Food Logistics using Swarm Intelligence

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ABSTRACT
In the growing era of technology and smart cities use of smart devices has increased a lot. Smart devices are being helpful in many ways. There were some conventional ways of shopping and then came in the e-shopping/shopping apps which changed the scenario completely. There are apps/services like Zomato and Foodpanda mostly available in major cities which are used a lot to provide info/delivery of food from hotels. But these kind of food cannot be reasonable and healthy on daily meal basis. So we targeted the home cooked food providers like Mess, Dabbawalas, and Maushis who provide food which is cooked like home food and is reasonable in a specific locality. It will substitute our method of going out and enquiring to the people about the home cooks, as all this information will be present on this platform. So for that we propose a new approach for smart city and smart citizens. An Online platform/app which will take over the old method of searching for good home cooked food in your surrounding area, having all information of Home Cooked Food providers generally as Mess, Dabbawala, Take-away Systems. This will help small scale businesses of locals to grow faster and avail bigger audience through app. It will also help people who are searching for daily meals which will be reasonable, close to their location and which can be discovered within a few seconds. Also a logistical part is introduced which will let facilities like home delivery of food possible. This will facilitate a system where the navigation will be simpler using logistic path planning algorithm. (ABC algorithm)

General Terms
Artificial Bee Colony(ABC) Algorithm.

Keywords
Smart Devices, Path planning, smart application, ABC algorithm.

1. INTRODUCTION
Nowadays there are many smart applications which provide food services from hotels and restaurants. Apps such as Zomato, Food Panda have provided these services. But such type of services or the food provided is not reasonable is not even healthy. So our approach is to target home cooked food providers like Mess, Home Cooked providers which provide reasonable and healthy food. So we propose an online platform for our app which will take over the old method. The massive growth of e-commerce has been developed which is quite interesting and retailers are finding new ways in which their products can be delivered. Basically there are main three ways in which the companies prefer to deliver their product. Firstly, they collaborate with the local store and then the deliver their products from there. Secondly, they deliver it from their warehouses. Thirdly, they outsource their delivery to the logistics companies. Today there are many applications available in the market which provides food ordering as well as their delivery. But this food came only from high-end restaurants and also only in big cities. Such applications only gave the chances to expand the business of already popular food destinations in the city. The main challenge of this system was that the common man could not afford this stuff. Also this food was only such which could be enjoyed may be once in a while. The idea of bringing home makers to an online platform which otherwise is not possible using the applications currently in business. The path planning algorithm which takes care of multiple points is also a new concept. It is a step towards the smart city. Applications currently available in market are very limited in service when it comes to smaller cities. Only metropolitan cities are being developed in full fledged speeds. Aiming at smaller cities with their growing market is the key towards a successful business start-up. Introducing a new service which can overcome all old limitations as well to providing a proper solution with which many issues will be solved.

This problem has two sides. One is the optimal delivery path that will be followed and the other one is the android application. And for the optimal path the Swarm Intelligence technique will be used. Swarm intelligence is the collective behavior of decentralized, self-organized the work on artificial intelligence [3]. The inspiration directly comes from nature. Examples in natural systems of Swarm Intelligence include ant colonies, bird flocking, animal herding, bacterial growth, fish schooling and systems, natural or artificial. As we are using Swarm Intelligence in this system we can have many algorithms based on this concept.

Swarm Intelligence may be Natural or Artificial. The meaning of swarm itself is that the biological organisms to their day to day task by collectively communicating with each other. This
is helpful technology for applications in communication network routing. Moreover, this system or the routing protocols has a very important advantage that it has a better communication when there are multiple points in the system. In this paper we are going to use the Artificial Bee Colony Optimization algorithm to solve the problem.

2. RELATED WORK

Swarm intelligence is used in Telecommunication network. France and British Telecommunication use this technology for the Phone net-work [3]. Marco Dorigo (1992) used the Ant Colony Optimization [7]. Bonabeau has defined the swarm intelligence as “any attempt to design algorithms or distributed problem-solving devices inspired by the collective behavior of social insect colonies and other animal societies” [4]. The classical example of a swarm is bees swimming around their hive. An ant colony can be thought of as a swarm whose individual agents are ants. Similarly, a flock of birds is a swarm of birds. An immune system is a swarm of cells and molecules as well as a crowd is a swarm of people. Particle Swarm Optimization (PSO) Algorithm that models the social behavior of bird flocking or fish schooling was developed by Kennedy and Eberhart in 1995[4].

3. SYSTEM ARCHITECTURE

The working of intercommunication network is depicted in the diagram. It contains five actors who is involved in the system namely the Administrator, service users/local users, Food providers (cook), Delivery person and the remote user. The intercommunication between all these users can provide a system to work efficiently.

The intercommunication method is based on a single server where all the databases will be present and it will communicate with each other using the webserver. Also the optimal path generated will be displayed as the output of the system which will be using the Path Planning Algorithm.

4. PROPOSED METHOD

4.1 Artificial Bee Colony

Artificial bee colony algorithm (ABC) is a meta-heuristic algorithm. It stimulates the foraging behavior of the bee [2]. The ABC algorithm has mainly the three types of bees which can come into the picture: employed bee, onlooker bee and scout bee. First of all, the bees try and search the food stuffs in their neighboring locations. These locations are selected based on the deterministic locations in the first phase that is the employed bee phase. So in the proposed applications these are the locations which we need to traverse and it is given as the input. In the next phase i.e. the scout bee phases the location which is not needed further is left or abandoned and the new locations are inserted. I.e. we enter the new location that we have got for the delivery of the food.

Employed bees keep a check on the locations that they are currently exploiting. i.e. its store the location of the currently traversed delivery points. They carry the information about this particular source and share this information with a certain probability by waggle dance [2]. Unemployed bees seek a food source to exploit. There are two types of unemployed bees: scouts and onlookers. Scout bees actually don’t have any information about the food sources. And these bees sometimes find out some of the rich and untraversed locations.

Movement of scout:

\[ x_i = x_i^{\text{min}} + r.(x_i^{\text{min}}-x_i^{\text{min}}) \]

r: A random number
x_i: The position of onlooker bee
j: The dimension of solution

Onlooker bees have their selection on probability based unlike the deterministic based scout bees. As the nectar amount of a food source increases, the probability value with which the food source is preferred by onlookers increases, too. In the ABC algorithm the first half of the colony consists of the employed bees and the second half includes the onlookers[2].

Movement of onlooker bee:

\[ P_i = \frac{F(\bar{X}_i)}{\sum F(\bar{X}_k)} \]

P_i: The probability of selecting the i\textsuperscript{th} employed bee
F(\bar{X}_i): The fitness value

Each food source is traversed by a single employed bee. And the main thing that happens is that if the employed bees find that the nectar is no more of sufficiency then that bee turns into a scout bee which goes and finds the new food sources. It eventually means that if the employed bees find that the quality of nectar is not improving even after visiting it for a number of times then it leaves that location and tries to find a new location like the scout bees. The main advantage of this type of algorithm is that it does not have a centralized communication rather it can communicate with multiple points even if the system is changing constantly. This system is similar to the ant colony which uses multi-agent phenomenon for the foraging of food. Basically the honey bee works with two important aspects like the foragers and the scouts. The scout bees searching for the food from the flower patch, when it finds the food source whose quality is better than that of predefined food source it move to dance floor and perform dance called Waggle dance, this dance is help for communication or transferring information about source to the other bees. After getting this information the Foragers bees are sent to the food source for collection of food. This algorithm uses the ad hoc networking model [2].

These colonies can be termed as the social colonies which provides the inspiration from the environment. The two essential components of bee colony system are as follows:

- Food Sources: the food sources are selected mostly on some of the important aspects such as the proximity of the nest as well as the richness of the nectar.
- Foragers
Unemployed foragers: Initially it is considered that the bees have no prior knowledge about the food sources and it starts finding the new path for the extraction of nectar. These can be again of two types. They can be as follows:

Scout Bee: Scout bees are those which spontaneously starts the search of the food sources without any prior knowledge. The percentage of scout bees varies from 5% to 30% according to the information into the nest. The scout bees in average accommodates 10% of the hive on average. (Seeley, 1995). If it gets the information from the waggle dance, then it starts searching with the help of it. Employed foragers:

Employed bee forages are those who memorize the location of the exploited flowers. After the employed foraging bee loads a portion of nectar from the food source, it returns to the hive and unloads the nectar to the food area in the hive [2]. According to the remaining nectar in the flower there can be three options available: If the nectar quality decreases or if there is no scope of any nectar to be found then it leaves that particular location and moves further. And if there is enough amount of nectar available in that particular food source then it continues to exploit the same location without sharing the information with the other bees. It can also inform the other bees about that particular food source by going there and performing the waggle dance. These options are selected based on the quality of nectar available in that food source. Experienced foragers: Experienced foragers are those who use their historical memories for finding the location of food. It has the job to inspect the locations which are recently found by the bees. If any other bees confirm the quality of food of a particular location, then it continues to exploit the same it the food is exhausted. Again when the whole food gets exhausted then it turns itself to be the scout bee. It can also work as a recruit bee which has the job to go and confirm about the food sources being made available by the other bees by performing the waggle dance.

The main steps of the algorithm are:

1) Send the scout bees to find the new locations.
2) The employer bees need to be send to find the new food sources found by the scout bees.
3) Calculate with the help of probability that which sources need to be preferred by the onlooker bees.
4) When the food is exhausted abandon that food source and move on.
5) Again send the scout bees for searching new locations, randomly
6) Store the best food path in the memory.

The above mentioned is a method to solve the traditional artificial bee colony optimization problem.

This method could be used in the proposed application as follows:

1) The delivery points and the pickup points will be fed in the application as the input. This works as a scout bee. The scout bee actually finds the positions but here it is possible to provide those positions as the information is already known.
2) Then it calculates the shortest path from the delivery location to each pickup points using some shortest path algorithm. As it works for long period basis the path is often memorized like the work of the employed bees.

3) The new locations when added comes as the onlooker bee. It traverses the new locations.

One of the example how it traverses the location is as given below:

![Tree diagram](image)

In the above tree diagram:
1) C1, C2, C3, C4 acts as the customers.
2) F1, F2, F3, F4 acts as the food providers.
3) Now in the first step only the food providers can be visited because until they are not visited there is no point in reaching the customers. And in the same way the path follows.

4.2 Steps for finding the optimal path using one of the proposed method

- **Input**: Delivery Points, Pickup Points, Current Location
- **Output**: Shortest optimized Path

1. Start
2. Get Current location
3. Get all Delivery Points and Pickup Points
4. Call ABC algorithm.
5. Mapping of Pickup Point to Delivery Points
6. ABC algorithm Logic
7. Return path
8. Shortest Optimized path
9. End.

5. GOALS AND SCOPE

The main goal of the system is to reach to wider range of customers who prefer home cooked food and to provide the home cooked providers with more customers. One more purpose is to allow customers to place order online using...
interactive menu so that they can receive order at home allowing customer to pay online. The logistics purpose will be developed in order to reduce the effort of customer to travel in search of quality food. This project helps the management to know customers order details in few seconds. It will be beneficial for the target audiences, and even for business perspective. The efforts for people on search of quality food will be reduce. It will be helpful by making our living easy, by saving our time for searching quality food, through the app. The objective is to make people satisfy through the app, and so as to increase more number of customer. The app can relate to business point of view, for the corporate world, for start-ups. It can be a plan of start-up for entrepreneur. The product can be a use for smart cities too. As it can be effective service for a smart city.

6. CONCLUSION
The wireless ordering system will be emerged progressively and revolutionized the food ordering business industry and other fields. This system will be convenient, easy and effective thereby improving the Home cooked providers work performance besides providing quality of service and customer satisfaction. This system will address many hindrances in food ordering process and management of other apps by making available the quality food and management for ordering of food and getting deliver to home. This system provides pleasure of quality food for the customer. Such an attempt is also made in this study to present performance of a bee inspired algorithm, "artificial bee colony" on a NP-hard problem which is known as generalized assignment problem. The proposed bee algorithm is found very effective in solving small to medium sized generalized assignment problems.

REFERENCES