On Some Features of Cellular Philosophy Based Approaches in Operations Management and Data Mining

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***Abstract*- Similarity in diversity is the law of nature. Similarity, if exploited duly, several benefits like space/cost/inventory reduction, enhanced productivity, comfort and ease to human, etc., can be derived. In this paper some approaches for cluster/cell formation are presented in such areas as manufacturing, administration, management, etc. Based on some kind of similarity expressed in terms of, say, pattern, class, shape, weight, color, journey/flow path, etc., the clusters or cells are designed. An overview of such approaches is presented. Clustering/cellular approach is also used for searching nearest neighbor in such cases as nearest park, garden, hotel/restaurant, hospital, mall, etc., with respect to a query point within a specified area. The geo co-ordinates of such facilities having specified provisions are indentified within the specified area from the query point and the facility having the nearest Euclidian distance is selected. An algorithm is proposed in this paper for locating fast nearest neighbor search. Two case studies-one in operations management and another in data mining- are presented. The paper, it is believed, is of interest to all concerned including mechanical engineers, travel agents, computer scientists, medical practitioners, management personnel, etc.**

***Keywords*- Cellular Manufacturing, ROC3, NNS, Operations Management, Data Mining.**

I. INTRODUCTION

The present digital age has opened up many avenues wide open for handling huge data readily available in several system areas like Operations Management, services/business sectors, etc. In a way it is a mine of data from which useful or relevant data is to be extracted as we extract metals from ores. Ores are selectively located from geographical clusters. In the Universe both living and non-living organisms do possess some kind of similarity and/or dissimilarity. Similarity leads to classification, called as group, cluster or cell. For instance Taxonomy relates to a classification of living organisms. As early as 1928, furniture classification was reported. By 1959, Mitrofanov, a Russian scientist, introduced the concept of group technology (GT) classifying components into rotating and non-rotating components.

GT is further extended to cellular manufacturing industry. A cell consists of a family of components based on their similarity, in such terms/attributes as shape, size, material, and processing, common routes for travelling/flow, etc. Thus in manufacturing environment, a cell consists of a family of components, a group of machine tools and a crew of operators. The cellular philosophy is deployed in many sectors like manufacturing, office administration, catering, education, medical care, services, etc. The next Section presents some features of cellular manufacturing.

II. CELLULAR PHILOSOPHY IN OPERATIONS MANAGEMENT

Several approaches PFA, MACE, ROC, ROC3, Genetic Algorithm, clustering approach, group theory, Opitz, etc., are available for handling real-life problems related with cellular manufacturing (CM) [1- 6]. Tamal et al, have presented an exhaustive survey of cellular manufacturing techniques using genetic algorithm, simulation, etc [2]. TABLE I presents a list of pioneers in the area of CM [1]. A critique on GT presents a wide scope of GT tools and techniques and brings home the utility of GT approaches in several functional areas of industry [4]. MACE is the improvement type of heuristic based on the concept of similarity coefficient of product type [5]. It is still being referred by researchers [5]. Fig 1 presents the basic steps of MACE algorithm as described below:

Step-I see Fig. 1 (a): Read the machines (m) X components (n) input matrix, normally n>m and cell value is either "1" (component visits the respective machine) or "0" (component does not visit the respective machine.

Step-II (see Fig. 1 (b): Compute the number of common components processed by each pair of machine (i, j) and converts m X n matrix into m X m matrix. The cell value presents total number of common components processed by a pair machines (i, j), whereas, the diagonal element shows (i, i) the total number of common components processed by the "i" th machine.

Step-III (see Fig. 1 (c): Convert the m X m matrix into SCij matrix using the formula:

SCij= (number of common components processed by a pair

of machines (i, j))^2 / (Total number of common components processed by machine "i" * Total number of common components processed by machine "j")…. .. (1)

Step-IV: Select the highest SCij and form the first cell, admitting the first pair of candidates "i" and "j" to a set or cluster and add to the set other machine candidates closest to the pair or other member candidate (s). If any machine is found closest to a set member, continue to find out its closest machine (s) in terms of SCij till no machine is found so. Else repeat Step-IV.

Step-V (see Fig. 1 (d): Rearrange the matrix according the machine members of cell(s) formed and get the solution.

m\ c	1	2	3	4	5	6	7
1	1		1		1	1	
2		1		1			1
3	1		1		1	1	
4		1		1			1
5		1		1			1

Fig. 1 (a): m X n matrix of 5X7

m\m	1	2	3	4	5
1	**4**	0	4	0	0
2	0	**3**	0	0	3
3	4	0	**4**	0	0
4	0	3	0	**3**	3
5	0	3	3	3	**3**

Fig. 1 (b): m X m matrix of 5X5

Machine pair-wise common components

Diagonal elements: total common components; ith machine

m\m	1	2	3	4	5
1	-	0	1	0	0
2	0	-	0	0	1
3	1	0	-	0	0
4	0	0	0	-	1
5	0	1	0	1	-

Fig. 1: (c) SCij matrix

m\c	1	3	5	6	2	4	7
1	1	1	1	1	0	0	0
3	1	1	1	1	0	0	0
2	0	0	0	0	1	1	1
5	0	0	0	0	1	1	1
4	0	0	0	0	1	1	1

Fig. (d): Final solution (pure cells)

Cell I: {1; 3 & 1, 3, 5, 6},

Cell II: {2; 5; 4 & 2, 4, 7}

MACE, a heuristic improvement type of approach, needs only basic knowledge of arithmetic operations. It facilitates isolation of "blocking machine(s)", the machine(s) required to process a large number of components. Also it identifies the "idle machine(s)", the machine(s) that do not process a single component. It can thus generate alternative solutions to a given problem; and the one can be accepted as optimum solution based on practical considerations. . MACE is an efficient approach for a large size machine-components matrix [5]; and executed for a 125 (machines) 571 (components) of a real life problem of TISCO, Jamshedpur. MACE is also deployed for facility design and layout problems [6].

TABLE I

SUMMARY OF THE GT APPROACHES [1]

Sr. No.	**Approach**	**Introduced by**	**Year**	**Sr. No.**	**Approach**	**First Introduced by (pioneer)**	**Year**
1	Production classification methods	Brisch E G	1956	14	Mathematical classification	Purcheck	1975
2	Classification system	Opitz H	1965	15	Linear ranking	Graham et al.	1976
3	Masking techniques	Iri M	1968	16	Simple complex cell approach	Malik & Dale	1977
4	Production flow analysis	Burbidge J L	1971	17	Rank Order Clustering approach	King J R	1979
5	Composite component	Edwards G A B	1971	18	Similarity coefficient and cluster analysis	Tarsulugi & Bloor	1079
6	Rule of thumb	Edwards G A B	1971	19	De Witte's approach	De Witte	1980
7	Work-piece statistic	Edwards G A B	1971	20	Rank order Clustering column algorithm-2	King & Nakromchai	1982
8	Bond energy algorithm	McCormick et al.	1972	21	Direct clustering algorithm	Chan & Milner	1983
9	Component flow	El-Essawy	1972	22	Machine-	Waghodekar & Sahu	1984

	analysis	& Torrance			component cell formation in GT(MACE)		
10	Simulation	Croockall & Baldwin	1972	23	Modified rank order clustering approach	Chandrasekharan & Rajgopalan	1986
11	Single linkage cluster analysis	McCauley	1972	24	Zero one data ideal seed algorithm (ZODIAC)	Chandrasekharan & Rajgopalan	1987
12	Numerical taxonomy	Carrie	1973	25	Occupancy value method	Khator & Irani	1987
13	Graph theoretic approach	Rajgopalan & Batra	1975	26	Rank order clustering3 (ROC3)	Waghodekar & Sahu	1994

TABLE II presents the potential benefits of Cellular Manufacturing (CM) in production and service sector [4].

TABLE II
BENEFITS OF CM IN PRODUCTION AND SERVICE SECTOR [4].

No.	Functional area	Brief details
1	Product design & drawing	1. Standardization & rationalization. 2. Efficient drawing numbering. 3. Variety reduction. 4. Better value analysis.
2	Production Planning & control	1. Ease of control. 2. Ease of scheduling. 3. Less planning effort. 4. Reliability of estimates. 5. Effective 6. Reduction in: • Setting time. • Down time. • Change time. • Overall production time.
3	Inventory & stores	1. Less finished inventory. 2. Less lead time. 3. Less work-in-progress. 4. Effective MRP.
4	Facility layout	1. Less floor area. 2. Line like layout. 3. Less work movement and material handling.
5	Organization behavior.	1. Unification of responsibility. 2. Enliven work situation. 3. Increased motivation. 4. Better job satisfaction and employee engagement.
6	Costing	1. More costing accuracy. 2. Overall cost reduction.
7	Others	1. Overall better control. 2. Less paper work and scrap. 3. Increased productivity. 4. Better customer service. 5. Increased order potential. 6. Better project control.

For Data Mining in the Digital Era, Cellular Philosophy approach is found to be rewarding. For instance, from a query point, the nearest neighbor in such cases as gardens, restaurants, schools, jogging parks, malls, hospitals, banks, hiring Ola/Auto, cab services, etc., is searched in real time. The next Section presents some proposed approaches for efficient fast nearest neighbor search (EFNNS).

III. CELLULAR PHILOSOPHY IN DATA MINING

This Section presents a brief literature overview of Data Mining using such approaches as Nearest Neighbor Search (NNS) [7-17]. B. Nitin and Vandana have presented an exhaustive survey of existing seventeen Nearest Neighbor Techniques with such features as key idea, advantages, disadvantages, target data , etc [7].

The approaches available work on the Cellular Philosophy forming clusters of desired types of facilities or provisions. Usually such a search is broadly based on the algorithm presented below:

1. Using GPS, locate the geo-coordinates of the query point.
2. Using data bank, form a cluster (cell) of similar facilities like cabs, schools, etc., in a specified area.
3. From this cell, generate another sub set (cell) of facilities that fulfill the customer specified needs, e.g., in case of restaurants, menu like chapatti, salad, curd, rice, or in case of a cab, single sitter, three sitters, etc.
4. The geo-ordinates of the facilities identified in the sub-cell under Clause 3 above are computed and the facility having the shortest Euclidean distance is selected as the output.

Some approaches that use this type of algorithm are presented as given below.

Agrawal, et al. Dbxplorer approach [10]

Internet search engines have popularized the keyword-based search paradigm. While traditional database management systems offer powerful query languages, they do not allow keyword-based search. DBXplorer is a system that enables keyword-based searches in relational databases. DBXplorer has been implemented using a commercial relational database and web server and allows users to interact via a browser

front-end. The authors have outlined the challenges and discussed the implementation of the system, including results of extensive experimental evaluation

Bhalotia et al. approach [11]

With the growth of the web, there has been a rapid increase in the number of users who need to access online databases without having a detailed knowledge of the schema or of query languages; even relatively simple query languages designed for non-experts are too complicated for them. The authors describe BANKS, a system which enables keyword-based search on relational databases, together with data and schema browsing. BANKS enables users to extract information in a simple manner without any knowledge of the schema or any need for writing complex queries. A user can get information by typing a few keywords, following hyperlinks, and interacting with controls on the displayed results. BANKS models tupelo as nodes in a graph, connected by links induced by foreign key and other relationships. Answers to a query are modeled as rooted trees connecting tupelo that match individual keywords in the query. Answers are ranked using a notion of proximity coupled with a notion of prestige of nodes based on in links, similar to techniques developed for web search. The authors have proposed an efficient heuristic algorithm for finding and ranking query results

Cao et al. approach [12]

The web is increasingly being used by mobile users. In addition, it is increasingly becoming possible to accurately geo-position mobile users and web content. This development gives prominence to spatial web data management. Specifically, a spatial keyword query takes a user location and user-supplied keywords as arguments and returns web objects that are spatially and textually relevant to these arguments. This paper reviews recent results by the authors that aim to achieve spatial keyword querying functionality that is easy to use, relevant to users, and can be supported efficiently. The paper covers different kinds of functionality as well as the ideas underlying their definitions.

Gao Cong approach [13]

The location-aware keyword query returns ranked objects that are near a query location and that have textual descriptions that match query keywords. This query occurs inherently in many types of mobile and traditional web services and applications, e.g., Yellow Pages and Maps services. Previous work considers the potential results of such a query as being independent when ranking them. However, a relevant result object with nearby objects that are also relevant to the query is likely to be preferable over a relevant object without relevant nearby objects. The author has proposed the concept of prestige-based relevance to capture both the textual relevance of an object to a query and the effects of nearby objects. Based on this, a new type of query, the *Location-aware top-k Prestige-based Text retrieval* (LkPT) query, is proposed that retrieves the top-k spatial web objects ranked according to both prestige-based relevance and location proximity. Empirical studies with real-world spatial data demonstrate that LkPT queries are more effective in retrieving web objects than a previous approach that does not consider the effects of nearby objects.

Yen-Yu Chen approach [14]

Geographic web search engines allow users to constrain and order search results in an intuitive manner by focusing a query on a particular geographic region.

Geographic search technology, also called local search, has recently received significant interest from major search engine companies. Academic research in this area has focused primarily on techniques for extracting geographic knowledge from the web.

The authors have studied the problem of efficient query processing in scalable geographic search engines. Query processing is a major bottleneck in standard web search engines, and the main reason for the thousands of machines used by the major engines. Geographic search engine query processing is different in that it requires a combination of text and spatial data processing techniques. The authors have proposed several algorithms for efficient query processing in geographic search engines, integrate them into an existing web search query processor, and evaluate them on large sets of real data and query traces.

Chandrashekhar approach [15]

The author has presented some features of data mining like fast analysis, complex data set, etc., and also has briefly described data mining applications, operations, techniques and algorithms. The author has discussed three issues, namely, queries focus on object's geometric properties, modern applications call for geometric coordinates and their associated texts and that major approaches being straightforward fail to provide real time answers on difficult inputs. The author has proposed the spatial inverted index that extends the standard inverted index to address multidimensional information and claims that the algorithm answers the nearest neighbor query with key words in real time. The system design proposed by the author consists of four modules, namely, Location Manager, HTTP Communicator, Spatial Inverted Index and Spatial Data Display.

Anjum Z approach [16]

In this paper, various techniques as collective spatial keyword query, the combined notion of keyword search with reverse nearest neighbor query, hybrid indexing structure, efficient method to answer top-k spatial keyword query, computing the relevance between the documents of an object and a query, spatial inverted index, etc., for nearest neighbor search for

spatial database are presented. The authors have proposed to overcome the drawbacks of previous methods, like, expensive space consumption, unable to give real time answer, etc., a new method based on variant of inverted index and R-tree and algorithm of minimum bounding method to reduce the search space. The approach accommodates a query with both spatial data and associated text. For this type of query, a variant of inverted index is used that is effective for multidimensional points and comes with an R-tree built on every inverted list, and uses the algorithm of minimum bounding method that can answer the nearest neighbor queries with keywords in real time.

Waghodekar has presented some glimpses of the proposed approach, i.e., Efficient and Fast Nearest Neighbor Search for Spatial Query with Associated Text using Keywords on Multidimensional Data (EFNNS) [17]. The main features of the proposed approach are presented in the next Section.

IV. THE PROPOSED APPROACH EFNNS

The main features of the proposed approach EFNNS are presented in this Section. The source code is developed and tested for searching out the nearest professional academic institute in Aurangabad, from a query point on the Beed bypass road, NH 211 near MIT, Aurangabad (Maharashtra State), India; and results are found acceptable. Source code is excluded from this paper, however.

Modules of EFNNS:

The four modules of the proposed approach are:

i. System Module.
ii. View.
iii. Distance Search.
iv. Neighbor Search.

Modules Description:

System Model:

a. In this module the user will have to register first, then only s/he gets access to the data base.
b. The user gets login with his/her email id and password.
c. Admin registers the location along with its famous places. Also it measures the distance of the corresponding place from the corresponding source place (query point) by using spatial distance.
d. The user can give the key in which place that the city/location is famous for .This results in the list of menu items displayed.

View:

i. The User can see the view of his/her locality.
ii. As our goal is to combine keyword search with the existing location-finding services on facilities such as hospitals, restaurants, hotels, etc., we will focus on dimensionality 2, but our technique can be extended to arbitrary dimensionalities with no technical obstacle.
iii. Note that the list of each word maintains a sorted order of point ids, which provides considerable convenience in query processing by allowing an efficient merge step. For example, assume that we want to find the points that have words ‘c’ and‘d’. This is essentially to compute the intersection of the two words’ inverted lists.

Distance Search:

a. The User can measure the distance and calculate time that takes him/her to reach the destination by giving speed. Chart will be prepared by using these values. These are done by the use of Google Maps.
b. Traditional nearest neighbor search returns the data point closest to a query point.
c. It is considered that the data set does not fit in memory, and needs to be indexed by efficient access methods in order to minimize the number of I/Os in answering a query.

Neighbor Search:

i. In this module we implement the neighbor search. The other problem with this search algorithm is that the indexing information has to be replicated in the broadcast cycle to enable twice scanning.
ii. The first scan is for deciding the search range, and the second scan is for retrieving k objects based on the search range.
iii. It, therefore, proposes the nearest neighbor query approach to improve the preceding on-air query categories algorithm.
iv. The system attempts to verify the validity of k objects by processing results obtained from several peers.

V. SYSTEM DESIGN

System Architecture:
Fig 3 (a) presents System Architecture.

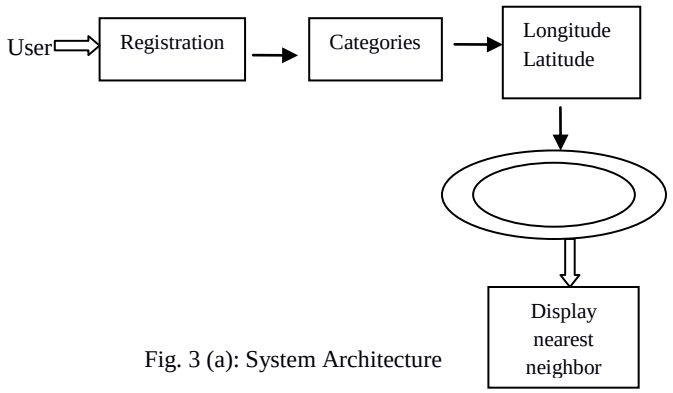

Fig. 3 (a): System Architecture

*Data Flow Diagram (DFD) (See Fig: 3a, 3b, 3c)**:***

1. The DFD is a simple graphical formalism that is used to represent a system in terms of input data to the system, various processing carried out on this data, and the output data generated by this system.
2. The DFD is one of the most important modeling tools. It is used to model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.
3. DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output.
4. DFD is also known as 'bubble chart'. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional details.

DFD Level 0

Data flow diagram for this level consists of 3 components: Input, System and Output.

DFD Level 1

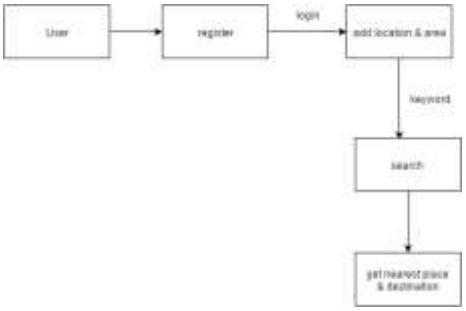

Fig. 3(b): Data Flow Diagram-level 1

DFD Level 2

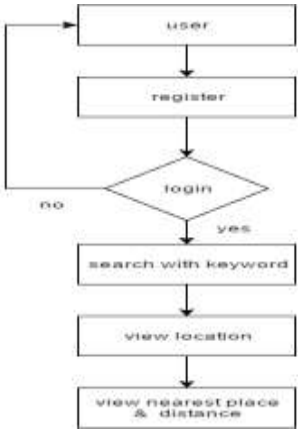

Fig. 3(c): Data Flow Diagram-level 2

Class Diagram (See Fig 4):

In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among the classes. It explains which class contains information.

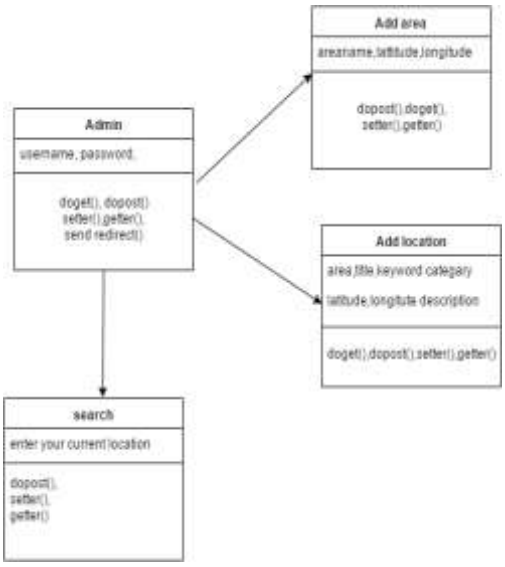

Fig. 4: Class Diagram

Use Case Diagram (See Fig 5):

A use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted.

Sequence Diagram (See Fig 6):

A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are typically associated with use case realizations in the Logical View of the system under development. It is a construct of a Message Sequence Chart. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

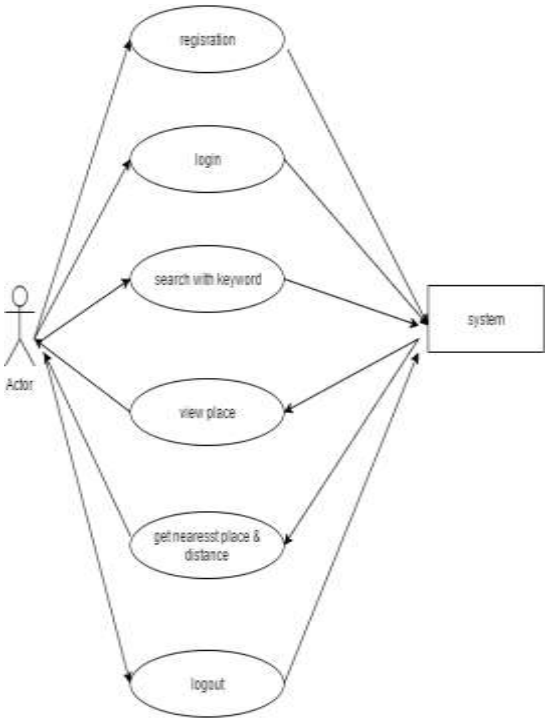

Fig. 5: Use Case Diagram.

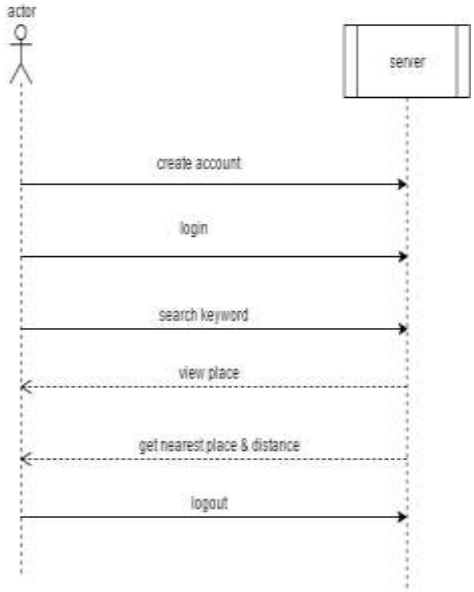

Fig. 6: Sequence Diagram

Activity Diagram (See Fig 7):

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.

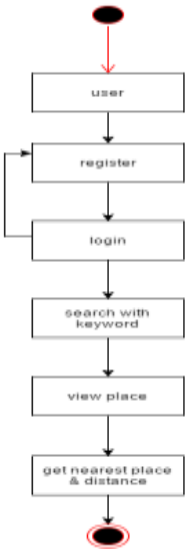

Fig. 7: Activity Diagram

Package Diagram (See Fig 8):

As the name suggests a package diagram shows the dependencies between different packages in a system.

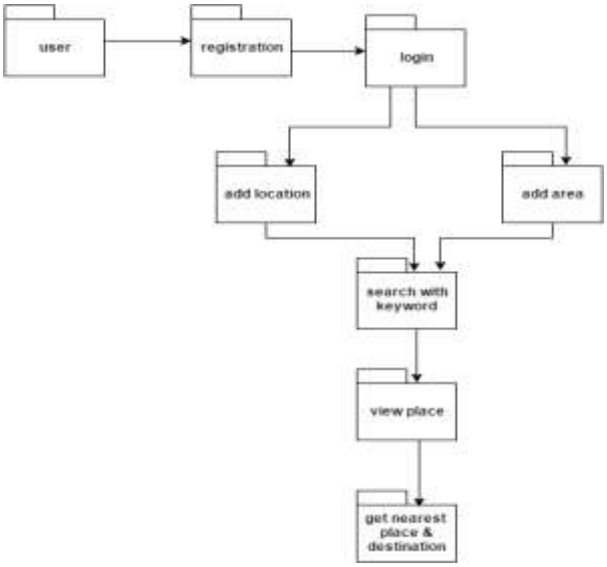

Fig. 8: Package Diagram

Deployment Diagram (See Fig 9):

Deployment diagrams are used to visualize the topology of the physical components of a system where the software components are deployed. So deployment diagrams are used to describe the static deployment view of a system. Deployment diagrams consist of nodes and their relationships.

Component Diagram (See Fig 10):

A component diagram displays the structural relationship of components of a software system. These are mostly used when working with complex systems that have many components. Components communicate with each other using interfaces. The interfaces are linked using connectors.

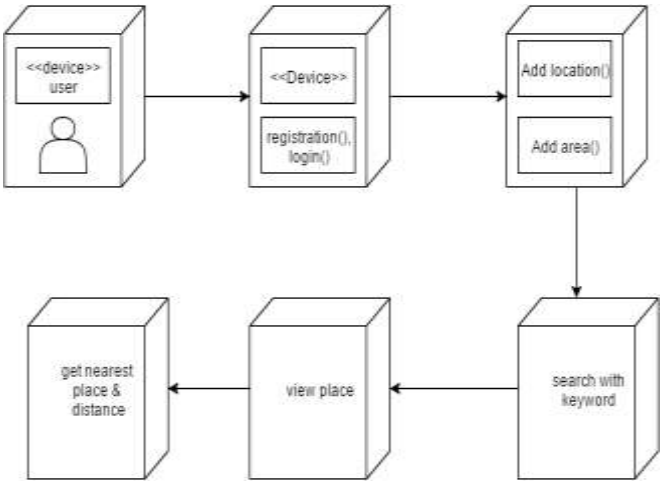

Fig 9: Deployment Diagram

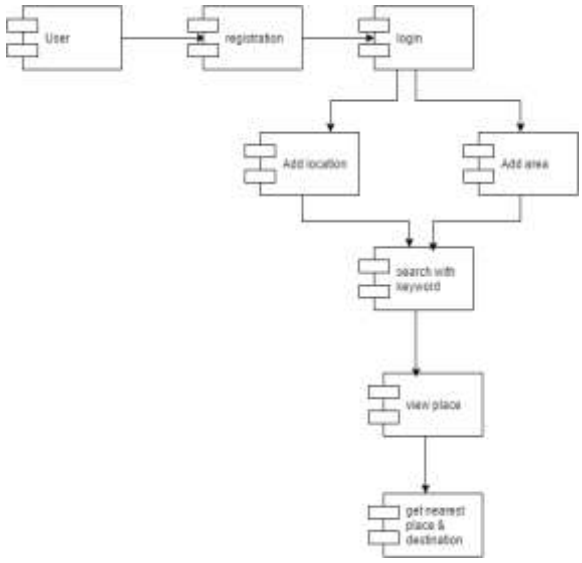

Fig. 10: Component Diagram

Collaboration Diagram (See Fig 11):

A collaboration diagram, also called a communication diagram or interaction diagram, is an illustration of the relationships and interactions among software objects in the Unified Modeling Language (UML). The concept is more than a decade old although it has been refined as modeling paradigms have evolved.

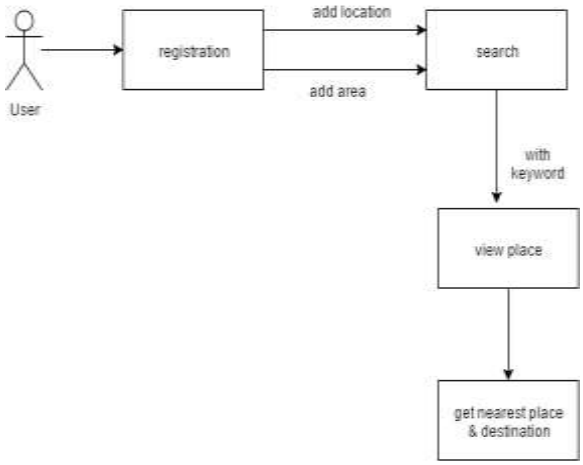

Fig. 11: Collaboration Diagram

VI. CASE STUDIES

This Section presents two case studies.

A) Cellular philosophy in operations management

Similarity in diversity is the law of nature. Cellular philosophy uses this law. Similarity is nothing but a certain pattern or class like a class of trees, animals, books, doctors, patients, departments, etc. It is widely used in production and/or services sectors deriving several benefits like fewer inventories, less manpower, enhanced productivity, less maintenance, etc. A Case Study using the ROC3/MACE approach in cellular manufacturing is presented in this subsection (1, 5].

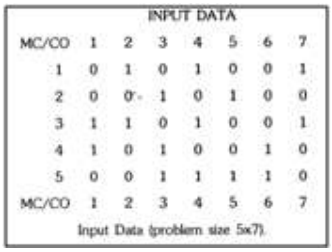

Fig. 12 (a) Input Data [1]

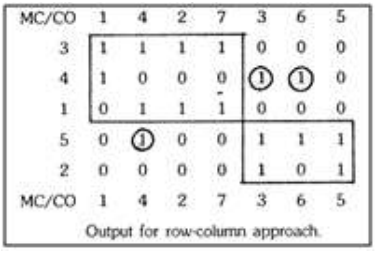

Fig. 12 (b) output using ROC/ROC2 [1, 5]

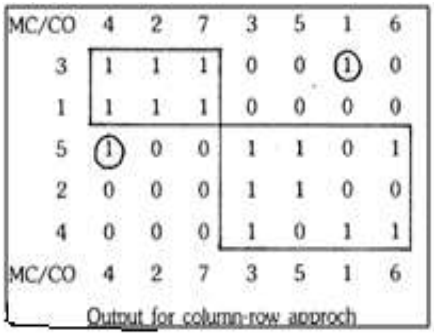

Fig. 12 (c) Output using ROC3/MACE [1, 5]

Fig. 12(a) presents a small size problem, a matrix: 5 machines X 7 components. In the matrix "1" means a component visits the corresponding machine for getting processed and zero means does not visit. Fig. 12(b) presents the cell-output using ROC or ROC2 approaches. For example cell-I consists of 3 machines (3,4, and 1) and 4 components (1,4,2, and 7) and Cell-II has 2 machines (5,2) and 3 components (3,6, and 5). The encircled matrix elements are termed as exceptional components as they do not belong to either of the cells causing undesirable inter-cell flows. This solution gives 3 exceptional elements. Fig. 12 (c) presents the output of ROC3/MACE approach [1, 5]. It gives two cells, Cell-I: 2 machines (3, 1) and 3 components (4, 2, and 7) and Cell-II: 3 machines (5, 2, and 4) and 4 components (3, 5, 1, and 6) with two exceptional elements. Thus, ROC3/MACE approach yields an efficient solution.

B) Cellular philosophy in data mining:

In a way NNS follows cellular philosophy. The proposed approach identifies the predefined types of similar candidates-facilities over a geographical space through GPS defined by the geo-coordinates of the query point with a radius say 50km or so from it. This set is further subjected to analysis selecting/adding candidate-members to the cluster/cell/set that complies with the requirements of a set, e.g., in case of search for a restaurant, menu is defined through a document or text like chapatti, plain rice, salad, tomato soup, etc., and another sub-set is derived that satisfies this need. The nearest neighbor with respect to the query point is then selected that has the shorted (nearest) Euclidean distance from it. The source code is developed for EFNNS, and tested for searching out the nearest neighbor for such facilities as restaurants, schools, parks, malls, etc. The output is getting in real-time mode but the source code needs further improvement to make it more efficient. A Case Study using the proposed EFNNS approach is presented in this sub-section. Some screen shots are presented below (see Plates 1 -6).

Plate 1: Home page

Plate 2: Admin entry for location

Plate 3: User search through current location

Plate 4: Output: user search using IR2 algorithm

Plate 5: Output: user search by IR2 algorithm

Plate 6: Output: user search by SI Algorithm

VII. CONCLUSIONS

Living organisms and inanimate entities show diversity in unity. Diversity, however, can be recognized on some similarity or pattern or groups or classification. Taxonomy relates with classification of plants and animals, whereas library books are classified subject wise. Furniture classification was done as early as 1928 and in manufacturing Group Technology (GT) was introduced in mid-1950. This paper presents an overview of GT techniques also called as cellular manufacturing and it is used in a great way fetching excellent dividend in operations management and services sectors as well. In case of Nearest Neighbor Search (NNS), approaches similar to clustering techniques are used but in another form deriving desired outcomes. Facilities such as parks, schools, hospitals, hotels, Ola/Auto, etc., need to be located (searched) nearest to a query point. This paper also presents a brief literature overview for NNS and the EFNNS approach is proposed. Some features of EFNNS, like, four modules, system design including such diagrams as Data Flow Diagram, Activity Diagram, Package Diagram, etc., are presented. Two case studies, one in operations management and another in data mining, are presented but EFNNS source code though developed is excluded in this paper. It is believed that the paper is of interest to all concerned, mainly researchers concerned with operations management and data mining.

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