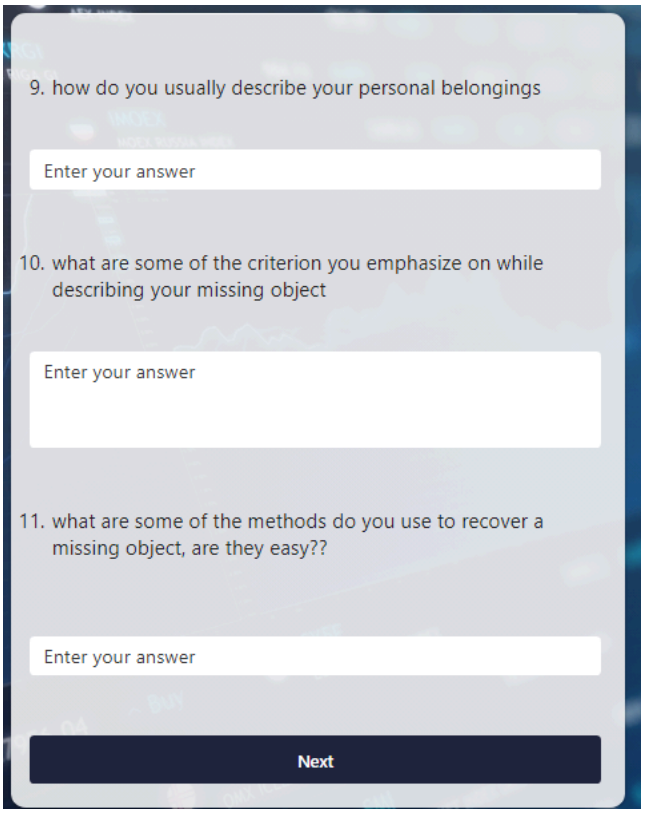
A prototype is **a** product built to test ideas and changes until it resembles the final product. This will be carried on later run in the project after having a first a design.

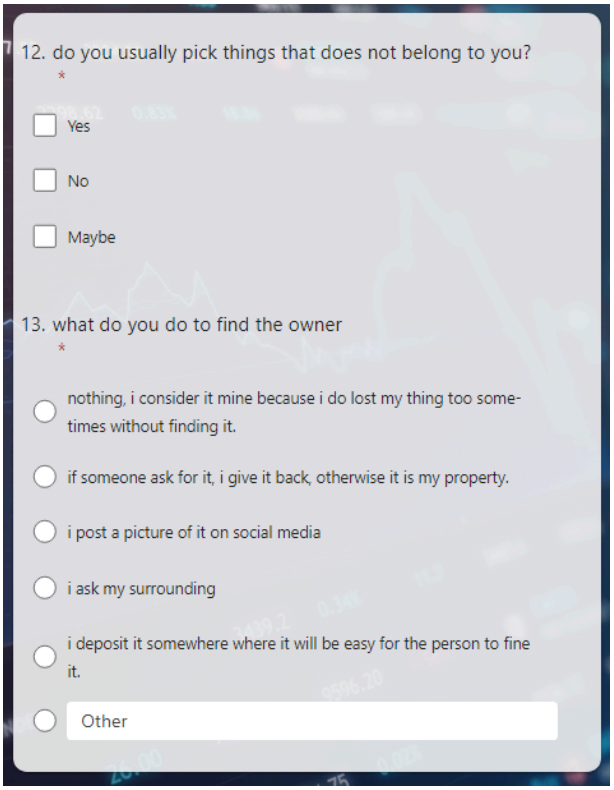
Online survey:

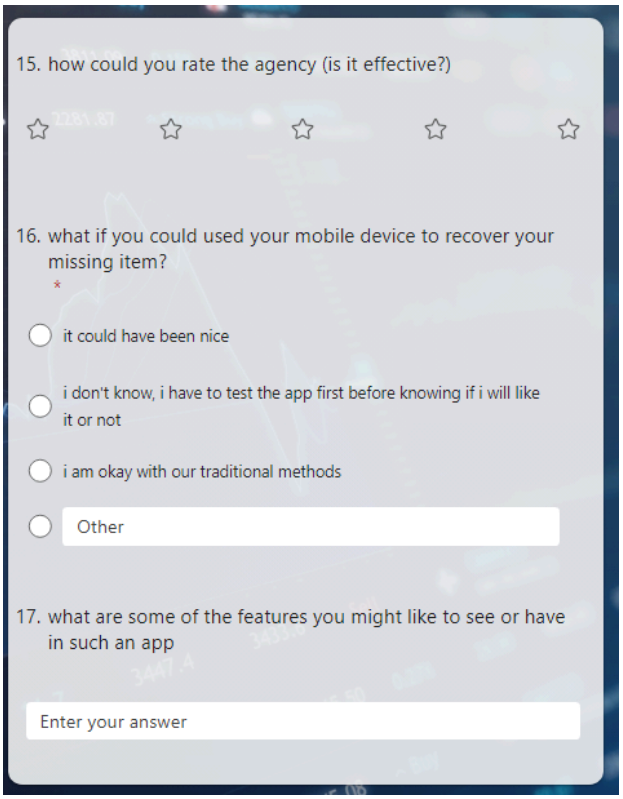

1. Email address *
Enter your answer
2. Contact number
Enter your answer
3. what is your age group?
*
18 and bellow
19-29
30-39
40-49
50-59
60 and above


1. Email address *
Enter your answer
2. Contact number
Enter your answer
3. what is your age group?
*
18 and bellow
19-29
30-39
40-49
50-59
60 and above

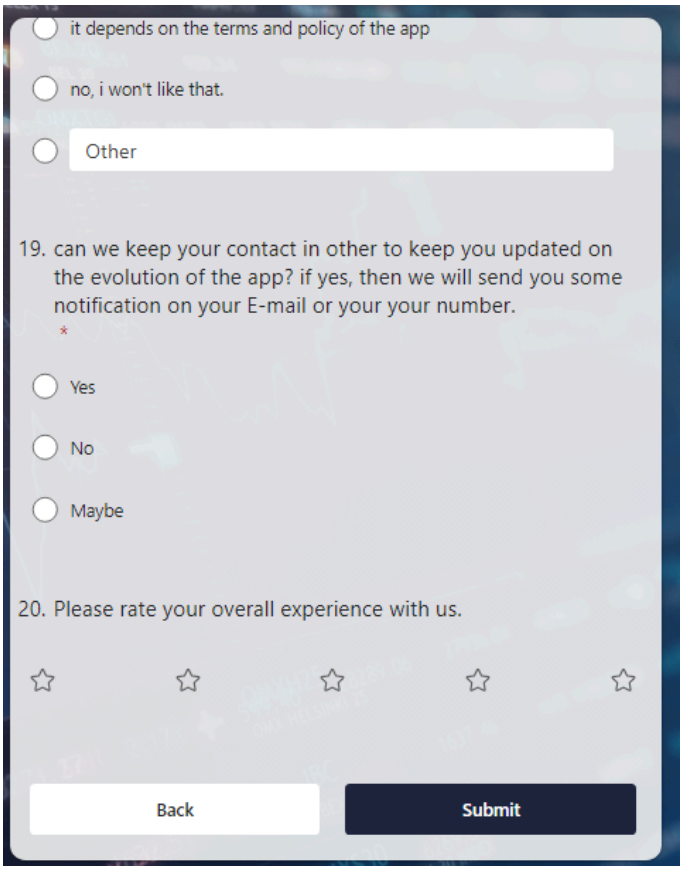

7. what type of personal belonging do you usually misplace?
*
Enter your answer
8. What do you do after realizing you misplaced what document? *
i just accept the fact and move forward
i go back to the last place i remember and look for it there
i go back to the last place i remember and ask for it there
i post my missing item on social media
i go to specified agency and drop my info there
Option 6
Other
9. how do you usually describe your personal belongings


9. how do you usually describe your personal belongings
Enter your answer
10. what are some of the criterion you emphasize on while describing your missing object
Enter your answer
11. what are some of the methods do you use to recover a missing object, are they easy??
Enter your answer
Next


12. do you usually pick things that does not belong to you?
*
Yes
No
Maybe
13. what do you do to find the owner
*
nothing, i consider it mine because i do lost my thing too some-times without finding it.
if someone ask for it, i give it back, otherwise it is my property.
i post a picture of it on social media
i ask my surrounding
i deposit it somewhere where it will be easy for the person to fine it.
Other


15. how could you rate the agency (is it effective?)
16. what if you could used your mobile device to recover your missing item?
*
it could have been nice
i don't know, i have to test the app first before knowing if i will like it or not
i am okay with our traditional methods
Other
17. what are some of the features you might like to see or have in such an app
Enter your answer

‘


it depends on the terms and policy of the app
no, i won't like that.
Other
19. can we keep your contact in other to keep you updated on the evolution of the app? if yes, then we will send you some notification on your E-mail or your your number.
*
Yes
No
Maybe
20. Please rate your overall experience with us.
Back
Submit

link to the form(online survey on microsoft form)::
https://forms.office.com/Pages/ResponsePage.aspx?id=DQSIkWdsW0yxEjajBLZtrQAAAAAAAAAAAANAAVdtvx1UNFRCOFpESTNJSlUzV0VESks5WktTUkMxTy4u

A seperate document will be provided for our result.

III. Brainstorming:

this involves a group problem-solving technique that involves the spontaneous contribution of ideas from all members of the group.

from the brainstorming sexion, we came out with the abelow functional report

➔ FUNCTIONAL REQUIREMENTS

Are product features or functions that developers must implement to enable users to accomplish their tasks. So it's essential to make them clear both for the development team and the stakeholders. Generally, functional requirements describe system behavior under specific conditions

- **Use case Diagram:** Below is the use case diagram which summarises the functional requirements.

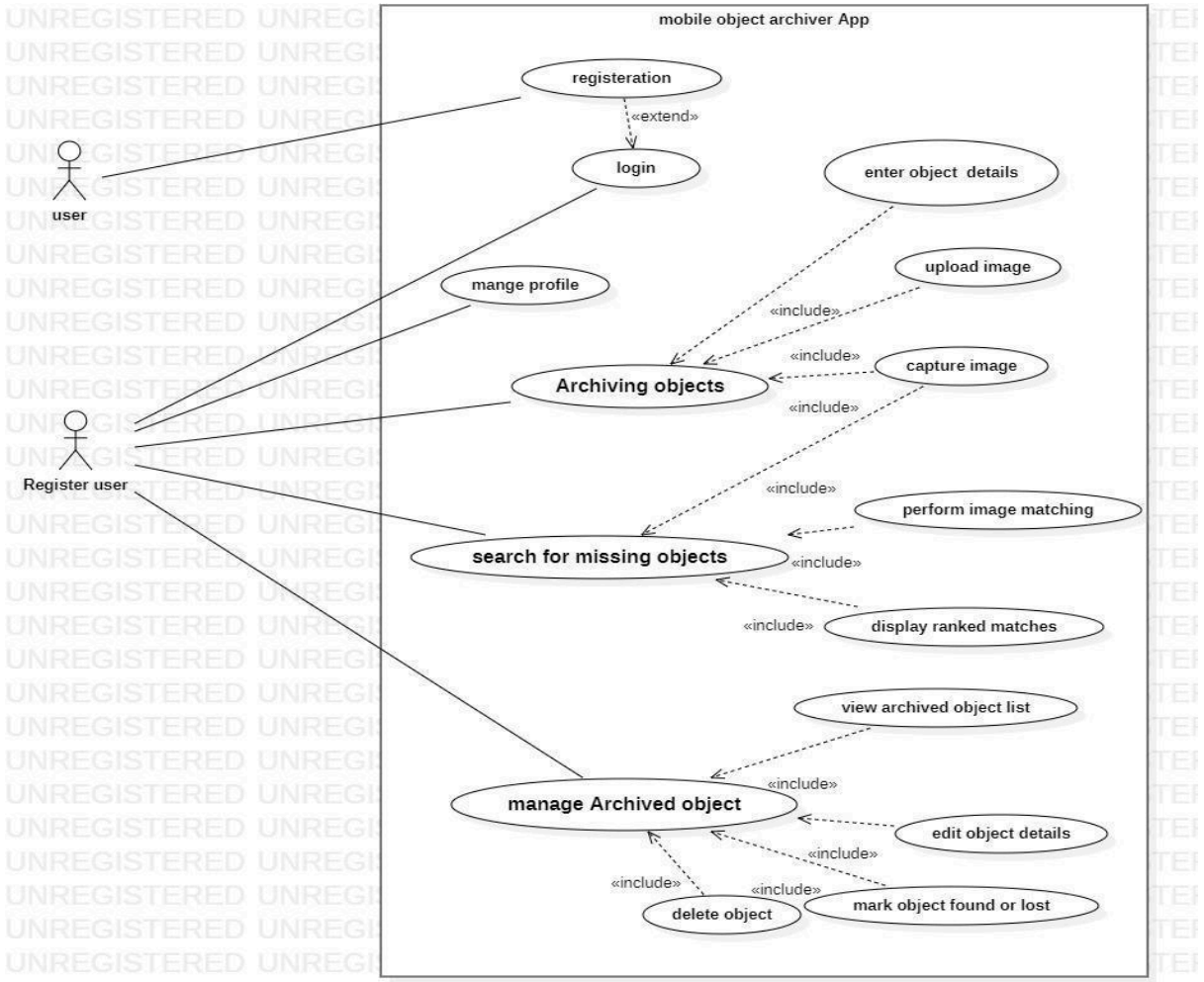


Figure1: Use case diagram for mobile base object archival application.

Use case specifications

I User Management:

Register and account creations

- The app should allow users to create accounts and log in using credentials like email and password or through social media integration

Authentication

- Users can log in to their account using their credentials
- Users can manage their profile information (e.g., name, email).

Also the user would be able to

- Capture or upload images of their belongings.
- Search for missing items by capturing a new image or uploading an existing one.
- Users can edit or delete archived object information.
- Users can filter and sort archived objects (e.g., by category, date added).

Reporting

- Users can mark an archived object as "found" or "lost."
- Users should also be able to provide feedback or rate services/products within the app.

- The app can send notifications to users for updates, reminders, or promotional content.

II Object archival

The preservation and management of digital representations of physical objects.
Here,

- Users can capture images of objects using the device camera.
- Users can upload images of objects from their device gallery.
- Users can add details to archived objects which could be optional.
  Example of these added details would include;
  - Name or description of the object.
  - Brand and model Serial number or other unique identifier (if applicable).
  - Purchase receipt information (image or text, optional).

III Object Retrieval:

- Users can search for missing objects using a new image captured by the camera.
- Users can search for missing objects by uploading an existing image from the device gallery.
- The search results should display a ranked list of potential matches from the archived database based on image similarity scores.
- Users can view detailed information associated with each matched object in the search results globally

➔ NON FUNCTIONAL REQUIREMENTS

Are not related to the system's functionality but rather define how the system should perform. They are crucial for ensuring the system's often influencing the overall experience. Gathering these requirements could be done by talking to people, conducting workshops, and using surveys etc.

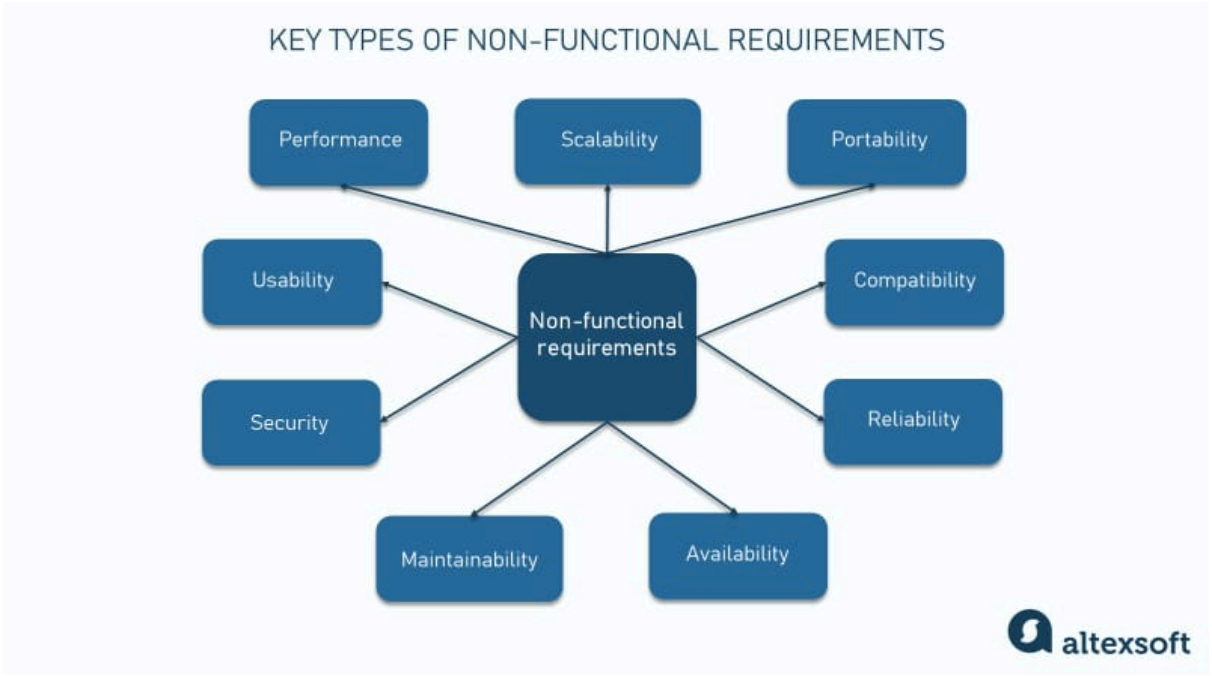


Figure 2: Key types of non-functional requirements

For

a) **Performance:**
   - The application should be responsive and perform actions within a reasonable timeframe.
     Example,
     - The app should launch quickly on various models of the mobile device.
     - Image capture and upload should be efficient and not take excessive time.
     - Image matching and search results should display within a tolerable wait time.

b) **Availability:**
   - The application should be available for use most of the time with an uptime target of about 98% and more.
   - Since it is a mobile based application, thus the need for it to function properly even under moderate network conditions (3G/4G).

c) **Security:**
   - User credentials must be securely stored using hashing or encryption to prevent unauthorized access.
   - User data (object details, images) must be securely stored in the applications database or on the device (with user consent for device storage) using encryption at rest and in transit.
   - The application should implement secure communication protocols (HTTPS) for data transmission.
   - The application should be regularly tested for vulnerabilities and patched promptly.

d) **Usability:**
   - The user interface should be intuitive and user-friendly for people with varying technical skills
   - The application should be accessible for users with disabilities (considerations for visual impairments, etc.).
   - The application should be localized to support different languages (if targeting a global audience).

e) **Reliability:**
   - The application should function consistently and reliably with minimal crashes or errors.
   - Also, the application should recover gracefully from unexpected errors and provide informative feedback to users.

f) **Scalability:**
   - The application should be able to handle an increasing number of users and archived objects without performance degradation.
   - The underlying infrastructure (image stored in the database,) should be scalable to accommodate future growth.

g) **Privacy:**
   - Users should have control over their privacy settings and the data associated with archived objects.
   - The application should collect and store only the data necessary for its functionality and comply with relevant data privacy regulations.

h) **Offline Functionality (Optional):**
   The application should allow users to capture images offline and store them locally for upload when an internet connection becomes available.

i) **Battery Consumption:**
   - The application should be energy-efficient and minimize battery drain on mobile devices.

j) **Maintainability:**
   - The application code should be well-documented, modular, and easy to maintain for future updates and bug fixes.

These non-functional requirements detail the "how" to address the overall qualities and characteristics of your application. By considering these alongside the Functional requirements detailing the "what" (features) you can ensure a well-rounded mobile application for retrieving and archiving missing objects that provides a positive user experience.

8 BEST PRACTICES FOR DOCUMENTING GATHERED REQUIREMENTS

Creating documentation is an integral part of any software development project. Well-documented requirements ensure that stakeholders and developers are on the same page and help define project scope and budget. Here are a few useful tips on how to make great documentation.

Gathered Requirements have to be clear and understandable. Make sure you state requirements concisely, without ambiguity or different interpretations. Also, try to avoid technological jargon. Remember that each audience is different, and stakeholders might not be familiar with specialized tech terminology. Instead, enrich your documents with visuals, diagrams, and graphs to support the information and make it easier to perceive. Adding glossaries and cross-links is also helpful.

Requirements have to be specific, accurate, and complete. When writing your documentation, be consistent with the language and make sure that your requirements are accurate. They should cover every scenario but never contradict one another. Avoid vagueness and weak phrases such as “system has to be fast” or “when something happens.” Be specific and quantify the terms so that all the readers can understand them similarly.

Requirements have to be testable. Write requirements so that after the product is created, testing can show whether they are delivered successfully.

Requirements have to be feasible and sensible. Focus on the functionality and quality attributes that user’s need. Remember that requirements have to reflect higher-level business objectives.

CONCLUSIONS

By effectively gathering and documenting requirements, a solid groundwork for a successful mobile application is perceived as A clear understanding of user needs, functional and non-functional requirements, and also with the design of the use case diagram to visualize core functionalities, and technical considerations will guide the development process and ultimately lead to a valuable tool for users looking to archive and potentially recover their belongings.

REFERENCES

[1] N. Ghazali and R. Razali, A preliminary review of interface design elements for mobile electronic government systems, In-formation and Communication Technologies (WICT), FourthWorld Congress, pp. 217223, December 2014
[2] T. Alhussain, S. Drew, and O. Alfarraj, Biometric authenti-cation for mobile government security, Intelligent Computing And Intelligent Systems (ICIS) IEEE International Conference,vol.2, pp. 114-118, October 2010.
[3] S. Chan, A. Connell, E. Madrid, P. Dongkuk, and R. Kamoua,RFID for personal asset tracking, Systems, Applications andTechnology Conference, 2009. LISAT 09. IEEE Long Island,pp. 1-7, May 2009.
[4] S. Chutichudet, T. Kanthathasiri, I. Ritsakunchai, and D. Wong-sawang, LFD: Lost and Found Dog application on mobile,Student Project Conference (ICT-ISPC), 2014. Third ICTInternational, March 2014.
[5] H. Bay, T. Tuytelaars, and L. Van Gool, SURF: Speeded UpRobust Features, Computer Vision and Image Understanding,vol.110, Issue 3, pp. 346-359, June 2008

[6]Jamali, H. R. (2018). Does research using qualitative methods (grounded theory, ethnography, and phenomenology) have more impact?*Library & Information Science Research*, *40*(3-4), 201-207.

[7] Lützén, K. (2017). The value of qualitative methods in prioritized healthcare research. *Nordic Journal of Nursing Research, 37(4), 175-176.*

[8] https://www.iiba.org/business-analysis-blogs/requirements-documenting--the-foundation-of-a-projects-success/