# Human Factors in Interaction Design

Currency identification Aid for the visually impaired in Indian Context

## Process

Previously covered

**Brief → Primary + Secondary Research → Ideation**

This presentation

**Prototyping → Iterating → Testing?**

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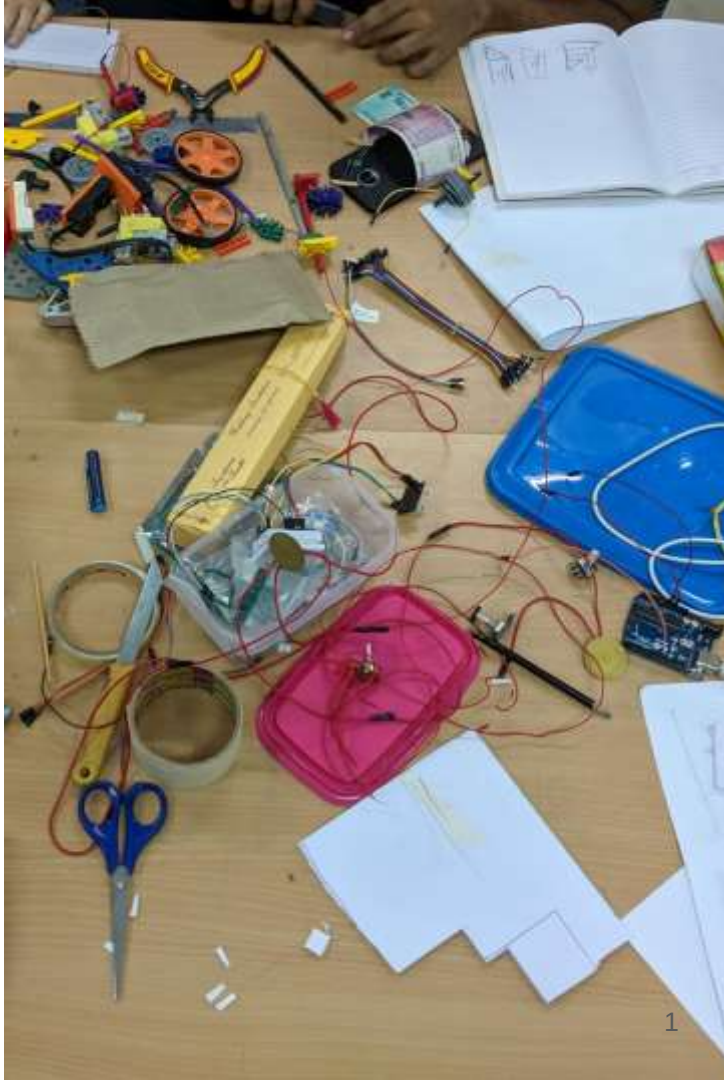


# Part A | Literature Review

### Mahatma Gandhi new series

| Denomination | Length | Breadth | Identifying Mark |
|---|---|---|---|
| 10 | 123mm | 63mm | None |
| 50 | 135mm | 66mm | None |
| 100 | 142mm | 66mm | // // |
| 200 | 146mm | 66mm | //○○// |
| 500 | 150mm | 66mm | // / // |
| 2000 | 166mm | 66mm | / // / // / |

### Mahatma Gandhi series

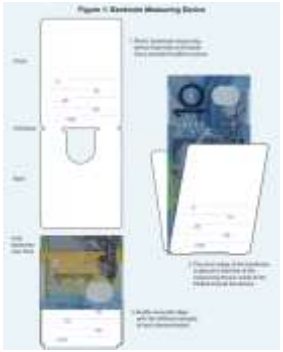
| Denomination | Length | Breadth | Identifying Mark |
|---|---|---|---|
| 10 | 137mm | 63mm | None |
| 20 | 147mm | 63mm | Rectangle |
| 50 | 147mm | 73mm | Square |
| 100 | 157mm | 73mm | Triangle |
| 500 | 167mm | 73mm | Circle |

## Current scenario in India

Difference in the dimensions are very small

# Non-digital solutions: Currency

**Folding notes**
Pros - Cheap, Compact, Independent
Cons - Time consuming, uni-directional



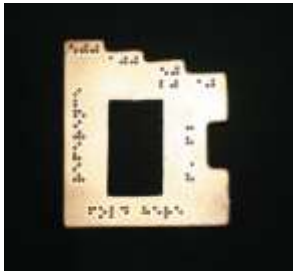
**Australian Gov. Banknote Measuring Device**
Pros - Cheap, Compact, Independent
Cons - Time consuming

**Hypothetical redesign**

**Embossing on notes**
Brazil, Thailand, Malawi

**Braille on notes**
China, Hong Kong

**Tactile Features**
Chile



**Tiffy Template**
Pros - Cheap, Compact, Independent
Cons - Braille is uncommon, time consuming

**Money Brailler**
Pros - Cheap, Compact
Cons - Time consuming, uni-directional

# Digital Solutions: Devices and Tools


**iBill Currency Identifier**
$119 price tag
Tone & vibration modes protect privacy

**ID mate galaxy**
$1,299 price tag
Bluetooth
Bar code scanning
Inbuilt database
Memory

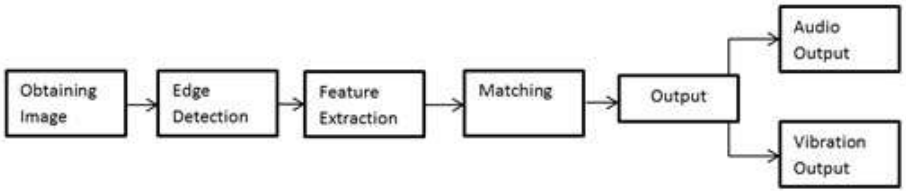
**Student research project**
Hardware Prototype for a currency identifier

# Tools on Android and iOS

**IDEAL Currency Identifier**


**EyeNote Currency Identifier**


**LookTel Currency Identifier**




Android App by IIT Delhi for Mobile Currency Identification (Article)

# Part B | Visit to Dept. of Rehabilitation

Interviews with 3 potential users

Transcripts and initial analysis here

## Daily life outside currency

- **Defined timetable** at the Rehabilitation Center
- Most people seem to be **accompanied** by friends when venturing out, but in an ideal case the environment would allow them to move independently.
- The center aims to make them **independent** to the **best of their abilities**
- Confidence is a major issue, even **small inconveniences** can be **major setbacks**
- **No one will wait** for them while they slowly find their way
- Identifying with the **community as the whole** - the need for **collective upliftment**

Photographs and Videos of the way notes and applications were used (Not detailed here for lack of time)

## Final Requirements

- **Quick and Accurate Usage**
- **Universal Accessibility**
  - Low Cost
  - Low reliance on internet/technology
  - Easy to learn, use, replace
- **Suitable across contexts**
  - Accepting payments
  - Conducting transactions
- **Better ergonomic designs**
  - Physical
  - Cognitive
- Waterproof, lightweight, secure, countable, verification features...

# Where these ideas lie

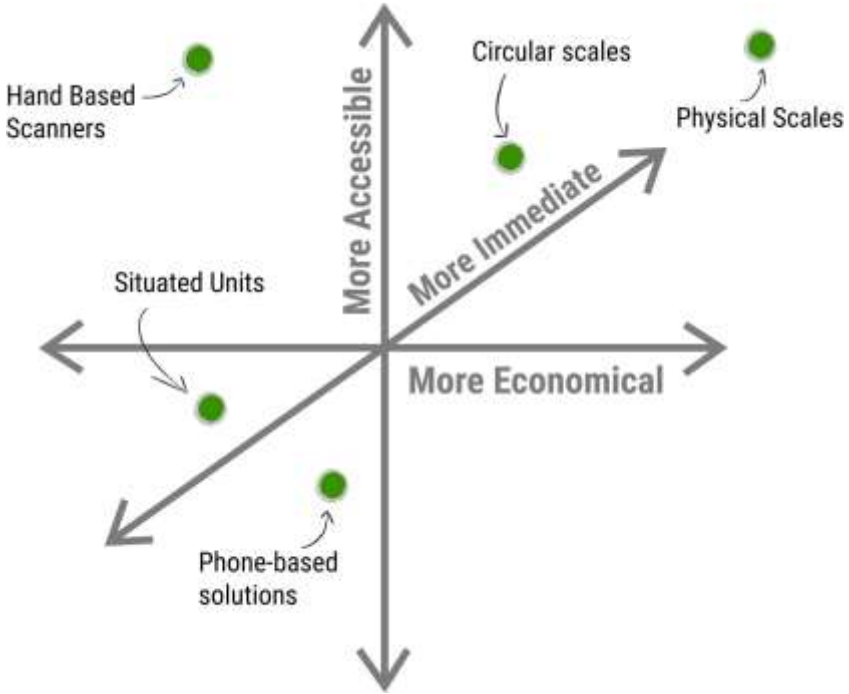
## Ideas → Prototypes

- Image recognition
- Colour sensor
- Rotary encoder with pull back string
- Rotary encoder with wheel turn
- Diagonal String

## Priorities

How did we decide which ideas to try?

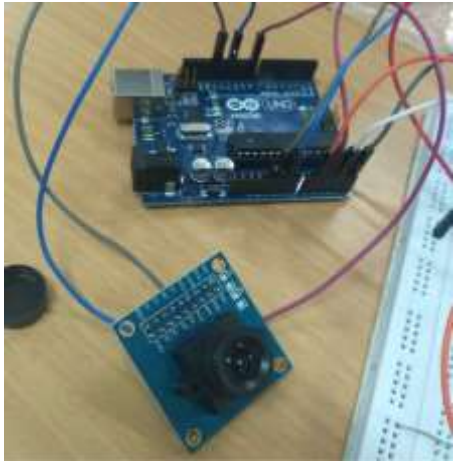
1. Aim for minimum possible cognitive load - avoid solutions which require user to memorize a mapping.
2. If technology makes for a more expensive but easier interaction, use technology.



# Image Recognition

A camera sensor + light source sends information to the wrist-mounted microcontroller, where the identity is determined and messages are sent to a smartphone via a Bluetooth module.

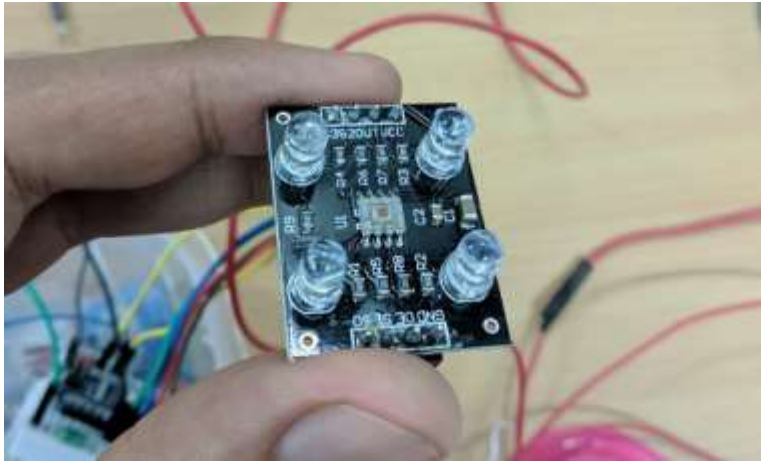
| Issues | Can it be solved? |
|---|---|
| **Prototyping** | |
| – Processing power required is very high | Yes |
| **Implementation** | |
| – Large dataset required | Yes |
| – Expensive | No |



# Colour Sensor

A colour sensor will identify the RGB values of a surface placed in front of it and the information can be sent to a smartphone via a Bluetooth module. A colour sensor can be considered as a 1 pixel camera which returns red, green, blue and brightness values which can be used to determine the denomination.

| | Can it be solved? |
|---|---|
| **Prototyping** | |
| – The resolution of the sensor was not known/editable | Yes<br>Yes |
| **Implementation** | |
| – Colour damage on the notes might hamper the results | No |



# Rotary Encoder with pull back string

A pull back string connected to a rotary encoder will measure the length of the note through the number of rotations of the encoder.

| Issues | Can it be solved? |
|---|---|
| **Prototyping**<br>- Accuracy | Yes |
| **Implementation**<br>- Two dimensions will have to be measured | No |
| **Usability**<br>- Accuracy might suffer because of human error | No |

# Rotary encoder with wheels

By sliding a note through two wheels and measuring their rotation, the length of the note can be measured. This interaction can be done through a small handheld device with a slit for the note to pass through

| | Can it be solved? |
|---|---|
| **Prototyping**<br>- Action was not smooth | Yes |
| **Implementation**<br>- Two dimensions will have to be measured | No |

# Diagonal String

Measuring the length and width of a note separately causes 2 actions to be required before a note can be accurately determined.

**Angle measurement**

Using potentiometer which has an accuracy of 0.29 degrees.

**Diagonal measurement**

Using rotary encoder.

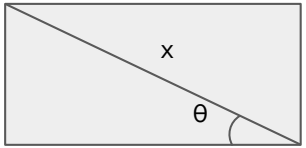



Table 2
Note diagonals (x)
+ angles (θ)

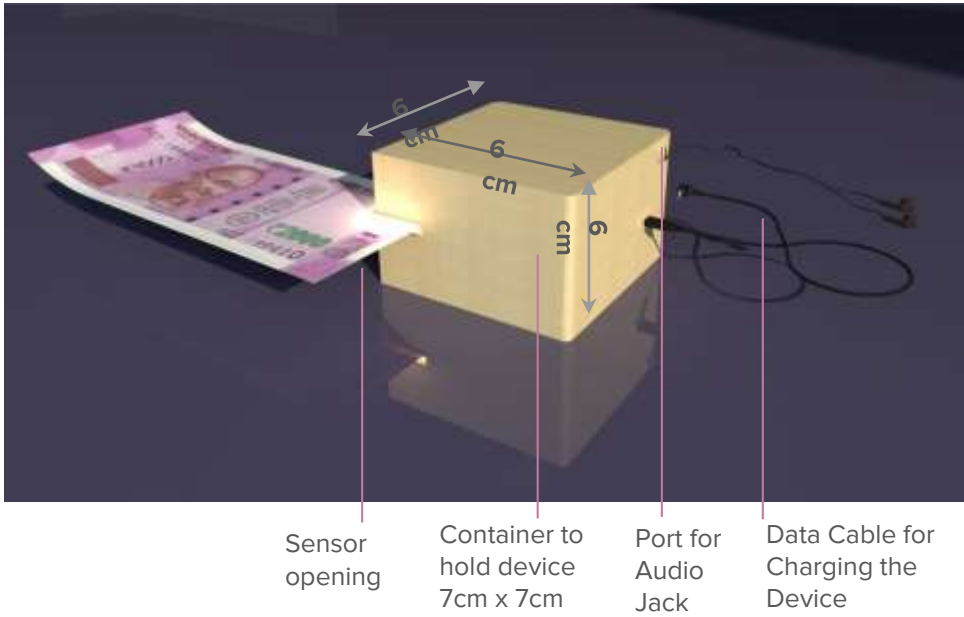
| Note | Diagonal x (mm) | Angle θ degrees) |
|---|---|---|
| 10 new | 138.19 | 27.12 |
| 50 new | 150.26 | 26.05 |
| 10 old | 150.79 | 24.70 |
| 100 new | 156.58 | 24.93 |
| 200 new | 160.22 | 24.33 |
| 20 old | 159.93 | 23.20 |
| 50 old | 164.12 | 26.41 |
| 500 new | 163.87 | 23.75 |
| 100 old | 173.14 | 24.94 |
| 2000 new | 178.63 | 21.68 |

# Prototypes → Iterations of Prototypes

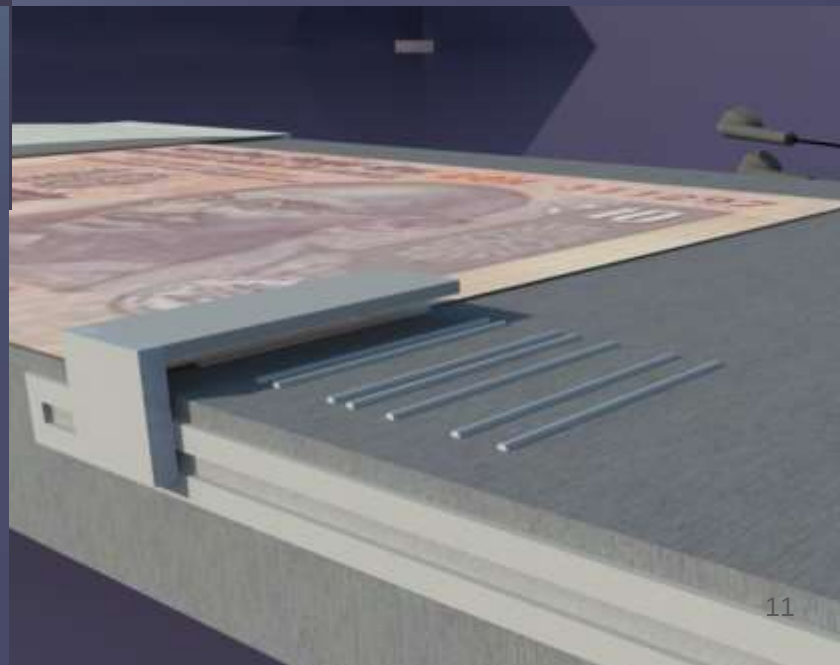
1. Optical sensor
2. Note Pocket

## Colour Sensor

A colour sensor will identify the RGB values of a surface placed in front of it and the information can be sent to a smartphone via a Bluetooth module. A color sensor can be considered as a 1 pixel camera which returns red, green, blue and brightness values which can be used to determine the denomination.



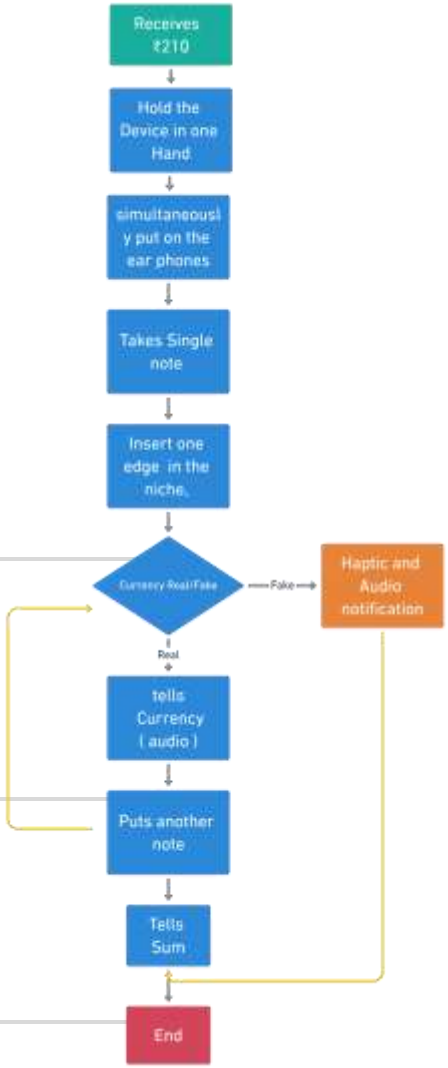

RESERVE BANK OF INDIA
10
दस रुपये



# Expected Task Flow

- Receiving Money
- Taking the device
- Inserting the ear phones
- Detecting currency
- Receiving feedback
- Repeating the same for no. of currency
- Getting the total amount in the end, for stores and calculates

https://whimsical.co/SmkATfYGVbRETR4m4Cfouj




| Issues | Can it be solved? | |
|---|---|---|
| **Prototyping** | | |
| – The movement of the prong is not smooth | – | Yes |
| **Implementation** | | |
| – The size of the product can't be less than 166mm by 66mm. | – | No |
| **Usability** | | |
| – Moving the prong is an added step that can be removed | – | Yes |

# Note Pocket

A basic circuit with multiple resistors can be used to identify the length and breadth of the notes based on the amount of space that the notes occupy on the grid of wires. The breadth of the notes is determined without any action by the user. This functionality can be extended to the length as well. This could help make it easier to measure multiple notes also.

- Receiving Money
- Taking the device
- Put on the ear phones
- Put money in the pocket
- Aligns the edges on one end
- Sliding the slider across the other edge
- Receiving feedback
- Repeating the same for no. of currency in hand

# Expected Task Flow

| Note | Width (mm) | Height (mm) |
|---|---|---|
| 10 new | 123 | 63 |
| 50 new | 135 | 66 |
| 10 old | 137 | 63 |
| 100 new | 142 | 66 |
| 200 new | 146 | 66 |
| 20 old | 147 | 63 |
| 50 old | 147 | 73 |
| 500 new | 150 | 66 |
| 100 old | 157 | 73 |
| 2000 new | 166 | 66 |