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Smart Road Maintenance: A Machine Learning and IoT based Approach

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Abstract - *Roads should be considered as assets as they play an important role in everyone's lives because it is important mode of transportation. Basically, if you observe any kind of transportation whether it be by Air, by Water or even the new Hyperloop System is difficult to use without road transportation. As other assets roads do require proper maintenance for a proper functioning and security purposes. The Smart Road Maintenance System is a System method for keeping the records and managing the inspections of the road with the use of Machine Learning and Internet of Things. The IoT is used to check the progress of the road maintenance and Machine Learning suggests any improvements to be done for the road maintenance. What is the condition of the asset in the current state? Is it cost effective when compared to paper records? The objective for writing this paper is to provide simple tools for evaluating and maintaining logs for the work done. To accomplish these objectives is the main task of this research paper. The proposed System addresses for storing of data related to road maintenance like what was maintained on which road, along with the date, contract company, total cost, etc. and it uses this data for the future road maintenance issues using Machine Learning Algorithms. This can be used for the concept of a smart city which is completely maintained using advanced software.*

***Key Words*: Machine Learning, Internet of Things, Smart Maintenance, Smart City Approach**

1.INTRODUCTION

Roads should be considered as assets as they play an important role in everyone's lives because it is important mode of transportation. Basically, if you observe any kind of transportation whether it be by Air, by Water or even the new Hyperloop System is difficult to use without road transportation. As other assets roads do require proper maintenance for a proper functioning and security purposes. The Road Maintenance Management System is a System method for keeping the records and managing the inspections of the road. What is the condition of the asset in the current state? Is it cost effective when compared to paper records? The objective for writing this paper is to provide simple tools for evaluating maintenance policies. To accomplish these objectives is the main task of this research paper. As we know Digital Recording System for storing records in Database is always better than recording data in paper. The proposed System addresses for storing of data related to road maintenance like what was maintained on which road, along with the date, contract company, total cost, etc.

1.1 Problem Definition

To develop a SQL Road Maintenance Management System which would help in annual maintenance plan for entire road network based upon measurable parameters. To develop a system which keeps record about roads and what work have been done to maintain it previously and what work will be done in future so it would be much easy to access information about a particular road and decide its maintenance accordingly so as to have defined level of service. To build a system which provides you appropriate information when asked for. By building such database you can easily decide what next you need to do to maintain the road properly and how much work has been done so far on rural area roads. This system will also keep record of which are re under maintenance and from when the work started and when it should end.

1.2 Phases

Phase 1: Planning, Analysis, Designing and Implementation.
Planning: Getting strong knowledge of the project title and doing exploration on it, we will get our description.
Analysis: After scrutiny we will first study about it and do some research on the project for our better understanding and getting a rough depiction about what would be our problem definition for this particular project.
Designing: Then we will build the design of the project and agreeing to that, we'll list down all the necessities needed for the creation for the prototype of our project.
Implementation: After gaining the requirements, we first develop a strong record of database on Machine Learning algorithms and thus make it manageable in the system.
Phase 2: Testing
Testing: After the database is ready, we will first associate the GIS with the allotted code and then we will check if it supports the system or not. If not, we will resolve the issues relating to it and we will test it again.
Phase 3: Deployment
Deployment: After completion of Phase1 and Phase 2 of project, real time testing, and operation of the database and software will be done.

2. METHODOLOGY

The employees will be hired for maintaining the records in the System, all the data entries are saved for the further use in the System itself. It would contain all the data recorded during the maintenance of the road including the project cost, project head, agreement company, project cost, etc. When in the further future when a survey is conducted on a road all the data is checked in the evaluation tool. It evaluates the road and assigns it certain points and if they are low the road needs to be reconstructed. All the faults and all the things that are to be maintained or reconstructed are displayed. The results are obtained from the analysis of the survey.

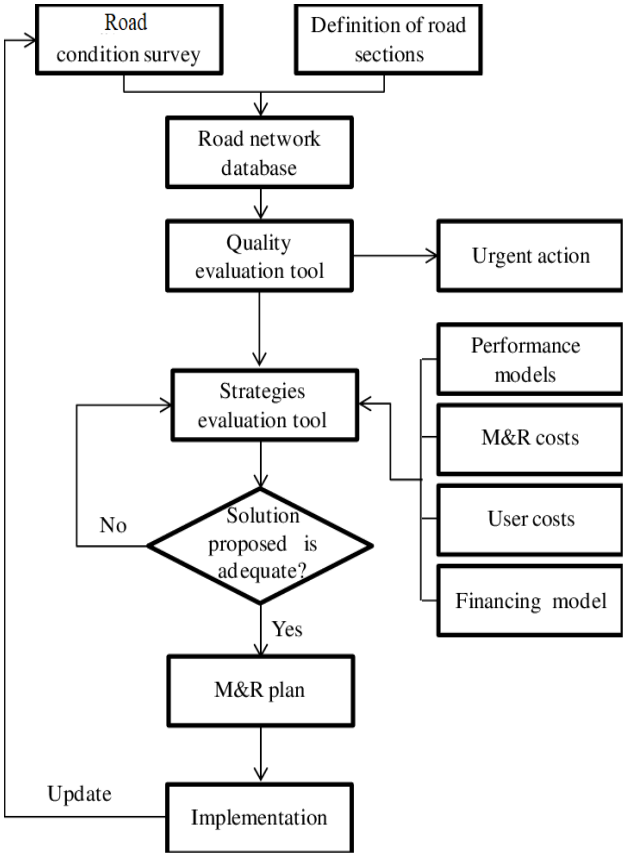


Fig 2.1 System flow

2.1 Evaluation

The maintenance quality depends on direction of maintenance works. The subsequent is that the situation with relevancy effectiveness of direction, work quality and task allocation:

i. Direction engineers square measure accountable for maintenance of roads and road facilities during a certain space. they're able to implement or execute maintenance works, to supervise and control their quality and progress, and to certificate the completion of works victimization drawings, images, and different necessary documents.

ii. Maintenance prices of roads and road facilities square measure reimbursed in line with actual works that square measure dole out touching on preliminary repair and maintenance plan/drawing and its estimated prices.

2.2 Implementation plan

The project implementation arrange is needed to supply the succeeding economic analysis with the projected time schedule supported due procedures like basic/detailed style, resettlement of PAPs, relocation of utilities, tendering method and construction works stemming from a study of the expected construction designing. the subsequent objectives square measure also considered:

i. To supply affordable construction designing and time schedule for whole project.

ii. To supply basic information and knowledge for the economic analysis.

iii. To form an inexpensive scale of improvement, decide to mirror the results of the demand forecast analysis.

iv. To mirror the study results to the conclusion and recommendation.

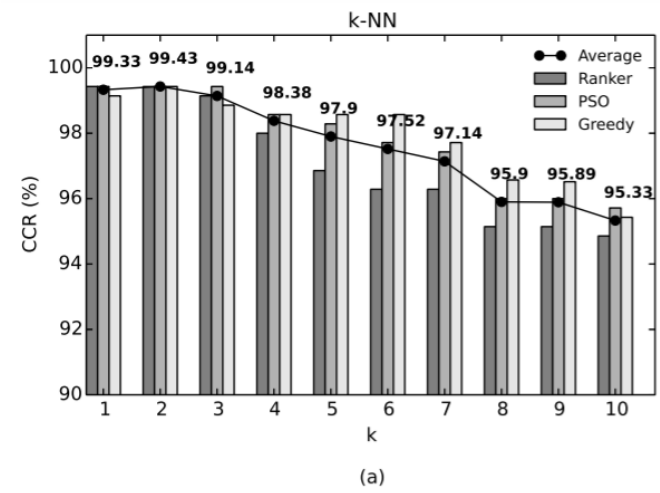
We would be using CCTV cameras for monitoring the road conditions to check the condition of the roads and check their maintenance on schedule. Based on the imaging the system would evaluate the quality of the road and using machine learning algorithms and previous data the system would suggest some improvements on the road maintenance.

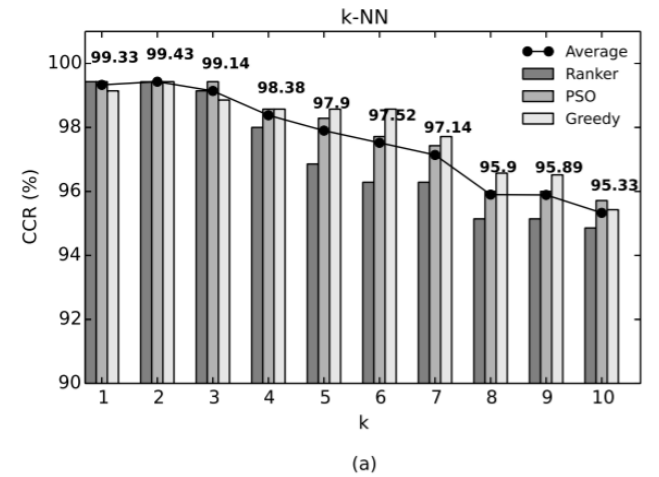
Fig 2.2.1 CCTV cameras and photoradar vehicle detectors.

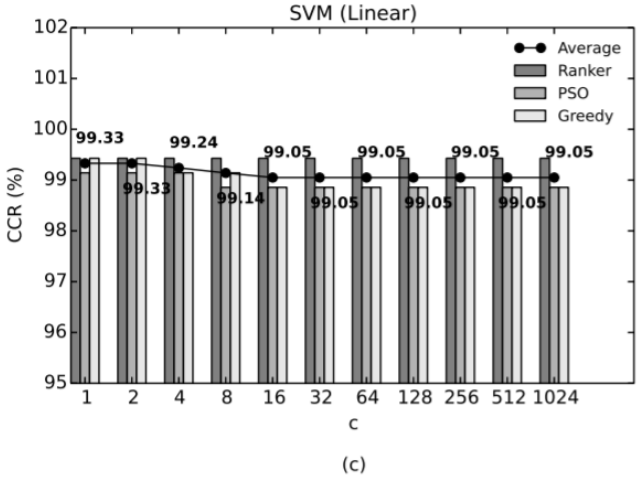
3. RESULT AND DISCUSSIONS

3.1 Performance evaluation of ML Algorithms

The overall performance of the classifiers is measured the use of the Correctly Classified Rate (CCR). CCR is represented as the share of the effectively classified variety of topics divided through the full variety of topics withinside the dataset. in which TP is the True Positive price, TN is the True Negative price, FP is the False Positive price and FN is the False Negative price. In its trade form, TP is the variety of street floor situations diagnosed and T is the full variety of street floor circumstance statistics. As with all device learning-associated experiments, we performed the following phases: schooling and testing. All statistics accumulated are utilized in each phase. For the schooling phase, the category fashions are received through optimizing each of the classifier's parameters. The maximum most desirable mixture of values for those parameters is decided empirically throughout the schooling phase.







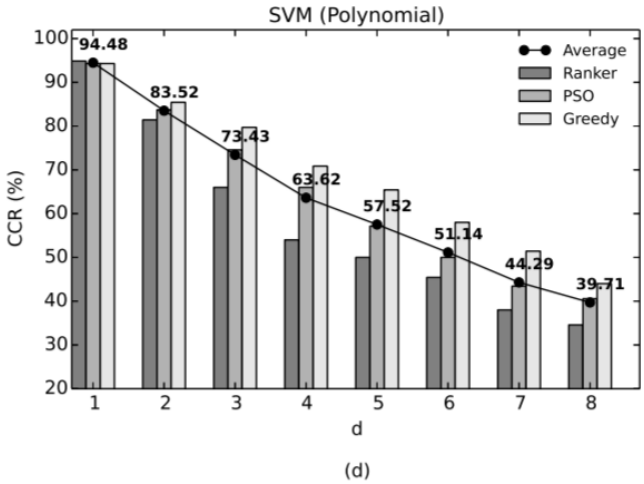


Fig 3.1.1 Correctly Classified Rate for (a) k-NN, (b) Random Forest, (c) SVM (Linear), and (d) SVM (Polynomial) using classification models obtained from training phase.

4. CONCLUSIONS

In this paper, a comprehensive system development for road management system was developed by using open-source software. The free software was used because it is becoming popular these days. Machine Learning become the core part of the system since it can support road data which consist of spatial and non-spatial data. Development of this system involves two parts which are system design and system development. This system will give benefits to road administrator to gather information in a single database. This helps in making decision for new reforms and keeps records clear in front of authorities. At the same time, it can provide a quick view for public users to accordingly analyses and plan their journey. By some specific login details, the administrator from authority departments can update information in the database easily. Only registered users are allowed to update the information in the database to maintain the authenticity and privacy of information. Although only administrator can make changes to the basic

database, but the public can see it on a graphical interface (map) to view the data. Other features such as photos and videos can be uploaded in the database to improve map visualizations.

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