POLITECNICO DI MILANO

MSc Automation and Control Engineering

Software Engineering

Requirements Analysis and Specification Document

For the Application of Medication Reminder

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1. Introduction

From studying the concept of a medicine reminder through a methodology that goes in line with the identification of the problem and implementing the solution as an application in a convenient platform, the Feasibility Study document provides evident justifications for developing the same. The development of the mobile applications follows different phases of documentation, starting from the Feasibility Study Document which explains the feasibility of the concept. Further, the next phase involves the study of requirements to develop the concept that makes the Requirement Analysis and Specifications Document (RASD). The other phases include the Design Document, Implementation Document, Testing Document, and User Manual, where the information regarding the documents would be mentioned correspondingly in the later phases of documentation.

Here, this document illustrates the Requirement Analysis and Specification Documents (RASD) of the project of the medication reminder abbreviated and named “MedRem”. The application allows the creation of medicine reminders round the clock with a display of the medicines and stock reminders. RASD discusses the identification of functional and non-functional requirements along with the analysis of different assumptions and constraints. It gives in detail, the results of a User Survey conducted for the study of users and the domain of healthcare with digitalization, identifying some of its properties. Also, it includes the UML modelling, scenarios, and use cases associated with the development of the application. At the end of the document, a short note on the development platform of MIT App Inventor is mentioned as well.

2. Health Care & Digitalization

The era of modern medicine started after the Industrial Revolution in the 18th century. With the discovery of antibiotics, a certain level of treatment and medication was provided. This is the accepted norm all over the world even now with the introduction of the digital revolution. People consume medicines every day and often forget about them also. The old school reminder methodologies were: First, to keep the prescription of the doctor with care and the second was to cut the name on the strip or the box and keep it with care. These methods are flawless but due to any inevitable situation, they can be easily misplaced and worn down.

After the digital revolution, the use of smartphones and other smart devices left a permanent mark on our lives. The application of information and communications technology together bonded to provide digital health interventions which prevent disease and improve quality of life, became a new concept.

Digital health, or digital healthcare, is a broad, multidisciplinary concept that includes concepts from an intersection between technology and healthcare. Digital health applies digital transformation to the healthcare field, incorporating software, hardware, and services. Under its umbrella, digital health includes mobile health (mHealth) apps, electronic health records (EHRs), electronic medical records (EMRs), etc. Mobile health technology - also known as mHealth - is fast becoming the patient-preferred way to access their providers, log in to patient portals, track their steps, and manage their medications and conditions.

These mHealth applications revolve around the point that they enable patients to take control of their health. mHealth apps can help patients with medication adherence, which is a "reminder" application. The application's main feature is to provide reminders about the different medications to the users. They can customize it as per the needs which includes an additional description of the medication, frequency, and interval. A dosage display can also be provided which would further strengthen the application.

Similar to the identification of requirements, it is equally important to identify the properties of a specific domain, in this case, healthcare, that links to digital applications, which integrates the sub-domain of mHealth applications and particularly "MedRem". The identified properties are included in the application in such a way that it is transformed into suitable components in accordance with the requirements. For following a course of medicines, it is quintessential for the patients to know the information comprised in the prescription and it is the same case for the doctors to proceed with writing prescriptions.

Considering a prescription, the pieces of information that are needed to follow any medication routines include the name of the medicine, the frequency at which it is taken, and its dosage. The names could be used to distinguish the drugs from one another. Also, it should be noted that the names can be either generic like paracetamol as used by doctors or pharmacists, or brand names like Panadol, which are provided by pharmaceutical companies. The frequency gives the number of times the medicine should be taken in a day without loss while the dosage gives the number of units (tablets or pills) that should be taken at a time. It is also important to see the time at which the medicines should be taken. Without this information, it is impossible to follow any routines and should be considered a mandatory requirement, which is also needed for the application of a medication reminder.

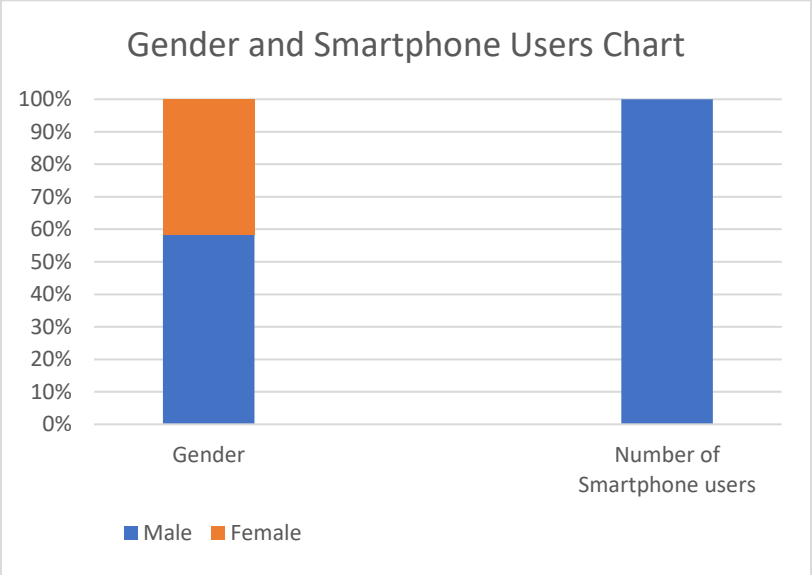
3. User Survey

Medication reminder applications notify people to take medicines at the right time with prescribed dosages. Anyone can download it on their smartphone and start immediately with it. Taking the medication at the right time improves how well it works and how safe it is.

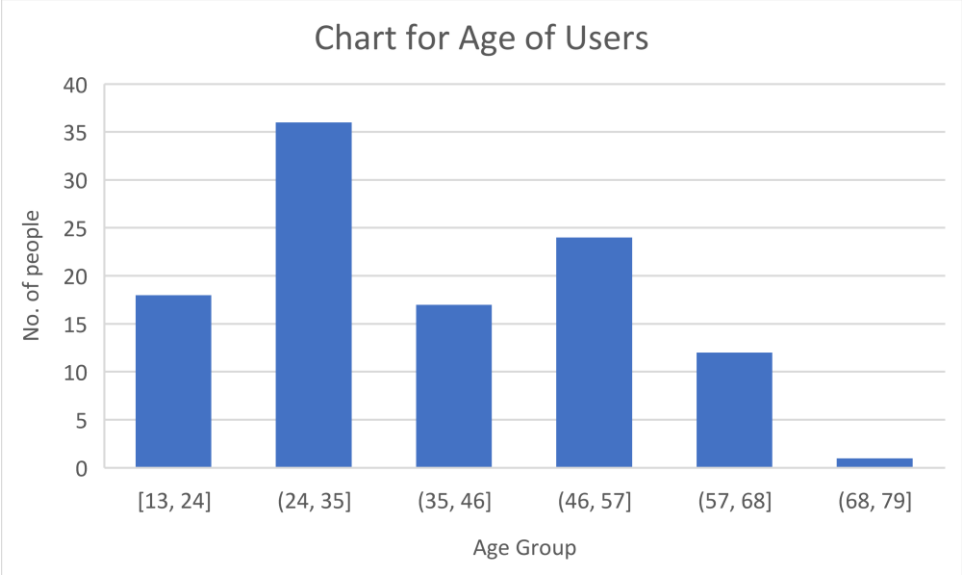
To derive the specifications for the application requires not only the study of properties in the domain but also an interaction with the user which is realized through a user survey. The survey also investigates how users perceive the need for a medication reminder application.

The survey contains about 10 questions (both in English and Italian) and returns both quantitative and qualitative data for analyzing the user's point of view of such an application. Also, it should be noted that the questionnaire does not need the users to disclose their personal data like name or e-mail ID, therefore making them anonymous. The survey took place in the month of May 2022, using Google Forms as the platform, which further made it easier for link generation and circulating it digitally through social media to friends and family members.

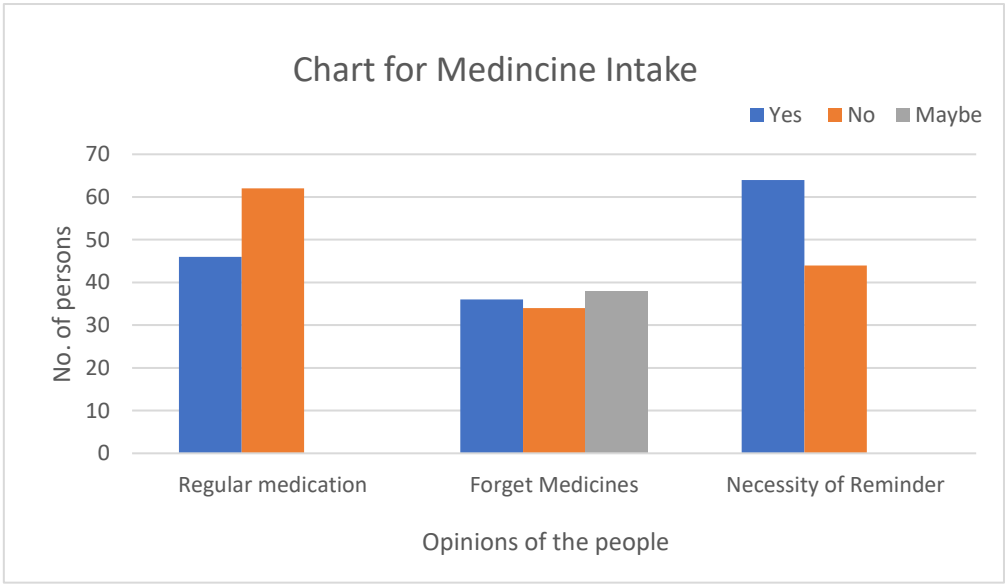
As already mentioned, the respondents were anonymous, and not needed to reveal their personal data apart from their age and opinions about the questions. Altogether, there were 108 responses recorded and analyzed by searching through trends and mapping our findings against existing research.



Of the 108 respondents, 58% were male and 42 % were female. Regarding age, there were different categories given and it was observed that half of the people were more than 35 and in that, almost 25 people were greater than 50 years of age. Since the other half of people particularly come in the age group of 21-30 years, because of the distribution of the survey among the students, it should be acknowledged that some interesting nuances about the study are lost as the expectation was to focus more upon the elderly population. In the Feasibility Study, it has been mentioned that the application should be more simple and easier to operate which can be seen as an advantage for older people, identifying them as the target group for the application. Another aspect of the study also says that all the people, even those aged more than 60, possess a smartphone and know how to operate them.

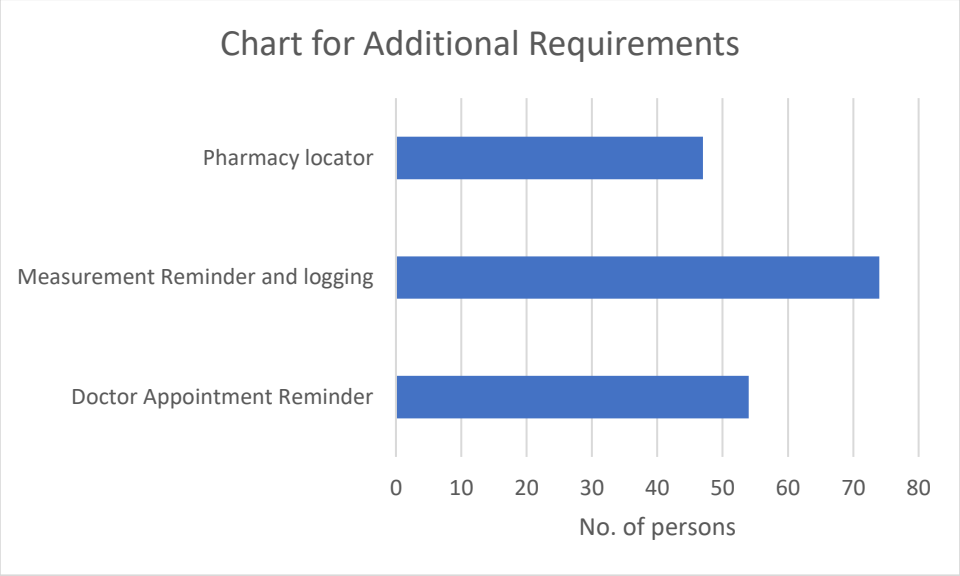


Some of the important aspects of the study revolve around three sections comprising whether the user takes medicines regularly, forgets to take medications or the necessary reminder. About 62 out of 108 respondents, claimed they do not have regular medications, and this could be primarily due to the fact that the survey had a large number of participants below the age of 30 with no chronic diseases. The question of being forgetful about taking medications was responded equally likely with all three answers including an additional option of "maybe", beyond the usual binary answers. The added option makes people doubtful for a moment, tending to the reason for the same, and this scepticism can itself be seen as a sign of being forgetful, making more than half of the people to be categorized as people who fail to remember medicine intake. This is further reflected in the section on whether users need a reminder to make them aware, and more than 60 people wanted to have it.



From the market study conducted for the Feasibility Study, the applications were also analyzed with respect to the features implemented. Some of these features have been implemented by multiple applications and out of those, 3 features were identified as more common, which are Pharmacy Locator, Measurement Logger and Reminder, and Doctor Appointment Reminder. The features listed were given as options to find out the user's perspective about keeping them as additional requirements. Almost 75% of the people have voted for Measurement Logger and Reminder while 50% think that both Pharmacy Locator and Doctor Appointment Reader would be a good addition to the application. Also, there has been another option given for the user to mention any other feature that they think would be more helpful, where a lot of people have commented their own responses, some of them are listed below.

Additional Recommendations
Customized health and lifestyle suggestions along with dietary charts and yoga
Price and current availability of the same medicine in nearby different pharmacies.
Instant doctor appointment. An SOS to the nearest hospital.
Reminder related to Regular medical tests (eg. Lipid profile)
Some cumulative data on how healthy I'm based on (age, bp, BMI, sugar level, blood reports) among your other registered users. I will feel better and in a position of improvement rather than being depressed.
Details about the medicine that I'm consuming and the relative side effects.



The user survey is helpful not only in identifying a few of the requirements but also gave an insight into the users' notion of a medicine reminder. The study also laid the answers to the questions of the target groups for the application and the reasoning for the need for such an application. It shows the expectation of users to adhere to the medication routines with the help of a reminder

and proves their readiness or acceptance to include a reminder in their day-to-day activities. Thus, complying with medication routines as prescribed by a medical practitioner. The survey has also proved to be an important checkpoint in the entire process of development, giving space to introspect about how the concept of a medicine reminder can change people's lives.

4. Product Description

The scope of the project is to develop an easy-to-use application of medicine reminders that anyone can use. From the market research in the feasibility study and also the user survey, it is evident that there are very less number of applications that are compatible with the needs of elderly population. Here, we would be focussing more to the necessities of older peoples with comprehensible sequences and simple in operations to set reminders for their medicines. In further sections, a systematic approach towards development is considered and taken.

4.1. Product Functions

Some of the major functionalities of the medicine reminder, "MedRem" includes the following:

- **Add/Modify medicines**: The application needs the user to add the medicines, to successfully set reminders according to required schedules and the necessary dosage at the right time. Also, in cases of change in prescriptions, users must be able to modify the information on medicine or the medicine itself and further, the timings of reminders.

- **Showing the medicines**: The medicines that are added to the application must be shown as a list, in a display, for the user to be sure of which medicines they are taking. It should be listing out all the information regarding the medicine including the name, dosage, and frequency, at the time when it is added. Also, it should be added that, whether the user sets reminders or not, the list of medicines should be displayed, nevertheless.

- **Stock Management**: During the time of adding medicines or modifying them, a user could be able to mention the number of pills or the stock of it, to keep in account how many medications are remaining with them. It can be further added or restocked in case of a change in prescriptions.

- **Reminders Management**: The addition of medicines to the application can be accompanied by setting multiple reminders according to the prescription for each

medicine. As part of the stock management, a stock reminder can also be set, for it turns on when the number of pills reaches a minimum quantity.

4.2. Assumptions and Constraints

Considering the domain of health care, it is imperative to say that the user should be taking medicines whether for the short term or long term, and have a comprehensible prescription, which lists out the required information of medication to add in the application. As evident from the User Survey, most people have the know-how of smartphones regardless of their age. Thus, it should be taken as an assumption in terms of the digital domain.

Regarding the hardware constraints, the users should possess a smartphone at least with the minimum specifications. The smartphone need not be connected to the internet or any other connectivity interfaces as it might be required only at the time of installation or update. It should be important that the operating system of the smartphones is Android with a version of 4.0.0 or above as per the software constraints of the development platforms. The application does not deal with any personal data other than information on medicines and will be stored in the smartphone itself.

4.3. MIT App Inventor

The application is developed on the MIT app inventor which is a web application integrated development environment originally provided by Google and now maintained by the Massachusetts Institute of Technology (MIT). It uses a graphical user interface (GUI) very similar to the programming languages Scratch (programming language) and Star Logo, which allows users to drag and drop visual objects to create an application that can run on Android devices.

Advantages and disadvantages are the different sides of the same coin. **First**, the libraries have limited features which inhibit users to develop an application to its full extent. **Second**, the graphics of the platform is also not very user-friendly. It is only good for developing and testing. Deployment of the application without any graphics is a huge error. **Third**, it will be difficult for people who want to transition from the coding world to the app inventor. Due to its limitations, the applications developed using the platform cannot be compared to the coding-based applications.

5. Requirements

5.1. Functional Requirements

In view of product functions, the first and foremost requirement which is a must and takes precedence over all the others is allowing to **add medicines**. Only if the medicines are added, the users would be able to set any kind of reminders.

The **prescription display** gives the medication information that the user has entered in a structured manner. Furthermore, it can also display information not only about the medicine but also the current stock and its own reminders.

During the addition of medicines, the users would also be able to **set reminders** based on the frequency and time to which they need to take the medicines. The application will remind the users in form of notification like an alarm with a message about the different medications and their dosages.

The users can also **create a stock** of different medicines by setting the number of pills they are having while adding the information of medicines. With this, users are also able to **set stock reminders** that notify them when the stock hits a minimum quantity, which should also be mentioned while creating the stock.

Similar to the entry of medicines, in cases of changes in the course of them, users are also allowed **to modify** the data on medicines or **delete** it from the database. The same can be performed also in reminders for medicines or in stock reminders **by changing the time** for reminders or **changing the minimum quantity** to be reminded. When the user buys the medicines in response to stock reminders, they are also given the option **to restock** by updating the number of pills they want to add to the stock.

5.2. Non-Functional Requirements

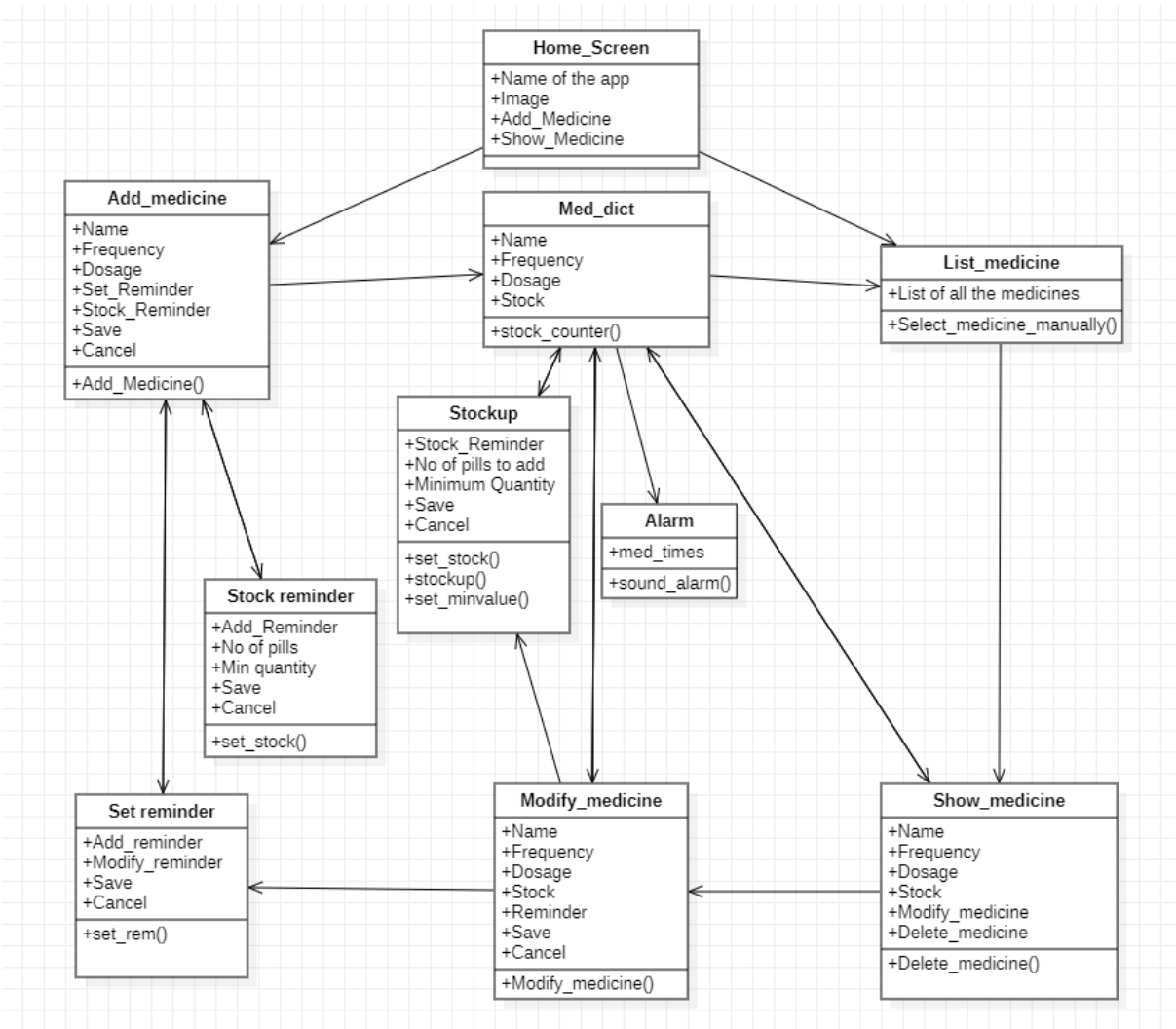
Since the mobile application of MedRem is static, it requires comparatively less computational power, and a large section of it goes to database management within the system. Therefore, the **performance** of the application would be well and good. About the **scalability**, it is out of the question as the application is static and any number of people can download and install it on their own devices. The user data on the information of medicines are stored in their respective devices, which breaches only if the data on the entire smartphone is compromised. Also, the application does not use any connectivity interfaces through which a breach can occur. Thus, **security** completely is ensured with the security protocols of smartphones. The application is also **reliable** for anyone at any point in time. Since the entire application is built in the MIT App Inventor and is

compatible only with the Android operating system, **portability** is a factor of concern, as it fails to work in iOS or any other operating system. The development for iOS can be included in future works.

5.3. Additional Specification

The user survey pointed out that the additional requirement as per the users' expectations goes to the **measurement reminder and logger**, in which most of the people gave their responses. As part of this functionality, the users will be able to enter the data on the kind of measurements and set reminders for the same. On the notification of reminders, the user can measure the parameter by themselves and enter the data on the current measurement, in the app which adds the measurement to a database. This data could be further extracted as an excel sheet or can be displayed as a graph. As of now, this functionality is put on hold to be implemented, due to time constraints and can be included in future works.

6. UML Diagram



7. Scenarios

1) Dr. Riccardo is an emeritus professor. He has many meetings and affairs in his daily routine. In his busy schedule, he forgets and gets confused to take regular medication for different ailments and ends up feeling tired. Noticing the situation, co-workers Sara and Francesco told him about the “MedRem” application. Using the app, now he can take medications effectively and remain healthy.

2) Francesca was recently diagnosed with high blood pressure. She was recommended to download the “MedRem” application by the doctor, as she might forget medications. Hearing that, Francesca downloaded and registered all her medications in the application.

3) Mr. Vincenzo is a government-assigned lawyer at the tribunal court of Milano. His irregular eating habits lead to the diagnosis of high cholesterol. He knew about his workload due to which he will forget about his medication. Knowing this, he went through the play store and came across the” MedRem” application. He took the application as “his lawyer” for the cholesterol.

4) Eduardo is diagnosed with diabetes where he must take insulin by a pump. Being a teenager and due to his carefree and irregular lifestyle, he forgets to stick on to the routine. The “MedRem” application was suggested by his friend Lorenzo and when he explored it, the application was found to be helpful for him to set reminders.

5) Federico is a sound engineer working for a very famous band. They travel worldwide to perform shows. In his busy life of traveling and performances, he often forgets to take medicines, which gets him hospitalized. That is when he came across the application of “MedRem” suggested through advertisements. Now, he can take medicines in a very effective manner by setting reminders and keeping the stock of them.

6) Filippo is identified with bipolar disorder at an age of 15. One day, because of his busy schedule, he forgot to restock his anti-depressants. Since he did not take any, he was filled with thoughts of self-despair and emptiness. When Luca had a talk with him, he immediately understood his condition and took him to the pharmacy. To never face such a situation again, Luca suggested the “MedRem” application where he talked about the stock reminder feature. Filippo found it interesting and downloaded it. Now, he never runs out of medication because of the “MedRem” stock reminder alongside the medication reminder.

8. Use Cases

- **Add Medicine:**
  INPUT CONDITION
  -The user must be on the homepage.
  EVENT FLOW
  -User opens the application and clicks on the “Add Medicine” button.
  -User fills the mandatory fields and clicks on “Save”.
  OUTPUT CONDITION
  -User adds up a new medicine to the list.
  EXCEPTION
  -User enters invalid input in any of the fields.

- **Show the medicines:**
  INPUT CONDITION
  -The user must be on the homepage.
  EVENT FLOW
  -User opens the application and clicks on the “Show Medicine” button.
  -It displays all the medications filled by the user in an alphabetical manner.
  -Once the user clicks on any medication (single press), it displays all the necessary information like frequency, reminder time, dosage value, etc.
  OUTPUT CONDITION
  -User was able to see the necessary information regarding any medication.
  EXCEPTION
  -User can only view one medication at a time.

- **Delete Medicine:**
  INPUT CONDITION
  -The user must be on the homepage.
  -The user must have already added medicine
  EVENT FLOW
  -User wants to delete the medication, click on “Show Medicine”.
  -User identifies from the list and clicks on the medication to be deleted.
  -User sees all the information about the medication.
  -User clicks on the delete option at the end of the screen.
  OUTPUT CONDITION
  -User performed deletion successfully.

EXCEPTION

-User can delete only one medication at a time.

- **Modify Medicine:**

  INPUT CONDITION

  -The user should be on the homepage.

  -The user must have already added medicine

  EVENT FLOW

  - User wants to modify the medication, click on “Show Medicine”.
  - User identifies from the list and clicks on the medication to be modified.
  - User sees all the information about the medication.
  - User clicks on the modify option at the end of the screen.
  - Previously filled data is shown to the user and the user can modify any data.
  - User modifies the necessary fields and clicks on Save.

  OUTPUT CONDITION

  -User performed modification successfully.

  EXCEPTION

  -User entered invalid input in any field while modification.

- **Set medication reminder (when medication is added for the first time)**

  INPUT CONDITION

  -The user must be on the homepage.

  EVENT FLOW

  -User selects the “Add medicine” option and fills in the mandatory details.

  -User also provides the reminder time or interval.

  -User clicks on Save.

  OUTPUT CONDITION

  - User set a new reminder for his medication.

  EXCEPTION

  - User enters invalid input in the field.

- **Set medication reminder (when medication is added already)**

  INPUT CONDITION

  -The user must be on the homepage.

  -The user must have already added medicine

EVENT FLOW

-User selects the “Show medicine” option and from the list chooses the medication.

-User selects the “modify” option and sets the reminder time or interval.

-User clicks on Save.

OUTPUT CONDITION

-User set a new reminder for his already available medication.

EXCEPTION

- User enters invalid input in the field.

- **Modify medication reminder**

INPUT CONDITION

-The user must be on the homepage.

-The user must have already added medicine and set reminders

EVENT FLOW

-User selects the “Show medicine” option and from the list, chooses a medicine.

-User selects the “modify” option and modifies the reminder time or interval.

-User clicks on Save and the modified reminder is set.

OUTPUT CONDITION

-User modifies the reminder for a particular medication.

EXCEPTION

- User enters invalid input in the field.

- **Set stock reminder (when medication is added for the first time)**

INPUT CONDITION

-The user must be on the homepage.

EVENT FLOW

-User selects the “Add Medication” option and fills in the mandatory details.

-User also provides a minimum value for the stock reminder activation.

-User switches on the binary switch button linked with the value.

-User clicks on Save and the new stock reminder is set.

OUTPUT CONDITION

-User set a new reminder for his medication.

EXCEPTION

- User enters invalid input in the field.

- **Set stock reminder (when medication is added already)**
  INPUT CONDITION
  -The user must be on the homepage.
  -The user must have already added medicine

  EVENT FLOW
  -User selects the “Show medicine” option and from the list chooses the medication.
  -User selects the “modify” option and adds the reminder linking with the minimum value for the stock reminder.
  -User switches on the binary switch button linked with the value.
  -User clicks on Save and the new stock reminder is set.
  OUTPUT CONDITION
  - User set a new reminder for his already available medication.
  EXCEPTION
  - User enters invalid input in the field.

- **Restock: (Receiving stock reminders, so refilling will stop them)**
  INPUT CONDITION
  -The user must be on the homepage.
  -The user must have already added medicine and set a stock reminder

  EVENT FLOW
  -User selects the “Show Medication” option and from the list chooses a medication.
  - User selects the “modify” option and chooses the stock option.
  -User fills the “No. of Pills to be added” with the number of pills he bought.
  -After filling in a certain value, the user clicks on Save.
  OUTPUT CONDITION
  - User restock the amount of medication
  - User modifies the reminder for a particular medication.
  EXCEPTION
  - User enters invalid input in the field.

9. Conclusion

The purpose of this document was to analyze the functional and non-functional requirements of the proposed system and provide an integrative view of the state of the art of digitalization in the

healthcare domain. With the aim to identify potential benefits of the previously introduced digital technology, the analysis was broadly classified into user surveys, product descriptions, requirements, use cases, and scenarios.

The user survey gives an idea about the target group of people on which the application is focused on. From the users' opinions, the necessity of such an application is further explained. The sections of product description and requirements throw light on, what the application provides for users in terms of functionalities and non-functional requirements such as performance, and scalability. etc, as taken from the user survey and preliminary analysis. The UML Diagram gives the sequence of functions in the application, to implement in a structured methodology. The UML is also associated with the Use Cases, in such a way to analyze the sequence of functionalities from a user's perspective, while the Scenarios show different situations in which people start using the application of MedRem and how it changes their lives.

The impact of digital transformation is felt across all aspects of health care, helping enable easier access to care, improving quality, and decreasing the cost of care. A domain like healthcare is accepting this system which is essential for its growth and strengthening customer relationships. Using this, customers will be able to transform their lives enabling easier access to resources, improved quality, and decreased cost of health care.

In conclusion, the document shows that the comprehension of digital technologies in the healthcare domain encompasses the digitalization of information. The user survey for our proposed system allowed us to have different insights and allowed the shift towards better healthcare models, redefining experience and improving outcomes for patients, providers, and insurers.

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