Real-Time Remote Nationwide Highway Road Maintenance Monitoring System

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Author Note

Simple Idea to save highway infrastructure maintenance cost

Abstract

Using ML, AI, and Bigdata, we can build an application that monitors highway road conditions on a 24\*7 basis.

This monitoring application can figure out the initial destruction signs at an exact road map (like initial cracks or damage in the road) using readily available real-time vehicle GPS streaming data.

And depending on feed maintenance budget and priority, this system will keep issuing the required quick maintenance work order or alerts for the road maintenance crew.

**Introduction:**

**Current Problem :**

Under staff counts of the road authorities inspectors, to perform inch by inch highway road inspections of the same area daily, which results in growing maintenance backlogs and estimated maintenance costs.

**Current Challenges:**

1. The current monitoring team is not focusing on minor road cracks (like stopping tiny sparks can prevent the forest burns); instead of this they are focusing on significant road damages to open the repair ticket for the maintenance backlog
2. inspectors are monitoring the roads/area on a quarterly or yearly basis.
3. Hight ticket work orders for vendors (to fix only considerable damages) and leave unconsiderable road wear & tears to become substantial damages during the next inspection cycle.
4. The lessor or no direct involvement of volunteers forces to help in road maintenance works (due to requirement of road maintenance skills or heavy equipment)
5. Delay of work allocation due to manual approvals and reporting process.
6. We do not have a proper mechanism to monitor the road's wear & tears during extreme weather conditions.

**Simple Solution for the Problem:**

Using ML, AI, and Bigdata, we can build an application that monitors highway road conditions on a 24\*7 basis. This monitoring application can figure out the initial destruction signs at an exact road map (like initial cracks or damage in the road) using readily available real-time vehicle GPS streaming data. And depending on feed maintenance budget and priority, this system will keep issuing the required quick maintenance work order or alerts for the road maintenance crew or volunteers.

**How ML, AI & Big data is going to solve the problems:**

Nowadays, almost all vehicles use GPS navigation or some types of tracking systems (google map or web bases navigation systems). Usually, this system's data are collected by different big data companies, and we can use this type of data to monitor the road conditions.

How We can use GPS data to monitor road conditions:

usually, GPS data contains navigation & motion coordinates (up-down or shaking movements). We can extract the pattern of shaking activities and location coordinates from all vehicles passing daily between the highway's targeted start & endpoints.

After aggregating and clustering the filtered values and giving these values to trained maintenance detector models, we can determine the type & spot of maintenance required. Depending on budget, resources & skills needed for the work, the AI intelligence technique will open the work order and assign it immediately to on-ground maintenance workforces (including volunteers).

**How we can enable any vehicles for our project:**

We will construct an ideal noice/vibration-free area in our targeted path when any vehicle passes through the perfect no-noise zone. Our algorithms will calculate the exact shaking factor for an individual vehicle. We will use that shaking factor dynamically to compute the equivalent shaking coordinates for all passing vehicles in real-time. In this way, we can get the required data from any cars or vehicles.

**Economic implications:**

* We are going to save dollars and reduce time to market duration by using this Maintainance model.
* By using this model, we can easily involve the public (by using volunteers) for nonskills maintenance work(like clean river movements)
* Reduce heavy machinery cost—since we have a system that can determine the road's initial wear & tears. We can fix the minor damages using small machinery or no machinery before turning it into massive damage.

**Political implications:**

* Government authorities will have accurate road data, so it helps politicians to propose infra maintenance budgets based on data, not artificially created agendas.

**Ethics:**

* A government-authorized road agency will tack the GPS data, and there is a possibility of a system hack or tracking VIPs in real-time. However, we can overcome this if we extract the data related to coordinates and not information about devise names and car pieces.

Resources :

This is my own Idea, and I haven't found any similar idea during my research.

However, I found some related world back documents which gave me an idea on road maintenance work type and costs

<https://documents1.worldbank.org/curated/en/971161468314094302/pdf/339250rev.pdf>

second resource: this resource gave me an idea of how the current road advance monitoring maintenance system is designed

<https://www.diva-portal.org/smash/get/diva2:721368/FULLTEXT02.pdf>