

Enriching the Text Mining Capabilities by Transforming the Text Mining Domain to Chess Game Domain to Simulate Future Scenarios

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ABSTRACT

Text mining depends on analyzing the text on different levels: words, sentences, paragraphs, articles and the whole corpus. However, following the fixed rules of analysis from the very start to the end proved to be poor in building trends and sequence analysis of respectful quality. Our point of view is that we need a more flexible approach to predict the writer's strategy; this strategy depends on 2 factors: 1) Information gained on each level. 2) Feedback information from a lower to a higher level in order to redirect the analysis assumptions to a more fruitful route. Such general stream of thinking indicates a possible resemblance with the use of Agile [16] technique in system analysis and design.

We are suggesting a technique relies on the adoption of a main strategy with possibility to reassess and act based on a closer feedback loops; such feature resembles to great extent the Chess game where we have a master plan and changeable tactics that depends on the feedback information gathered on every move. The paper presents this new methodology that enriches the results of text mining by using its output as parameters for a Chess game; the new domain has very rich historical records that help researchers in building future scenarios which is too hard to be accomplished within the text mining domain itself. This issue can largely affect the decision makers and researchers in politics and sociology. The reader may guess that some of the implementation is overlapped with classical simultaneous games or Chess Min-Max algorithm; which is not true [1].

Keywords

Frequency Analysis – Sentiment Analysis – Chess – CQL – Markov Processes – Heijden-PGN.

1. INTRODUCTION

This paper presents a new methodology that helps in illustrating different future scenarios that can occur as a chain reaction to the current social or political situations as depicted by analyzing newspapers as an online discourse. Scenarios detection and simulation is done through Chess board and Chess literature. The Chess board, pieces mapping, game fundamental development theme (sequence of pieces' moves) are all initialized through Text Mining and Markov processes. A huge database of Chess games - named 'Heijden database' [3] - is searched for similar game theme using a specific Chess language query named 'CQL' [4]. Each found game is an alternative scenario which must be taken into consideration.

The paper is organized as follows. First, in the following section the Text Mining techniques used to feed the Chess game parameters are discussed. Next, the newspapers' articles used in Text Mining analysis and the 'Heijden' Chess data source are described. The following section discusses the technique used to build Chess scenarios. The later section demonstrates a political case study in details. The final section gives a quick summary and conclusions.

2 TEXT MINING TECHNIQUES

Text Mining looks for hidden information and employs common algorithms from AI, machine learning and statistics. While data mining deals with structured numeric data, text mining deals with unstructured text. Text Mining is a bunch of statistical techniques to transform the text into numeric data which is much easier to analyze.

2.1 Levels of Text Mining Processing [5]

2.1.1 Word Level

Every word has some properties, the most important are:

- Homonymy: same form, different meanings
- Polysemy: same form, related meanings
- Synonymy
- Hyponymy: hierarchical relation: breakfast, meal

While parsing then text, removing words that do not carry information from a non-linguistic view. These words are called stopping words. For example, in English: a, about, above, alone, he, does, why. In Classic Arabic:

هو، الذي، الله، يفعل، ما، في، لماذا

And in Colloquial Arabic: شايه، معلش، يا فندم، اللي

After parsing, beginning to stem every word, stemming means to correlate a word to its normalized form, because different forms are problematic because they have different spelling while their meanings are the same. For example, in English: learn-learns-learned-learning. In Arabic, تلميذ-تلاميذ-تلاميذ-تلاميذ.

To solve the problem, stemming procedure is broken into three steps [10]:

- Prefix removing
- Suffix removing
- Morphology statistics

2.1.2 Sentence Level

While parsing, some words are noticed to appear sequentially a lot of times. This is called N-Gram which is defined as a sequence of consecutive words that appear in the indexed documents and it must have a threshold of frequencies. Example: 'استطلاعات سياسية' is an N-Gram of level 2.

If the application focus is sentence translation, it will take place here. Translation process may be stated as decoding the meaning of the source language text and then re-encoding the meaning in the target language text. Several approaches may be adopted here.

2.1.3 Document Level

This task aims to get a summarized version of the original document. Here there are two methods to use:

- Knowledge-based (summary-generation): discover meaning and produce a text within length constraints.
- Selection-based (sentence-extraction): based of weighting model.

The summarization is based on weighting words; focus on word of greater weights. Words are weighed from 4 aspects:

- Thematic: simply the word frequency
- Location: opening and closing words are given greater weight than other words in the same sentence
- Heading: the header of the document is weighted higher
- Cue: sentences stamped with expressions like: hence, significant are given more weights

2.2 Frequency Analysis

The tf-idfweight (term frequency of inverse document frequency) weight is often used in information retrieval and text mining. This weight is a statistical measure used to assess the importance of a word is to a document collection or corpus. The importance increases proportionally to the number of times a word appears in the document but is offset by the frequency of word in the corpus. System variations of tf-idf weighting are often used by search engines as a central tool in scoring and ranking.

One of the simplest classifications is calculated by adding the tf-idf for each search term; more sophisticated ranking functions are variations of this simple model. The simplest formula for tf-idf [6]:

$$tf - idf = \frac{(\#ofoccurrencesofterm\ in\ this\ document\ D)}{(\#ofdocuments\ with\ mention\ of\ term\ t)} * \log\left(\frac{total\ \#of\ documents}{\#ofdocuments\ with\ mention\ of\ term\ t}\right) [15]$$

2.3 Sentiment Analysis [7]:

Sentiment Analysis extracts emotions from text. Three types of analysis can be conducted here:

1. Polarization Analysis (positive – negative - neutral)
2. Subjectivity versus Objectivity Discourse [11]
3. Modes Analysis (angry – sarcastic – reverent – skeptical – melancholic - etc)

For the polarization analysis conducted in this research, two dictionaries for Arabic positive and negative words have been built. The sentiment analysis is conducted per paragraph where Turney's method is applied. Turney's Method measures the Pointwise Mutual Information between every word in the paragraph and the words in the two dictionaries; this calculates the Sentiment Orientation (SO) for the word and then average SO for the whole paragraph is calculated.

$$dSO(w) = \log\left(\frac{hits(w\ NEAR\ \{positive\ dictionary\ words\})}{hits(\{positive\ dictionary\ words\})} / \frac{hits(w\ NEAR\ \{negative\ dictionary\ words\})}{hits(\{negative\ dictionary\ words\})}\right) [9]$$

$$SO(w) = \frac{\log(hits(wNear\{positivedictionarywords\})hits(\{positivedictionarywords\}))}{\log(hits(wNear\{negativedictionarywords\})hits(\{negativedictionarywords\}))} [9]$$

A negation rule is applied here. Every dictionary word found in the paragraph is allocated into a small context window (2 words before and 2 words after); if a negation word is found in these 4 words, the dictionary word is reversed from positive to negative and vice versa.

2.2 Research done in using game theory for enhancing text analytics

To great extent, this research is novel in mixing game theory and text analytics. Nevertheless, this research benefitted from some core ideas in game theory; especially: backward induction and applying Zermelo's theorem in calculating the winning strategies.

3 DATA DESCRIPTION

3.1 Articles used in Text Mining

This study depends on articles collected from May to September 2011 from eight newspapers' sites' articles. The articles that mention the Prime Minister Dr. Esam Sharaf are the only ones get analyzed. The statistics of the articles mentioned Dr. Sharaf is stated in the following table.

Table 1. Distribution of analyzed articles

Source	Number of articles					Total
	May	June	July	August	September	
Al-Ahram	39	34	19	31	27	150
Al-Masry Al-Youm	21	17	15	22	16	91
Youm7	18	25	13	23	26	105
El-Gomhoreya	28	26	17	20	21	112
El-Wafd	30	22	12	17	20	101
El-Sherouk	21	15	18	16	20	90
El-Mesa	23	9	12	13	19	76
El-Tahrir	14	8	16	12	9	59
Total	194	156	122	154	158	784

The articles acquisition is done through a desktop application that fetches those articles daily from the internet and stores them into the database then it does the text analytics upon the

fetches filtered articles. A snapshot of the application is illustrated in the following figure.



Fig 1: Application used for articles acquisition

3.2'Heijden' Chess Database

The Heijden database is the largest collection of Chess games in the world; it contains 76132 games. It was created by Dr. Harold der Heijden. The games are written in a specific format designed for Chess games which stored as plain text; this format is named Portable Game Notation (PGN) [8]. A PGN file contains 2 types of notations:

1. Metadata
 - a. Event
 - b. Date
 - c. White Player
 - d. Black Player
 - e. Result
 - f. Moves Count
 - g. Time Control
2. Game Moves
 - a. Pieces Moves
 - b. Events

The pieces (king – queen – rook –bishop – knight - pawn), events (castling – promotion – check - checkmate) and cells notations, moreover, an example of a PGN file are listed in the following tables.

Table 2.Pieces Notations

Piece	Notation
King	K
Queen	Q
Rook	R
Bishop	B
Knight	N
Pawn	P

Table 3.Events Notations

Event	Notation
Kingside castling	O-O
Queenside castling	O-O-O
Promotion	=
Check	+
Checkmate	#



Fig2:Squares Notations

Table 4. PGN game example

PGN game moves				
.1.f4 d5	12.Nf2 Qd6	23.Ne6 Nxe6	34.g5hxg5	45.bxc4 bxc4
2.Nf3 Bg4	13.d3 c6	24.Bxe6+ Kb8	35.hxg5 Kd8	46.Kf5 c3
3.e3 Bxf3	14.e4 fxe4	25.Qc5 Nxf5	36.Kf2 Ne7	47.Ba4 Nh4 +
4.Qxf3 e6	15.dxe4 Nc7	26.Qxe7 Nxe7	37.Kf3 Ke8	48.Kxe5 Nf3+
5.c4 Nf6	16.Be3 Bxe3	27.Rxf8 Rxf8	38.Be6 Kf8	49.Kf4 Nd2
6.cxd5 Nxd5	17.Qxe3 Nc8	28.Rd7 Ng8	39.Kg4 c5	50.Ke3 Nc4+
7.Bc4 Nc6	18.Rad1 Qe7	29.Rxg7 Nf6	40.b3 b5	51.Kd4 Nxa3 1/2-1/2
8.a3Bc5	19.Nd3 Nd6	30.Bf5 h6	41. Bd5 a5	
9.Nc3 Nce7	20.Ba2 Rf8	31.g4 Rg8	42.g6 Kg7	
10.Ne4 Bb6	21.Nc5 e5	32.Rxg8+ Nxg8	43.Bf7 Nxg6	
11.O-O f5	22.f5 O-O-O	33.h4 Kc7	44.Be8 c4	

4 EXPERIMENT: BUILDING CHESS SCENARIOS

The case study game focuses on the future scenarios for the government and SCAF regarding their handling of the increasing pressures and demands in the current transitional phase. Three different scenarios are detected and demonstrated: The use of the military council of the government as a front receiving blame and criticism, SCAF tries to deal directly and oppressively with the demonstrators

and giving the government full power to reach a state of reassuring stability.

The pressures and demands on the government and SCAF are increasing rapidly. The origin of the problem is that despite the success of the revolution in the overthrow of Mubarak regime but the political forces did not agree on how to manage the transitional phase from the start, leading to conflict between rebels who are eager for a revolutionary government in performance (school of Jean-Jacques-Rousseau) and the transitional government and SCAF who tend to be very conservative in performance (school of Thomas Hobbes and David Hume) [2].

1. Game Objective Detecting and illustrating different future scenarios that can occur as a chain reaction to the SCAF and government attitudes towards the various demands and pressures
2. Defining Players
 - a. Black: SCAF and Government
 - b. White: Instability stemmed from pressures and demands

60% of the games played in the Heijden database are won by the White, as the study simulates stress test upon SCAF and the government; the White was chosen to represent the pressures and demands.

3. Defining the pieces
4. The text mining analysis specifies the most frequent entities (persons – organizations – dates – places) that are mentioned in the daily articles. A time series analysis is performed upon these extracted entities frequencies and polarities. The following figures show the application analyzing the articles' entities.



Fig 3: Example of daily extracted entities

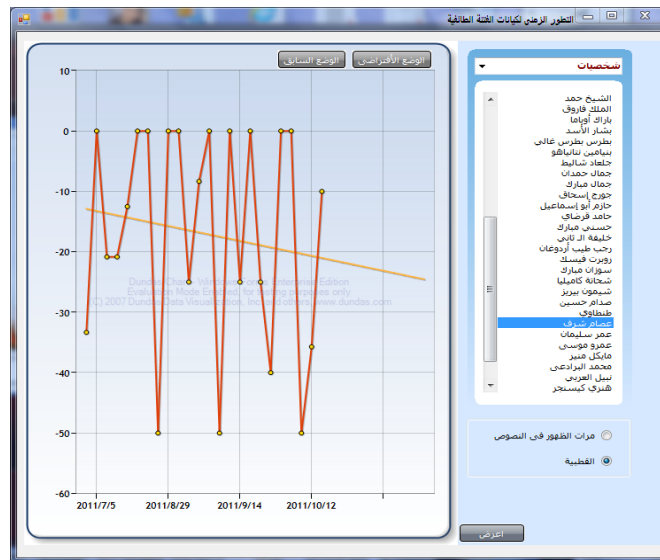


Fig 4: Example of entities trend analysis

An entity impact is measured by multiplying the frequency by its polarity degree. The most frequent entities are ranked in a descending order according to their impacts. On the other hand, Chess pieces are ranked in a descending order according to their powers in literature. The pieces mapping is listed in the following table.

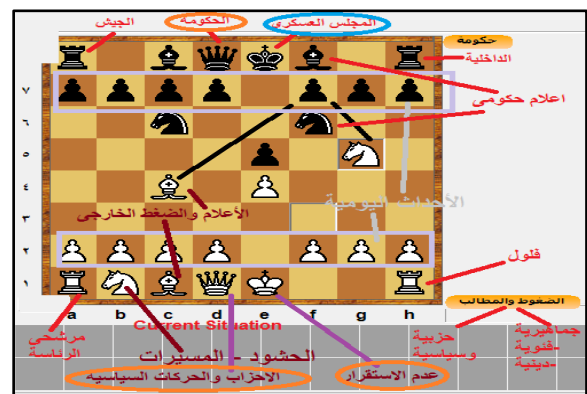


Fig 5: Chess board mapping

Table 5. Pieces mapping

Piece	White	Black
Pawn	Daily events	
Bishop	Private Media	State media
	Foreign pressures	
Knight	Demonstrations and set-ins	
Rook	Remnants of Mubarak regime	Ministry of interiors
	Presidential candidates	The army
Queen	Political parties and movements	Sharaf's government
King	Instability	SCAF

5. Game ThemeThe theme denotes the initial conditions of the game, the pieces moves sequences, the relations among them and specifying some events such as: castling, promotion or check. From the text mining analysis the story board of the game starts by a scene where the SCAF and the government are attacked by the demonstrators and the private media in the same time, which refers to a fork situation. All the scenarios must contain intensive private media moves (Knights) and aggressive attacks to the government (the Black queen) and may be the ministry of interiors also (the White rook). The scenario which implies the success of the government to eradicate instability must include collateral moves from the government's parties: ministry of interiors, prime minister, mature state media and tactical handling of the daily procedures. The theme initial conditions must yields the board illustrated in the next figure.

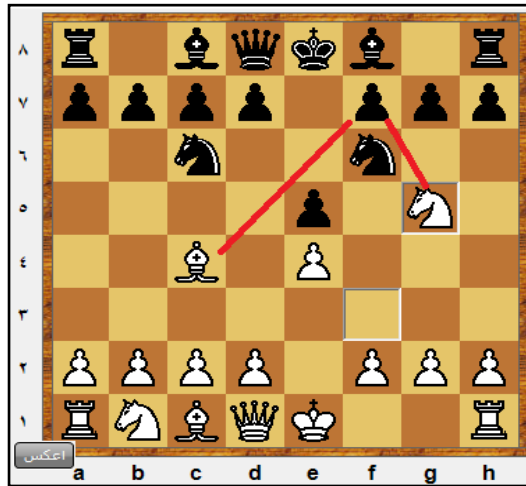


Fig 6: Initial board for all scenarios

- a. The games that have similar theme are queried from the Heijden database using a special script named Chess Query Language (CQL) which was developed by Lewis Stiller and GadyCosteff. Using CQL the games that have specific Chess openings, initial conditions, certain moves, certain pieces on certain squares, pieces left and specific events are found. A simple example of a CQL query is provided below where games that contain a White move turn where the piece goes from and to specific squares [12]: (match:pgnheijden.pgn ;the name of the PGN file to look for studies:output result.pgn ;the name of the result file)position :wtm :movefrom .d4 moveto: .d3;(end position); end match
- b. After using impact analysis to map the pieces, we use Markov chains [13] to filter games that have the same patterns of the pieces. Each piece makes a sequence of moves detected from the text mining analysis. Each piece has 5 states: current position, moving forward, moving backward, attacking, taken. Suppose that the text mining analysis depicts 6 snapshots, this means we have 6 states in sequence for each piece to be searched for in the database. For every snapshot, each piece is tagged with one of these five states. Only the games that match the pieces states sequences are initially picked. If the result set has more than 3 games; only the games that match a Markov process of the first order are chosen. The Markov Chain transition matrix [14] is built during the model creation for each piece by calculating the cells one by one using the CQL query language.

Table 6. Transition Matrix for the Bishop

	Current	Forward	Backward	Attacking	Take n
Current	0.24	0.29	0.09	0.34	0.04
Forward	0.4	0.19	0.1	0.22	0.09
Backward	0.42	0.13	0.15	0.11	0.19
Attacking	0.34	0.21	0.1	0.05	0.3
Taken	0	0	0	0	1

If there were 4 moves depicted from the text mining, then the next probable move for the Bishop can be guessed using the Transition Matrix (P) by multiplying it to itself 5 times.

$$S_5 = s_4P; s_4 = s_3P; s_3 = s_2P; s_2 = s_1P; s_1=[1,0,0,0,0]$$

5. DISCUSSING THE GENERATED CHESS SCENARIOS

Three scenarios have been found: a weak government used as a front to deal with the people and receive all their blames, an

SCAF that oppresses the demonstrators directly due to continuous pressure and an SCAF that gives the government which is up to the responsibility full power to manage.

The 3 scenarios can be logically classified as:

- The power given to the government is incomplete
 1. Government is used as a front for the actions of the Military Council
 2. The military is facing directly the demonstrators and protestors
- Full power given to the government
 3. SCAF gives the government -which is up to the responsibility- full power to manage

5.1 Scenario one - Government is used as a front for the actions of the Military Council

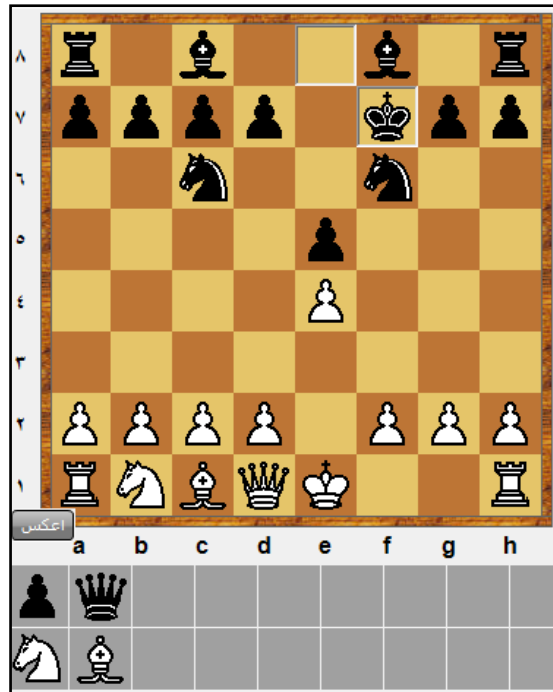


Fig 7: scenario one board

5.1.2The scenario development and explanation

Table 7. Scenario one development and explanation

Government is used as a front		
Mov e ID	Black (future of Sharaf's government and SCAF)	White (instability and revolution failure)

	Movement	Explanation	Movement	Explanation
1	Queen moves one step forward	defending		
2			Knight moves one step forward	Pressure on the government to show lack of

				satisfaction
3	Queen takes knight	Getting rid of the pressure by oppression		
4			Bishop takes queen	Private media pressure leads to government's resignation
5	King flees from the bishop	two variations exist: Change in SCAF attitude and strategy that adjusts the course of the revolution (most probable) or hostile protestors and repeat Libya's pattern (total deviation from the revolution course)		

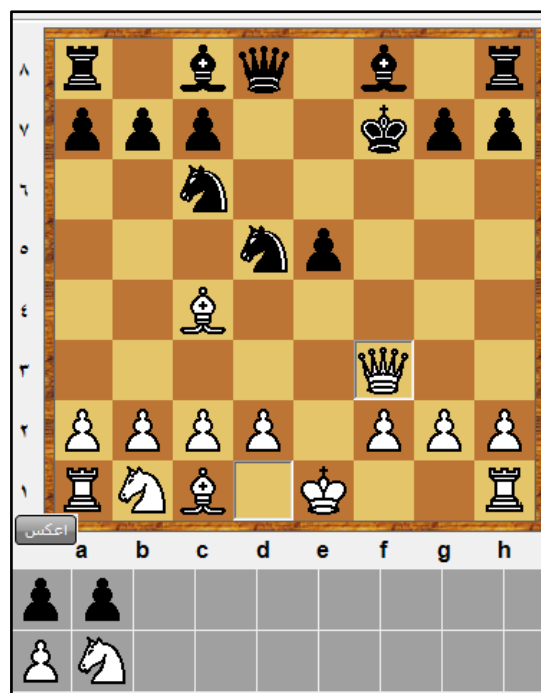


Fig8: scenario two board

5.2 Scenario two - SCAF oppresses the demonstrators directly due to continuous pressure

5.2.1 The scenario board¹

5.2.2 The scenario development and explanation

Table 8 . Scenario two development and explanation

Move ID	SCAF oppresses the demonstrators directly due to continuous pressure			
	Black (future of Sharaf's government and SCAF)		White (instability and revolution failure)	
	Movement	Explanation	Movement	Explanation
1	Pawn moves one step forward	Procedures to lessen the bondage between the private media and foreign influence on one hand and the demonstrations on the other hand		
2			Pawn takes pawn	Daily events
3	Knight moves one step forward	Confronting the demonstrations by using the state media and lessen the power of private media		
4			Knight moves one step	Escalation in the public

¹ A simplified version of PGN file is provided in the appendix

			forward	demands and a direct threat to the government due to security forces
5	King moves one step forward and takes the knight	Eradicating the demonstrations by military confrontations		
6			Queen moves one step forward	Escalation from parties and political movements against SCAF
7	King flees from the White queen or defend through the Black queen	The first variation means that SCAF will appear as the weak party. The second variation means that SCAF will again tend to use the government as a front or may be will empower another one (most probable – returning to the first scenario)		

5.3 Scenario two - SCAF gives the government which is up to the responsibility full power to manage

5.3.1 The scenario board²

² A simplified version of PGN file is provided in the appendix

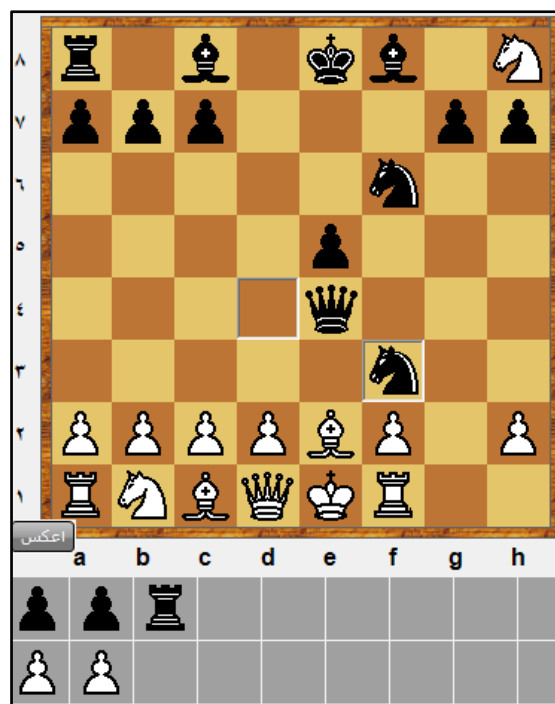


Fig 9: scenario three board

5.3.2 The scenario development and explanation

Table 9.Scenario three development and explanation

SCAF gives the government which is up to the responsibility full power to manage				
Move ID	Black (future of Sharaf's government and SCAF)		White (instability and revolution failure)	
	Movement	Explanation	Movement	Explanation
1	Pawn moves one step forward	Procedures to lessen the bondage between the private media and foreign influence on one hand and the demonstrations on the other hand		
2			Pawn takes pawn	Daily events
3	Knight moves one step forward	Using state media to affect the citizens		
4			Pawn moves one step forward	More daily events
5	Queen moves one step	The government is acting to		

	forward	satisfy the people		
6			Knight moves one step forward	Escalation upon the government and police
7	Queen sacrifices the rook	Change the minister of interior		
8			Knight takes rook	Ending the current security system
9	Queen attacks rook	Issuing the political isolation law		
10			Rook moves towards the king	Escalation from the remnants
11	Queen attacks the king	Decisive actions to eliminate expected instability		
12			Knights protects the king	Foreign aid tries to support the instability
13	Knight moves one step forward and checkmate	Cleverly use the media to show how the foreign aids tries to help the subversive		

		parties – ending the state of instability		
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6. CONCLUSION AND WORK FUTURE

Chess simulation is successfully built to give three possible future scenarios that illustrate the results of SCAF and government's strategies of dealing with the pressures and increasing demands. The game parameters are fed from text mining analysis performed on 784 articles collected from eight different newspapers. The game parameters are the game theme which is searched in a famous Chess database named Heijden that contains 76132 games in specific format named PGN; the search query is done using a special script named CQL which enable the analysts to find specific game themes.

Applying Markov Chain proved to be very useful in limiting the results and only choosing those which matches the sequence analysis of the pieces states which are: current position, moving forward, moving backward, attacking, and being taken. The case study demonstrate this new methodology unique capabilities to extend the text mining features to accurate predict and guess the future scenarios using the text mining output as parameters to feed Chess games due to having richer data. The whole process is automated which gives the advantage of being subjective in analysis.

Nevertheless, this new methodology has two challenges: The number of variables in the political reality is greater than number of playing pieces. At certain times the speed of change events is too large while the game remains very rigid. For confronting these 2 issues, the author needs to investigate into a modified technique that using an alternative Chess game rules named: "Atomic Chess"; in Atomic Chess, the attacking and attacked pieces explode with the neighboring cells after the capturing. This technique seems to be keeping up with systems with fast fluctuations.

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APPENDIX

Simplified version of first scenario PGN file

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<"Game Scenario_id="1">  
</ "Move MoveNo="1" From="e2" To="e4">  
</ "Move MoveNo="1" From="e7" To="e5">  
</ "Move MoveNo="2" From="g1" To="f3">  
</ "Move MoveNo="2" From="b8" To="c6">  
</ Move MoveNo="3" From="f1" To="c4" S>  
</ "Move MoveNo="3" From="g8" To="f6">  
<"Game Scenario_id="2">  
</ "Move MoveNo="1" From="e2" To="e4">  
</ "Move MoveNo="1" From="e7" To="e5">  
</ "Move MoveNo="2" From="g1" To="f3">  
</ "Move MoveNo="2" From="b8" To="c6">  
</ "Move MoveNo="3" From="f1" To="c4">  
</ "Move MoveNo="3" From="g8" To="f6">  
</ "Move MoveNo="4" From="f3" To="g5">  
</ "Move MoveNo="4" From="d7" To="d5">  
</ "Move MoveNo="5" From="e4" To="d5">  
</ "Move MoveNo="5" From="f6" To="d5">  
</ "Move MoveNo="6" From="g5" To="f7">  
</ "Move MoveNo="6" From="e8" To="f7">  
</ "Move MoveNo="7" From="d1" To="f3">  
</Game>
```

Simplified version of third scenario PGN file:

```
<"Game Scenario_id="3">  
</ "Move MoveNo="1" From="e2" To="e4">  
</ "Move MoveNo="1" From="e7" To="e5">  
</ "Move MoveNo="2" From="g1" To="f3">  
</ "Move MoveNo="2" From="b8" To="c6">  
</ "Move MoveNo="3" From="f1" To="c4">
```

```
</ "Move MoveNo="4" From="f3" To="g5">  
</ "Move MoveNo="4" From="d8" To="e7">  
</ "Move MoveNo="5" From="g5" To="f7">  
</ "Move MoveNo="5" From="e7" To="f7">  
</ "Move MoveNo="6" From="c4" To="f7">  
</ "Move MoveNo="6" From="e8" To="f7">  
<Game/>
```

Simplified version of second scenario PGN file

```
</ "Move MoveNo="3" From="g8" To="f6">  
</ "Move MoveNo="4" From="f3" To="g5">  
</ "Move MoveNo="4" From="d7" To="d5">  
</ "Move MoveNo="5" From="e4" To="d5">  
</ "Move MoveNo="5" From="c6" To="d4">  
</ "Move MoveNo="6" From="d5" To="d6">  
</ "Move MoveNo="6" From="d8" To="d6">  
</ "Move MoveNo="7" From="g5" To="f7">  
</ "Move MoveNo="7" From="d6" To="c6">  
</ "Move MoveNo="8" From="f7" To="h8">  
</ "Move MoveNo="8" From="c6" To="g2">  
</ "Move MoveNo="9" From="h1" To="f1">  
</ "Move MoveNo="9" From="g2" To="e4">  
</ "Move MoveNo="10" From="c4" To="e2">  
</ "Move MoveNo="10" From="d4" To="f3">  
</Game>
```