



# USING THE DEFERENTIAL EQUATION, BUILDING A MECHANICS SUPPLY CHAIN USING A CROSS-PLATFORM VROOM APPLICATION

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## Abstract

We tested our backend to discover the nearest mechanic based on a user's geolocation and found that our algorithm always returns results under 12000 milliseconds. This is incredibly efficient and may be utilised in production. On a lengthy drive, your vehicle breaks down and you look for help, but no one comes. Just remember us once, and we'll be there to rescue you from such a dilemma and save your vacation from becoming a nightmare. By clicking on your phone, you may fix this difficulty and enjoy your journey. You wake up to flat tyres or a dead battery, but there's a Doorstep Pick-up and Drop facility, so no more workshops/garages. Get your car fixed or a new body component installed at your doorstep at a competitive price. During a pandemic, mechanics too struggle to locate customers. Creating a supply demand chain for mechanics is needed. People confront unreasonable pricing for body parts, and more than half of clients prefer multi-brand service centres over brand-authorized repair centres. The multibrand vehicular repair sector has significant potential, and we want to target this area with technology to create a win-win situation for all stakeholders (Users, Mechanics, Company).

**Keywords:** mechanics, supply and demand, Location based mechanic app.

## 1. INTRODUCTION

In today's world, smartphones have become highly accessible. With just a few taps, you can get multiple items delivered at your doorstep. Be it food, clothing, electronics, everything is available online. Then why not we think of getting mechanic help online. Wont it be convenient if you are a working member of your family who gets Sunday for rest and instead of going to a garage and spending hours for repairs and wasting your holiday, it would be better if mechanic comes to your house, gets your vehicle, fixes it and drops it at your doorstep.

As a mechanic, it's really difficult to get repair works especially in times of pandemic. On the other hand, people too are reluctant to go out of their houses due to the pandemic situation. This is where we want to come into picture and make it a win-win situation for mechanics and the customers. Mechanics would get more repair works via our application. On the other hand, customers will get convenience and a hassle-free experience without having to step out of their houses.

Even if it's not a major breakdown, some people might need to have small fixes like fixing the headlights, or adding fog lights and so on. For these issues, people have to go to the garages and wait for long. Instead, we aim to change this situation and thus improve the entire experience with vehicles. By our mobile application, we would pair the customers who need help with the mechanics located nearest to them. No need to push the

cars and no need to pay unfair prices. All they need to do is a few taps on their smartphone. And in case there's no cellular network, customers can call our emergency number and get special help.

## 2. PROBLEM STATEMENT

### Vehicular Breakdowns

Most of the people experience a vehicle break down at least once in their lives. We've all seen the cars abandoned at the side of the road, hazards flashing and the owner trudging down the motorway with a fuel-can swinging by their side. And it doesn't look fun. Sometimes, the roads are deserted and mechanics are hard to find. Besides, it might happen that cellular networks are unavailable in that area.

### Unfair Prices of Vehicle Parts

Another problem that we are focusing is the unfair prices of vehicle body parts. Most of the authorized showrooms charge huge amounts under the name of authenticity and fitting charges. As a result, customers end up paying a lot more than needed. Post the guarantee period, 65% of customers visit multi-brand car service companies and only a small chunk of 35% return to the authorized ones [1]. Thus, a majority of customers are unsatisfied and creates a demand for players like us.

### Demand Supply Gap

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Customers face difficulty finding the mechanics and Mechanics face difficulty finding their customers because of the unorganized nature of the mechanic shops and nearly no advertising of these shops.

### 3. LITERATURE SURVEY

#### *Huge Time spent on repairs*

According to AAM Annual Report 2013, 70% of the vehicular repairs are resolved immediately which are classified as minor failures [2]. However, plenty of time is spent on finding the mechanic and towing the car to the garage (if needed). Thus, people face a lot of hassle even for small breakdowns. This may become one of the worst experiences in case the vehicle breaks down when people are on time bound journeys.

#### *65% Indians prefer multi brand service companies*

According to Ken Research [1], post the guarantee period, 65% of Indians prefer multi-brand service companies over the authorized service centers which charge 40% more [3]. The number of post warranty cars is anticipated to witness a Computed Annual Growth Rate (CAGR) of 3% during the period FY'20 - FY'25 [1]. This assures that Vroom has a lot of potential demand in the upcoming future.

#### *People hugely unsatisfied from Car Brand Authorized Centers*

According to survey by Mehrani and Azma (2014) [4], 56% were not satisfied with the after sales service provided by the showroom, 40% of the customers agreed that staffs were not available in timely manner, 20% said that they had to extra charge which were not needed, 26% agreed that they could have cheaper services rather than showroom, 44% agreed that staff took longer time to deliver the vehicle, 22% agreed that staff were not so skilled, only 26% of people were satisfied with the services. This again assures the potential demand for Vroom in the future

#### *Meagre wages of Mechanics*

The median salary of a mechanic in India is 10,900 INR per month, which means that half (50%) of people working as Mechanics are earning less than 10,900 INR while the other half are earning more than 10,900 INR. A great reason for such unstable income was not finding the customers near them. 60% of them were not able to make stable wages as they did not have a good reach or not having consistent customer. Vroom aims to help them find customers 24\*7 and also ensure fair pay.

### 4. PROPOSED METHOD

#### Existing Systems

Most of the existing systems have partnered with a few partners across some selected cities. However, no organization has tried to pair the mechanics and the customers based on location and creating a supply chain of mechanic services.

#### System Objectives

We will make a cross platform application using React Native and backend using NodeJS and ExpressJS. This application will enable all those people with vehicular

breakdowns to request for help. Once help is requested, the mechanic nearest to the user would be paired with the user. The mechanic would then visit the location of the user, tow the vehicle and deliver it back after getting it repaired. Also, the user can buy body parts available in our application and get them fitted at his/her doorstep at fair prices.

#### Advantage of Proposed System

The advantage of our proposed system is that:

1. Users would experience a hassle-free repair work and most importantly save their time.
2. Mechanics reach of customers increases significantly amidst the city. Mechanics who usually don't have big shops would get noticed through our app. Also, most mechanics aren't listed on major map applications.
3. Entire system of multi brand service centre would be hosted online which would result in a one stop solution for users.

#### System Architecture

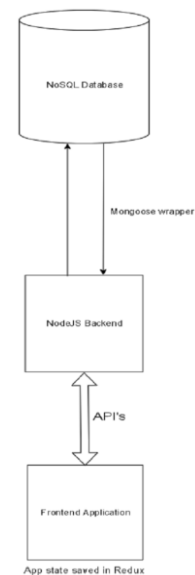


Figure 1 System Architecture of Vroom Application

#### System Requirements

Our application requires the following system requirements:

- Desktop
  - Chrome (>=91)
  - Firefox (>=80)
  - Edge (>=88)
  - Opera (>=73)
  - Safari (>=11.1)
- Android: >= 6.0 Marshmallow
- iOS: >= 12.5

### 5. IMPLEMENTATION

We implemented the following modules in our cross-platform application:

1. Login/Signup: It will enable the users and mechanics to sign up and login to their respective accounts. While signing up, essential information would be taken from the end user.
2. Request Help module: It will enable the users to request for help in case of vehicular breakdowns.
3. Shop module: The users would be able to shop for body parts online through this module.
4. Car Price Estimator Module: This will enable the users to check the current price of the car.
5. Billing Module: This module will help the mechanic generate a bill based on our fair price policy and enable the users to pay it online via payment gateways.

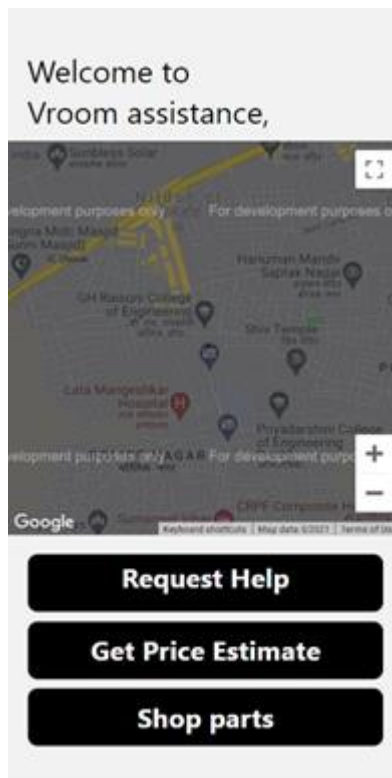


Figure 2 User Dashboard in Vroom App

Figure 3 Car Price Estimator in Vroom App

Our application emits longitude and latitude of both user and the mechanic every 5 seconds to the backend server. This way, we provide real-time location on our application. Location is stored in GeoJSON format in the database. GeoJSON is a format for encoding a variety of geographic data structures which is built in by default in our NOSQL database MongoDB [5]. It is highly fast and helps us in finding the nearby mechanics within a specified radius of kilometers.

While requesting for help, a cost quote is shown to the user. This cost is estimated depending on the distance of mechanic from the user. The cost criteria are given as follows:

Base Inspection Charge: Rs. 300

6. Visiting Charge:

- Distance less than 50km: 8Rs/km
- Distance greater than 50km: 10Rs/km

Once user agrees to the quote, the paired mechanic is on his way to the user's location to get the vehicle and tow it to the garage.

On the other hand, if the user wants to order some body parts like headlights, fog lights, all he/she has to do is order these parts and then the mechanic would go to their location and get it fitted.

So, we have successfully been able to pair the customers who need help with the mechanics who are willing to get repair orders based on the geolocation.

## 6. TESTING

We tested our backend to find the nearest mechanic based on a user's geolocation and we found that our algorithm always gives output under 12000 milliseconds. This is very efficient and can be used at production

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