Empowering Hair Health with Intelligent Hair Disease Detection System.

Project Id: 2023-154

Final Project Thesis

D.G.N.L.Wickramarathna – IT20154158

BSc (Hons) Degree in Information Technology
(specialization in information Technology)

Department of Information Technology

Sri Lanka Institute of Information Technology

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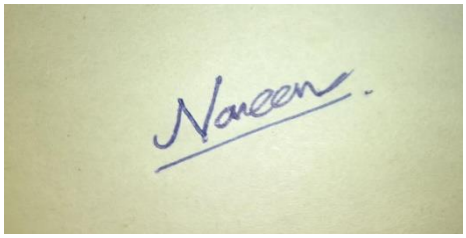
DECLARATION

This final project thesis, to the best of my knowledge and belief, does not contain any previously published or written by someone else material, unless it is specifically acknowledged in the text. I hereby affirm that this is my original work and that no previously submitted materials for a degree or certificate at another university or institution of higher learning have been included in this proposal without my permission.

Name	Student ID	Signature
D.G.N.L.Wickramarathna	IT20154158	

The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

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Signature of the Supervisor Date

ABSTRACT

In this study, it is suggested that machine learning and Internet of Things technologies be used to enhance hair health and disease management. The proposed system would use sensors to track hair loss and scratching, analyze patient prescriptions, and use machine learning algorithms to offer alternate treatments. By incorporating customized, data-driven guidance, the system hopes to improve patient outcomes and promote early identification and prevention of hair health issues. This study examines how the fields of hair health and disease management may alter as a result of machine learning and the Internet of Things.

Regarding my contribution, the patient extracted the prescription that was recommended by the doctor using easyOCR and according to the data available there, set the reminders using matching learning. After extracting the data which is a prescription recommended by the doctor show the those data separately and correctly. And also the data is stored so that it can be viewed again when needed.

It also analyzes the patient's prescription and according to the extracted data, automatically sets the reminders using matching learning. Also at the same time, the patient can set a reminder at the relevant time to enter the date and time of the patient's visit to the doctor in advance manually. By utilizing Machine Learning this approach has the potential to transform the management of illnesses and hair health.

Keywords: - Machine Learning, Mobile Application, IOT, easyOCR.

ACKNOWLEDGMENT

We would like to express our gratitude to Ms. Lokesha Weerasinghe, our esteemed supervisor, for her unwavering support and counsel throughout this study project. Their insightful comments and constructive criticism enabled us to refine our research and methodology. We also thank our co-supervisor, Ms. Thamali Dassanayake, for her significant work and support throughout this process.

We appreciate the members of our CDAP panel for their thoughtful observations, sage advice, and valuable feedback. Their suggestions and expertise were quite helpful in raising the caliber of this proposal.

Finally, we would like to express our gratitude to the research participants and colleagues who made major contributions that made this study possible. We appreciate the support and understanding of our family and friends. I sincerely appreciate your valuable efforts.

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LIST OF ABBREVIATIONS

ML	Machine Learning
OCR	Optical Character Recognition
IOT	Internet of Things
NLP	Natural Language Processing
NN	Neural Network
IOT	Internet of Things
UI	User Interface
UX	User Experiences
API	Application Programming Interface
HIE	Health Information Exchange
EHR	Electronic Health Records

1. INTRODUCTION

1.1 Background

Healthcare is undergoing a technological transformation as a result of the Internet of Things (IoT) and wearable technology. These devices feature sensors that collect data and enable ongoing monitoring of several health indicators. In the last few years, there has been a lot of interest in the use of IoT-enabled wearable devices for sickness diagnosis and management. The classification of hair diseases is one application for such tools. Early identification can help prevent hair loss and other negative effects from hair illnesses, which are a serious public health issue. This work proposes a novel approach to collect data from IoT-enabled wearable devices, such as hair bands or caps, analyze the data using image processing methods, and identify any potential signs of hair sickness. The technology will alert the user of any potential health problems via a smartphone app.

Along with monitoring the hair health, the doctor will extract the medical records given to the patient and analyze the data using machine learning methods, the system will evaluate the data provided and provide personalized therapy recommendations to the user. Understanding user input and responding accordingly, chatbots will be used to interact with users and learn about their symptoms. The technology will then apply deep learning neural networks to evaluate user data and recommend personalized treatment plans.

The system will collect and interpret information related to past and potential future symptoms of disease to train machine learning models. The system will use this information to suggest appropriate medications based on patient input and preferences. In addition, relevant medical expert data will be collected for each disease, and a machine learning model will be developed and added to the system. Based on that information, the algorithm will suggest suitable doctors for each disease, and the locations of those doctors will be displayed on a Google map.

Overall, the proposed system uses wearable sensors, machine learning algorithms, and natural language processing to provide a comprehensive solution for hair disorder classification, diagnosis, and treatment.

1.2 Literature Survey

1.2.1 OCR in Healthcare

OCR, which transforms printed or handwritten text into machine-readable formats, is a key piece of technology in the healthcare industry. Its importance in the area is noteworthy, particularly for its part in digitizing a variety of paper-based documents, including patient forms, prescriptions, and medical records, which simplifies data administration and accessibility. OCR was essential in the shift from paper medical records to electronic health records (EHRs), which significantly increased productivity and reduced costs. OCR is particularly important in the prescription filling process since it helps to extract important pharmaceutical information, ensure accuracy, and improve patient safety. OCR streamlines data extraction procedures in research and clinical applications, enhancing patient care while lessening administrative demands on medical staff. OCR in healthcare does, however, confront several difficulties, such as handwriting diversity, various document layouts, and the need for high accuracy, especially in medical contexts.

Figure 1-1 OCR circle

OCR also enables data interoperability between diverse healthcare providers and systems, allowing seamless information exchange while adhering to strict regulatory rules like HIPAA. This permits secure Health Information Exchange (HIE). The future promises advanced data extraction and in-depth analysis when OCR is combined with cutting-edge technologies like Natural Language Processing (NLP), which has the potential to further transform healthcare processes, improve patient outcomes, and accelerate the ongoing digitization of healthcare data.

1.2.2 Reminder Systems in Healthcare

By improving patient involvement and drug adherence, reminder systems play a significant role in healthcare. These systems use a variety of channels, like as mobile apps, text messages, and email, to send reminders at the right times for taking medications, attending appointments, and performing other chores connected to your health. They have been proven to be beneficial in enhancing patient outcomes, decreasing missed appointments, and lowering medication errors through extensive research and clinical investigations. Reminder systems not only improve patient wellbeing but also lessen the burden on medical staff by encouraging a proactive attitude to healthcare management. To ensure their widespread adoption and efficiency in a variety of healthcare settings, these systems must be designed and implemented with patient preferences, privacy concerns, and accessibility in mind. This will eventually improve patient care and health outcomes.

Figure 1-2 Reminders of automatically seted

1.2.3 Integration of OCR and Reminder Systems in Healthcare.

Reminder systems and optical character recognition (OCR) technology working together in healthcare is a game-changing synergy. Reminder systems are smoothly integrated with OCR's capacity to extract important information from a variety of medical documents, including prescriptions and medical records, allowing for automatic and contextually appropriate reminders for patients. This integration improves patient engagement overall, appointment scheduling, and medication adherence. In order to reduce the possibility of medication errors and missed visits, personalized reminders that are tailored to patients' individual healthcare needs are created using the extracted data, processed and formatted using OCR.

Although this integration promises to change administrative effectiveness and patient care, it also necessitates a thorough approach to data security and privacy, underscoring the necessity for adherence to healthcare standards. Therefore, the OCR and reminder system integration represents a crucial step toward enhancing patient outcomes, streamlining healthcare delivery, and increasing the effectiveness of the healthcare system.

1.2.4 Storing Patient History Using Extracted Data

In addition to serving as a reminder, the use of data generated using optical character recognition (OCR) technology also includes the thorough management and archiving of patients' medical records. Electronic Health Records (EHRs) and patient histories can be created more easily because to OCR's ability to convert paper-based records into digitized, structured data. This digital repository stores a wide range of vital patient data, such as diagnoses, treatment plans, and medical procedures, making it simple for healthcare professionals to access and update patient data. A centralized system like this improves care coordination, cuts down on duplication, and helps in decision-making. To protect sensitive patient information, the application of this strategy calls for stringent data security measures and adherence to privacy laws. By doing this, OCR is integrated into patient history management, which improves patient care quality and continuity while also streamlining healthcare workflows and improving patient outcomes.

Figure 1-3 Store extracted data

1.3 Research Gap

The combination of optical character recognition (OCR) with reminder systems provides an exciting new area of research in the field of healthcare that deserves more investigation. One significant area for future research is how patients and healthcare professionals use and use OCR-integrated reminder systems. The extent to which users find the integration process simple and user-friendly is a crucial topic even if OCR technology has the ability to streamline data extraction from prescription forms and other medical records. In order to fill this gap, it is necessary to evaluate the user experience, comprehend any adoption hurdles, and come up with ideas for improving these systems' usability. Researchers can help to improve the integration process and facilitate its acceptability within healthcare settings by examining the human-computer interaction components of OCR-integrated reminders.

Additionally, a significant research gap exists in assessing the accuracy of OCR technologies, particularly when faced with difficult circumstances like illegible handwriting or irregular prescription formats. In order to ensure patient safety, data extraction accuracy is crucial because mistakes in pharmaceutical information or dose guidelines might have serious repercussions. Therefore, there is an urgent need for research into establishing reliable error-detection and repair procedures inside OCR-integrated systems. Researchers should look into ways to improve OCR precision, effectively manage errors, and make sure that the digitized data complies with industry standards and best practices. By closing this gap, OCR technology in the medical field becomes more dependable and trustworthy while also protecting patient safety.

The overall research gap also relates to the long-term effects and results of OCR-integrated reminder systems in the healthcare industry. The sustained impacts on patient health outcomes, such as medication adherence rates, hospitalization frequency, and general well-being, are still largely unknown, despite the fact that initial research may offer insights into short-term advantages. To monitor and evaluate these results over time, extensive longitudinal research projects are required. This study may reveal the long-term benefits of OCR-integrated reminders and their potential to fundamentally alter patient care.

In conclusion, there is a wide range of potential study topics related to the integration of OCR technology and reminder systems in healthcare. By filling in these study gaps, we may improve the OCR-integrated systems' usability, accuracy, and safety while also learning more about their long-term consequences and potential implications for patient-centered care. We can open the door for healthcare procedures that are more effective, dependable, and patient-focused by starting these research projects.

2. RESEARCH PROBLEM

To promote drug adherence, decrease medication errors, and improve patient care, the healthcare sector is rapidly embracing technological solutions. The efficient extraction of precise prescription data, which is frequently supplied in handwritten or other printed formats, and the use of this data to set up efficient medication reminders, both present substantial challenges. In order to improve patient outcomes, this research aims to address the issue of seamlessly integrating Optical Character Recognition (OCR) technology with reminder systems in healthcare. It does so by enhancing user experience, increasing data extraction accuracy, protecting data privacy and security, and improving user privacy and security. By bridging the gap between the theoretical advantages of OCR-based prescription data extraction and the actual deployment of reminder systems, this research challenge also takes into account the moral and legal ramifications of handling private patient data.

3. OBJECTIVES

3.1 Main Objectives

- To Develop an OCR-Based Prescription Data Extraction System:

Create and deploy an OCR system that can properly extract prescription data, such as drug names, doses, and frequency information, from a variety of sources, including printed and handwritten prescriptions.

- To Create an Integrated Reminder System:

Create a reminder system that works smoothly with the OCR-extracted prescription data to schedule and send patients their own customized medicine reminders via several communication channels (such mobile applications, text messages, and email).

3.2 Specific Objectives

- To Optimize OCR Accuracy and Error Handling:

Look into methods and algorithms to boost OCR accuracy, especially when handling problematic issues like various handwriting styles and unconventional prescription formats. To improve data reliability, create systems for mistake detection and rectification.

- To Assess User Usability and Experience:

To evaluate the user-friendliness of the OCR-integrated reminder system, conduct usability studies and collect opinions from healthcare professionals and patients. Identify potential adoption obstacles, then put user feedback into practice to make improvements.

4. METHODOLOGY

To achieve the third sub-objective of this study, which is identifying the stone tool-making technique, the researcher has followed the concepts in ML, OCR and image understanding and processing concepts in the methodology.

In this initial stage, I clearly define the research problem, which is the need to develop a system that extracts prescription data using OCR and utilizes it to set medication reminders. The research objectives should be specific and measurable, such as improving OCR accuracy, enhancing patient engagement, ensuring data privacy, and evaluating the system's impact on patient outcomes.

4.1 Collection of Data

I gathed a wide range of prescription documentation in this stage. After I met the doctor name called Dr. H.D.Abeygunawardana(RMO) at Karapitiya Teaching Hospital. The dataset must be diverse and include different prescription kinds, patient characteristics, and prescription formats (both printed and handwritten). A portion of the dataset will also be hand transcribed as a validation benchmark.

4.2 OCR Implementation

I choosed and set up an OCR tool or library (EasyOCR) to accurately extract text from prescription paperwork. Improved OCR accuracy will receive specific focus, especially for handwritten text, which is frequently difficult for conventional OCR systems. To evaluate the OCR's performance, validation against manually transcribed material is crucial.

4.3 Data Parsing and Structuring

Create programs and algorithms that parse the retrieved text and organize it into a uniform prescription data format. Names of medications, dosages, frequency, start dates, patient data (such as name and age), and prescriber information (such as a doctor's name and contact information) are all identified and categorized in this manner.

4.4 Reminder System Development

Incorporate the organized prescription data with a user-friendly reminder mechanism. Users of the system, including patients and healthcare professionals, should be able to set up medication reminders based on the data that has been retrieved. Make that the system is usable on a variety of hardware and software, such as mobile apps and online interfaces.

4.5 Implementation of the Mobile Application

The mobile application was developed with Java and Android. The images were uploaded to the Upload Care server using the mobile application's use of the retrofit library. Retrofit handles the REST API queries made by the Android application. A public link that may be acquired from the node server and passed to the function that executes the model is created in the Upload Care server. The model's output is merged with the outcomes generated by the other components. The node server returns the integrated result as a JSON object. This response is captured by the Android app and shown to the user.

4.6 Usability Testing

Conduct usability tests involving healthcare professionals and patients to assess the ease of use and user-friendliness of the OCR-integrated reminder system. Gather feedback and observations to identify any usability issues that need improvement.

4.7 Accuracy Assessment

Compare the OCR-extracted prescription data against data that has been manually transcribed in order to assess its accuracy. To improve data dependability and decrease disparities, use error detection and correction procedures.

4.8 Individual Component Diagram

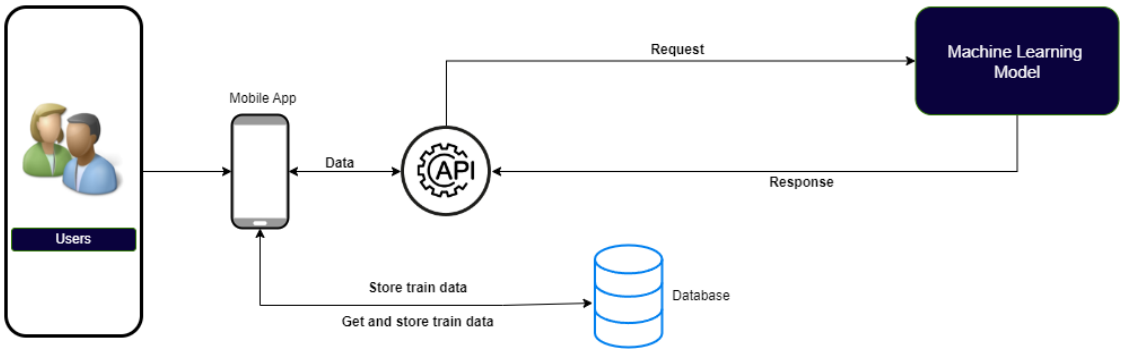


Figure 4-1 Individual Component Diagram

4.9 Overall System Architecture Diagram

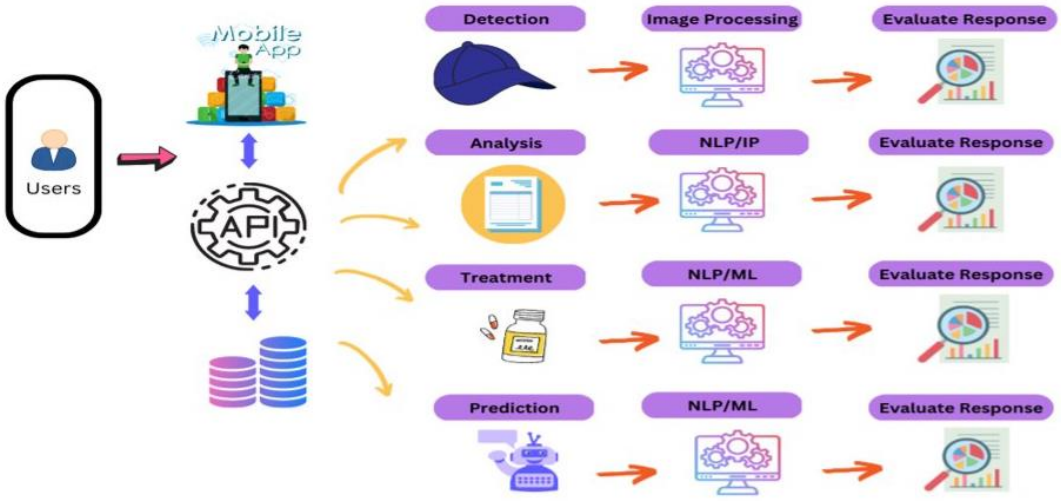


Figure 4-2 Overall System Architecture Diagram

4.10 Software solution

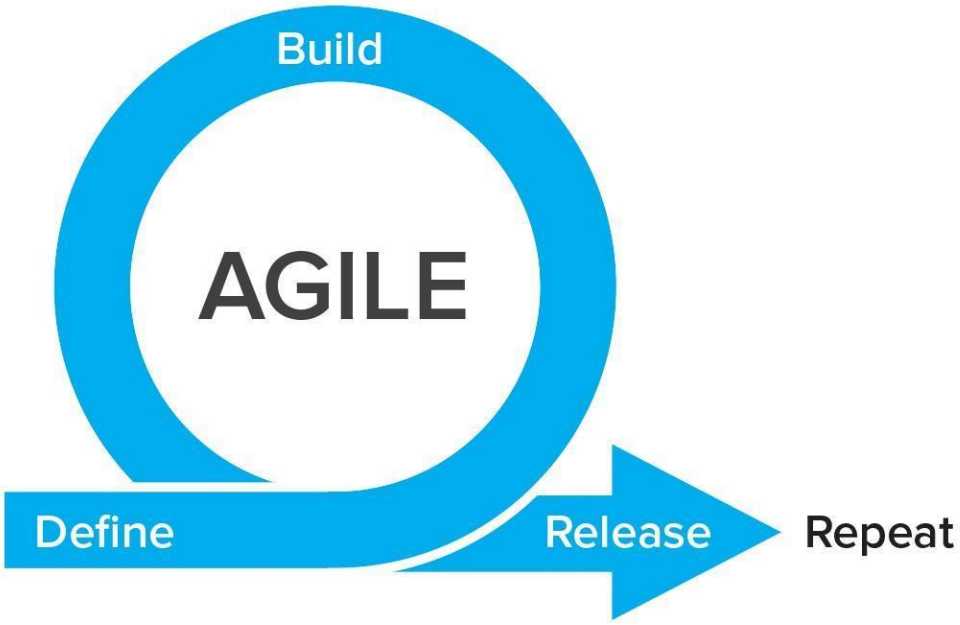


Figure 4-3 Software Solution Diagram

The agile software development technique will be used to construct this mobile application throughout this study. The iterative creation of software applications is at the heart of the Agile methodology. The agile scrum technique can be used to design the system flexibly. Sprints can be completed in 10 days (about one and a half weeks) using the agile approach. After one sprint is finished, it can be iterated into the following sprint, and so on, until the project is finished. The agile scrum technique can be used to prioritize task management, which will aid the team in developing the product by decreasing time and increasing productivity. Daily scrum meetings allow the team to stay in touch and discuss the development process progress. We may discuss and resolve any particular issues in this manner, avoiding obstacles in the development process and moving forward. Through the scrum, each member will know well what the other members are doing. As a result, due to its productive and efficient qualities in software development, the agile methodology was chosen to accomplish this project.

4.11 Requirement gathering and analyzing

The requirement gathering and analysis for this process was done in the following ways:

1. Interviews and discussions with the archaeological field's external supervisor.
2. Meet the patieants and gather requament and related details.
3. We can learn about it through study papers, articles, and videos.
4. A brainstorming session was held with team members and managers to define the technological stacks and associated challenges.
5. With the help of an external supervisor, collect the dataset.

4.11.1 Functional requirements

- OCR Data Extraction
- Structured Data Storage.
- Reminder Scheduling.
- User Authentication.
- Usability and User Interface.
- Error Handling and Correction.
- Reporting and Analytics

4.11.2 Non-functional requirements

- Accuracy and Reliability
- Performance and Scalability.
- Usability and User Experience.
- Security and Compliance.

4.11.3 System requirements

- Android versions above version 8.0 (Above Android Oreo)

4.11.4 User Requirements

- A basic understanding of how to operate a mobile application.
- Basic English skills.

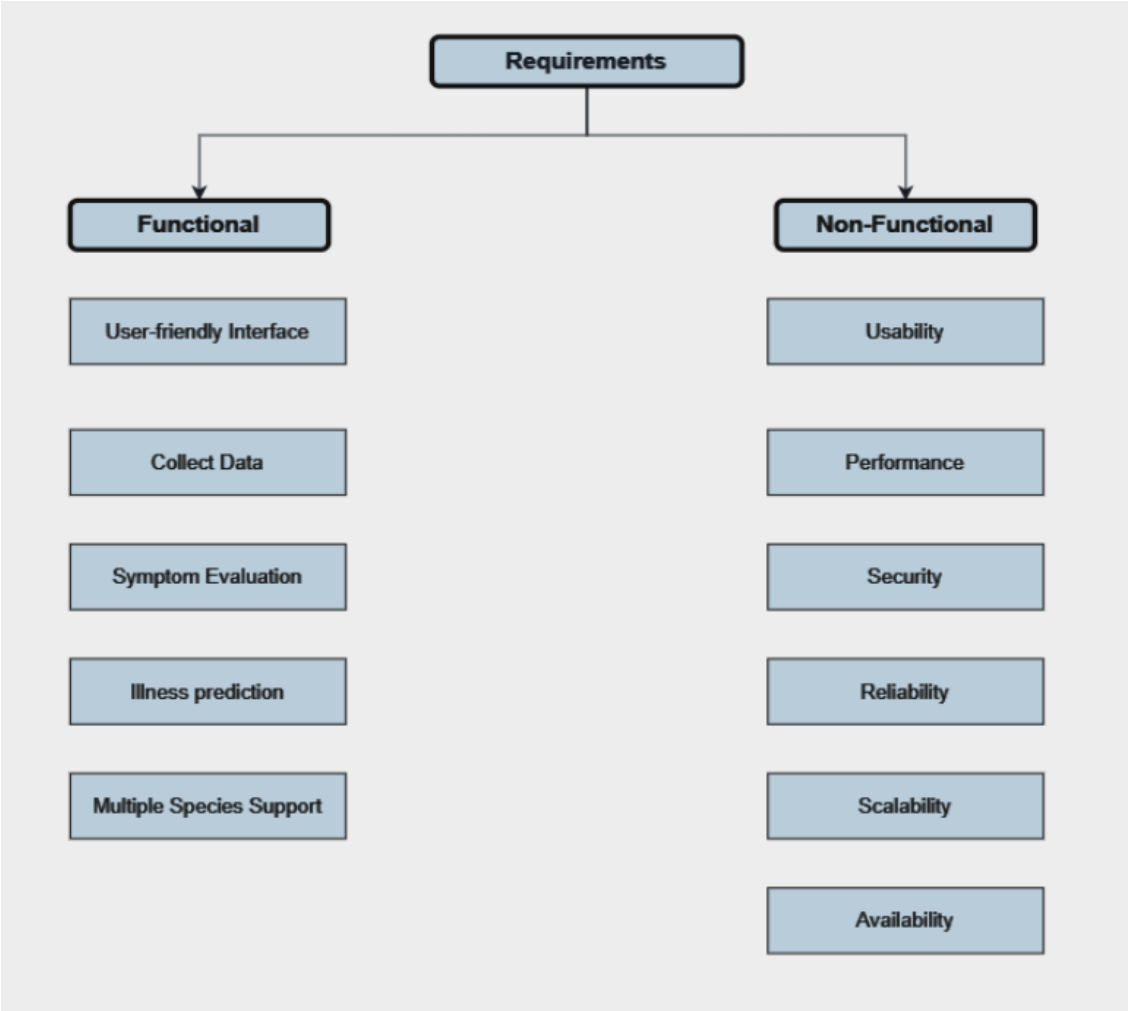


Figure 4-4 Common Requirements

4.12 Design

At this stage, the system's four major components are split and planned in order to reach the system's end aim within the projected time frame. This phase clarifies and discusses the essential technology and hardware components. Documentation, resources, system diagrams, and technical and hardware components are organized during the designing phase.

4.13 Developments and implementation

At the start of the project, the four key components of the system will be built as separate units, and at the end of the project, they will be integrated into a single main system. To deploy the system as a functioning application to the device, all of the components must keep the same consistency and work well together. Before releasing the application to the market, it will be thoroughly tested.

4.14 Work Break-Down Structure

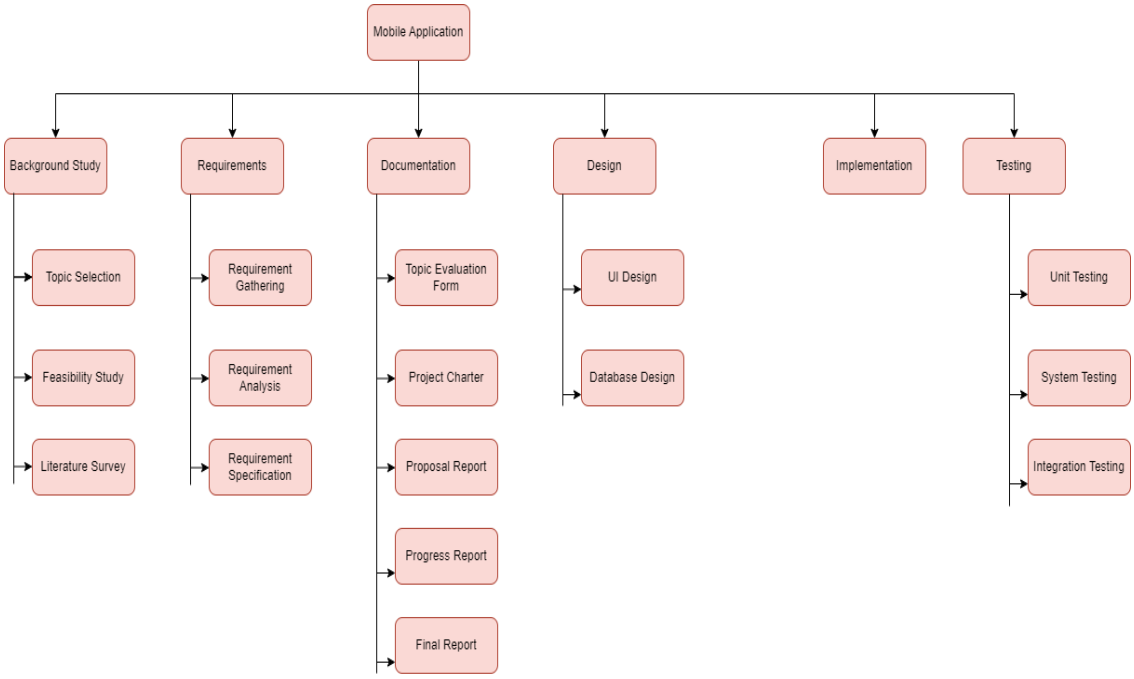
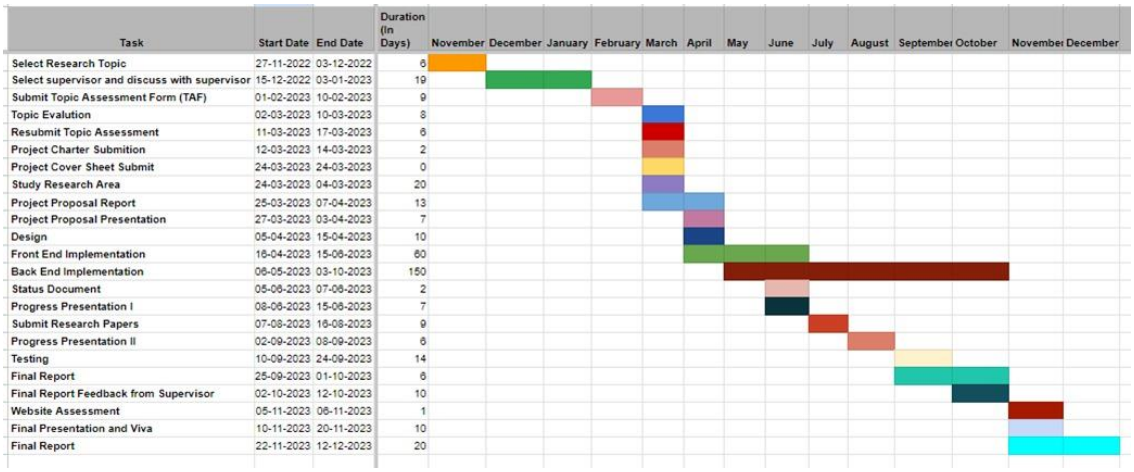


Figure 4-5 Work Break-Down Structure

4.15 Gantt Chart



Task	Start Date	End Date	Duration (In Days)
Select Research Topic	27-11-2022	03-12-2022	6
Select supervisor and discuss with supervisor	15-12-2022	03-01-2023	19
Submit Topic Assessment Form (TAF)	01-02-2023	10-02-2023	9
Topic Evalution	02-03-2023	10-03-2023	8
Resubmit Topic Assessment	11-03-2023	17-03-2023	6
Project Charter Submition	12-03-2023	14-03-2023	2
Project Cover Sheet Submit	24-03-2023	24-03-2023	0
Study Research Area	24-03-2023	04-03-2023	20
Project Proposal Report	25-03-2023	07-04-2023	13
Project Proposal Presentation	27-03-2023	03-04-2023	7
Design	05-04-2023	15-04-2023	10
Front End Implementation	16-04-2023	15-06-2023	60
Back End Implementation	06-05-2023	03-10-2023	150
Status Document	05-06-2023	07-06-2023	2
Progress Presentation I	08-06-2023	15-06-2023	7
Submit Research Papers	07-08-2023	16-08-2023	9
Progress Presentation II	02-09-2023	08-09-2023	6
Testing	10-09-2023	24-09-2023	14
Final Report	25-09-2023	01-10-2023	6
Final Report Feedback from Supervisor	02-10-2023	12-10-2023	10
Website Assessment	05-11-2023	06-11-2023	1
Final Presentation and Viva	10-11-2023	20-11-2023	10
Final Report	22-11-2023	12-12-2023	20

Figure 4-6 Gantt Chart

4.16 Commercialization of the Product

4.16.1 Why should buyers use this app

- Can get a best knowledge hairdiary diseases and treatments.
- Helps to make financial safe decisions.
- Helps to make decisions based personal preferences.
- Trustworthy properties, minor chance caught into frauds.

4.16.2 Why should sellers use this app

- Seller journey will be smooth due to extensive seller support system.
- Can expect larger pool of buyers.
- Hair diseases treatment will be automatically suggested appropriate buyers .

5. BUDGET

5.1 Infrastructure and Technology:

- **Cloud Services:** Costs for cloud hosting, storage, and infrastructure.
- **Software Licenses:** Expenses for software tools and frameworks used in development.
- **Hardware:** If physical servers or hardware are needed.

Component	Amount LKR
IOT Device	30,000 /=
Internet Charges	3,000 /=
Telephone Charges	1,000 /=

Table 1 - Budget

6. TESTING & IMPLEMENTATION

6.1 Testing

Importing successfully libraries called torch, pandas, torchvision etc.

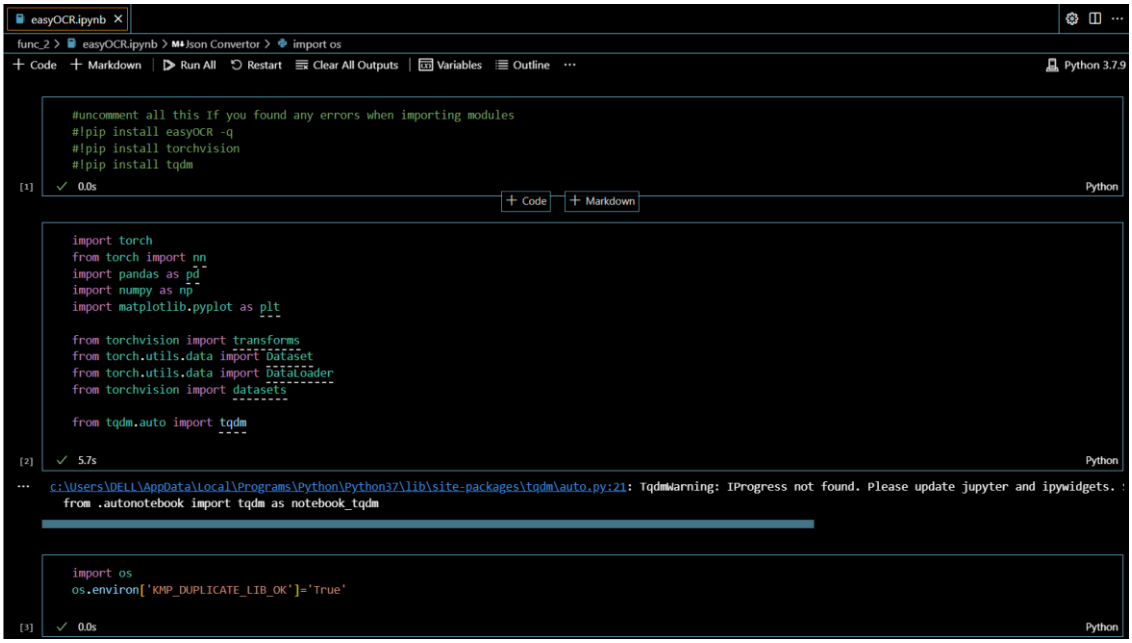


Figure 6-1 Direct output

Import easyOCR and import prescriptions and extract those data in English language.

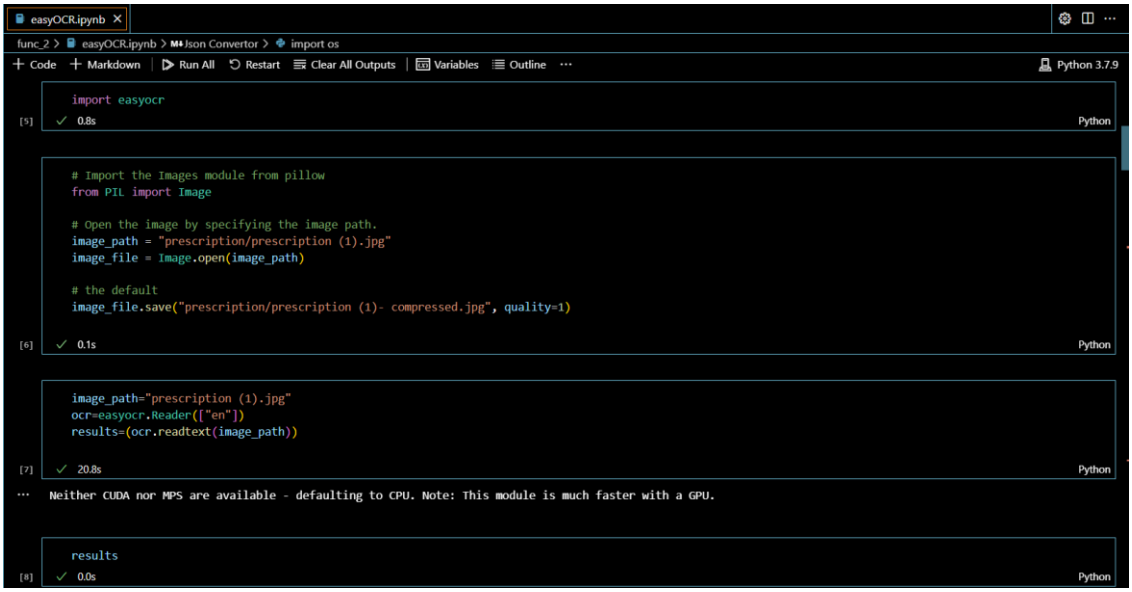


Figure 6-2 Direct output

5.2 Implementation

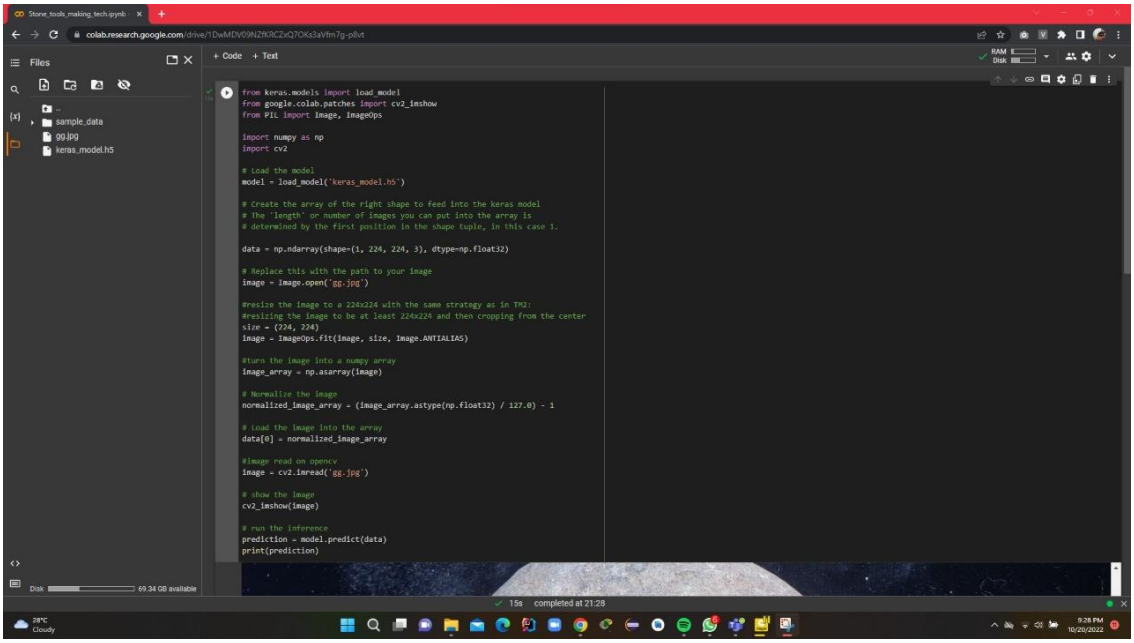


Figure 6-3 Model output code

7. RESULTS & DISCUSSION

7.1 Results & Discussion

- Extract data and analyze data successfully

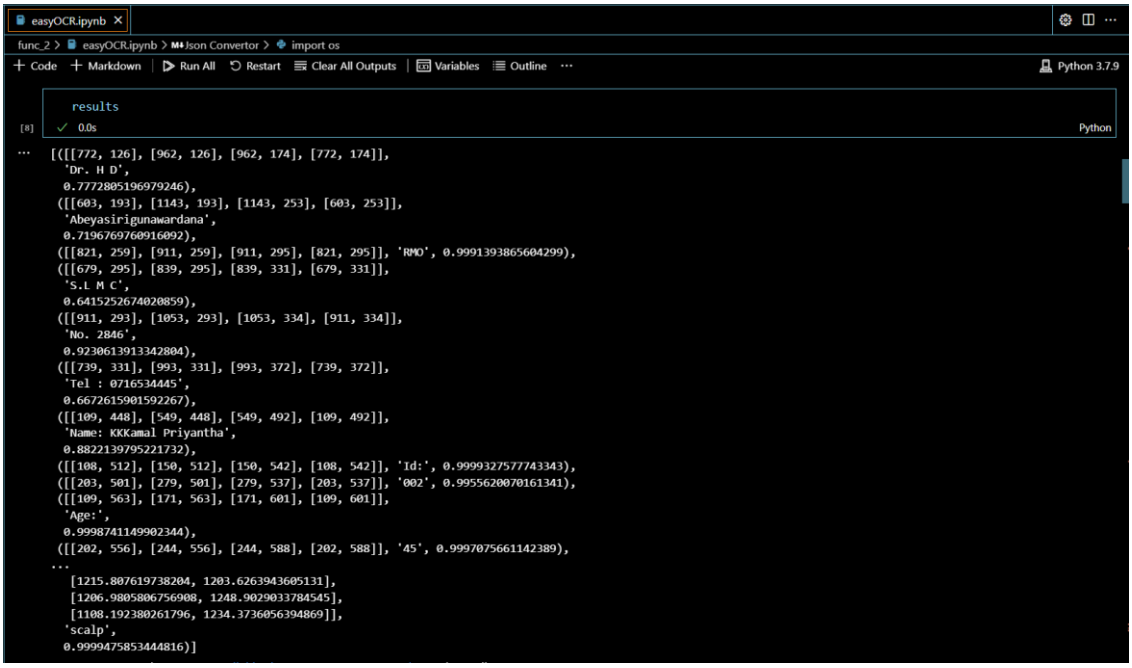


Figure 7-1 Extracted data

Figure 7-2 Extracted data convert to json format

- Using extracted data show relevant data and set reminders in mobile app.

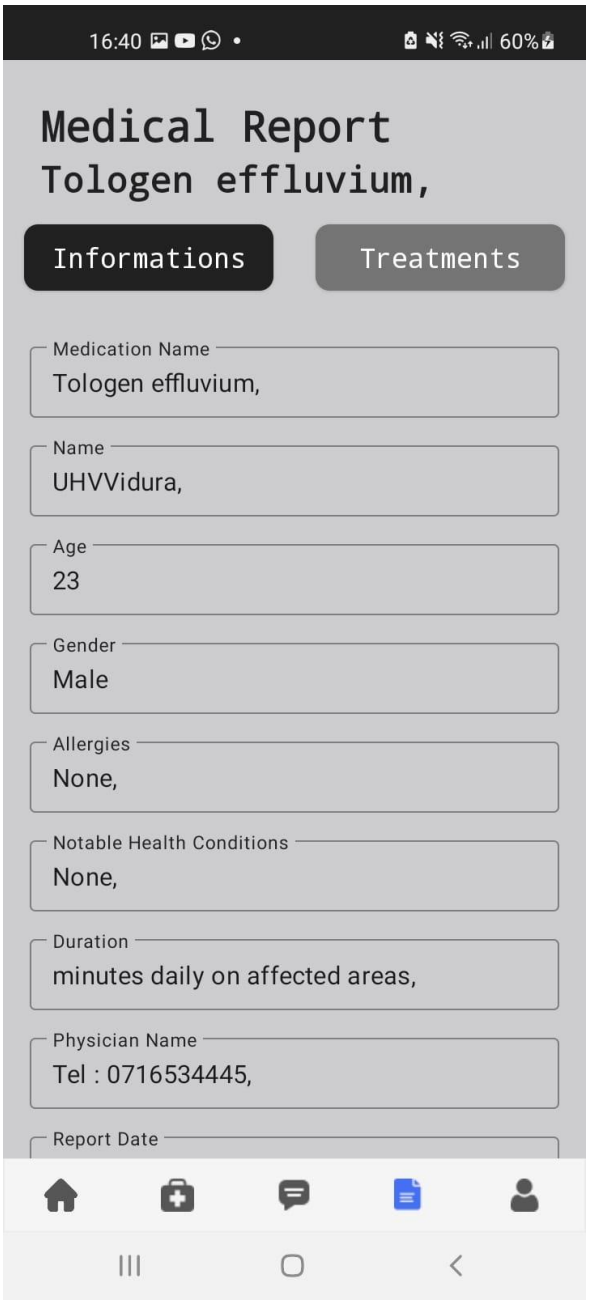


Figure 7-3 Show extracted data in app

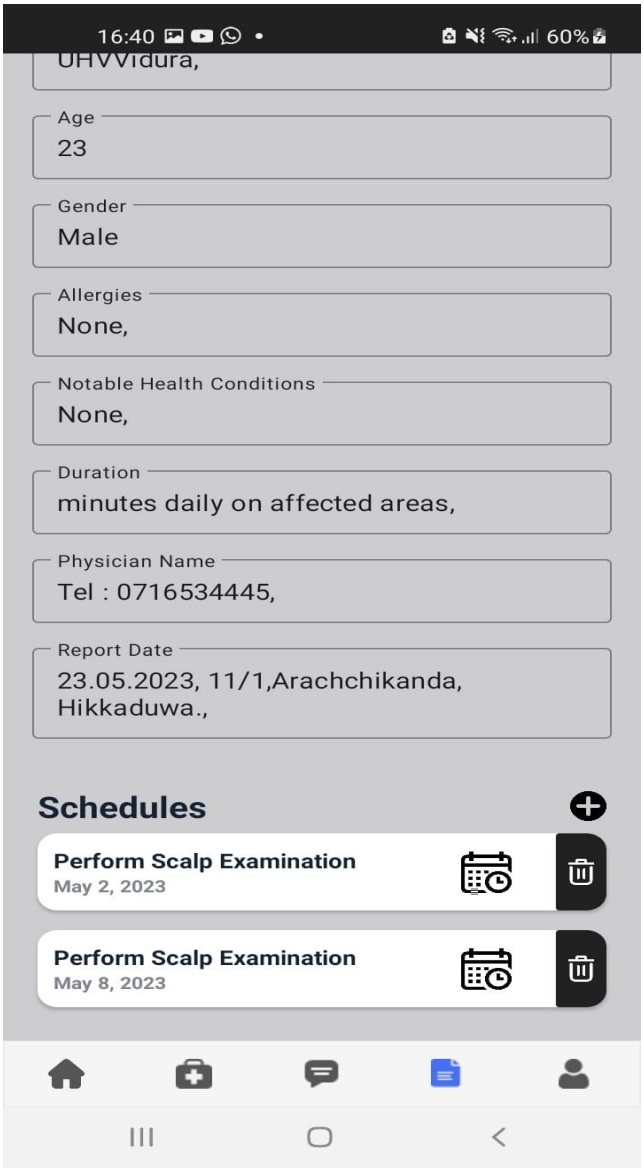


Figure 7-4 sheduled reminders

8. CONCLUSION

Finally, by creating and executing a creative solution that uses optical character recognition (OCR) technology to extract patient prescription data and use that data to support medication reminders, this research aims to close a crucial gap in healthcare. This project aims to dramatically improve medication management and patient care through a thorough process that includes data gathering, OCR implementation, reminder system development, and rigorous testing. The goals of the study include increasing data extraction accuracy, enhancing user experience, protecting data privacy and security, and determining how the system affects patient outcomes. The research seeks to develop healthcare technology and the delivery of patient-centered care by addressing these goals and using a careful approach to data processing. Furthermore, with a constant focus on accuracy, usability, security, and compliance, the functional and non-functional criteria lay a solid foundation for the system's design, implementation, and evaluation. This research aims to deliver a transformative tool that not only simplifies the management of prescription data but also encourages patient participation, medication adherence, and general well-being as healthcare increasingly adopts technological solutions. Ultimately, this research's conclusion represents a significant step toward streamlining medication-related procedures in healthcare, which will benefit patients and healthcare practitioners alike and advance the general digitization of healthcare data and services.

9. REFERENCES

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10.APPENDICES

Appendix A

Mobile Application User Interfaces

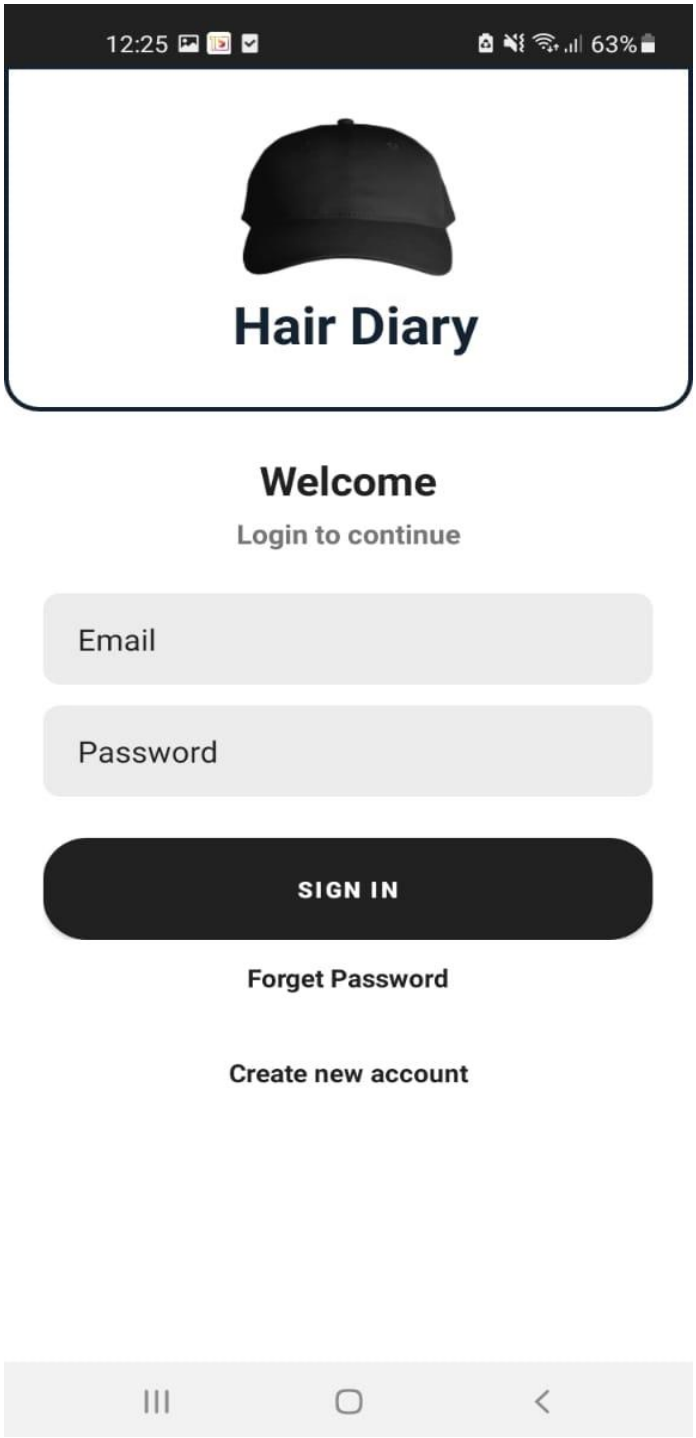

Figure 10-1 Login User Interface

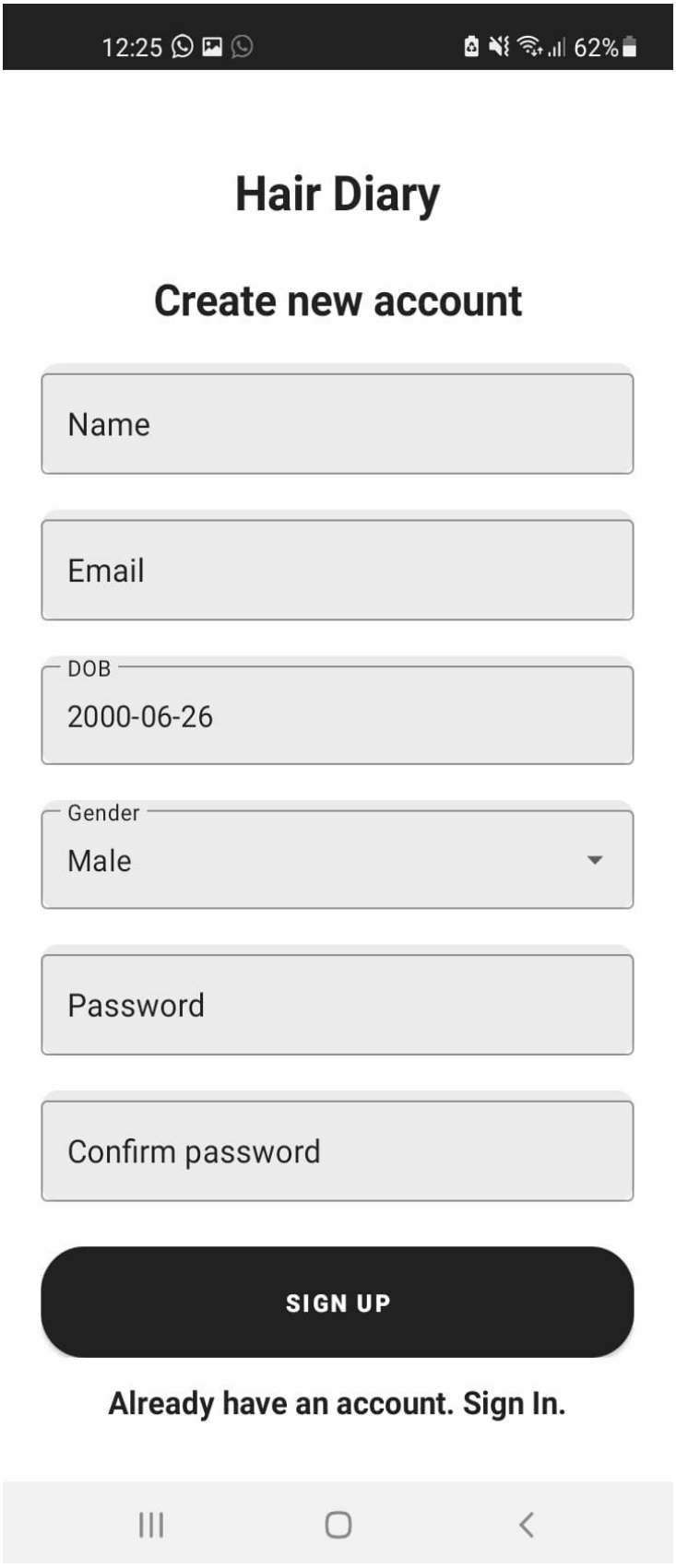

Figure 10-2 Registration User Interface

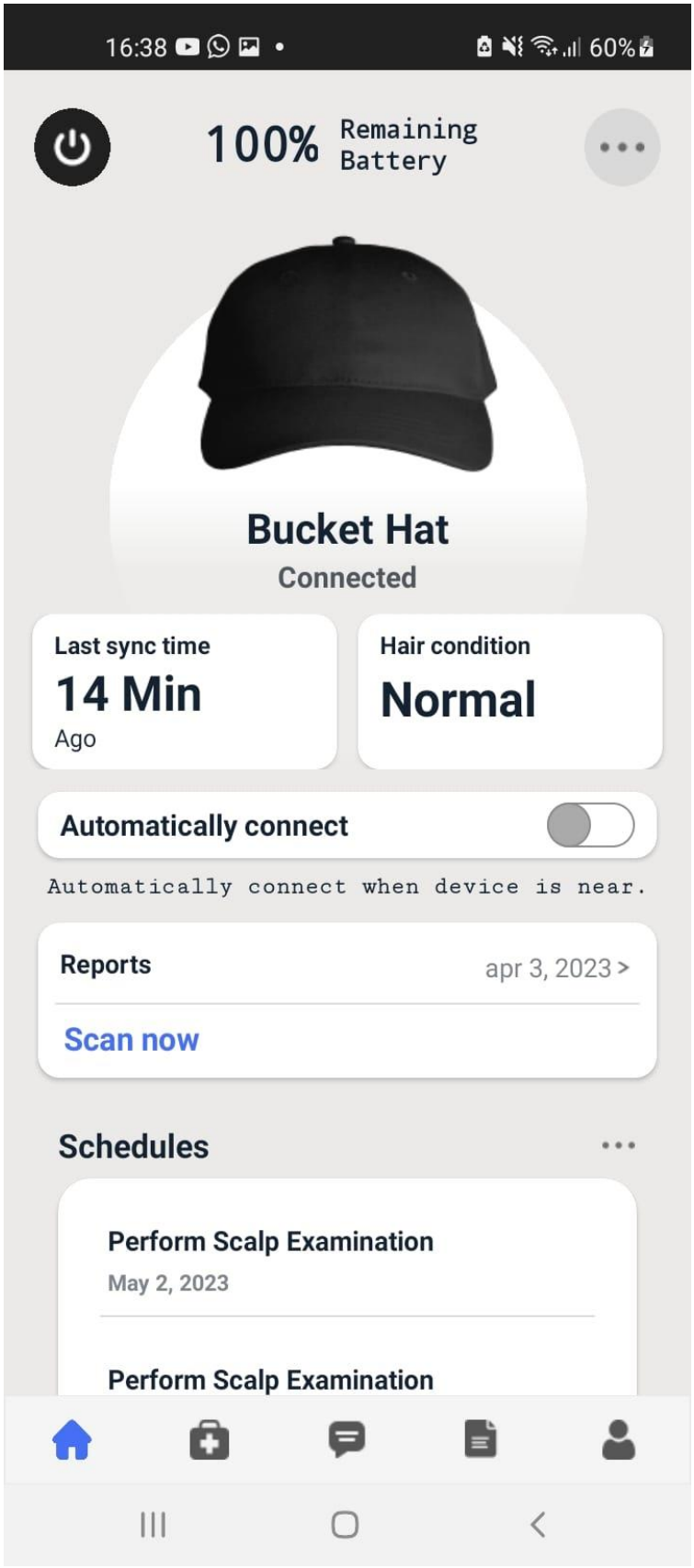

Figure 10-3 Home User Interface

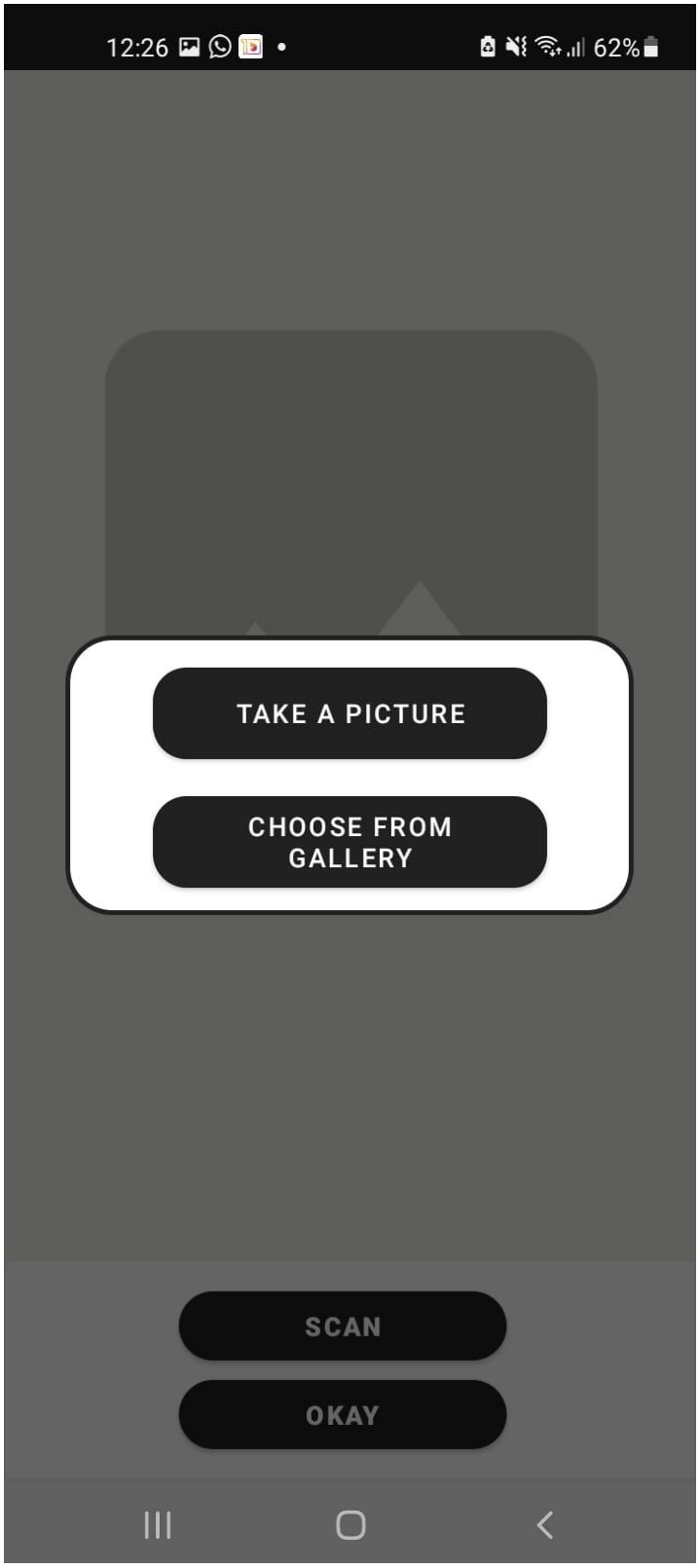

Figure 10-4 File Upload User Interface

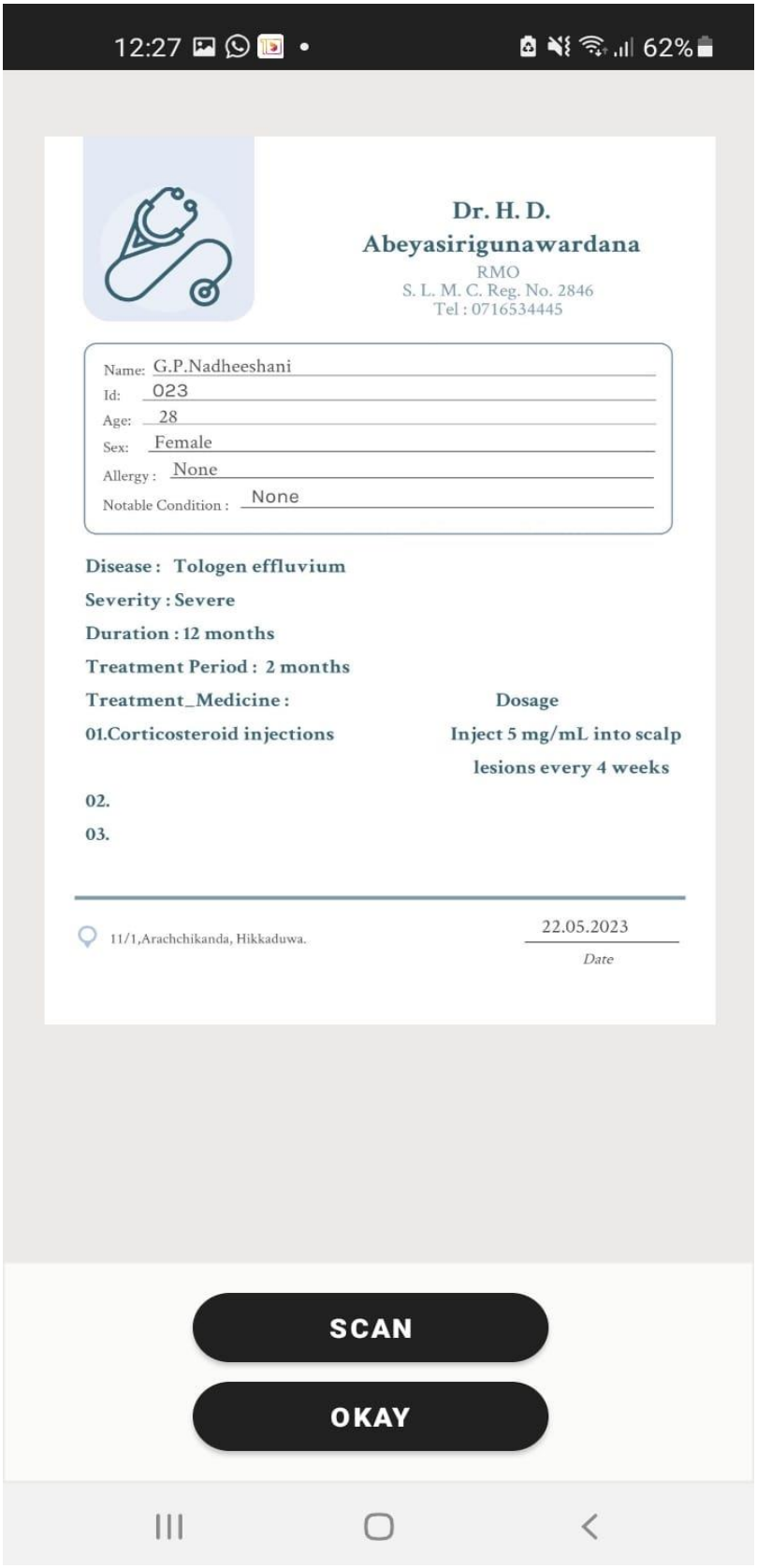

Figure 10-5 File Uploaded User Interface

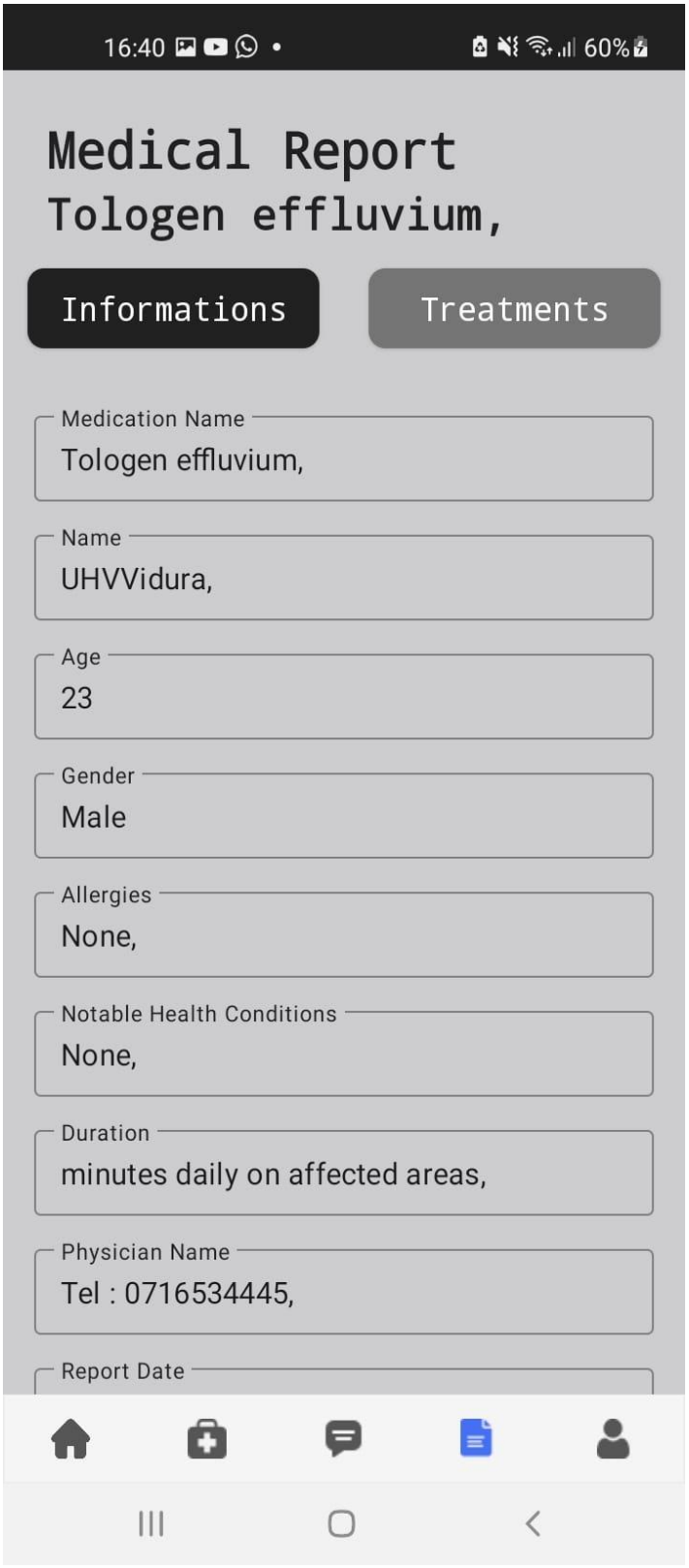

Figure 10-6 Result of the extracted data

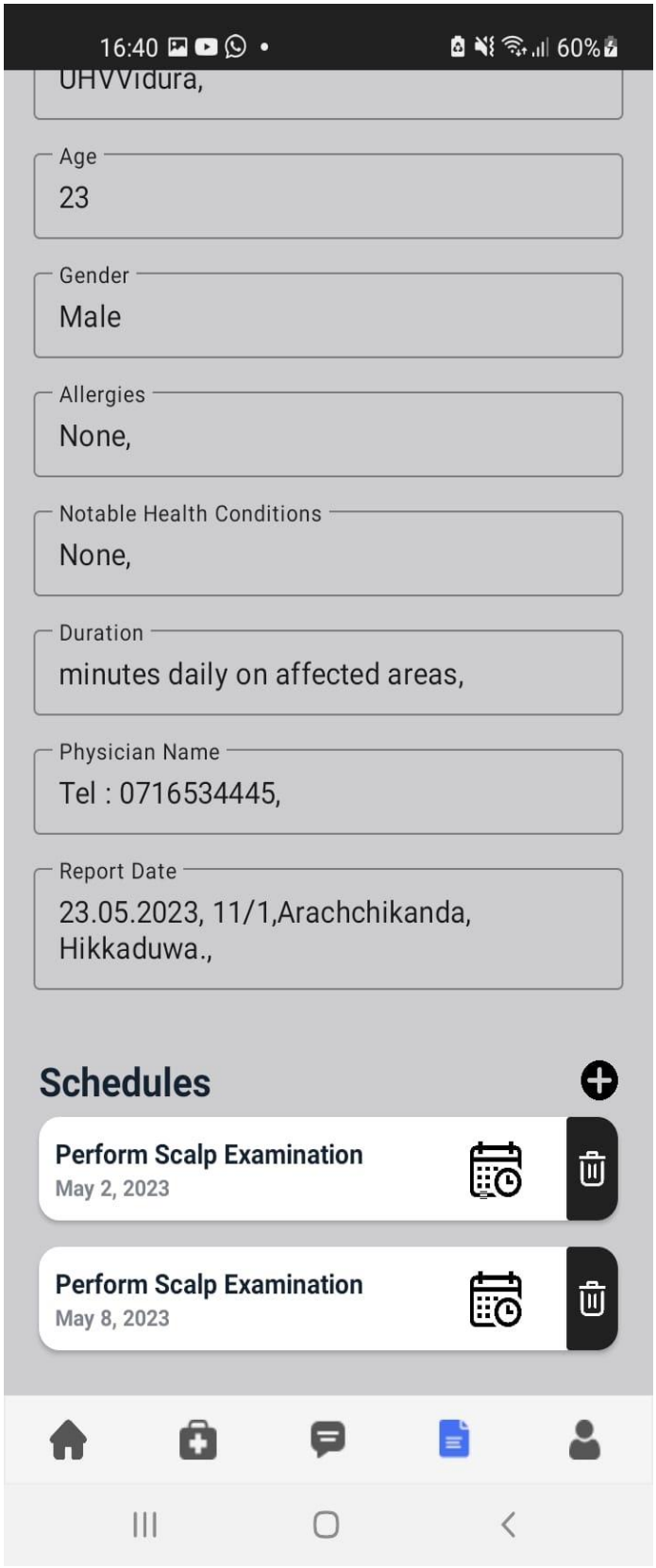

Figure 10-7 Result of the set Riminders