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# Ergonomic and Transportation Safety in Accidents Using Cellular Automata Algorithm

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### ABSTRACT

In recent years by increase of engine vehicles the number of accidents with pedestrians also have increased .Whereas it seems that there is no specific plan to minimize these losses . One of the ways which has the most number of losses are highways. The present study attempted to make clear dimensions of such accidents further to determine real role of pedestrians and to present effective solutions in order to minimize losses, respecting pedestrians rights and understanding this matter that he is not an object ,but he's a intellect and free entity and it directs researchers to find a ways through which pedestrians get attentions and so to minimize accident's risks . One of these solutions is subway that has attracted large number of pedestrian's .By using cellular automata those regions around high ways and roads have divided us into separate cells and based on automata's rules major and strategic regions are considered and a subway will be constructed. We are hopeful this article make some rules to construct subway in high ways and streets.

KEY WORDS: accidents, pedestrians, cellular automata, accident's losses

#### **1. INTRODUCTION**

In recent years driving accidents were the 9<sup>th</sup> reason of deaths in the world and the second reason of death after cardiovascular diseases in Iran .unfortunately a large number of people have been injured in various ways annually. Analysis of accidents as an efficient tool can provides valuable information for considering accident's reason and appropriate solutions for it ,since 1.5 millions of peoples have died and nearly ,50 millions injured because of accident per years .but 90 percent of these people live in low income countries and it's itself thoughtful , 46 percent of killed persons in driving accidents were pedestrians and bikers ,and 30% of them were below 25 years old . young men were killed three times over women ,now we should find an efficient solution for minimizing these losses, of course those solution that a pedestrian also acclaims it and then to decrease a little part of society's pains.

#### 2. HISTORY

Chen and Jvanys by using linear logarithm have made a relation for accidents and related agents .in the present study 408 of observed cases were related to bus accidents in a highway in Taiwan between years 1985 to 1993 were used and because of few number of deaths in result of accidents ,those accidents that were lead to death have been combined with those lead to injury .They have emphasized on significance of grouping data such as accident's time. Front- back accidents, driving at last hours at night or morning, driving errors and ... etc were considered as main reasons for accident.

Kvkylmn has presented and explored some models for accidents which include single vehicle and double vehicles and other types of accidents .because of differences between entities of accidents and their occurrence causes , their separation was recommended for achieving better results .Finally he introduced front-front ,high speed ,reversal ,alcohol ,old age, lead maneuver and accidents at night ... as high depth accidents and front-back and side to side accidents as low depth ones. Sakvmanv More than explaining and presenting significance of depth models of accident, has considered validity of these models based on provided data of accident's data bank.

He applied binary Lajit models in his investigation and some causes like as driver's error ,bad condition for driving (hesitation, sickness) lack of sufficient view, wetness of road, accident at night, vehicle break down ,alcohol and etc as cumulative causes and those causes as using seat belt as reducer ones. He has shown in representation of models that if in one group for example accidents which lead to die, the numbers of observations be few to total accidents, combining it with injury accidents and getting it as a group leads to meaningfulness and better results in models.

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In general, search in literatures states different results about depth of cause's effects. Actually, in each one of research plans, cumulative and reducer causes were stated regard to available type of data.

### **3. Definition of main parameters**

**3.1**. Accident rate: in present study are number of pedestrians that have accident to each 1000 persons in studied population.

**3.2.Principals of cellular automata** : cellular automata of mathematic model for systems in which several simple parts have associated with each other to make complex patterns .cellular automata space is comprised by a regular cellular grid that each cell has an finite state automaton and it can has various(k>1) amounts . Automata's cells based on local transition rule that called  $\phi$ , when in which amount of each cell is determined based on neighbor cells .regards to cellular automata in various sciences , each one of fields presents a definition of CA .in following part , a definition of two-dimensions cellular automata was stated: two-dimensions cellular automata are dynamic systems that comprised of finite numbers of rXc which has placed on two-dimensions cellular space in the same way. Each cell has one state of total finite states Q that at any time step it's state will be changed based on local transition rule. In other word state of each cell at t depends on state of cell itself and other cells at t-1 .CA will be defined by four figures (c,q,v,f).

Image 1-3.six line neighborhood, square neighborhood Moore, square neighborhood von Neumam (right to left)



Fig.1-3: Neighborhood hexagonal, square neighborhood Moore Square neighborhood von Neumann (right to left)

3-3-cost productivity: ratio of cost to decrease of accident number to be a reasonable ratio

## 4. RESEARCH METHODOLOGY

In the present study, firstly we divide area around high ways which are studying as neighbor cell. By data gathering vehicle accidents with pedestrians in any cell; based on accessed data from trooper and traffic police about way and place of crash interesting results have been achieved. By analyze of these data, these results were more interesting than others.

The divided highway adjacent areas

Table 1-1.sample of an accident cell's data in emam Khomeini highway

Kilometer	The accident	Ft / injury	Pedestrian bridge	Age pedestrian
11-12	Leg	Injury	*	65
11-12	Chest	Ft	*	57
11-12	Head	Injury		58
11-12	Leg	Injury	*	26
11-12	Head	Ft		38
11-12	Basin	Ft	*	41
11-12	Basin	Injury		49

Almost of these accidents in living regions with high population density

B. in 40% of these points pedestrians bridges were grade separation.

c. 45% of persons involved in accident were miserable to climb bridges



Image 1-4-effect of population density around the high way

Existence of density in regions is not a reason for increase of driving accidents' loses and this was considered by data gathering from various regions. Existence of different cultures and welfare level also were effective causes in minimization and maximization of accidents numbers. But there was this capability so that numbers of these losses be fewer than mentioned statistics. By cost of a subway bridge and paying attention to disease; old age; large number of stairs, we can achieve pedestrian's satisfactory and minimization disposed costs to society for made damages in result of driving accidents.

4-2- a representation of cells with high density



4-3-the effect of welfare and culture in society in accident's losses minimization

Some of points because of high population density have more importance to other and are prior to them. In term these points or points are important cells. As a cell be high density has more importance than other points. As cells are more compact. Importance of building grade separation will be maximized and some of items increase weigh of a cell.



4-4-comparison of three states of pedestrian's passing

1-population density

2-existance of major and crowded points

3. Increase of machine's speed

4. Minimize of driver's sight for seeing pedestrian

5. High age average in cell's residents

It's noticeable that a cell can has effect on its neighbor and minimize or maximize weight of cell. So that the number of neighbor weighted cells be much, weight of others also will be increased and so possibility of building a bridge also will increased. As it's seen in diagram, existence of grade separation in various kilometers also has the best performance and it made minimization in driving losses in that cells.

### 5. Solutions

Accidents have concerned experts so to explore solutions for minimizing them. Using courts and presented and gathered data make it possible to analyze and evaluate quantity and quality of effective causes on accidents ,and we can investigate suggested changes effects of transportation facilities on traffic security in long term horizon and also to make a technological and more strong justify for reject and or acceptance of related designs. Experts get their attempts for designing safe solutions but statistics show that being standard has not ended to omission of insecure points and smoothness of it, and signs and boards ,safety physical warning equipments are some important constituting parts of way security and standardized way. Since this study is one of the most important solutions for reduction in numbers of driving losses in interaction with pedestrians is existence of required subways in crowded strategic region and there are several reasons which made pedestrian to use subway:

1-existance of fewer bridges than overpasses

2-lack of fear for many pedestrians

3- More Flexibility of subway for pedestrians with various disability

4-lower cost for building than overpasses with height

It's recommended that for reducing accidents way making and traffic managers pay attention to this important subject and also to concentrate on it when they are building high ways and roads.



1-5- example of a standard underpass

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