Key Projects Exhibition

Matt Shi

Outline

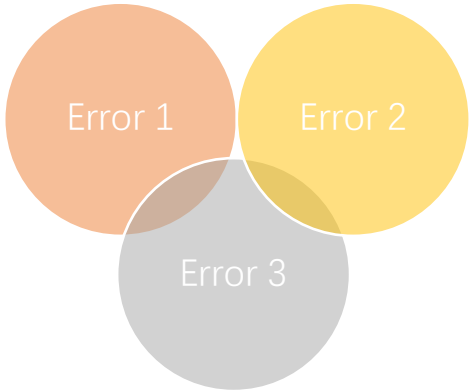
- Firmware Validation Optimization-Strategic Framework
- Battery Application-NPI
- Drive Unit Application-NPI
- Robot Localization and Path Planning-Engineering
- Demand Forecasting with Machine Learning Techniques-Engineering
- Digital Image Processing & Computer Vision-Engineering

Firmware Validation Optimization - Pain Point & Motivation

Project 1

Capturing Errors Efficiently and Effectively

- Offline Validation
- Online Validation
  - Check
  - Find
  - Troubleshoot



Pain Point

Test Name	Correlation
Test 1	…%
Test 2	…%

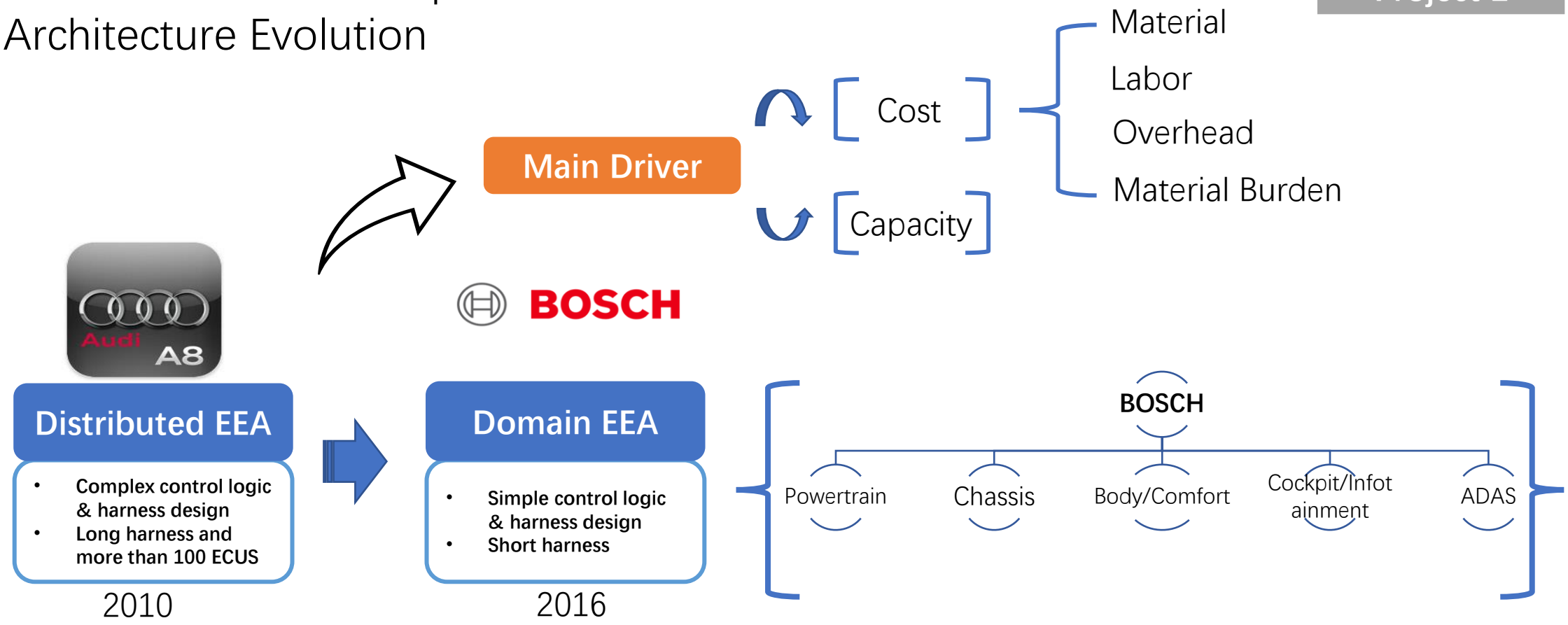
Expectation

Test Result				
Test Name	Pass	Failure	FPY	Details
Test 1	10	0	100%	…
Test 2	5	5	50%	…
Test 3	2	8	20%	…
Test 4	9	1	90%	…
Test 5	10	10	100%	…

Splunk Dashboard

Firmware Validation Optimization - Term Definition & Architecture Evolution

Project 1



Term:

- ECU (Electronic Control Unit): ECU is dedicated for simple functions like Ibooster.
- Domain Controller: Domain Controller is responsible for a set of vehicle functions.
- Harness Design: EEA leads to harness design. In some situations, EEA refers to systematic harness design.

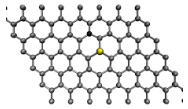
Firmware Validation Optimization - Methodology

Project 1

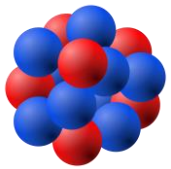
Philosophy

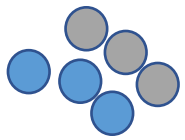
Filtered Result

Architecture Classification



Ying Yang





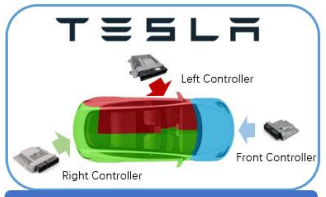
Experience

Filtered Result

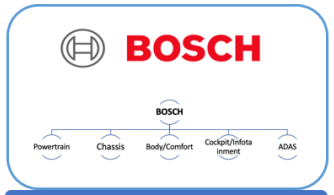
Existing Method: Experience Driven (Data Driven)

Proposed Method: Architecture Driven (Assumption Driven)

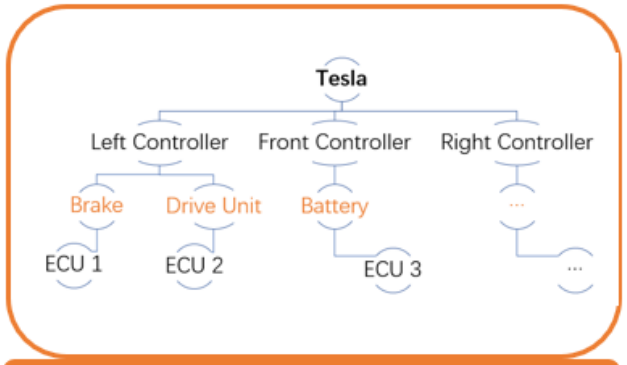
Architecture Classification



Domain Based On Location



Domain Based On Function



Optimized EEA

Test Items Grouping

Design Change In Cell From Battery Pack

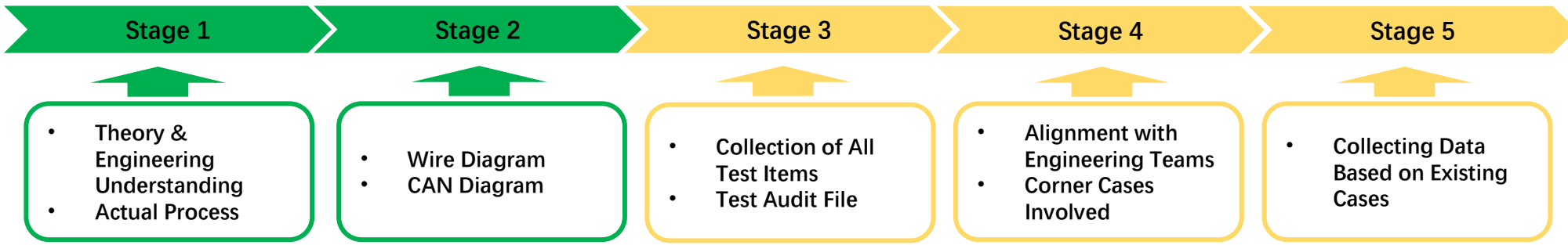
Test 3 In The Battery	Cell Related Test 1	Test 6 In The lamp
Cell Related Test 2	Test 4 In The Brake	Test 5 In The Door

High Correlation	Medium Correlation	Low Correlation
Directly related tests confirmed by engineers	Tests in related subsystems	Tests in other subsystems

Firmware Validation Optimization - Roadmap

Project 1

Roadmap



Here is the roadmap for the strategic framework. First two Steps have finished.

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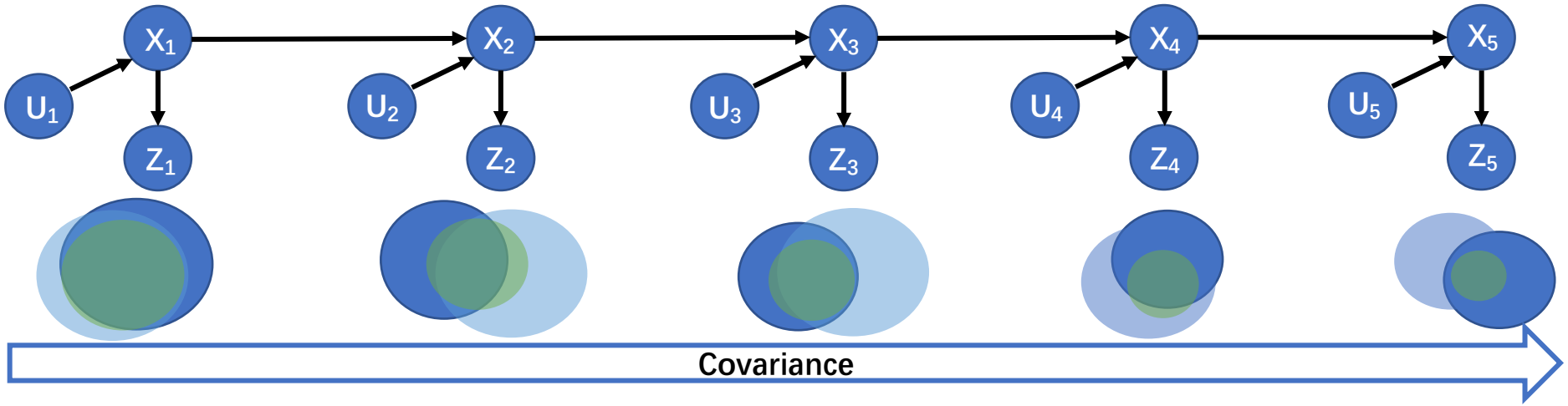
Kalman Filter



X: State or Time Step
U: Control Input or Motion Input
Z: Measurement

Covariance becomes small

Battery Application - NPI

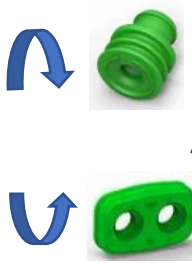
Project 2

Technical Background

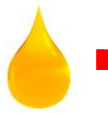
Battery

Contactor

Connector



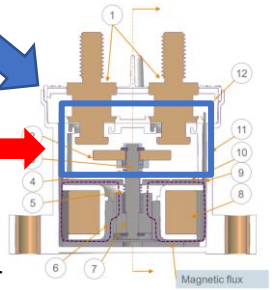
Sealing



Silicon Oil/ Material with Silicon

Bridge Contact

Silicon Evaporates In high temp. and sticks to the contact.



Contactor Side View

Pain Point/ Issue

- Lifetime revenue is around $16 million
- Launched first silicon-free connector in Great China.

Reward

Program Workflow/ Timeline

Project Proposal

- PRD (a new connector without silicon in high temp.)
- Product Concept (mechanical design)
- Challenges:
  - Never developed in China team.
  - Material selection

Prototype and Validation

- Product Prototype (Soft tooling or 3D print)
- Design Validation (Depend on OEM standard)
- P&L calculation including cost, price, CAPEX and demand forecast.

Project Review

- Steering Committee Review:
  - Financial Review
  - Supply Chain Part Review
  - Business Background Review
  - Timeline Review

Ramp up and Validation

- Production Validation (product dimension report, product test, production line)
- Challenges:
  - High defect rate (Engagement force higher than threshold)
  - Tight timeline

SOP

- Deviation approval from end OEM
- Lifetime revenue is around $16 million

Aug. 2017

Jul. 2018

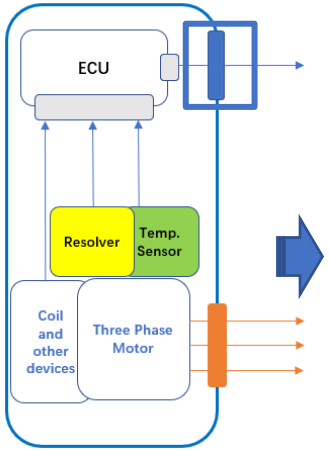
NISSAN

Drive Unit Application - NPI

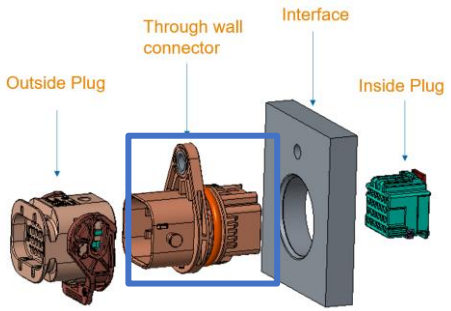
Project 3

Technical Background

Drive Unit



Electric Architecture



Existing Design

New Requirements of Connector (90 degree)

Price

Pain Point/ Issue

- Implement Price Erosion to get Temp. sensor business.
- Double the lifetime revenue from $4M to $8M.
- Extend the product array without using CAPEX

Reward

Program Workflow/ Timeline

Project Proposal	Prototype and Validation	Project Review	Ramp up and Validation	SOP
• PRD (90 degree connector in oil environment) • Product Concept (mechanical design)	• Product Prototype (Soft tooling or 3D print) • Design Validation (Depend on OEM standard) • P&L calculation including cost, price, CAPEX and demand forecast.	• Steering Committee Review: • Financial Review • Supply Chain Part Review (Got Challenged) • Business Background Review • Timeline Review	• Production Validation (product dimension report, product test, production line) • New Process, coating, Introduction to cut the cost.	• OEM agreed to open the tooling ownership. • This is one of the successful cases where products designed by China team are directly promoted to Global OEM headquarters.

Jul. 2019 — Jun. 2020

Robot Localization and Path Planning - Engineering

Project 4

Technical Background

Sensor: Ultrasonic Sensor

Sensor: Encoder

Mobile Robots

Controller: Microcontroller Unit
Firmware and Software

Actuator: Electric Motor

- Localization: What is the most likely location for the robot.
- Path Planning: What is the best route between beginnings and ends.

Pain Point/ Issue

Program Workflow/ Result

Individual Module Design

- Product Concept (Software module design including localization and path planning)

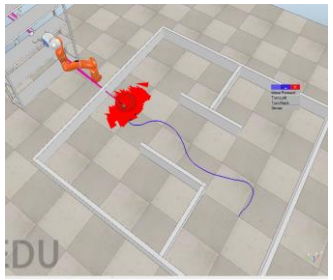
Project Proposal and Integration

- Combine the modules into a big program
- Project Proposal (the interaction between manipulator and mobile robot)

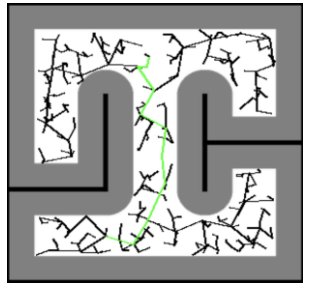
SOP

- Challenges:
- System bugs

Step. 2021 → Dec. 2021



Particle Filter Algorithm
for localization



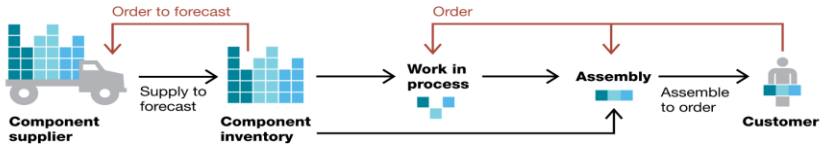
RRT Algorithm
For path planning

Result

Demand Forecasting with Machine Learning Techniques - Engineering

Project 5

Motivation/ Pain Point



The Flowchart of The Supply Chain

- Demanding forecasting is premise of raw material planning, purchasing, inbound logistics, cash flow, and manufacturing

Motivation

- There is mismatch and inefficiency in supply-demand due to asymmetric information between downstream and upstream enterprises.
- Manufacturing is not like the IT industry. Increasing and decreasing capacity is not easy.

Pain Point/ Issue

Program Workflow/ Result

Preliminary Analysis

- Find out whether there is weekly, quarterly and yearly correlation between data points.

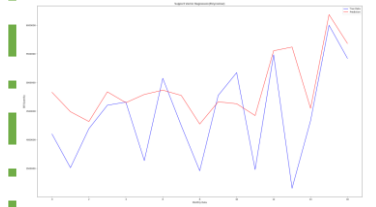
Data Preprocessing

- Turn time-series problems into supervised learning problems.
- Apply one-hot encoding and group datapoints.

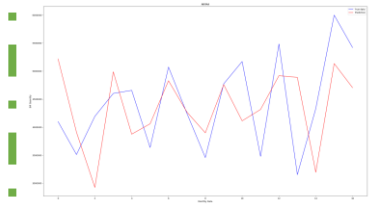
Applying ML Algorithms

- Utilize SVR, ARIMA, and LSTM to optimize demand forecasting.
- Compare the performance of different algorithms.

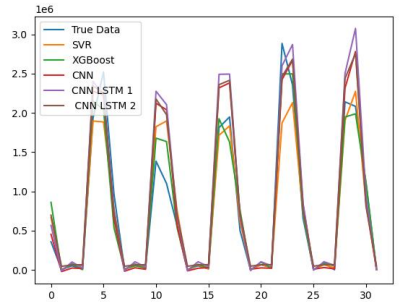
Apr. 2021 — Jun. 2021



SVR



ARIMA



LSTM

Result

Digital Image Processing & Computer Vision - Engineering

Project 6

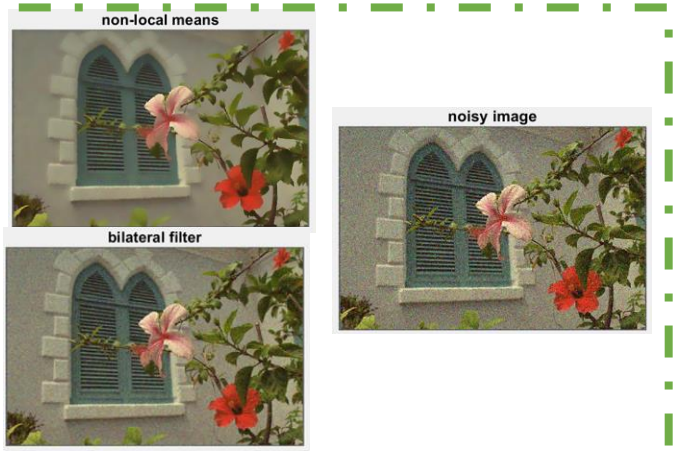
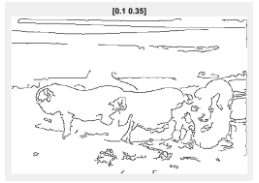


Image Denoising

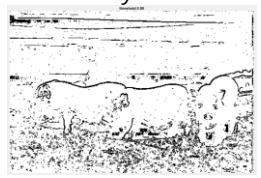
Edge Detection

Computer Vision

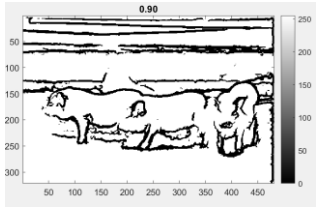
Image Segmentation



Canny Filter



Sobel Filter



Structured Filter

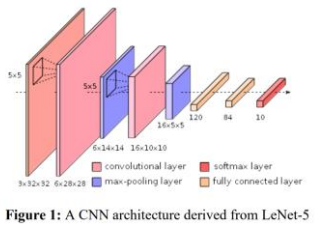
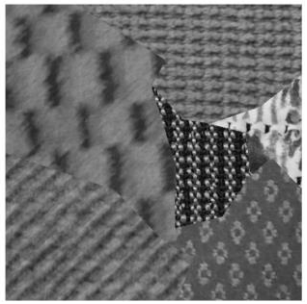


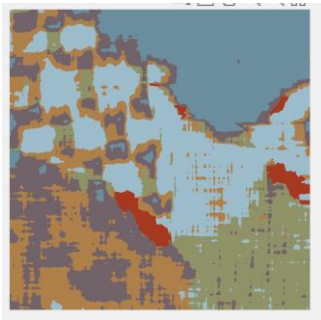
Figure 1: A CNN architecture derived from LeNet-5

LeNet-5 Structure

CIFAR-10



Input Texture
Mosaic Image



Output Result

Thank You