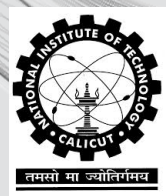
Aadhar Authentication for Aakash Tablet

Archana Iyer	D. J. S.
Hitesh Yadav	VNIT
Pooja Deo	VNIT
Prashant Main	Terna Eng.
Prateek Somani	B. M. Eng.
Prathamesh Palyekar	VNIT
Sonu Philip	NIT-C
Sudhanshu Verma	VNIT

03 July 2013


Outline

Scope

1. The project is focused primarily on capturing the users fingerprint using Aakash tablet.
2. The existing system uses an external scanner. This makes it expensive. The system developed by the team uses an optical assembly which makes use of the Aakash tablets camera. Hence it is cost effective.
3. The image thus captured is refined and sent to the Authentication Service Agency(ASA) server for the authentication of the Aadhar card holder.

Existing Product

1. Provided by Futronic tech.
2. Costs around Rs.4000.
3. Can be connected to the tablet with the help of OTG cable and requires drivers software.
4. Has a high-end camera.
5. Uses Infrared lightning.

Figure: 1.Futronic Tech Device

Optical assembly

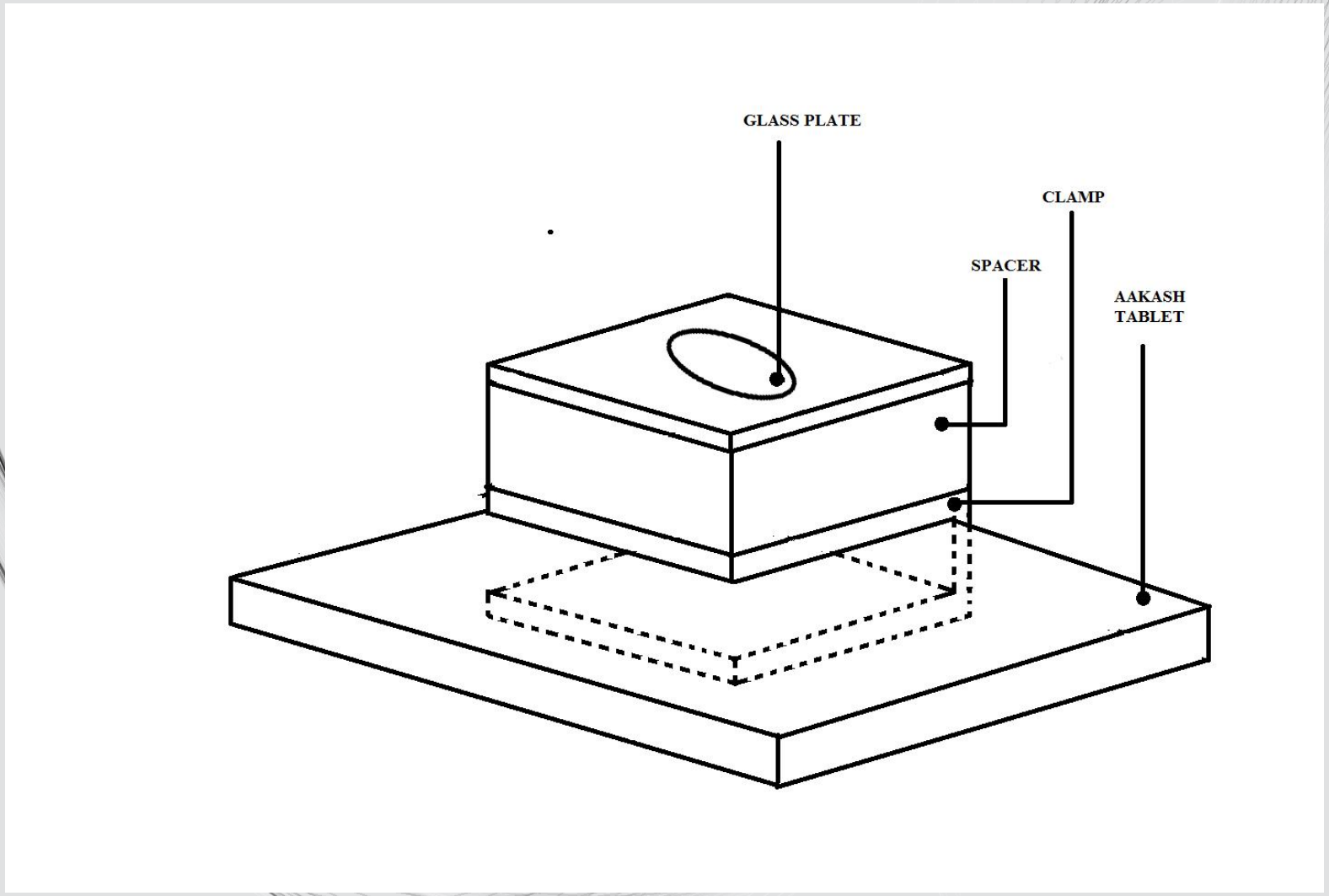


Figure: 2.Optical Assembly

Components of optical assembly

1. Clamp: The clamp is built to fix the assembly to the tablet over the camera
2. Spacer: A predefined distance needs to be maintained between the finger and the camera in order to obtain a clear image.The spacer undertakes this functionality.
3. Optics: This assembly works on the FTIR principle (Frustrated total internal reflection).
   - PCB(Printed Circuit Board)
   - Lid

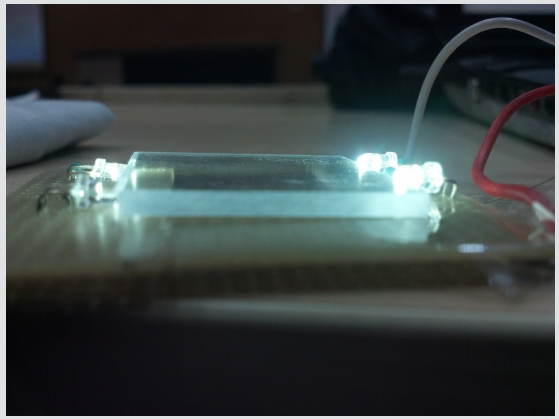


Figure: 3.Side View

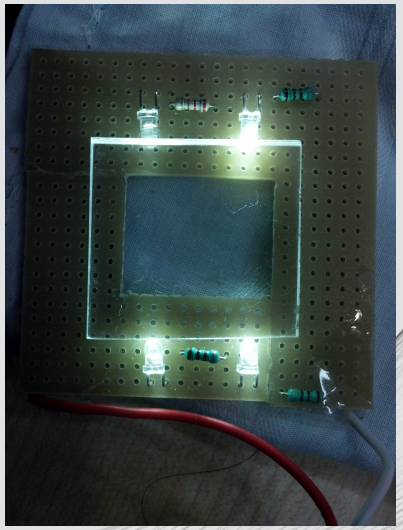


Figure: 4.Top View

Hardware Used

1. Black acrylic (3 mm thick)
2. Transparent acrylic (3 mm thick, 32.5mm x 35 mm)
3. PCB
4. LEDs (4 quantity, 3 mm thick)
5. Resistors (4 quantity, 220 ohms)
6. Power source 4.5 V (3 AAA (1.5 V) cells in series)
7. Switch

Frustrated Total Internal Reflection-FTIR

1. The behaviour of light after it hits the fingerprint ridges makes it possible to distinguish the contrast between the ridges and valleys in the image.

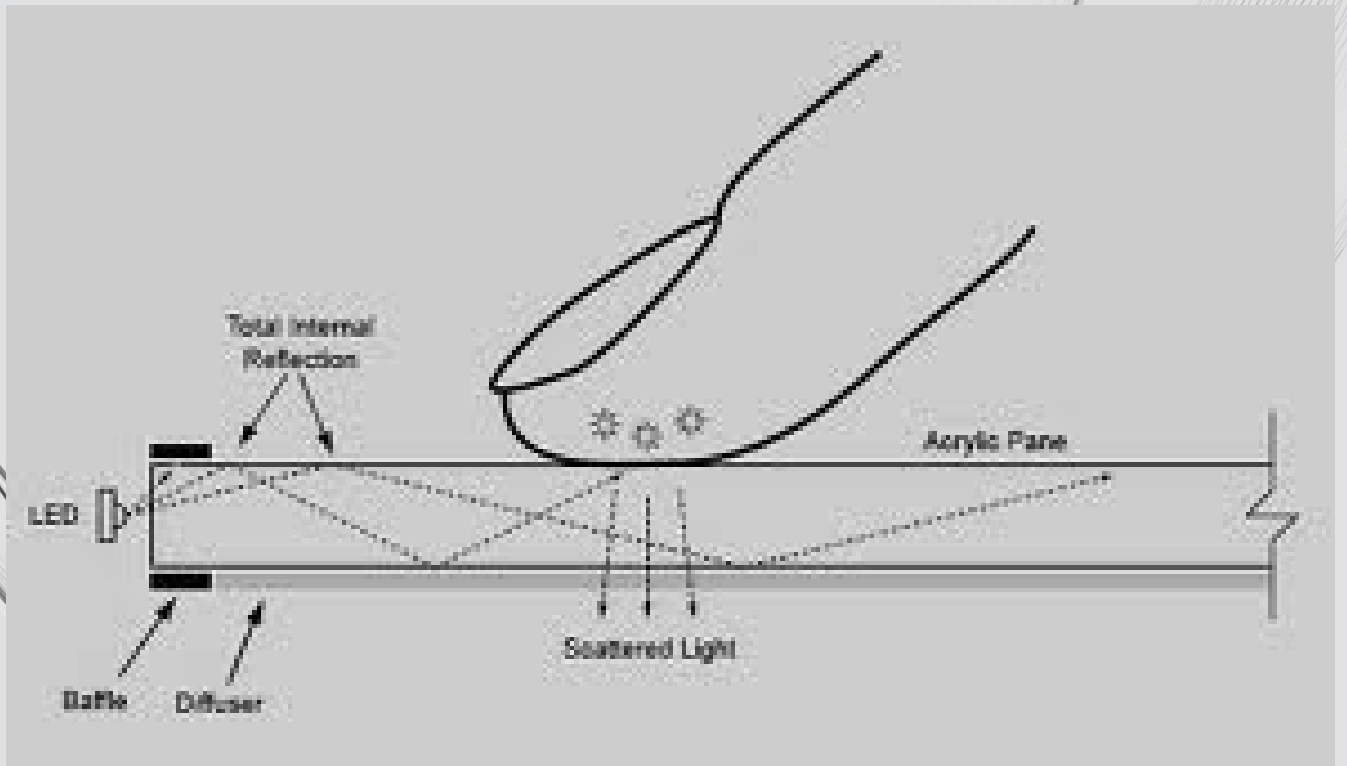


Figure: 5.FTIR

Workflow

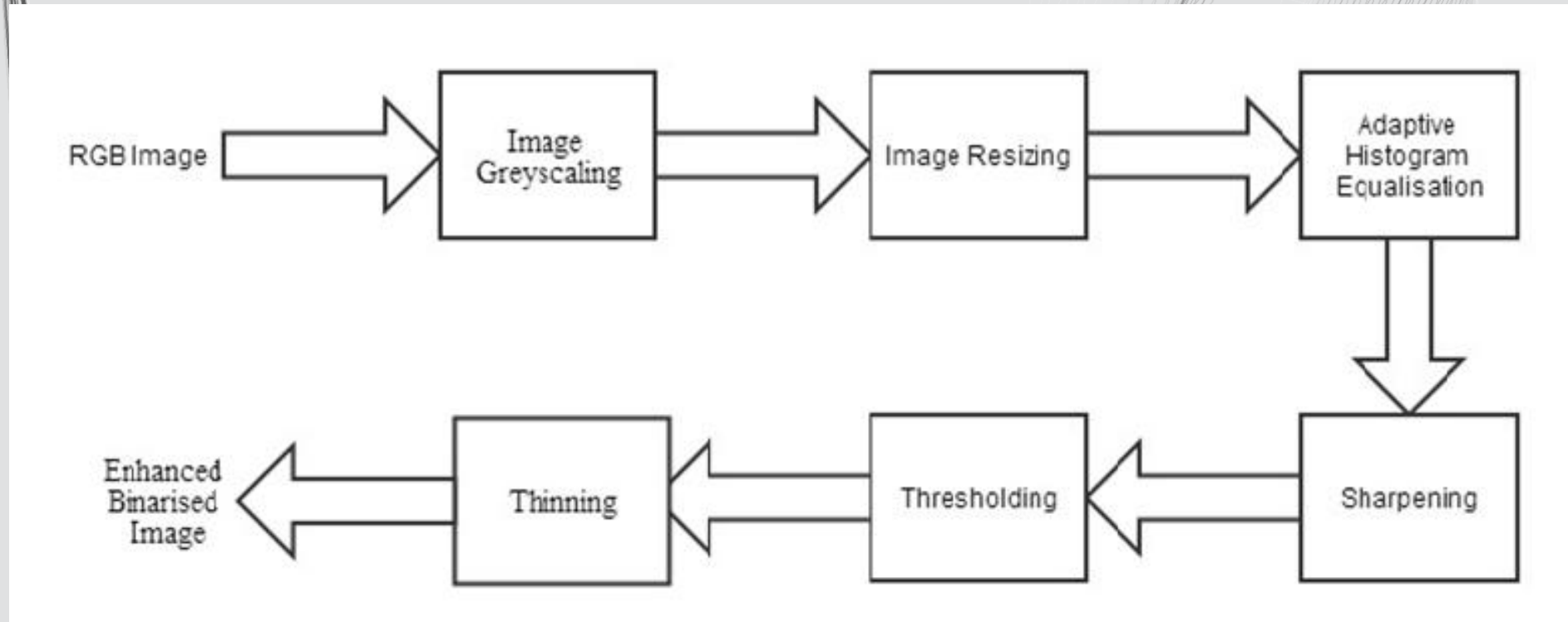


Figure: 6.Workflow diagram

Live Finger Detection

1. This detects whether the finger is real or a spoof.
2. The perspiration phenomenon affects the grayscale of an image. The LFD algorithm makes use of this principle.

Adaptive Histogram Equalization

1. It enhances the contrast of an image.
2. This makes it easier to differentiate between the parts of the image.
3. The distribution of the pixel intensities is skewed towards both the low intensity and high intensity extremes of the intensity range.

Algorithm:

1. Compute the histogram.
2. Calculate normalized sum (CDF) of the histogram.
3. Transform input image to output image, using S = T(R) =CDF

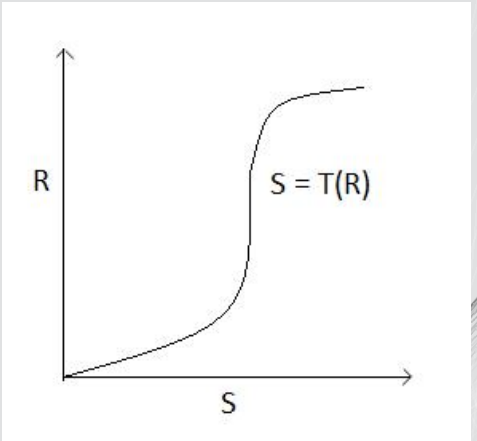


Figure: Graph

Thus, histogram equalization helps obtain a more uniform histogram.

Figure: Before AHE

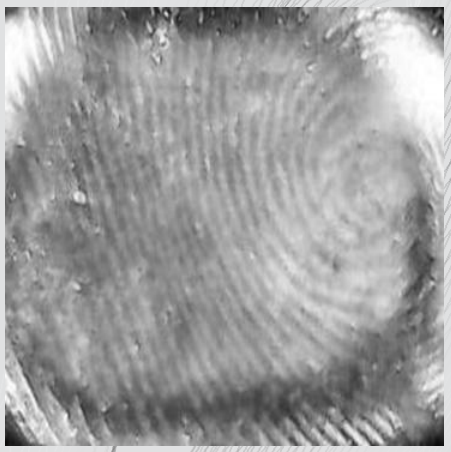


Figure: After AHE

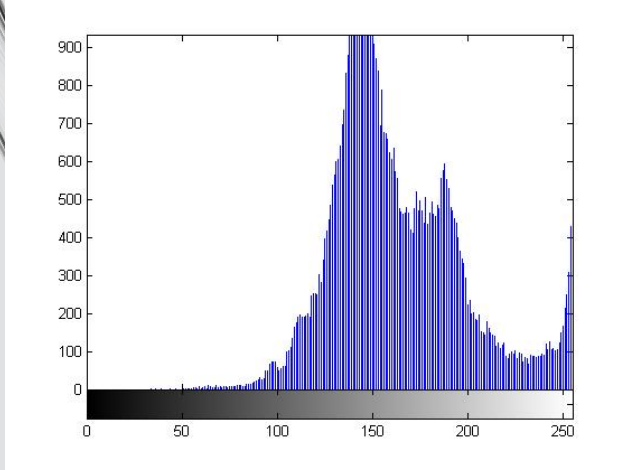


Figure: Before AHE

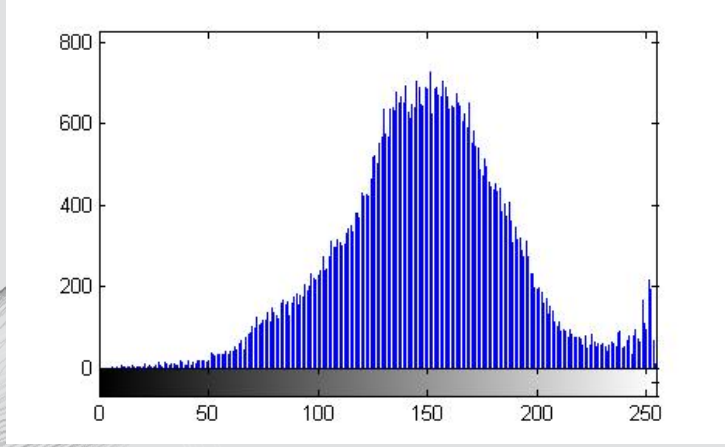


Figure: After AHE

Image Thresholding

Thresholding is done to convert the grayscale image to a black and white image.

Algorithm:

1. Compute the histogram and probabilities of each intensity level.
2. Set up initial probabilities and mean.
3. Step through all possible thresholds t=1..maximum intensity.
   - Update weight and mean.
   - Compute variance.
   - Compute within class variance.
4. Desired threshold corresponds to the minimum within class variance.

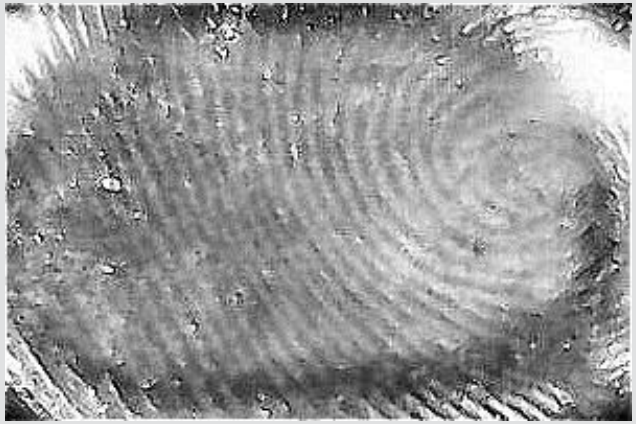


Figure: Before Thresholding

Figure: After Thresholding

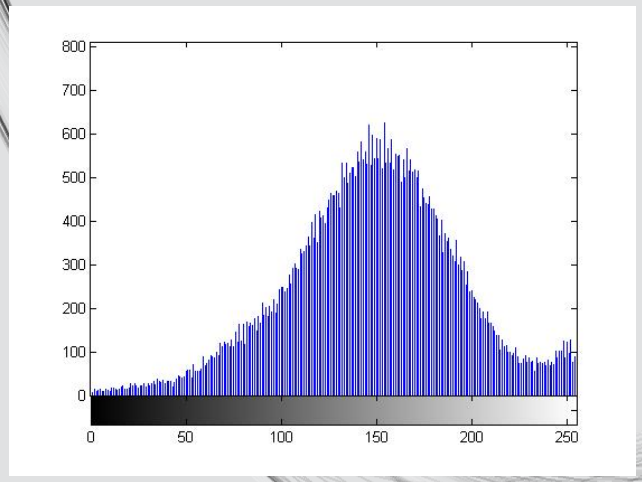


Figure: Before Thresholding

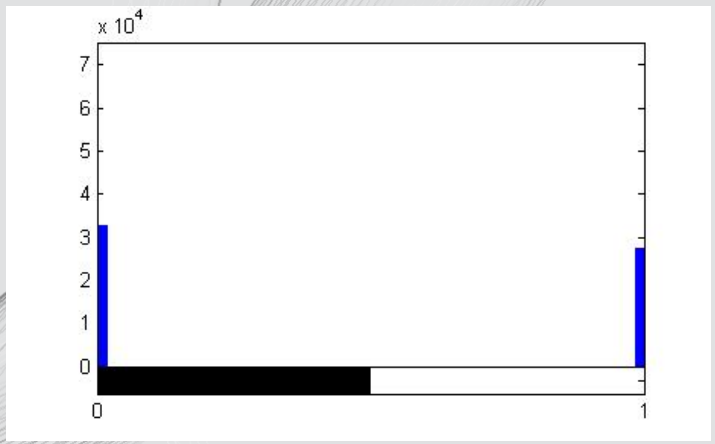


Figure: After Thresholding

Image Sharpening

1. Sharpening brings out image details that were not clearly visible before.
2. It enhances the pre-existing features.
3. No new details are actually created.
4. Sharpening emphasizes the edges in the image and makes it easier for the eye to pick out .

Sharpening involves the following steps:

1. Read the input image.
2. Choose the appropriate kernel to do the sharpening.
3. Apply the above kernel to the image matrix using convolution.
4. The image thus obtained, is sharpened.

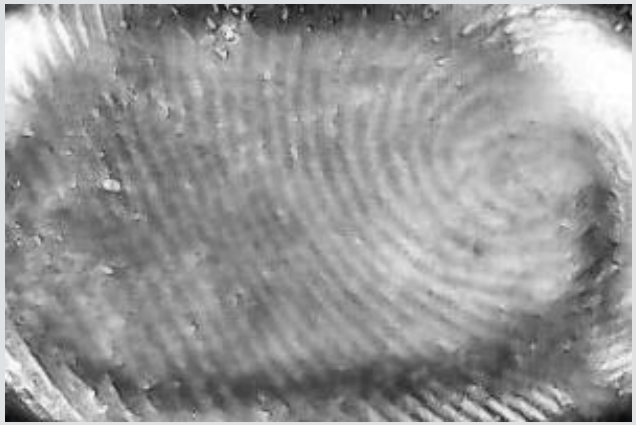


Figure: Before Sharpening

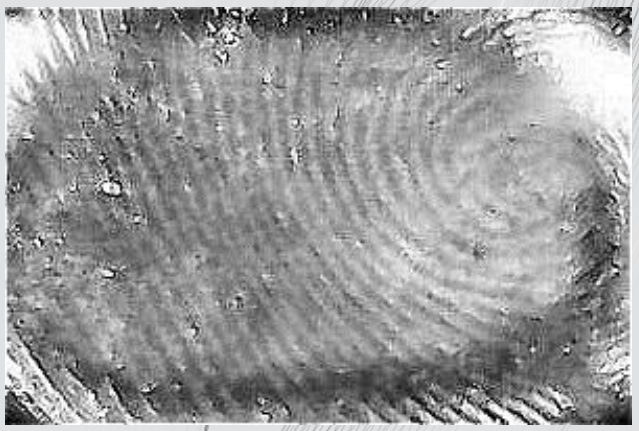


Figure: After Sharpening

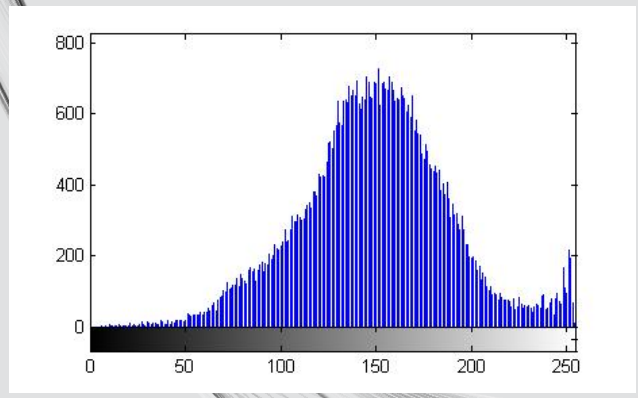


Figure: Before Sharpening

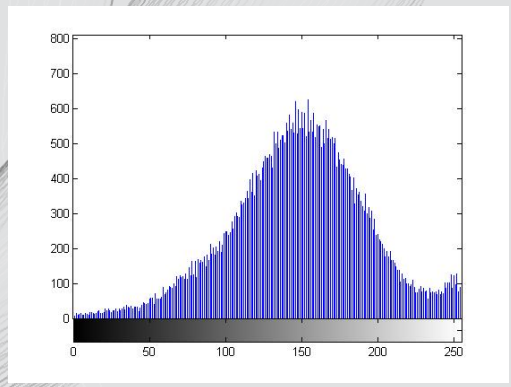


Figure: After Sharpening

Image Thinning

1. In thinning, the ridge lines of the fingerprint image are transformed to a one pixel thickness.
2. Thinned images require lesser memory and are easier to process.
3. It is easier to extract details from thinned images(minutiae points) which are used for fingerprint classification, recognition and matching.

Thinning can be done iteratively by deleting the pixels till they are one pixel thick.

Figure: Original fingerprint image and Corresponding thinned image.

Future Scope

1. Test the optical assembly with IR(infra-red) and SMD(Surface Mounted Device) LEDs.
2. Try different techniques like use of polarising filters and macro lenses in orded to enhance the quality of the image captured.
3. Test the enhanced image with the Aadhaar Server.

Problems faced

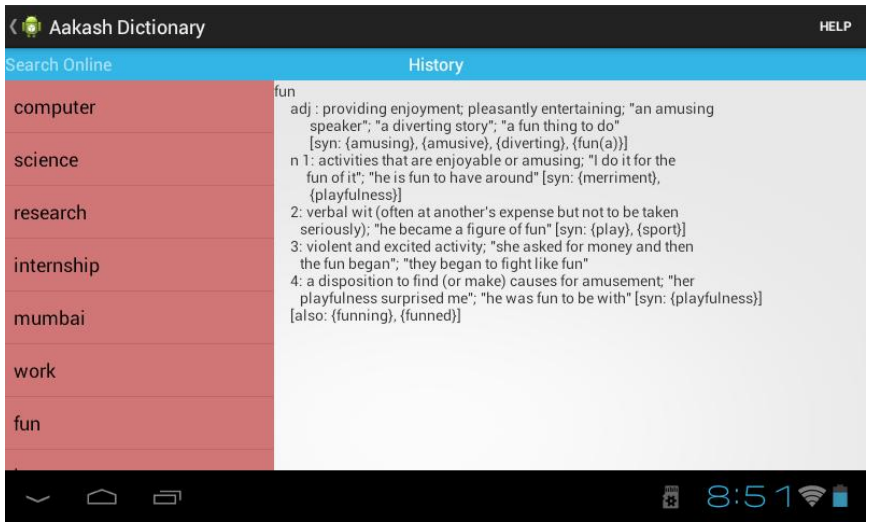
1. Finding the distance at which the image is focused and clear.
2. Green tint in glass.
3. Illumination of the acrylic sheet.
4. Deciding workflow of image enhancement processes.
5. Implementation on Aakash tablet.

Things learnt in the project

1. Image Processing using OpenCV.
2. Image Processing using Scilab.
3. Some algorithms used in image enhancement.
4. Developing applications on the Android platform
5. Creating a hardware assembly and overcoming various problems while doing the same.
6. Formal documentation of project(SRS, SDD and project report were submitted)

Educational Application - I

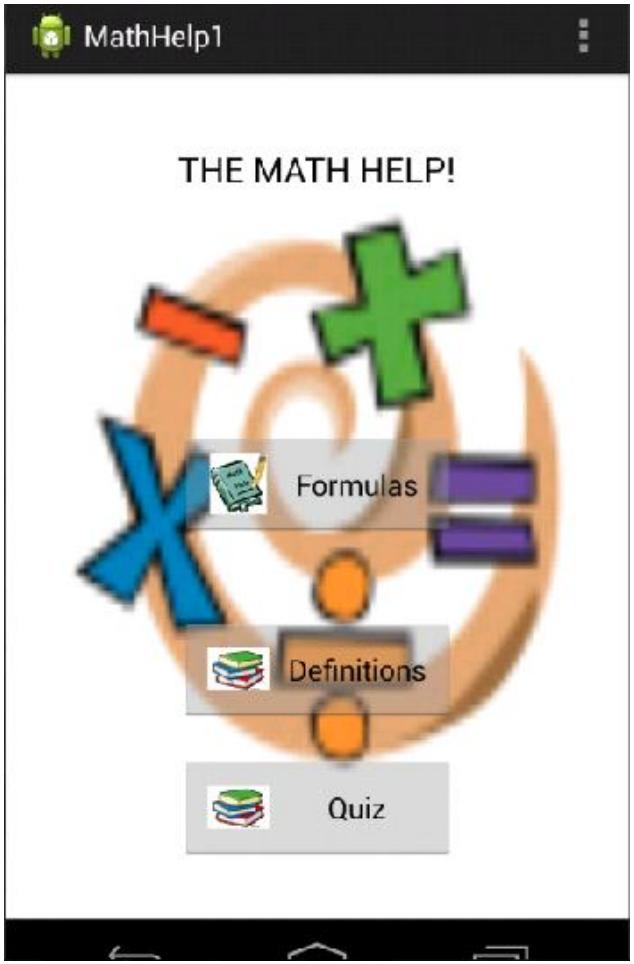
Aakash Dictionary



1. The user can search for any word online
2. Maintain a history of his searches
3. He can delete any of his search.

Educational Application - II

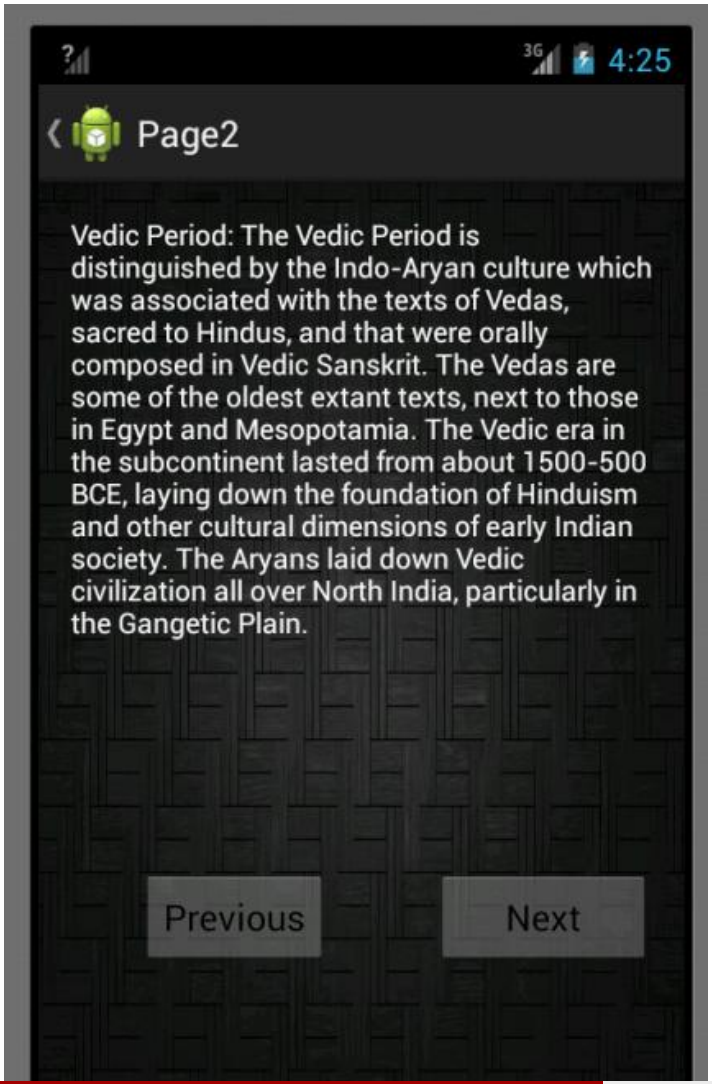
MathHelp!



1. Provides users with some of the basic formulas and definitions present in Algebra and Geometry.
2. Contains a quiz that will help to revise some of the concepts in math.

Educational Application - III

Indian History



1. Gives information on Indian History from Vedic era to recent years.
2. Contains competitive quizzes about the history of India.

Educational Application - IV

Plot Graph

1. Plots a line by taking the equation of the line as input.
2. If user wants to draw a rectangle on the graph,the user needs to give the starting point and the dimensions of the rectangle.

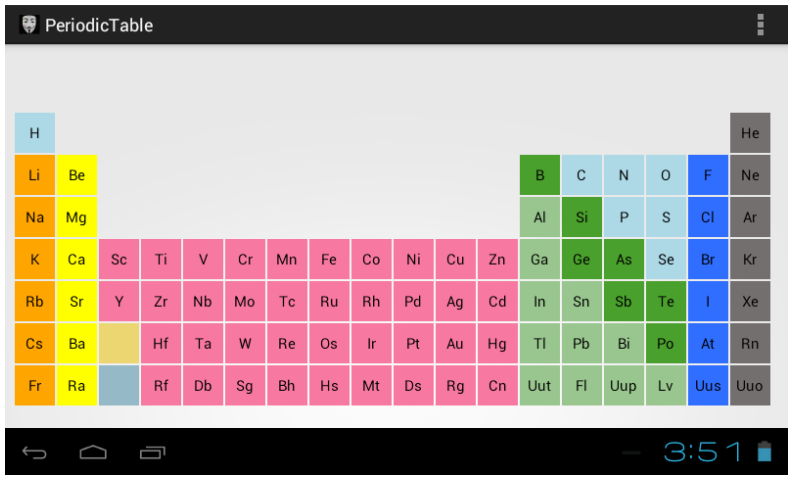
Educational Application - V

Incredible India

1. On clicking on a State, a dialog box pops up with details about a particular State such as the currency,Capital and the languages spoken.

Educational Application - VI

Periodic Table



1. Helps to understand the periodic table in detail.
2. Gives brief information about each element and shows to which group and period it belongs.

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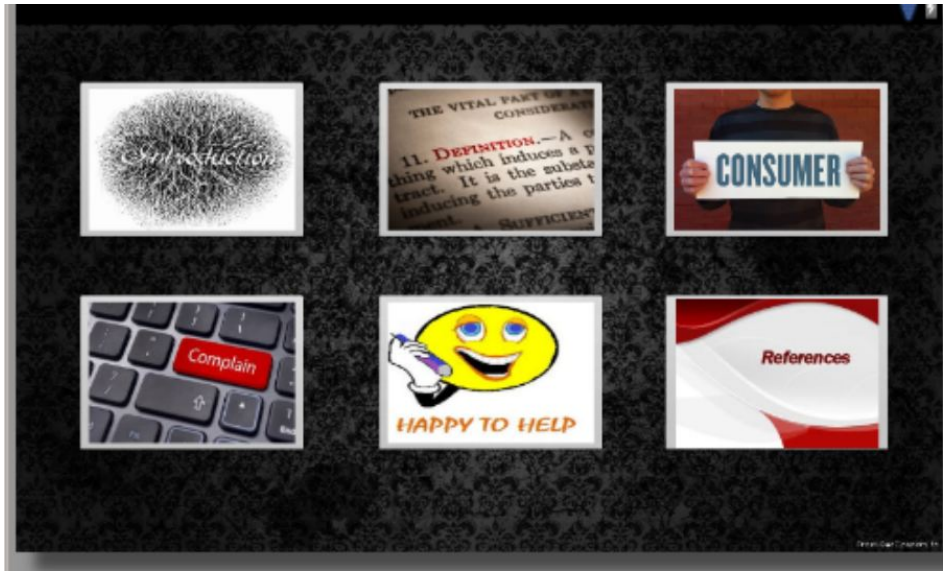
Educational Application - VII

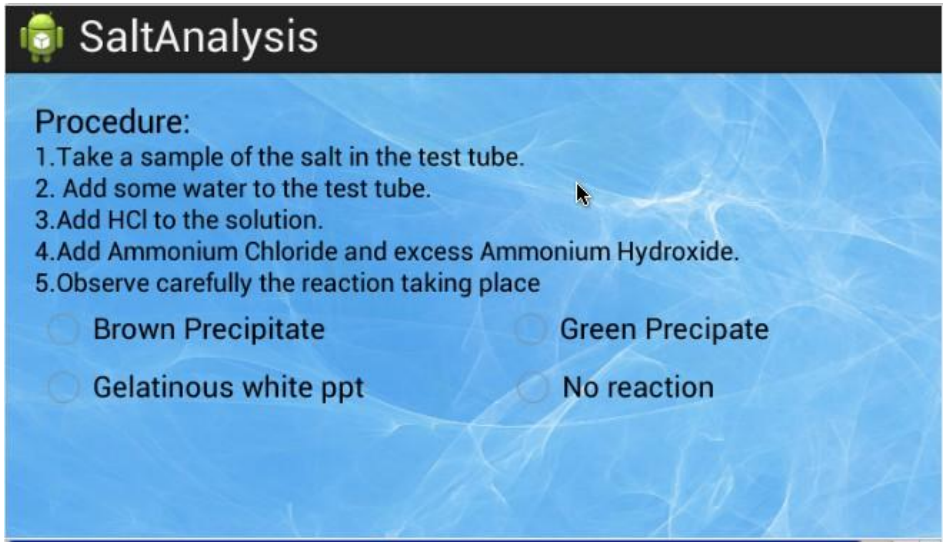
Consumer Protection Right



1. Informative application which is useful for consumer to know their rights.
2. If user faces some sort of difficulty,they can get precise guidance.

Educational Application - VIII

Salt Analysis



1. Gives the user a number of steps to follow.
2. Takes input of the result and tells the salt.

Demo

1. DEMONSTRATION

Comparison of fingerprint image

Without Optical Assembly

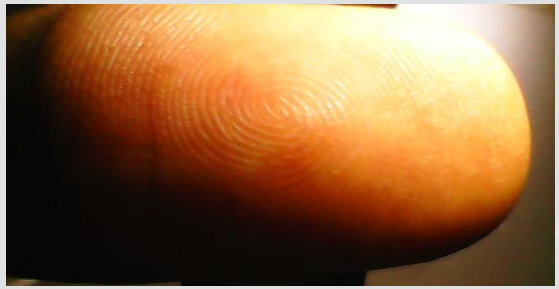


Figure: Fingerprint

With Optical Assembly

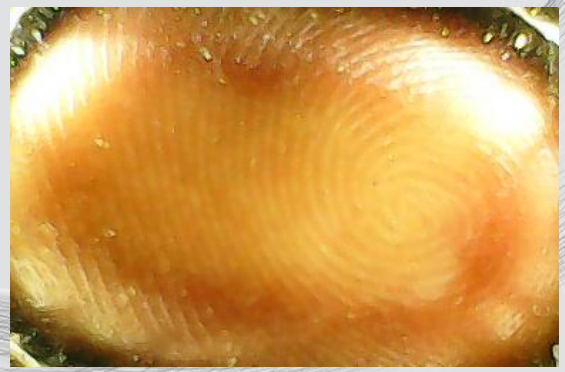


Figure: Fingerprint

Archana

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