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Development of a Decision Support System for Urban Planning by Using K-means ++ Algorithm

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ABSTRACT

This article depicts a decision support system (DSS) devoted to the coordinated administration of urban frameworks. This framework defines the information and related treatments normal to a few civil managers and characterizes the necessities and functionalities of the PC devices created to enhance the conveyance, execution and coordination of metropolitan administrations to the populace. The cooperative framework called Decision Support System for Urban Planning (DSS-UP) is made out of a universal planning and coordination framework. So, it helps the decision-making process, a DSS was created as a learning-based framework gave derivation components that empower urban architect to settle on key decisions as far as specialized meditations on civil foundations. The learning-based framework stores experts_ information and additionally answers for past issues. Preparatory execution comes about demonstrate that DSS-UP viably and effectively underpins the decision-making process identified with overseeing urban foundations by using K-means++ data mining algorithm.

KEYWORDS: Decision Making; Decision Support System –Urban Planning; Data Mining; K-Means++

الخلاصة

تعرض هذه المقالة نظاما لدعم القرار (DSS) مخصص لإدارة التخطيط العمراني. يحدد هذا النظام المعلومات والمعالجات ذات الصلة بالتخطيط الحضري بشكل طبيعي لعدد قليل من المديرين المدنيين ويصف ضرورات ووظائف أجهزة الحاسوب التي تم إنشاؤها لتعزيز نقل وتنفيذ وتنسيق الإدارات الحضرية إلى السكان. يتكون نظام اتخاذ القرار للتخطيط الحضري التعاوني المسمى نظام دعم القرار للتخطيط الحضري (DSS-UP) من إطار تخطيط وتنسيق عالمي. لذلك ، فإنه يساعد عملية صنع القرار ، تم إنشاء DSS كنظام قائم على التعلم بحيث يعطي الاستنتاجات التي تمكن المهندس المعماري للمناطق الحضرية على اتخاذ القرارات الرئيسية بقدر الوساطة المتخصصة في المؤسسات المدنية. يقوم النظام القائم على التعلم بتخزين معلومات الخبراء والإجابات بالإضافة إلى ذلك على المشكلات السابقة. يأتي التنفيذ التحضيري لإثبات أن DSS-UP تدعم بشكل فعال عملية صنع القرار المحددة مع الإشراف على المؤسسات الحضرية باستخدام خوارزمية التنقيب عن البيانات K-means++.

INTRODUCTION

The restoration of an urban foundation is presently one of the principle worries of districts in Iraq. Urban framework administration has dependably been the after effect of the joint effort of different actors. In any case, these urban frameworks as of now have more limitations because of the exchange of duties and also the diminishing of human and monetary assets. These days, just a deliberate exertion among the gatherings that take an interest in urban framework administration and kept checking will permit the rehabilitation of the infrastructure. The delineation design and task of urban frameworks and urban administrations are a regularly expanding complex action. The populace requests top quality administrations at the least conceivable cost. Today, three zones are staying for the following decade, of up most worry in the administration of urban infrastructures; those regions are the rebuilding of the nature of the urban condition, the administration of expansive and complex frameworks and the preventive support and rehabilitation of existing frameworks [1].

The integration of innovations constitutes the central challenge confronting urban particular architect's more urban managers. All around this integration, new instruments what's more eventually, better approaches about doing things clinched alongside metropolitan associations will be implemented, thus, helping will new answers for better urban infrastructures management, specially, towards the individuals particular three territories. Without correlation from claiming new technologies, gathering those tests of the future in the oversaw economy of urban frameworks might make exceptionally troublesome. Currently, during the arranging level, the support level alternately those restoration level, choices need aid now and again constructed without consulting the sum stakeholders [2]. On the other hand, since that origin of the Multi-Agent System frameworks (MAS) hypothesis needs to develop enthusiasm toward examining more demonstrating those conduct techniques from claiming different operators that work together should unravel an issue, or with doing a particular errand. Dispersed issue fathoming and collective choice-making are maybe those standard illustrations from claiming movement previously, multi-agent frameworks. This happens when an assembly of consistently decentralized operators participates to tackle issues that need aid normally past the abilities of any distinct agenize [3].

The application of an intelligent framework to information understanding the state screening is a propelling research field. Done later years, self-sufficient intelligent operators' also multi-agent frameworks need picking up a significant part consideration inside diverse constant requisitions. An assortment of intelligent techniques needs being connected clinched alongside plant monitoring, which brought about those improvements about unified methodologies to state monitoring, e. g. Model-based reasoning systems, case-based reasoning systems, and artificial neural networks. These methodologies have a tendency will make fixed, in this way absence adaptability and extensibility. Moving should an agent-based construction modeling permits synchronous complex errands on a chance to be performed previously, genuine-time; exceptional taking care of about erroneous information is attained. Also each agenize might a chance to be freely updated. For example, it introduces a hierarchic decentralized multi-agent construction modeling formed for information understanding and state checking requisitions. Origin of the hypothesis of multi-agent systems (MAS) there needs to be developing enthusiasm toward examining and demonstrating the conducting technique for different operators that team-up will unravel an issue alternately on do a particular assignment [4].

That Decision Support System for Urban Planning (DSS-UP) itself essentially backs the examination from alternatives. Hopefully, the execution could be moved forward through (what if) examination since those computer-based DSS-UP speeds dependent upon such Investigation What's more related calculations. The average methodology with decision making takes after these procedures: point out those destinations alternately problem; get data; produce alternatives; assess alternatives; select an alternative; actualize all those chose elective and get input on the executed electively. A DSS-UP is an intelligent system, flexible, versatile also particularly formed with backing the result of a non-structured oversaw economy issue to progressed decision making, and utilization data, give not difficult client interface, also could fuse the decision-makers identity or insights [5].

The DSS-UP acquires together people's judgment also electronic data giving help will decision-makers fundamentally in the examination for poorly alternately unstructured circumstances. Those decision-makers could whichever make a singular or a group, a functional ability will location multi-disciplinary issues. Decision making by large might be progressed on one or a greater amount of these methods could be streamlined alternately robotized. It might a chance to be could be allowed should augment the abilities of a DSS-UP through combination with an expert system to attain such rearrangements. On effect, that expert system might a chance to be acting for a report limit throughout a few of the decision making methods previously, a great deal the same path similarly as a supervisor. Since those decision-makers must define those problems, the variables and the decision model will tackle those problems, an intelligent might

be called upon with offer suggestions for different alternatives will make considered, and additional support to the suggestive [6].

A DSS-UP might address low-level (well defined) choices such as those choices of a strategy around a constrained number of alternatives. DSS-UP camwood additionally tackles medium level furthermore high-keyed choices that suggest the union of a substantial amount of information, and the scan to trade-offs between the level for the administration of the number and the worldwide cosset of the framework. In urban infrastructures more related benefits management, these choices are normally because of propelled innovative unrest also building expertise, concerning the learning of the necessities and requests of the population, around a comprehension of the collaborations between local, territorial furthermore actually national strategy making, and additionally on the cooperation the middle of those private and the general population parts [7].

The Decision Support System for Urban Planning (DSS-UP) gives the majority of the data that should help the client apart from the DSS-UP decide ahead of a strategy. It might whichever proposes a decision that those clients need with affirm or a set for workable activities for those clients to finish the determination. This approach needs to be utilized for comparative issues. This paper displays a model for decision support system committed to facilitated administration of urban infrastructures. It will be composed as follows. Section2 examines data mining, K-means, and K-means++. Section 3 provides for a portion of points around DSS-UP structural engineering. Section 4 unequivocally depicts the DSS-UP. Section 5 displays the usage of subtle elements of the system; furthermore, finally, Section 6 displays the conclusion.

DATA MINING AND K-MEANS++ ALGORITHM

Data mining (DM) is a method to discovering the designs around huge add up of data, finding a new majority of the data as far as examples standards starting with an enormous sum of information. DM includes different disciplines such as; database Technology, Statistics, Machine-Learning, Artificial Intelligence, Data Science, high-activity Computing, also Visualization techniques. Information mining strategies would use to mine various rules furthermore examples done type of association rules, consecutive patterns, classification trees, and so forth. It may be preceded toward information preparation preceding it will be might be yield suitable data. The primary objective of data mining comprises extracting concealed data from a data set. Clear data will be useful for decision making. Currently, a few data mining instruments would effectively connect to find predictive data. The goal from data mining might be reported in an assortment for formats, for example, such as listing, pictures outputs, abstract tables also visualizations [8].

K-means++ algorithm (Clustering)

Clustering is a method for discovering similitude groups in information, called clusters. i.e., it bunches information cases that are like (close to) each other in one group and information examples that are altogether different (far away) from each other into various bunches. Clustering is regularly called an unsupervised learning undertaking as no class esteems signifying from the earlier gathering of the information occasions are given, which is the situation in supervised learning. Because of authentic reasons, clustering is frequently viewed as synonymous with unsupervised learning. Truth be told, association rule mining is likewise unsupervised.

Given k, the k-means++ algorithm works as follows:

1. Randomly choose k data points (seeds) to be the initial centroids, cluster centers.
2. Assign each data point to the closest centroid.
3. Re-compute the centroids using the current cluster memberships.
4. If a convergence criterion is not met, go to step 2 of the k-means++ algorithm.

Algorithm k-means (k, D)

1. Choose k data points as the initial centroids (cluster centers)
2. Repeat
3. For each data point, x ∈ D do
4. Compute the distance from x to each centroid;
5. Assign x to the closest centroid // a centroid represents a cluster //
6. End for
7. Re-compute the centroids using the current cluster memberships.

Until the stopping criterion is met [9].

K-means++ algorithm

We propose a particular method for picking centers for the k-means algorithm. Specifically, let D(x) indicate the briefest separation from an information point to the nearest center we have just chosen picked. At that point, we characterize the following algorithm, which we call k-means++.

K-means++ algorithm

1. Take one focus c1, picked consistently at arbitrary from X.
2. Take another center ci, picking x ∈ X with the likelihood

$$\frac{D(x)^2}{\sum_{x \in X} D(x)^2} \qquad 1$$

3. Rehash Stage 2 until the point when we have taken k centers altogether.

The steps 2-4 in the k-means (k, D) algorithm, continue as with the standard k-means algorithm. We call the weighting utilized as a part of Stage 2 essentially D2 weighting [9].

RESTRICTIONS

Notwithstanding being touchy to the introduction, the k-means++ algorithm experiences a few different issues. To start with, watch that k- means is a constraining instance of fitting information by a blend of k Gaussians with indistinguishable, isotropic covariance frameworks (∑=σ2I) when the delicate assignments of data point to blend segments are solidified to apportion every datum point exclusively to the in all probability segment. In this way, it will flounder at whatever point the information isn't all around portrayed by sensibly isolated circular balls, for instance, if there are non-convex molded groups in the information. This issue might be mitigated by rescaling the information to (brighten) it before bunching, or by utilizing an alternate separation measure that is more suitable for the dataset. For instance, data theoretic clustering utilizes the KL-uniqueness to quantify the separation between two data points describing to two discrete likelihood circulations. It has been as of late demonstrated that on the off chance that one gauge remove by choosing any individual from a vast class of divergences called Bregman divergences amid the task step and rolls out no different improvements, the fundamental properties of k-means, including ensured union, straight partition limits, and adaptability, are held. This outcome makes k- means successful for a considerably bigger class of datasets insofar as a proper dissimilarity is utilized [10].

K-means++ can be matched with another calculation to portray non-curved clusters. One first bunches the information into countless utilizing k- means. These gatherings are then agglomerated into bigger clusters utilizing single connection various leveled grouping, which can distinguish complex shapes. This approach likewise makes the arrangement less touchy to instatement, and since the hierarchical strategy gives comes about at numerous resolutions, one doesn't have to pre-determine k either. The cost of the ideal arrangement diminishes with expanding k till it hits zero when the quantity of clusters breaks even with the number of unmistakable data-points. This makes it harder to (a) specifically contrast arrangements and diverse quantities of groups and (b) to locate the ideal estimation of k. If the coveted k isn't known ahead of time, one will ordinarily run k- means with various estimations of k and after that utilization a reasonable rule to choose one of the outcomes. For instance, SAS utilizes the cube-clustering-criterion rule, while X- means includes a many-sided quality term (which increments with k) to the first cost function and after that distinguishes the k which limits this balanced cost. Then again, one can logically expand the number of clusters, in conjunction with an appropriate ceasing basis. Bisecting k-

means++ accomplishes this by first putting every one of the data into a solitary cluster, and afterward recursively part the slightest smaller cluster into two utilizing 2- means. The observed LBG calculation utilized for vector quantization pairs the quantity of clusters till an appropriate code-book estimate is gotten. Both these methodologies hence reduce the need to know k previously. The calculation is likewise delicate to the nearness of exceptions, since (signify) isn't a powerful measurement. A preprocessing venture to expel anomalies can be useful [11].

GENERALIZATIONS AND COMMUNICATIONS

As before, k- means is firmly identified with fitting a mix of k is o tropic Gaussians to the information. Also, the speculation of the separation measure to all Bregman divergences is identified with fitting the information with a mix of K parts from the exponential group of dissemination. Another expansive speculation is to see the (signifies) as probabilistic models rather than points in Rd. Here, in the task step, every data point is allocated out to the in all probability model to have produced it. In the (movement) step, the model parameters are modified to best fit the allocated datasets. Such model-based k- means++ enable one to oblige more perplexing information, for example arrangements portrayed by Hidden Markov Models. One can likewise (kernelize)

k means++ [12]. Although limits between clusters are as yet direct in the verifiable high-dimensional space, they can progress toward becoming non- linear when anticipated back to the first space, therefore permitting portion k-means++ to manage more difficult clusters. The authors in [13] have demonstrated a nearby association between part k- means and ghostly clustering.

The K-medoid algorithm is like k- means++ except for that the centroids need to have a place with the informational index being clustering. Fluffy c- means is likewise comparative, except for that it figures fluffy participation capacities for every cluster instead of a hard one [13].

Despite its disadvantages, k- means++ remains the most broadly utilized partition clustering algorithm practically. The algorithm is basic, effectively justifiable and sensibly adaptable, and can be effortlessly adjusted to manage spilling data. To manage expansive datasets, significant exertion has likewise gone into additionally accelerating k-means, most strikingly by utilizing KD-trees or abusing the triangular disparity to abstain from contrasting every data point and every one of the centroids amid the task step. Persistent upgrades and speculations of the fundamental algorithm have guaranteed it's proceeded with pertinence and step by step expanded its adequacy too [14].

RELATED WORK

Transport arranging assumes an unquestionably enter part in the financial development of any district. When done carelessly, this arranging can be adverse to the biophysical and social condition of the locale. In transport, course arranging by and large one or a couple of elective courses are proposed, as a rule acting to the enthusiasm of the advocate. If required, an ecological effect evaluation is done on these choices. The authors in [15] recommend an application to be viable in making educated choices about the proposed course, these options (the core of effect evaluation) are themselves concocted in a subjective and non-spatial way. Such an application may effortlessly ignore courses, which could somehow or another have been more reasonable. An arranging framework that straightforwardly considers natural and financial contemplations in choosing elective courses encourages economic improvement. The authors in [16] act as a comprehensive and cognizant spatial multi-criterion organize investigation strategy for the age of ideal steering choices under various arrangement visions, in a system of existing streets. The exhibited system was case-tried for the profoundly challenged 340 km segment of the utilizing Baltica passageway in Poland, a piece of the trans-European transport organize (TEN-T) program. The approach demonstrates its capacity to fill in as an adaptable impact based choice effect-based decision support system for transport course arranging at a deliberately larger amount of arranging, especially for (geologically) vast scale venture plans [16].

The authors in [17] Report the improvement of a Spatial Decision Support System (SDSS) that is as of now in the beginning times of execution and testing. It includes a vigorous, non-restrictive information structure fusing 3D spatial models, utilization of VRML/X3D for designs displaying and consolidating XML based information and redid apparatuses to help powerful electronic client communication. Even though the more extensive task expects to build up an SDSS that backings all parts of the administration of open lodging for a legislative expert and spotlights particularly on a module to help open interest through the catch of group criticism and other info. Also one of the kind approaches was taken in this undertaking toward the organizing of the geospatial information that lies at the core of the framework and the instruments created to help client connection and group investment [17]. The utilization of geographic data frameworks as an arranging and administration apparatus for provincial and urban improvement in beachfront territories, and the extra instruments that a tweaked choice DSS connected to such a framework can give, once reenactment, financial and ecological models are coordinated in a similar system [18].

In the journey toward urban maintainability arranging, a helping instrument as a data frame is required for improving analyses and determining judicious choices. (DSS) and planning support system (PSS) are among the apparatuses for accomplishing quality getting ready for ideal advancement. They bolster the errands of plan definition, observing and survey which include the get-together and incorporation of geographic data and are known to be broadly utilized as a part of considering elective spatial advancement methodologies and besides evaluating improvement possibilities associated with arrive utilize arranging [19].

The authors in [20] Developed a DSS for water administration, and decision-makers amid water contamination mischances, by methods for investigation instruments for evaluating techniques to keep away from water contamination impacts coming about because of the waste industry, oil contamination, and different causes. The DSS depends on Web and Web advances. The WATERDSS online information (web) administrations give a registered urban administration framework file or water contamination test per water application unit utilizing measurable models. WATERDSS tests the information on water administration stations continuously. The aftereffects of the test are introduced in GIS maps (ArcGIS) with time arrangement diagrams, email reports and sites. The framework consequently sends notices when water contamination levels are surpassed, utilizing instant messages as email reports. Likewise, they put the information on the guide by utilizing ArcGIS to decide the area of the water stations [20].

The arranging of urban frameworks has vital spatial ramifications. The assessment of elective game-plans in this setting requires the express thought of numerous criteria as they have essential social, financial, and natural impacts. A DSS went for offering the clients (e.g., government or metropolitan offices) an adaptable and easy to use condition to give choice guide in urban foundation arranging. The representation of accessible options on maps gives added to decision support forms in urban foundation assessment issues. The improvement of this framework has been propelled by a true urban contextual investigation [21].

Proposed Model Components of Urban System

User interface (UI) is considering to the vehicle for either demonstrate development (or model decision) and for exploring the outcomes. A decent UI should make the model on which the framework's thinking is based straightforward to the user. Displaying is once in a while a one-shot process, and great models are normally refined and upgraded as their users assemble pragmatic encounters with the framework suggestions. The level by a chart considering to the communications model can be expanded significantly at the UI among its segments; for instance, an illustration of a diagram on which a model is based. This diagram is a subjective, basic clarification of how data streams from the free factors to the reliant factors of interest. The exploration expects to build up a DSS for urban framework administration in light of four columns (Figure 3): the database, the urban administration show connected to numerical

models for urban framework display, the sensible coordination unit in charge of the correspondence with record coordination control models and the UI which takes into consideration the meaning of parameters identified with the reenactment and the introduction of results through adaptable tables. Urban framework administration procedures or single mediations are secured by various situations, coming about to leaders in setting up the choice emotionally decision support system to composed administration of urban foundations by demonstrating the number of points in facilitating record, demonstrate the focuses of territory and drawing the point zone.

We improved a DSS framework model for the urban administration framework. DSS of urban administration framework is depicted underneath which had been produced to settle on the choice of urban administration framework when computing the urban administration framework index. The application is utilized K-means++ (machine learning (ML)) algorithm. These, empower the PC program to consequent examination a tremendous data and choose what data is generally applicable. This crystallized information can then be used to automatically make predictions or to help the people to make faster decisions and more accurately.

Algorithm and System Flow of DSS-UP

The main problem of the agents is not separated in their execution from the platform. The design of the architecture Urban Decision Support System(DSS-UP) platform can define the object of clarifying something which exists in the real world like (user) and in the present minds which belongs to the system architecture model.

The algorithm of the DSS-UP application can be implemented in Global Remotely.

Input: User Name and Password authentication
Output: Reports (best area of points, centers of points, and groups of points).
Start: (log in DSS-UP)
Authorized of DSS-UP SYSTEM
{If administrator authorized Upload text files as points of the area
- Enter the number of areas (point)
- Call for solution select
- Show the number of points in the coordinate file
- Show the centers of the area
End if}

Else: exit
Stop.

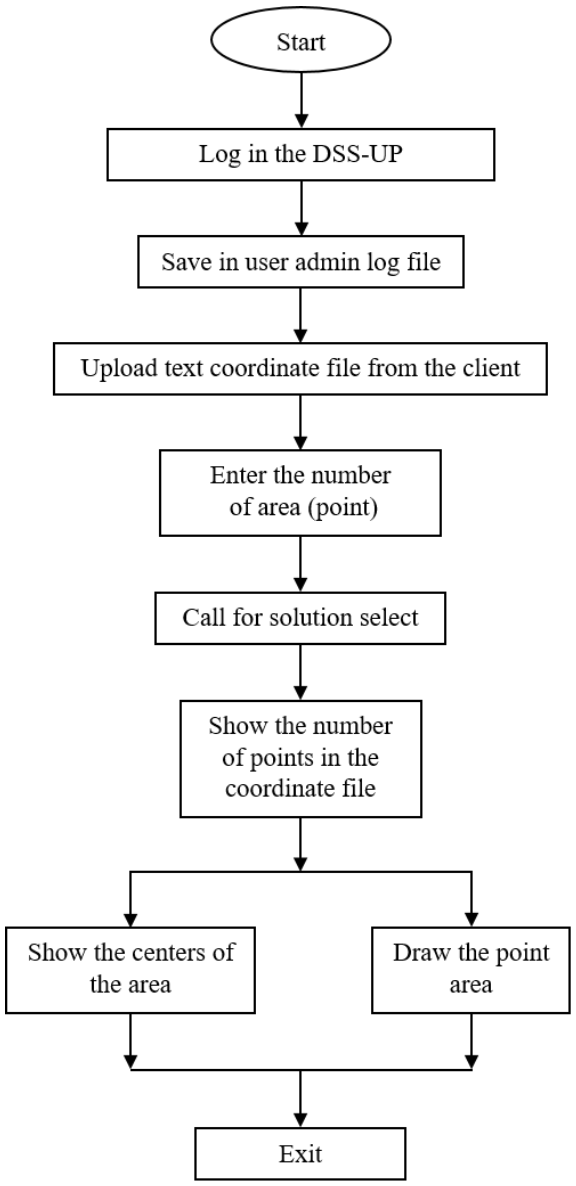

Figure 1. Process the system flow of DSS-up platform.

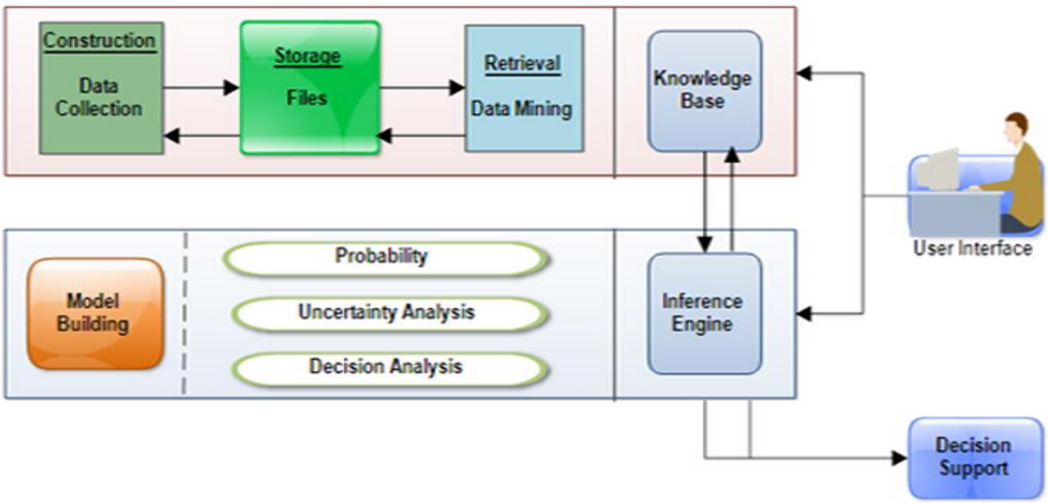

Figure 2. Generic architecture for urban decision support system (DSS-UP).

A model comprises of various factors and determinations characterizing the connections among them (figure 2), from a basic decision making perspective, a model and its factors represent to the accompanying three segments: a measure of inclinations over decision targets, the decision alternatives accessible, and a measure of uncertainty over factors affecting the choice and the results. The inclination is broadly seen as the most imperative idea in basic decision making.

A decision procedure comes about are not similarly great, and it is indispensable that the decision-maker analyzes these outcomes regarding their need. Inclinations can be ordinal, yet for accommodation and regularly out of need; they are displaying to as numerical amounts. This is especially the case if the choice procedure comes about comprise of different ascribes that should be looked at on a typical scale. This is additionally pertinent when the result is just a solitary quality if the decision to be made incorporates uncertainty. The second part of decision issues comprises of the decision choices accessible. Frequently these choices can be figured; however now and again they represent to consistent estimations of indicated strategy factors. An imperative component of model organizing is posting decision choices accessible [22]. The third component of decision models is uncertainty. Uncertainty is a standout amongst the most characteristic and most common properties of knowledge. Its roots are inadequate data, imprecision, and model approximations which are utilized for effortlessness.

Decision making that includes uncertainty can be viewed as a flow. The objective is to figure out what move ought to be made with a specific end goal to boost the normal pick up. The indented result can't be ensured, because of uncertainty, the planned objective sought after here being to expand the possibility of an attractive outcome. The procedure is the fundament on the presumption that a decent decision-making process brings about a decent choice. Such a procedure contemplates all the essential elements. It also states explicitly all of the decision alternatives, preferences, and uncertainty. Good decisions are different from good results, a distinction between the two beings very important. Based on the above, good decisions can lead to bad results, and in turn bad decisions can have very good results. For one to support a decision, one must support the decision-making process on which the decision rests. This enables better decisions to be made, which can in turn lead to better results. The graphical UIs (UI) for DSS-UP were customized in C# and deal with the information base by utilized MySQL server.

DSS-UP Implementation

Figure 3 demonstrates the login page to enter urban management system information. The client can include a client name and secret key (username: administrator and password: administrator) as default esteem and can change his client name and password.

Figure 3. Authentication window to input DSS-UP data.

The segments of the DSS-UP approach are numerous fields as buttons (Figure 4), Enter coordinates file: which included data about the points of the area. Many areas: enter the number of locations for each area in the city. Solution: calculating the report of an urban system for decisions to show the best locations to the infrastructures. Centers: display the centers of coordinates points in the urban system. Groups: provided all the group points for each area of the urban management system. Exit: Exit from the DSS-UP system.

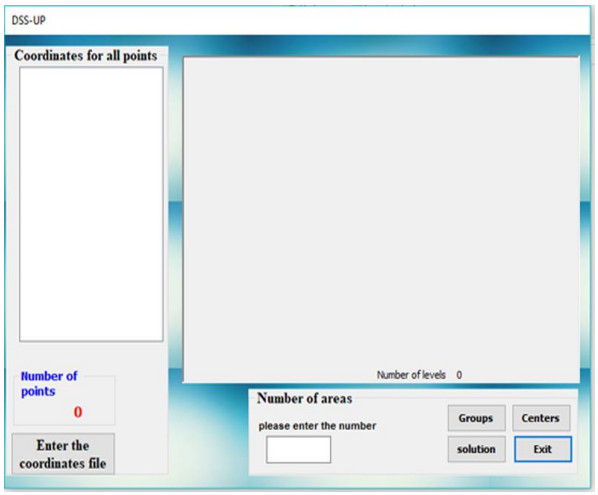

Figure 4. Home page of an urban planning decision support system (DSS-UP).

Figure 5 demonstrates the interactive page. The client can upload the file data of the coordinate's area and perform out the investigation to calculate and show the groups of points to assist the urban engineers to take a good decision. The information investigation and modeling infrastructures can be recovered through DBMS (MySQL) to figure the urban coordinates. Besides, a reproduction report age benefit was likewise given to the customer to encourage a similar examination of various conceivable arranging techniques to accomplish an ideal arrangement. All data is put away in a meta-database.

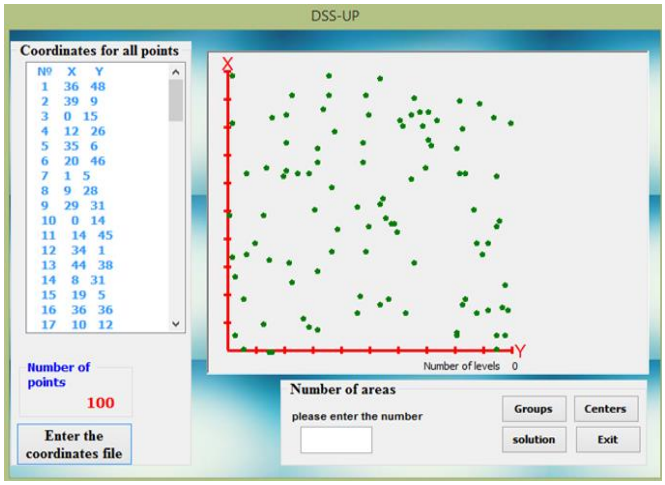

Figure 5. Main window for uploading the file of coordinates for calculating.

Figure 6 demonstrates the urban management system data input page. The user will input the data in entering (the coordinates file button only), which act the observed coordinates of each area point, the solution will be automatically calculated and will show the information examination result.

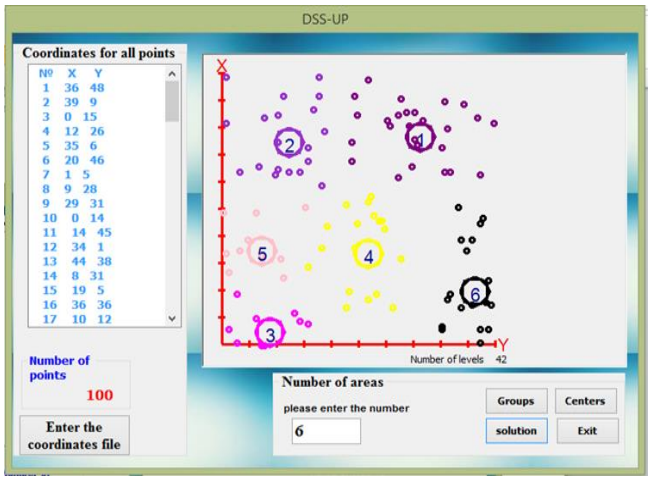

Figure 6. Main page of data analysis and display for urban management system calculation.

Figure 7 shows the information examination result utilized for calculating the urban management system. The figure shows that the coordinates file was 100 points; the number of areas is 6. Finally, the program will draw the areas like the 100 coordinates file as showing below.

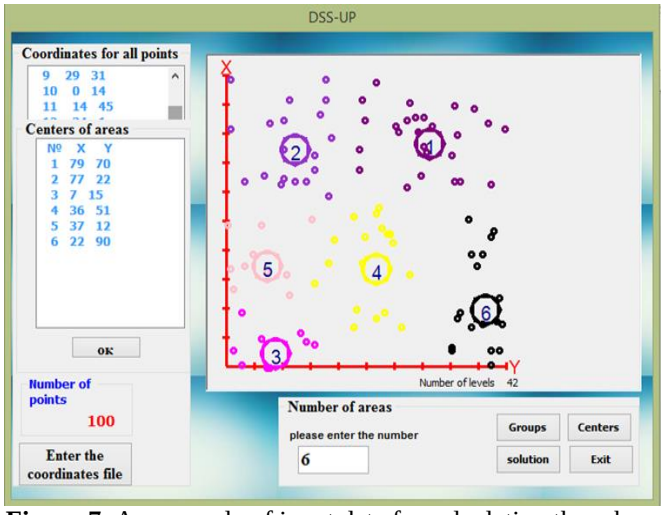

Figure 7. An example of input data for calculating the urban management system.

CONCLUSIONS

In this research, we suggested a model of a decision support system for Urban Planning (DSS-UP) devoted to facilitated administration of urban foundations. This framework recognizes the information and related solution common to many civil activities and characterizes the necessities and functionalities of the PC instruments created to enhance the conveyance, execution and coordination of city administrations to the populace. This model consolidates knowledge-based and decision making methodologies advancements. This combination has been utilized to accomplish a nonexclusive framework. Our emphasis on the utilization of non-specific models, information portrayal and DSS-UP is the most unmistakable component. In this work, the information about the fields of data mining and machine learning is grouped in an easy and understandable form. Besides, an analysis of freely available data mining tools is made with the consideration of various aspects. The analysis provides various benefits and explains how to extract data concerning functions, analyzing the functions of each of the tools and the advantages and disadvantages of them. Examination considered the help of statistical investigation abilities, different database frameworks, perception and different functionalities particular to the individual programming bundles.

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