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# REVIEWER OF THE ISSUE

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REVIEWER
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VOL 5 ISSUE 1

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Saba Journal of Information Technology and Networking (SJITN)

# Article

## Detecting Polymorphic No-Operations in Shellcode Based on Mining Techniques

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Mining,
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**Abstract**

Shellcode acts as a weapon to perform Buffer Overflow (BOF), which is ranked as the most dangerous vulnerability. It consists of three sections that always transform their parts to be a Polymorphic Shellcode. Solutions available from Intrusion Detection Systems (IDS) still depend on the signature. Also, solutions that use data mining depend on Shellcodes with the factor of including payloads and not getting the high results, so polymorphic and unknown Shellcodes could not be detected. We proposed a new solution using a data mining classification technique on special features extracted which depends on the operation code of no operation instructions; which can classify the packets on the transport layer of the network as clean or buffer overflow Shellcode attack. This solution can detect unseen Shellcodes.

A dataset generated for malicious packets consists of 500,000 files from Metasploit No-Operation engines and 72,000 files of a clean dataset from various types of data. By applying different classification methods on the dataset which include selected features we specified and evaluating them by evaluation metrics; it showed that the solution has achieved high accuracy results with a 94% rate. In contrast, signature based on SNORT IDS detects only 50.02% of polymorphic Shellcodes in the experiment that was generated to compare the proposed solution with real IDS system. SVM algorithm was selected because of the recall rate 99.33% in detecting polymorphic NOOP's with low false alarm.

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## 1.Introduction

Information Technology infrastructure suffering from various vulnerabilities threats especially zero-day (0day) vulnerabilities which is the main reason in destroying systems, leaks information, and causes financial destruction. Buffer overflow is the most famous type of vulnerability which can hijack systems, execute remote applications, and spreading worms. Figure 1 shows that buffer overflow appears in a high severity and dangerous vulnerability that is used in cyber-attacks [1] [2]. This type of attacks forced security companies and security researchers to find optimal solutions that can protect complete solution that can protect and avoid systems from being hacked by buffer overflow.

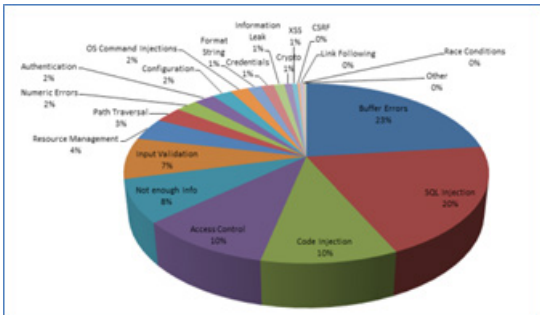


*Figure 1 Top Vulnerability types with a high severity [2]*

Buffer overflow is caused by bad programming practices used from programmers through working with memories without any boundary check, so while writing data to a buffer, it overruns the buffer's boundary and overwrites adjacent memory locations [3].

According to this issue, researchers started putting solutions by advising, using alternative programming languages that have built-in protection against accessing or overwriting data in any part of a memory. As C and C++ provide ability to work with the memory without checking the boundaries of buffers in writing, beside that, advise to stop using standard library functions and uses safe libraries that check boundaries [4], Microsoft provided application programming interface (API) routine to use Point Guard, implemented executable space protection in the core of operating systems, created data execution prevention (DEP), invented address space layout randomization (ASLR), Return Oriented Programming (ROP) prevent etc…. Inspite of these efforts, hackers always find ways, holes, and new techniques to skip these prevention techniques. To date, network intrusion detection systems detect and prevent such attacks by identifying worms and Shellcodes through using a fixed byte sequence of signature which is stored in updatable database of previously known worm's payload [5]. Concluding that there is no one solution for this threat, instead, we need dozens of solutions through which every solution solves one face from buffer overflow faces, so researchers use static analysis by analyzing the source code and dynamic analysis that analyses the applications on runtime. A point of view that handles this problem from another perspective by not working on the system itself but working on the network level and identify the packets transferred in the network that cause buffer overflow attacks. In this area there are lots of researches that detect and prevent the payloads on the network; but as usual there are techniques used by hackers to evade these approaches. Nowadays, there lots of engines that produce encrypted Shellcodes like those in Metasploit Framework [6], ecl-poly [7], AdMutate [8], or CLET [9]. By digging down into the structure of a Shellcode, there are main sections that must be in the Shellcode to make the overflow successful, which consist of NOP sled, payload, and return sled. Our work takes NOP sled section to identify the Shellcode while being transferred in the network, NOP section can consist of a huge probability of useless instructions which are generated and obfuscated by Shellcode engines.

In this Paper, Bernoulli Naïve Bayes, Decision Tree, and SVM data mining algorithms are used to be trained on special selected features that areextracted from very large amounts of polymorphic NOPs in Shellcodes. This allows the classifier to know the patterns which identify this section of a Shellcode. Therefore, the proposed solution can alarm that the system under buffer overflow is being attacked.

The rest of this paper is organized as follows: section two; related work, section three; methodology, section four; experimentation, section five; the results of experimentation and section six concludes the paper.

## 2.Related Work

Overflow detection and prevention problems have been studied since the mid-nineties. However, many recent researches have been published to solve this hot problem.

### *2.1.Static Analysis:*

Zhao, Z. et al. proposed a technique for modeling Shellcode detection and attribution through the instruction of sequence abstraction, which extracts coarse-grained features from an instruction sequence. This technique uses Markov model for Shellcode detection and supports vector machines for encoded Shellcode attribution [10]. The solution is based on static analysis and supervises machine learning techniques, to extract coarse-grained features used instead of byte patterns. The evaluation shows that this solution can detect all types of un-encoded Shellcodes from their dataset and can attribute encoded Shellcodes to their origin engine with high accuracy. Despite the efforts that got our attention, they used a small sample for training and all of these samples were from only one engine that also uses all Shellcode sections in the training because the model works on known payloads and returns ranges. But it is bypassed by adding low NOOP's altogether with unknown payloads in the Shellcode, so it can spoof it and pass.

Gamayunov, D. et al. proposed Racewalk algorithm which is a significant modification of the Stride algorithm that had linear computational complexity [11] [12]. It claims novelty of NOOP-sled detection using IA-32 instruction frequency analysis and SVM-based classification.

This approach reduces the false positive, and the speed of operation is 1Gbps. The main idea in this algorithm is the NOOP-zone which consists of generally useless instructions that allow the return address zone to be in the correct stack segment; because this varies from system to system, so it detects the sled candidates and sends them to SVM-based instruction frequency analyzer. Using only Four Shellcode engine generators, this algorithm was applied.

Still, there are many defects like detecting NOOPs of IA-64 and not being able to detect the Shellcode construction methods that do not rely on NOOP-sleds or using self-modified sleds that are not supported and bypassed by spoofing classifiers in the same instruction set but with unusual operands.

### *2.2.Dynamic Analysis:*

Fen, Y. presented a method that uses randomization based on data protection through protection of pointers and arrays, because of buffer overflow nature which depends on exceed writing on the limited area and to populate the return address, they use randomization on the arrays and pointers in program space to protect buffers, point data, and return address. This randomization is applied on the source by using XOR encryption for all the arrays and buffers. So, when the overflow happens, the target will be an encryption value which couldn't be point to, then the attack would fail. This approach is applied on the coding time to protect your self-application from being used in any type of buffer overflow attacks on the systems; but the major problem still exists; the applications from the shelf or on the operating system itself [13].

Khodaverdi, J. et al. proposed robust run time heuristic for detecting those Shellcodes which are hard-coded addresses; taking into consideration the fact that there are still too many users using older versions of windows that are not protected by Address Space Layout Randomization (ASLR) -enabled Windows. They used a custom emulator which supports the execution of IA-32 instructions, and they repeated the execution multiple times starting from each location of the input stream, to find all possible executable sequences of instructions in the input stream and detect any hard corded addresses that point to the stack pointer. Their evaluation results showed low false positive on 10 million random binaries [14].

They assumed using this emulator in a host level to detect the attacks, and for better performance. However, this approach could not detect return oriented programming (ROP).

### *2.3.Quantitative Analysis:*

Song, Y. et al. presented a quantitative analysis of the strength and limitations of Shellcode polymorphism and described the impact of these techniques in context of learning-based IDS systems. They focused on two methods: Shellcode encryp-

tion-based and targeted blending attacks; because these two types are used in wild attacks and are successive in evade IDS sensors [15]. Their paper demonstrates metrics to measure the effectiveness of modern polymorphic engines and provide insights into their designs. The paper dived in the construction of many Shellcode types to understand the overall issue, and after that analyzed the polymorphic engines –six of them- and by generating 10000 unique samples they plotted visualization images for each engine outputs to extract the pattern they used in creating the op codes. Also, they combined two engines that use polymorphism and blended them into one engine that they called A Hybrid Engine. They simply used CLET to cipher the Shellcode, then hid CLET's decoder with ADMmutate and used ADMmutate's advanced NOP sled generator and showed how the attackers can blend between many engines to generate new patterns. After that present newed a design to detect the modern obfuscation techniques. This paper allows us to go throw the inside of designing the polymorphic Shellcode engines.

### *2.4.Hybrid Analysis:*

Yuan, J. et al. proposed a method that uses static analysis (source code analysis) with the dynamic test (test a program while it is running), so this approach strikes a proper balance between static and dynamic analysis to identify buffer overflow vulnerabilities in a binary code (IA-32) without a source code [16].

They used two steps in their approach, first found some potential weakness locations then tested every potential weakness locations to reduce the false positive. After disassembly programs they went through many steps including identifying function call relations, analysing stack space, analyzing parameters, the use of local buffer, and finally determining the overflow function by using BugScam that can detect functions utilized in the binary file like Strcpy and so on.

And on the dynamic use Ollydbg to populate these functions that were identified before in static to see if it would check bounders or their overflow. Testing results shows low false alarm. We see that this approach can handle the stack overflow, and heap overflow can be a successful and needs us to put all the binaries of the organizations to this analysis to allow it to know if there is the ability to buffer overflow and this is not easily achieved!

The proposed solution is different than those solutions by depending on special feature extraction to make the classifier algorithm know the pattern of the polymorphic NOP generated.

## 3.Methodology

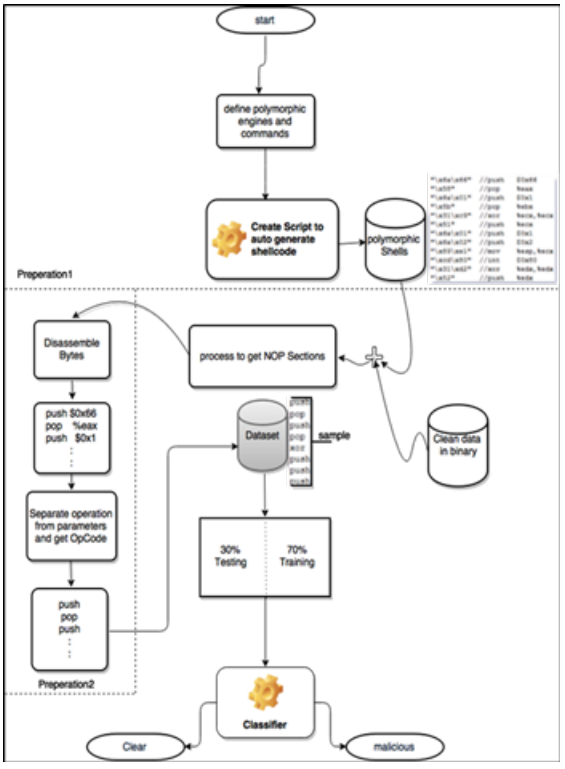


*Figure 2 The Proposed Solution*

The proposed solution depends on data mining classification techniques. It identifies malicious packets transferred in the network by using the first part from the three parts of Shellcode, which is known as NOP sled and specifically the polymorphic NOPs. This type of NOPs is applied as an advance fully undetectable attack.

Figure 2 shows the steps of the solution that are followed to achieve the target. Firstly, defining the polymorphic engines. Metasploit Shellcode engines (SINGLE-BYTE and OPTY2) are chosen and which have architecture IA-32. Then implementing a script that applies automatic generation on the engines with all possible parameters. This step produces significant amount of polymorphic Shellcodes that are generated and

labeled as malicious.

These Shellcode are CPU instructions in hexadecimal format, which do nothing other than forwarding the execution of payloads to the next instructions. In the same time, we collect massive files with different types of data to be the clean data and convert them to HEX.

After that moving to the next preparation by using Capstone Engine to disassemble all the hexadecimals of the two labels. This disassembly will convert the HEX to sequence of CPU instructions (assembly).

The last step here in building the dataset is to extract the features that aree used in the classification algorithms.

So, just extracting the operation code of all assembly instructions for the two labels. This leads to having a dataset that looks like Figure 3. Each line represent a file with its label.

| |
|---|
| ({and, dec, jg, xor, sub, mov, jge, jl, jecxz, add, adc, lahf, xchg, jae, jno, loop, cmp}, **'clean'**) |
| ({and, lea, dec, inc, sub, salc, mov, sbb, jecxz, add, test, adc, jg, das, xchg, xor, cwde, or, cmp}, **'clean'**) |
| ({and, lea, jnp, inc, stc, jp, mov, cwde, jo, das, xchg, jg, dec, aad}, **'malicious'**) |
| ({jns, and, xor, sub, stc, mov, js, clc, rcl, jbe, xchg, mul, jg, jno, inc}, **'malicious'**) |

*Figure 3 Four Samples of Dataset*

By going forward, all these features are ordered without repetition as shown in Figure 4. This sequence is the header of the classification input matrix, listing the instructions like this without respect to the order and the length of the input; because real environments systems couldn't determine the length of Shellcode or from where it's starting.

aad,adc,add,and,clc,cmp,cwde,das,dec,inc,jae,jbe,jecxz,jg,jge,jl,jno,jnp,jns,jo,jp,js,lahf,lea,loop,mov,mul,or,rcl ,salc,sbb,stc,sub,test,xchg,xor

*Figure 4 Feature names header*

Then dataset refined to be suitable to the classification method by converting its records to Boolean matrix which is produced from Formula 1.

$$M_{n,j} = \begin{cases} 1, & n \text{ is available in } j \text{ record} \\ 0, & n \text{ is not available in } j \text{ record} \end{cases}$$

Where,

$n$ is the index of feature in the features name header.

$j$ is the index of feature records.

Formula 1 Record to Boolean Value Conversion

Representing dataset example to the Boolean by using Formula 1. Producing Boolean matrix as shown in Figure 5.

The matrix in Figure 5 consist of rows that are equal to the dataset files count that appear in Figure 3 and the columns is the number of the features in Figure 4. So by checking the availability of each feature in the record, we can identify the matrix element is 0 or 1.

$$\begin{bmatrix} 0&1&1&1&0&1&0&0&1&0&1&0&1&0&1&1&1&1&1&0&0&0&0&0&0&0&1&0&1&1&0&0&0&0&0&0&0&1&0&1&1 \\ 0&1&1&1&0&1&1&1&1&1&1&0&0&1&1&0&0&0&0&0&0&0&0&0&1&0&1&0&1&0&1&1&0&1&0&1&1&1&1 \\ 1&0&0&1&0&0&1&1&1&1&0&0&0&1&0&0&0&1&0&1&1&0&0&1&0&1&0&1&0&0&0&0&0&1&0&0&1&0 \\ 0&0&0&1&1&0&0&0&0&1&0&1&0&1&0&0&1&0&1&0&1&0&0&1&0&0&0&1&1&0&1&0&0&1&1&0&1&1 \end{bmatrix}$$

*Figure 5 Matrix of Boolean Weighing of Four Example Records*

The last step in the solution is to pass this matrix to the classification algorithm. Classification methods are used such as SVM, Decision Tree, and Bernoulli NB to find which of them is the most method that suites the target of efficient malicious packets detection.

Representing how Decision Tree model will be applied on the four records of Boolean matrix shown in Figure 6.

This figure shows that the algorithm took a second feature as a root because if the record that has (adc) instruction, it will be clean and malicious if not available.

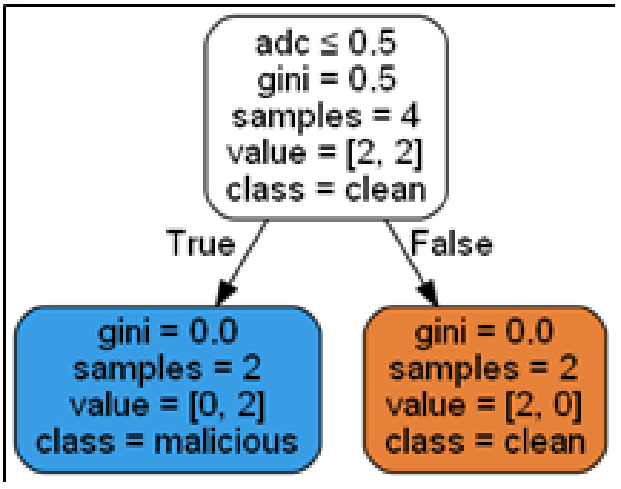


*Figure 6 Output Representation of Decision Tree Applying on the four Samples.*

The 4 records model is a small example that can be larger according to how large the dataset is. In Figure 7 the representation of a Decision Tree is applied on twenty-eight samples' matrix as another example.


*Figure 7 Decision Tree Model for Twenty eight Samples*

## 4.Experimentation

### *4.1.Corpus:*

The corpus contains 500,000 malicious files and 72,000 clean files. Malicious corpus is generated from Metasploit polymorphic NOP's engine for 1 byte and multi bytes (OPTY2) with a max of 5000 bytes. Also collected clean files from various types.

### *4.2.Setup Tools:*

Installed python 2.7 on 2.5 GHZ core I7 machine with 10Gb RAM. Using script tools available in python, we installed NLTK by this command (pip install nltk). After that installed scikit-learn tool by applying the command (pip install -U scikit-learn).

### *4.3.Preprocessing*:

We collected malicious files as well as clean files which have the hexadecimal representation converted to assembly lines using Capstone Engine [17], then got the operation code of each line as it's the selected feature that we need to apply the experiments on it.

Malicious dataset has large number of files compared to the clean data so dataset shuffled and chose 70,000 records randomly.

Processing:

Script implemented to use the algorithms API of SKLEARN Library to process this dataset with respect to training the algorithm and testing it and calculating the accuracy, precision, and recall to evaluate each algorithm performance and determine its effectiveness. Precision is the percentage of predicted documents class that is correctly classified. Recall is the percentage of the total documents for the given class that are correctly classified. Also, computed the F-measure a combined metric that takes both precision and recall into consideration [18].

## 5.Experimentation Results

This section presents the results of three experiments using the three different algorithms which are: SVM, BNB, and DT. Algorithms training applied on 70% of the two labeled and used the rest (30%) of the dataset to measure the performance and efficiency of each algorithm.

Table 1 illustrates the performance measurement results of each algorithm according to the precision (TP/TP+FP), recall (TP/TP+FN), and F-measure (2*precision*recall / precision + recall) metrics. From this, results found that SVM has the highest rate 99.3% of correctly malicious prediction from all of real malicious and this computed from recall. Beside that, they found that SVM had 9.5% of false alarm.

The Accuracy (TP+TN/TP+TN+FN+FN) metrics are computed and listed in Table 2. It shows clearly that SVM has the highest accuracy with 94.91%.

*Table 1 Precision, Recall, and F-measure of algorithms.*

| | Precision | | Recall | | F-measure | |
|---|---|---|---|---|---|---|
| | Pos | Neg | Pos | Neg | Pos | Neg |
| BNB | 90.9% | 96.78% | 97% | 90.33% | 93.87% | 93.44% |
| SVM | 91.27% | 99.26% | 99.3% | 90.5% | 95.13% | 94.68% |
| DT | 91.93% | 94.82% | 95% | 91.66% | 93.44% | 93.22% |

*Table 2 Accuracy and Execution Time*

| | accuracy | Execution Time | |
|---|---|---|---|
| | | Training | Testing |
| BNB | 93.66% | 2.7039 sec | 1.671 sec |
| SVM | 94.91% | 3.968 sec | 1.734 sec |
| DT | 93.33% | 3.233 sec | 1.405 sec |

## 6.Conclusion

We demonstrated how dangerous the buffer overflow is, and how hackers can be employing the weapons of polymorphic Shellcodes to hack the systems and bypass security that can catch Shellcodes.

Data mining classification is used in this solution.

This solution depends on the idea of getting the op-code of the CPU Intel architecture instruction sets for the polymorphic sled NOOPs of 32-bit and applying the classification on it. Our solution depends on a self-generated dataset from Metasploit polymorphic NOOPs engines. Applying different classification algorithms on the dataset to get the perfect method that can deal with the problem.

Solution experiments illustrated high accuracy in detecting malicious data on the network with low false alarm for most of the algorithms we used. SVM was chosen as the best classification algorithm that can handle this issue because of it's 94% accuracy and getting 99.33% of recall metrics and the low false alarm we get.

Our solution shows significant results comparing against signature based on SNORT IDS which we compared against 1000 packets of polymorphic Shellcodes and the IDS classified 50.2% packets as harmful packet. On the other hand, our solution detects most of these packets with a close rate of 94%.

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# Article

## Content-Aware Image Seam Carving Technique for Object Resizing

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Big image

**Abstract**

Image re-targeting is one of the most popular multimedia contents and manipulation techniques in the digitalized world. Seam carving is used for image retargeting processes. Seams are successfully related or repeated pixels along rows or columns of an image which never impact on an object when removed or resized. The proposed research focus on preserving the objects and its saliency, which includes a facial photographic image, is significant objects in an image and shadows using CRIST (Content Retargeting and Image Seam Carving Techniques). The Image retargeting focuses on image resizing by preserving the quality of actual image objects. The experiment result of proposed system outperforms the rest of the real state of art image retargeting technique. The accuracy is calculated based on resolution and Mean Opinion Score (MOS).

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## 1. Introduction

The growth of the digital media technology is increasing very festally, a variety of displays devices of various resolutions and sizes such as laptop computer, mobile phones, cameras and televisions have appeared within the recent years [1]. Images and videos have to typically change in size and ratio to completely adapt to different screens ranging from high-resolution laptop monitors to low-resolution mobile devices. For this reason, image retargeting has become a hot topic in the image mining area. Traditional image retargeting process like cropping and undiversified scaling usually cannot end in the satisfactory image result [1]. These methods are not considering the content of the image. Cropping will shield a locality of an image as well as lead to the loss of the different components which can embody valuable data. Undiversified scaling will be successful to retain all the information within the image [1], however, it will cause visual distortions. To address these issues, several content-aware retargeting methods are projected. Many of the researchers are adopting Seam Carving Techniques.

The detection of interesting or salient areas in a picture is critical, and is a part of a PC vision research. A substantial body of labour in graphics focuses on making additional compelling images, and also the human-computer interaction community has an interest in exploring new kinds of interaction for retargeting images, as well as evaluating the effectiveness of retargeting algorithms in different tasks [1],[2].

## 2. Related Works

The digital image mining and processing started in the year 1920 for sending newspaper picture work tasks. Digital images were displayed in different PDA applications as a diverse variety of image resolutions. The resolution variations will affect the appearance of images in PDA devices.

Numerous content-aware image retargeting techniques have recently been proposed. Cropping has been widely used to eliminate useless information from the image periphery or to improve the overall composition [3], [4], [5]. Seam carving methods iteratively remove a seam in the input image to preserve visually salient contents [1]. Multi-operator algorithms combine seam carving, homogeneous scaling and cropping to optimally resize images [6]. Real-world images usually contain vivid contents and rich textural details for retargeting, they design a new framework based on content-aware synthesis to enhance content-aware image retargeting. Image Retargeting Quality Assessment, a Study of Subjective Scores and Objective Metrics, presents the result of a recent large-scale subjective study of image retargeting quality on a collection of images generated by several representative image retargeting methods [7]. In Perceptual Relevance Based Image Retargeting, two map based retargeting techniques are used; Density map and Region of interest. These techniques compare with benchmark conditions [8]. Some images contain different types of objects in that Yan et.al proposed canny edge detector and Bi-directional seam operations for identifying the region of interest and region of Unimportant [2]. An image is divided into two parts; Real-time image with high dynamic range (HDR) region and Low dynamic range (LDR) region in the presented paper, efficient image retargeting for high dynamic range scenes [9].

An adaptive seam carving algorithm was used for seam carving. This algorithm has taken some feathers for seam carving and detect Gradient magnitude, Saliency, Edge, Face, and Straight lines [10]. 2D images are also used for seam carving [11] [12]. Seam insertion and removal can be done by using reverse seam carving. Reduction, expansion and Forward energy operation are occurring throughout the process [13]. An image may define as a two-dimensional function, f(x, y), where x and y are spatial (plane) coordinates, and the amplitude of any pair of coordinates (x,y) is called the intensity or gray level of the image at that point [1],[13].

## 3. System Architecture

The system architecture consists of a college of algorithms called CRIST (Content Retargeting and Image Seam Carving Techniques) to focus on preserving the objects and their saliency, which includes a Facial photographic image i.e. significant Objects in images and shadows. The proposed system, having three types of inputs,

bald a person's image. Images contain big objects and last shadows.

A bald person image is taken for resizing the existing systems to produce a wrong result by changing the shape of the head and also the person's round face, losing the face identity. Some images contain two or three big objects. After retargeting operations, the output result looks like cropping and scaling. All the existing resizing does not consider the shadows in the resizing images.

All the three different objective outputs are compared with the height and width parameter, and the result shows that "CRIST" is better than all the other octal retargeting methods. A retargeting image quality evaluation survey was conducted by Mean Opinion Score (MOS) with the help of expert persons.

### *3.1. Image Retargeting (Resizing)*

A common solution to image retargeting is to uniformly rescale the original image according to the target screen size [3].Image retargeting is often mistaken for image cropping and scaling[14]. Epitome (Joji et all) method is a little method of retargeting process. The cropping deals with removing positions of the image with or without considering the important parts of an image, increasing or decreasing the size of objects in an image which may tend to lose its visual originality. The retargeting focuses on resizing the image by preserving the quality of the output result as its original image. The entire process is also termed as seam carving. It is the methodology of dividing images into vertical or horizontal seams. The seams can be represented as single linear thread portions of image containing pixels with unique identity, colour and relationship.Seam carving applications include increasing the size of an image, changing the size of an image in two dimensions and even object [15], and the removal reducing of an image means by removing pixels that will go unnoticed [16]. The Seams can be either vertical or horizontal [17]. A vertical seam is a path of 8 connected pixels from top to bottom, in an image with one pixel in each row. A horizontal seam is similar, except the connection being from left to right [15]. The importance energy function values a pixel by measuring its contrast with its neighbour pixels. Seam carving is a process of modifying the least low energy peals in an image[18]. The typical application of image seam carving is the resizing of an image along its on dimension [19]. This can be done by finding one pixel wide paths from the top to the bottom of the image and removing those paths. If the pixels in those paths are similar to the surrounding pixels, then their removal may be unnoticed.

Let I be an m*n image, then

The vertical seam is defined as

It is an eight connected path of pixels in an N x M image from top to bottom, containing one and only one pixel in each row of in the image [1], [11].

$$s^y = \left\{s_i^x\right\}_{i=1}^{N} = \left\{\left(x(i), i\right)\right\}_{i=1}^{N}, s.t. \forall i, \left|x(i) - x(i-1)\right| \le 1$$

Where x is a mapping x: [1...N] [1...M]. (1)

The horizontal seam can be defined as [1]

$$s^y = \left\{s_i^y\right\}_{j=1}^{M} = \left\{\left(x(i), i\right)\right\}_{j=1}^{M}, s.t. \forall j, \left|y(j) - y(j-1)\right| \le 1$$

Where x is a mapping x: [1...N] [1...M]. (2)

It is an eight-connected path of pixels in an N x M image from left to right, containing one and only one pixel in each column of in the image[11]. The energy of every pixel is measured vertical and horizontal direction [1]. Then the energy operates to reason the energy of each pixel within the image is outlined as:

$$e(I(x,y)) = \sqrt{\left|\frac{\partial}{\partial x} I(x,y)\right|^2 + \left|\frac{\partial}{\partial y} I(x,y)\right|^2} \quad (3)$$

The energy map of the image then may be computed using this energy perform [1]. The seam energy is going to be the total of the energy of pixels constituting the seam.

A cumulative energy cost for the three possible connected vertical seams at each entry M (i, j) can be calculated as follows:

$$M(i,j) = E(i,j) + \min\{M(i-1, j-1), M(i-1, j), M(i-1, j+1)\} \quad (4)$$

Where M (i ,j) is the accumulative energy at the current pixel, energy to each pixel in an image, the energy calculation is based on the sum of X

and Y derivatives of each pixel points [4],[20]. The derivatives are calculated taking the finite divided difference between the pixel and the neighbour.

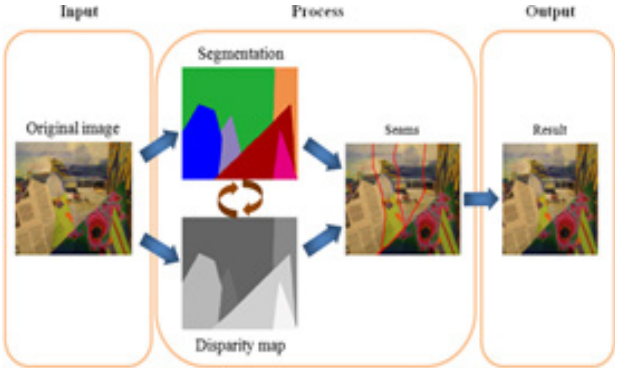


*Figure 1 is taken from Dawei Lu, Huadong Ma;* Liang Liu, ‚Journal of electronic imaging, and is on visually preserving stereoscopic image retargeting using depth carving April 28,2016, 25(2).

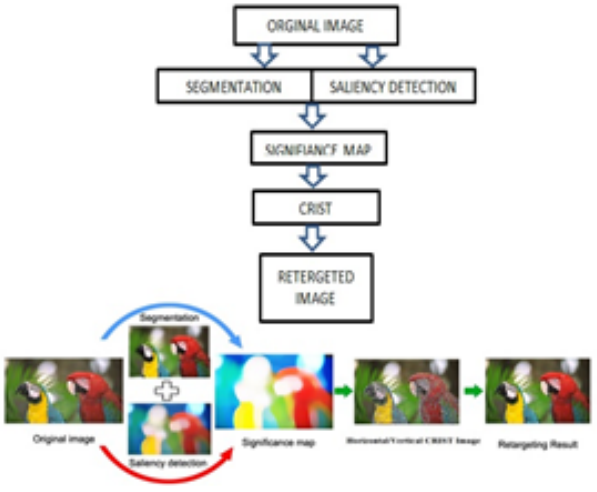


*Figure 2: Framework of proposed method*

Traditional algorithms work on single criteria and they are focused on expected results. These algorithms are applied on entire processing models with a few sub algorithms. The sub algorithms are existing algorithms without any change in any aspect, such kind of algorithms are least used in the processed models. For preserving the content of the image the entire re-targeting process is carried.

The proposed method first calculates the energy of each input image pixel using equation (3). Saliency detection is a part of segmentation. In calculating the saliency map of the input Image we consider the depth and colour of the image. $I_{Col}$ and $I_{Dep}$ are the two constrains for saliency S detection process. Saliency value at position x is calculated as

$S(x) = \lambda S_{Col}(x) + (1-\lambda) S_{Dep}(X)$ (5), λ is the regularization constant of $S_{Col}(x)$ and $S_{Dep}(X)$.

S is generated and used for foreground extraction. It is observed that foreground has a higher saliency value than background. With the help of saliency map, the proposed method can extract the foreground objects.

*Figure 3: Example of input images and their saliency maps.*

In the next stage significance map of the processed input image, we proposed a novel significance map which is a combined result of the prepossessing methods and it is a process of ROA (region of attention) extraction.

We define ROA as a rectangle R(C W H), where C denotes ROI centre, W and H are the width and height of the rectangle respectively. Concerning the saliency map and saliency point information, C position should correspond to the maxima of local saliency values. 9 feathers are extracted from the input image such as four gray value statistic feathers mean **m**, variance $\boldsymbol{\sigma^2}$ skewness s, kurtosis **k** two colour feathers. CIE lab is more suitable for image segmentation.

Third stage is the CRIST implementation stage which is a combination of algorithms. After completing all the existing prepossessing stages, we apply the seam carving horizontal equation (1) and vertical equation (2) algorithms for image resizing.

The seam path calculation was carried using the equation (4) findin the lowest energy seam in the entire processed input image and removing the entire lowest seams from the image frame, the image comes into a new size. These iterations are carried many times to get a desired image size output resolution.

## 4 .Models and Implementations

There are eight existing models for image retargeting Cr-manually chosen cropping windows [Manual] [21], Sv stereo video [Krahenbuhl et

al. 2009] [22], MultiOp multi operator [Rubinstein et al. 2009] [23], Sc seam carving [Avidan & Shamir, 2007] [24], Simple Scaling Operator [Cubic interpolation] [25], Sm-shift map [Pritch et al. 2009] [26], Sns-scale and streatch [Wang et al. 2008] [27], Warp Non Homogeneous Warping [Wolf et al. 2007] [28]. We introduced a new image re-targeting model called CRIST.

The proposed GUI was created in MatLab environment. MATLAB (matrix laboratory) is a numerical computing environment and fourth-generation programming language.

The GUI of proposed model having seven different functions opening; an image reset, the input image, CRIST vertical process, and CRIST horizontal process, State of art resizing function, Gradient and Energy map of input image. First we selected an input image into our GUI, then using the input image we calculated the saliency map and gradient energy in the segmentation function before seam carving. The proposed model focuses on the width and height of the processed image. Horizontal and Vertical CRIST operations are done in third and fourth stage, these stages resized output images are compared with the next stage .The fifth stage in the System model contains state of art methods. The CRIST output image is compared with eight state of art re-targeting methodologies. Finally, the Mean Opinion Score is calculated with the help of 30 expert review comments. The experiment's result shows improved retargeted results.

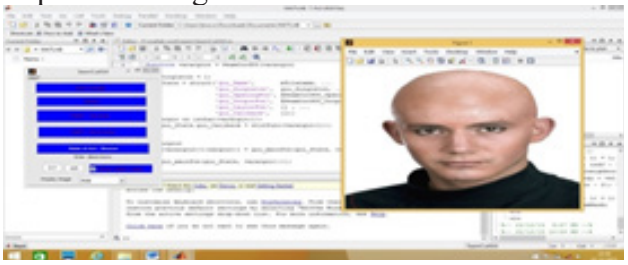

*Figure 4: The Mat lab GUI of the proposed method*

## 5. Experiment Measurements

Our proposed approach is implemented in three types of photographic image like facial image shadows, and some big objects. The experiment results show that the proposed algorithm outperforms the relevant state-of-the-arts image retargeting algorithms significantly. Eight output result Mean Opinion Score is calculated based on the state of the art retargeting methodologies.

### *5.1. Mean Opinion Score*

In image retargeting, quality usually dictates whether an expert experience is a good or bad one [29]. Besides the qualitative description the subject expert viewer, like and comment 'quite good' or 'very bad', there is an opinion method of expressing image quality. The opinion method is called Mean Opinion Score (MOS) [29]. MOS gives a numerical indication of the perceived quality of the image after being re-targeted using different retargeted methods. In our research survey MOS is expressed in one number, from 1 to 5, 1 being the worst and 5 the best. MOS is quite subjective, as it is based on figures that result from re-targeting and what is perceived by people during their opinion. Saliency detection and segmentation processes of input images are both carried on the first stage in CRIST. Based on the energy level in the input image pixel, two types of image maps are generated; Significance map and energy map. In the last stage the horizontal and vertical CRIST algorithms are applied and the final retargeted images are obtained.

The Mean Opinion Score Values Taken in whole numbers, the numbers are quite easy to grade. It is shown in table 1. Perfect = 5,Fair. = 4,Not clear = 3,Annoying = 2,Bad = 1

| ALGORITHM | RESOLUTIONS | MOS | | | | |
|---|---|---|---|---|---|---|
| Men face | | Bad | Annoying | Not Clear | Fair | Perfect |
| CR | 368*387 | | ✓ | | | |
| SV | 138*279 | | | | ✓ | |
| MULTIOP | 368*276 | | | ✓ | | |
| SC | 228*247 | | | | ✓ | |
| SSL | 287*138 | | | ✓ | | |
| Shift Map | 283*247 | | | | ✓ | |
| SNS | 266*146 | | ✓ | | | |
| WARP | 276*149 | | | ✓ | | |
| CRIST | 400*400 | | | | | ✓ |

*Table 1: Model of a mean opinion score calculating chart of an expert comment*

$$\text{Retargeted Image Quality} = = \frac{1}{N}\sum_{i=1}^{N} xi \quad (6)$$

The perceptual quality of each image is subjectively rated by at least 30 expert computer science viewers, the mean opinion scores (MOS) were obtained. It is revealed that the subject viewers have arrived at a reasonable agreement on the perceptual quality of the retargeted image. Therefore, the MOS values obtained can be regarded as the ground truth for evaluating the quality metric (resolution) performances [30][31]. In this paper, an output performance study is conducted to as-

sess the perceptual quality of the retargeted images. The study carried over three main objectives of images (in two image resolutions) is generated by different retargeting methods. With the source image as the reference, the perceptual quality of Try objective retargeted image has been subjectively rated by at least 30 human subject expert viewers based on output image resolution scale. After processing the subjective ratings, the MOS value and the corresponding standard deviation are obtained for each image. Based on the MOS values, the output images retargeting data's are analysed from the perspectives of the retargeting resolution scale, the retargeting method, and the source image content [6]. The above figure, 3, explains the three image selected as our three objectives after implementing the CRIST algorithm. The three types of CRIST retargeted image results are better than all other state of art techniques. The study was carried over all these three images and retargeting techniques. The Mean Opinion Score value of CRIST is greater than all other state of art techniques. The algorithm focuses on the superior region of each input image and energy level as well as gradient map of retargeting input images. The systems focus mainly on the resolutions of retargeting images.

| Big Objects comparisons chart | | | |
|---|---|---|---|
| **TECHNOLOGY** | **HEIGHT** | **WIDTH** | **MOS** |
| CRIST | 400 | 300 | 80 |
| CR | 365 | 239 | 65 |
| SV | 368 | 300 | 45 |
| SC | 351 | 300 | 70 |
| SHIFTMAP | 391 | 285 | 50 |
| WARP | 290 | 239 | 55 |
| SNS | 365 | 186 | 40 |
| SSL | 333 | 183 | 60 |

*Table 2:Compression chart of Big obect image.*

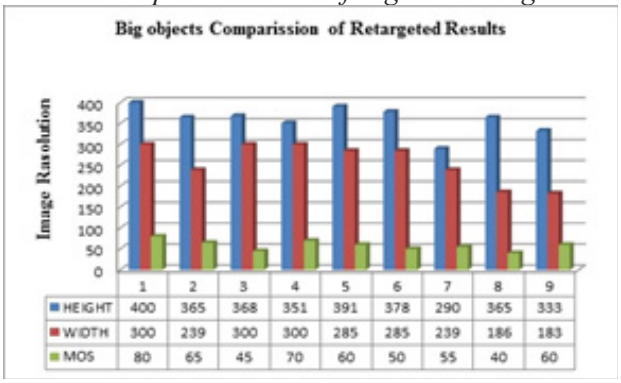


*Figure 5: Bar diagram of big object compression result (Height, Width, and MOS)*

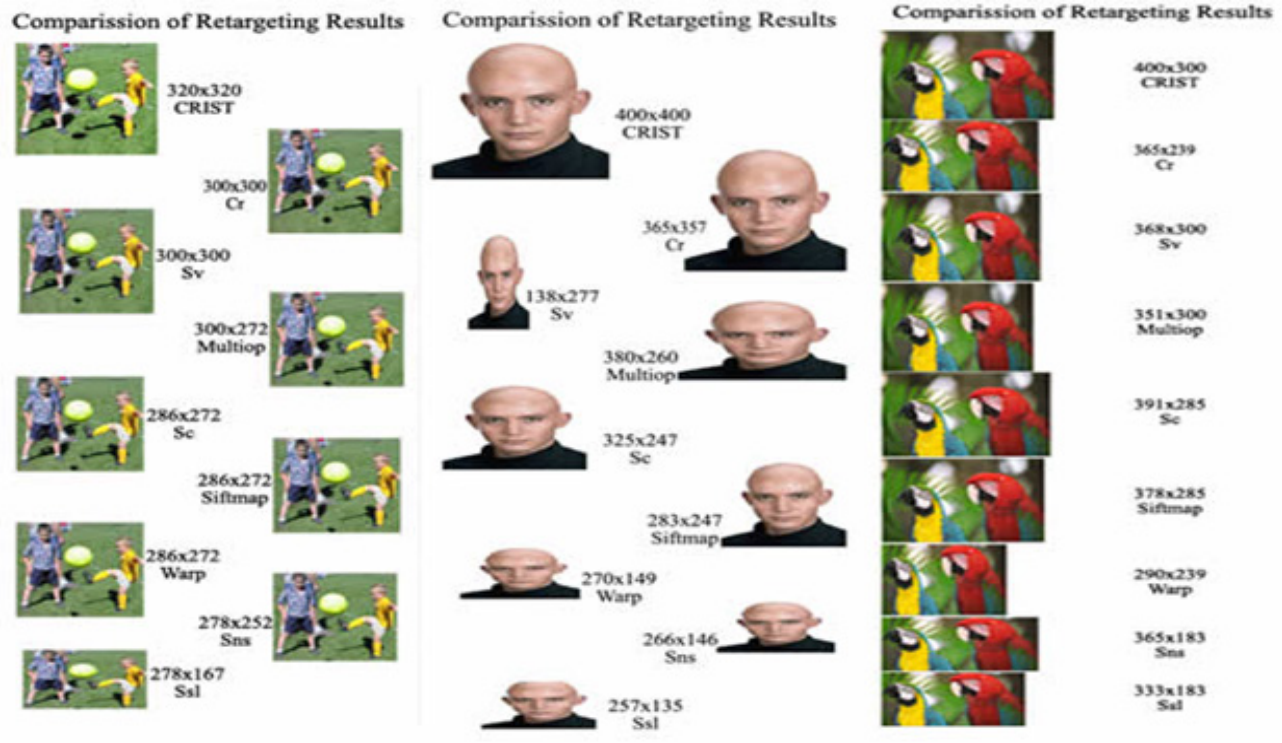


*Figure 6: Result of the three input image using different retargeting methods*

## 6. Conclusion

The proposed research focuses on tri objectives' functionalities of digital images. The output result is verified using Mean Opinion Score. Our method, Figure 6, shows three types of image (Shadows, Facial image and big objects).The method works only with a specified data set. The algorithm splits the segmentation and saliency work into different stages, combined result is significance map. CRIST carried Horizontal and vertical ways over an input image. The experimented output is compared with state of the art existing image re-targeting methods; MOS Compares the octal existing algorithms outputs, those objectives never consider the region of meaningful and resolutions of the retargeted images, whereas proposed CRIST categorize the image objects and feathers based on their importance and resolution.

## 7. Future Works

The future direction of our research work can be carried out by increasing the complexity of data acquisition example videos, and image sequence the CRIST can apply by enhancing the data volume for handling streaming videos. Future research can be made possible with 3D images.

## 8. Acknowledgments

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# Article

## Identifying and Explaining the Affective Factors of IT Innovation Acceptance in Government Agencies by Using Structural Equation Modeling

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**Abstract**

In the present era, information technology is a new tool that has affected all dimensions of organizations. Therefore, it seems impossible to imagine an organization without information technology (IT) to be able to keep pace with new technologies. The aim of this study is to identify the affective factors in adopting IT innovation in governmental organizations. In order to achieve the paper's objective after investigating, the theoretical foundations of affecting factors on the acceptance of IT innovation have been identified, and five factors have been classified using exploratory factor analysis. In addition, using the confirmatory factor analysis based on modeling, the structural equation relation of factors and indicators were discussed. Results show that factors such as relative advantage and innovation capability, safety and reliability, organizational culture, management support, economic status and social cooperation and coordination among organizations, play an important role in the acceptance of innovation.

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## 1.Introduction

After World War II, governments and governmental agencies have seen an increase and expansion in their economic and social responsibilities [1] and the demand of citizens had increased to provide economic and social programs by the government. To respond quickly to this need, the government began to increase the number of governmental agencies and development of informational systems, in order to increase the reliability and quality of the services. Thus, in order to face this challenge (citizens demand), public sector organizations were receptive to a set of information technology [2]. Therefore, one of the main issues that governmental agencies faced was acceptance and successful implementation of innovations in information technology, in order to keep pace with the new technologies [2] [3].

Nowadays IT is a new tool that has influenced all aspects of human life including organizations. Therefore, the organizational vision seems impossible without information technology [4]. Using information technology as an approach to development of Governance tools and providing a better service to citizens refer to e-Government [5]. E-Government has become increasingly a means of providing public services in many governmental organizations of the world [6].

During recent decades, governmental organizations have seen notable developments in a rapidly changing technology. Since, IT innovation has become a key factor in creating the competition and as an engine of growth and development that allows organizations to be more efficient in the global economy [7]. Hence, government agencies turned to accept innovations of information technology to benefit from innovation and competitive advantages [8].

Citizens expectations, improvement productivity, reduction of administrative costs, transparency, people's satisfaction, providing quality services to citizens and increase in the speed of to providing services, are all important innovations in information technology for Government agencies. Generally, for organizations to create more value, satisfaction of citizens and improvement of the efficiency should be through the use information technology [4].

The development of information technology in governmental organizations in developing countries, including Iran; with sporadic activities emerging in deploying e-government, from the years of the Internet advent in the late 1991 in the country and TEKFA plan, is of special importance. Therefore, on one hand, application and development of the technology is a national development strategy. On the other hand, the role of the massive public importance in the national economy, will double the theme [4].

Although several studies on the causes of success and failure of innovative technologies were conducted, the focus of this study was on the public sector. Many new technologies in this section have failed for reasons such as the lack of an experienced manager, lack of understanding of the citizen's requirements, lack of sufficient familiarity with innovations, lack of full understanding of IT capacity, relative benefits and management capabilities [2].

Hence, the main objective of this research is to identify and explain the affecting factors on the acceptance or rejection of innovations in information technology within governmental organizations. Thereby, a further step is taken towards facilitating the acceptance and uptake of IT innovations in addition to taking advantages from them.

## 2.Theoretical Foundations

In this section, the concepts of innovation and information technology are defined. Then the roles of information technology in governmental organizations, as well as the affecting factors on the acceptance of information technology in governmental organizations are described.

### *2.1 Innovation*

Innovation in an organization means creating and accepting original ideas and behaviors. Innovation includes product innovation, process innovation, technological innovation and administrative innovation. Moreover, because of the higher importance of technology in many studies, the focus has been on the technology innovation [9].

Innovation in technology may cause renewing the use of technology in the organization. Also new use of present technology is considered, innovation in technology. A new technical knowl-

edge can be technological innovation as well [7]. Highly stimulating innovation leads to rapid changes in technology and increasing prosperity as well as economic growth [10].

### *2.2 Information Technology*

Information Technology was developed in the late 70s; to refer to the use of computer technology for working with information [11]. Information technology refers to tools and methods that collect Storage, retrieval, process, analyzing and distributing information in different ways [12] [4] [13]. This definition has a close connection with the application of information technology in our research. Information technology helps to create new goods and services, and licensed firms and service. Moreover, it improves the company's operations in different areas of decision-making, partners, as well as suppliers and customers [13]. Since the advent of Information technology, by a profound impact on the most aspects of the business, it has played an undeniable role in the global economy [14]. Therefore, IT development and its ease of use, makes organizations equip their processes and practices with it [15].

Without the development and application of information technology, knowledge-based development objectives of the country cannot be expected to be realized [4].

However, forecasts indicate that this technology will continue to grow rapidly in the future. Nevertheless, evidence showed that successful application of this technology in governmental organizations was not so satisfactory [11].

Due to the advent of the information technology age, circumstances dictate that governmental organizations have to be more flexible and compatible towards their clients. Therefore, the use of information technology in the public sector to provide information services and respond to audiences and beneficiaries have been all emphasized [16].

### *2.3 The role of the information technology in governmental organizations*

Despite the widespread use of information technology in business activity, more governments have activated a lot of research in the field of IT applications to know what the advantages of information technology are [17].

Information technology, having very important capabilities in the promotion of efficiency and effectiveness in organizational performance areas, will play a dominant role in the new Millennium. Many developing countries are trying to develop and implement e-government projects, to adjust themselves to the new environment and make use of its advantages [18].

Since the 80s, the expansion of the supply of personal computers has led government managers in organizations to equip a tool of information technology. Thus, they began a new phase of information technology in governmental organizations [19].

We now talk a little about IT innovations and applications. At the beginning, we knew that the Internet Revolution and the related technologies, in addition to the rise of electronic business, have raised the proposed transformation of the structure and processes in the field of the government performance. E-government is the reflective of raised perspectives in the modernization and reorganization of public administration that covers formed IT innovation and many innovative initiatives public administration performances, based on the potentials of information technology [17]. Development of new public management ideas and ideals can be considered as one of the potential factors of e-government policies. Because in new public management, a combination of the traditional values of governmental management (performance, saving and effectiveness) along with the values of modern governmental management (such as responding to citizens, and citizens' involvement in Decision-making, equal distribution of public services and providing a range of citizenship choices) are considered [20]. E-government refers to the use of systematic governmental organizations from the Internet, computer networks and information technologies that aim to improve the efficiency, effectiveness, synergies, transparency and customer orientation [21]. Establishment of e-government enables all citizens, businesses, organizations and government employees to enter the network through a website without having the limitations of space and time; and access government information and services [22]. E-government is the easy use of in-

formation technology for the distribution of governmental services boarding to citizens directly [23]. It relies on the Internet and other emerging technologies, in order to receive and distribute information and services simply, quickly, efficiently and at a low cost [24].

Therefore, e-government is a set of all of the electronic communications that occur between government, businesses and citizens [19].

Nowadays, due to the advancement of information technology, the impact of this technology on different aspects of life, and the arrival of digital age, changes in various fields are inevitable. And in the case of inconsistency of organizations with these changes and innovations, inefficient organizations will be evident more than ever [25] [6]. In the recent years, e-government was placed seriously on the agenda of the government, and intelligence States Men have deployed their forces to the realization of such conditions and have sought to reform political, economic and social process with the help of new information technology and thereby to deliver services to their citizens in a more effective way [25].

The aim of such a government is to take advantage of new technologies in order to provide better services to citizens; providing integrated services, offering value-added services, providing services more quickly, and intergovernmental restructuring. One of the opportunities that new information technologies gives us is that it provides the possibility of the use of this technology to re-engineer the state architecture and to become more accessible, efficient and responsive. To rule the society of information and its management, we need to create e-government and keep pace with new technologies, and information society cannot be well managed with traditional information processes and structures [26].

IT innovation, changes in citizens and economic institutions and investment firm's expectations in the IT sector, place in the category of most important factors that need to establish e-government. IT innovations facilitate serving to citizens, downsizing of government, taking information and services by citizens, businesses and government organizations to facilitate business processes and reduce costs through integration and elimination of parallel systems [25].

### *2.4 Process and models of acceptance of IT innovation*

IT innovation acceptance process involves sequential steps that an organization already gets through before starting to implement a new technology. The main decision of acceptance happens between the two steps of starting and performing. In other words, the first stage involves awareness, consideration and intention. In the performing step, the organization decides to develop a new technology and use it. Therefore, acceptance of innovation that precedes the implementation of its decision is very important [27].

The carried out researches in relation to the acceptance and development of information technology innovation, explain attitudes and behaviors related to innovation based on a set of theoretical models [28]. Several basic models can be derived from previous studies in connection with the acceptance of information technology. These models include: the dissemination of innovation [24], theory of reasoned action [29], technology acceptance model [2], acceptance model of IT innovation [30], the process of innovation admission [31], and the acceptance and implementation of innovation model [28] [25].

Although many of the innovation acceptances in organization occur at the individual level, the term acceptance of innovation is used within the organization [32].

However, Fichman, Kemerer and Orlikowski showed in their own research that many of the conventional methods have neglected the fact that a higher acceptance decision occurs in the Organizational level [33] [34].

Accordingly, the conditional decisions of innovation are posed in organizations that adopt an initial decision about acceptance of innovation, and the users have little choice power in acceptance. Therefore, they strive to perform adaptive actions, to use that specific innovation, in performing their tasks [35] [28].

A summary of the most important models and processes of IT innovation acceptance are presented in table (1) below:

| Source | Model | Process |
|---|---|---|
| (Liaoa & Liu, 2008) [36] | Change Model | Exit from freezing, changed, re-freezing |
| (Pierce & Delbecq, 1977) [37] | Organizational innovation model | Initially, acceptance, implementation |
| (Darmawan, 2001) [38] | Acceptance process innovation | Initially, acceptance, implementation, |
| (Becker & Whisler, 1967) [31] | Admission process innovation | Motivation, perception, suggestions, decided to accept |
| (Gallivan, 2001) [28] | Acceptance of innovation in organizations | Awareness, consideration, intention, the acceptance decision, continuous use, acceptance by the user |
| (Rogers, 1995) [39] | Acceptance of innovation | Knowledge of innovation, attitude towards innovation, the acceptance decision, applying innovative ideas, making decisions |
| (Dixon, 1999) [40] | Information Technology Acceptance Model | Requirements and Assessment, analyzing the appropriateness of the technology, making acceptance, approval (implementing or upgrading) |
| (Zaltman et al, 1973) [35] | A two-stage model of innovation acceptance | Early acceptance (organizational decisions for acceptance), accepting a secondary (implementing innovation and acceptance at the individual level) |
| (Agarwal & Prasad, 1998) [30] | Model derived from research | Knowledge, understanding, acceptance decision |

*Table (1) Acceptance Model of IT Innovation*

By looking at the table above, it is observed that we did not select a specific conceptual model, because all studied models are not commensurate with the status of our organization. Therefore, we have to choose the most important factors affecting the acceptance of IT innovations. All models studied, and a questionnaire was prepared containing all of the factors affecting the acceptance of IT innovation. Then we took questionnaires to experts and university professors. They completed the questionnaires and we have analyzed the questionnaire, and the most important of all factors relevant to the situation of our organizations were selected based on the results of the questionnaire.

### *2.5 The acceptance of IT innovation in public organizations*

Governmental organizations are trying to improve their productivity and effectiveness, by reviewing missions, re-engineering process and establishing IT systems [13].

Studies have shown that Information technology has many advantages to governmental organizations, but it creates challenges for management and policy-making of organizations. Governmental organizations are involved with new challenges such as changing priorities and goals, so they

face changes in the political, economic and social environment. Effective use of information technology is essential for dealing with these changes [23]. IT innovations, such as the World Wide Web, information systems, data warehouse and customer relationship management, are examples that are used in governmental agencies to support the aims and interact with citizens and other organizations [41]. Using information technology, government agencies quickly redesign their business processes and promote their productivity [8].

### *2.6 Affecting factors on the Acceptance of IT innovation in government agencies*

Various internal and external factors are affecting the acceptance of information technology in governmental organizations. These include government policies on trade and investment; market forces, such as competition and technology costs and National infrastructure of information technology. Organizational culture is one of the main factors. That is effective on acceptance and dissemination of IT in governmental organizations. Other factors such as size, degree of centralization and formalization are effective on the acceptance of information technology innovation [42]. The probability of adopting IT innovation in organizations that are unwilling to change their political environment is higher. Thus, improvement of IT facilities in public organizations depends on the support of senior officials. Managers' tendency to innovation plays an important role in the allocation of resources to do so. Acceptance of new information technology requires high investment and its effect will not be marked in the short time [43]. As a result, senior managers need to risk and accept the risk of failure and delay receiving the results of new technology acceptance [44].

Managers who are aware of the capacities of information technology will have positive attitudes towards simply accepting innovation. Legislator governmental agencies play a key role in the acceptance of IT innovation because of being effective on funding and legal protections [2]. The availability of financial resources for the development, improvement of IT infrastructure, procurement of software and hardware, and user education are important factors that play a role in the acceptance of IT innovation [45] [24]. Investment in information technology should be along with the change of IT infrastructure. Therefore, support leading and future innovations [46] existing in a lot of human resources, with capabilities to create a new idea, are other factors influencing information technology acceptance [45], and innovations are proposed by people who are experts in a particular field [47]. IT managers' capability in identifying problems in the current system is very impressive. These capabilities include IT knowledge, willingness to innovate and a willingness to change [43].

Successful acceptance of an innovation is associated with open style of management [41]. By investigating large innovative organizations, it is recognized that IT innovation emerges in these organizations continuously; because the top management encourages innovation and leads organizational environment to support innovation [48].

The complexity of a technology refers to the systems required for effective communication and whether the staff of the organization understands sharing of information by systems that they thought whether difficult to be used or not. The complexity of a technology plays a role as a major factor influencing the acceptance decision [49]. While some believe that complexity is a powerful disincentive for innovation acceptance [50]. Information technology within organizations has been very influential; nevertheless, it has been more complex as well. In a way, decisions and organizational processes form technologies; and this adds to the complexity of the organization [51].

New technology compatibility and compliance with existing technologies of the organization play an important role in making its acceptance. To achieve Technology integration, compatibility and compliance will be considered as a main factor by decision makers. The integration of technologies is the most important issue of concern among public sector managers [52].

Incompatibility of hardware, software and communication networks has a negative impact on inter-organizational information sharing [53]. Studies have shown that history of innovation-oriented organizations leads to positive organizational environments that facilitate the acceptance

of technology by governmental agencies [54] [55]. Many innovations have been successful because of the knowledge and understanding of market demands. An unstable environment causes increase of the potential for innovation absorption. The need for IT innovation in institutional infrastructure creates demand for information technology in order to facilitate innovation processes [56].

Size (the number of provided services and extent of a society that has received the services) has a positive effect on the acceptance of information technology innovation [24].

Governments in larger cities compared to smaller ones accept more advanced information technologies [55].

In addition, size of the organization is a stimulus for innovation and the acceptance of information technology innovation [45] [54]. Increasing awareness and knowledge causes rapid development and these changes reduce the cultural differences between different information systems in geographical distances [41].

This means that a rapid innovation improves coordination between systems and different parts of the organization. Therefore, communication and collaboration between departments and organizations are factors that lead to the acceptance of innovation [56].

Capabilities of information technology within an organization, such as the extent of information technology resources, knowledge of workers in the field of information technology and ease of access to adequate equipment are important factors that are considered in the acceptance of new technologies [57] [49].

One of the major factors affecting the application of Information Technology is qualified employees [58]. Staffs of governmental organizations are not well trained for the use of information technology, and this inadequate education creates an obstacle to the change and use of innovation [55]. Having skills and perfection in information technology, indicating the level of understanding, as well as managers' support of information technology to achieve organizational goals; have been introduced as affective factors on the Acceptance of IT innovation [24] [50].

Factors such as the grant, the pressure for technology transfer, and technical support are the external factors influencing public acceptance of IT innovation in organizations. In addition, the socio-economic situation of cities is associated with the acceptance of technological innovation. So that in cities with lower socioeconomic status, probability for acceptation of need-driven innovations is more in comparison with the innovations for welfare. Nevertheless, the opposite is true in larger cities [59] [2].

Mutual trust for sharing information between organizations is necessary. Despite the mutual trust between organizations and departments of an organization, it is not necessary, for every organization, independently to start collecting the required data for a single issue. Therefore, mutual trust between organizations can be effective in the acceptance of IT innovation [53] [60]. Governmental organizations are influenced by organizations accepting IT innovation; that are similar in size and budget, as well as the trading partners [50] [2].

Therefore, factors affecting the acceptance of innovation in government agencies are provided in table (2).

| Row | Source | Factor |
|---|---|---|
| Var 1 | (Clegg et al, 1997; Dasgupta, 1997)[51][42] | Consistency and compliance |
| Var 2 | (Chwelos et al, 2001; Newcomer & Caudle, 1991; Norris, 1999)[50][57][55] | Comparative advantage and innovation capability |
| Var 3 | (Ebrahim & Irani, 2005)[8] | Security and reliability |
| Var 4 | (Anderson et al, 2003)[61] | Organizational Structure |
| Var 5 | (Gunes et al, 2003; Kim & Bretschneider, 2004)[62] [2] | Organizational Culture |
| Var 6 | (Koh et al,2006; Anderson et al, 2003)[43][61] | Financial support |
| Var 7 | (Damanpour, 1991; Rogers, 1995)[54][39] | The size of the organization |
| Var 8 | (Dasgupta, 1997)[42] | Knowledge and information technology skills |
| Var 9 | (Akbulut, 2002; Chwelos et al, 2001)[49][50] | Socioeconomic status |
| Var 10 | (Bingham, 1976; Brynjolfsson, 1993; Brudney & Seldon, 1995)[59][63][64] | The size of the community and support from clients |
| Var 11 | (Kim & Bretschneider, 2004)[2] | Legal and political framework |
| Var 12 | (Dasgupta, 1997)[42] | Cooperation and coordination parts of the organization |
| Var 13 | (Gunes et al, 2003)[62] | Inter-organizational trust |
| Var 14 | (Akbulut, 2002)[49] | Complexity |
| Var 15 | (Chircu & Hae-Dong Lee, 2003)[65] | Productivity |
| Var 16 | (Kim & Bretschneider, 2004)[2] | Social attitudes |
| Var 17 | (Koh et al,2006)[43] | Innovation capacity |
| Var 18 | (Kim & Bretschneider, 2004)[2] | Integration |

*Table 2. Factors Affecting the Acceptance of IT Innovation*

## 3.Methodology

Research method, method of sampling and data analysis software

This research is an applied and empirical. In particular, it is considered as a structural equation modeling. Its statistical population consists of IT managers and experts of government agencies (Asia Insurance Agency and Organization of information and communication technology) that were selected randomly (three hundred; 300), and by calculating the statistical sample by law Cochran, we see that our samples were 168. The data collection instrument was a questionnaire whose responses were considered based on Likert five-choice scale. To measure the reliability of the research questionnaire, Cronbach's alpha coefficient was used. Its amount was estimated 0.895 and represented reliability. We have to choose the most important factors affecting the acceptance of IT innovations. All models were studied, and a questionnaire was prepared containing all of the factors affecting the acceptance of IT innovation. Then we took questionnaires to experts and university professors. They completed the questionnaires, we analyzed them, and the most important factors relevant to the situation of our organizations were selected based on the results of the questionnaire. To evaluate the contents of the questionnaire, the comments of several professors and specialists in the field of information technology have been used for the index appropriateness. Also, determining of inventory validity (factor) carried out by using questionnaires from exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The results are presented in the following. The data have been analyzed by the software SPSS 20 and LISREL 8.50.

## 4.Results

Two indexes from eighteen, identified indexes including the integration and usability were removed because of overlapping with other similar variables in the analysis of content validity, and twenty-two other indexes entered exploratory factor analysis. According to the estimated value of KMO, that equals 0.843. This value is more than 0.7, thus adequacy of sampling is approved. (Square of K: 1626.741 and Significance level: 0.000) In addition, this analysis shows that factor analysis can be completed on its indices. After that, using factor analysis by using varimax rotation indicators of complexity and maximum possibility, productivity, social attitudes and creative capabilities, due to acquiring less than 0.5, were excluded from the set of investigation variables and remaining eighteen indexes were placed in five factors. According to the indicators placed in each factor, the extracted factors were named based on table (3).

Increased public access to information technology has affected methods of work and life of the citizens. For this reason, e-government during the last decade, has been mentioned so extensively in the developed world and has been faced with a good chance. The successful implementation of e-government requires knowledge of effective factors in the acceptance of IT innovations. The findings show that according to standardized coefficient (Figure 2) technological factors in explaining the variance of indices of comparative advantage and innovation capability (0.67) and the security and reliability of (0.6) are most effective. Organizational factors have the highest impact coefficient (0.31) in explaining the variance in organizational culture. The supportive factors are effective in explaining the variance in the management support with the coefficient of 0.55. External factors have the most influence in explaining the social and economic status in the variance (0.34) and the size of the community and support of the clients is 0.33. Cooperation and coordination are the most influential factors with a coefficient of 0.44 in explaining variance of cooperation and coordination among parts of the organization. Due to the significant coefficients between the five factors, it is clear that these are not independent factors. According to the covariance estimation, the greatest interaction between organizational factors and factors related to cooperation is with the covariance of (1.34), and the lowest relationship between technological factors and protective factors is with the covariance of 0.49.

| Indicators | The first factor | The second factor | The third factor | The fourth factor | The fifth factor |
|---|---|---|---|---|---|
| | Technology factors | Organizational factors | Supportive factors | External factors | Cooperation and coordination factors |
| Var 1 | 0.791 | | | | |
| Var 2 | 0.679 | | | | |
| Var 3 | 0.829 | | | | |
| Var 4 | 0.747 | | | | |
| Var 5 | | 0.703 | | | |
| Var 6 | | 0.693 | | | |
| Var 7 | | 0.751 | | | |
| Var 8 | | 0.737 | | | |
| Var 9 | | | 0.810 | | |
| Var 10 | | | 0.863 | | |
| Var 11 | | | 0.631 | | |
| Var 12 | | | | 0.702 | |

| | | | | | |
|---|---|---|---|---|---|
| Var 13 | | | | 0.729 | |
| Var 14 | | | | 0.765 | |
| Var 15 | | | | 0.664 | |
| Var 16 | | | | | 0.865 |
| Var 17 | | | | | 0.755 |
| Var 18 | | | | | 0.706 |

*Table 3. Factors derived from factor analysis and load index*

After extracting five factors by exploratory factor analysis, in order to verify the indicators and the identified factors based on structural equation, modeling confirmatory factor analysis was used. Using confirmatory factor analysis will determine how much the five factors (Latent variables) are involved in explaining the variance of their indices (indicator variables). The parameters of model fitting show the rate of model fitting for research data. In figures (1), (2), and (3) respectively, the results of confirmatory factor analysis of non-standard estimation, standard estimation and significant coefficients are presented. According to the chart in figure 1, with the assumption of zero in factor analysis, considering zero in the factor identifying analysis as the indicator of model justifying, and based on significance level estimation equating (0.08322) more than 0.05, with accepting of zero assumption; it is resulted that the presented model is justified in the population.

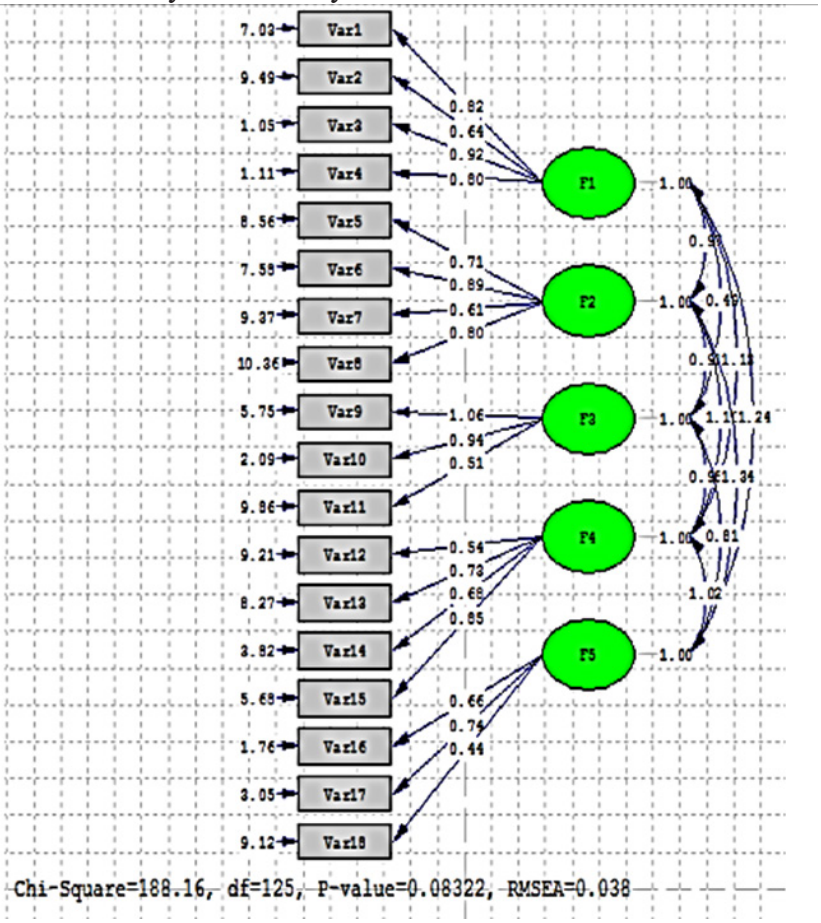


*Figure 1. The results of confirmatory factor analysis in the estimation of non-standard diagram*

Standard coefficients are provided in figure (2); that indicates the effect of each factor in explaining the variance of indexes.

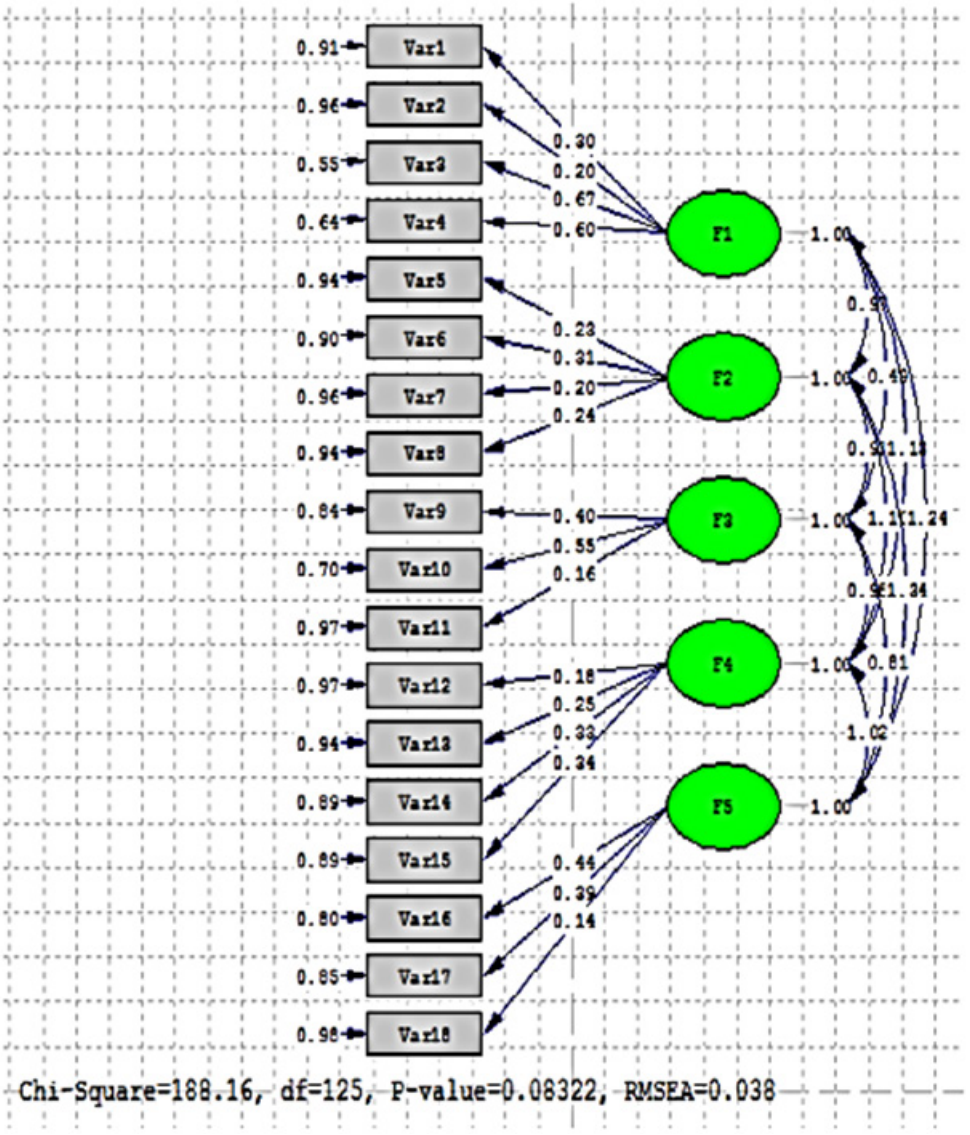


*Figure 2. Diagram results of confirmatory factor analysis in standard estimate*

Based on the chart of figure (3) and due to the fact that all statistic values of t ,which are more than 1.96, it is found that All designated routes in Model are significant. In other words, the five factors extracted from factor analysis, will explain the variance of their coefficients marker. Therefore, five factors identified, together with relevant variables, are approved.

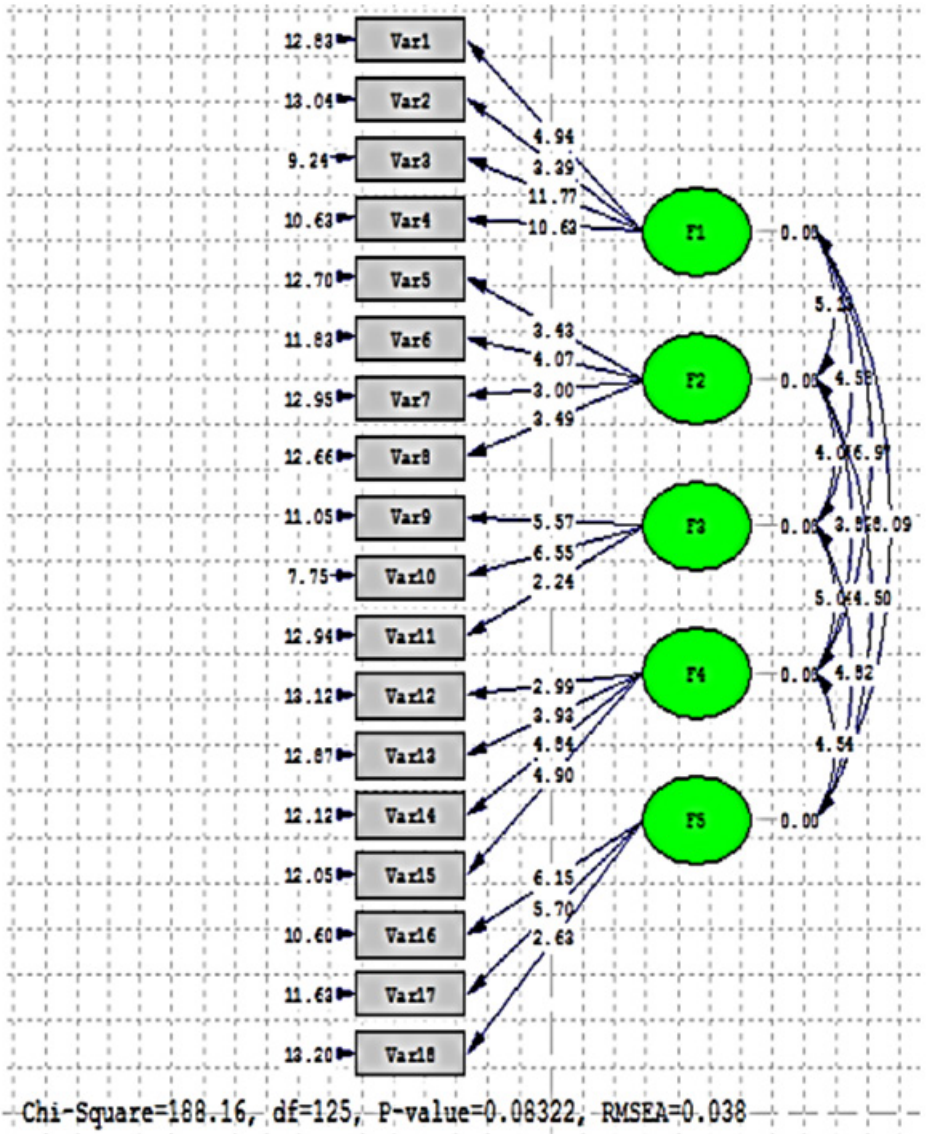


*Figure 3. Diagram results of confirmatory factor analysis in significant coefficients*

Also, according to various indices fitting provided in the table (4), it is concluded that the proposed model with research data has a good and acceptable fitting.

| Indicator | the amount |
|---|---|
| Square of the degree of freedom (x^2/df) | 1.50 |
| The square root of the variance estimation error of approximation (RMSEA) | 0.038 |
| Fitness Indicator (GFI) | 0.94 |
| Adjustment intensity fitness Indicator (AGFI) | 0.92 |
| Comparative fit Indicator (CFI) | 0.89 |
| Softened fitness Indicator (NFI) | 0.86 |
| Not soft fitness Indicator (NNFI) | 0.89 |
| Increasing fitness Indicator (IFI) | 0.88 |

*Table 4. The results of the model Fitness*

## 5.Conclusion

Due to the lack of independence of five factors affecting the acceptance of IT innovation, attracting investment planning and policy innovations in information technology will play an important role. These findings correspond and are parallel to the results of many other studies. Indexes in this study were confirmed in previous studies such as Akbulut (2002)[49], Anderson et al (2003)[61], Bingham (1976)[59], Brudney & Seldon (1995) [64], Brynjolfsson (1993)[63], Clegg et al (1997) [51], Damanpour (1991)[54], Dasgupta (1997) [42], Ebrahim & Irani (2005)[8], Johannessen (1994)[41], Newcomer & Caudle (1991)[57], Kim & Bretschneider (2004)[2], Norris (1999) [55] and Premkumar & Ramamurthy (1995)[66]. In addition, the factors affecting acceptance of information technology in governmental organizations have been identified. According to these findings, it is suggested, adopting new technology to relative advantage and capabilities of it should be considered more than the previous or similar technologies. Moreover, if it is superior compared to previous or similar technologies, it should be introduce to the organization. In addition, the consideration of the security level and reliability of technologies to ensure accuracy in the sharing and exchanging of information is recommended. By strengthening the organizational and cultural environment that encourages change and acceptance of new technology, along with senior management support, we can take an effective step in facilitating the acceptance of new technology. As well as focusing on creating external and internal mutual confidence within the organization will play an important role in the acceptance of IT innovation in order to enhance cooperation and coordination among various departments.

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