ENHANCING AUTOMOTIVE SERVICE EFFICIENCY WITH PREDECTIVE TIME FORECASTING

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CONTENTS

INTRODUCTION

- Proposed system is created intending to use Service duration Forecasting Model to forecast service time of a vehicle in automotive industry.
- Automotive industry needs to optimize service efficiency and accuracy.
- Proposing approach combining forecasting models and machine learning for vehicle service optimization.

LITERATURE SURVEY

"A comparative study of predictive algorithms for time series forecasting“[1]

- Compared 3 predictive algorithms - Linear Regression, Support Vector Machine, and Multilayer Perceprtone for time series forecasting.
- Tested on sample time series datasets related to airline passengers, temperature, and birth rate.
- Not based on statistical forecasting methods.
- Found that the Linear Regression model performed better than SVM and NN overall.
- Limitations include small number of test datasets and lack of model tuning and numerical accuracy metrics.

LITERATURE SURVEY (cntd..)

"A Job Completion Time Estimation Method for Work Center Scheduling" [4]

- Presented methods to estimate job completion times under uncertainty.
- Considered future job arrivals stochastically, reduced scheduling time step.
- Demonstrated on small examples only, lacked implementation details and accuracy analysis.

LITERATURE SURVEY (cntd..)

"Available work time estimation“[5]

- Discussed estimating available work hours before scheduling to improve estimates.
- Identified categories of lost time based on informal surveys.
- Had limitations around limited data, informal methodology, and lack of overhead factors.

LITERATURE SURVEY (cntd..)

"Exact Task Completion Time Aware Real-Time Scheduling Based on Supervisory Control Theory of Timed DES" [6]

- Proposes real-time scheduling methods for safety-critical applications using Supervisory Control Theory.
- Models task execution to capture all possible completion times between BCET and WCET.
- Synthesizes non-preemptive schedulers that recognize exact completion times.
- Aims to reclaim higher unused resources compared to WCET-only models.
- Evaluated on an Instrument Control System example with 5 tasks.

LITERATURE SURVEY (cntd..)

"Duration Estimation Method for Highway Construction Work"

- The paper introduces a novel method for estimating work durations in highway construction projects, addressing the impact of random factors.
- Employs Monte Carlo simulation to quantify the effects of weather conditions on construction work durations
- It illustrate how the method accommodates different starting times for construction activities, reinforcing its effectiveness in estimating durations for highway construction projects.

PROPOSED SYSTEM

- Uses advanced techniques like random forest regression known for accuracy and scalability.
- Models customized based on vehicle type, service history, needs.
- Seamlessly integrates vehicle data like maintenance records for comprehensive analysis.

METHODOLOGY

1. Data Loading and Preprocessing
2. Model Initialization and Training
3. Model and Label Encoder Saving
4. User Inputs and Prediction
5. Model Evaluation and Accuracy

METHODOLOGY(cntd..)

1) Data Loading and Preprocessing

- Import libraries like pandas, sklearn, joblib
- Load dataset, encode categorical features
- Logically split into attributes (X) and target variable (y)

METHODOLOGY(cntd..)

2) Model Initialization and Training

- Use random forest regressor
- Define parameters like number of estimators, random seed
- Fit model on training data (X_train, y_train)

3) Model and Label Encoder Saving

- Save trained model as 'rf_model.pkl'
- Save label encoders in separate files

METHODOLOGY(cntd..)

4) User Inputs and Prediction

- Get inputs on vehicle model, age, service type etc.
- Organize the user-provided inputs into a structured dataframe, which will be used as input to the predictive model.

METHODOLOGY(cntd..)

5) Model Evaluation and Accuracy

- Evaluate the model's performance to ensure its accuracy.
- The accuracy can be measured in terms of R-squared.

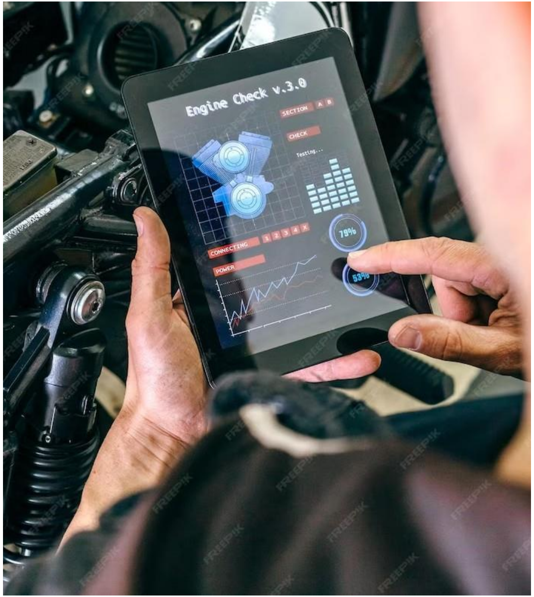
$$\mathbf{R2 = 1 - (\Sigma(y_i - \hat{y}_i)^2) / \Sigma(y_i - \bar{y})^2}$$

Where:

- R2: R-squared, a measure of goodness of fit.
- y_i: The actual values (service times) from your test dataset.
- $\hat{y}_i$: The predicted values (service times) generated by your model.
- $\bar{y}$: The mean of the actual values (service times).

RESULTS AND DISCUSSION(cont..)

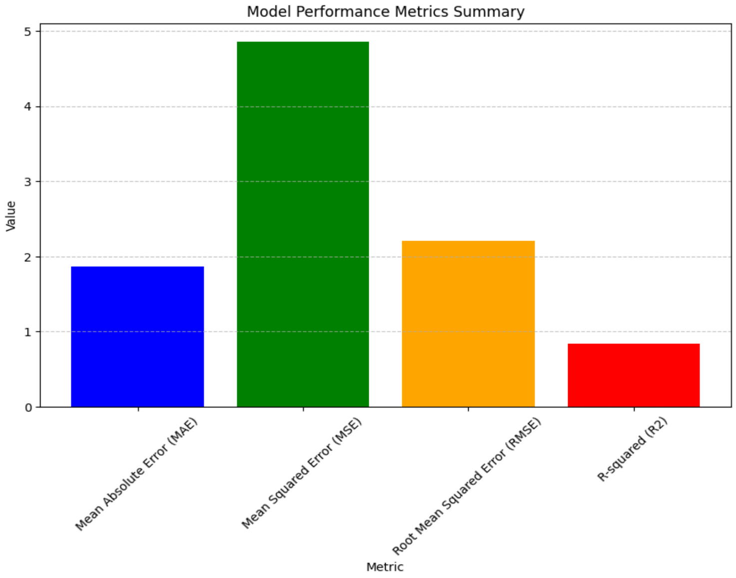
- In line with best practices, we divided our dataset into 80% for training and 20% for testing purposes.
- We trained our predictive model using a Random Forest Regressor, a robust machine learning technique known for its predictive accuracy and scalability.
- The R-squared (R2) score of approximately 0.84 highlights that a significant portion of the variance in service times is predictable based on the input features.



RESULTS AND DISCUSSION(cont..)

- **Mean Absolute Error (MAE):** The MAE is a reasonable 1.8616, which suggests that, on average. A low MAE indicates good predictive performance.
- **Mean Squared Error (MSE):** The MSE, with a value of 4.8566, also indicates relatively small prediction errors. The square root of the MSE (RMSE) is 2.20, suggesting that, on average. This value is reasonable.

RESULTS AND DISCUSSION(cont..)



CONCLUSION

- We developed a predictive model for estimating service times in the automotive industry, offering a valuable tool for optimizing service efficiency and reducing uncertainty in maintenance schedules.
- The predictive model is based on a Random Forest Regressor, a machine learning technique known for its accuracy and scalability. This approach is tailored to specific vehicle types, service histories, and needs.

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Thank You.