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# CHAPTER-01
# INTRODUCTION

In our society, we have people with disabilities. The technology is developing day by day but no significant developments are undertaken for the betterment of these people. Communications between deaf-mute and a normal person has always been a challenging task. It is very difficult for mute people to convey their message to normal people. Since normal people are not trained on hand sign language. In emergency times conveying their message is very difficult. The human hand has remained a popular choice to convey information in situations where other forms like speech cannot be used. Voice Conversion System with Hand Gesture Recognition and translation will be very useful to have a proper conversation between a normal person and an impaired person in any language.

The project aims to develop a system that converts the sign language into a human hearing voice in the desired language to convey a message to normal people, as well as convert speech into understandable sign language for the deaf and dumb. We are making use of a convolution neural network to create a model that is trained on different hand gestures. An app is built which uses this model. This app enables deaf and dumb people to convey their information using signs which get converted to human-understandable language and speech is given as output.

The advances in Machine Learning techniques, intelligence is being added to the products and services we use every day. We routinely speak to voice assistants, use vision processing to identify friends and family in photos, and quietly benefit from behind the algorithms that improve quality and reliability. The communications industry, which was once at the forefront of many of these technologies, is now presented with a plethora of new options for improving existing applications, finding new cost advantages, and redefining existing communications modalities.

This study examines the role of Artificial Intelligence (AI) and Machine Learning in Real Time Communications. It is designed to help product, strategy, and business development decision makes communications service providers, technology vendors, communications-centric app providers, and enterprise information technology organizations.

## 1.1 Project Overview

Have a friend or family member with speech and hearing impairment? Is communicating with such people your daily requirement or you like the idea of having a seamless communication with the especially abled? Well, all you need to do is, download a software on your smartphone, tablet, laptop or PCs and talk away in the sense of fulfillment. This has been made possible by a third-year engineering student at BNMIT who has developed an Artificial Intelligence (AI) powered software application for the welfare of the deaf and mute people. The software, christened

DnD Mate, does not only translate sign language into text and speech, but also translates speech into sign language, all in real time and as quick as the person speaks. Currently, there are no applications/software that facilitates a two-way communication channel.

This easy-to-use innovative digital translator works with your device’s in-built cameras, reads hand and facial gestures by the deaf and mute user and translates them into text and speech. That is not all! The software will also translate your voice or text input into sign language.‘The software is based on a Deep Learning model and can work both offline and online. While in the offline mode, the deaf and mute person can communicate with you on the same device in real time; in the online mode, you can converse sitting in far off places as well, just like you talk to anyone over a video call,’ says Bhargav DV, the third year Electronics and Communication Engineering student at BNMIT.

## 1.2 Purpose

Many of these options are created with the goal of providing independence to those with disabilities. Independent living is often attained by using a combination of technologies. Also, a degree of cooperativeness from an employer often helps a great deal. Under the Americans With Disabilities Act (or ADA), employees can formally request an accommodation using EEOC guidelines either during the application process or at any time while employed. If you are disabled, let your manager or HR person know if you encounter any workplace barriers.

Other adaptive technologies like text-to-speech, on-screen boards, text-to-speech synthesisers, magnification applications, screen readers, electronic pointing devices, alternative keyboards, computers with visual and voice output can help the differently abled interact freely and manage their job roles efficiently.

Many organisations and institutions are now implementing assistive technologies such as automated wheelchairs, automatic flat escalators, sight, and sound technology, and more that help the differently abled to move. Other adaptive technologies like text-to-speech, on-screen boards, text-to-speech synthesisers, magnification applications, screen readers, electronic pointing devices, alternative keyboards, computers with visual and voice output can help the differently abled interact freely and manage their job roles efficiently.

According to the 2011 Census, 36% of the total population of differently abled are employed, which indicates that a huge gap can be filled through social inclusion and a slight tweaking of job roles to empower them and create career opportunities for them. Let’s take a look at a few options.

# CHAPTER-02
# LITERATURE SURVEY

## 2.1 EXISTING PROBLEM

The technology is developing day by day but no significant developments are undertaken for the betterment of these people. Communications between deaf-mute and a normal person has always been a challenging task. It is very difficult for mute people to convey their message to normal people. Since normal people are not trained on hand sign language. In emergency times conveying their message is very difficult. The human hand has remained a popular choice to convey information in situations where other forms like speech cannot be used. Voice Conversion System with Hand Gesture.

## 2.1 REFERENCES

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[9]What is SDN [online]Available at(02/09/2021 23:07)

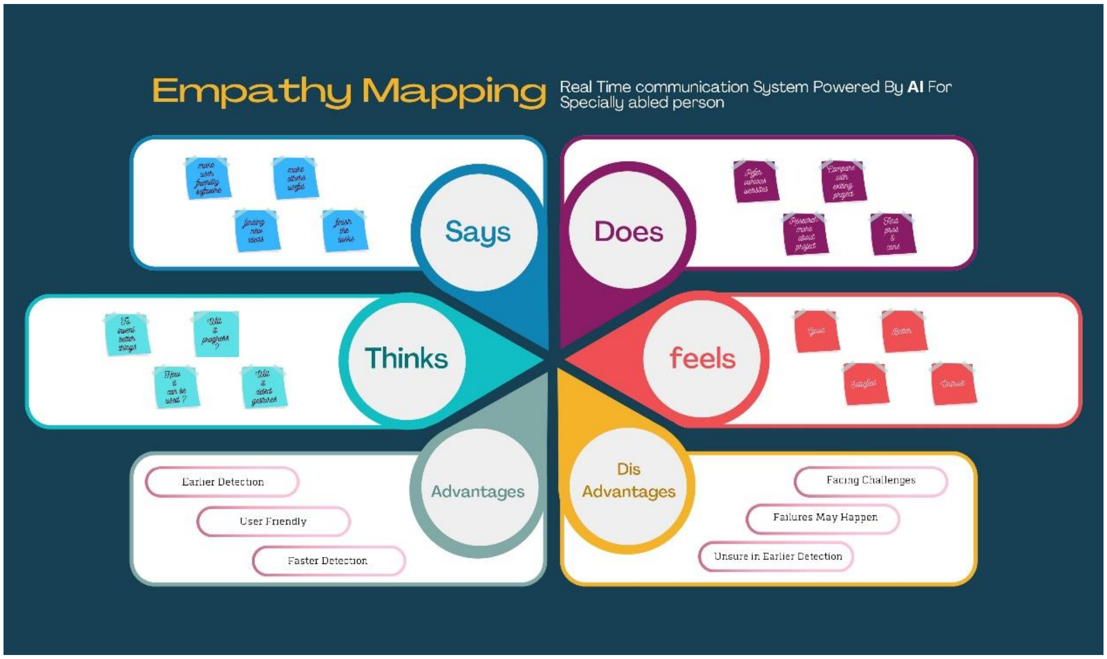
[10]What is Network Function visualization (NFV). [online]Available at< https://www.blueplanet.com/resources/What-is-NFV-prx.html>(02/09/2021 23:58)

## 2.3 PROBLEM STATEMENT DEFINITION

- Many physical and cognitive challenges disabled individuales face at woík and in daily life.
- AI can cíeate life changing oppoítunities foí people with limited vision
- AL poweíed poweíe self díiving caís and otheí foíms of autonomous tíanspoítation incíedible fíeedom of mobility for house
- AL technology helping disabled people opens up new opportunitiesfor accessibility,inclusion in society and indepedent living
- AL voice assisted technologiesm, like Echo,google home etc havecíeated new means of accesibilty foí specially disabled people

# CHAPTER-03
# IDEATION & PROPOSED SOLUTION

## 3.1 EMPATHY MAP CANVAS



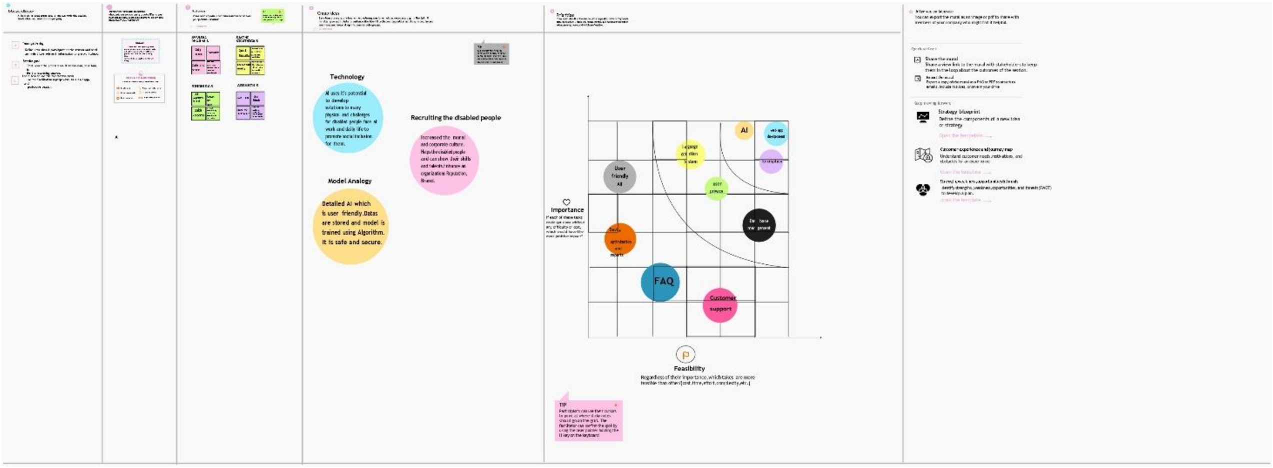
## 3.2 IDEATION & BRAINSTORMING

People nowadays are increasingly paying attention to the safety of their private information when using the internet, as they are terrified by the abuse of private information. To solve the intriguing problem, network security should be improved. Additionally, the moral principles that should be concerned during the designing of communication networks with the help of artificial intelligence are also important. The authority should ensure that individuals ‘rights and interests are inviolable while benefiting from the technology, so it is crucial to investigate which aspects of ethical concerns should be applied. The future research focus of applying AI in communication networks should pay attention to SDN and NFV technologies. Although SDN and NFV are applied in modern society in some instances, the spread of the technologies has to be reinforced to provide a more effective way of communicating. However, the new systems for communicating face problems such as lack of experience and being replaced by updated methods. As people are generally less familiar with the rationales of SDN and NFV, the potential problems are not clearly shown unless more time for application

## 3.3 PROPOSED SOLUTION

AI uses it's potential to develop solutions to many physical and challenges for disabled people face at work and daily life to promote social inclusion for them.Increased the moral and corporate culture. Helps the disabled people and can show their skills and talents.Enhance an organizations Reputation, BrandIncreased the moral and corporate culture. Helps the disabled people and can show their skills and talents.Enhance an organizations Reputation, Brand

## 3.4 PROBLEM STATEMENT FIT


Technology
AI uses it's potential to develop solutions to many physical and challenges for disabled people face at work and daily life to promote social inclusion for them.
Model Analogy
Detailed AI which is user friendly.Datas are stored and model is trained using Algorithm. It is safe and secure.
Recruiting the disabled people
Increased the moral and corporate culture. Helps the disabled people and can show their skills and talents.Enhance an organizations Reputation, Brand.
AI
User friendly AI
FAQ
Customer support
Importance
Feasibility
Regardless of their importance, which takes are more feasible than others? (cost, time, effort, complexity, etc.)
TIP

# CHAPTER-04

# REQUIREMENT ANALYSIS

## 4.1 FUNCTIONAL REQUIREMENTS

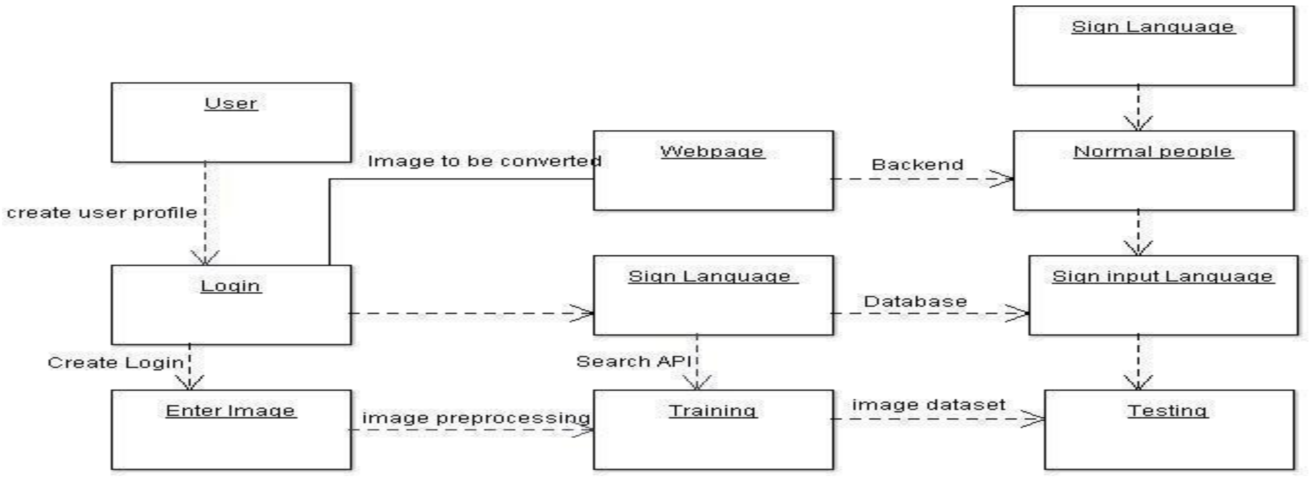
| | **Functional Requirement (Epic)** | **Sub Requirement (Story / Sub-Task)** |
|---|---|---|
| FUNCR-1 | User Registration | **LOW VISION:**<br>As a user who has trouble reading due to low vision, I want to be able to make the text larger on the screen so that I can read it.<br>**Registration through Gmail** |
| FUNCR-2 | User Confirmation | **IMPAIRED USER:**<br>As a user who is hearing -impaired, I want a turn on video captions so that I can understand what is being said in videos.<br>**Confirmation via Email** |
| FUNCR-3 | User Registration | **COLOR BLINDNESS**:<br>As a user who is color blind, I want to links to be distinguishable on the page so that I can find the links and navigate the site.<br>**Registration through Gmail** |

## 4.2 NON-FUNCTIONAL REQUIREMENTS

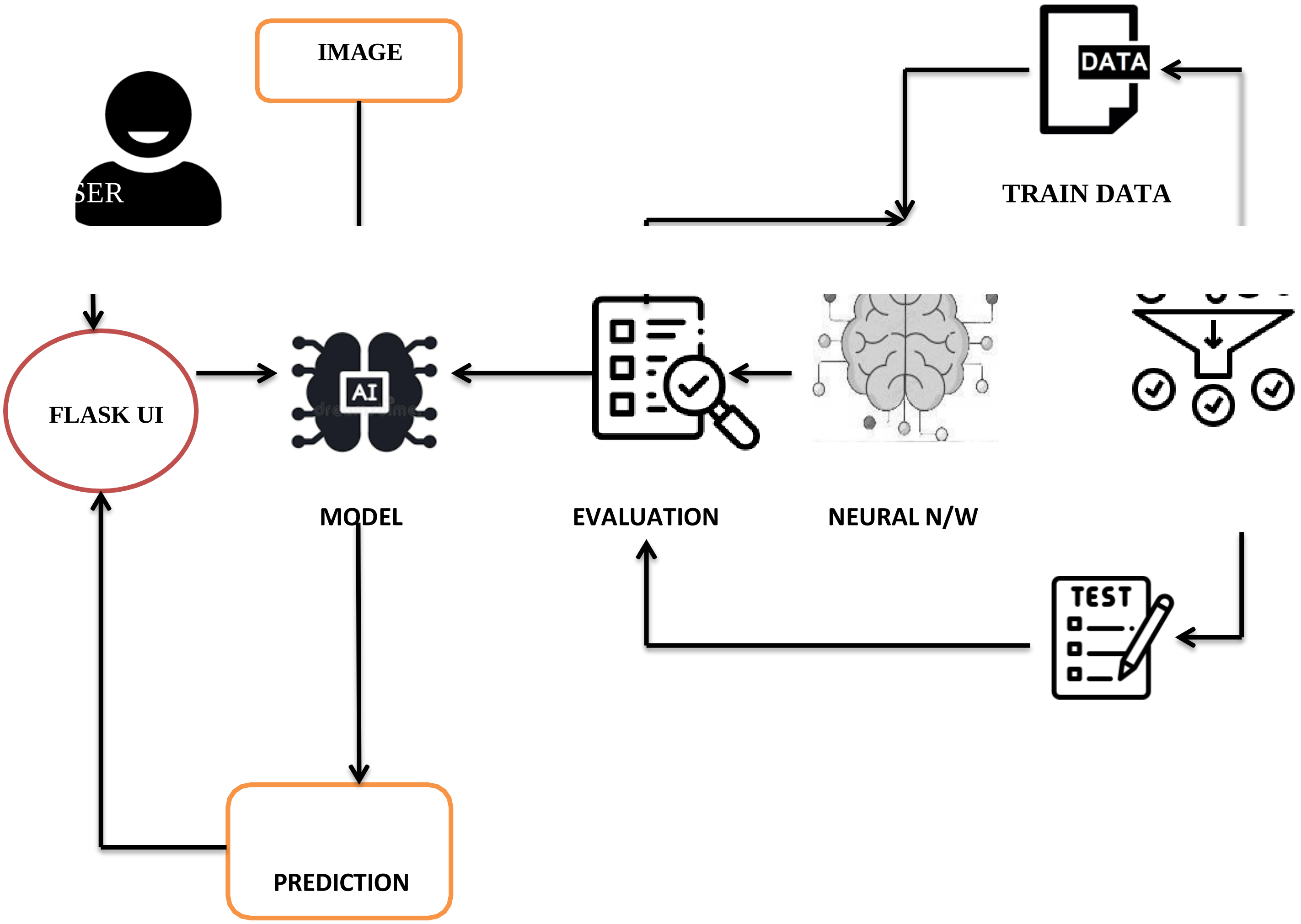
| FR No. | Non-Functional Requirement | Description |
|---|---|---|
| NF-1 | **Usability** | • Visual and Audio Help<br>• Text size scaling<br>• Reverse contrast |
| NF-2 | **Security** | Important information:<br>• Walking in single file or in narrow space.<br>• Steps, Stairs and Slope.<br>• Kerbs and Roads. |
| NF-3 | **Reliability** | To determine reliability measures are:<br>• Test-Retest Repeatability<br>• Individual Repeatability |
| NF-4 | **Performance** | To determine predictors of success in reading with low vision aids, in terms of reading acuity, optimum Acuity reserve, and maximum reading speed, for observers with low vision for various causes. |
| NF-5 | **Availability** | Lack of adequate low vision services and barriers to their provision and uptake impact negatively on efforts to prevent visual impairment and blindness. |
| NF-6 | **Scalability** | There is a large selection of device to help people with low vision. Some are "Optical", glass lenses such as magnifying glasses and telescopes. |

# CHAPTER-05
# PROJECT DESIGN

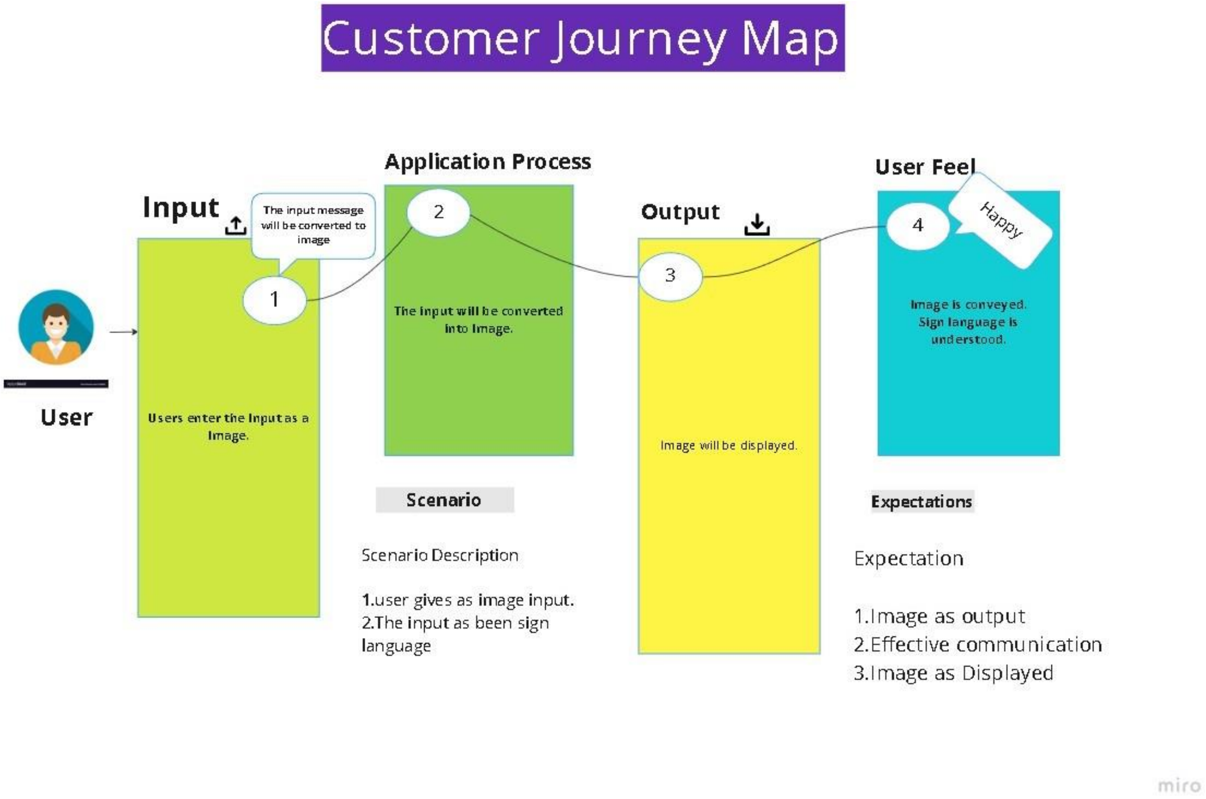
## 5.1 DATA FLOW DIAGRAMS



## 5.2 SOLUTION & TECHNICAL ARCHITECTURE



## 5.3 USER STORIES


Customer Journey Map
Input
The input message will be converted to image
1
Users enter the input as a Image.
User
Application Process
2
The input will be converted into Image.
Scenario
Scenario Description
1.user gives as image input.
2.The input as been sign language
Output
3
Image will be displayed.
User Feel
4
Happy
Image is conveyed. Sign language is understood.
Expectations
Expectation
1.Image as output
2.Effective communication
3.Image as Displayed
miro

# CHAPTER-06
# PROJECT PLANNING & SCHEDULING

## 6.1 SPRINT PLANNING AND ESTIMATION

All the required datasets are collected and documented.

Dataset Details

Source: Kaggle (https://www.kaggle.com/datasets/ahmedkhanak1995/sign-language-gesture-images-dataset)

| Class | Number of Images |
|---|---|
| 0 | 1500 images |
| 1 | 1500 images |
| 2 | 1500 images |

| | |
|---|---|
| 3 | 1500 images |
| 4 | 1500 images |
| 5 | 1500 images |
| 6 | 1500 images |
| 7 | 1500 images |
| 8 | 1500 images |
| 9 | 1500 images |
| A | 1500 images |
| B | 1500 images |
| C | 1500 images |
| D | 1500 images |
| E | 1500 images |
| F | 1500 images |
| G | 1500 images |
| H | 1500 images |
| I | 1500 images |
| J | 1500 images |
| K | 1500 images |
| L | 1500 images |
| M | 1500 images |
| N | 1500 images |
| O | 1500 images |
| P | 1500 images |
| Q | 1500 images |
| R | 1500 images |
| S | 1500 images |
| T | 1500 images |
| U | 1500 images |
| V | 1500 images |
| W | 1500 images |
| X | 1500 images |
| Y | 1500 images |
| Z | 1500 images |
| Space | 1500 images |

## 6.2 SPRINT DELIVERY SCHEDULE

The first step in the sprint planning process. During this step, the team selects the amount of workit can deliver from the prioritized backlog, and using historical velocity as a guide, determines how much to schedule in each sprint.

You can schedule a sprint from the **Sprint Scheduling** page. From this page, you can view sprint details and schedules for individual teams, schedules across all teams for a selected project, including the following summary information:

- Sprint start and end dates
- Cumulative estimate for each sprint (and progress bars showing amount of work completed for active sprints)
- Number of stories and defects to be worked during the sprint with their estimates

Closed Sprints and their detaStay on track of sprint goals and improve retrospectives with data scrum teams can put to use sprint over sprint.

## 6.3 REPORTS FROM JIRA

**Sprint report**

Determine overcommittment and excessive scope creep and understand completed work in each sprint.

**Burndown chart**

Track progress towards sprint goals to manage progress and respond accordingly.

**Release burndown**

Track and monitor the projected release date for versions and take action if work is falling behind Projected schedule.

**Velocity chart**

Track work from sprint to sprint to helps teams determine the velocity and better estimate thework a team realistically achieve in future sprints.

### Optimize kanban flow for continuous delivery

Better predict future performance and spot bottlenecks with agile reports for kanban teams.

### Cumulative flow diagram

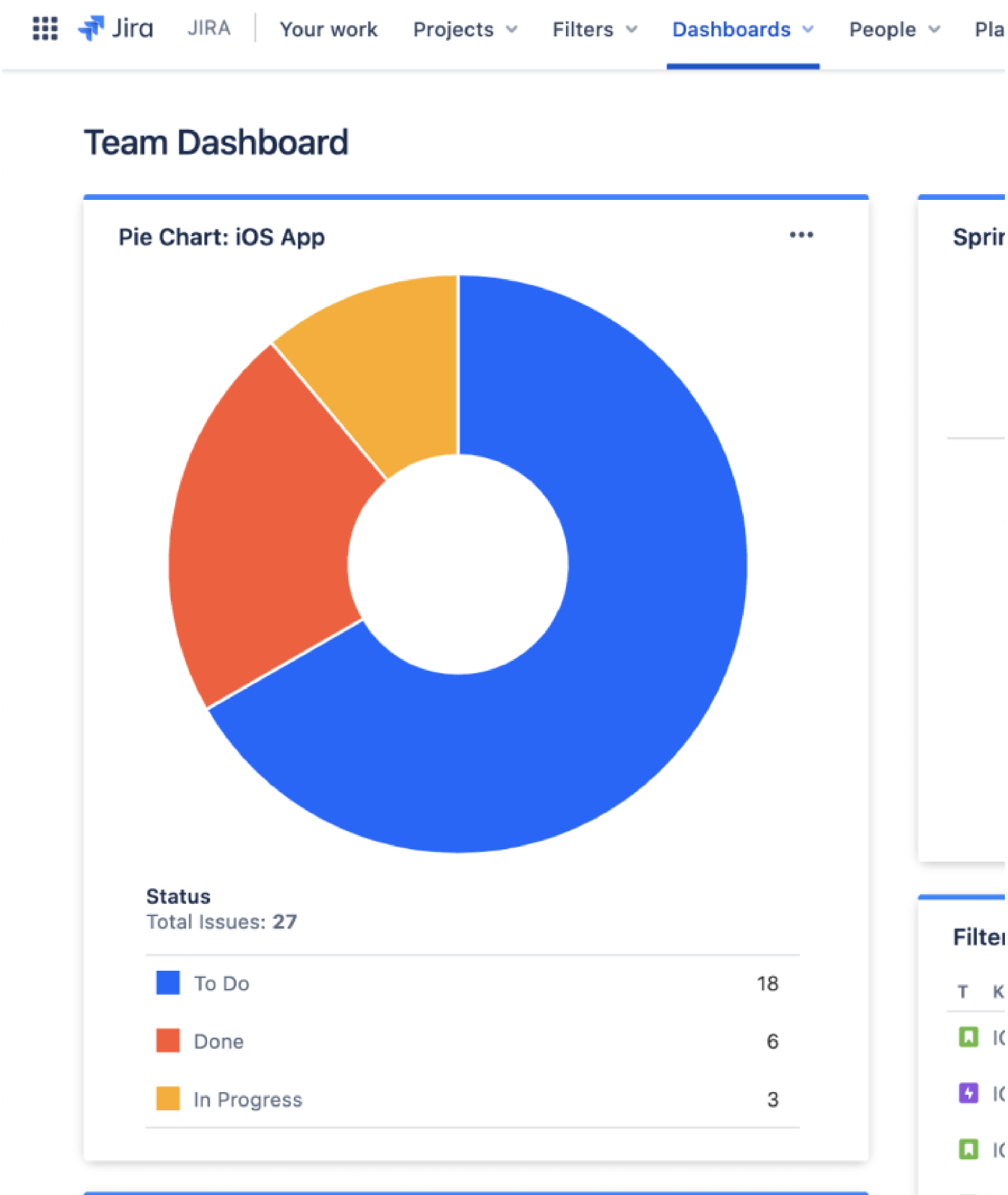
Easily spot blockages by seeing the number of issues that increase in any given state.

### Control chart

Determine future performance with cycle and lead times for your product, version, or sprint

### Work management made easier with Jira reports

Identify trends and work smarter, with out-of-the-box reports for issue analysis and forecastingin Jira Software



Team Dashboard

Pie Chart: iOS App

Status
Total Issues: 27

| | | |
|---|---|---|
| 🟦 | To Do | 18 |
| 🟥 | Done | 6 |
| 🟨 | In Progress | 3 |

# CHAPTER-07
# CODING AND SOLUTIONING

## 7.1 FEATURE 1

### A method for solving problems

This method is from the book *How to Solve It* by George Pólya. It originally came out in 1945 and has sold over one million copies.

His problem-solving method has been used and taught by many programmers, from computer science professors (see Udacity's Intro to CS course taught by professor David Evans) to modern web development teachers like Colt Steele.

Let's walk through solving a simple coding problem using the four-step problem-solving method. This allows us to see the method in action as we learn it. We'll use JavaScript as our language of choice. Here's the problem:

Create a function that adds together two numbers and returns that value.
There are four steps to the problem-solving method:

1. Understand the problem.
2. Devise a plan.
3. Carry out the plan.
4. Look back.

## 7.2 FEATURE 2

### Step 1: Understand the problem.

When given a coding problem in an interview, it's tempting to rush into coding. This is hard to avoid, especially if you have a time limit.

However, try to resist this urge. Make sure you actually understand the problem before you get started with solving it.

Read through the problem. If you're in an interview, you could read through the problem out loud if that helps you slow down.

As you read through the problem, clarify any part of it you do not understand. If you're in an interview, you can do this by asking your interviewer questions about the problem description. If you're on your own, think through and/or Google parts of the question you might not understand

**This first step is vital as we often don't take the time to fully understand the problem. When you don't fully understand the problem, you'll have a much harder time solving it.**

To help you better understand the problem, ask yourself:

**What are the inputs?**

What kinds of inputs will go into this problem? In this example, the inputs are the arguments that our function will take.

Just from reading the problem description so far, we know that the inputs will be numbers. But to be more specific about what the inputs will be, we can ask:

Will the inputs always be just two numbers? What should happen if our function receives as input *three* numbers?

Here we could ask the interviewer for clarification, or look at the problem description further.

The coding problem might have a note saying, "You should only ever expect two inputs into the function." If so, you know how to proceed. You can get more specific, as you'll likely realize that you need to ask more questions on what kinds of inputs you might be receiving.

Will the inputs always be numbers? What should our function do if we receive the inputs "a" and "b"? Clarify whether or not our function will always take in numbers.

Optionally, you could write down possible inputs in a code comment to get a sense of what they'll look like:

```
//inputs: 2, 4
```

Next, ask:

**What are the outputs?**

What will this function return? In this case, the output will be one number that is the result of the two number inputs. Make sure you understand what your outputs will be.

### Create some examples.

Once you have a grasp of the problem and know the possible inputs and outputs, you can start working on some concrete examples.

Examples can also be used as sanity checks to test your eventual problem. Most code challenge editors that you'll work in (whether it's in an interview or just using a site like Codewars or HackerRank) have examples or test cases already written for you. Even so, writing out your own examples can help you cement your understanding of the problem.

Start with a simple example or two of possible inputs and outputs. Let's return to our addition function.

Let's call our function "add."

What's an example input? Example input might be:

```
// add(2, 3)
```

What is the output to this? To write the example output, we can write:

```
// add(2, 3) ---> 5
```

This indicates that our function will take in an input of 2 and 3 and return 5 as its output.

### Create complex examples.

By walking through more complex examples, you can take the time to look for edge cases you might need to account for.

For example, what should we do if our inputs are strings instead of numbers? What if we have as input two strings, for example, add('a', 'b')?

Your interviewer might possibly tell you to return an error message if there are any inputs that are not numbers. If so, you can add a code comment to handle this case if it helps you remember you need to do this.

```
// return error if inputs are not numbers.
```

Your interviewer might also tell you to assume that your inputs will always be numbers, inwhich case you don't need to write any extra code to handle this particular input edge case.

If you don't have an interviewer and you're just solving this problem, the problem might say what happens when you enter invalid inputs.

For example, some problems will say, "If there are zero inputs, return undefined." For cases like this, you can optionally write a comment.

```
// check if there are no inputs.

// If no inputs, return undefined.
```

For our purposes, we’ll assume that our inputs will always be numbers. But generally, it’s good to think about edge cases.

Computer science professor Evans says to write what developers call *defensive* code. Think about what could go wrong and how your code could defend against possible errors.

Before we move on to step 2, let’s summarize step 1, understand the problem:

```
-Read through the problem.

-What are the inputs?

-What are the outputs?

Create simple examples, then create more complex ones.
```

## 2. Devise a plan for solving the problem.

Next, devise a plan for how you’ll solve the problem. As you devise a plan, write it out in pseudocode.

Pseudocode is a plain language description of the steps in an algorithm. In other words, your pseudocode is your step-by-step plan for how to solve the problem.

Write out the steps you need to take to solve the problem. For a more complicated problem, you’d have more steps. For this problem, you could write:

```
// Create a sum variable.

Add the first input to the second input using the addition operator.

// Store value of both inputs into sum variable.

// Return as output the sum variable.
```

Now you have your step-by-step plan to solve the problem.

For more complex problems, professor Evans notes, “Consider systematically how a human solves the problem.” That is, forget about how your code might solve the problem for a moment, and think about how *you* would solve it as a human. This can help you see the steps more clearly.

## 3. Carry out the plan (Solve the problem!)

The next step in the problem-solving strategy is to solve the problem. Using your pseudocode asyour guide, write out your actual code.

Professor Evans suggests focusing on a simple, mechanical solution. The easier and simpler your solution is, the more likely you can program it correctly.

Taking our pseudocode, we could now write this:

```
function add(a, b) {
 const sum = a + b;
 return sum;

}
```

Professor Evans adds, remember not to *prematurely optimize.* That is, you might be tempted to start saying, “Wait, I’m doing this and it’s going to be inefficient code!”

First, just get out your simple, mechanical solution.

**Step 4: Look back over what you've done.**

Once your solution is working, take the time to reflect on it and figure out how to make improvements. This might be the time you refactor your solution into a more efficient one.

As you look at your work, here are some questions Colt Steele suggests you ask yourself tofigure out how you can improve your solution:

- Can you derive the result differently? What other approaches are there that are viable?
- Can you understand it at a glance? Does it make sense?
- Can you use the result or method for some other problem?
- Can you improve the performance of your solution?
- Can you think of other ways to refactor?
- How have other people solved this problem?

One way we might refactor our problem to make our code more concise: removing our variable and using an implicit return:

```
function add(a, b) {
 return a + b;

}
```

With step 4, your problem might never feel finished. Even great developers still write code that they later look at and want to change. These are guiding questions that can help you.

If you still have time in an interview, you can go through this step and make your solution better. If you are coding on your own, take the time to go over these steps.

When I'm practicing coding on my own, I almost always look at the solutions out there that are more elegant or effective than what I've come up with.

## 7.3 DATABASE SCHEMA

The Aito database schema is a description of how the database is constructed and internally processed. A schema contains the information of:

- The name of the tables
- The name and the ColumnType of the columns in each table
- The Analyzer of a column if needed
- The relationships (links) between tables

The Aito database requires a defined schema before executing other operations. The schema is defined in the JSON format and populate to Aito using the Schema API Endpoint.

# CHAPTER-08
# TESTING

## 8.1 TEST CASES

| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task |
|---|---|---|---|
| Sprint-1 | Data Collection | USN-1 | Collect Dataset . |
| Sprint-1 | Image processing | USN-2 | Image preprocessing |
| Sprint-2 | Model Building | USN-3 | Import the required libraries, add the necessary layers and compile the model |

| | | | | |
|---|---|---|---|---|
| Sprint-2 | CNN MODEL | USN-4 | Training the image classification model using CNN | |
| Sprint-3 | Training and<br>Testing | USN-5 | Training the model and testing themodel's<br>performance | |
| Sprint-4 | Implementation of the application | USN-6 | Converting the input sign language<br>images into English alphabets | |

# CHAPTER-09
# RESULTS

## 9.1 PERFORMANCE METRICS

As a small business owner, you will always want to keep an eye on how your business is performing.

Whether that is keeping an eye on your sales, your customer satisfaction, or even your warehouse efficiency.

A business that is performing well, is a business that is making money.

But how do you measure performance? And what are performance metrics?
Let's take a closer look.

Performance metrics are data used to track processes within a business.

This is achieved using activities, employee behavior, and productivity as key metrics.
These metrics are then used by employers to evaluate performance.

This is in relation to an established goal such as employee productivity or sales objectives.

# CHAPTER-10
# ADVANTAGES & DISADVANTAGES

**Artificial Intelligence is one of the emerging technologies which tries to simulate human reasoning in AI systems.** John McCarthy **invented the term Artificial Intelligence in the year1950.** He said, '**Every aspect of learning or any other feature of intelligence can in principle be soprecisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions, and concepts, solve kinds of problems now reserved for humans, and improve themselves.**'

Artificial Intelligence is the ability of a computer program to learn and think. Everything can beconsidered Artificial intelligence if it involves a program doing something that we would normally think would rely on the intelligence of a human.

The advantages of Artificial intelligence applications are enormous and can revolutionize any professional sector. Let's see some of them

**1) Reduction in Human Error:**

The phrase "**human error**" was born because humans make mistakes from time to time. Computers, however, do not make these mistakes if they are programmed properly. With Artificial intelligence, the decisions are taken from the previously gathered information applyinga certain set of algorithms. So errors are reduced and the chance of reaching accuracy with a greater degree of precision is a possibility.

**Example:** In Weather Forecasting using AI they have reduced the majority of human error.

**2) Takes risks instead of Humans:**

This is one of the biggest advantages of Artificial intelligence. We can overcome many risky limitations of humans by developing an AI Robot which in turn can do the risky things for us.

Let it be going to mars, defuse a bomb, explore the deepest parts of oceans, mining for coal andoil, it can be used effectively in any kind of natural or man-made disasters.

**Example:** Have you heard about the **Chernoby**l nuclear power plant explosion in Ukraine? At that time there were no AI-powered robots that can help us to minimize the effect of radiation bycontrolling the fire in early stages, as any human went close to the core was dead in a matter of minutes. They eventually poured sand and boron from helicopters from a mere distance.

AI Robots can be used in such situations where intervention can be hazardous.

**3) Available 24x7:**

An Average human will work for 4–6 hours a day excluding the breaks. Humans are built in sucha way to get some time out for refreshing themselves and get ready for a new day of work and they even have weekly offed to stay intact with their work-life and personal life. But using AI wecan make machines work 24x7 without any breaks and they don’t even get bored, unlike humans.

**Example:** Education

# CHAPTER-11
# CONCLUSION

Artificial intelligence has the potential to transform all organizations. The process by which this transformation happens can vary, but the steps will tend to follow the roadmap we have listed inthis book. Following all the steps outlined in the previous chapters will enable your organizationto implement and excel in the use of AI technology. AI holds the key to unlocking a magnificentfuture where, driven by data and computers that understand our world, we will all make more informed decisions. These computers of the future will understand not just *how* to turn on the switches but *why* the switches need to be turned on. Even further, they may one day ask us if weneed *switches* at all.

Although AI cannot solve all your organization's problems, it has the potential to completely change how business is done. It affects every sector, from manufacturing to finance, bringing about never before seen increases in efficiency. As more industries adopt and start experimentingwith this technology, newer applications will be invented. AI will bring a change even more widespread and sweeping than the introduction of computing devices. It will change the way we transact, get diagnosed, perform surgeries, and drive our cars. It is already changing industrial processes, medical imaging, financial modeling, and computer vision. We are well on our way totapping into this enormous potential, and as a result, the future holds better decision-making potential and faster,

# CHAPTER-12
# FUTURE SCOPE

The feature scope refers to the extent to which a feature is applied. For example, in a multi-bodypart, we can apply a feature such as an extruded cut and specify which body can be included in the cut and which body should not be included. In our exercise, notice in the drawing provided that there is a hole that goes through bodies 2 and 4 and skips body 3.

To utilize the feature scope, we can follow the same steps as for an extruded boss. However, wewill notice options under the Feature Scope tile in our cut extrude PropertyManager. We can seeoptions highlighted in the screenshot with both the sketch and the other options for the extrudedcut feature. Under the Feature Scope options, we can select the Selected.

# CHAPTER-13
# APPENDIX

To utilize the feature scope, we can follow the same steps as for an extruded boss. However, we will notice options under the Feature Scope tile in our cut extrude PropertyManager. We can seeoptions highlighted in the screenshot with both the sketch and the other options for the extrudedcut feature.

The feature scope refers to the extent to which a feature is applied. For example, in a multi-bodypart, we can apply a feature such as an extruded cut and specify which body can be included in the cut and which body should not be included. In our exercise, notice in the drawing provided that there is a hole that goes through bodies 2 and 4 and skips body 3.

## SOURCE CODE

```
import cv2
import numpy as np
import math
"""
Python 3.7.3 + OpenCV 4.0.0
"""
# initialize weight for running average
aWeight = 0.05

# region of interest (ROI) coordinates
top, right, bottom, left = 100, 400, 300, 600

# initialize num of frames
num_frames = 0
value = (35, 35)

cap = cv2.VideoCapture(0)
_,init = cap.read()
init = cv2.flip(init, 1)
bg = init[top:bottom, right:left].copy().astype("float")
cv2.imshow('bg',init)
threshold=25
```

```
nocount = 0
lastno = False
"""
mhi = np.zeros((bottom-top, left-right), np.float32)
mask = None
orientation = None
retval = 0
"""
cX0, cY0 = None, None
con_mat = [0, 0, 0, 0, 0]

while(cap.isOpened()):
crtno = False
# ret returns True if camera is running, frame grabs each frame of the video feed
ret, frame = cap.read()

# mirror the frame
frame = cv2.flip(frame, 1)

# Recognizing skin color
for i in range(top, bottom):
for j in range(right, left):
b,g,r = frame[i,j]
if(r>95 and g>40 and b>20 and int(max(r,g,b))-int(min(r,g,b))>15 and abs(int(r)-int(g))>15 and r>g and r>b):
frame[i,j] = [0,0,0] #black
roi = frame[top:bottom, right:left]

# convert to grayscale and apply gaussian blur
gray = cv2.cvtColor(roi, cv2.COLOR_BGR2GRAY)
blurred = cv2.GaussianBlur(gray, value, 0)

# calibrate the static background at the beginning
```

```
if num_frames < 30:
cv2.accumulateWeighted(roi, bg, aWeight)
elif num_frames == 30:
print("Initialization Ready!")
else:
# display number of frames
if num_frames % 100 == 30:
print("Frames: ", (num_frames // 100) * 100)
if sum(con_mat) % 100 == 0:
print(con_mat)
# isolate the hand in region of interest
# find the absolute difference between background and current frame
graybg = cv2.cvtColor(init[top:bottom, right:left].copy(), cv2.COLOR_BGR2GRAY)
blrdbg = cv2.GaussianBlur(graybg, value, 0)
diff = cv2.absdiff(blrdbg.astype("uint8"), blurred)

# apply a threshold filter/mask on diff image to get foreground
thresholded = cv2.threshold(diff, threshold, 255, cv2.THRESH_BINARY)[1]
# get the contours in the thresholded frame
cnts, hierarchy = cv2.findContours(thresholded.copy(), cv2.RETR_TREE, cv2.CHAIN_APPROX_NONE)

if len(cnts) != 0:
# get the maximum contour which is the hand
segmented = max(cnts, key=cv2.contourArea)

# finding convex hull
hull = cv2.convexHull(segmented)

# define area of hull and area of hand
areahull = cv2.contourArea(hull)
areacnt = cv2.contourArea(segmented)
```

```
# find the percentage of area not covered by hand in convex hull
arearatio=((areahull-areacnt)/areacnt)*100

# draw contours
drawing = np.zeros(roi.shape,np.uint8)
cv2.drawContours(drawing, [segmented], 0, (0, 255, 0), 0)
cv2.drawContours(drawing, [hull], 0,(0, 0, 255), 0)

# find convex hull
hull = cv2.convexHull(segmented, returnPoints=False)

# find convexity defects
defects = cv2.convexityDefects(segmented, hull)
count_defects = 0
cv2.drawContours(thresholded, cnts, -1, (0, 255, 0), 3)
thumb_angle = 0

# find angle between fingers using trig formulas
for i in range(defects.shape[0]):
s,e,f,d = defects[i,0]

start = tuple(segmented[s][0])
end = tuple(segmented[e][0])
far = tuple(segmented[f][0])

# find length for each side of triangle
a = math.sqrt((end[0] - start[0])**2 + (end[1] - start[1])**2)
b = math.sqrt((far[0] - start[0])**2 + (far[1] - start[1])**2)
c = math.sqrt((end[0] - far[0])**2 + (end[1] - far[1])**2)

# apply cosine rule to find angle
angle = math.acos((b**2 + c**2 - a**2)/(2*b*c)) * 57
```

```
# ignore angles > 105 and highlight rest with red dots
if angle <= 110:
count_defects += 1
cv2.circle(roi, far, 5, [0,0,255], -1)
#dist = cv2.pointPolygonTest(cnt,far,True)

# draw lines from start to end i.e. the convex points (finger tips)
cv2.line(roi,start, end, [0,255,0], 2)
#cv2.circle(roi,far,5,[0,0,255],-1)

# update text and display based on gesture detected
if count_defects == 0 and arearatio<25:
cv2.putText(frame,"Rock", (right, top-5), cv2.FONT_HERSHEY_SIMPLEX, 1, (0,0,0), 2)
"""con_mat[0] += 1
if con_mat[0] == 1:
cv2.imwrite('trial00a.png',frame[top:bottom, right:left])
cv2.imwrite('trial00b.png',thresholded)
print("Mark0", arearatio, count_defects)
"""
elif (count_defects == 2 or count_defects == 1):
if arearatio > 20:
cv2.putText(frame,"L", (right, top-5), cv2.FONT_HERSHEY_SIMPLEX, 1, (0,0,0), 2)
"""con_mat[1] += 1
if con_mat[1] == 1:
cv2.imwrite('trial01a.png',frame[top:bottom, right:left])
cv2.imwrite('trial01b.png',thresholded)
print("Mark1", arearatio, count_defects)
"""
else:
cv2.putText(frame,"Scissors", (right, top-5), cv2.FONT_HERSHEY_SIMPLEX, 1, (0,0,0), 2)
"""
```

```
con_mat[2] += 1
if con_mat[2] == 1:
cv2.imwrite('trial02a.png',frame[top:bottom, right:left])
cv2.imwrite('trial02b.png',thresholded)
print("Mark2", arearatio, count_defects)
"""
elif count_defects == 4:
cv2.putText(frame,"Paper", (right, top-5), cv2.FONT_HERSHEY_SIMPLEX, 1, (0,0,0), 2)
"""con_mat[3] += 1
if con_mat[3] == 1:
cv2.imwrite('trial03a.png',frame[top:bottom, right:left])
cv2.imwrite('trial03b.png',thresholded)
print("Mark3", arearatio, count_defects)
"""
elif count_defects == 4 and arearatio>18: # dynamic gesture - waving
crtno = True
if nocount == 0:
nocount += 1

#mhi = cv2.motempl.updateMotionHistory(thresholded, mhi, num_frames, 5)
#mask, orientation = cv2.motempl.calcMotionGradient(mhi, 0.05, 0.25, apertureSize=5)
#retval = cv2.motempl.calcGlobalOrientation(orientation, mask, mhi, num_frames, 5)

for c in cnts:
# calculate moments for each contour
M = cv2.moments(c)

# calculate x,y coordinate of center
if M["m00"] != 0:
cX0 = int(M["m10"] / M["m00"])
cY0 = int(M["m01"] / M["m00"])
cv2.circle(frame, (cX0, cY0), 5, (255, 255, 255), -1)
```

```
elif nocount < 5:
if lastno:
nocount += 1
else:
nocount = 0
else:
for c in cnts:
# calculate moments for each contour
M = cv2.moments(c)

# calculate x,y coordinate of center
if M["m00"] != 0:
cX1 = int(M["m10"] / M["m00"])
cY1 = int(M["m01"] / M["m00"])
cv2.circle(frame, (cX1, cY1), 5, (255, 255, 255), -1)
if math.sqrt((cX1-cX0)**2 + (cY1-cY0)**2) > 20:
cv2.putText(frame,"No", (right, top-5), cv2.FONT_HERSHEY_SIMPLEX, 1, (0,0,0), 2)
#con_mat[4] += 1
nocount = 0
lastno = False
else:
cv2.putText(frame,"Lavi's Cam", (right, top-5), cv2.FONT_HERSHEY_SIMPLEX, 1, (0,0,0), 2)
"""con_mat[4] += 1
if con_mat[4] == 1:
cv2.imwrite('trial04a.png',frame[top:bottom, right:left])
cv2.imwrite('trial04b.png',thresholded)
print("Mark4", arearatio, count_defects)
"""


#print(nocount, retval)
#print(arearatio, count_defects)
```

```
# draw the segmented region and display the frame after thresholding
cv2.drawContours(frame, [segmented + (right, top)], -1, (0, 0, 255))
cv2.imshow("Thesholded", thresholded)
#lastno = crtno
if num_frames <= 35:
cv2.imwrite('trial00a.png',frame[top:bottom, right:left])
cv2.imwrite('trial00b.png',thresholded)
print("Mark0", arearatio, count_defects)
# draw the ROI
cv2.rectangle(frame, (left, top), (right, bottom), (0,255,0), 2)
cv2.imshow('frame',frame)


num_frames += 1

if cv2.waitKey(1) & 0xFF == ord('q'):
break

cap.release()
cv2.destroyAllWindows()
```

***GITHUB-IBM PROJECT LINK***

- https://github.com/IBM-EPBL/IBM-Project-48840-1660813507