



MARATHWADA MITRA MANDAL'S COLLEGE OF ENGINEERING
Karvenagar, Pune

Group ID: P2

Name of Guide: Prof. Asma Shaikh

**Title of BE-Project: Design & Development of
A System For Polycystic Ovarian Syndrome Detection**

Group members:

Sayali Deodikar - BC114

Shraddha Jadhav - BC122

Aishwarya Joshi - BC123

Sejal Mutakekar - BC142

AGENDA



- Introduction
- Our Aim
- Literature Summary
- System Architecture
- Data Specifications
- Module 1
- Module 2
- Deployment Status
- Demo
- Test Cases
- References



INTRODUCTION

- Polycystic Ovary Syndrome (PCOS) is a hormonal disorder that affects 2 in 10 women at their reproductive age. (18-44 years)
- It can be the primary reason for permanent infertility, and gynaecological cancer if it remains untreated.
- Manual diagnosis of this disease consumes time and can be a challenge for women in underserved areas.



OUR AIM

This motivated us to develop a system for the detection of polycystic ovarian syndrome.

As a part of this project, we aimed to:

- Detect the PCOS from ultrasound images using deep learning
- Provide a symptom-based self-diagnostic PCOS test using semi-supervised machine learning
- Spread awareness about PCOS



LITERATURE SURVEY

Paper name	Authors	Year of publication	Journal name	Inference
PCOS Detection using Machine Learning Algorithms	Kinjal Raut, Chaitrali Katkar, Prof. Dr. Mrs. Suhasini A. Itkar	2022	IRJET	Random Forest, Decision Tree, Support Vector Classifier(SVC), Logistic Regression, K-Nearest Neighbor(KNN). Highest accuracy: 92.64%
Detection of polycystic ovarian syndrome using follicle recognition technique	B. Rachana, T. Priyanka, K.N. Sahana et al	2021	IEEE	Various approaches for segmentation and classification were studied to obtain a model with greater Highest accuracy: 87.27% by decision tree,
Classification of PCOS/PCOD Using Transfer Learning and GAN Architectures to Generate Pseudo Ultrasound Images	Sweta Kumari	2020	IRJET	Author has trained the model with VGG-19, DenseNet-121, ResNet-50 and inception V3 and model stacking,Highest accuracy : 70%, VGG19
Classification of polycystic ovary based on ultrasound images using competitive neural network	Subrato Bharati ¹ , Prajoy Podder, M. Rubaiyat Hossain Mondal	2018	Research Gate	Use of Gabor Wavelet Method of feature selection. Extracts features directly from gray scale images.The highest accuracy obtained was 80.84% with 32 feature vectors.

LITERATURE SURVEY

Paper name	Authors	Year of publication	Journal name	Inference
Detecting PCOS using Machine Learning	Namrata Tanwani	2020	IRJET	KNN and logistic regression model is used for classification PCOS,F1 score is used to choose the model for KNN-0.90 and for logistic regression -0.92 hence Logistic regression is used for classification
Deep Learning Algorithm for Automated Detection of Polycystic Ovary Syndrome Using Scleral Images	Wenqi Lv, Ying Song ^{2†} , Rongxin Fu ¹ ,et al	2022	IRJET	Results show that non-invasive screening method achieved a mean AUC of 98%, a mean accuracy of a dataset that contains 721 subjects
PCOS (POLYCYSTIC OVARIAN SYNDROME) DETECTION USING DEEP LEARNING	Shubham Bhosale, Lalit Joshi, Arun Shivsharanan	2022	IEEE	Author has used DCNN algorithm for detecting the PCOS on the basis of ultrasoung images. Before applying CNN algorithm author has Preprocessed the data with image segmentation which is used for reducing the noise in the image and the Univarient feature selection method used for selecting the most suitable features.
Detection of Polycystic Ovarian Syndrome using Convolutional Neural Networks	Vikas B, Radhika Y, Vineesha K.	2021	IJCR	The authors have followed iterative process. In every iteration they have compared the accuracy with previous iteration.The accuracy significantly improved by 10% from the initial model. The highest accuracy obtained was 94%

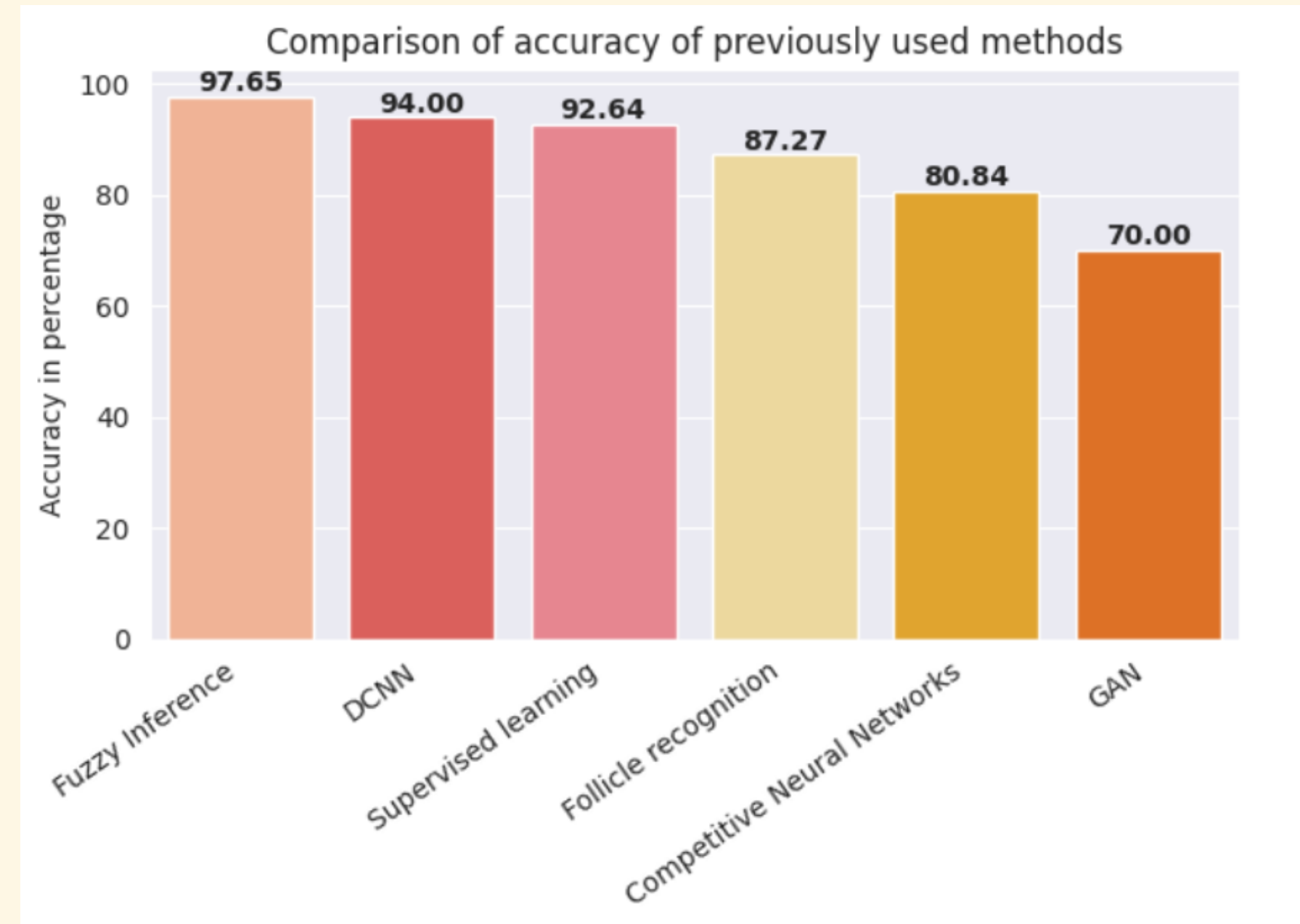
LITERATURE SURVEY

Paper name	Authors	Year of publication	Journal name	Inference
A Novel Approach for Polycystic Ovary Syndrome Prediction Using Machine Learning in Bioinformatics	Shazima Nasim , Mubarak Almutairi , Kashib munir , Ali Raa , Faizan Youna	2022	IEEE	The technique shows that k-folds validation achieved 100% accuracy and the MLP models achieved 99% accuracy and by k-fold 98% accuracy had achieved. The SGD and KNC models achieved the lowest accuracy.
An extended machine learning technique for polycystic ovary syndrome detection using ovary ultrasound image	Sayma Alam Suha and Muhammad Nazrul Islam	2022	Scientific report	The base learner model VGG-16 and meta learner model XGBoost model as image classifier gives the highest accuracy of classification with is 99. 89%. DNN algorithm gives better results. Performance analysis was done on the basis of accuracy,precision, recall, and F1 score.
A Convolutional Neural Network Architecture to Detect Polycystic Ovary Syndrome (PCOS) from Ovarian Ultrasound Images	Shruti Bhargava Choubey	2021	ICEET	The noise was analyzed with a focus on its ill effects in PCOS Images that can lead to the evaluation of diseases. The PCOS test images had some development in most of the parameters in deliberation.
Prediction of PCOS and Mental Health Using Fuzzy Inference and SVM	Ashwini Kodipalli and Susheela Devi	2021	national library-front public health	Naïve bias, Decision tree, and Random forest have an accuracy of 97.65%, 96.27%, and 89.02% respectively. The study proved that 66.07% of women with PCOS have associated mental health issues.

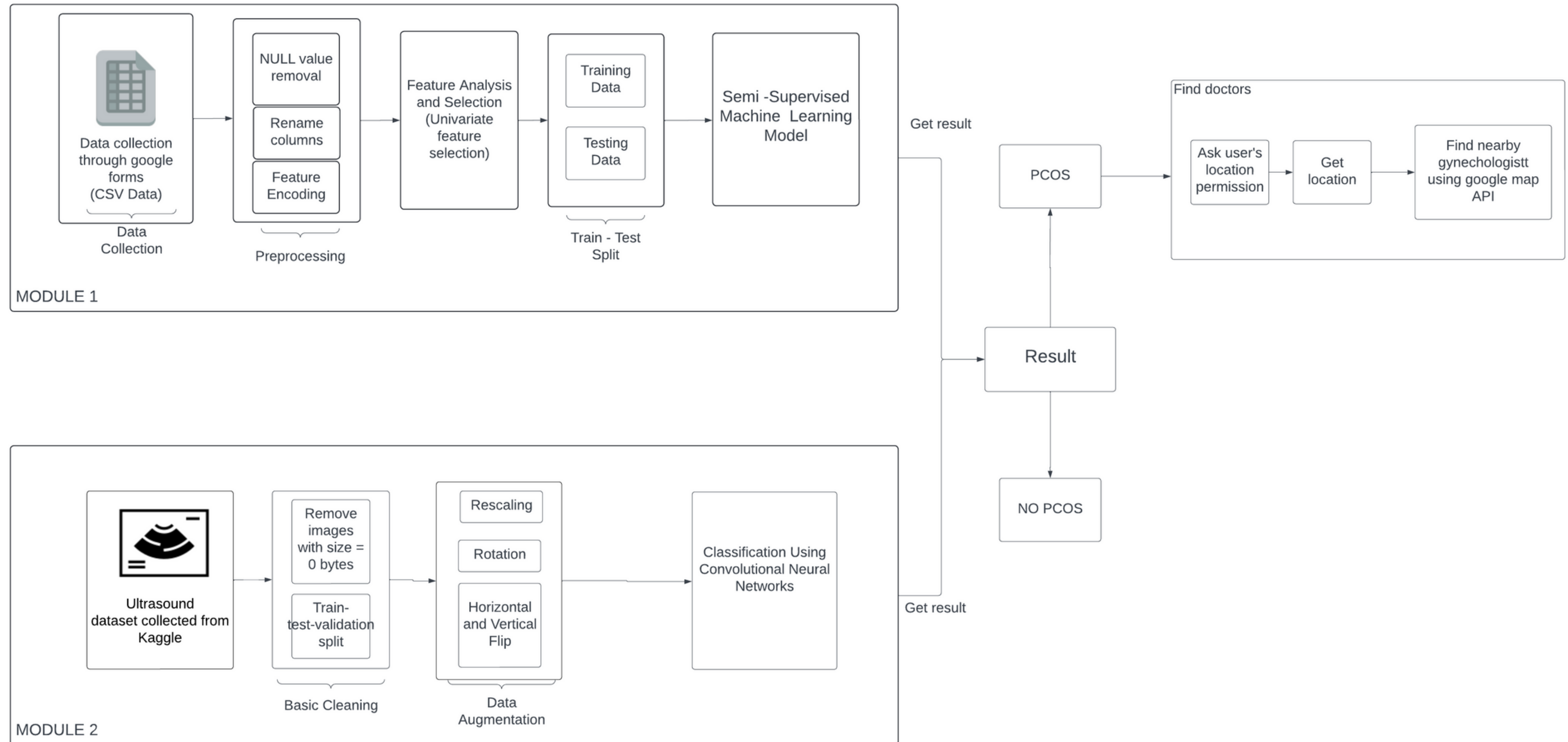
LITERATURE SUMMARY

Key Findings

- The use of selective features leads to better performance.
- Hyperparameter tuning is essential in order to avoid bias in training.
- PCOS is highly associated with menstrual cycle parameters.
- PCOS can affect physical as well as mental health.



SYSTEM ARCHITECTURE



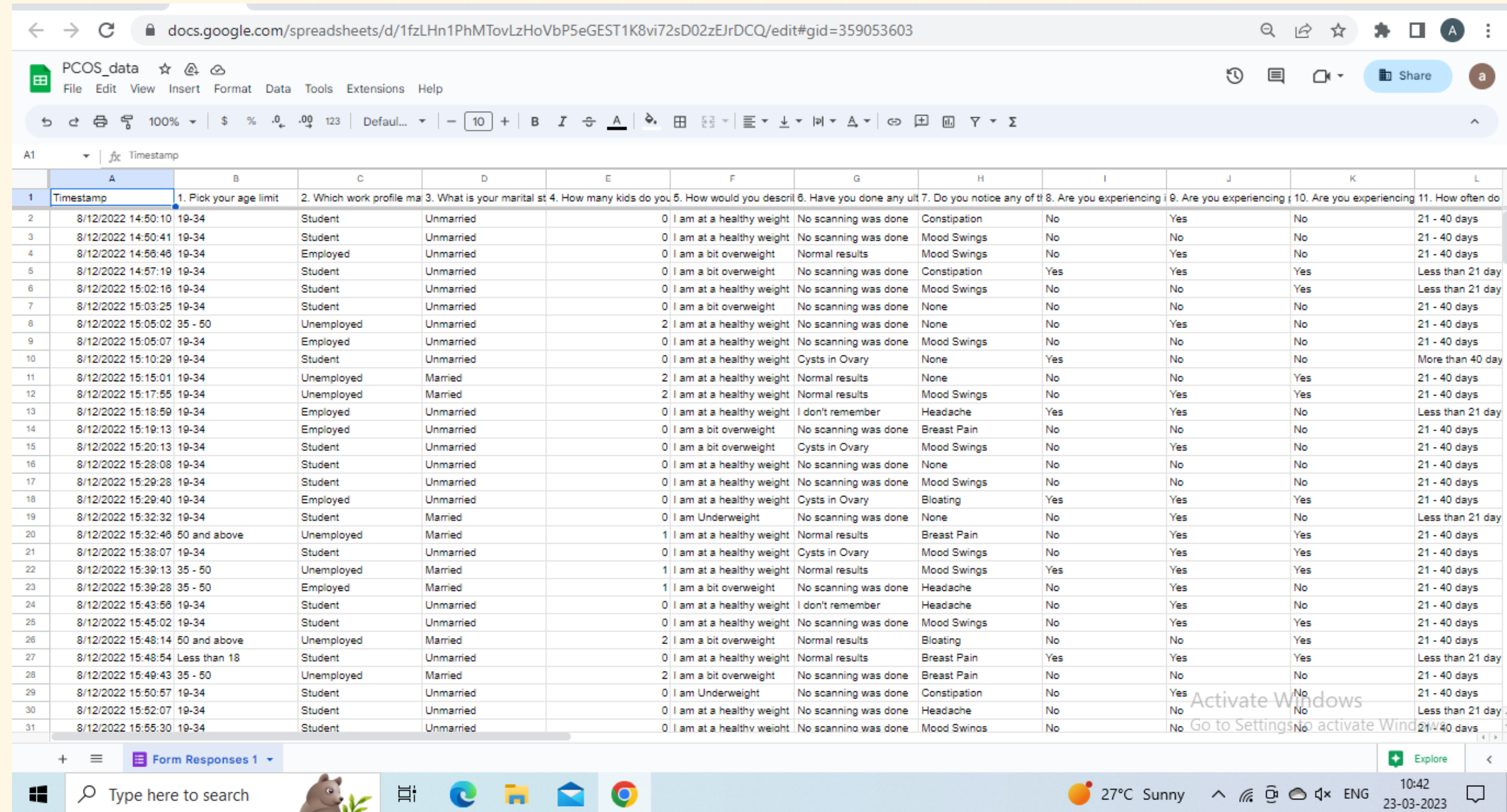
DATASET SPECIFICATIONS

Module 1

- Data values were collected with a Google form, for a symptom-based model
- 23 Questions and 167 Responses

Q: 24. Are you diagnosed with PCOS/PCOD?

- yes
- No
- I dont know

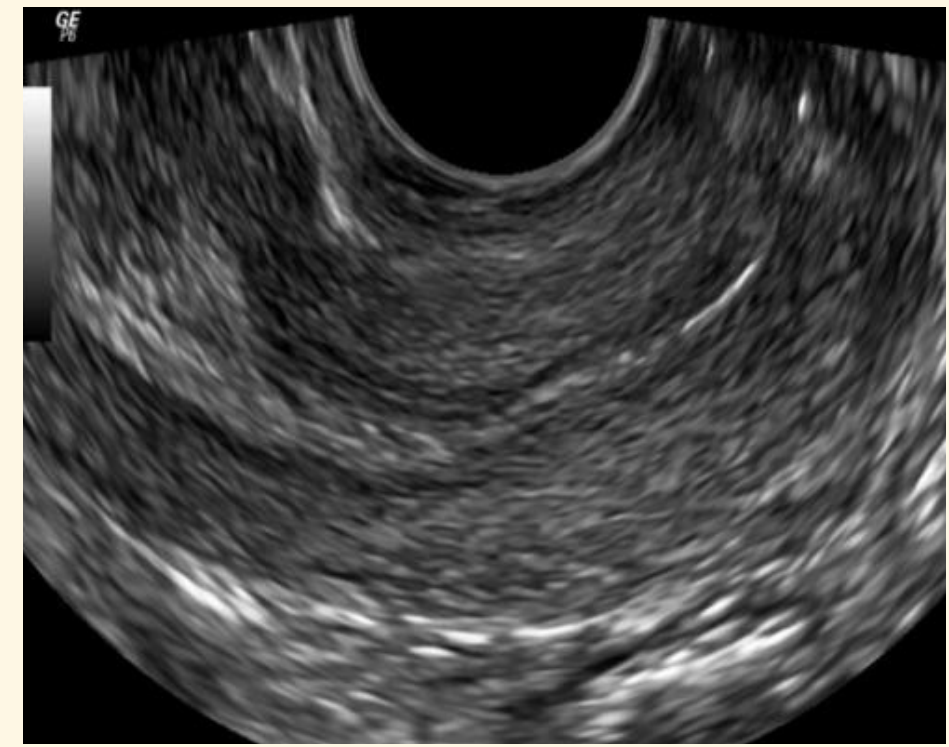
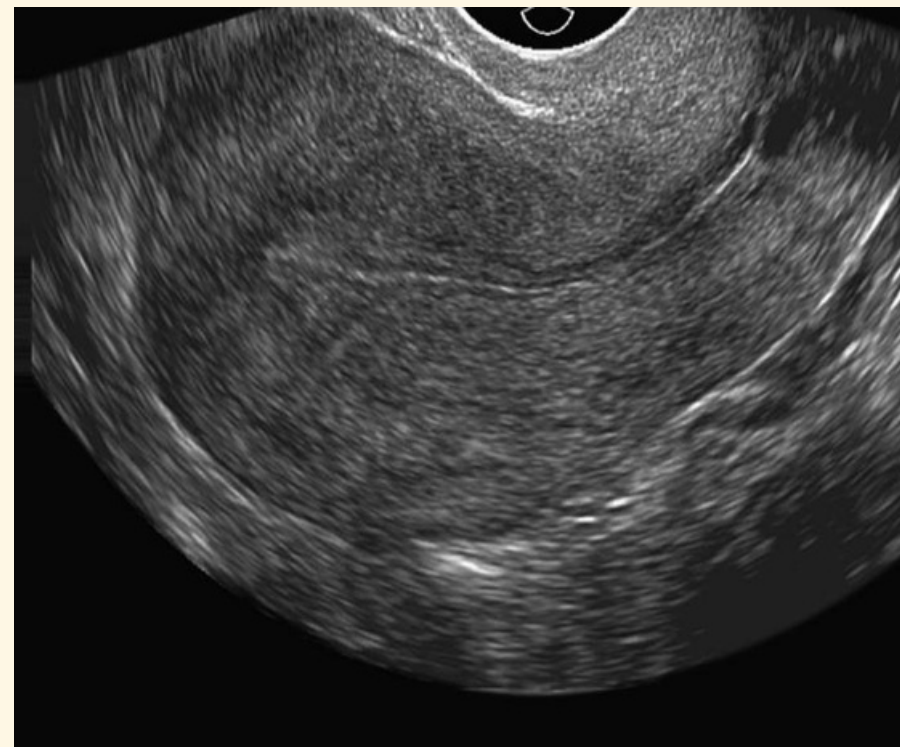


Timestamp	1. Pick your age limit	2. Which work profile mai	3. What is your marital st	4. How many kids do you	5. How would you descri	6. Have you done any ult	7. Do you notice any of th	8. Are you experiencing	9. Are you experiencing	10. Are you experiencing	11. How often do
8/12/2022 14:50:10	19-34	Student	Unmarried	0	I am at a healthy weight	No scanning was done	Constipation	No	Yes	No	21 - 40 days
8/12/2022 14:50:41	19-34	Student	Unmarried	0	I am at a healthy weight	No scanning was done	Mood Swings	No	No	No	21 - 40 days
8/12/2022 14:56:46	19-34	Employed	Unmarried	0	I am a bit overweight	Normal results	Mood Swings	No	Yes	No	21 - 40 days
8/12/2022 14:57:19	19-34	Student	Unmarried	0	I am a bit overweight	No scanning was done	Constipation	Yes	Yes	Yes	Less than 21 day
8/12/2022 15:02:16	19-34	Student	Unmarried	0	I am at a healthy weight	No scanning was done	Mood Swings	No	No	Yes	Less than 21 day
8/12/2022 15:03:25	19-34	Student	Unmarried	0	I am a bit overweight	No scanning was done	None	No	No	No	21 - 40 days
8/12/2022 15:05:02	35 - 50	Unemployed	Unmarried	2	I am at a healthy weight	No scanning was done	None	No	Yes	No	21 - 40 days
8/12/2022 15:05:07	19-34	Employed	Unmarried	0	I am at a healthy weight	No scanning was done	Mood Swings	No	No	No	21 - 40 days
8/12/2022 15:10:29	19-34	Student	Unmarried	0	I am at a healthy weight	Cysts in Ovary	None	Yes	No	No	More than 40 day
8/12/2022 15:15:01	19-34	Unemployed	Married	2	I am at a healthy weight	Normal results	None	No	No	Yes	21 - 40 days
8/12/2022 15:17:55	19-34	Unemployed	Married	2	I am at a healthy weight	Normal results	Mood Swings	No	Yes	Yes	21 - 40 days
8/12/2022 15:18:59	19-34	Employed	Unmarried	0	I am at a healthy weight	I don't remember	Headache	Yes	Yes	No	Less than 21 day
8/12/2022 15:19:13	19-34	Employed	Unmarried	0	I am a bit overweight	No scanning was done	Breast Pain	No	No	No	21 - 40 days
8/12/2022 15:20:13	19-34	Student	Unmarried	0	I am a bit overweight	Cysts in Ovary	Mood Swings	No	Yes	No	21 - 40 days
8/12/2022 15:28:08	19-34	Student	Unmarried	0	I am at a healthy weight	No scanning was done	None	No	No	No	21 - 40 days
8/12/2022 15:29:28	19-34	Student	Unmarried	0	I am at a healthy weight	No scanning was done	Mood Swings	No	No	No	21 - 40 days
8/12/2022 15:29:40	19-34	Employed	Unmarried	0	I am at a healthy weight	Cysts in Ovary	Bloating	Yes	Yes	Yes	21 - 40 days
8/12/2022 15:32:32	19-34	Student	Married	0	I am Underweight	No scanning was done	None	No	Yes	No	Less than 21 day
8/12/2022 15:32:46	50 and above	Unemployed	Married	1	I am at a healthy weight	Normal results	Breast Pain	No	Yes	Yes	21 - 40 days
8/12/2022 15:38:07	19-34	Student	Unmarried	0	I am at a healthy weight	Cysts in Ovary	Mood Swings	No	Yes	Yes	21 - 40 days
8/12/2022 15:39:13	35 - 50	Unemployed	Married	1	I am at a healthy weight	Normal results	Mood Swings	Yes	Yes	Yes	21 - 40 days
8/12/2022 15:39:28	35 - 50	Employed	Married	1	I am a bit overweight	No scanning was done	Headache	No	Yes	No	21 - 40 days
8/12/2022 15:43:56	19-34	Student	Unmarried	0	I am at a healthy weight	I don't remember	Headache	No	Yes	No	21 - 40 days
8/12/2022 15:45:02	19-34	Student	Unmarried	0	I am at a healthy weight	No scanning was done	Mood Swings	No	Yes	Yes	21 - 40 days
8/12/2022 15:48:14	50 and above	Unemployed	Married	2	I am a bit overweight	Normal results	Bloating	No	No	Yes	21 - 40 days
8/12/2022 15:48:54	Less than 18	Student	Unmarried	0	I am at a healthy weight	Normal results	Breast Pain	Yes	Yes	Yes	Less than 21 day
8/12/2022 15:49:43	35 - 50	Unemployed	Married	2	I am a bit overweight	No scanning was done	Breast Pain	No	No	No	21 - 40 days
8/12/2022 15:50:57	19-34	Student	Unmarried	0	I am Underweight	No scanning was done	Constipation	No	Yes	No	21 - 40 days
8/12/2022 15:52:07	19-34	Student	Unmarried	0	I am at a healthy weight	No scanning was done	Headache	No	No	No	Less than 21 day
8/12/2022 15:55:30	19-34	Student	Unmarried	0	I am at a healthv weight	No scanning was done	Mood Swinos	No	No	No	21 - 40 days

DATASET SPECIFICATIONS

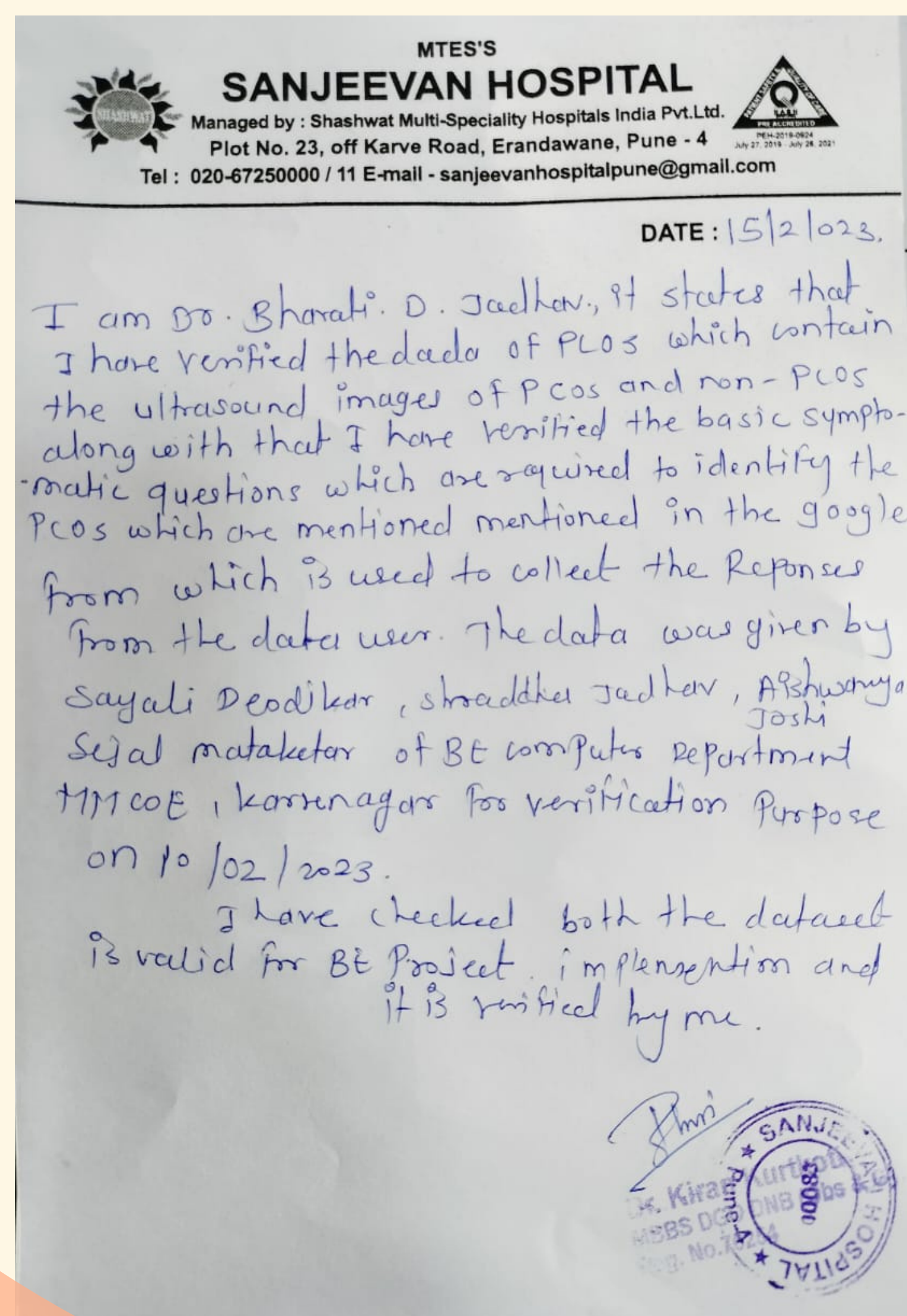
Module 2

- Infected class - 1,562 images (Net-like structure in ovaries)
- Non-infected class- 2,284 images (Healthy Ovaries)



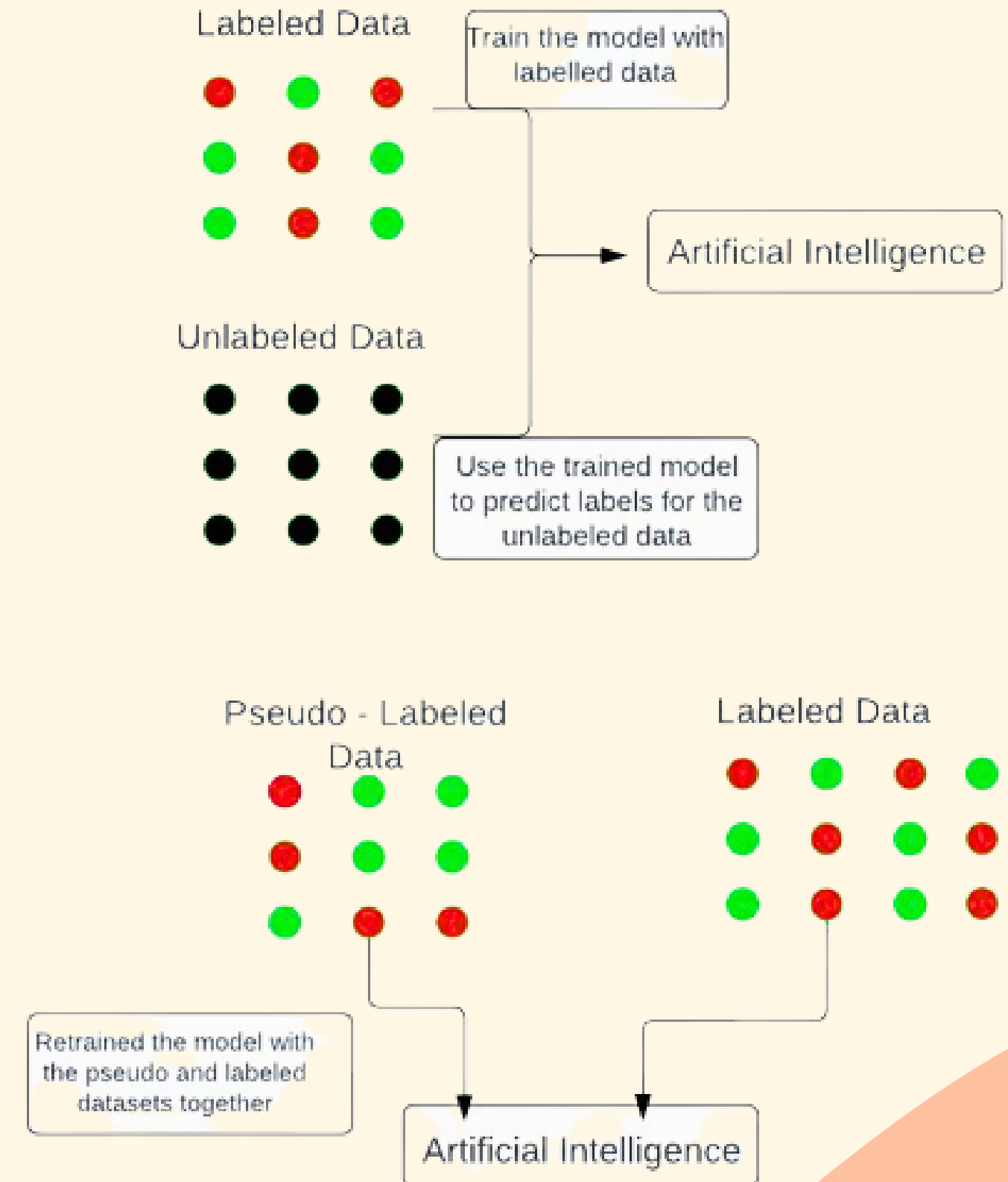
Dataset Verified by Gynaechologist

**By Dr. Bharti D. Jadhav from
Sanjeevan Hospital, Pune**



MODULE I - SELF DIAGNOSTIC TEST

- Semi-supervised machine learning-based model.
- Pseudo-labeling, a technique of semi-supervised learning, is the process of using the labeled data model to predict labels for unlabelled data.
- First, a model is trained with the dataset containing labels, and that model is used to generate pseudo labels for the unlabelled dataset. Finally, both the datasets and labels(original labels and pseudo labels) are combined for a final model training.



MODULE I - SELF DIAGNOSTIC TEST

Top 5 Features :

S. No	Feature	Correlation
1	Regular Period	0.528616
2	Period Cycle	0.572458
3	Period Pain Scale	0.351006
4	Excess Hair Growth	0.314092
5	Stress	0.316228

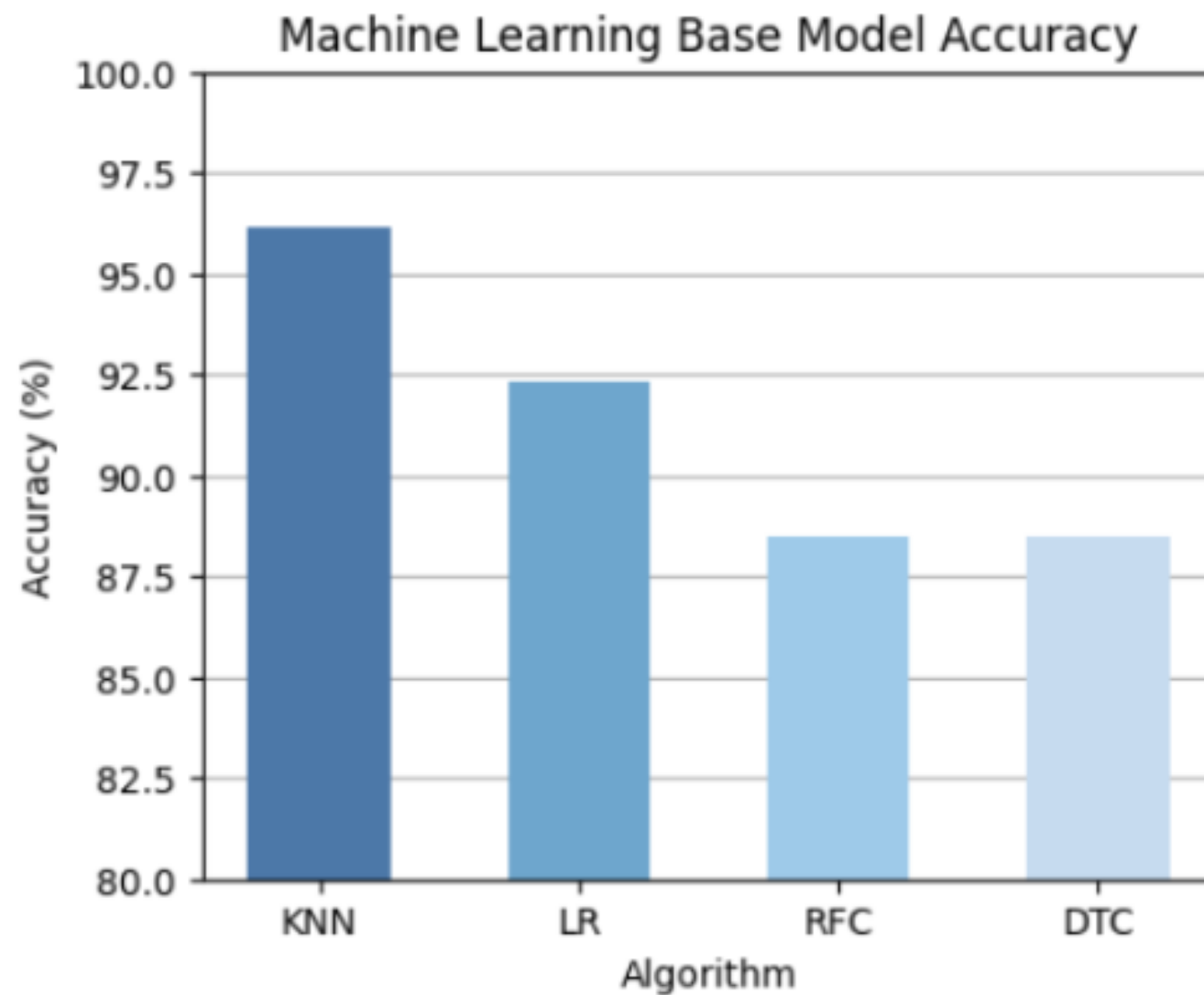
Algorithms :

1. Logistic Regression
2. K-Nearest Neighbour
3. Decision Tree
4. Random Forest

MODULE I - SELF DIAGNOSTIC TEST

RESULTS

Base Model :



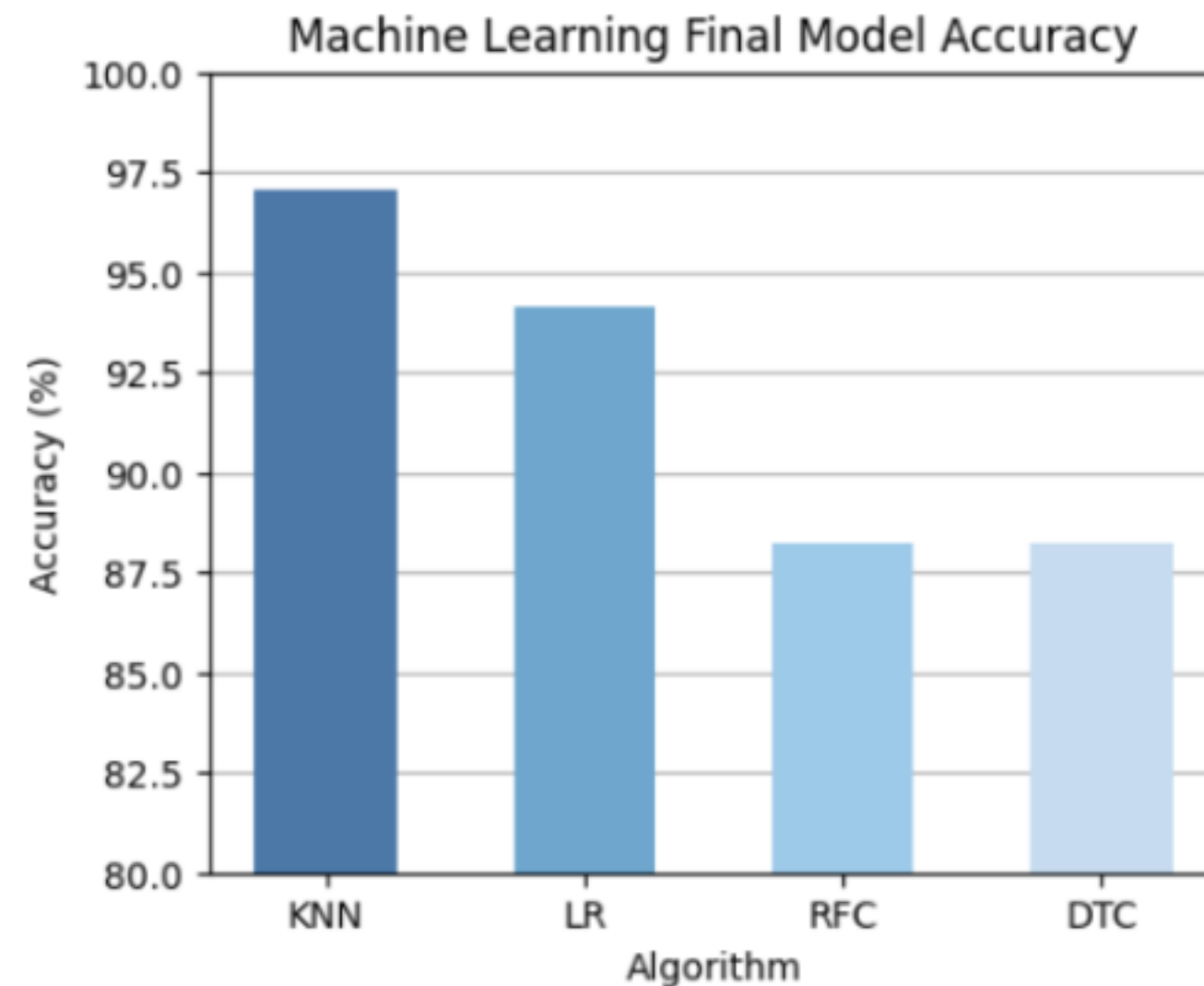
	Algorithm	Accuracy
0	KNN	96.15
1	Logistic Regression	92.31
2	Random Forest Classifier	88.46
3	Decision Tree Classifier	88.46

For the base model, the KNN algorithm is selected as it provided the highest accuracy of 96.15%

MODULE I - SELF DIAGNOSTIC TEST

RESULTS

Final Model :



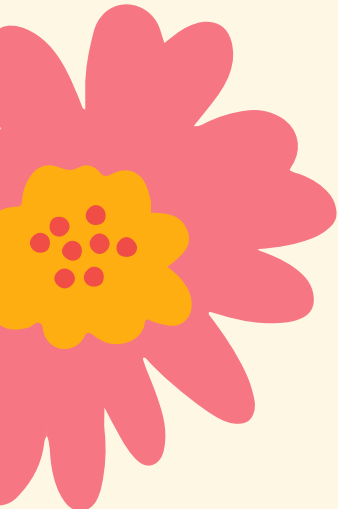
	Algorithm	Accuracy
0	KNN	97.06
1	Logistic Regression	94.12
2	Random Forest Classifier	88.24
3	Decision Tree Classifier	88.24

For the final model, KNN algorithm is selected as it provided the highest accuracy of 97.06%

MODULE I - SELF DIAGNOSTIC TEST

RESULTS

KNN Classification Report :



KNN:		precision	recall	f1-score	support
	0	0.97	1.00	0.98	31
	1	1.00	0.67	0.80	3
	accuracy			0.97	34
	macro avg	0.98	0.83	0.89	34
	weighted avg	0.97	0.97	0.97	34

The classification report shows the precision, recall, f1-score, and support for the KNN algorithm, where 0 denotes PCOS negative and 1 denotes PCOS positive with the accuracy of 97.06%

MODULE II - ULTRASOUND TEST



- Deep learning-based model.
- Category of Machine Learning
- Based on Neural Networks - Mimics human brain behavior
- Model training - Dataset containing 'Ultrasound Images'
- Dataset has been validated by doctors.
- Algorithms - CNN (Convolutional Neural Networks)
 - VGG16 (Visual Geometry 16)
 - Resnet50 (Residual Network 50)
 - InceptionV3

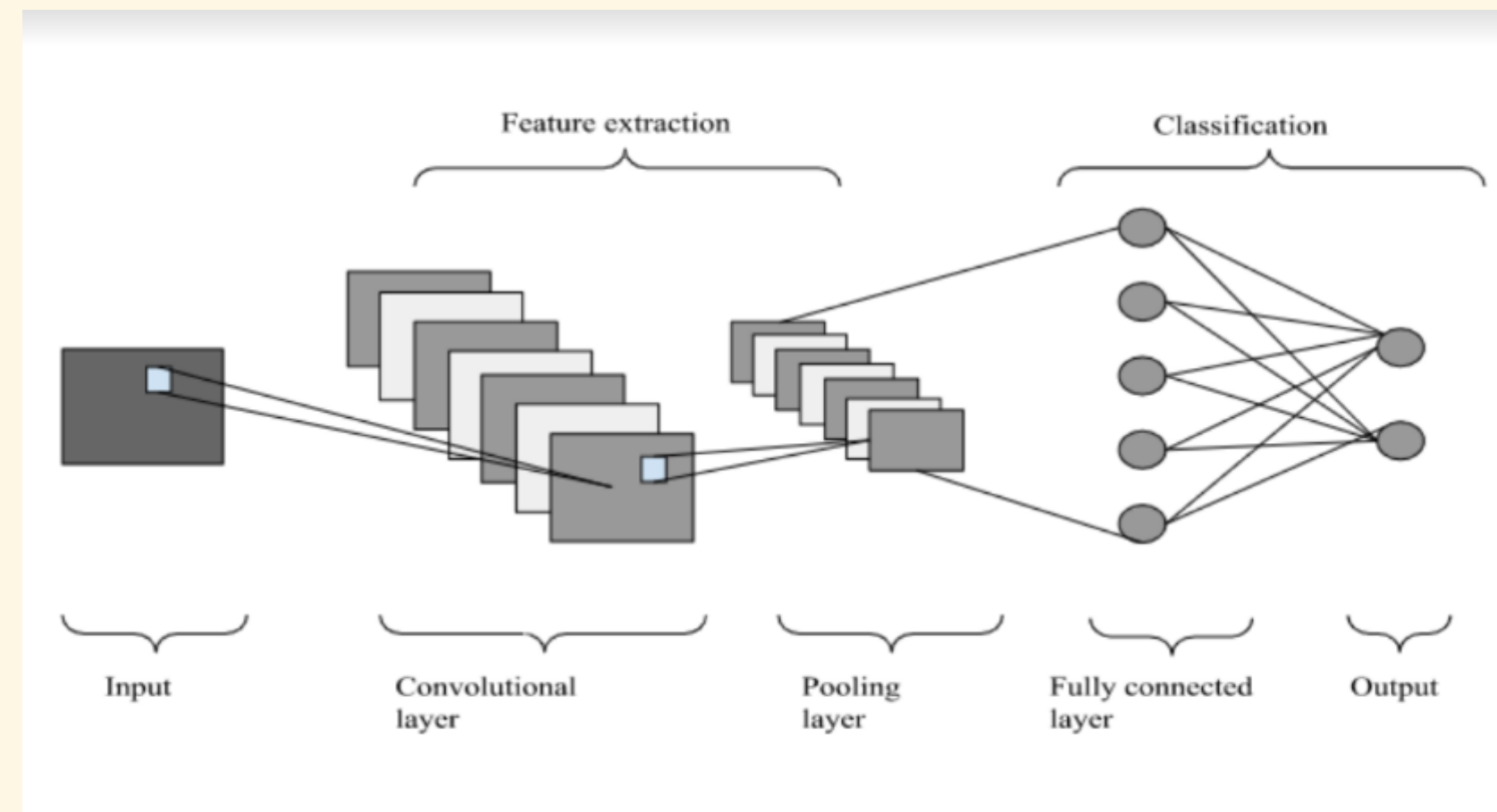
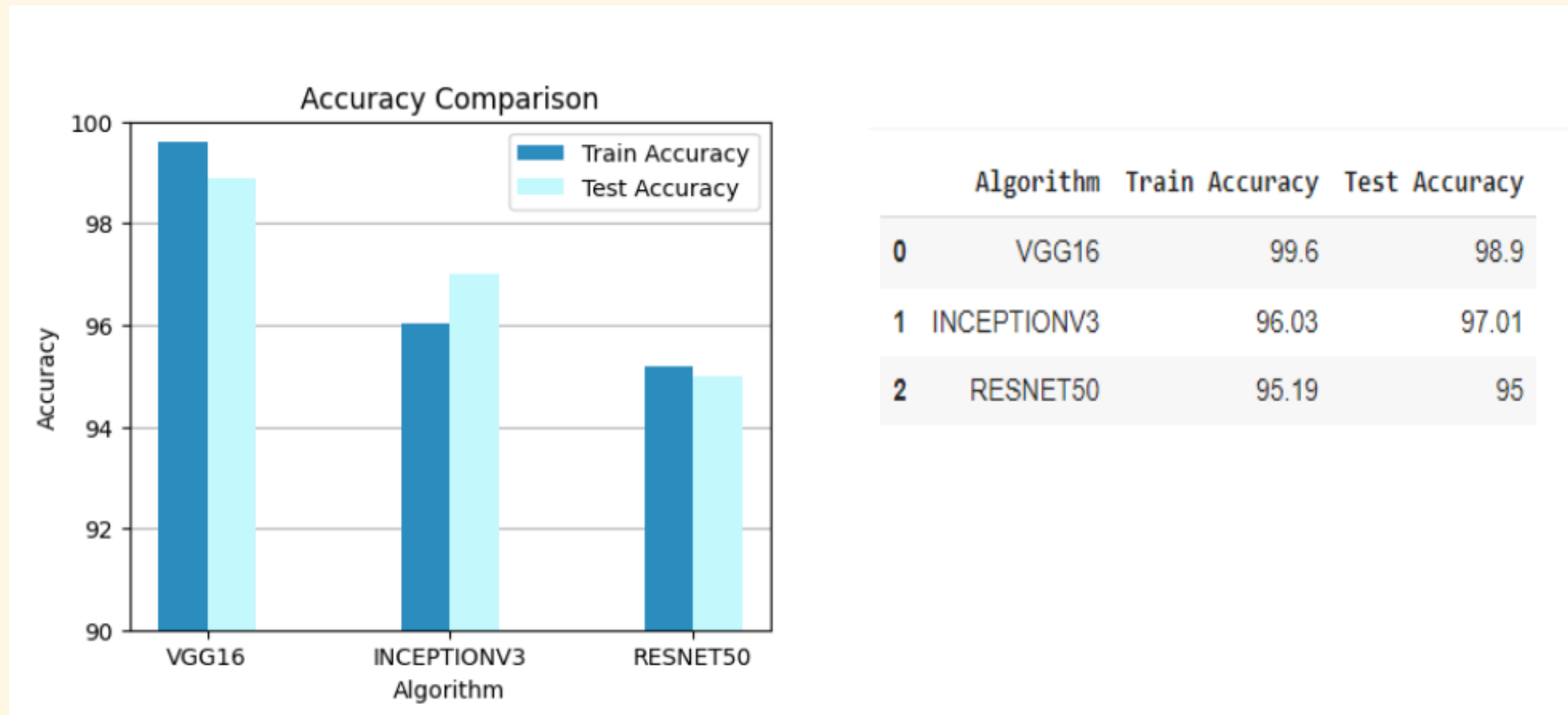


Fig. Architecture of CNN

MODULE II - ULTRASOUND TEST RESULTS

Algorithms :



For Ultrasound Testing, VGG16 model has been selected, since it gives the highest train accuracy of 99.6% and testing accuracy of 98.9%.

MODULE II - ULTRASOUND TEST

Selected Algorithm :

VGG16 (Visual Geometry 16) :

Use : Image Recognition

Specification :

- 13 Convolutional layers
- 3 fully connected layers

Required Image size : (224, 224)

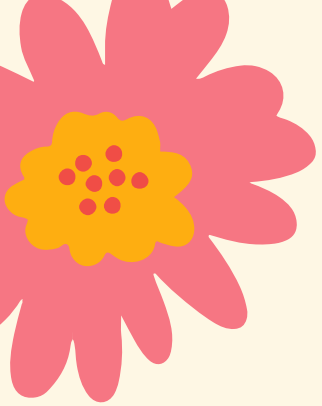
Technique : Transfer Learning

Activation Functions :

- Softmax
- RELU

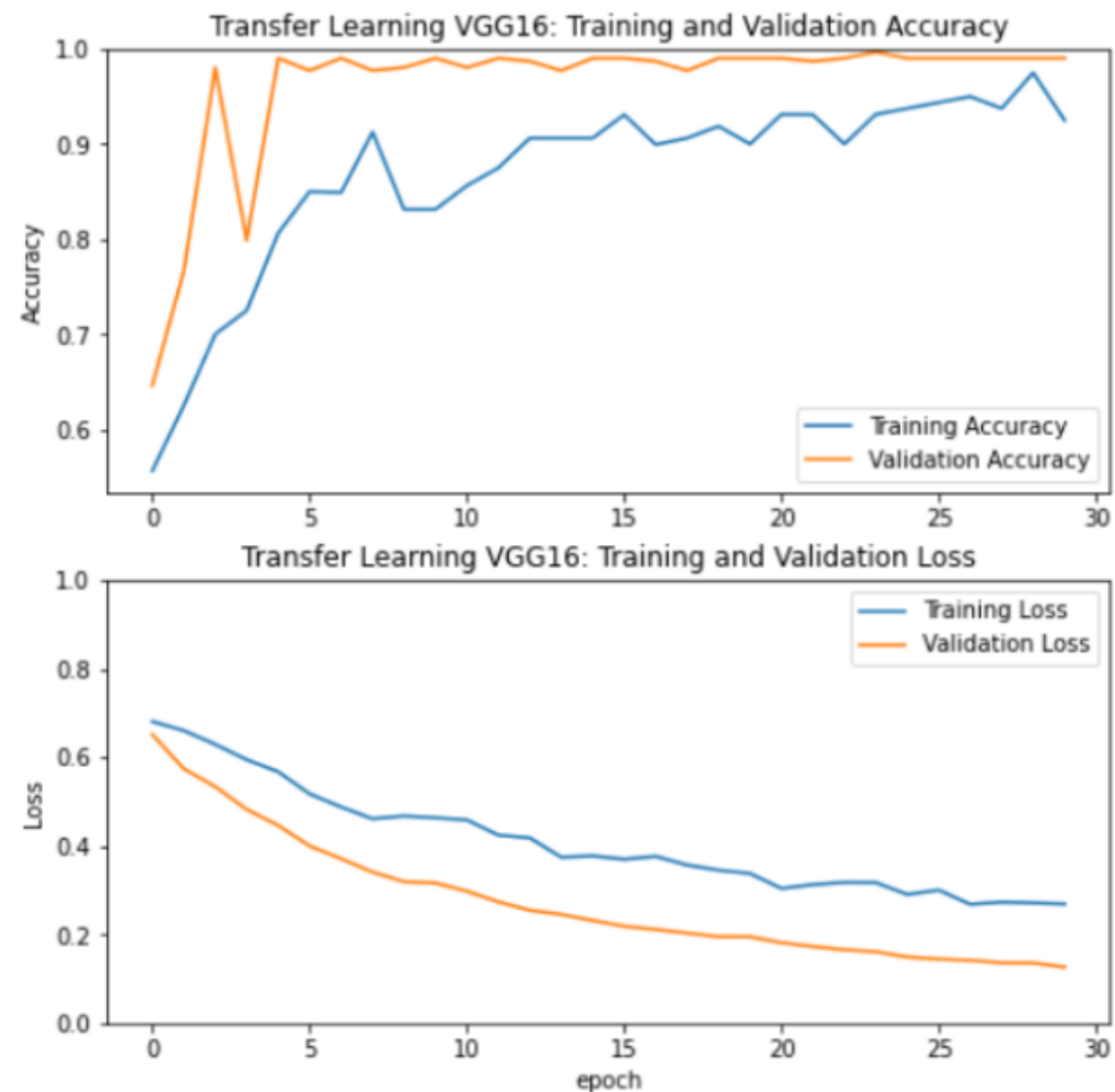
Best Combination of Hyperparameters:

S. No	Parameters	Value
1	Batch size	16
2	No of epochs	30
3	Learning Rate	0.0001
4	Optimizer	Adam
5	Performance Matrix	Accuracy



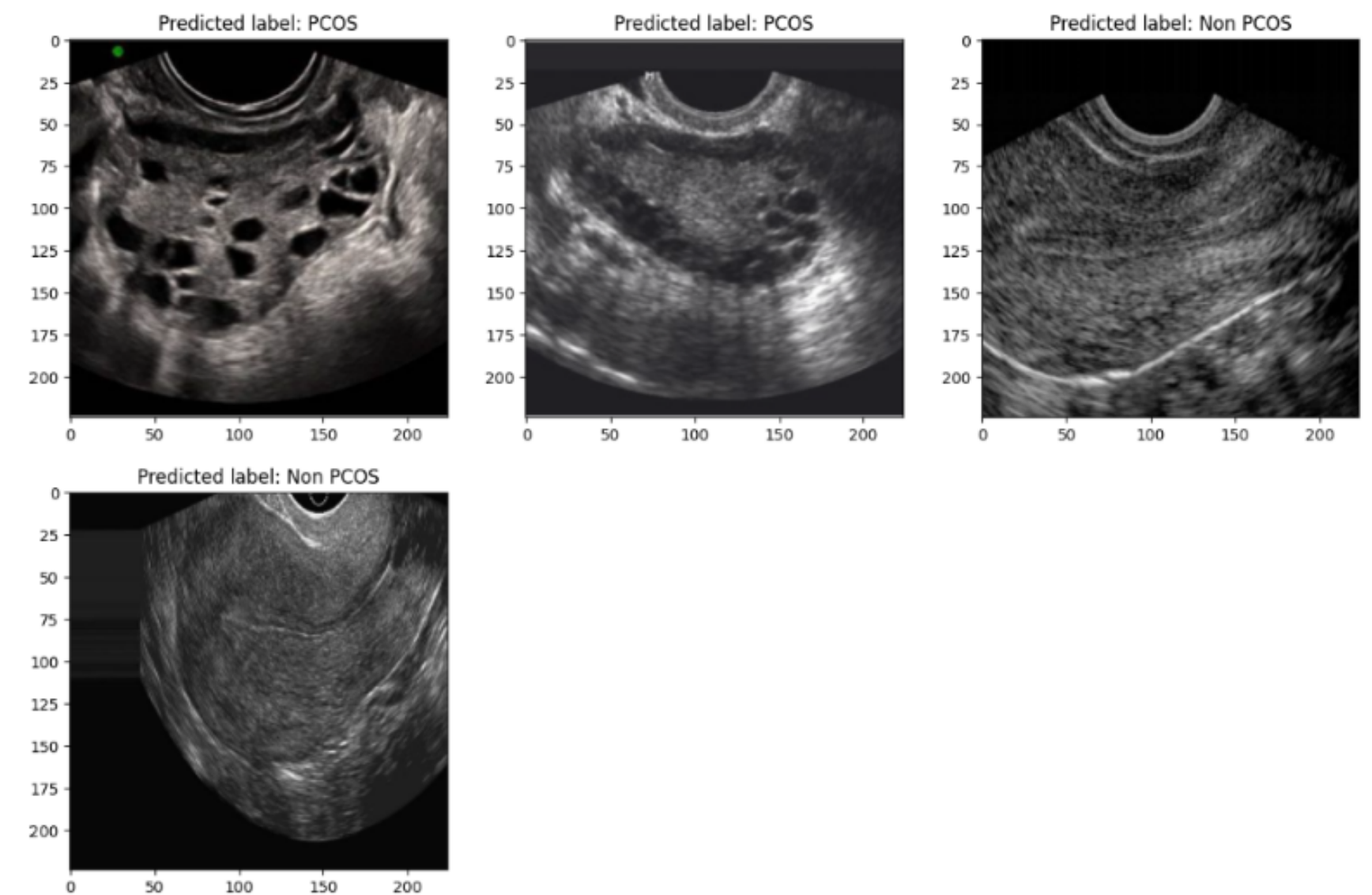
MODULE II - ULTRASOUND TEST RESULTS

VGG16 prediction report :



25/25 [=====] - 2s 65ms/step - loss: 0.1321 - accuracy: 0.9896
Model accuracy on test set: 99.0%

Predictions using VGG16:



Images categorized into 'PCOS' or 'Non-PCOS' categories

Website Verified by Gynaechologist

**By Dr. Bharti D. Jadhav from
Sanjeevan Hospital, Pune**



I am Dr. Bharati Jadhav writing to verify that I have Reviewed the system "PCWomen OS" website, which provides the facility to detect PCOS from ultrasound images and also has a self-diagnostic facility. The system was built by Sayali Deodikar, Shraddha Jadhav, Aishwarya Joshi, and Sejal Mutkar BE computer engineering department MMCOE, Karve Nagar.

As A gynecologist at Sanjeen Hospital I can confirm that the system has been developed in accordance with the current standards of PCOS. The system is based on ultrasound image analysis and has been shown to be effective in detecting PCOS. Furthermore, I have reviewed the diagnostic Facility provided by system and have found it to be accurate and reliable. The system provides a user-friendly interface that PCOS with ease in multiple languages.

18km

Dr. Devendu She
DHB (Gen Med) DNB
Reg. No. 1521207

00003
SANJEVAN HOSPITAL

DEPLOYMENT STATUS

- **Render** is a unified **platform** to build and run apps and websites with free SSL, a global CDN and private networks and auto deploys from Git.
- Currently deployed with the free plan
- Scalable up to 50 connections
- System link: <https://pcwomens-team.onrender.com>





DEMO



TEST CASES

Test Case ID	Test Objective	Expected Result	Actual Result	Test Status
TC01	Launch the web page	Home page must be displayed	Successful display of home page	Pass
TC02	Working of Navigation Bar	All options must redirect to the particular page on click	Navigation Bar redirecting the user to a particular page on click	Pass
TC03	User Manual Video	Video must start after clicking on User Manual Link	Video starts after clicking on User Manual Link	Pass
TC04	User entering incomplete data	Form must show error about the incomplete form status	Browser Popup (Alert Popup) will be displayed	Pass

TEST CASES

Test Case ID	Test Objective	Expected Result	Actual Result	Actual Result
TC05	Checking the type of image uploaded by the user	Test result if the format is correct	Display of test result page	Pass
TC06	Checking the type of image uploaded by the user	Prompt "invalid image type" if the image is not of the required type	Prompts the invalid due to the wrong image type	Pass
TC07	Displaying the test result	Test result must be displayed on the screen as 'You have PCOS' or 'You don't have PCOS'	Display of accurate on the screen	Pass
TC08	Nearest Gynecologists suggested by system	Suggestion of the nearest possible Gynecologist	List of Gynecologists in the vicinity	Pass
TC09	Healthy Life Style page	If the result is 'No PCOS' user can click on the link to navigate to healthy lifestyle page	Successful loading of the healthy lifestyle page	Pass

RESEARCH PAPER STATUS

- Name of publisher: **Apple Academic Press**
- Book title:
Mindtech: The Intersection of Artificial Intelligence & Mental Health
- Chapter title:
"Innovative Approach: Designing a System to Detect PCOS"
- The book and book chapters will be indexed in **Scopus, Web of Science, and Google Scholar.**

IMPORTANT DATES



PROOF OF SUBMISSION



Editors MindTech

to me ▾

Thu, May 18, 11:05 AM



Dear Authors,

I hope this email finds you well. I am writing to inform you that we have successfully received your research paper which you recently submitted for consideration in our upcoming research book.

Firstly, I would like to express our gratitude for choosing to contribute to our publication. Your work promises to make a valuable contribution to the field, and we appreciate the effort and dedication you have put into your research.

As part of our rigorous quality assurance process, we would like to inform you that we will be conducting a plagiarism check on all submitted papers. Once the plagiarism check is complete, we will carefully review the results. If any issues are identified, we will notify you promptly and provide an opportunity for you to address and rectify the concerns.

Once again, we appreciate your contribution to our research book and look forward to reviewing your research paper further. If you have any questions or concerns, please do not hesitate to reach out to us. Thank you for your understanding and cooperation.

Best regards,

Editors,
MindTech



REFERENCES

- [1] Kinjal Raut, Chaitrali Katkar, Prof. Dr. Mrs. Suhasini A. Itkar. “PCOS Detect using Machine Learning Algorithms”, Published by: International Research Journal of Engineering and Technology (IRJET), e-ISSN:2395-0056, p-ISSN: 2395-0072, Volume: 09, Issue: 01, January 2022
- [2] Shubham Bhosale, Lalit Joshi, Arun Shivsharan. “PCOS (POLYCYSTIC OVARIAN SYNDROME) DETECTION USING DEEP LEARNING”, Published by: International Research Journal of Modernization in Engineering Technology and Science (IRJMETS), e-ISSN: 2582-5208, Volume:04, Issue:01, January-2022
- [3] Wenqi Lv, Ying Song , Rongxin Fu , Xue Lin , Ya Su, Xiangyu Jin , Han Yang, Xiaohui Shan , Wenli Du, Qin Huang , Hao Zhong , Kai Jiang , Zhi Zhang, Lina Wang and Guoliang Huang. “Deep Learning Algorithm for Automated Detection of Polycystic Ovary Syndrome Using Scleral Images”, Published by:National Library of Medicine, January 2022
- [4] Shruti Bhargava Choubey¹, Abhishek Choubey¹, Durgesh Nandan^{2*}, Anurag Mahajan. “Polycystic Ovarian Syndrome Detection by Using Two-Stage Image Denoising”, Published by: International Information and Engineering Technology(IIETA), Volume: 38, No: 4, pp: 1217-1227, August 2021

REFERENCES

[5] Namrata Tanwani, “Detecting PCOS using Machine Learning”, Published by: International Journal of Modern Trends in Engineering and Science, ISSN: 2348-3121, Volume:07, Issue:01 2020

[6] Sweta Kumari. “Classification of PCOS/PCOD Using Transfer Learning and GAN Architectures to Generate Pseudo Ultrasound Images”, Published by: National College of Ireland, 2020

[7] Vikas B, Radhika Y, Vineesha K. “Detection of Polycystic Ovarian Syndrome using Convolutional Neural Networks”, Published by: International Journal of Current Research and Review, Volume: 13, Issue: 06, March 2021

[8] R M Dewi, Adiwijaya, U N Wisesty, Jondri, “Classification of polycystic ovary based on ultrasound images using competitive neural networks”, Published by: International Conference on Data and Information Science, 2018



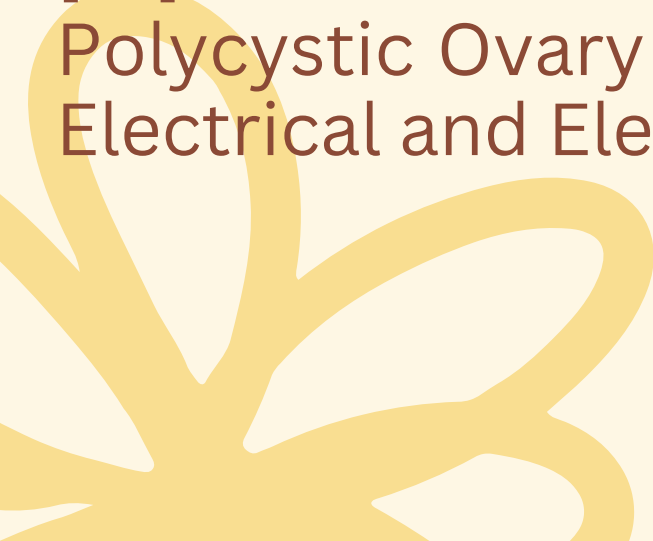
REFERENCES

[9] Siji Jose Pulluparambil 1 & Subrahmanya Bhat, “Medical Image Processing: Detection and Prediction of PCOS – A Systematic Literature Review”, Published by: International Journal of Health Sciences and Pharmacy, ISSN: 2581-6411, Volume: 5, No: 2, December 2021

[10] Jesper E. van Engelen¹, Holger H. Hoos, “A survey on semi-supervised learning”, Published by: Springer, November 2019

[11] Sayma Alam Suha & Muhammad Nazrul Islam “An extended machine learning technique for polycystic ovary syndrome detection using ovary ultrasound image”, Published by: Scientific Reports, October 2022

[12] Shazia Nasim, Mubarak Almutairi , Kashif Munir, Ali Raza , AND Faizan Younas ,“A Novel Approach for Polycystic Ovary Syndrome Prediction Using Machine Learning in Bioinformatics”, Published by: Institute of Electrical and Electronics Engineers, Volume: 10, September 2022



ACHIEVEMENT - SEM 2



Thank you!

