LupusMate

“A web-app that helps in self monitoring autoimmune disease.”

Customer: Dr. Ramon Bonegio

Team:

Arshita Reddy

Johnpaul Kambazza

Manasa Kavuru

Meghana Vishwanath

Pavan Jhaveri

AI-Mate

“A web-app that helps in self monitoring autoimmune disease.”

Customer: Dr. Ramon Bonegio

Team:

Arshita Reddy

Johnpaul Kambazza

Manasa Kavuru

Meghana Vishwanath

Pavan Jhaveri

Outline

- **Introduction**
  - Application
  - Target Users
  - Customer Requirements
- **Software Solution**
  - Overview of App
  - Medication Reminder
  - Rash Selfie
  - Protein Analysis
  - Hand Drift Analysis
- **Conclusion**
- **Live Demo**

Introduction-Application

- User-friendly symptom-monitoring smart-phone compatible application primarily focused on monitoring the Lupus disease.
- A win-win solution for the patients and the doctor(s). The patient does not have to secure an appointment to carry out tests. The doctor can monitor more patients than previously possible.
- **Why a Web App?**

  Web Applications are highly portable across multiple platforms and form factors.

  Reliable, fast and minimize overhead costs.

Introduction - Target Users

Target users -

- Particularly, people with Lupus disease. Anyone with an auto-immune disease that can be remotely monitored, generally.

App helps **patients** to -

- Self monitor disease symptoms between visits to the clinic
- Get reminders to take medication
- Perform ad-hoc and routine checkups

App helps **doctors** to -

- Treat/monitor patients remotely and more efficiently
- Make informed decisions based on trends in patients results

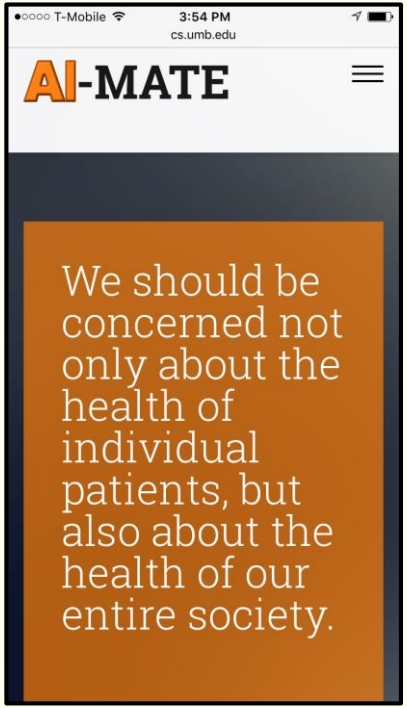
Introduction - Customer Requirements

Customer would like his patients to be able to:

- An application that can be accessed and used in all kinds of mobile device (like Iphone, Android and Windows phones)
- The application to monitor patients response to treatment over drawn out periods of time
- Help patients to take all of their medicines with correct dosages on time.
- Send their reports to the doctor

Software Solution – Design Decisions

- A simple non-conspicuous mobile-friendly web application.
- **Front-end**: open, intuitive interface.
- **Back-end**: minimalist implementation that does not store any data (no database). It processes input from a user (patient) and promptly sends the output to the doctor without keeping copies.
- **Challenges**: compatibility issues (mostly browser- and device-), dependencies (internet and privacy), HIPPA compliance, etc.
- **Achievements**: a web app that meets our customer's needs.

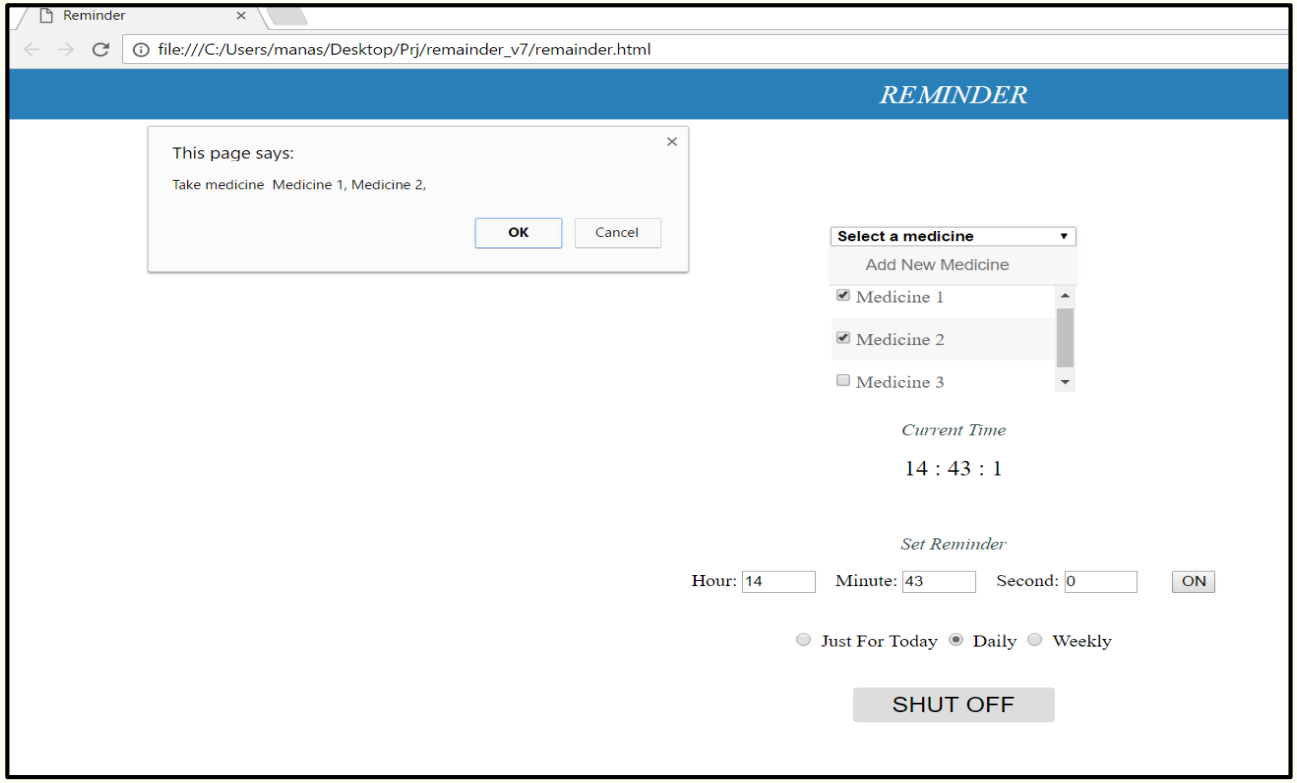


Software Solution - Technologies

- Client Side Coding : JavaScript, Ajax
- Server Side Coding : PHP
- Google Calendar API
- Free Template – UI

MEDICATION REMINDER

Initial Design Considered



Challenges:

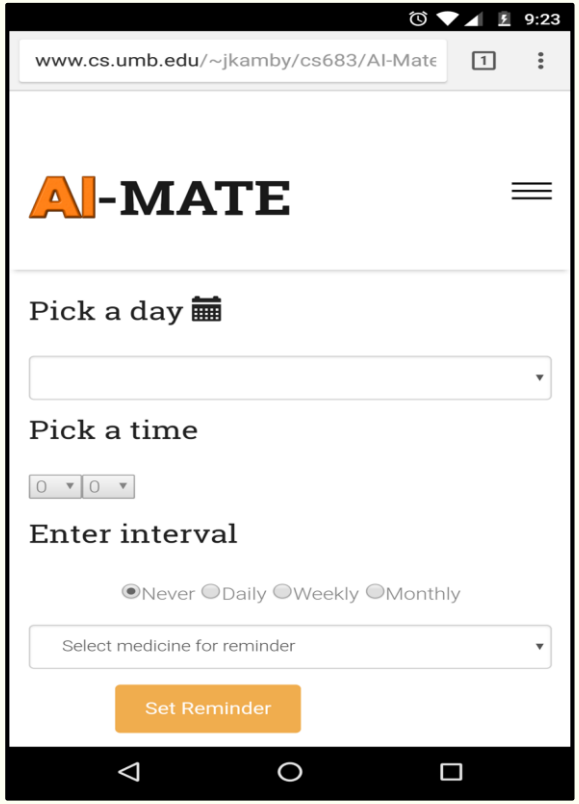
- Data retention and retrieval

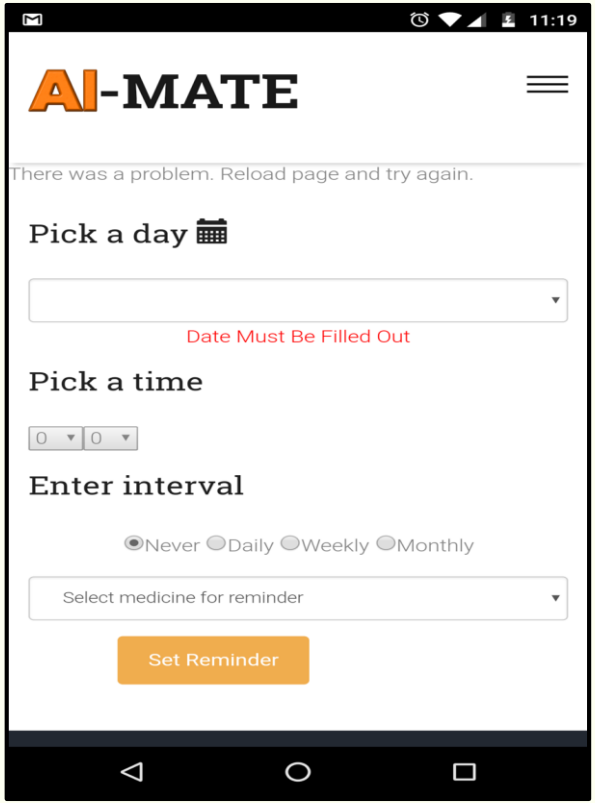
  No cloud storage or database (Had to work with browser cookies only)

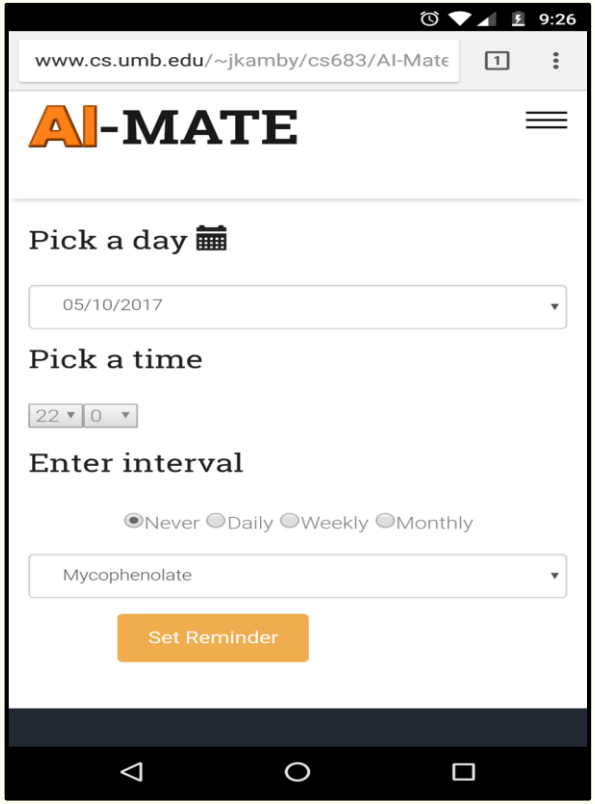
- Compatibility across various devices and platforms

  eg: Mobile(IOS-Chrome)

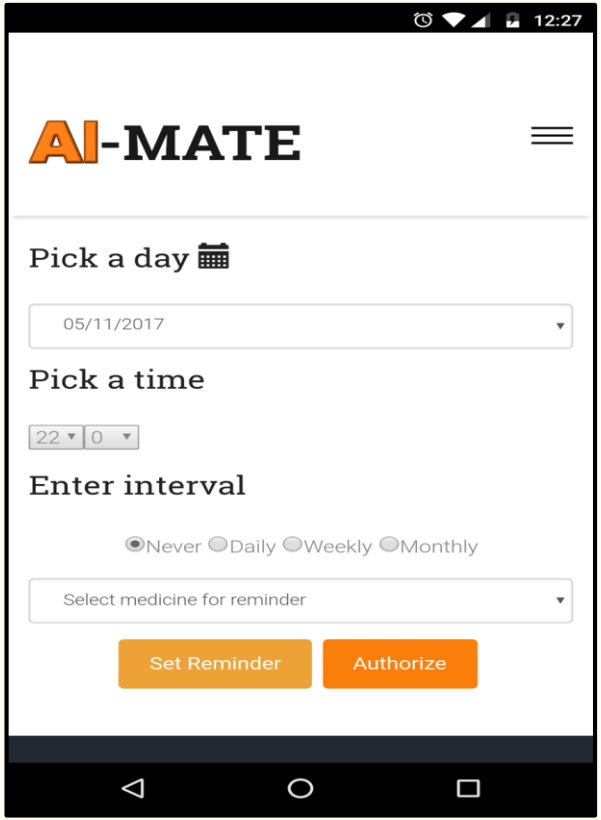
Software Solution - Medicine Reminder

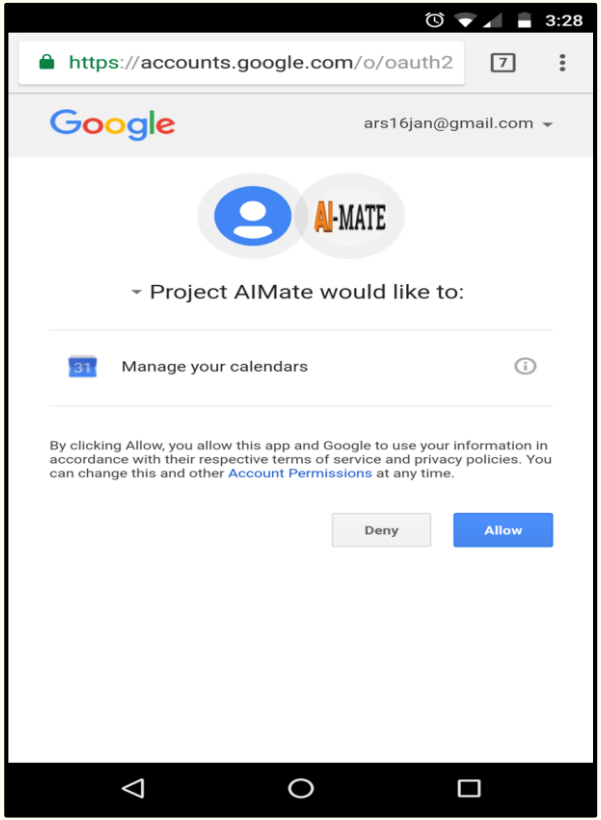


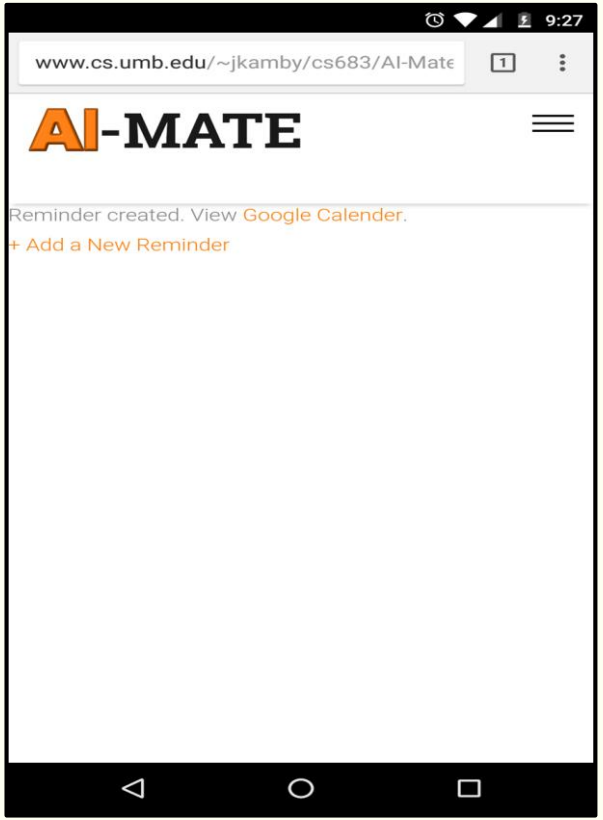




Software Solution - Medicine Reminder

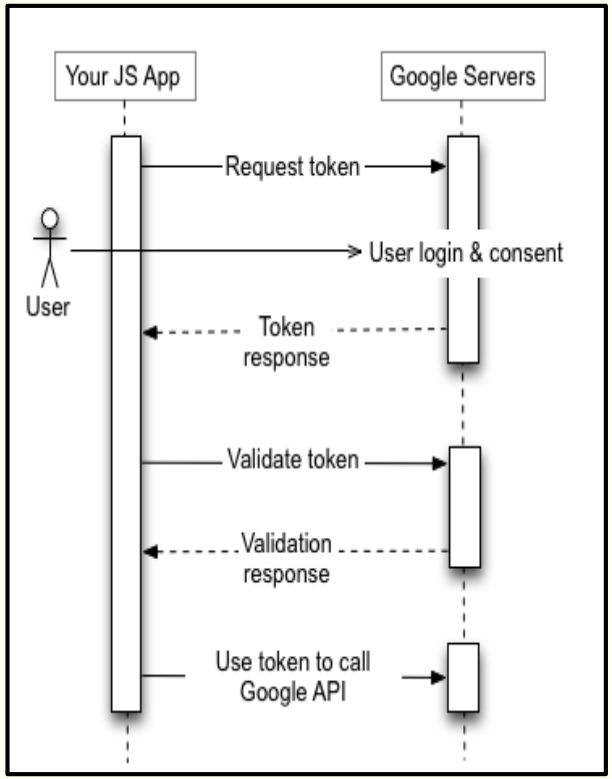






Software Solution - Medicine Reminder

- The authorization sequence begins when the application redirects a browser to a Google URL.
- The URL includes query parameters that indicate the type of access being requested.
- Google handles the user authentication, session selection, and user consent.
- The result is an access token, which the client should validate before including it in a Google API request.
- The Google API client library handles the response from Google's authorization server and it also automatically validates the access token returned by Google's authorization server
- When the token expires, the application repeats the process.



Requirements:

- User must have a google account
- Google calendar has to be installed in their phone to receive notification on phone else only email notification

Limitations :

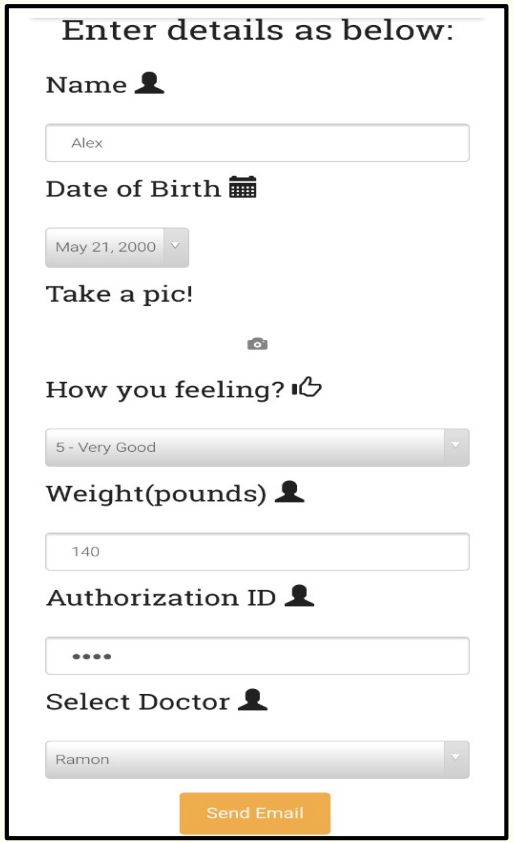
- Since our website does not have any database, we cannot store “Event Id’s” for each reminder we create for the patients. Because of this, a user cannot edit/delete the reminder once created from our web-app.

- User needs to explicitly go to Google Calendar app/web to edit or delete the reminder, if he/she wants to.

RASH SELFIE

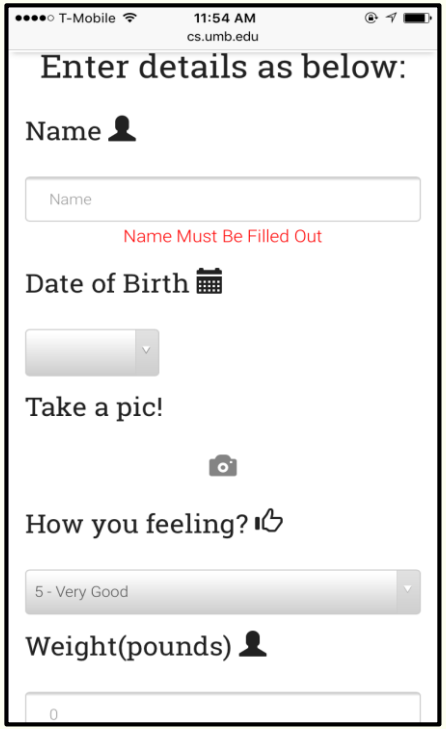
Software Solution - Selfie

- Patient enters the required details.
- Selects the rash picture from local photo gallery or take a new picture.
- Select the name of the doctor from the drop down list.
- And then clicks on Send email button.



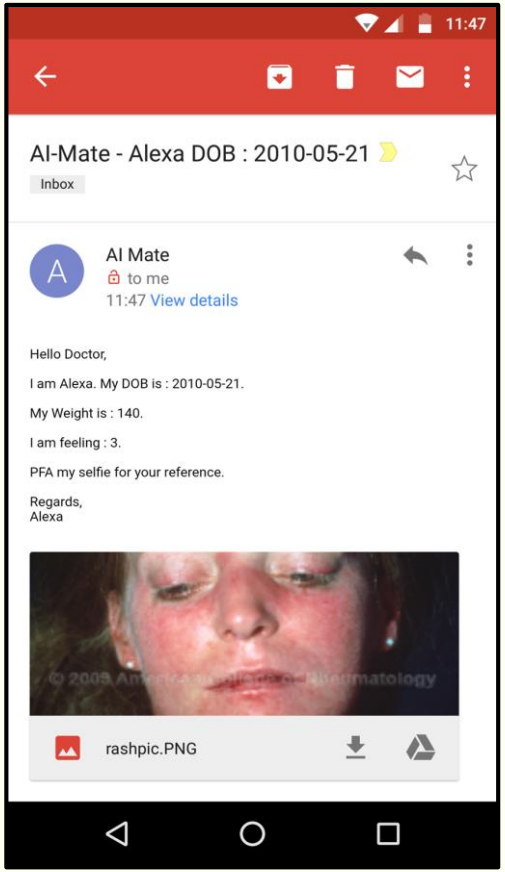
Pseudo Code:

- On clicking ‘Send Email’ button input validation is performed, if any.
- Else selected image is uploaded to the ./uploads folder on server.
- Then using multipart/mixed mime, the details entered by the patient with the attachment is sent to the doctors email id.
- And then the image is deleted from the uploads folder.
- Code prevents HTML code injection at input points.



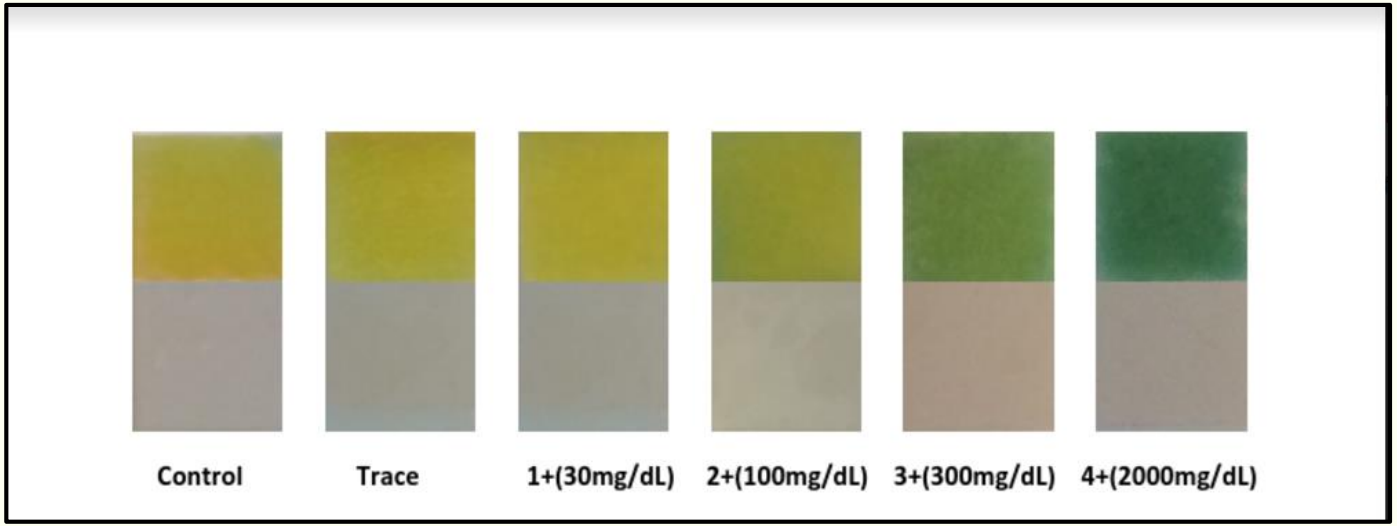
Output:

- The doctor can keep record of the patients progress using these emails.



PROTEIN ANALYSIS

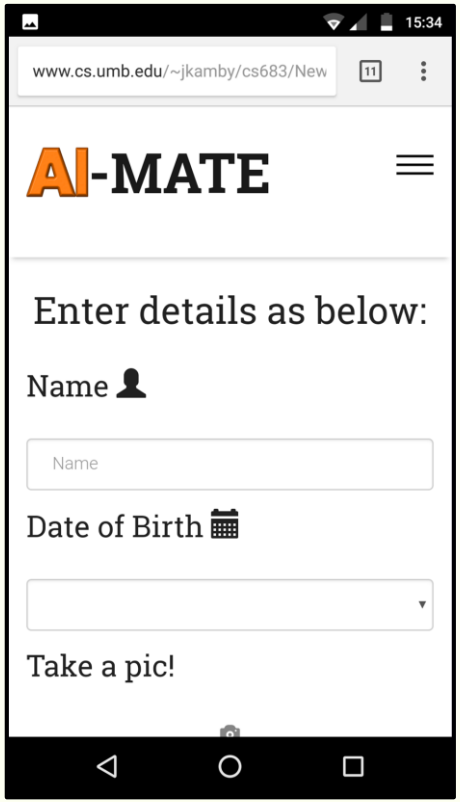
Protein Analysis

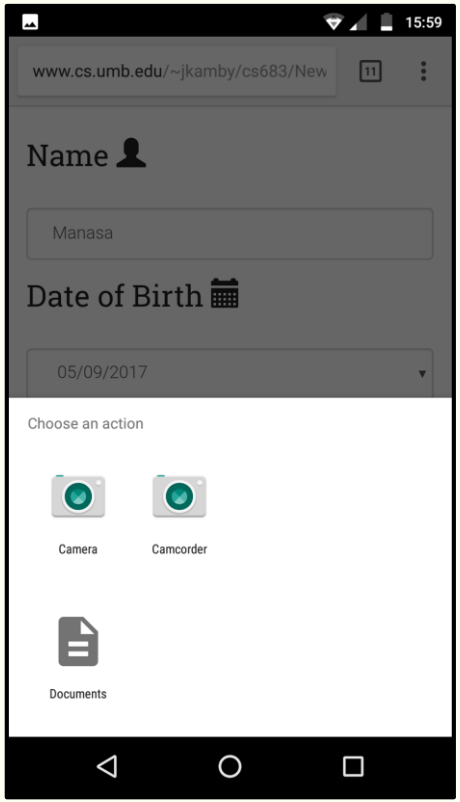


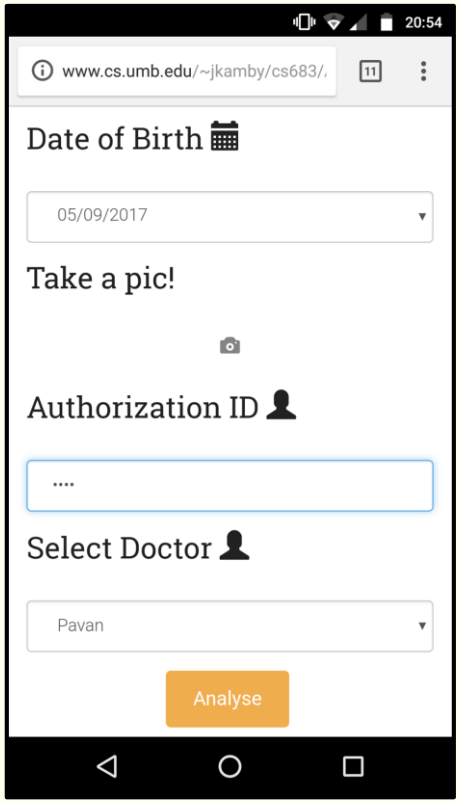
Steps:

- Dip the protein strip in the urine
- Place it on a white tissue paper and make sure that no noise(here, image noise) is captured while clicking the pic
- Enter the details on the app
- Take a pic!

Software Solution - Protein Analysis





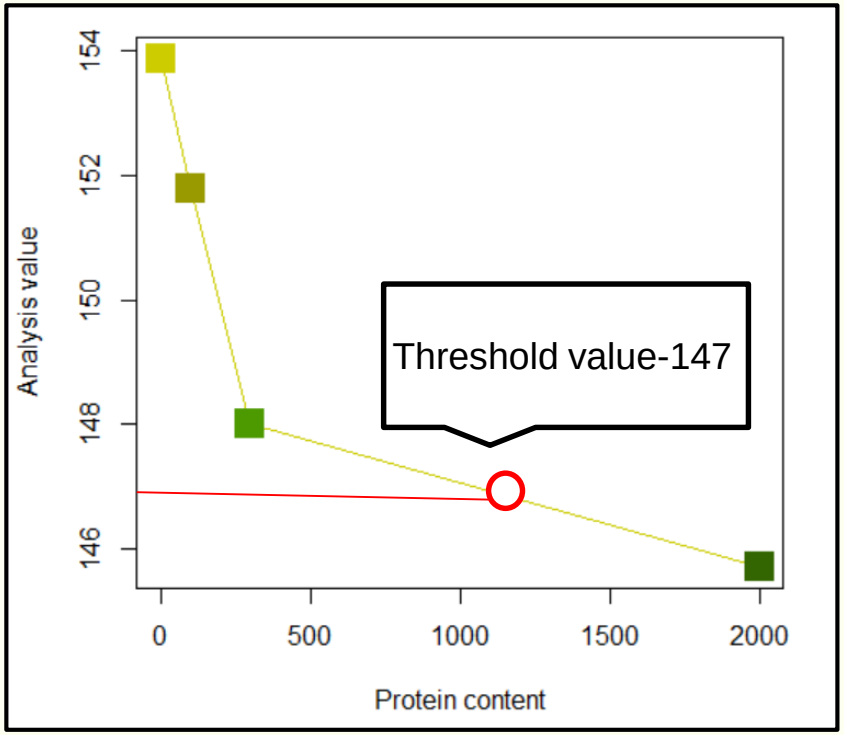


Software Solution - Protein Analysis

Pseudo Code :

- On clicking ‘Analyse’, it uploads the pic on server
- Convert any format into JPEG file using imagecreatefromjpeg
- Navigate through the whole image by pixel using x and y coordinates of the image matrix
- Get RGB components at each pixel
- Get grayscale value using “Average” method (r+g+b/3)
- Calculate the average of green component, if the grayscale value is between 100 and 200 (ignore pure black and pure white color pixel since we are mainly focusing on green color here)
- If the average value is below threshold show “NEGATIVE” else “POSITIVE”, send the image and the result to the Doctor in form of an email

Analysis Results :



Limitations :

- The analysis may vary depending on the light conditions.
- The pic must be taken in the same environment, strictly under white light.

Note: As a backup, as shown before we share the analysis results with the doctor as well. So if in any case the results are not as expected, Doctor can reach out to client and manage internally.

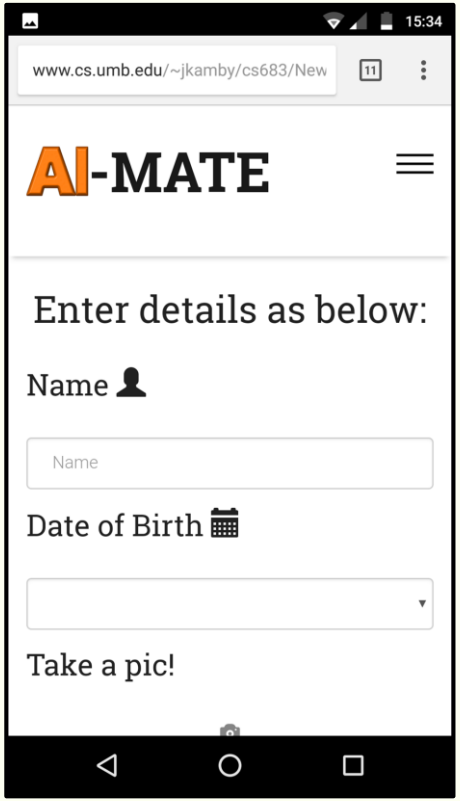
HAND DRIFT ANALYSIS

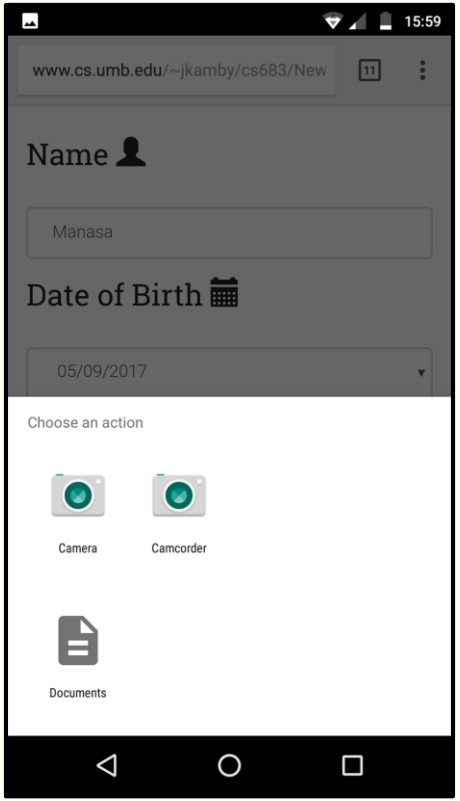
Hand-Drift Analysis

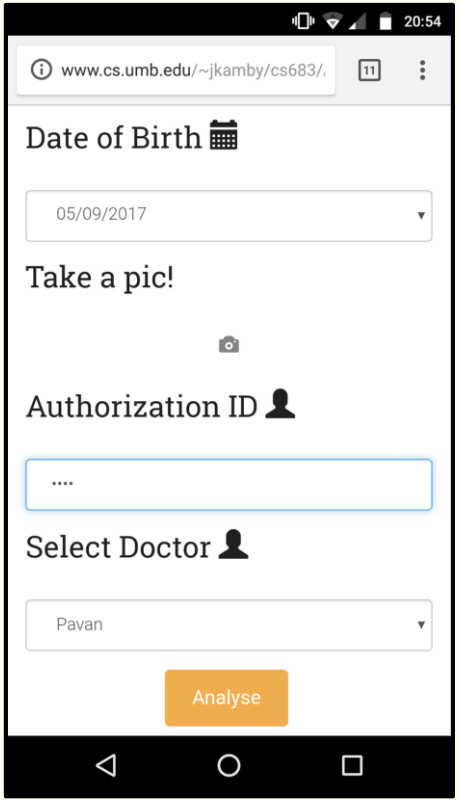
Steps:

- Keep the hand as straight as you can on the plain surface
- Please make sure that no noise(here, image noise) is captured while clicking the pic
- Enter the details on the app
- Take a pic!

Software Solution - Hand-Drift Analysis







Software Solution - Hand-Drift Analysis

Software Solution – Hand-Drift Analysis

Pseudo Code :

- On clicking ‘Send Email’, it uploads the pic on server
- Convert any format into JPEG file using imagecreatefromjpeg
- Create a temporary image ($final) of same size as input image
- Get RGB components at each pixel
- Get luminance value by adding together 30% of the red value, 59% of the green value, and 11% of the blue value

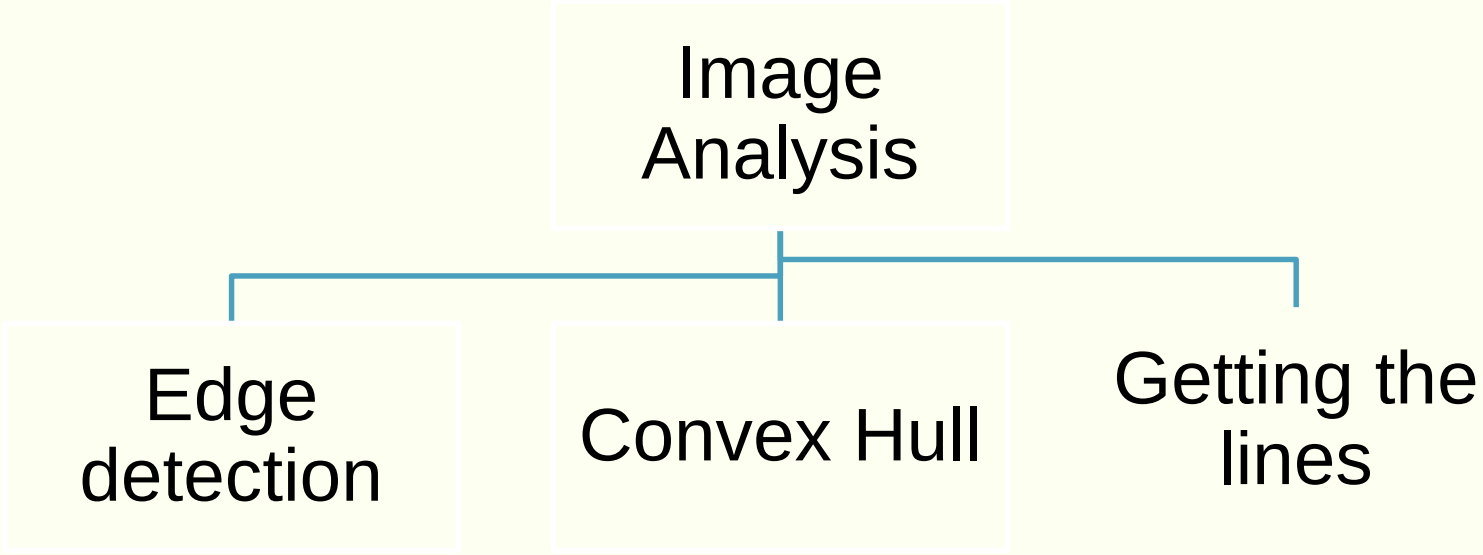


Image Analysis
Edge detection
Convex Hull
Getting the lines

Edge detection:

- We will use Sobel filter to detect the edges using a pair of 3x3 convolution mask :

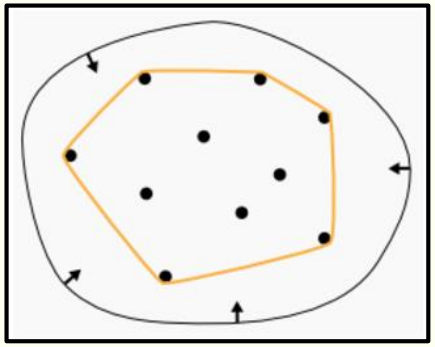
$$\mathbf{G}_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ +1 & +2 & +1 \end{bmatrix} * \mathbf{A} \quad \text{and} \quad \mathbf{G}_x = \begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix} * \mathbf{A}$$

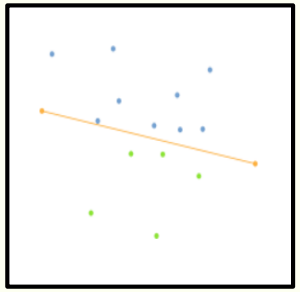
$x = ($pixel_up_left+($pixel_left*2)+$pixel_down_left) - ($pixel_up_right+($pixel_right*2)+$pixel_down_right)
$y = ($pixel_down_left+($pixel_down*2)+$pixel_down_right) - ($pixel_up_left+($pixel_up*2)+$pixel_up_right)

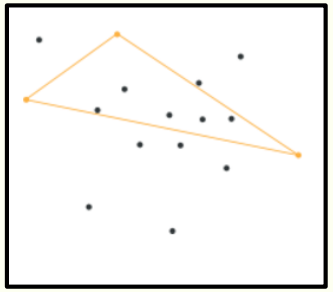
$$\mathbf{G} = \sqrt{\mathbf{G}_x^{\,2} + \mathbf{G}_y^{\,2}}$$

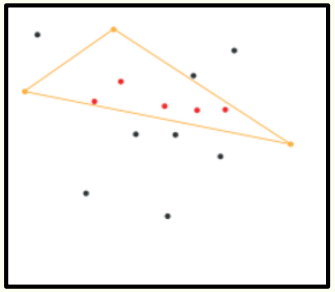
Quickhull Algorithm(Convex Hull):

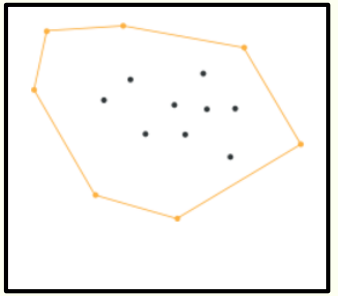
- Take two farthest horizontal points
- Divide the plane into two parts
- For one part select the farthest point from the line
- Exclude the points belonging in a triangle/polygon
- Recursively make it work for all the points





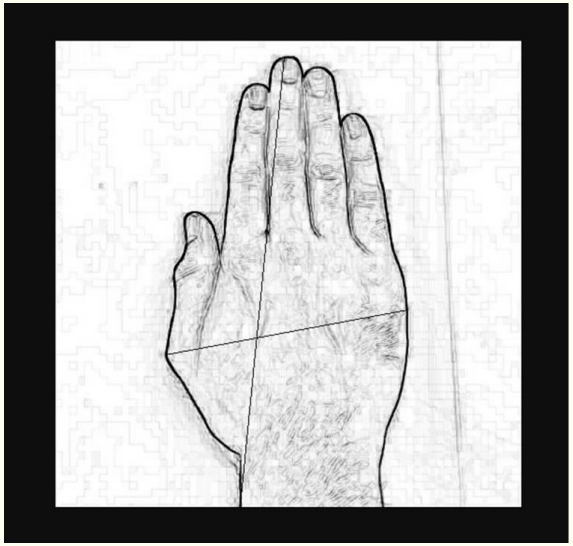






Getting the lines :

From the convex hull array, select the top most, right most, left-most and bottom-most pixel and connect them.



If the angle between the lines is less than threshold (here 15˚), show result “NEGATIVE” else “POSITIVE”, send the results to doctor as well

Limitations :

- The analysis may vary depending on the light conditions.
- The pic must be taken in the same environment, strictly under white light.

Note: As a backup, as shown before we share the analysis results with the doctor as well. So if in any case the results are not as expected, Doctor can reach out to client and manage internally.

Conclusion (& Future Versions)

- AI-Mate is a convincing proof-of-concept. There is so much more we wanted to add to it but were constrained by resources (especially time).
- We are very eager for the customer to deploy it and look forward to get the feedback from the patients.
- We, as students, also got a significant amount of invaluable industry experience dealing with a real client with a deadline fast approaching. We have learnt a lot along the way.

Future versions:

- We really look forward to a client-server implementation
- Adding more conditions to diagnose
- Better UX (interface design) and automated processing
- Off-line capability

Live Demo

AI-MATE

Questions & Suggestions

Thank You!