INTERNET OF THINGS FOR HEALTH CARE

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INTRODUCTION

- What is IOT ?
- IOT for Health Care
- Provide a IOT-based Remote health monitoring system design which consists of a four-tier architecture to store and process a huge volume of wearable sensor data and uses the machine learning model at its core for prediction of heart diseases.
- To implement a Machine learning based decision support system for prediction of heart diseases.
- The performance of prediction model is comparatively analysed with the help of various performance evaluation metrices to assess the reliability of our expectations.

WHAT IS IOT?

- The Internet of things(IOT) is the network of physical objects or things embedded with electronics, software, sensors and network connectivity, which enables these objects to collect and exchange data.
- IOT can be thought of as the interconnection of uniquely identifiable smart objects and devices within todays internet infrastructure with extended benefits.

IOT APPLICATIONS

- Smart Home
- Smart cities
- Wearables
- Waste Management
- Security & Emergencies
- Logistics retails
- Industrial control
- Health Care

THE INTERNET OF THINGS LIFE CYCLE

Collect → Communicate → Analyze → Act

Collection

Devices And sensors are collecting data Everywhere

- At your home
- In your Car
- At the office
- In the manufacturing plant

Communication

Sending data and events through some network

To some destination

- A Cloud Platform
- Private data centre
- Home network

Analysis

Creating information from data

- Visualizing the data
- Building Reports
- Filtering Data

Action

Tacking action based on the information and data

- Communication with other machine to machine
- Send a notification(SMS, email, text)
- Talk to another system

IOT FOR HEALTHCARE

- Medical care and health care represent one of the most attractive application areas for the IOT
- IOT- based healthcare services are expected to reduce costs increase the quality of life, and enrich user's experience.
- Up-to-date healthcare networks driven by wireless technologies are expected to support chronic diseases, early diagnosis, real time monitoring and medical emergencies.

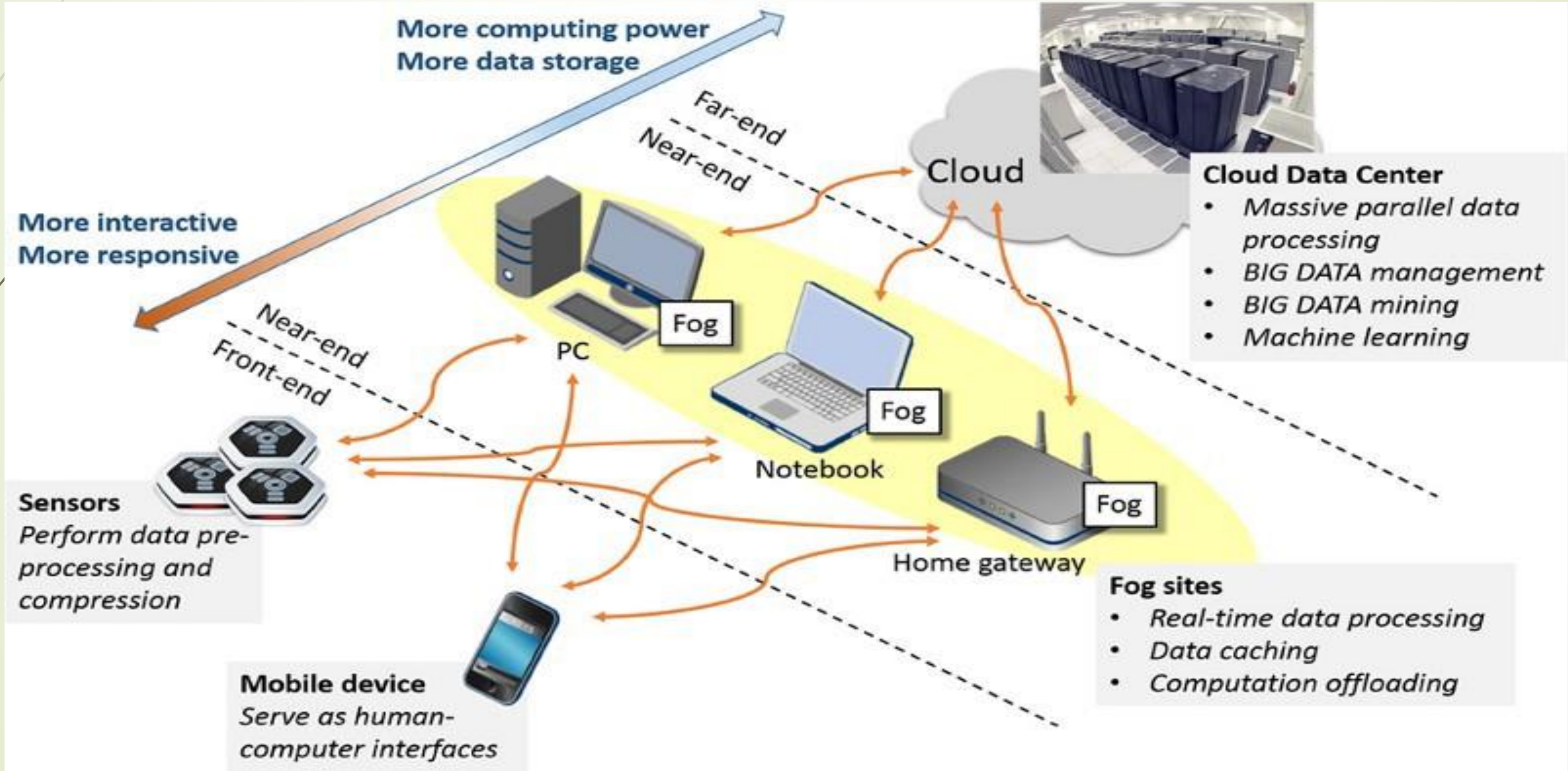
APPLICATIONS

- Diabetes
- Wound analysis for advanced diabetes patients
- Melanoma detection
- Eye disorder, skin disorder
- Heart rate monitoring
- Blood Pressure monitoring
- Respiratory rate monitoring
- Body temperature monitoring
- Oxygen saturation monitoring
- Cough detection
- Allergic rhinitis and nose related symptoms
- Rehabilitation System

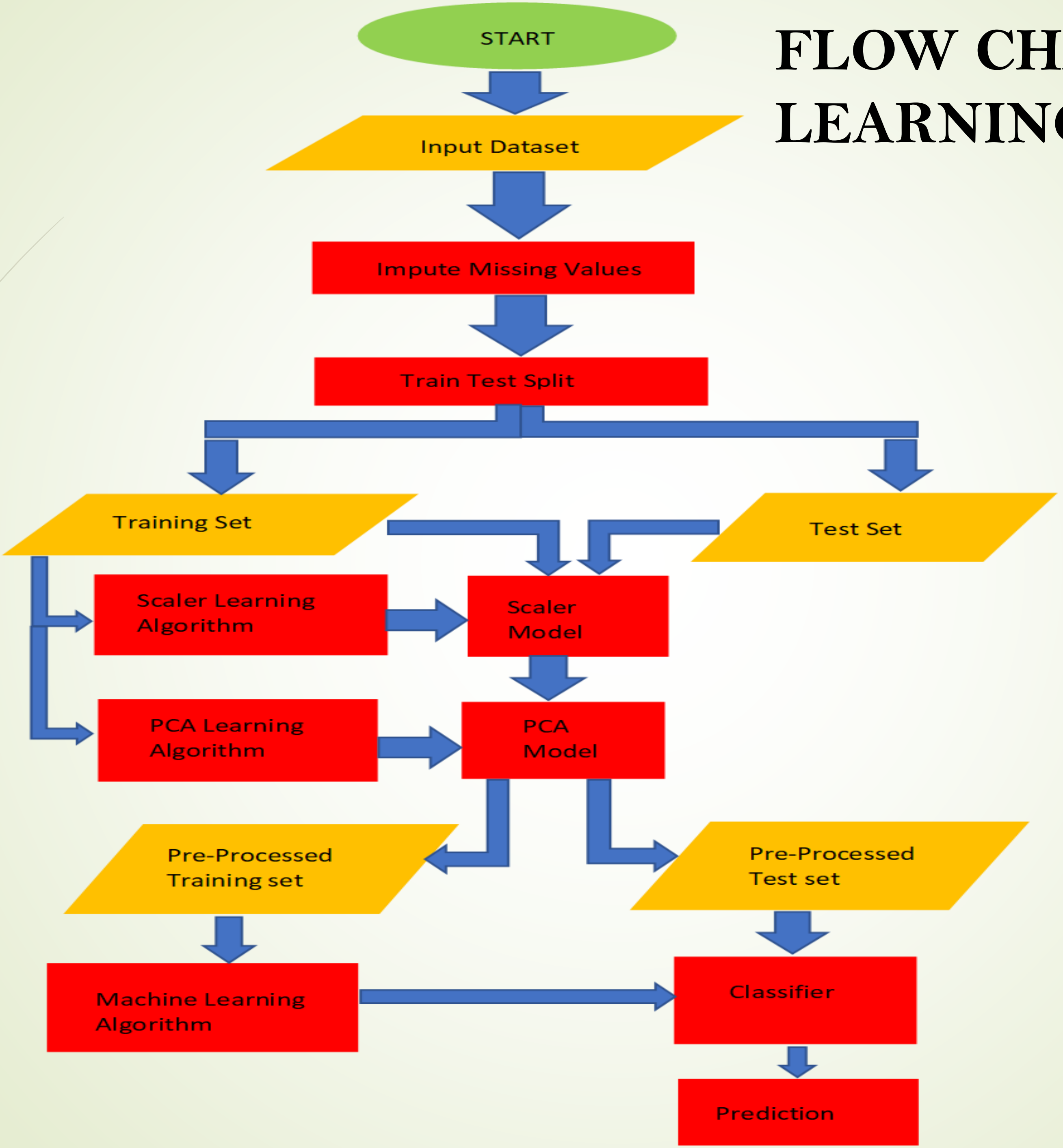
EXAMPLE

- At Boston Medical Centre, where everything from new born babies to leftover food are reaping the benefits of the Internet of Things in healthcare.
- The hospital uses sensors for security purposes. New born babies are given wristbands, allowing a wireless network to locate them at any time. If a new born is taken too close to an exit door without being signed out, elevators will stop and exit doors will lock
- In the intensive care unit, nurses receive critical alerts on hospital cell phones about their patients' medical conditions, including heart rate and oxygen changes that sensors have detected, allowing them to get to patients' bedsides more quickly.
- Wireless sensors are installed in refrigerators, freezers and laboratories to ensure that blood samples, medications and other materials are kept at the proper temperatures.

HEALTH MONITORING SYSTEM FRAMEWORK



FLOW CHART OF MACHINE LEARNING BASED MODEL



TOOLS AND TECHNOLOGIES

- Apache Spark
- Scala

DATASET DETAILS

Dataset	No of Attributes	No of Class Labels	No of Instances	No of Instances in Training Set	No of Instances in Test Set
Cleveland	14	2	303	244	59
Cleveland+Switzerland (Mixed)	14	2	426	338	88
Arrhythmia	279	16	452	361	91

PREVIOUS WORKS

Ref No	Details of publication	Dataset Used	Method	Accuracy
11	Humar Kahramanli *, Novruz Allahverdi	Cleveland heart disease	combination of artificial neural network and fuzzy neural network	86.8%
12	Das, Resul & Turkoglu, Ibrahim & Sengur, Abdulkadir. (2009).	Cleveland heart disease	neural networks ensemble method	89.01%
15	Asha Rajkumar, G.Sophia Reena (2010)	Cleveland heart disease	Naive Bayes	52.33%
16	A. Ozcift and A. Gulten (2011)	Cleveland heart disease	RBF Network	84.48
19	K. Polat, S. Gunes, (2007)	Arrhythmia	support vector machine	100%

RESULTS

Classifier	K	Reg Param	Max Iterations	Accuracy	AUC	TPR	FPR	PPV	NPV
SVM	8	0.0	25	0.88	0.87	0.79	0.06	0.92	0.93
Logistic	8	0.1	20	0.84	0.85	0.79	0.1	0.88	0.9
MLP	5	Layers (5, 2)	20	0.83	0.83	0.79	0.13	0.85	0.86

Classification Results of Cleveland heart disease dataset

	Predicted class=1	Predicted class=0
Actual class=1	24	5
Actual class=0	2	28

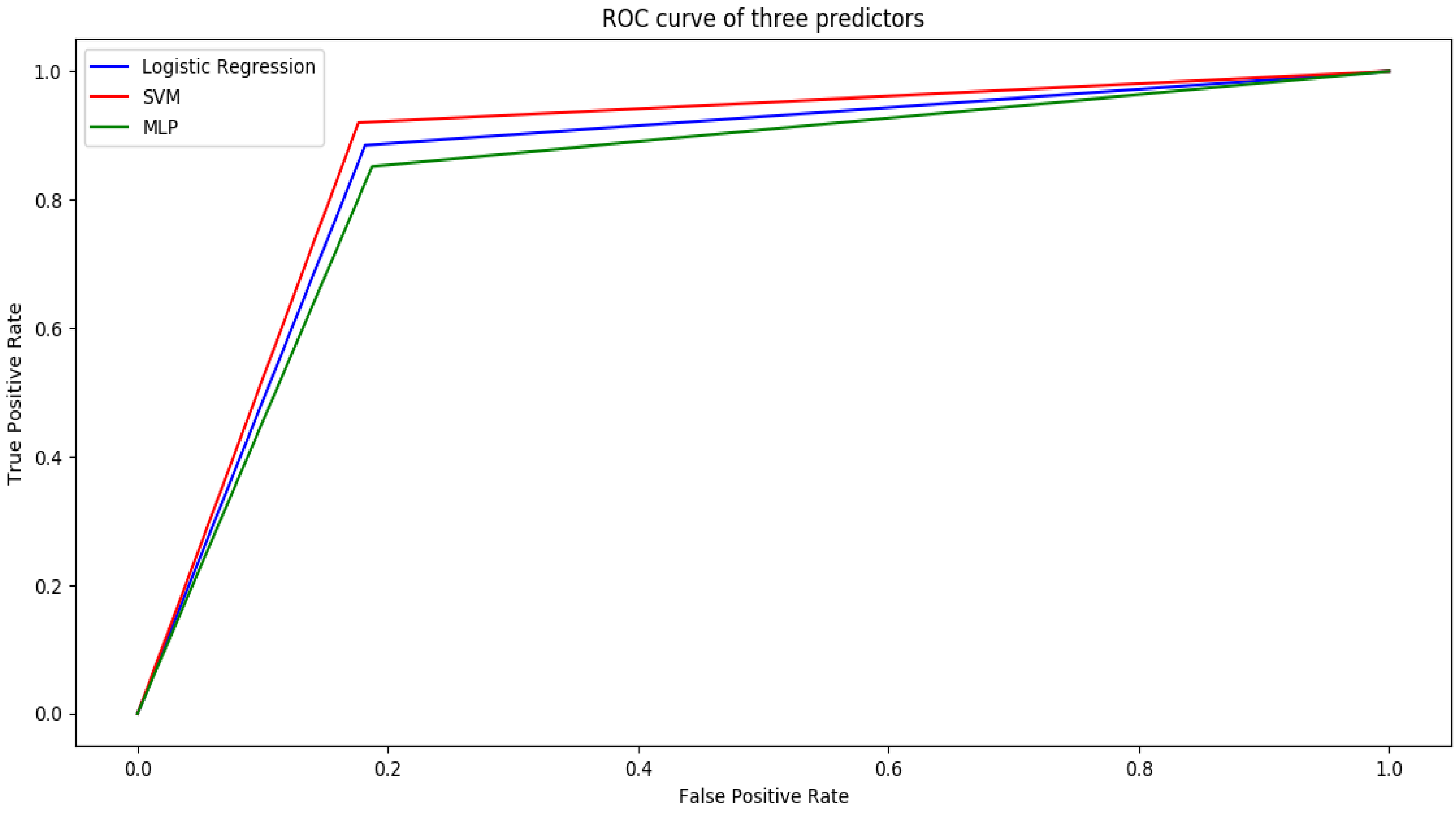
Confusion Matrix of Cleveland heart disease dataset using Support Vector Machines

	Predicted class=1	Predicted class=0
Actual class=1	23	6
Actual class=0	4	26

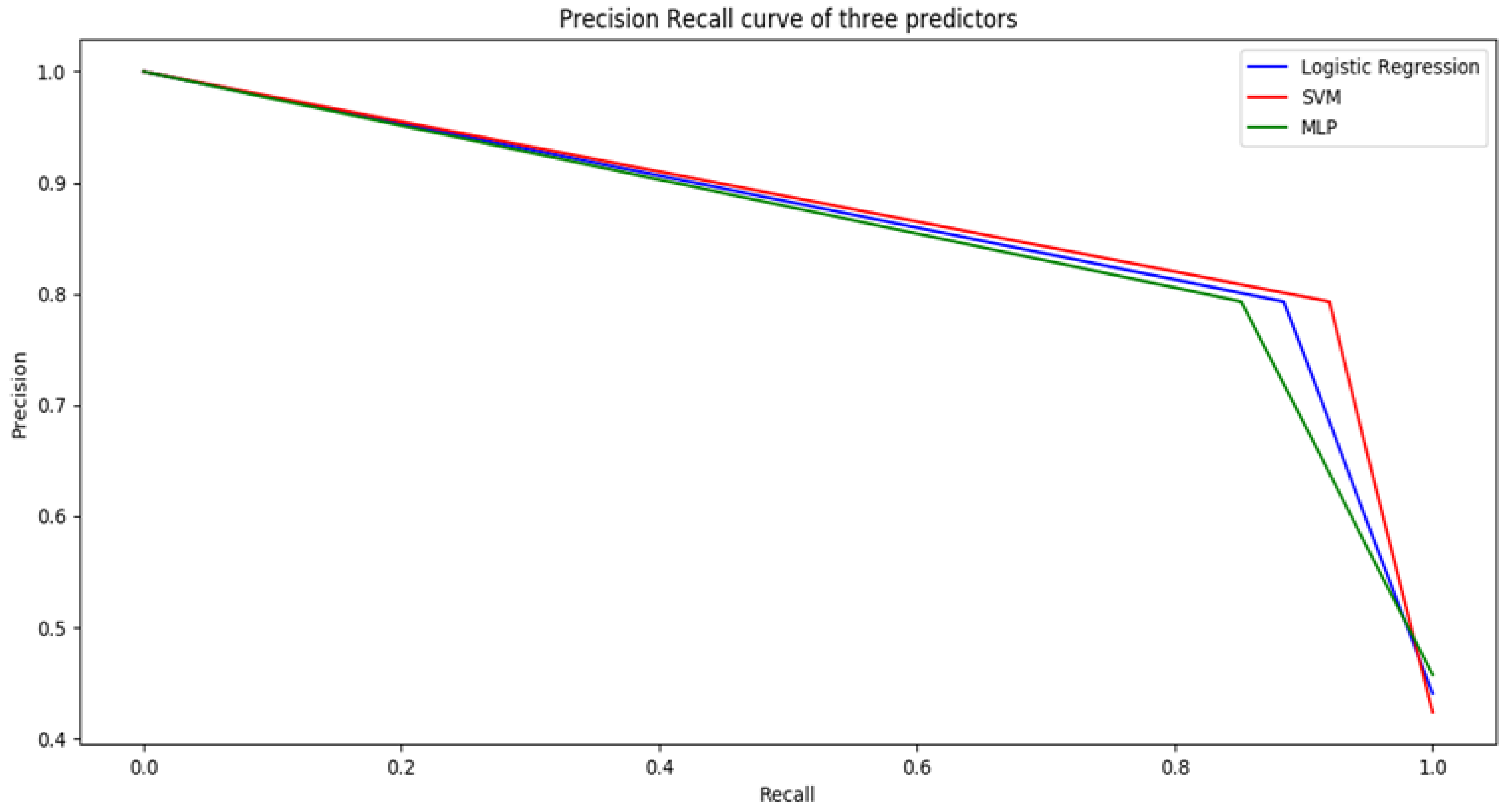
Confusion Matrix of Cleveland heart disease dataset using MLP

	Predicted class=1	Predicted class=0
Actual class=1	23	6
Actual class=0	3	27

Confusion Matrix of Cleveland heart disease dataset using Logistic Regression



ROC curve of three predictors on Cleveland heart disease dataset



Precision Recall curve of three predictors on cleveland heart disease dataset

Classifier	K	Reg Param	Max Iterations	Accuracy	AUC	TPR	FPR	PPV	NPV
SVM	5	0.6	25	96.59	0.95	0.96	0.03	0.98	0.96
Logistic	8	0.0	20	94.31	0.93	0.94	0.06	0.96	0.93
MLP	8	Layers (8, 2)	20	94.31	0.93	0.94	0.06	0.96	0.93

Classification Results of Cleveland + Switzerland (Mixed) Heart Disease Dataset Results

	Predicted class=1	Predicted class=0
Actual class=1	57	2
Actual class=0	1	28

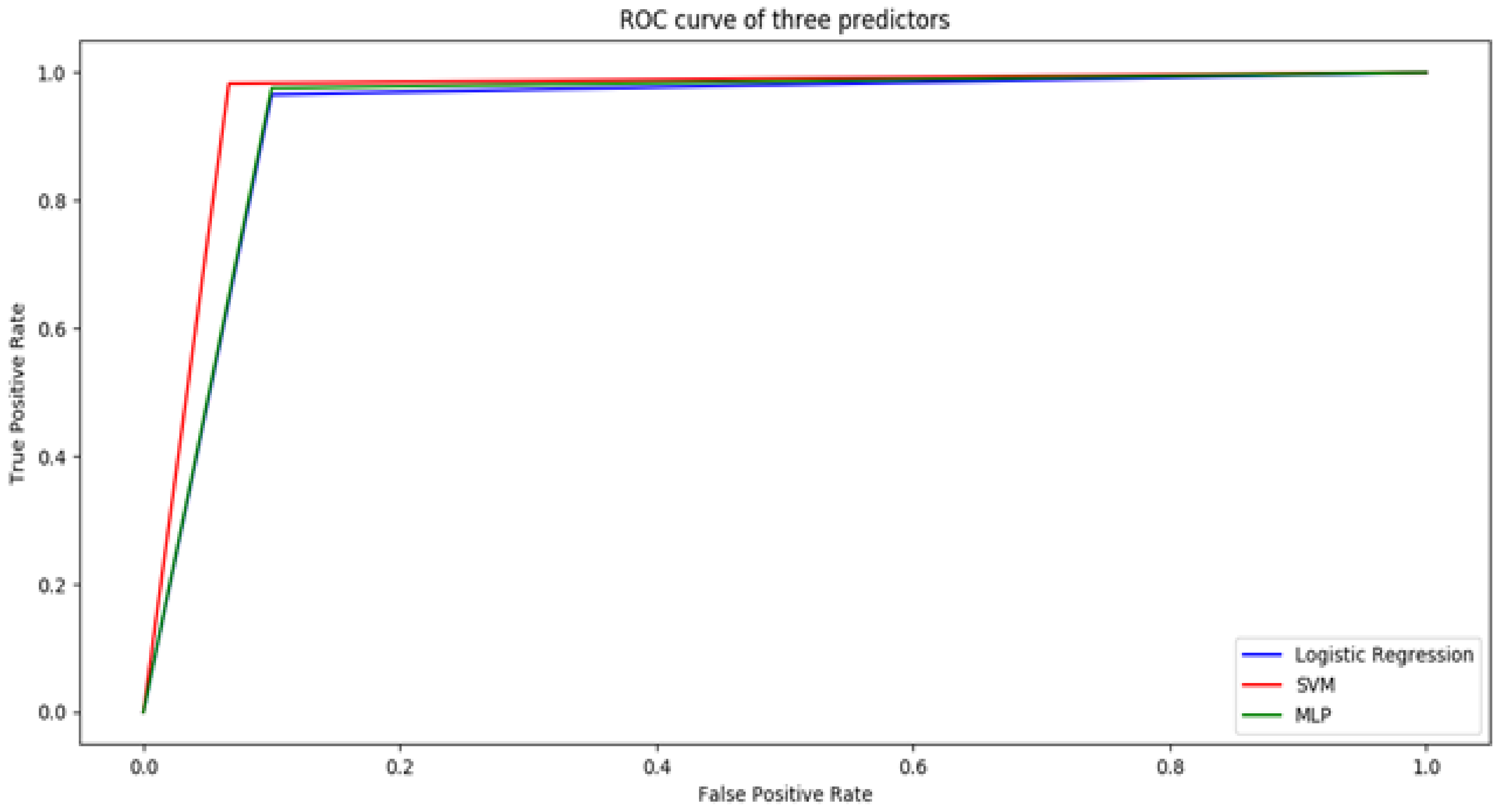
Confusion Matrix of mixed heart disease dataset using Support Vector Machines

	Predicted class=1	Predicted class=0
Actual class=1	56	3
Actual class=0	2	27

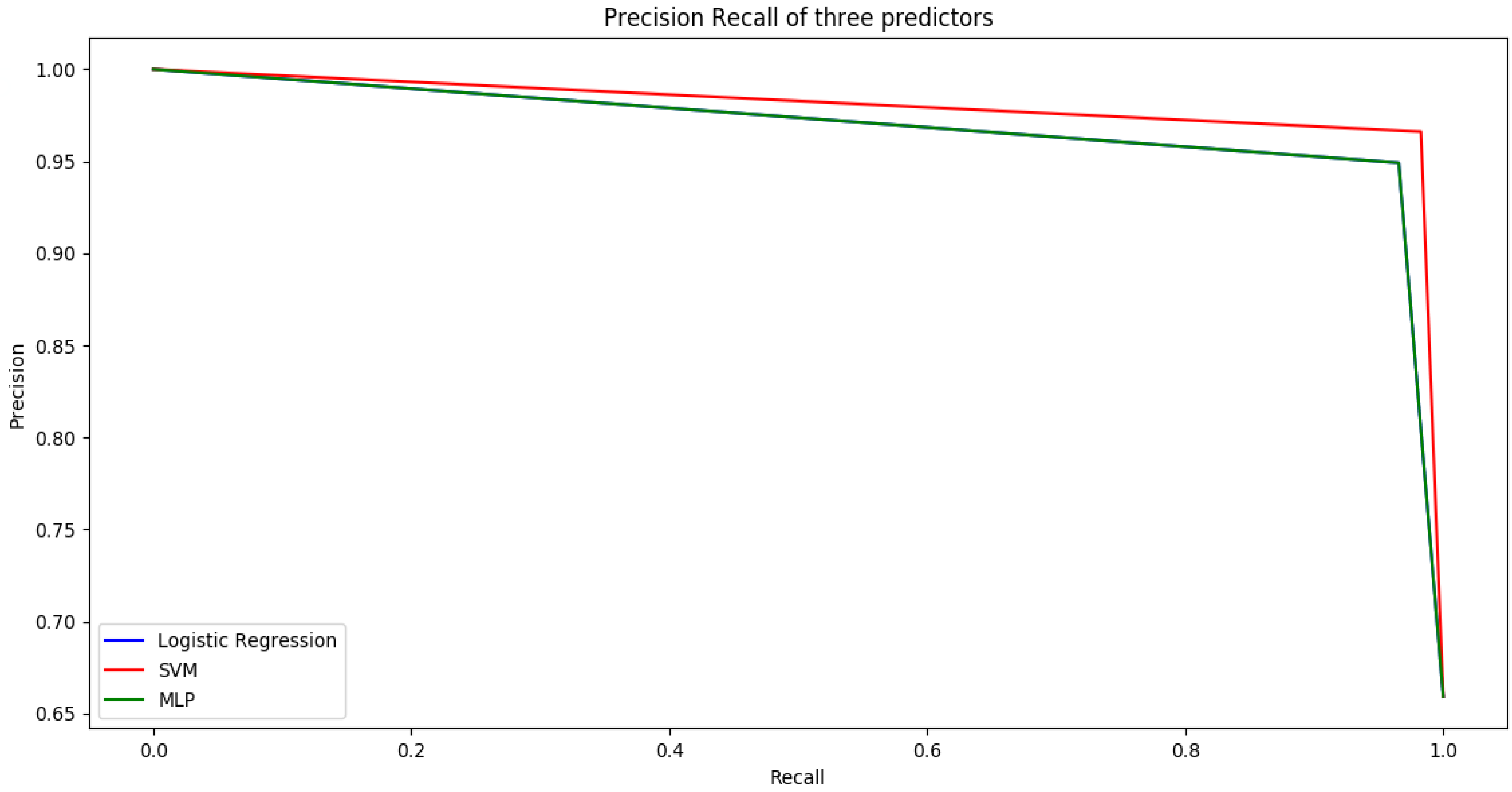
Confusion Matrix of mixed heart disease dataset using MLP

	Predicted class=1	Predicted class=0
Actual class=1	56	3
Actual class=0	2	27

Confusion Matrix of mixed heart disease dataset using Logistic Regression



ROC curve of three predictors on cleveland+Switzerland (Mixed)heart disease dataset



Precision Recall curve of three predictors on cleveland+switzerland (Mixed) heart disease dataset

Classifier	K	Reg Param	Max Iterations	Accuracy
SVM	60	0.2	30	0.74
Logistic	65	0.0	25	0.70
MLP	60	Layers (60,48,16)	30	0.75

Classification Results of arrhythmia dataset

CONCLUSION

- Proposed a IOT-based Remote health monitoring system design which consists of a four-tier architecture to store and process a huge volume of wearable sensor data and uses the machine learning model at its core for prediction of heart diseases.
- Implemented a Machine learning based decision support system for prediction of heart diseases
- SVM based decision support system performed better on heart disease datasets
- Multi-Layer Perceptron based decision support system performed better on arrhythmia disease datasets

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Thank you