



VOLKSWAGEN

GROUP TECHNOLOGY SOLUTIONS INDIA

i.mobilathon 3.0

NexGen Student Hackathon From VWITS
for Mobility Solutions

“Catalytic Converter Security & Monitoring”

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Problem Statement

CATALYTIC CONVERTER MAINTAINANCE AND EFFICIENCY

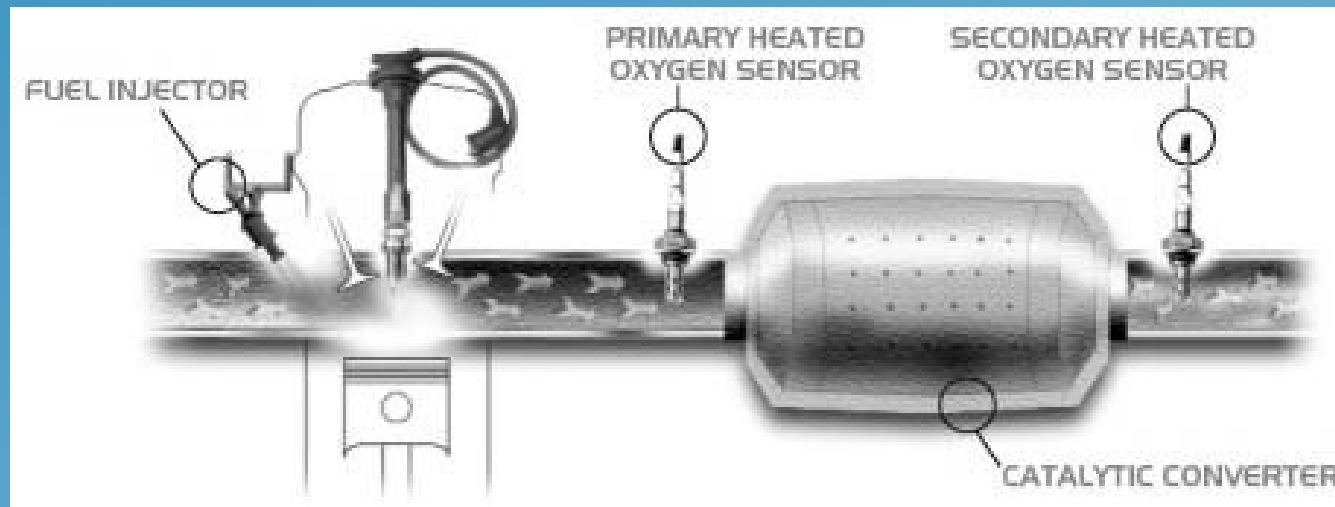
- Traditional Vehicles have static sensors that track the **fuel efficiency** and **catalytic converter health** using just the *Oxygen Sensors*.
- There are a lot more gasses that need to be checked to ensure the proper functioning of the catalytic converter like **NOx, CO, and HC**.
- The stats are just limited to the **ECU of a vehicle**. There's no such way to keep track of the vehicles that are causing *extra-ordinary pollution, and running inefficiently*. This is not a sustainable process and causes much harm to the environment.
- The **safety and privacy** of a User's Personal Data will be put at stake if we share the ECU's data with the third-party alliance.

CATALYTIC CONVERTER THEFT PREVENTION

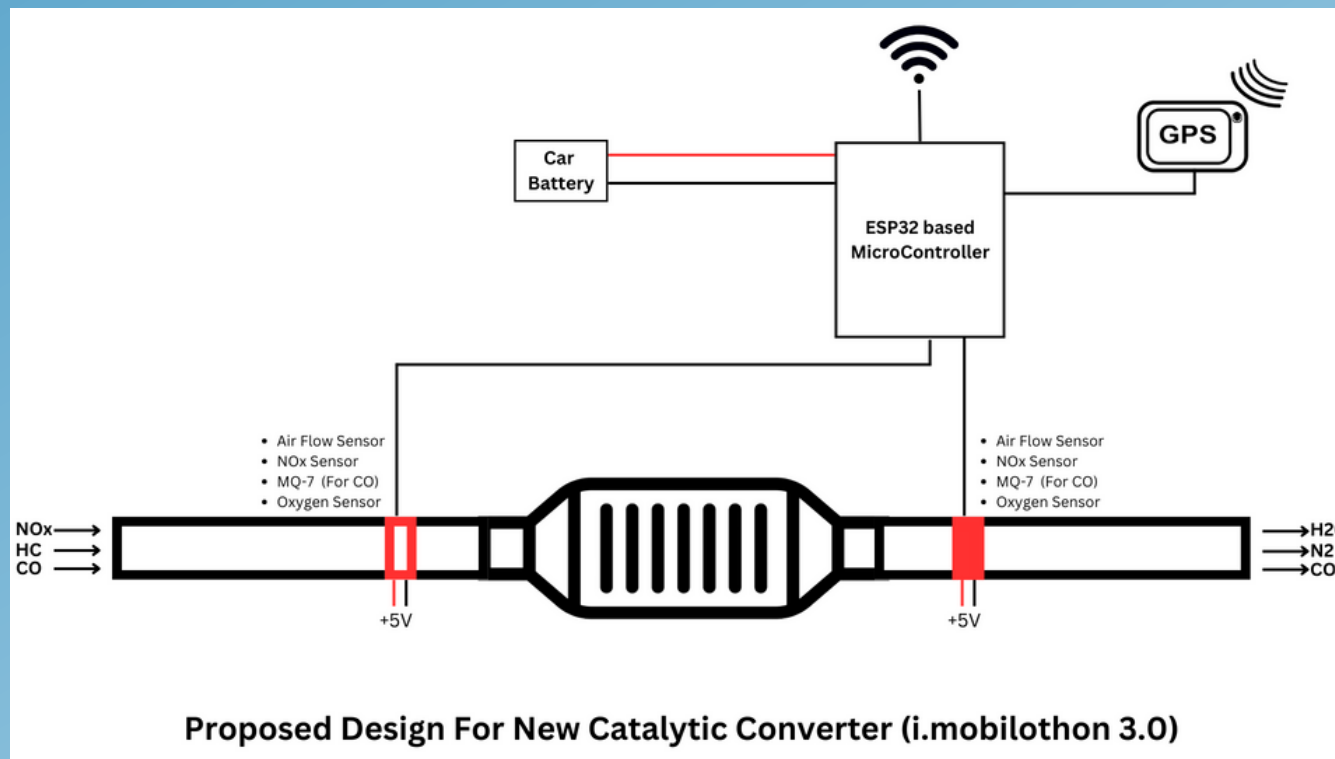
- A Catalytic Converter is considered the Heart of the vehicle as its purpose is to **filter harmful gasses**.
- It contains precious metals like **Palladium, Rhodium, and Platinum**.
- *For Example, Maruti Suzuki's Eeco van's catalytic converter costs around Rs. 55,000/-.*
- In recent years, the thefts of these parts have increased as they are **very easy to steal** and it's not possible for everyone to know whether their vehicle's Catalytic Converter is safe or not, until and unless they notice performance issues.
- Many local Mechanics tend to **Damage the Catalytic Converter** in order to increase the airflow of the vehicle, hence defying its purpose.



Idea Description



Traditional Catalytic Converter



IoT-based Catalytic Converter Design

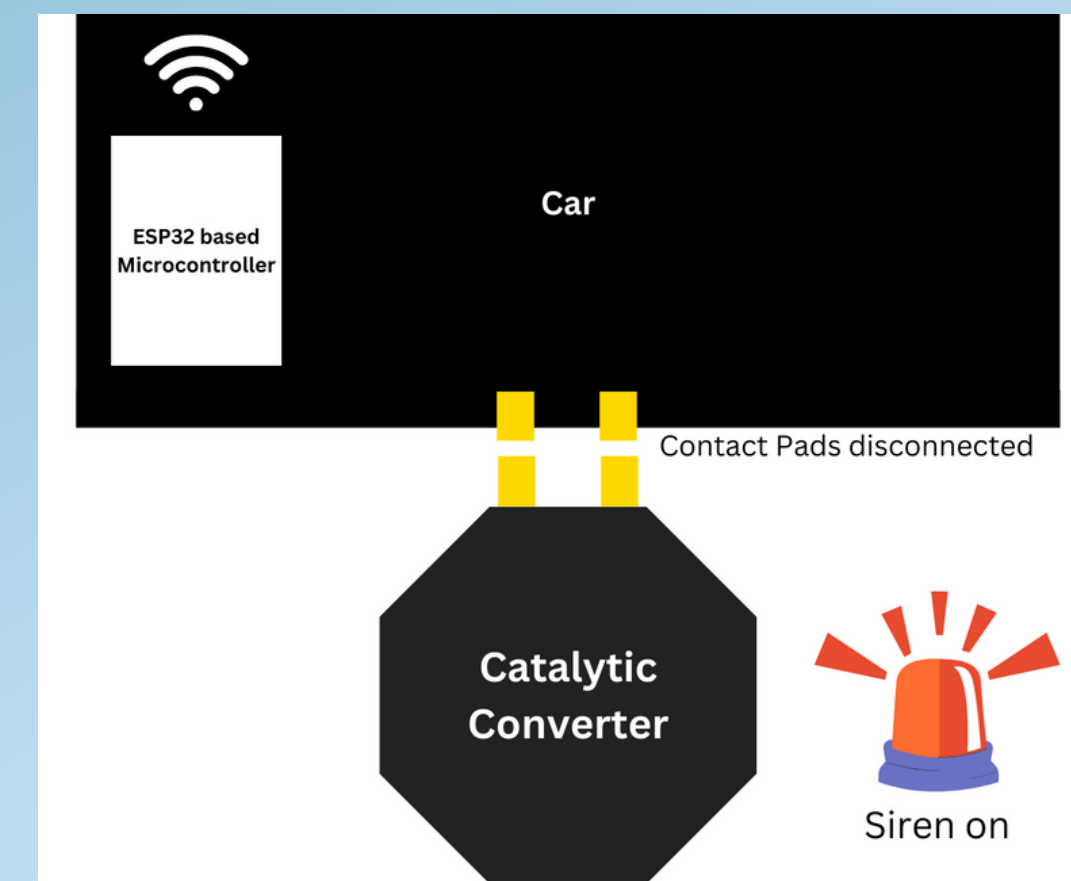
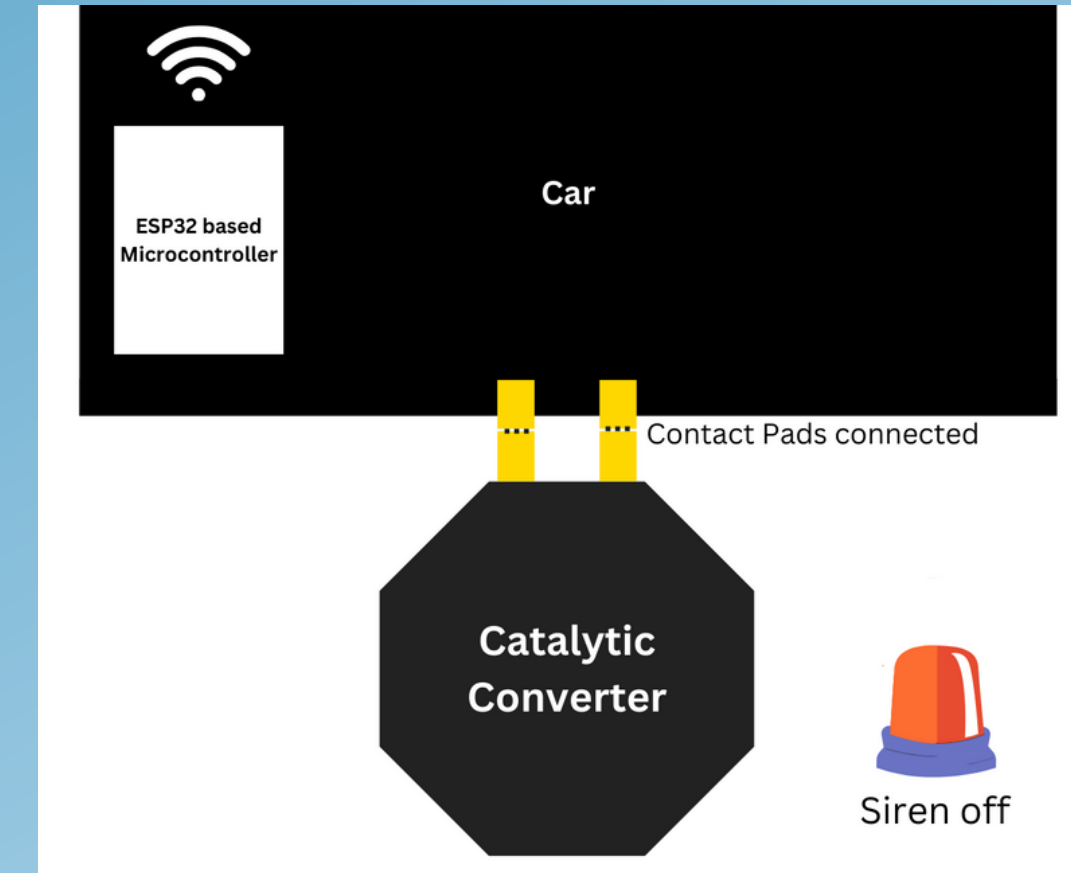
1. Catalytic Converter Maintainance and efficiency

- To enhance the efficiency of vehicles, we're upgrading the *traditional Oxygen Sensor* to a **new IoT-based approach**, that not only measures the Oxygen level before and after the Catalytic Converter but also measures the **presence of Gasses like NOx, CO, and HC** at both stages.
- Air Flow** measured at the beginning and end of the Catalytic Converter will ensure that the Catalytic Converter is *not clogged*.
- This ensures that the catalytic converter is in **good health** and also helps to ensure the **engine is running efficiently**.
- This information will be **recorded, computed, and stored** on a cloud server by using an ESP-32 Development Board.
- In case of any vehicle's inefficient performance, this information will be updated over the cloud and the user will be informed through a **WhatsApp message** generated.
- The efficiency of the Engine will be monitored by measuring various parameters and an **ML model running on the development board** itself.

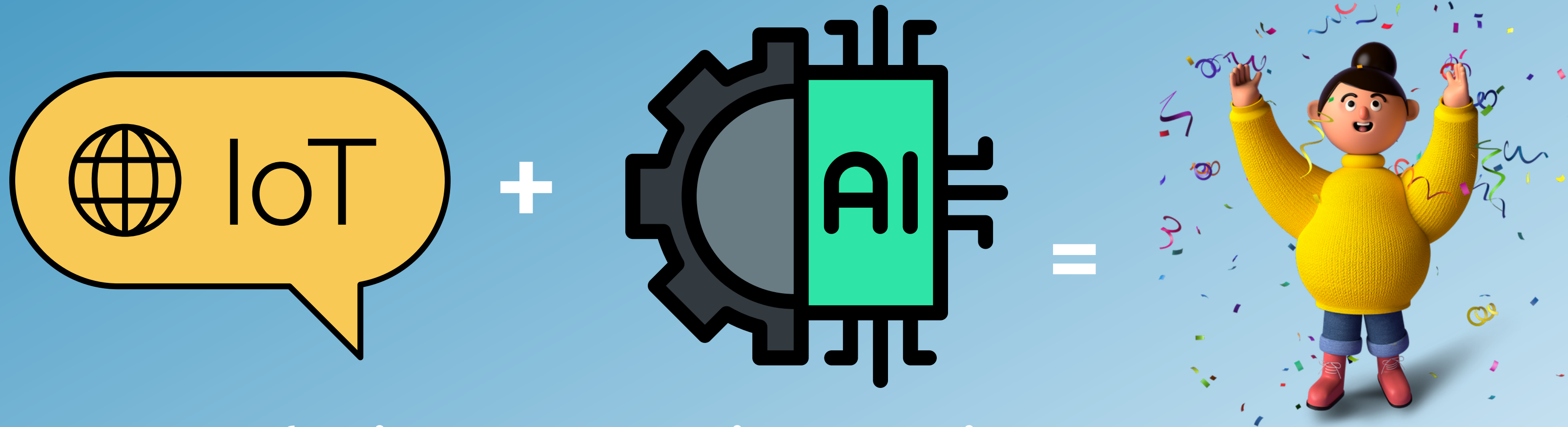
Idea Description

2. Catalytic Converter Theft Prevention

- To deal with the increasing robbery of Catalytic Converters in India, we're using the same development board to handle this problem.
- We'll attach a **set of contact pads** on the Catalytic Converter and to the Vehicle.
- In case, the *Catalytic Converter is separated* from the Vehicle, the alert will be generated and cause the following:
 1. Car Siren will be triggered.
 2. The user will get an emergency Alert on his Phone.
 3. The Car Manufacturer/Third Party Service Provider will get the **exact coordinates** of the vehicle and respective departments and concerned persons can be informed for handling the theft.
- Handling the cases, where the catalytic converter is separated from the vehicle, will be done by a *professional/registered mechanic* to ensure that nothing is *damaged/stolen* in the process. This accounts for the **authenticity of the service** of the vehicle.



We introduced, IoT-based design for Catalytic Converters with support of ML and IoT Sensors so that we Save our Environment !



Internet of Things

- ESP32-based microcontroller
- Airflow Sensor
- NOx Sensor
- Oxygen Sensor
- GPS Sensor
- MQ-7 Sensor

Machine Learning

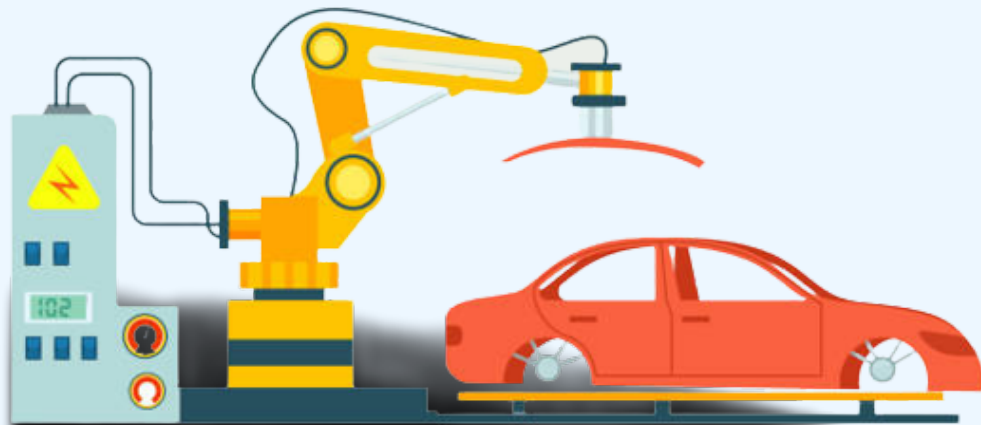
- Gradient Boosting Algo
- Flask for deployment

Our Objectives

- **Preserve Our Planet:** Contribute to a sustainable Earth by reducing harmful emissions.
- **Curb Catalytic Converter Theft:** Safeguard vehicles from theft and illicit trade.
- **Empower Drivers:** Raise awareness and enable eco-conscious driving habits.
- **Promote Sustainable Driving:** Encourage eco-friendly practices for a greener future.
- **Security for Your Vehicle:** Ensure the safety of your valuable catalytic converter.
- **Compliance and Accountability:** Keep vehicles in line with emission regulations.

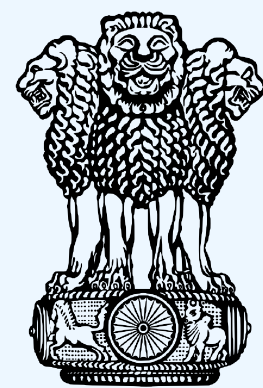


Project Beneficiaries



Vehicle Manufacturers

- Ensuring on-time and authorized service of vehicle
- Gaining Customer's Trust
- Hi-Tech in Industry.
- Easy Maintainance



सत्यमेव जयते

सड़क परिवहन
एवं राजमार्ग मंत्रालय
MINISTRY OF
**ROAD TRANSPORT
AND HIGHWAYS**

Government Of India

- With fewer emissions, this technology will ensure that the pollution caused by vehicles will be reduced significantly.
- Contributing to the Green Initiative of MRTH.



Police Department

- With information on the Crime Location, Police officials can take action in no time.
- The number of Crimes will be reduced significantly.



Prototype Screenshots

Car Health Predictor (This data will be supplied by the sensors)

NO:

NO2:

NOx:

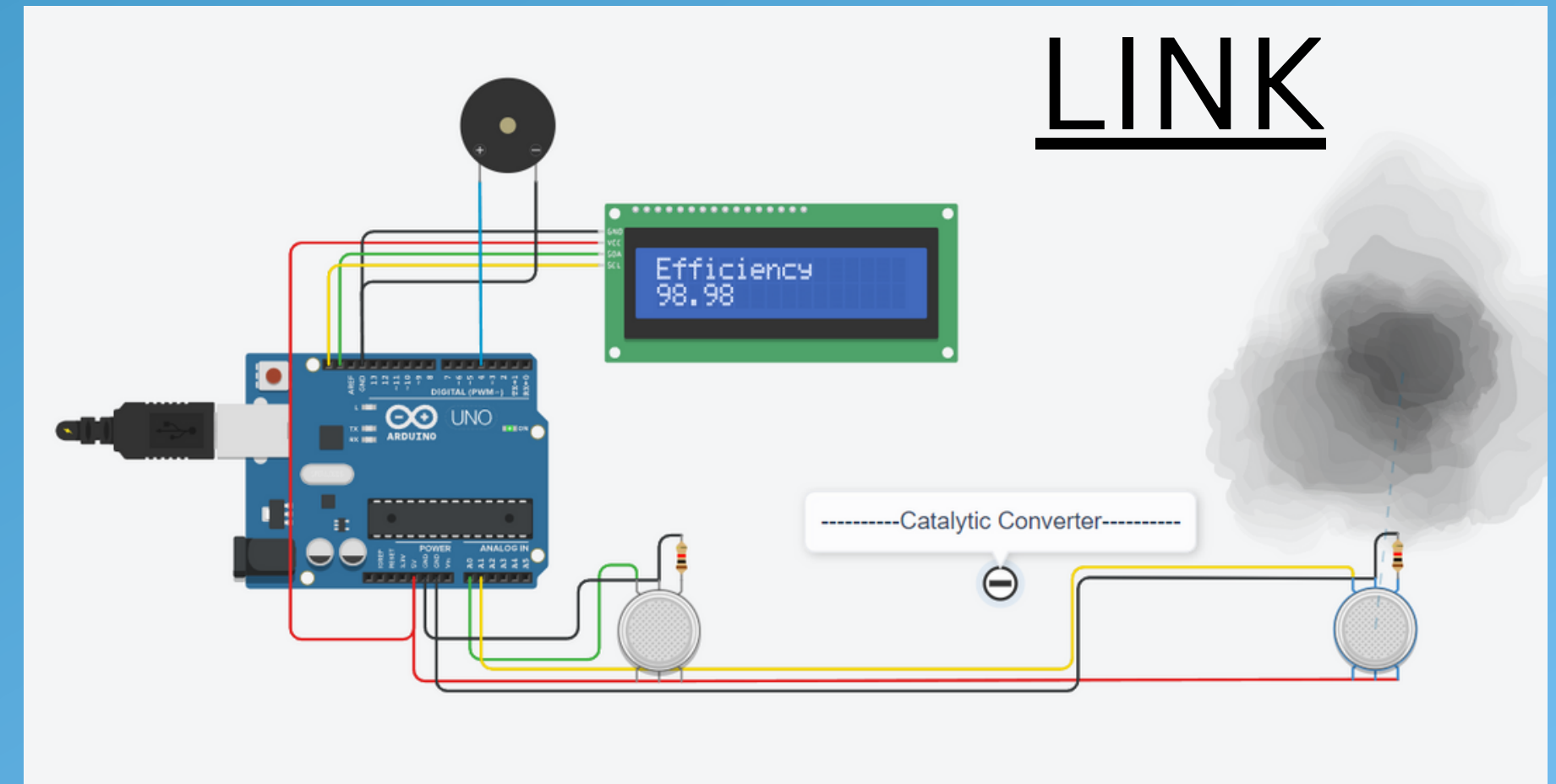
CO:

SO2:

Benzene:

High NOx levels along with benzene emissions may indicate both incomplete combustion and inefficient engine operation, likely resulting in increased fuel consumption.

<https://github.com/Aniket2002/Volkswagen-IT-Challenge>



```
from sklearn.metrics import accuracy_score

# Make predictions on the test set
y_pred = model.predict(X_test)

# Evaluate the model's accuracy
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)

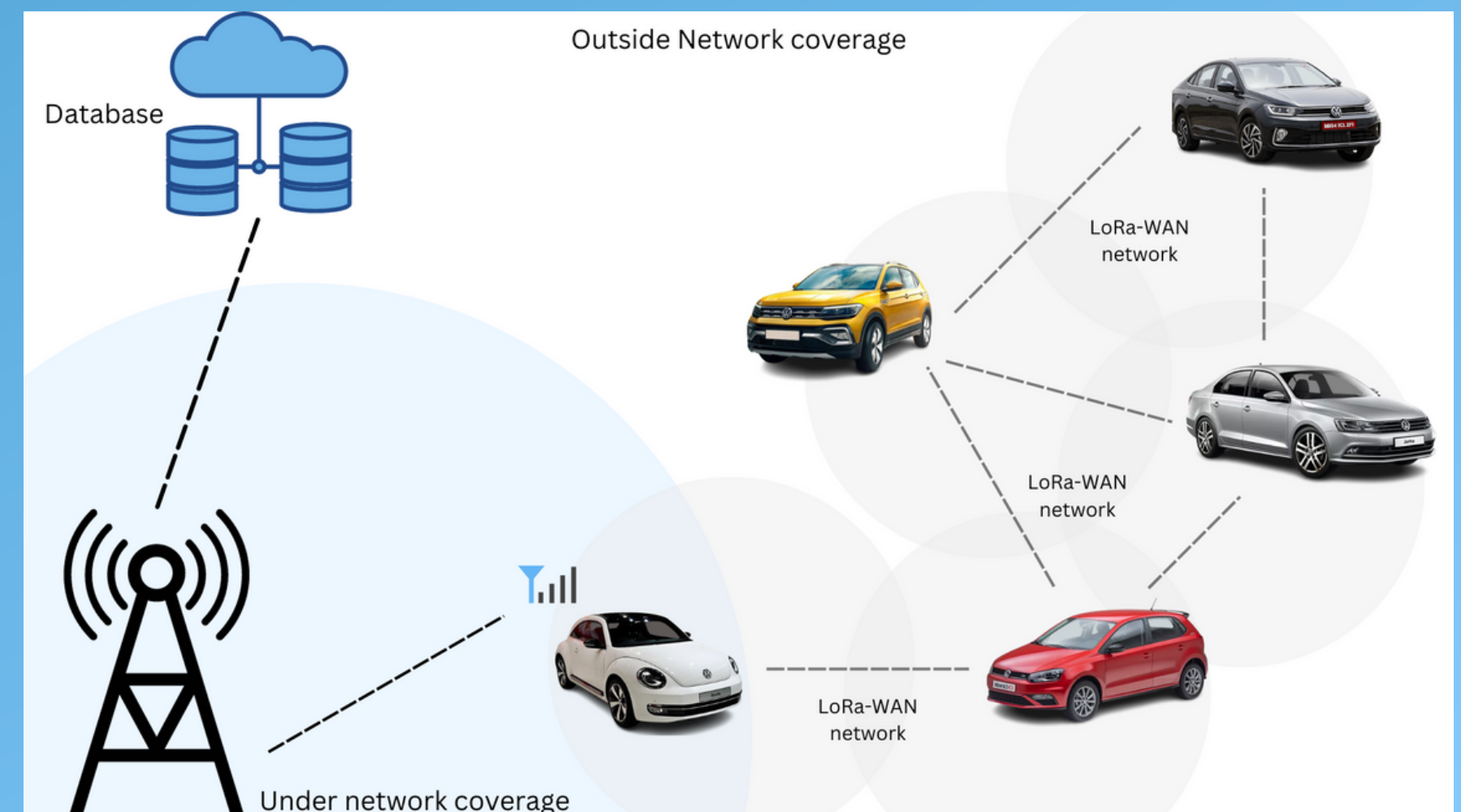
Accuracy: 0.9980099041977137
```



Future Scopes



- Use a **GSM/LTE**-based Development Board that works on a SIM Card instead of a WiFi to ensure remote connectivity.
- Integrate the Development board with the ECU of the vehicle to enable more IoT-based modeling techniques for the Future.
- Create a network of vehicles using **LoRa-WAN** technology to ensure more rigid connectivity. This will create a mesh of vehicles that are interconnected and any one vehicle with internet access can be used as a link between all the vehicles and the internet.





THE END

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| **Team
Beetles**

