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Optimising the Mobile Cab Rental System App using Particle Swarm Algorithm

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Abstract

Abstract: The cab rental system has undergone a sea change in the last decade from the manual system to internet based online based system. In mobile app cab rental system, companies like Uber and Ola, the customers and drivers are connected with the pre-determined fare and cab is reached within specified time. Provision for payment is done digitally and as well as through cash. The cab rental mobile app is user friendly and satisfying the customers. However because of last minute booking cancellations of late the customer satisfaction service is getting affected. The problem is further aggrieved with the cab cancellations close to the trip start time, thereby causing passengers inconvenience. The problem could be tackled by accurately classifying the data of cab bookings using data mining techniques. For this Particle Swarm Optimising Technique is suitably modified and implemented for forecasting the booking cancellations.. The modified Particle Swarm Algorithm is compared with CSO, GSO and ACO. The proposed Algorithm showed better results in terms of Sensitivity, Specificity and Accuracy, so as to satisfy the customers.

Keywords: Car Rental System app, Booking Cancellations, Data Mining Techniques, Particle Swarm Optimisation Technique,

1. Introduction

The cab rental system has undergone a sea change in the last decade from the manual system to internet based online based system. The traditional cab rental service is highly manual and here the customer register for the cab by phone or come directly to the office so it took a lot of time and resources and also related each process requires different resources causing the existing report data becomes difficult to manage. Then came the online cab rental system in which the customer place requisition for cab on line and the travelling agent office arranges the cab and drivers and send to the customer place. The payment is directly sent to the cab rental offices. With the advent of GPS and increased Internet speeds, the mobile apps of car rental systems have emerged and completely replaced the traditional manual and online rental systems. In mobile app cab rental system, companies like Uber and Ola, the customers and drivers are connected with the pre-determined fare and cab is reached within specified time. Provision for payment is done digitally and as well as through cash. The cab rental mobile app is user friendly and satisfying the customers. However, there are some disadvantages with the existing system. Women safety while travelling, Last minute cancellations by the drivers, travelling different locations are monitored hence privacy of the customer is violated. This need updates for the existing system. In this paper the last minute cancellation problem is addressed and presented solution for this using Data Mining Techniques.

2 Methodology adopted for the Study:

The cab rental mobile app is user friendly and satisfying the customers. However because of last minute booking cancellations of late the customer satisfaction service is getting affected. The problem is further aggrieved with the cab cancellations close to the trip start time, thereby causing passengers inconvenience. The problem could be tackled by accurately classifying the data of cab bookings using data mining techniques and design a predictive model there by forecasting the booking cancellations and take necessary steps so as to satisfy the customers. For this Ant Colony Optimisation (ACO) algorithm, Cat Swarm Optimisation (CSO) algorithm, Particle Swarm Optimisation (PSO) algorithm and Glow worm Swarm Optimising (GSO) algorithms are considered. Because of better sensitivity, the Particle Swarm Optimisation is taken, and modified so as to tackle last minute cab cancellation bookings dynamically. The modified Particle Swarm Optimisation is implemented using Python Language and compared with ACO, GSO and CSO. The modified PSO showed better Results in terms of Specivity, Sensitivity and Accuracy.

3 Optimization Algorithms

There are two types of Optimization algorithms in Swarm Intelligence. See Fig. 1. The first one is Ant Colony Optimization (ACO). Here the algorithm is based on the collective behavior of ants in their colony. The second technique is Particle Swarm Optimization (PSO). In PSO, the focus in on a group of birds. This group of birds is referred to as a '*swarm*'. Let's try to understand the Particle Swarm Optimization from the following scenario. Suppose there is a swarm (a group of birds). Now, all the birds are hungry and are searching for food. These hungry birds can be correlated with the tasks in a computation system which is hungry for resources. Now, in the locality of these birds, there is only one food particle. This food particle can be correlated with a resource. As we know, tasks are many, resources are limited. So this has become a similar condition as in a certain computation environment. Now, the birds don't know where the food particle is hidden or located. In such a scenario, how the algorithm to find the food particle should be designed. If every bird will try to find the food on its own, it may cause havoc and may consume a large amount of time. Thus on careful observation of this swarm, it was realized that though the birds don't know where the food particle is located, they do know their distance from it. Thus the best approach to finding that food particle is to follow the birds which are nearest to the food particle. This behaviour of birds is simulated in the computation environment and the algorithm so designed is termed as Particle Swarm Optimization Algorithm. These algorithms include Genetic Algorithms (GA), Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Differential Evolution (DE), Artificial Bee Colony (ABC), Glowworm Swarm Optimization (GSO), and Cuckoo Search Algorithm (CSA).

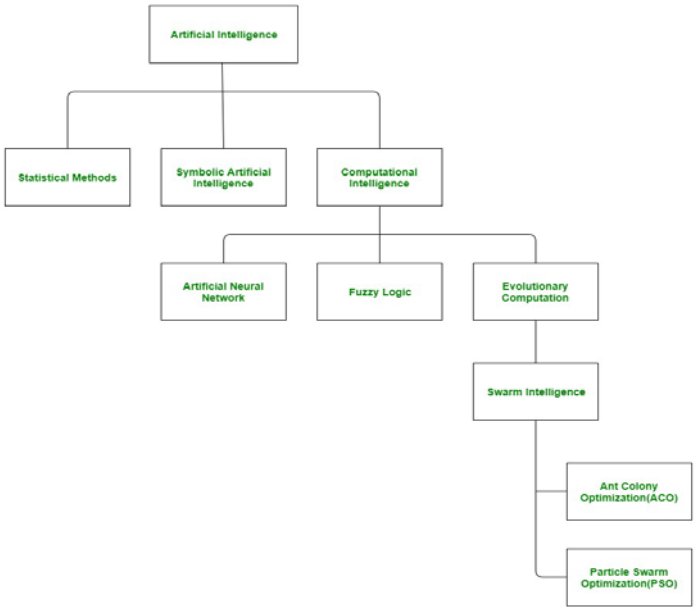

Fig. 3.1: Optimisation Algorithms

For our cab reservation cancellation system, to predict the cancellation, we have studied the Particle Swarm Optimisation Algorithm (PSO), Cat Swarm Optimisation Algorithm (CSO), Ant Colony Optimisation Algorithm (ACO), Glowworm Swarm Optimisation Algorithm (GSO) and Modified Particle Swarm Optimisation Algorithm) (MPSO), compared the algorithms. All the Algorithms are implemented using Python language. The matrics used for comparing above algorithms are Specifivity, Sensitivity and Accuracy. The implementation results are presented below.

4. Test Results and Analysis

Comparing all other optimization PSO is efficient one, in this cab rental system optimization some important parameters are measured they are specificity, sensitivity, precision and accuracy. A modified particle swarm optimization (MPSO) here so named as modified swarm optimization is compared with other swarm optimization (i.e.) MPSO, CSO, GSO, ACO, PSO and result is analyzed.

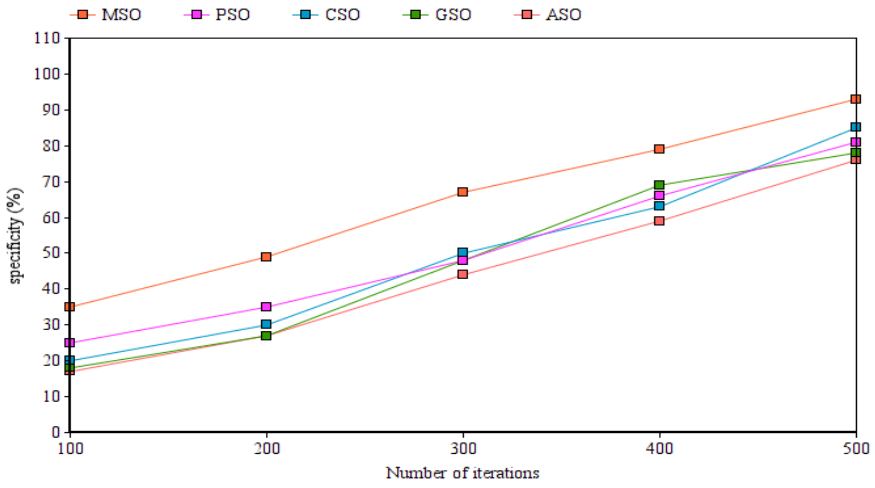

Figure 4.1: No. of iteration V/S specificity

The figure 5.1 shows the no. of iteration v/s specificity. In the below graph specificity shows 90% in 500 th iteration. Comparing with other optimization technique the modified particle swam optimization gives the better specificity. Table 5.1 shows the comparison result of swarm optimization with specificity.

Table 4.1: Comparison result of swarm optimization with specificity

Swarm Optimization	**Specificity (%) at 500th iteration**
ACO	64.289
GSO	72.106
CSO	85.6
PSO	88.564
MSO	**90.21**

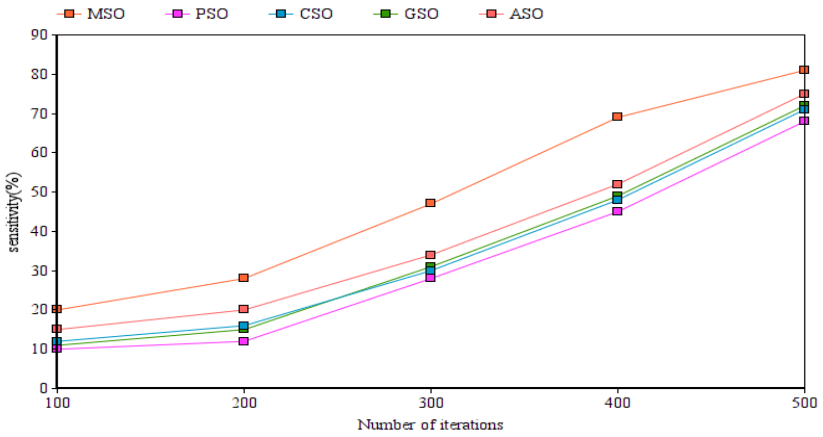

Figure 4.2: No. of iteration V/S sensitivity

In figure 5.2 shows the number of iteration v/s sensitivity in this the sensitivity factor of MSO is higher than other optimization. It has a value of 82.53% specificity. Table 5.2 shows the Comparison result of swarm optimization with sensitivity

Table 4.2: Comparison result of swarm optimization with sensitivity

Swarm Optimization	**Sensitivity (%) at 500th iteration**
ACO	70.015
GSO	73.45
CSO	77.485
PSO	80.866
MSO	**83.153**

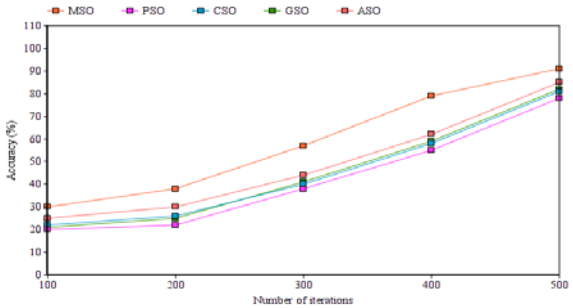

Figure 4.3: No. of iteration V/S Accuracy

The number of iteration v/s accuracy shown in figure 5.3.Here, the sensitivity factor of MSO is higher than other optimization. It has a value of 90.9465% accuracy. Table 5.3 shows the Comparison result of swarm optimization with accuracy.

Table 4.3: Comparison result of swarm optimization with accuracy

Swarm Optimization	Accuracy (%) at 500th iteration
ACO	78.489
GSO	83.784
CSO	88.805
PSO	89.01
MSO	**90.9465**

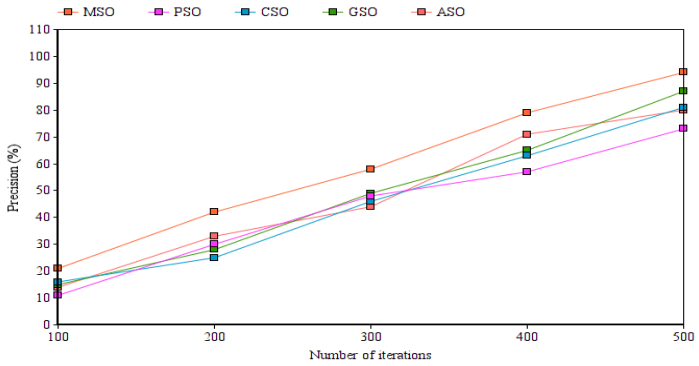

Figure 4.4: No. of iteration V/S Precision

The number of iteration v/s precision shown in figure 5.4.Here, the sensitivity factor of MSO is higher than other optimization. It has a value of 91.741% precision. Table 5.4 shows the Comparison result of swarm optimization with precision

Table 4.4: Comparison result of swarm optimization with precision

Swarm Optimization	Precision (%) at 500th iteration
ACO	71.456
GSO	74.845
CSO	81.7456
PSO	85.84
MSO	**91.741**

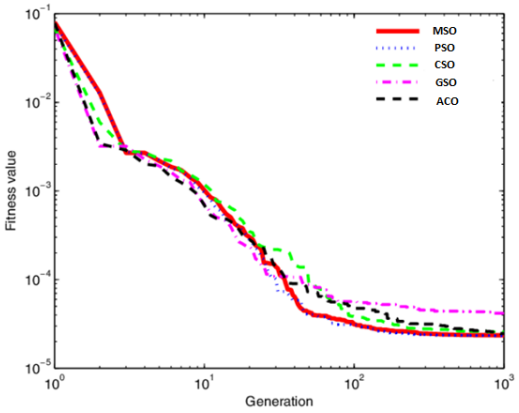

Figure 4.5: Convergence graph of swarm optimization

In numerical analysis, the speed at which a convergent sequence approaches its limit is called the rate of convergence. Although strictly speaking, a limit does not give information about any finite first part of the sequence, the concept of rate of convergence is of practical importance when working with a sequence of successive approximations for an iterative method, as then typically fewer iterations are needed to yield a useful approximation if the rate of convergence is higher. This may even make the difference between needing ten or a million iterations. In figure 5.5 convergences is faster in proposed MSO system than other optimization technique.

5. Conclusion

Cab rental system using application based various optimization techniques has been analyzed. Comparing to the existing system our proposed modified particle swarm optimization technique showed enhanced accuracy result. Convergence is faster for MPSO, so complexity will get reduced. The modified PSO has a better performance in stability and global convergence; it is the most important conclusion. Although the modified PSO do some modifications to two particles' position and velocity, but its convergence rate for the multi-peak function is much faster as compared with the second improvement. In modified PSO, the maximum and minimum velocity of particles has obvious impact on the convergence rate. Predicting Cab cancellation is very fast and Locating and booking cab is easier by using proposed method. Its network reliability is high and this MPSO method is a cost effective one.

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