International Journal of Applied Research 2016; 2(9): 224-228

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2016; 2(9): 224-228
www.allresearchjournal.com
Received: 04-07-2016
Accepted: 05-08-2016

Mobin Ahmad
Professor, Department of Mathematics, Faculty of Science, Jazan University, Saudi Arabia

Correspondence
Mobin Ahmad
Professor, Department of Mathematics, Faculty of Science, Jazan University, Saudi Arabia

Optimization of disaster management system

Mobin Ahmad

Abstract
The paper examines the possible efficacy to help disaster response organizations improve the administration of territorial crisis resources and operations; we propose to interface a specialist based, discrete event test system with a geographic information system and a principle base (portraying standard approaches and conventions for various disaster responses). The framework engineering will empower modules to powerfully "talk" with each other by trading ongoing information and making intelligent deductions. This incorporated framework is designed to precisely emulate this present reality disaster response situation. The framework will be utilized to better evaluate how different arrangements and operations of crisis assets may affect the viability of reactions to different extensive scale incidents.

Keywords: Disaster management, agent-based simulation, discrete event simulation, geographic information system, rule-based system

1. Introduction

Disasters are one of the significant obstructions to the sustainable development of society. As of late, we have watched both vast scale common and man-made disasters that have impact affected significant urban areas. [1, 2] The risk to lives is colossal in thickly populated urban areas where numerous structures, offices and individuals are concentrated. For a huge scale disaster, even a little defer in reacting can bring about numerous more setbacks and an immense loss of property. The fumble of Katrina reactions cost more than $100 billion and more than 1,300 lives [3]. Disasters can be ordered into a few noteworthy sorts: regular occasions, technological events, and human events [4]. Different disasters have unmistakable qualities as far as scale, intricacy and treatment, so they oblige responders to act diversely as indicated by particular circumstances. Step by step instructions to react to a disaster appropriately is a noteworthy test for crisis leaders, e.g., occurrence directors. While crisis administrators are all around prepared work force that has great information of the reactions to most sorts of disasters, to some degree, everyone is an impromptu occasion that requires uncommon treatment on the grounds that unfathomable circumstances can develop. Good disaster decisions are based upon a lot of data and learning of the occasion. In any case, in view of the unpredictability of genuine occasions, learning and experience if consolidated with a constrained capacity for preparing data are not adequate for disaster management to unequivocally foresee how future circumstances may emerge and develop. Decision makers could be deserted far developing occasions because of their impediments so that their choices may really postpone the start of more proper reactions. Conversely, a PC based and flawlessly coordinated reenactment, data sharing and decision making system could be utilized as an instrument to exhaustively prepare data and settle on choices on dispensing current assets and dispatching specialists on call for treat the fiasco appropriately.

2. A Dynamic Simulation-based System:

2.1 System Architecture and Work Flow

Discrete event simulation (DES) has been generally connected in displaying perplexing, huge scale frameworks and assessing their exhibitions. DES is liked to different methodologies (e.g., mathematical programming formulations) since it can completely catch the stochastic and element nature of such frameworks. At the point when a huge scale occurrence happens, the scene could be to a great degree clamorous in view of the unnecessary jams brought on by both the responders and harmed or freeze individuals.

It is to a great degree difficult to model such a stochastic and dynamic system mathematically, yet it is conceivable to mimic it with the operational tenets and rationale. Reenactment can kill a large number of the presumptions required for numerical programming definitions and permit us to show the framework all the more practically. With reproduction, we can acquire more exact results which are basic for educated disaster decisions. In this research, an automated computer system will be created which consolidates a specialist based discrete event test system, a geographic data framework (GIS), a tenet base, intuitive databases, and other supporting segments. The modules can wisely "talk" with each other by trading continuous information and making derivations through implanted calculations. This usage will understand the possibility of developmentally producing ideal or semi-ideal operational decisions based upon the advancement of the occasions. The recreation environment is a center segment yet by all account not the only bit of the disaster decision emotionally supportive network. One test, likewise a development of this examination, is the joining of the discrete event reproduction with other continuous data frameworks to encourage the synergic basic leadership process. Generally, reenactment has been principally a framework assessment instrument, not utilized for settling on choices as a part of ongoing (or close continuous). We will likely break this constraint and amplify reenactment for use as an evolutionary decision driver and optimizer. A developmental decision means the choice is not generally static after it is made; it can be changed to enhance the general execution as the time slips by and the occasion advances. The proposed coordinated framework will work in an iterative approach to reason out the best possible choices for disaster management. The framework stream diagram is portrayed in Figure 1.

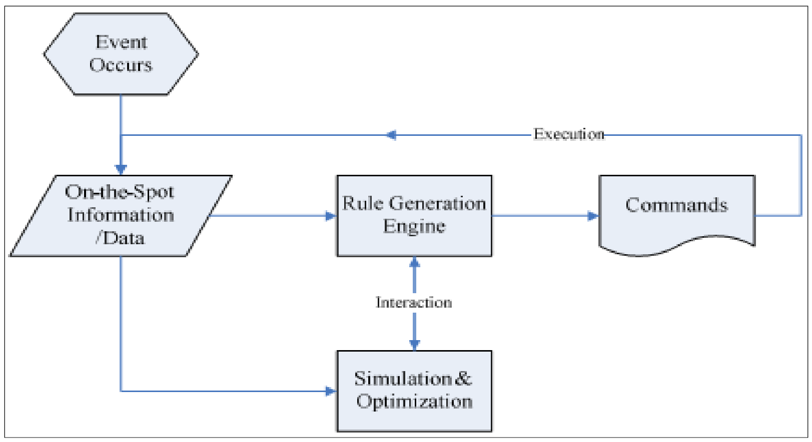

Fig 1: Dynamic, rule-driven simulation system flow chart

Figure1 illustrates the essential work stream of the disaster decision support system. At the point when an occasion happens, sure on the-spot information (e.g., number of casualties, kind of the occasion) are accounted for. The information quality influences the framework's performance significantly. The more trustworthy the information center, the better the decisions made later. The information is then transmitted to the "Principle Generation Engine" and "Simulation and Optimization" module, individually. The guideline motor can start some fundamental, brief reactions to the disaster based upon the underlying report of the occasion and send the reaction tenets to the reenactment. The test system will be educated of upgraded information and operational guidelines which are produced as the framework runs. Alternately, the reenactment results will criticism to the guideline era module to help the motor in growing better choices. It is trusted that the principle based framework can grow better conclusions in the event that it has more precise and sufficient data info [5]. Numerical and measurable optimization techniques can likewise be consolidated into the recreation module to enhance the execution of standards from the guideline era motor. For instance, the standard based system may make just broad principles, for example, sending Emergency Medical Services (EMS) ambulances to the scene, yet it won't determine the ideal guideline parameters, for example, the quantity of ambulances that ought to be dispatched. In this sense, streamlining can add specificity to the general principles, making them more operational. The communication between the principle generation process and the reproduction/advancement module is a crucial capacity of the entire choice framework and requires adequate watchful alignment before it is really utilized for genuine problem solving. In this framework, the recreation is a static framework evaluator as well as a dynamic choice driver. After a few cycles, an operable arrangement will be delivered by the tenet motor, then defended and sent by the episode authorities, and executed by the crisis work force to react to the occasion. Another cycle of the framework stream will begin by upgrading the on-the-spot information.

2.2. Evolutionary Rule Generation Process

We propose to use a rule-based system (also called knowledge-based system) to simulate the decision making process for emergency responders and incident commanders. The system should be scalable and flexible to the change of rule sets in order to serve as a test bed for different types of incidents in the future. Normally, a rule-based system consists of a rule base with permanent data, a workspace or working memory with temporary data, and an inference engine. A user-friendly interface can be added to help decision makers interact with the system and improve the reasoning process [5]. The system architecture is depicted in Figure 2.

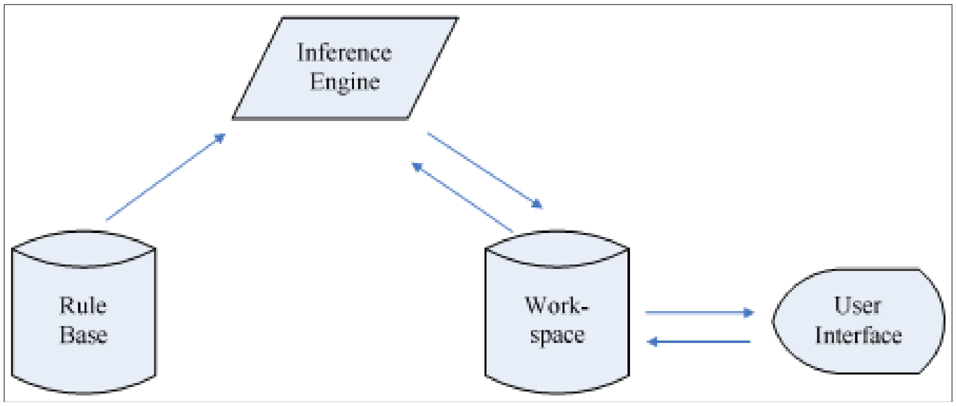

Fig 2: Rule-based system architecture

The knowledge used by first responders, episode directors and other chiefs is put away as bits of standards in the guideline base. The induction motor decides how to pick and apply suitable guidelines to the working memory and execute the principles. The execution of a guideline may change the actualities in the workspace instantly or before long that would trigger different tenets. In such a transformative way, the time-subordinate guidelines are produced and executed. The UIs can envision the advancing circumstance and the choices furthermore encourage human chiefs to interface with the framework. Empowering the human specialists to track the framework's advancement can help them recognize some impossible or deficient principles and enhance the disaster decision making process. The tenets created by the framework and the dynamic circumstances rely on upon each other: a guideline will be started by changing circumstances and the circumstance will be changed by new standards. In the event that the mimicked result is not good, we can modify the recreation clock back for a period interim, say, one hour and apply an alternate guideline until the general result is tasteful at last A sample dispatching rule set and its structure are as follows:

```
At 0:00, send <object(s)> from <base(s) ##>.
At 1:00, send <object(s)> from <base(s) ##>.
At 2:00, send <object(s)> from <base(s) ##>.
```

In a more intelligent system, the rule updating interval can be flexible (update rules only when needed) instead of fixed.

3. Agent-based Discrete Event Modeling

The concept of specialists has been utilized as a part of the manmade brainpower field to model genuine wise elements. A computer agent is characterized as an independently controlled element that can see its own particular operations and the encompassing environment, incorporate predefined principles to settle on operational choices, and act in view of these choices [6]. The specialist based model is a gathering of such self-governing operators. It could best reproduce mind boggling, dynamic frameworks on the grounds that their operations very closely resemble. In view of this method of reasoning, we will consolidate the specialist based model into the discrete occasion test system to recreate the conduct of the responders to the different disaster scenarios. The disaster responders can be viewed as judicious operators that work by guidelines towards a shared objective and endeavor to accomplish the best results for their activities [7]. Each responder specialist is equipped for executing and changing its activities based upon its own status, that of different operators and/or the general framework, all of which are managed by an arrangement of activity standards. As it were, the responders are told with regards to the following move to make and how to react to the occasion by the charges or their own particular judgments approved by the guidelines. The specialist activities and connections of an EMS rescue vehicle are portrayed in Figure 3.

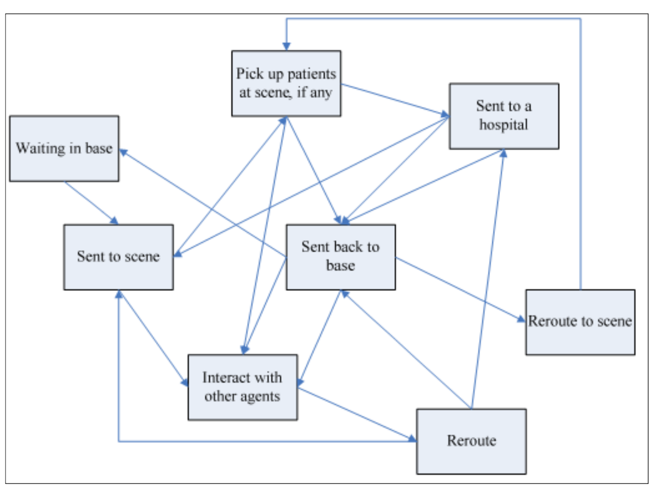

Fig 3: Agent actions and interactions of an EMS ambulance

The above showed emergency vehicle specialist's activities and collaborations with different substances are characterized by an arrangement of rescue vehicle dispatch and operation rules. Other reacting operators, for example, crisis vehicles and clearing vehicles will be inherent a comparative way in the recreation framework. The other crisis vehicles incorporate flame trucks, squad cars, HazMat trucks, and so on; the departure vehicles incorporate helicopters, open transports and private-segment travels which can be briefly enlisted as casualty transportation apparatuses amid crisis. The reacting vehicles are demonstrated as individual specialists to encourage their semi-self-sufficient basic leadership process amid the reenactment run, based upon an arrangement of preset operational tenets. Various diverse sorts of moving specialists worked in the framework. Distinctive characteristics and operational principles apply to different sorts of specialists. For instance, a rescue vehicle needs to go between the scene and healing centers forward and backward, ceaselessly transporting patients while a flame truck and the firefighters will stay at the scene to balance out the circumstance [8-10]. The specialist's characteristics characterize its operational status. To empower the dynamic status transforms, the greater part of the characterizing ascribes ought to be parameterized to quantitative variables and kept up by databases. A portion of the trait qualities are altered while numerous others are variable and upgraded as the recreated occasion advances. The operators' status is basic data for chiefs to watch the practices and build up the reacting plans.

Besides the designated vehicles, other relevant objects such as emergency assets (e.g., fire hydrants, medical suppliers) and city infrastructure (e.g., streets, bridges) are also tagged by their defining attributes. These objects are as important as the emergency vehicles in the process of decision making. Some of the object definitions are listed in Table 1.

Table 1: Sample of object definitions for agent-based model

Object	Attributes	Property	Values
Vehicle	Vehicle ID	Fixed, read-only	Integer ID
	Vehicle Type	Fixed, read-only	Integer ID
	Trip Start Node	Dynamic, simulation	Node ID
	Trip End Node	Dynamic, simulation	Node ID
	Last Action	Dynamic, simulation	Encoded integer
	Current Action	Dynamic, simulation	Encoded integer
	Next Action	Dynamic, simulation	Encoded integer
	Action Parameter	Dynamic, simulation	Integer
	Queuing Priority	Fixed, or dynamic	Integer
Street	Street ID	Fixed, read-only	Integer ID
	Connectivity	Fixed, read-only	Node ID
	Lane No	Fixed, read-only	Integer
	Speed Limit	Fixed, read-only	Integer
	Condition	Dynamic, GIS	Encoded integer
	Congestion	Dynamic, GIS, simul.	Floating-point

In the computer simulation system, all of the agents' attributes have to be encoded numerically as well as the discrete events because computers can only understand quantitative numbers. Whenever an agent performs actions, a simulation time delay will be imposed on that agent and its action attributes (defined in italics in Table 1) will be updated at the same time. In order to track the agent's behaviors, we need to encode all the possible actions into computer-readable numbers. Conversely, such codes can be easily decoded to provide more informative data to human decision makers. Some of the vehicle actions are encoded as shown in Table 2.

Table 2: Sample of vehicle action codes for agent-based model

Vehicle Agent	Numerical Codes	Action/Task Description
N/A	*0*	*Unknown or N/A*
EMS Ambulance	500	At base waiting for call
	501	At base called and processed (delay)
	502	Travel Base-Scene
	503	Travel Hosp-Scene
	504	Pick up LT at Scene
	505	Travel Scene-Hosp
	506	Drop off LT at Hospital
	507	Travel Scene-Base
	508	Hosp prepare after drop-off
	509	Travel Hosp-Base
Field Hospital	1400	At base waiting for call
	1401	At base called and processed
	1402	Travel Base-Spot
	1403	Stay at FH spot and operate.
	1404	Setup FH at spot.

The instructional rules and knowledge for the agents are coded in the format of "what-if" clause supported by the simulation. The programs can simulate human thought processes. When an entity finishes one action, it will "think" about what to do next so the computer programs will be executed to facilitate the "thinking" process, just like a human's brain. With the modeling schemes described above, we can build each responding entity as a rational agent whose behaviors will be instructed by the integrated rules and applications.

4. Conclusions

We have introduced an overview of a proposed dynamic reproduction based decision system to accomplish the objective of settling on better choices in light of more reasonable models for different disaster scenarios. In the framework, the major, germane geology related items are put away in a GIS. These items incorporate structures, transportation courses, assets, populace conveyance, et cetera. In the center test system, responders are worked as moving substances whose activities are controlled by standard conventions or particular choice principles. Under typical conditions, the elements carry on subject to the framework limitations. In some new circumstances, say, calamities, they will be represented by extra adhoc standards and limitations. Such impromptu principles and requirements are resolved progressively by the commandants' choices, responders' association, and other articles' practices. Utilizing an approved reproduction framework, the leaders can anticipate the impacts of different basic choices before really executing them on the scene. The framework can recognize improper administration ahead of schedule to abstain from declining the circumstance. In this approach, the reactions are reconsidered at whatever point vital taking into account the recreation input as the occasion develops. Generally, discrete occasion reproduction is an apparatus for breaking down and assessing an unpredictable framework's operations. In this element decision system, DES will be utilized as a part of an imaginative way: it is basically a decision driver. The incorporated framework will have a substantial assortment of uses. Its utilization by civil governments to deal with the urban huge scale disasters the fundamental center of this examination; it could likewise be connected in army installation administration and the more extensive country security fields. It gives chiefs a dynamic research center to test strategies, preparing, procedure and strategies in a reproduced genuine decision scenario.

5. References

1. ESRI. New Orleans, Louisiana, Leverages Spatial Data to Aid in Damage Assessment Efforts after Hurricane Katrina, 2006. www.esri.com/news/arcnews/spring06articles/new-orleans.html, accessed October 13, 2006.
2. Nossiter A. New Orleans Population Is Reduced Nearly 60%, New York Times, 2006.
3. Hurst A. Davis Watch: Katrina Response Mismanaged, www.hurstforcongress.com, assessed, 2006.
4. Emergency, Disaster Management Inc. Hazards and Disasters, www.emergency-management.net, accessed, 2006.
5. Turban E, Aronson J, Liang T. Decision Support Systems and Intelligent Systems, 7th Edition, Prentice Hall, New Jersey, 2005.
6. Russell S, Norvig P. Artificial Intelligence – A Modern Approach, 2nd Edition, Prentice Hall, New Jersey, 2003.
7. Shuman L, Sepulveda J, Wolfe H. Computer Modeling of Rural Emergency Medical Services Delivery Systems," Journal of World Association for Disaster and Emergency Medicine, 1, Supplement I, 1985, 44-8.
8. Shuman L, Wolfe H. RURALSIM: The Design and Implementation of a Rural EMS Simulator," Journal of the Society for Health Systems. 1992; 3(3):54-71.
9. Son Y, Wysk R, Jones A. Simulation Based Shop Floor Control: Formal Model, Model Generation and Control Interface, IIE Transactions on Design and Manufacturing. 2003; 35(1):29-48.
10. Goldberg J, Dietrich R, Chen J. A Simulation Model for Evaluating a Set of Emergency Vehicle Base Locations: Development, Validation, and Usage, Socio-Economic Planning Sciences. 1990; 24(2):125-41.