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A CELLULAR POSITIONINING AND NEIGHBORHOOD DETERMINATION SYSTEM FOR SHARED AGRICULTURAL MACHINE USAGE

Abdullah ÇAVUŞOĞLU Baha ŞEN
Gazi University, Technical Education Faculty, Ankara, Turkey

ABSTRACT

The machinary that are used in agriculture still cost high considering the variety of them used on the agricultural farmland. Sharing the existing machinary among the neighboring farmlands is a common, well known practice (i.e. Machine Rings). In this study, this well known practice is put into a more effective use by our Cellular Positioning and Neighborhood Determination Algorithm in the huge agricultural area of Turkish South-Eastern Anatolian Project. As a case study, the algorithm provides the farmers with the information of the available machinary, listed as from the nearest to the furthest. Therefore providing the farmers a valuable information, which reduces time and cost spent for it.

Key Words : Cellular Positioning, Shortest Path, Machine Rings

TARIMSAL MAKİNA PAYLAŞIMI SAĞLAMAK İÇİN HÜCRE TABANLI KOMŞULUK BELİRLEME SİSTEMİ GELİŞTİRİLMESİ

ÖZET

Tarımsal alanlarda kullanılan makinalar büyük çeşitlilik arzetmelerinden dolayı hala yüksek maliyetlere sahiptirler. Mevcut makinelerin birbirine komşu tarımsal alanlarda kullanılması sık rastlanan bir uygulamadır (Machine Rings). Bu çalışmada, sözü edilen uygulama daha etkin bir şekilde Türkiyenin Güneydoğu Anadolu Projesi (GAP) çerçevesinde kullanılmak üzere Hücre Tabanlı Yer Bulma ve Komşuluk Belirleme algoritması geliştirilmiştir. Örnek çalışmada, algoritma çiftçilere kullanılabilir durumdaki komşu çiftcilerin makinalarının listesini en yakından en uzağa olacak şekilde vermektedir. Dolayısıyla çiftçilere sağlanan bu değerli bilgi sayesinde zaman ve maliyet girdileri düşmektedir.

Anahtar Kelimeler: Makina paylaşımı, Kısayol algoritmaları, Hücresel komşuluk belirleme

1. INTRODUCTION

Finding the position of a certain cell at a predetermined region often forces the searchers of varying field to use resembling algorithms. Cellular position determination and shortest path algorithms are used in robotics, PCB applications [Alan, et. al. 1992 and Zwick, 2000] and many other applications that may total a long list if we may do so.

Cellular position determination was needed as a requirement of an existing and completed project. Within the scope of the South-Eastern Anatolian Project (SAP) [Demirtas, 1997] a sub-project called “Pilot Application Project for Mechanization Requirements and Shared Machine Usage (SMU) in SAP Area” put into practice. The cellular position determination and shortest path finding algorithm was adapted to the data obtained from the framework of this project.

Common or shared machine usage is in fact as a result of the term “Machine Rings” firstly used in Europe and USA described by Culpin in [1975]. As described by Sindir, [1997] the over machining of small size enterprizes, in other words, the increase of big and expensive machine usage in the agriculture has forced people to use the machines in more than one enterprize and for more rationall and effective machine usage thereby "Shared Machine Usage" has been put into practice in early fifties and increased from then. In the SMU Project, to be able to provide a fare and just irrigation mechanism for the farmers living in the SMU region irrigation unions are formed. Each union covers a limited territory of which it holds the responsibility. For the time being there are about 20 irrigation unions located within the SMU region. They are responsible for making the regulations and plans to irrigate the land. Using this starting point, an application software has been developed for the members of irrigation unions within scope of SMU project.

We collected the detailed data on the agricultural tools and other machinery belonging to these members [TEMAV 2002]. Afterwards, these data has been gathered in a data pool to be evaluated by the application software. Although the software has many aspects in terms of the operations it performs: in this study we will only focus on the feature of cellular position and neighbor determination mechanism. The other facilities and reports that the software provides, are mainly based on this mechanism. The cellular positioning and neighborhood finding algorithm can be described as: an operation which marks a mainland –which is devided into sub-regions- from a selected point outwards to contain all the regions in a circular manner.

The aim of this study is to provide necessary neighborhood information that might be used for several different purposes. For instance: this information may be used to plan and regulate planting and harvesting in certain regions, sharing machines between the farmers living in the same district and even contributing towards the social activities relating to the farmers living in the same area etc. As a case study, we tried to focus on providing the necessary information required to develop a hiring mechanism for the machinery that the farmers own within the borders of the unions under the SMU project. The project is an application project and is aimed to be applied within districts of the unions as a demonstration practice and planned to spread to the area as a common practice afterwards [Coskun, 2000].

The usage of the algorithm can shortly be described as: on the application of a union member the data pool is interragated and the free machines that are located at the nearest neighbors are listed. The list is arranged in the following manner: starting from the location of the applicant free machines located at the neighboring farmer is listed first and the rest is listed outbound, taking this farmers location as a center of a circle. Therefore the list that we optained is in fact a list of machinery that are available listed from the nearest distance towards the furthest.

2. THE ALGORITHM

The cellular positioning and neighborhood determination algorithm starts with, deviding the regions' map into sub-cell as illustrated at the Figure 1. The grid structure can be numbered as shown at the figure. In the figure we have selected a 5*5 matrix. Depending on the size of the area or the size of the farmlands this dimensioning can be increased to give more precise and detailed results. Depending on the position of the farmer, (i.e. random regions such as 6, 23, 20) the algorithm determines the starting point for the marking. This is provided by the declaration of the applying farmer. Then, the algorithm marks the rest of the cells located on the map with regards to their positions to this farmer. Afterwards, the free machinary located at the neighboring reqions is examined using the 'shortest path' algorithm.

Let us assume that the aplicant's region is labeled as 6 on the map that has been labeled by our program. This is also shown in figure 1. This position is marked by the algorithm and labeled as '0'. Starting from this cell all the remaining cells are marked according to their destination to this center cell. At the and of this marking operation new regions are generated and saved with respect to their destination to this cell. This is shown at the figure 2.

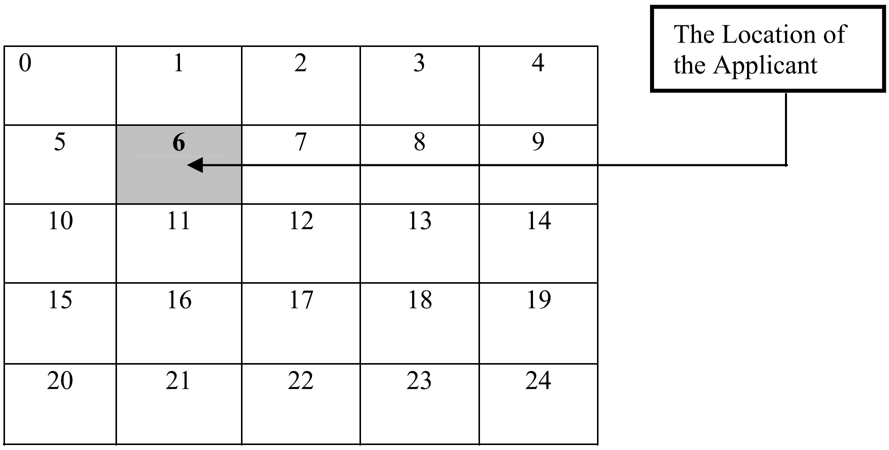
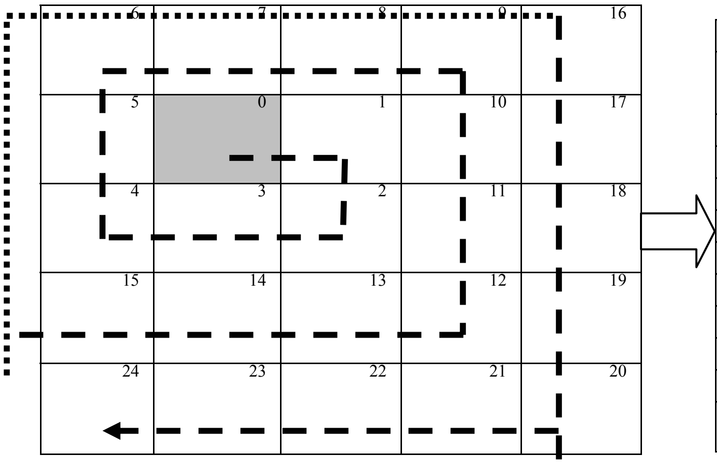


Figure 1 : Marking the Location of the Applicant on the Sub-divided Map

At the Figure 1 a 5x5 matrix has been formed to represent the land and the location of the requester has also been marked. At this point our algorithm labels this location as point '0' and starts marking the rest of the cells, with respect to their distance to this starting point. Therefore the neighboring cells have smaller labeling numbers while the distance ones have



Parcel.DB

Id	Plot_ Num	Parcel _Num	Region_ Code
4	115	4	0
2	116	1	0
1	115	4	1
3	115	3	2
6	115	2	2
7	115	1	4
8	106	2	4
9	106	1	5
10	116	2	7
11	115	5	9

Figure 2 : The Ordering of the Neighboring Regions on the Map

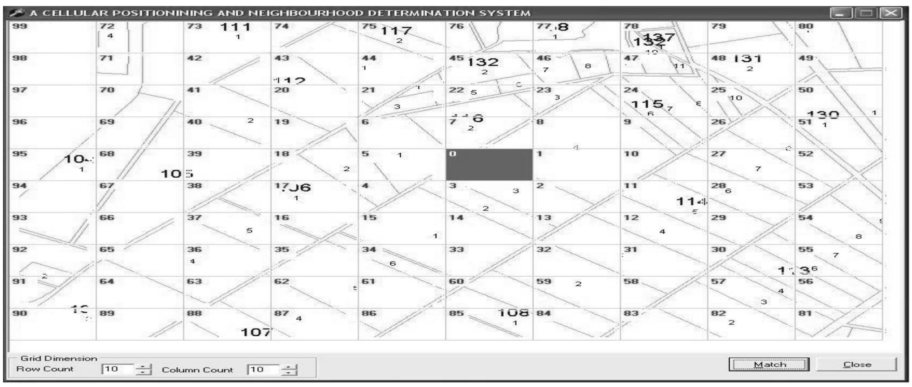


Figure 3 : The Execution of the Algorithms on a Sample Map.

greater ones. This also assures that, each increase of a label corresponds to a shortest path between the regions.

At the Figure 2 this situation is shown. As it can be seen from the figure, each neighboring region is also decomposed as a different region and a corresponding arrow is used to show this distinction. The direction of the arrows show the way the algorithms mapping approach. As we stated above the starting point is labeled as ‘0’ and then initiating from the south of it, the labeling starts and continues at the clockwise direction till a complete circle is achieved (i.e. if one exists). Then the labeling continues with the second circle until the whole map is labeled. To make sure that the labeling comlates the whole map the the column value of the starting point is used along with the dimension of the matrix. This approach is used when the scanning for the nearest neighboors occurs.

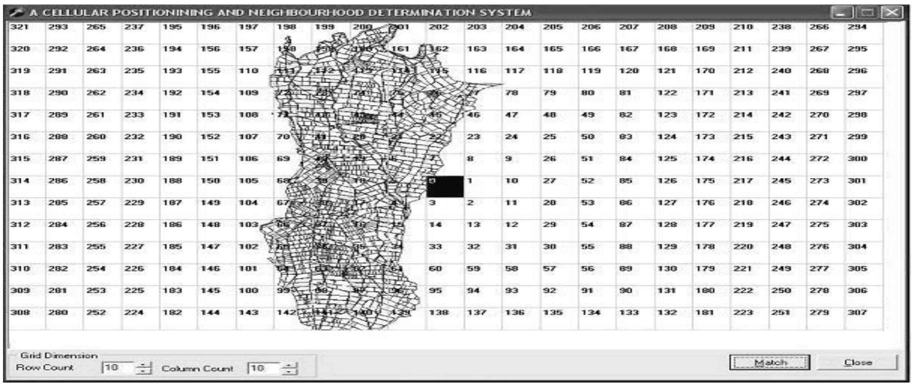


Figure 4 : A Bigger Scale Map Showing the Execution of the Algorithm.

The algorithm is coded with Borland Delphi 7.0 programming language. The algorithm sets the cell labelings in a circular manner. After the execution of the algorithm as it can be viewed from the Figure 2 three circular regions can be noticed cells marked as 1,3,4,5,6,7,8 forms the first circle and 9,10,11,12,13,14,15 the second circle and finally 16, 17, 18, 19, 20, 21, 22, 23, 24 forms the last circle on the map. The evaluation of them, give us the ability to say that neighborhood of the some of the cells are more stronger compared to the others. Figure 3 Figure 4 show real life applications.

3. RESULTS AND CONCLUSIONS

Technicaly cellular position and neighborhood determination algorithm is quite easy to understand and simple to implement given that a two dimensional map of the corresponding region is accessible. Our algorithm does not need the expensive detailed GIS (Geographic Informatin Systems) databases. However, the algorithm works with them as well.

As mentioned in the above sections the main abjective was to provide the farmers with the necessary machine park information located nearby them starting from nearest towards the furthest. The system has been into practice at Urfa province within the border of a single irrigation union. The system has successfully worked and the required information obtained by requesting users.

We have received several feedbacks regarding to the useability of the software. One of the main critisizm was the nature of the database interrogation mechanism provided by our system. Currently, our algorithm works on a client-server based method and the farmers who do not have access to a computer can reach this informatin via a telephone. At the outset, -considering the percentage of internet usage in the area- we developed our system on client-server based mechanism. However this was not so practical. Therefore a web based version has been requested by the users. Now, a web based version of the project is being developed. Therefore the access mechanism to the system will be more flexiable and more informatin such as: whether the machines are broken or not or the details of transport mechanism or the list of dates about the availibility of the machines can be embedded into the system altogether.

The system can be used for varying purposes depending on the requirements: the database of the system may be arranged to hold different data that might be useful to the farmers. For instance if a certain product is intended to be planted at certain districts the database may be improved to hold this information as well. Allowing the system to be used as a guide for plantation regimes.

The harvesting information may also be embedded into the system allowing the relevant bodies to make statistical projections on this matter. Finding and evaluating the effects of disasters (i.e. floods) can also be an easy matter since all the relevant information regarding to the zones and individual farmers are included in the system.

As it can be observed from the figure 3 and 4, the algorithms gives the neighborhood relationship with the selected metrics. Changing these metrics increases the sensitivity of the algorithm to give more precise results. Also incorparating the algorithm to GIS systems increases the usefulnes of these databases as well.

REFERENCES

1. Alon, N.; Galil, Z.; Margalit, O. and Naor. M. 1992. **Witnesses for Boolean matrix multiplication and for shortest paths. In 33rd Annual Symposium on Foundations of Computer Science (FOCS). IEEE Computer Soc. Pr**., Los Alamitos, ISBN 0-8186-2900-2.
2. Culpin, C. 1975. **Profitable Farm Mechanization. Granada Publ**. 3rd Ed. ISBN 0246 11571 8, England.
3. Coskun, G. 2000. **GAP Sulama Birlikleri Ortak Makine Kullanımı Projesi Sosyoloji Raporu**, Temav.
4. Demirtas, S. 1997. **G.A.P. : Southern Anatolian project : the cradle of civilisation regenerated**. p 240-242, Interbank Pr, Istanbul, 000041298 EE 97.
5. Sindir, K. O. 17-19 Eylül 1997. **Ortaklasa Makina Kullanımı ve Makina Ringleri**, Tarımsal Mekanizasyon 17. Ulusal Kongresi, Tokat.
6. TEMAV 2002, T.C. Basbakanlık GAP Bolge Kalkınma Idaresi Baskanlıgı, **GAP Bolgesinde Tarımsal Mekanizasyon Gereksinimleri Etudu II. Asama Ortak Makine Kullanımı (OMAK) Pilot Uygulama Projesi Sonuc Raporu** Ankara.
7. Zwick, U. 2000. All **Pairs Shortest Paths using Bridging Sets and Rectangular Matrix Multiplication. Electronic Colloquium on Computational Complexity,** Bd. 60, ISSN 1433-8092.