

# 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

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# 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

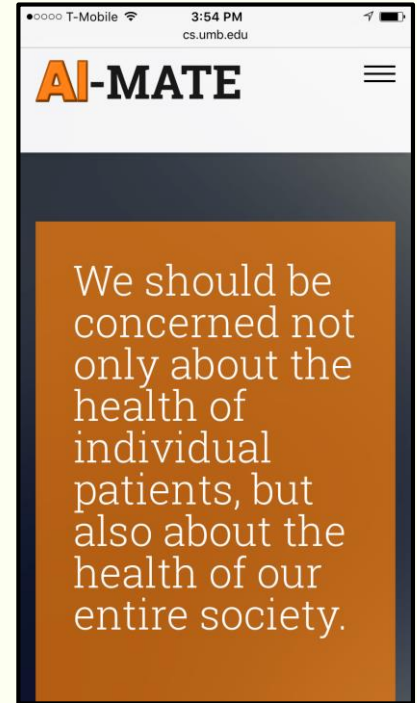
# Introduction - Customer Requirements

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

Reminder

file:///C:/Users/manas/Desktop/Prj/remainder\_v7/remainder.html

## REMINDER

This page says:  
Take medicine Medicine 1, Medicine 2,

OK Cancel

Select a medicine ▼

Add New Medicine

☒ Medicine 1

☒ Medicine 2

☐ Medicine 3

Current Time

14 : 43 : 1

Set Reminder

Hour:  Minute:  Second:

☐ Just For Today ☒ Daily ☐ Weekly

## 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

www.cs.umb.edu/~jkamby/cs683/AI-Mate 1

## AI-MATE

Pick a day 📅

Pick a time

0 0

Enter interval

☒ Never ☐ Daily ☐ Weekly ☐ Monthly

Select medicine for reminder

Set Reminder

AI-MATE

There was a problem. Reload page and try again.

Pick a day 📅

Date Must Be Filled Out

Pick a time

0 0

Enter interval

☒ Never ☐ Daily ☐ Weekly ☐ Monthly

Select medicine for reminder

Set Reminder

www.cs.umb.edu/~jkamby/cs683/AI-Mate 1

## AI-MATE

Pick a day 📅

05/10/2017

Pick a time

22 0

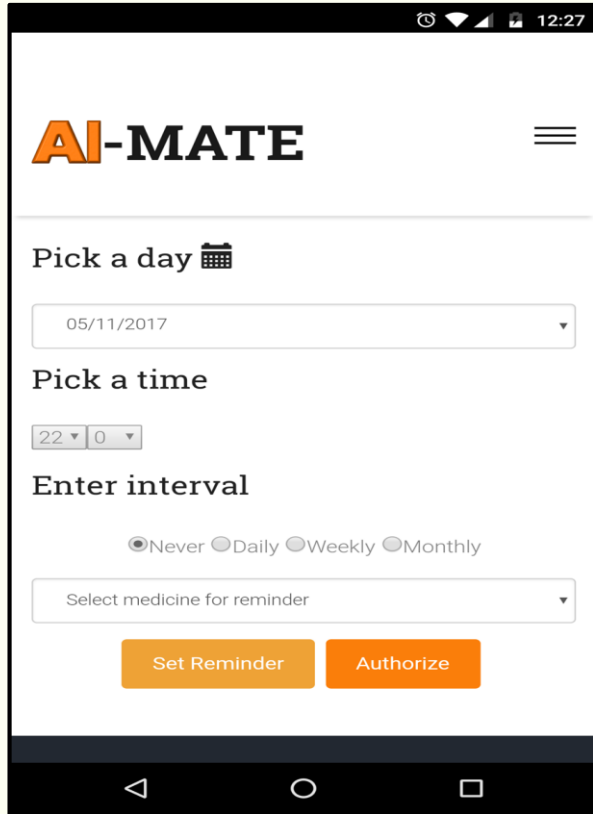
Enter interval

☒ Never ☐ Daily ☐ Weekly ☐ Monthly

Mycophenolate

Set Reminder

# Software Solution - Medicine Reminder



AI-MATE

Pick a day 📅

05/11/2017

Pick a time

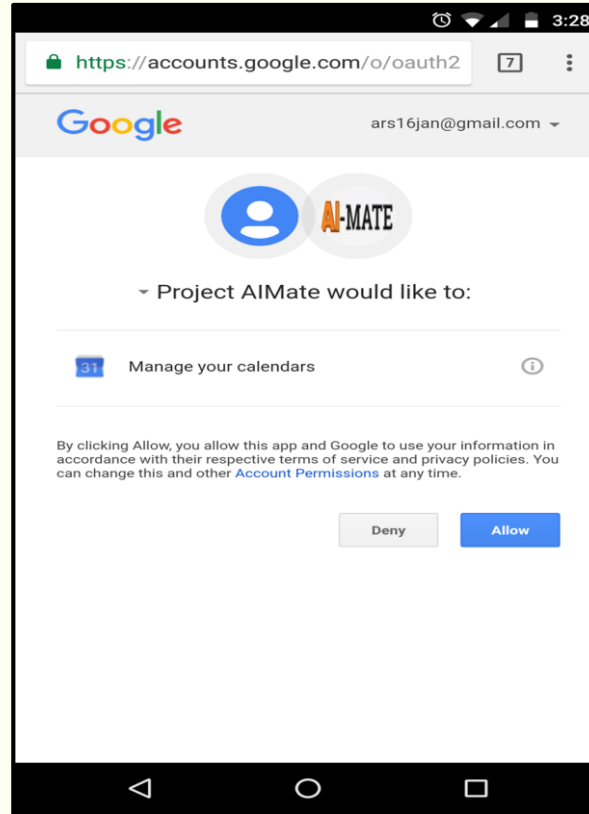
22:0

Enter interval

☒ Never ☐ Daily ☐ Weekly ☐ Monthly

Select medicine for reminder

Set Reminder Authorize



https://accounts.google.com/o/oauth2

Google

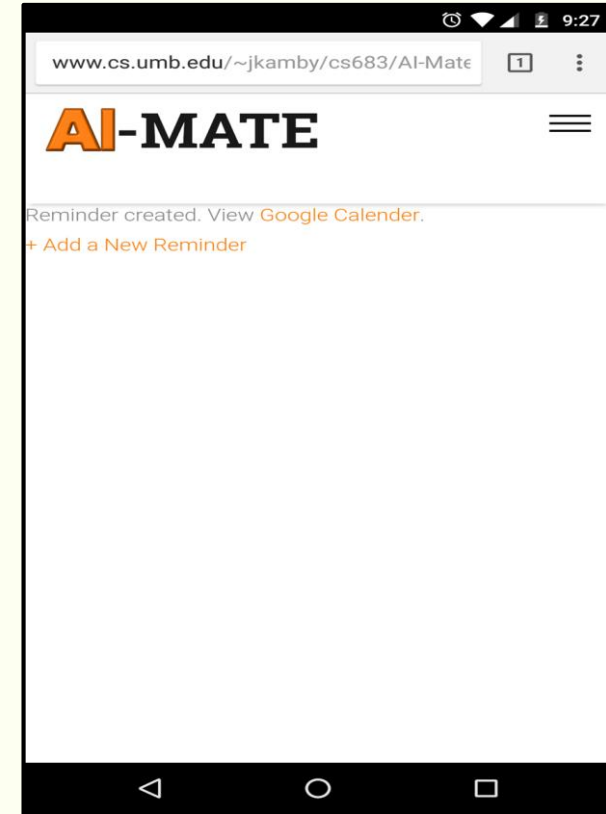
ars16jan@gmail.com

Project AIMate would like to:

31 Manage your calendars

By clicking Allow, you allow this app and Google to use your information in accordance with their respective terms of service and privacy policies. You can change this and other [Account Permissions](#) at any time.

Deny Allow



www.cs.umb.edu/~jkamby/cs683/AI-Mate

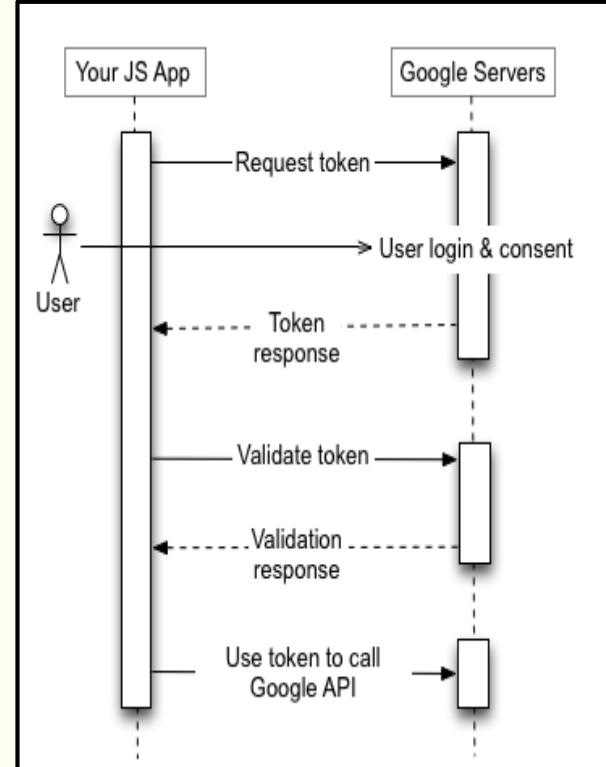
AI-MATE

Reminder created. View [Google Calendar](#).

+ Add a New 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.


Enter details as below:


Name 


Date of Birth 


Take a pic!



How you feeling? 

Weight(pounds) 

Authorization ID 

Select Doctor 


## 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.


Enter details as below:


Name 


Name Must Be Filled Out

Date of Birth 

Take a pic!

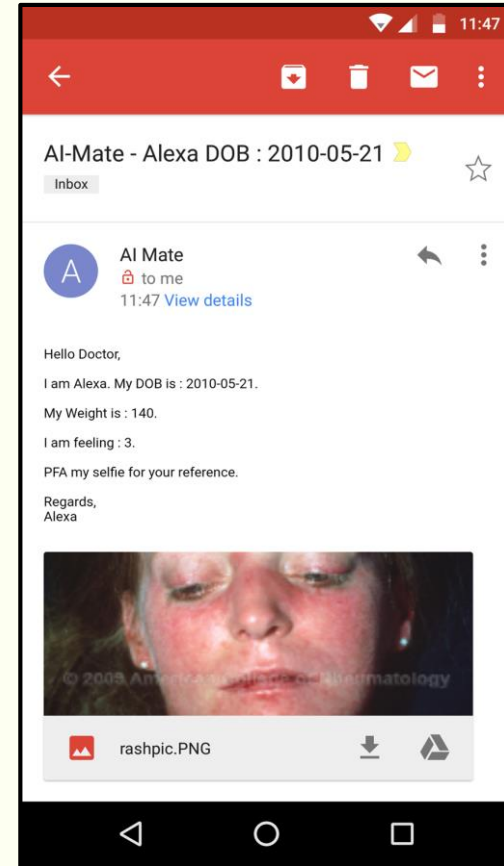


How you feeling? 

Weight(pounds) 

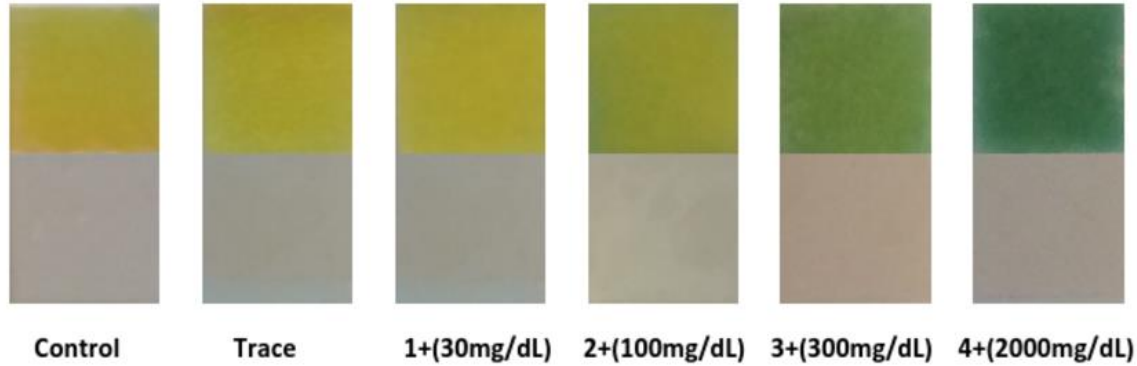
## Output:

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



# PROTEIN ANALYSIS

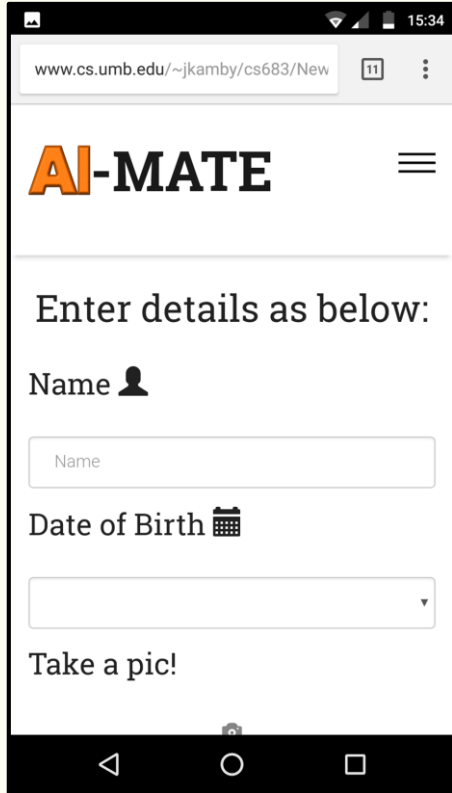
# Protein Analysis



## 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





www.cs.umb.edu/~jkamby/cs683/New 11

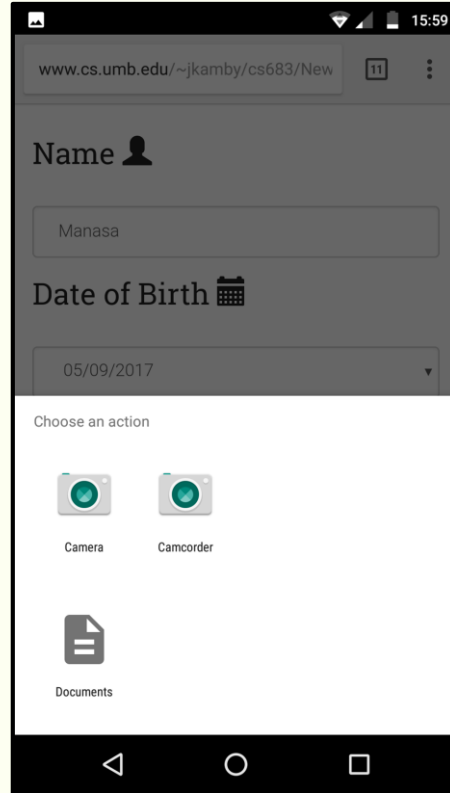
## AI-MATE

Enter details as below:


Name 


Date of Birth 

Take a pic! 





www.cs.umb.edu/~jkamby/cs683/New 11


Name 

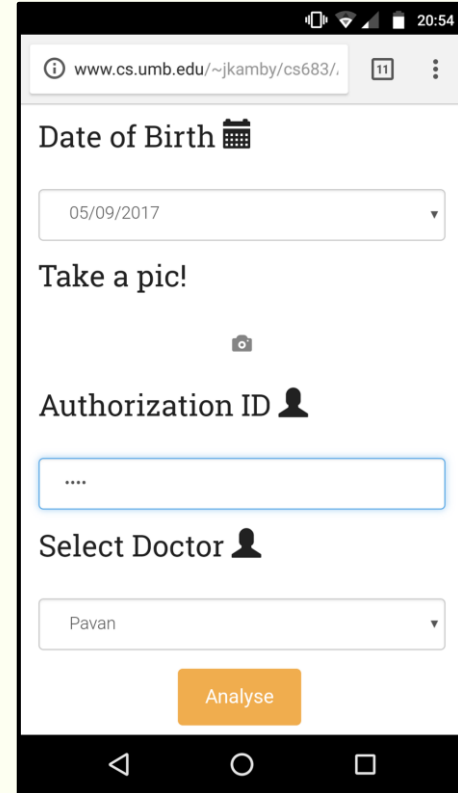
Date of Birth 

Choose an action


  
Camera


  
Camcorder


  
Documents




www.cs.umb.edu/~jkamby/cs683/ 11

Date of Birth 

Take a pic! 

Authorization ID 

Select Doctor 

Analyse



# Software Solution - Protein Analysis





www.cs.umb.edu/~jkamby/cs683/New 11 15:35

**AI-MATE**

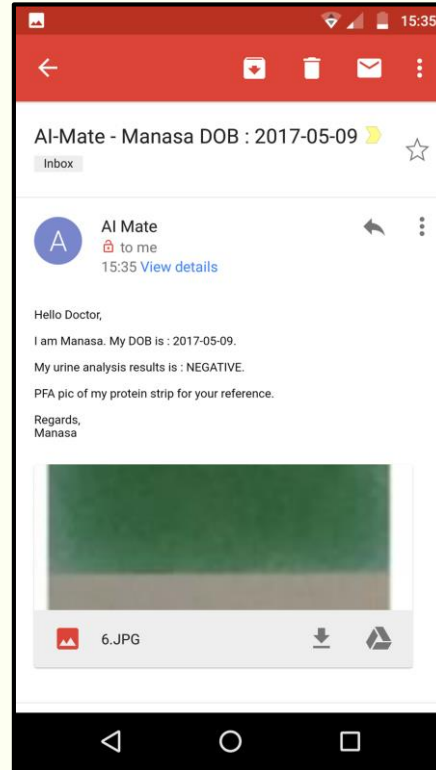
The result is :  
**NEGATIVE**

Enter details as below:

Name 

Date of Birth 

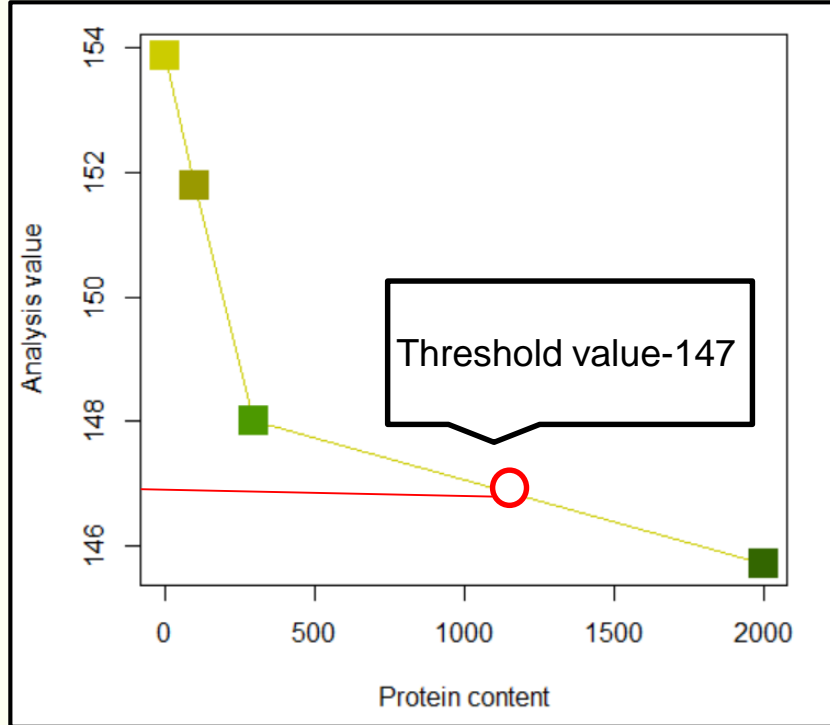
This image shows a mobile browser displaying the AI-MATE web application. The address bar shows the URL www.cs.umb.edu/~jkamby/cs683/New. The page features the AI-MATE logo and a large text display showing 'The result is : NEGATIVE'. Below this, there is a prompt 'Enter details as below:' followed by input fields for 'Name' and 'Date of Birth'.



## 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

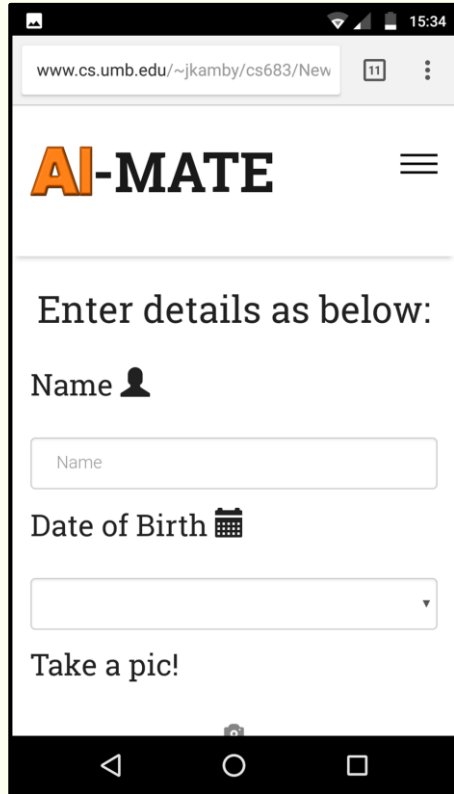
## Hand-Drift Analysis



## 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





www.cs.umb.edu/~jkamby/cs683/New 11 15:34

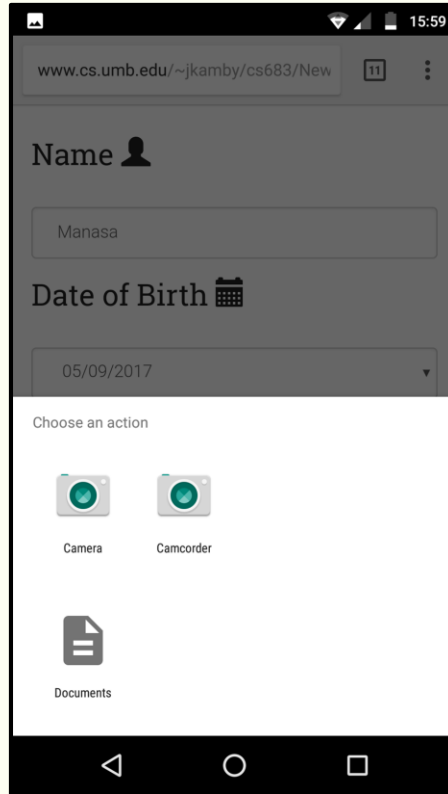
**AI-MATE** ☰

Enter details as below:


Name 


Date of Birth 

Take a pic! 





www.cs.umb.edu/~jkamby/cs683/New 11 15:59


Name 

Date of Birth 

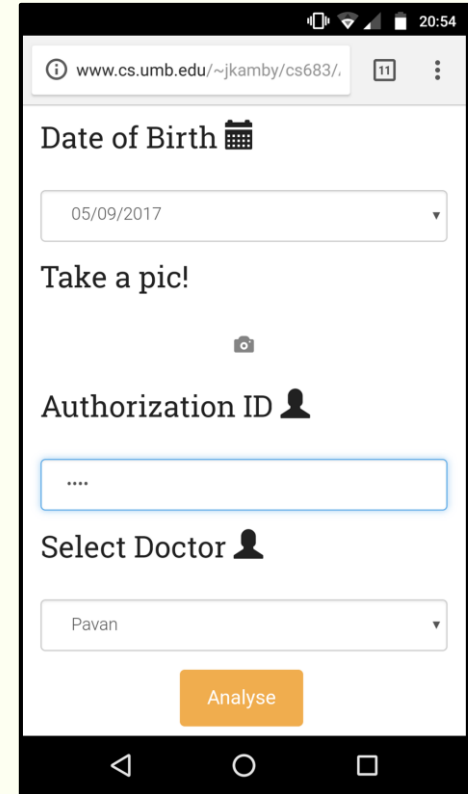
Choose an action


Camera Camcorder





Documents




www.cs.umb.edu/~jkamby/cs683/. 11 20:54

Date of Birth 

Take a pic! 

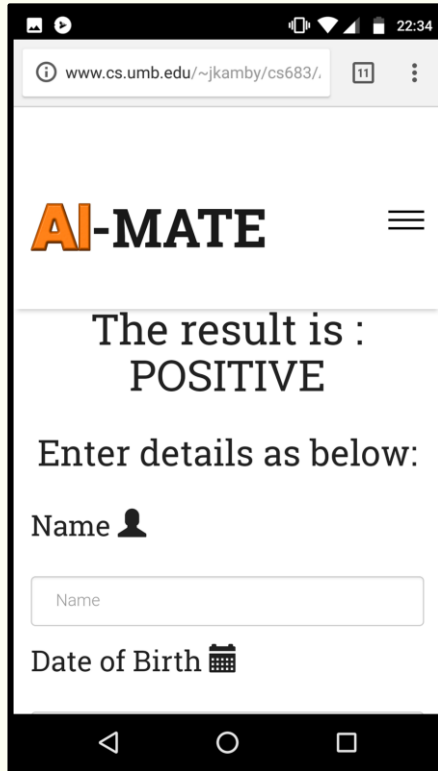
Authorization ID 

Select Doctor 

Analyse



# 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

```
graph TD; A[Image Analysis] --> B[Edge detection]; A --> C[Convex Hull]; A --> D[Getting the lines];
```

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 :

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

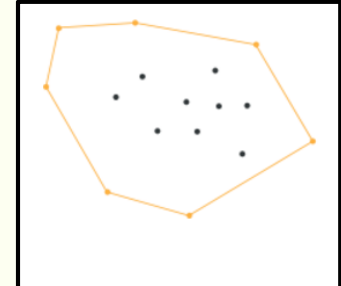
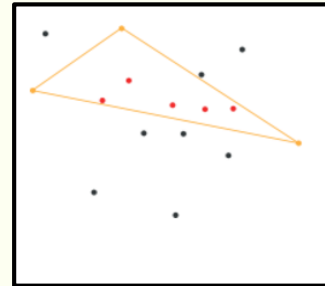
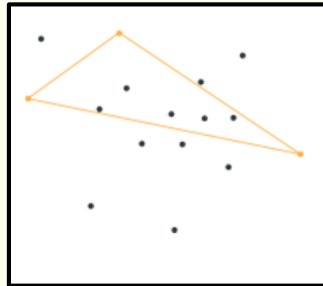
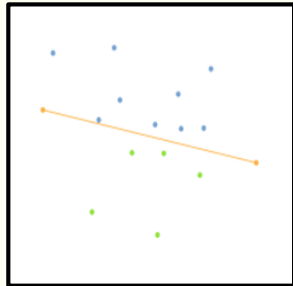
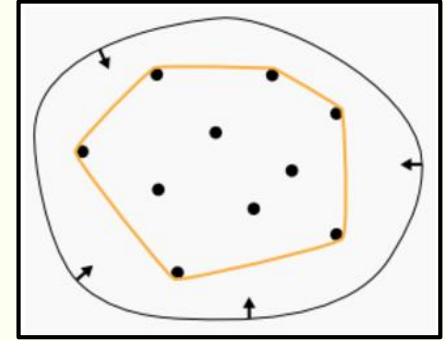
$\$x = (\$pixel\_up\_left + (\$pixel\_left * 2) + \$pixel\_down\_left) - (\$pixel\_up\_right + (\$pixel\_right * 2) + \$pixel\_down\_right)$

$\$y = (\$pixel\_down\_left + (\$pixel\_down * 2) + \$pixel\_down\_right) - (\$pixel\_up\_left + (\$pixel\_up * 2) + \$pixel\_up\_right)$

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

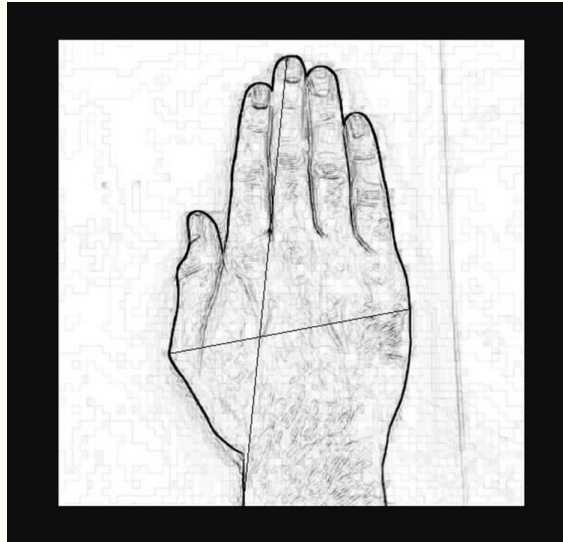
## Quickhull Algorithm(Convex Hull):

- ▶ 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  $15^\circ$ ), 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



# Questions & Suggestions

Thank You!

AI-MATE

