

UPGRADED EXHAUST SYSTEM

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PROJECT ABSTRACT

- It solves the problem of excess carbon particulate matter in the air which is a grade 1 carcinogen, thus improving the air quality. It also enables the usage of older diesel vehicles in cities with strict emission laws.
- We're designing an upgraded exhaust system for Diesel cars which reduces the soot developed as a result of the engine combustion. The soot is collected in periodical service re-generations which is later treated with oil to develop ink.

An IOT module would be implemented in this project to track the amount of soot produced, the time until the next service and to measure the volume of carbon footprint flowing through the exhaust.

The exhaust can be attached over the existing exhaust of the car and is so designed to reduce the engine back-pressure by using perforated tubes placed in a hexagonal close packing.

- The upgraded exhaust system is ideal for people who still want to drive their old cars in cities with emission control restrictions.
- The soot collected can be given to us and imbursement will be provided to the customer which will help the public and the service sector customers. Moreover, the impact the product will have on the world is immense as it curbs the carbon emission from vehicles which amounts to about 35% of all the factors

MARKET ANALYSIS:

1. Customer Need Identification:

Recently, a law has been passed in the Delhi NCR region to ban 10-year old Diesel vehicles by the Central Pollution Control Board terming the region's air quality as very critical. This will force the vehicle owners to scrap their old cars and buy newer ones. A properly maintained vehicle lasts about 20 years. This results in wasting energy in producing cars every 10 years just for the sake of controlling emissions.

There was a need to control emissions in such cars. A lot of solutions were invented to filter the particulate matter but they would end up resulting in a lot of back-pressure on the engine thus decreasing its efficiency.

This resulted in:

- Increased pumping work
- Reduced intake manifold boost pressure
- Cylinder scavenging and combustion effects

This in-turn reduces the life of the car.

A few months back, Paris banned all the diesel cars registered from Jan. 2011 - corresponding to Crit'Air levels 1 and 2 out of 5. That comprised of 60% of the total cars in the city. As the years pass, the emission laws will only get stricter and stricter.

2. Serviceable Addressable Market (SAM)

Identification & Justification:

- **VEHICLE OWNERS**

Due to such laws, a huge market has opened up in the form of old vehicle owners. To control the carbon emission from old vehicles, the filters in market increase the back-pressure and our product would work to actually reduce it to a negligible amount using perforated tubes and arranging them in a Hexagonal Closed Packaging arrangement.

- **PUBLIC & SERVICE TRANSPORT**

While public transport reduces air pollution, it can be even further reduced to a minimum by using our product. Subsidies could be provided for the Service sector workers like the auto rickshaw drivers to buy the product. Moreover, the product is a one-time long lasting investment with weekly imbursements for returning the collected soot.

- **VEHICLE MANUFACTURERS**

Once the product is known widely through our first customer base, we will start selling the product to the manufacturers directly. The Auto Rickshaws will be already fitted with this product and hence it would benefit the drivers and public.

- **INDUSTRIES**

It can be extensively used in Diesel generators in industries which emit a lot of particulate matter at its exhaust. The space constraint for this model is minimal, hence the estimated time for soot recollection increases drastically. It benefits the industry owners in a way that they can still meet their Carbon Credit Cap with more number of generators in stock.

3. Product Differentiation w.r.t. Competition &

Justification:

Numerous solutions have been implemented for reduction in particulate matter ejected from the exhaust. The ones implemented in cars cause a significant back-pressure in the engine thus decreasing its efficiency rendering the product useless. Our ESP design is developed by taking the overall car's efficiency into consideration right from its engine to the catalytic converter and the Diesel Particulate Filter. The product uses perforated tubes with a larger area of contact arranged in a Hexagonal Close Packing, which reduces the back-pressure significantly. This could be a feasible replacement for a final treatment device in a diesel exhaust.

4. Understanding of your customer & user

| | | | | |
|-----------|----------------|-------------------------------|----------------------------|------------|
| CUSTOMERS | Vehicle Owners | Truck owners (Service Sector) | Government (Public Sector) | Industries |
| USERS | same as above | Truck drivers | Bus Drivers | Workers |

5. Distribution Channel Identification

We will be directly selling our product to the consumers. After a two year steady growth, we will be targeting an approach of selling through intermediaries. That is, we will be making annual, bi-yearly or quarterly deals with the car manufacturers which then will provide an option for the consumers and/or will make the product compulsory in all their cars.

TECHNICAL DETAILS

● Product Brief:

The product consists of an electrostatic precipitator inside a small ceramic barrel attached at the end of vehicle exhaust along with a meager controller box attached to the underside of the automobile. It is powered by the principal automotive's battery and uses the collected soot from the cartridge to produce ink.

The exhaust quality, filter status, carbon content, and cartridge life is timely sent via push notifications to the user. Allowing them to refill and clean and reimburse their old cartridges for the new ones at relatively small sums of money.

Core Technical Innovation:

Electrostatic precipitator's collector and ionizing cartridges in a hexagonal close packing structure for reduced back pressure on engines.

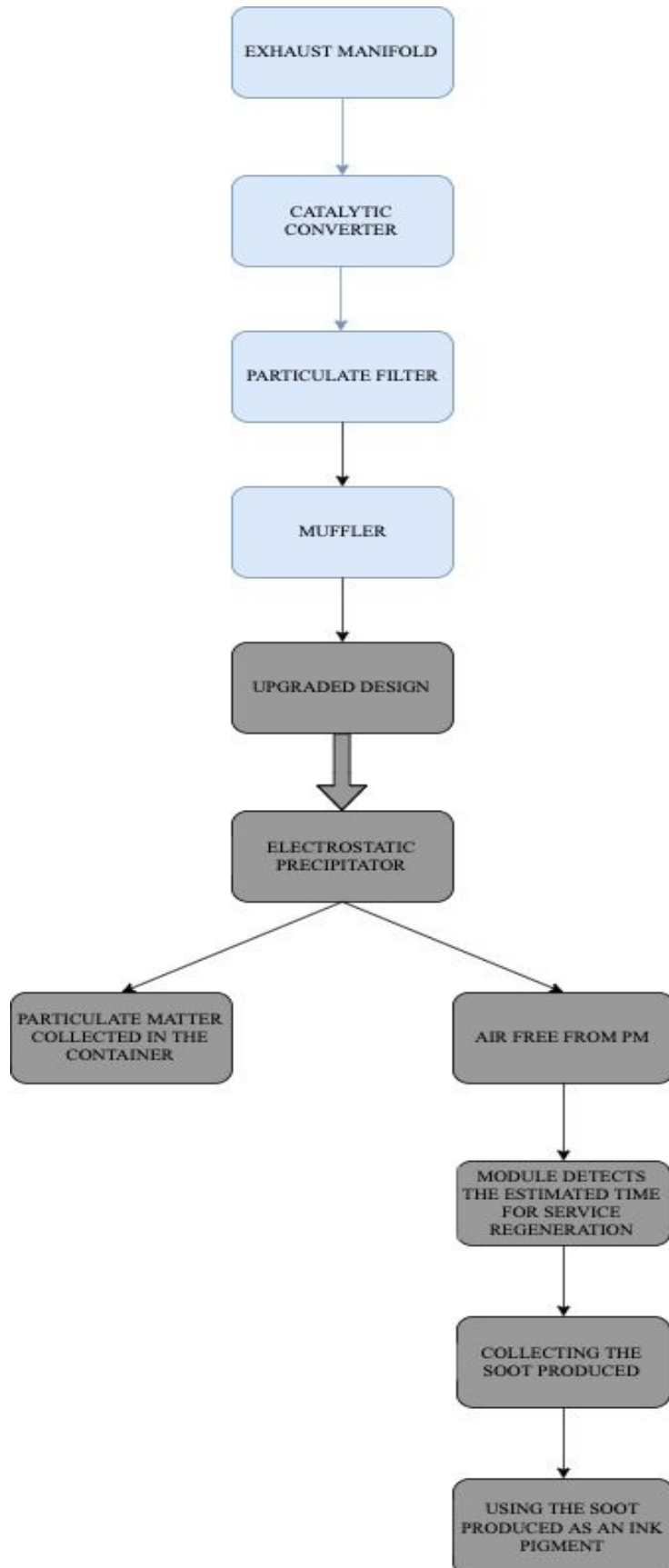
Uniqueness in the design:

IoT enabled, cheap feasible electrostatic precipitator with adaptive sensors to notify the status of collector cartridge. The product is optimized to aid engine performance along with the filtering.

Objective:

In wake of extensive air pollution from vehicles and alarming rates of deteriorating air quality along with stricter government norms and laws we aim to reduce air particulate matter released from vehicles by using relatively cheaper smarter and convenient electrostatic precipitators which will collect soot and other polluting particulate matters, the cleaning cartridge will have to be timely cleansed or replaced the collected carbon will be used to make ink, and the end user would be given subsidy for newer cartridges.

● **Proposed Design (Block Diagram):**



● **Innovativeness of the Proposed Solution**

So far the only alternatives to diesel soot collections on a vehicle are particulate filters, NSR, and DE-NOx systems. These alternatives are fairly expensive, customized and not affordable by the common citizen, along with high and cumbersome maintenance charges and challenges, our product's maintenance is plug and play and user friendly, puts very little to no backpressure on the engine and is affordable by the common citizen very little customization needs to be done as the control module takes care of the emission via a closed loop feedback. Installing is also a relatively less of a hassle as the product has a variable bore size to fit a wide range of exhausts.

● **Impact of the proposed solution**

This product has an extensive market potential as it enables the usage of diesel engines in cities with strict emission laws for. The ink generated as a by-product has a revenue of its own. Moreover, the impact it has on the environment is enormous as it contributes to a cleaner air by removing particulate matter.

TI COMPONENTS NEEDED:

| TI part number | Its role in the project | Number of Components |
|-----------------------|--------------------------------|-----------------------------|
| MSP430 + wifi module | Controller module. | 1 |

NON-TI COMPONENTS NEEDED:

| Component name | Its role in the project | Number of Components |
|---|--|-----------------------------|
| Perforated cartridge | Works as an ionizing cartridge | 2 |
| Ceramic Barrier | Works as a casing sheet for the product. | 1 |
| High voltage Arc Circuit | To produce extremely high voltages for ESP. | 1 |
| OMRON D6FPH Differential Pressure Sensor. | Indicates status of collection cartridge. | 1 |
| Steel Pipes and Wires | Forms the outer cover of the product. | 1 each |
| SHARP Dust Sensor | For monitoring the Air Quality Index and the flow of particulate matter. | 2 |