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**MINISTER OF HIGHER
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FACULTY OF ENGINEERING AND TECHNOLOGY

COMPUTER ENGINEERING

CEF440: INTERNET PROGRAMMING AND MOBILE PROGRAMMING

**REQUIREMENT GATHERING FOR THE DESIGN AND
IMPLEMENTATION OF A MOBILE BASED ARCHIVAL AND
RETRIEVAL OF MISSING OBJECTS APPLICATION USING IMAGE
MATCHING**

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TABLE OF CONTENT

LIST OF FIGURES	3
1.	4
1.1	4
1.2	5
1.3 PROJECT SCOPE	5
2.	5
2.1	6
2.2	6
2.2.1	6
2.2.2	8
2.3	17
2.3.1	17
2.3.2	17
2.3.3	22
3.	22
3.1	23
3.2	23
4.	24
5.	25
6.	26

LIST OF FIGURES

Figure 1: steps of requirement gathering

Figure 2: an overview of image Hashing

Figure 3: an overview of template matching

1. INTRODUCTION

In today's digital age, mobile technology plays a crucial role in enhancing our daily lives and solving complex problems. One such challenge is the retrieval and archival of missing objects, a common issue that affects individuals and communities worldwide. The development of a Mobile-Based Archival and Retrieval of Missing Objects Application using Image Matching aims to address this problem by leveraging advanced image recognition technology to assist users in locating lost or stolen items efficiently. This approach harnesses the ubiquity of smartphones and advances in image recognition to create a practical solution for retrieving missing items.

1.1 PROBLEM STATEMENT

Every year, countless personal items are lost or stolen, causing not only significant financial loss but also personal inconvenience and emotional distress to individuals.

Traditional methods of locating missing objects often rely on manual searches or centralized databases, leading to inefficiencies and delays in retrieval. There is a need for a more streamlined and accessible solution to aid in the swift recovery of lost items.

In the digital era, there is a critical need for a more dynamic and technologically advanced solution that can offer a higher rate of recovery with less effort and time. Existing digital solutions fail to fully exploit the potential of modern technologies like image recognition, which can significantly enhance the process of identifying and matching found items with their rightful owners.

The objective of this project is to design and implement a user-friendly mobile application that enables users to upload images of missing objects and search through a database of found items using image matching algorithms. This technology promises not only to enhance the probability of recovering lost items but also to streamline the process, making it quicker and more efficient .

1.2 PROJECT GOALS

- To create an easy-to-use mobile platform that allows users to upload images of lost or found objects.
- To use image matching technology to automate the comparison of newly uploaded images against existing entries in a robust database.
- To enable users to communicate securely and coordinate the return of objects.

1.3 PROJECT SCOPE

This report explores the development and implementation of a Mobile-Based Archival and Retrieval of Missing Objects Application using Image Matching technology. It delves into the functionalities of the proposed application, examining how image matching algorithms can be leveraged to efficiently locate lost items. Additionally, it investigates potential use cases across various sectors, such as transportation, hospitality, and personal belongings. Furthermore, the report assesses the effectiveness and feasibility of the proposed solution in comparison to traditional methods of object retrieval.

2. REQUIREMENT GATHERING

For a successful design and implementation of a Mobile-Based Archival and Retrieval of Missing Objects Application using Image Matching, the requirement gathering process is crucial. This process will guide the development of an application that efficiently serves the needs of users wanting to find their missing objects using image matching technology. This phase is critical as it directly influences the scope, design, functionality, and overall success of the application. Here is a detailed breakdown of the requirement gathering process for this project:



Figure 1: Steps of requirement gathering

2.1 IDENTIFYING STAKEHOLDERS

This step involves listing all parties who might have an interest in or be affected by the mobile app. By brainstorming, we identified the following stakeholders:

- End Users: Individuals who will use the app to find missing objects.
- Contributors: Users who may upload images of found objects.
- Law Enforcement: If the app will be used for stolen objects, police and other law enforcement agencies might be involved.
- Legal and Compliance Experts: To address data privacy issues, especially related to uploading personal data and images.
- Developers and Technical Staff: Those who will develop and maintain the app.
- UI/UX Designers: Specialists in user interface and user experience design.
- Data Scientists: Experts in image recognition and matching technologies.
- Marketing Team: To promote the app and ensure it reaches a wide audience.
- Investors and Sponsors: If external funding is involved.
- Community Organizations: Local groups interested in property safety or community services.

2.2 GATHERING ESSENTIAL INFORMATION:

Gathering essential information for a mobile-based application that uses image matching technology for the retrieval and archival of missing objects involves collecting critical data and insights across multiple dimensions. This foundational step ensures the app's functionality aligns with user needs, technological capabilities, and market expectations. We gathered our informations by conducting interviews, surveys, contextual analysi and competitor analysis.

2.2.1 INTERVIEW:

This is a qualitative research method used to gather in-depth information from potential users, stakeholders, experts, and other relevant parties. We conducted interviews with a series of questions. Here's a detailed look at how interviews the interview was structured and the out comes;

2.2.1.1 INTERVIEW QUESTIONS

- How often do you misplace or lose important items?
- Which types of items do you commonly misplace or lose?
- Have you used any similar apps or solutions for finding lost items before? If yes, please specify.
- What features would you expect from an app designed to help you find missing objects using image matching?
- How comfortable are you with using technology to track and locate your belongings?
- What devices do you primarily use for such tasks (e.g., smartphone, tablet, computer)?
- Would you be interested in receiving notifications or alerts when an item is detected using image matching?
- How important is accuracy in locating missing items for you?
- Are you concerned about the privacy and security of your data while using such an app?
- Would you prefer a free app with ads or a paid app without ads for this purpose?
- Do you have any suggestions or specific features you would like to see in this app?

- We obtained the following answers from the interview:

2.2.1.2 INTERVIEW RESULTS

Respondent	Age	Frequency	Types of items	Previous Apps	Expected Features
1	21 - 30	sometimes	keys, wallet	none	search, notification
2	21-30	Rarely	keys, ID cards,money	none	Upload images,notification
3	Above 30	Rarely	phone, glasses	Find my iphone	image recognition
4	Above 30	Often	Documents, glasses	none	notification
5	15-21	Rarely	headphones, backpack	Find my iphone	voice commands, search
6	Above 30	sometimes	glasses, watch	none	customizable alerts
7	Above 30	Often	keys, umbrella	none	offline mode, notification
8	Above 30	Rarely	wallet, ID	none	social sharing,notification
9	Above 30	sometimes	phone, bag	none	good UI, notification
10	Above 30	Often	glasses, keys	Find my iphone	geolocation tracking
11	Below 15	Rarely	notebook, pen	none	voice commands, search
12	21-30	Often	phone, umbrella	none	offline mode, notification
13	21-30	sometimes	wallet, glasses	Find my iphone	augmented reality
14	Above 30	Rarely	keys, headphones	none	customizable alerts
15	Above 30	Often	phones	none	voice commands, tracking
16	21-30	sometimes	glasses, watch	none	notification

2.2.2 ONLINE SURVEY:

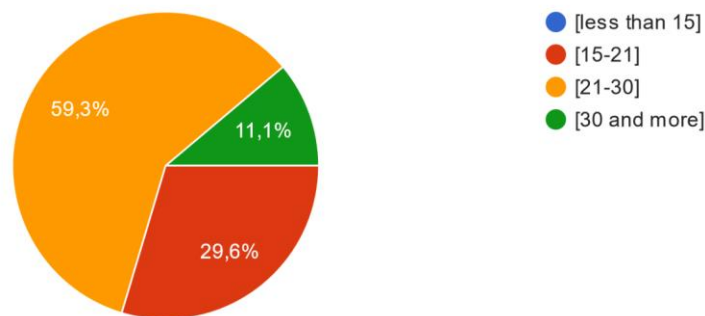
An online survey is a research tool used to collect data from a large group of people about their needs, preferences, behaviors, and perceptions. This method is particularly valuable for gathering quantitative insights from a wide audience quickly and efficiently. We conducted the online survey with a series of question and we obtained the following result:

We have **27 person** who are filled the form

- concerning the person who lost an Items

What is your age?

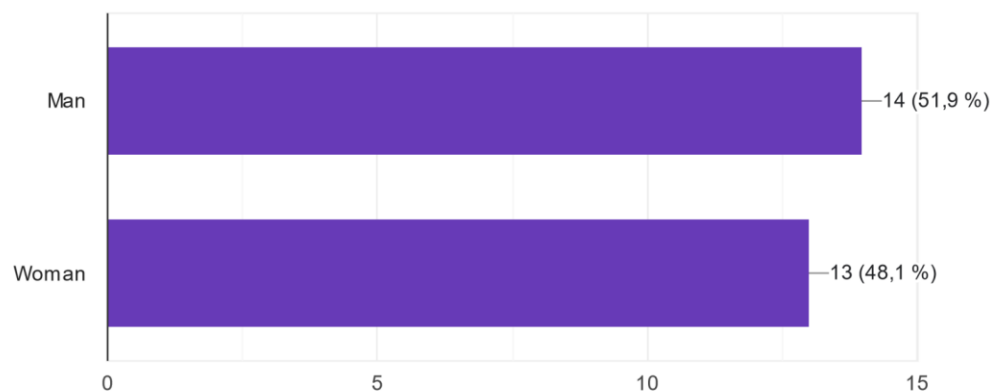
27 réponses



so the majority were people between [21-30]

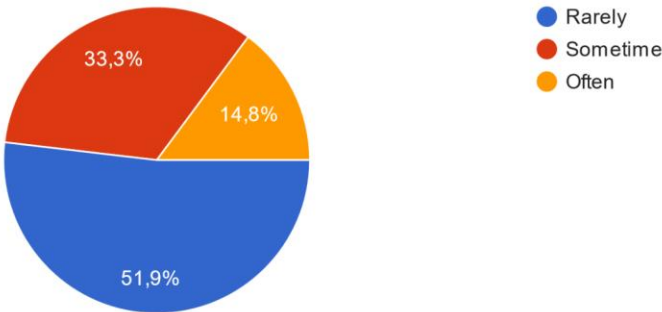
What is your gender?

27 réponses



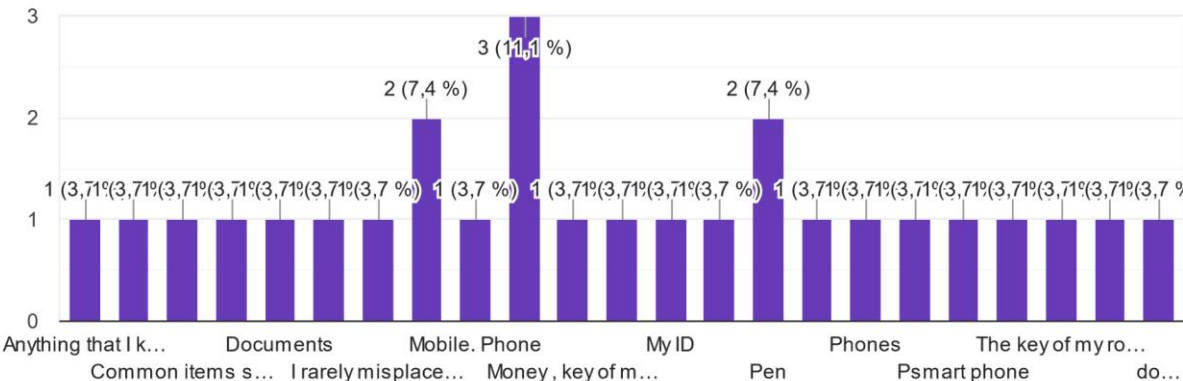
How often do you misplace or lose important items?

27 réponses



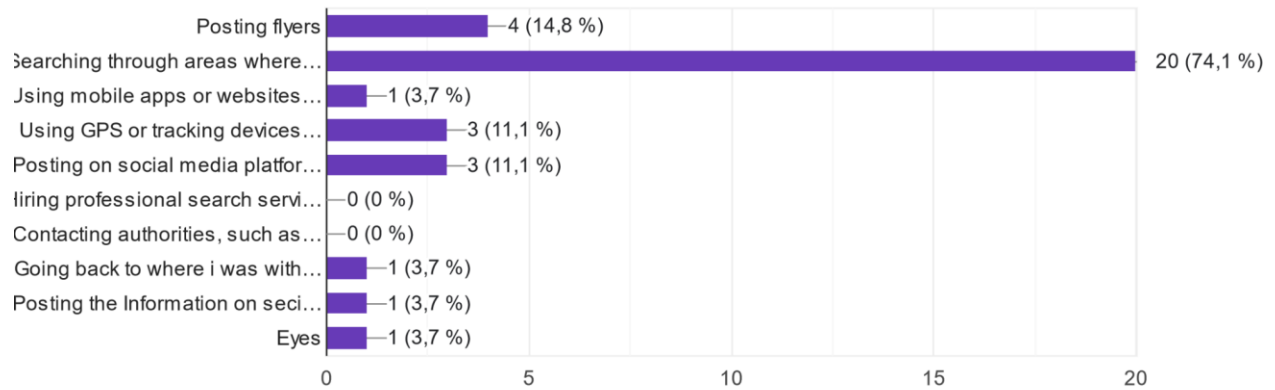
Which types of items do you commonly misplace or lose?

27 réponses



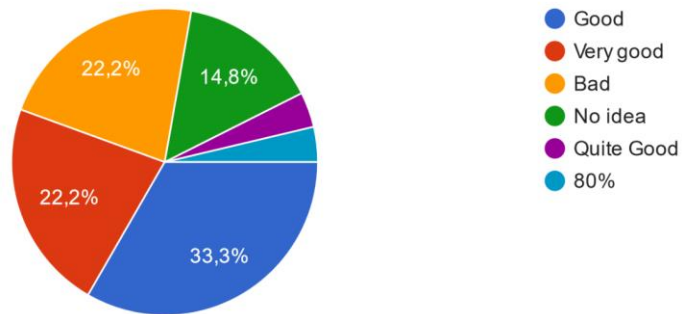
Which method have you use to find this items ?

27 réponses



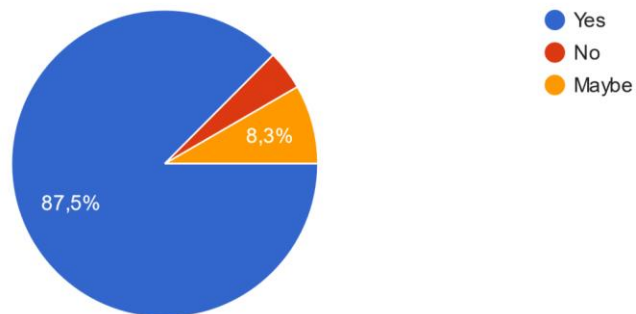
How effective do you find this methods in retrieving lost items ?

27 réponses



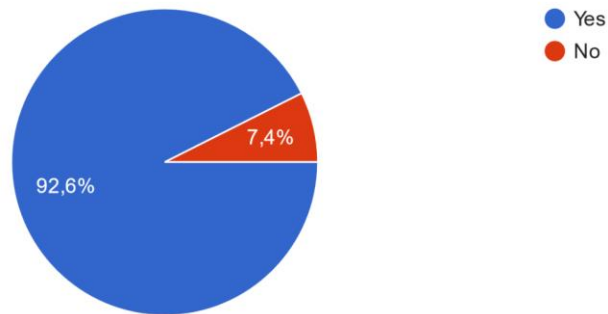
Do you want to have a mobile App to found your items ?

24 réponses



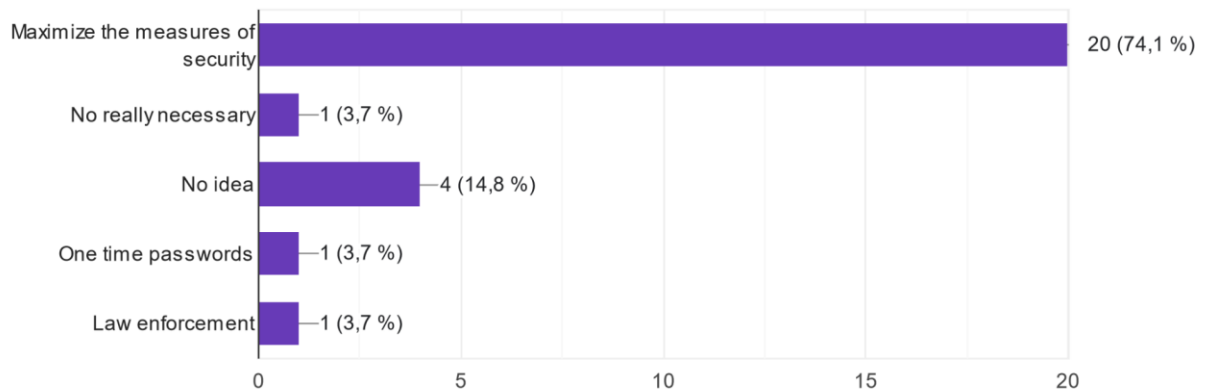
Are you concerned about the privacy and security of your data while using a such App ?

27 réponses



What measures would you expect the app to take to protect your privacy and ensure compliance with legal requirements?

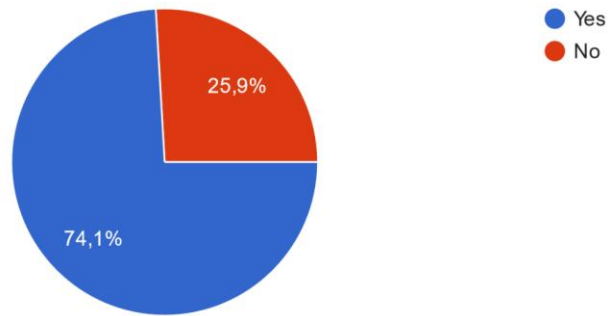
27 réponses



- Concerning the person who found an items

Have you ever found a lost item and successfully returned it to its owner?

27 réponses



What motivates you to return lost items when you find them?

27 réponses

Good moral and the joy the person will have on it face

The nature of the item

My conscience

The need of the owner

Concern for the person who lost his item

Honesty

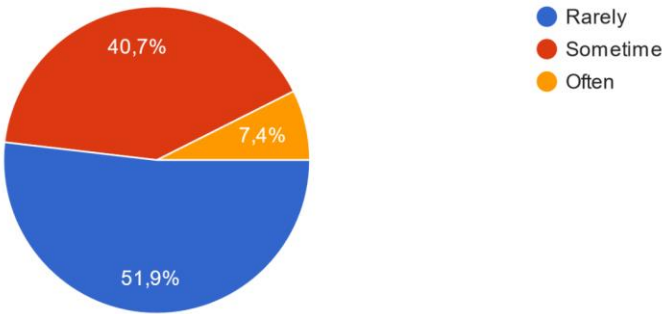
The fact that I am also capable of losing something and someone returns it back to me.

I believe it has a value to the owner

I feel sad for the owner

How often do you come across lost items in your daily life?

27 réponses



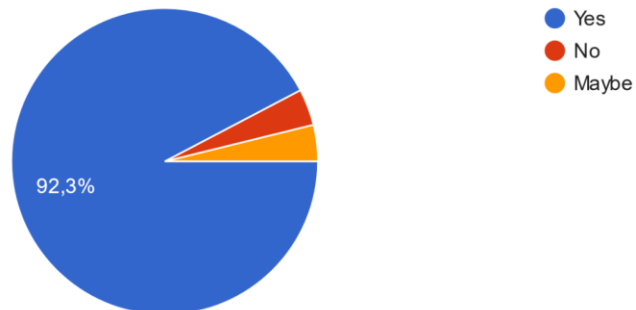
What challenges do you face when trying to return a found item to its owner?

27 réponses

To find the owner
Distance
Identification of the owner's identity
I'm occupied
Where do I start
U can be accuse of collecting
No challenge.
No way of identifying the owners
The identification of the owner

Would you be willing to use a mobile app to help identify the owner of a lost item through image matching?

26 réponses



What features would encourage you to actively use an app for returning found items?

19 réponses

Small funny and delicious rewards like chocolates or a date

No idea

Reduce my work

A mobile application

If it doesn't use data

Effective image matching, reliable means to verify and contact the owners

No bugs

Offline functionality

Advertisement

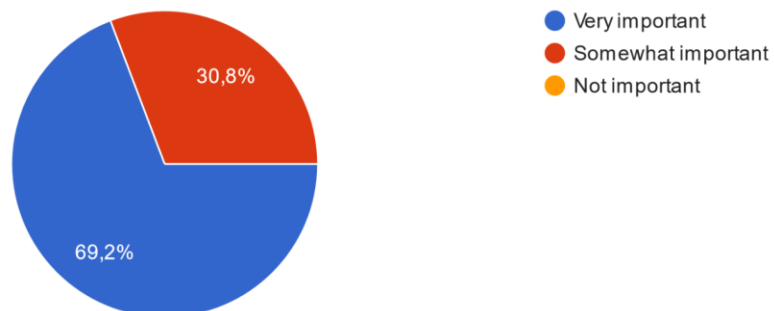
Are there any concerns or barriers that would prevent you from using such an app?

27 réponses

No
Yes
If i need to spend too much time and data .i should just be able to post what I found and wait for the owners reply.
None
False accusations from the owner
Yes finance , reason that some mobile apps are sometimes costly to purchase in order to have the access into it
Network
System failures

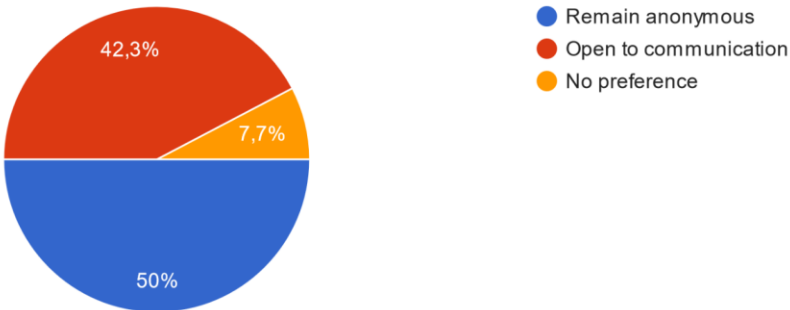
How important is it for you to have a reliable and secure method to connect with the owner of a lost item?

26 réponses



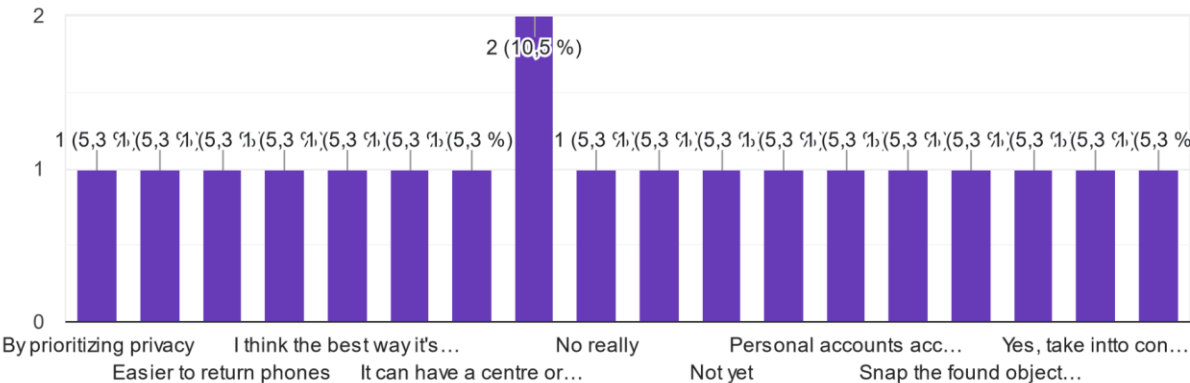
Would you prefer to remain anonymous when returning a found item, or are you open to communication with the owner?

26 réponses



Do you have any suggestions or feedback on how an app could improve the process of returning lost items?

19 réponses



Conducting detailed interviews and online survey with people who have experienced losing items, we found out that the following objects are commonly lost by people in our community:

- Personal Documents like National Identification Cards, Passports, Driver's license, Credit Cards, Certificates.

- Personal electronics like phones, laptops and tablets.
- School Items like textbooks and school books.
- Wallets and Purses.
- House and car keys.
- Jewelry and Watches.

The loss of these items often prompts the need for systems that can help in their quick retrieval to minimize inconvenience or the potential for theft.

2.3

2.3 COMPETITOR ANALYSIS

Conducting a competitor analysis for requirement gathering in the development of a mobile-based application for archival and retrieval of missing objects using image matching involves systematically reviewing existing documentation and sources relevant to our project. This method helps to understand current capabilities, identify gaps, and define the scope of new system requirements based on learned information. We studied some existing systems and we identified the following gaps:

2.3.1 EXISTING SYSTEMS LIMITATIONS

- Manual Matching: In some systems, users must manually browse and compare lost and found listings, which can be time-consuming and inefficient.
- Low Recovery Rates: The effectiveness of these apps often depends on the user base size and engagement, leading to potentially low recovery rates.
- Limited Search Capabilities: in some systems, Search functions are often basic, relying on text descriptions without utilizing more advanced filtering or matching technologies.

2.3.2 IMAGE MATCHING TECHNOLOGIES:

Explore image matching technologies available and decide on the most suitable options based on performance, accuracy, and cost. From our document analysis, we came out with four image matching technologies which will be describes below:

2.3.2.1 FEATURE BASED MATCHING

This method involves detecting key features (like edges, corners and others) in images, describing these features in a way that is invariant to scaling, orientation, and lighting conditions, and then matching these features between different images.

- Highly accurate and effective in varied conditions.
- Can be computationally intensive, which might affect performance on mobile devices unless optimized.
- Tools/Algorithms: SIFT (Scale-Invariant Feature Transform), SURF (Speeded Up Robust Features), ORB (Oriented FAST and Rotated BRIEF).

2.3.2.2 HASHING TECHNIQUE

Image hashing involves converting images into compact digital "hashes" that can be quickly compared. Changes to the image result in changes to the hash, but similar images produce similar hashes.

- Extremely fast comparison times and low memory requirements.
- Sensitivity to image modifications.
- can vary minor changes and can sometimes produce different hashes.
- Tools: pHash (Perceptual hashing), dHash (Difference hashing).

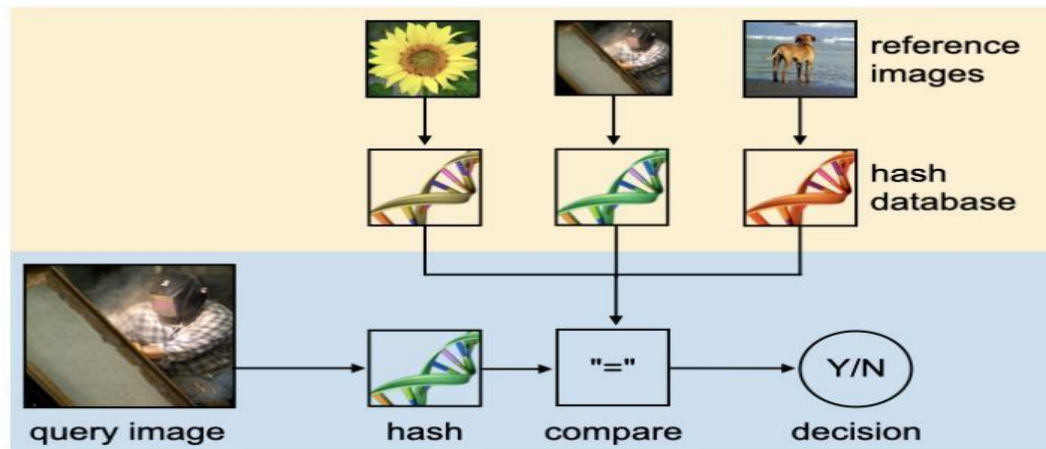


Figure 2: an overview of image Hashing

2.3.2.3 TEMPLATE MATCHING

Template matching works by sliding a template image over a source image to determine if the template matches a portion of the source image.

- Simple and easy to implement.
- Not robust to changes in scale or rotation, and can be inefficient if the template size and the source image size are large.
- Best for scenarios where objects have a standard orientation and size.

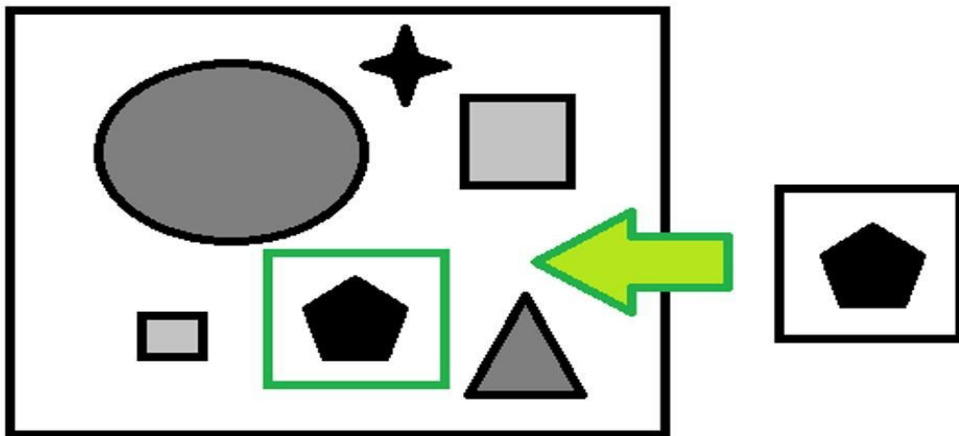


Figure 3: an overview of template matching

2.3.2.4 HISTOGRAM COMPARISON

This technique compares the color histograms of two images. If the histograms are similar enough based on a defined threshold, the images are considered a match.

- Fast and not affected by image size or orientation.
- Can fail if the image backgrounds are different or if the color distribution overlaps significantly despite the images being different.
- Useful when color distribution is a reliable identifier.

2.4 CONTEXTUAL ANALYSIS:

Contextual analysis in the development of a mobile-based application for the retrieval and archival of missing objects using image matching involves thoroughly understanding the environments and conditions under which the application will be used. Here's a breakdown of how we conducted our contextual analysis

- ✓ **Identify Participants:** Select participants who are likely to use the app, such as individuals who frequently lose or find objects, or those who work in environments where lost and found items are common (e.g., airports, train stations, public spaces).
- ✓ **Conduct Contextual Interviews:** Engage with participants in their natural environments where they may encounter lost or found objects. Observe their behaviors, workflows, and challenges related to identifying and matching lost items.
- ✓ **Ask Open-Ended Questions:** During the interviews, ask open-ended questions to gather insights into participants' experiences, needs, and pain points. Some example questions include:
 - Can you describe a recent experience of losing or finding an object?
 - What steps do you typically take when trying to match a found item with a lost item?
 - What difficulties do you encounter during this process?
- ✓ **Capture User Stories:** Document user stories based on the insights gathered during the interviews. User stories should describe the tasks users want to accomplish with the app, such as uploading images of lost or found items, searching for matches, and communicating with other users.
- ✓ **Identify Functional Requirements:** Based on the user stories, identify the key functionalities the app needs to fulfill. This may include:
 - Image upload and recognition: Users should be able to upload images of lost or found items, and the app should use image recognition technology to match similar items.

- Search and filtering: Users should be able to search for lost or found items based on various criteria such as location, category, or description.
 - Communication features: The app should facilitate communication between users who have lost and found similar items, allowing them to arrange for item retrieval.
 - User authentication and privacy: Implement user authentication to ensure the security of user accounts and privacy features to protect sensitive information.
- ✓ **Consider Non-Functional Requirements:** In addition to functional requirements, consider non-functional requirements such as performance, scalability, usability, and security. For example:
- Performance: The app should provide fast and accurate image recognition results.
 - Usability: The user interface should be intuitive and easy to navigate, catering to users with varying levels of technological proficiency.
 - Security: Implement measures to protect user data and ensure the secure transmission of information.
- ✓ **Prototype and Validate:** Develop prototypes or mockups of the app's interface and functionality based on the gathered requirements. Validate the prototypes with participants to ensure they meet their needs and expectations.
- ✓ **Iterate and Refine:** Incorporate feedback from participants into the design and requirements of the app. Iterate on the prototypes to address any usability issues or missing features identified during validation.
- ✓ **Document Requirements:** Document the gathered requirements in a clear and organized manner, ensuring all stakeholders have a comprehensive understanding of the app's functionalities and features.

2.4.1 STAKEHOLDERS NEEDS AND EXPECTATIONS

From our various requirement gathering technique, we came out with the following stakeholder's need and expectation:

- **User-Friendly Interface:** Users expect a simple, intuitive interface that makes uploading images, searching for items, and navigating the app straightforward.
- **Accuracy of Image Matching:** High accuracy in matching found objects with lost items to ensure users can reliably recover their belongings.
- **Speed:** Quick responses and fast loading times, especially when uploading images and receiving match results.
- **Privacy and Security:** Robust protection of personal data, including images and contact information. Users want assurance that their information is secure and privacy is respected.
- **Accessibility:** The app should be accessible to users of all abilities, including provisions for those with visual or motor impairments.
- **Notifications and Updates:** Timely notifications about potential matches and updates on their lost or found items.
- **Support and Help:** Easy access to customer support in case of issues or questions regarding the app's use.

3. SYSTEM REQUIREMENT

The system requirements for designing and implementing a mobile application focused on archival and retrieval of missing objects using image matching technology encompass both functional and non-functional aspects. These requirements will guide the development process, ensuring the application meets its intended purpose effectively and efficiently. Here's a breakdown of these requirements:

3.1 FUNCTIONAL REQUIREMENT

Functional requirements describe what the system should do. They detail the behaviors and functions the application must support. These include:

- **User Registration and Authentication:** Users can create, manage, and delete accounts.
- **Image Upload and Storage:** Users can upload images of missing or found objects.
- **Image Matching Functionality:** Implement advanced image matching algorithms to compare uploaded images against the database. Automatically notify users of potential matches.
- **User Notification:** Real-time notifications for users when a potential match is found. Notifications for system updates or important information.
- **Search and Filtering Option:** Allow users to search the database using various filters (date, location, type of object). Intuitive user interface for easy navigation and use.
- **User Interaction and Communication:** Enable secure messaging or contact methods between users to discuss potential matches. Privacy controls to manage what information is visible to other users.
- **Reporting and Management Tools:** Tools for users to report issues or give feedback. Administrative tools for managing the system, user activities, and data.

3.2 NON FUNCTIONAL REQUIREMENT

Non-functional requirements specify how the system performs certain tasks and under what constraints. They are critical for ensuring the usability, reliability, and performance of the application:

- **Performance:** The application should load and respond quickly, even under high user load.
- **Scalability:** The system must be scalable to accommodate a growing number of users and data entries. Efficient data handling and storage solutions to manage large volumes of images.

- **Security:** Robust data encryption for storing and transmitting user data and images. Compliance with data protection regulations (e.g., GDPR, CCPA) to ensure user privacy.
- **Usability:** The application should be user-friendly, with a clean and intuitive interface suitable for varied demographics. Accessibility features to cater to users with disabilities.
- **Reliability:** High availability of the application with minimal downtime. Maintainability: The system should be easy to update and maintain.
- **Compatibility:** The application should be compatible across multiple mobile platforms (iOS and Android) and ensure good performance across various device models and screen sizes.

By meticulously defining both functional and non-functional requirements, you can ensure that the mobile application for archival and retrieval of missing objects using image matching is developed to meet both user expectations and technical standards. This foundational work is key to creating a successful and widely adopted application.

4. IMPORTANCE OF REQUIREMENT GATHERING

- **Clarifies User Needs:** Ensures the product meets actual user expectations and solves the right problems.
- **Defines Project Scope:** Helps in accurately defining what needs to be done, preventing scope creep and ensuring effective resource allocation.
- **Reduces Costs:** Minimizes the likelihood of expensive changes and rework later in the development process by clarifying requirements upfront.
- **Improves Efficiency:** Provides developers and project managers with a clear roadmap, streamlining the development process and reducing time to market.
- **Enhances Communication:** Fosters better understanding and cooperation among all stakeholders, including developers, clients, and end-users.
- **Increases Success Rate:** Detailed requirements lead to higher quality outputs and greater satisfaction, enhancing the overall success of the project.

5. DIFFICULTIES ENCOUNTERED IN GATHERING REQUIREMENT

- Difficulties encountered Getting the appropriate survey questions It was challenging establishing the correct survey questions , likewise making them unambiguous and less time consuming as well . Participants complain of many questions even though they were necessary.
- Understanding project expectation. Though project description may sound easy, understanding how the app was to function wasn't. Realized that for an object to be found the owner must have images of it, which can be archived in the database and later retrieved when an image matching is done with a found object.

6. CONCLUSION

The requirement gathering phase is pivotal in setting the foundation for a successful project. By systematically collecting and analyzing the needs and expectations of all stakeholders, this phase ensures that the project is precisely aligned with user requirements and business objectives. Effective requirement gathering not only clarifies the project scope and facilitates efficient resource allocation but also minimizes risks and reduces the need for costly revisions later in the development process. Ultimately, investing in thorough requirement gathering enhances communication among stakeholders, streamlines the development workflow, and significantly increases the likelihood of project success.

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