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Software Development for First Aid Decision Support System

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Abstract

This work presents an approach to deal with modelling a decision support system framework to introduce an application for decisions in medical knowledge system analysis. First aid is extremely important worldwide and, hence, a decision support framework, known as First Aid Decision Support System (FADSS), was designed and implemented to access experimental cases exerting danger to the general population, offering advanced conditions for testing abilities in research and arranging an emergency treatment through the graphical user interface (UI). The design of first aid treatment in FADSS depends on the general cases in first aid. We presented a strategy to manage first aid treatment by modelling an application (FADSS) that assists people in finding information about first aid cases that are available as an application service. FADSS service uses a set of 15 important situations that might happen to people. The decision for treatment is suggested on the system for a different accident. FADSS tests the information in real-time by using mathematical models, decision tree and data mining (C4.5 algorithm) that are used in this research to build a decision making system. The system automatically sends warnings when the case is very critical, using text messages as email reports. The main objective of this study is to provide an efficient tool that helps people and junior workers in first aid centres in order to find the available resources of information.

Keywords: Decision Support System, C4.5, Data Mining, Emergency Medical Cases, First Aid Treatment

تطوير برنامج لنظام دعم قرارات الإسعافات الأولية

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الخلاصة

في هذا العمل تم انشاء تطبيق ذكي لاتخاذ القرار في المجال الطبي (الاسعافات الأولية) حيث يعتبر هذا المجال مهم جدا في العالم واسم التطبيق هو (First Aid DSS) الذي تم تصميمه وتنفيذه لاعطاء مدخل الى الحالات الطارئة التي تحدث لعامة الناس ويعطي التطبيق القابلية للعاملين في الطوارئ لتقديم العلاج والاجراء المناسب الفوري لانقاذ الناس المصابين ويقدم التطبيق واجهات سهلة الاستخدام اي واجهات

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رسومية (Graphical UI). تم بناء التطبيق على اساس الحالات العامة الاساسية في الاسعافات الاولية حيث تم استخدام (15 حالة مهمة التي قد تحدث للناس). التطبيق او النظام يختبر المعلومات في الوقت الحقيقي باستخدام نموذج او تصميم رياضي وتم استخدام شجرة اتخاذ القرار وتقييم البيانات باضافة خوارزمية (C4.5 Algorithm) لبناء نظام اتخاذ القرار. النظام يعمل بشكل اوتوماتيكي لارسال تحذير عندما تكون الحالة حرجة جدا بواسطة ارسال رسالة نصية عن طريق البريد الالكتروني. المساهمة الاساسية لهذا البحث هو توفير اداة كفوءة لمساعدة الناس والعاملين المبتدئين في مجال الاسعافات الاولية لاجاد المعلومة حول تقديم الاسعافات الاولية.

1. Introduction

First aid is an emergency care service provided for injury or sudden illness before emergency medical treatment is available. The first-aid provider in the workplace is someone who is trained in the delivery of initial medical emergency procedures using a limited amount of equipment to perform a primary assessment and intervention while awaiting arrival of emergency medical service (FADSS) [1].

The School Health Programs Department delivers emergency treatment flipcharts that contain information adapted from different resources. Flipcharts of a first aid are intended to provide essential "what to do in a crisis" data for school staff without medicinal/nursing preparation [2].

Medical emergency can happen at any time and in any setting. Individuals are harmed in circumstances like falling, engine vehicle accidents, or sudden diseases such as heart assault or stroke. In the USA, about 900,000 people die each year because of heart diseases. Another cause of death is the accidental damage, with about 118,000 Americans died from an unintentional injury in 2008. Because of the large number of sudden illnesses and injuries that occur in any place, the availability of people with knowledge about dealing with emergency situations is necessary. In these cases, such people should know who and when to call, what action to take, and how to treat persons with emergency accidents until emergency medical help comes. The user of FADSS application will play a main and a more effective role during first aid tasks. When a person detects an emergency case and decides to take an action, the role FADSS begins, as with calling the number of local emergency to send an ambulance for help. FADSS provides the information that determines what necessary help is needed. The system includes four steps:

Step 1: Detect that an emergency case exists.

Step 2: Take an action.

Step 3: Run the FADSS application.

Step 4: Give a primary care until the arrival of the ambulance.

In 2004, 4.3 million aggregate workplace injuries and sicknesses were recorded in the USA, with about 1.3 million sick workers who had to be away from work. The estimated cost to the economy due to these occupational illnesses, injuries and fatalities was about \$142.2 billion [2].

The use of FADSS application to support decision making is very necessary for the general population, since it enables them to rapidly accumulate information about various emergency cases that might suddenly happen. In addition, it allows them to process the information in various ways in order to assist with making diagnosis and treatment decisions. The areas these FADSS could help to provide information of the way to recovery from any accident of first aid action (causes and treatment) records, putting away and recovery of key treatment from reasons of accident. A decision is take the wright choice when an accident is happened and assessments the values of those choices. A model incorporating DSS and Data mining System was proposed to build the FADSS application. This approach was created to improve a decision support system which assists in making choices under complex emergency cases [3].

One of the important specifications of FADSS is the ability to deal with the information's uncertainty. Data mining in FADSS is one of the processes of knowledge discovery from the data, where all data stored in the database must be used to discover the patterns of data, which are then interpreted by applying the knowledge of domain. Agent technology is progressively being utilized to support decision-making in medical DSS implementation [3].

According to FADSS, the system assesses the given cases and evaluates the task that contains the suitable action. As any DSS system, FADSS provides suitable advices to avoid dangerous cases that occur during accidents and evaluates each treatment related with each cause of accident. Furthermore,

the selected emergency cause must mainly contain treatments events. Due to this fact, it was very easy to find a proper treatment that contains drugs and a suitable way to treat each type of emergency cause. Additionally, it was needed for first aid information; therefore, developed for the purpose of FADSS [3], and to study the ontology enhancement (ontology web language (OWL) & Unified Modelling Language (UML)) Methodology of FADSS [4].

The aim of this research is to present a detailed medical DSS, dealing with first aid management issues. DSS provides tools to assess emergency accident, find the solution, and give an immediate advice or action. It also shows the suitable action and treatment to save people from death and supports the junior workers in first aid centres to find information resources.

The system is logically and practically partitioned into three layers; solving the assignments of information combination, discovering the patterns, and decision making. We used the discovery of patterns as a foundation for real-time decision making. In building up this design, this is very useful for medical cases that use first aid actions, considered an expansive scale dynamic data mining, relevant learning extraction, and incorporated information portrayal techniques. In the application of the composed model in a suitable medical data with particular parameters for FADSS, a C4.5 algorithm was used to improve the system.

2. Related Work

There are many published studies related to the clinical efficacy of essential first aid treatments for the management of heart failure, heart assault, burns, outer draining and associated crack with an appendage. Furthermore, evidence of the adequacy of first aid instruction was previously reported. A fundamental first aid treatment was characterized as a preliminary intervention by the British Red Cross (BRC), one of the essential suppliers of emergency treatment around the world, which also specifies the possibly reliable actions by non-medical service professionals with insufficient preparation. A first aider is characterized as a non-social insurance proficient who has received some kind of formal preparation in medical aid from a perceived preparing body such as the BRC [5].

Articles with first aid performed by human service experts were avoided aside from where writing on non-medicinal services proficient medical aid mediations was missing and proof from investigations of social insurance proficient intercessions had been utilized to determine medical aid rules. In this case, comparative investigations have been incorporated for illustrative purposes. The issue of first aid is globally imperative. Thus, a FADSS framework has been produced to give access to reproduced results on various circumstance and to offer advanced situation-testing capacities for research and therapeutic purposes through the graphical user interface with known controls [6].

First aid represents an important issue related to human health, with emergency cases being one of different causes of death. The data produced from these cases are in complicated forms and frameworks. In this way, the data acquire all the fundamental qualities to be demonstrated with the operator DSS approach. These qualities include autonomy, mobility, adaptability, reactivity, communication with other agents, and learning. The DSS operator approach FADSS is the main strategy which can lessen the many-sided quality of the framework by making measured parts, which unravel private subtasks that together comprise the overall objective. Each agent utilizes the best strategy for explaining the subtask and does not make a difference in the general methodology [7].

Data Mining (DM) techniques were used for example for Knowledge Discovery (KD) and early diagnostics to enable early mediation in first aid actions [8]. The authors of a previous article [9] presented a multi agent system (MAS) named "Instrumented City Database Analyst", whose purpose was to uncover any relationship between human wellbeing and ecological pressure factors (movement activity, meteorological information and claim or checking data) by making use of an extensive variety of DM strategies, including relapse examination, neural systems, ANOVA and others [9].

The authors in another publication [10] suggested utilizing a combination of intelligent agents operating within an agent-based intelligent DSS for clinical administration and research. The intelligent DSS intended purpose is the improvement of decision quality, and its proposed use focuses on urgent cases. The decision making process system, namely the arrangement supervisor benefit, examines data from the data integrator layer and fabricates arrangements, makes utilization of alternate layers in its activity, and of web administrations to show and oversee its task. As every one of these activities have shown novel and promising common sense and hypothetical results, FADSS will be essential to make an agent-based DSS (ADSS) for information revelation and appraisal of medical tension on the population through detailed analysis of endogenous and exogenous disease cases [10].

3. Agent Based FADSS

Agent approach is practical one way of implementing a FADSS. Specifically, agents are integrated into FADSS in order to automate a higher number of instructions for the decision maker, empowering more indirect administration, and requiring less immediate control of the DSS [11].

Specifically, agents were utilized to gather data and create options that would permit the first aid advices to focus around arrangements observed to be useful. In view of this and considering that correspondence capacities assume a fundamental job in FADSS to empower (whenever, wherever) activity method of the framework, the proposed infrastructure of the agent-based FADSS is under enhancement. An agent-based FADSS is meant in principle to help a first aid advices solutions FADSS in a medical system. To delineate the possibility of the idea, graphs are provided in Figures- 1 and 2. To give the different data sources and related decision support instruments, the result, particular, and execution of a FADSS regularly in a distributed medical is as yet an open research issue [12]. Firstly, a FADSS regularly comprises the information and related tools, which originate from multidisciplinary regions. Related tools and data were not initially intended to cooperate. Conventional DSS plan strategies have limited capacity to be arranged in various levels and to formally indicate the product structures of a FADSS [13].

In such medical distributed system, FADSS needs a distributed framework to oversee and incorporate the tools and data flawlessly [13].

Stan Franklin and Art Graesser have their own definition: A self-ruling agent is a framework arranged inside and a piece of a domain that detects the senses of the environment and acts on it, after some time, in quest for its own motivation to influence what it facilities later on. From these we can define general keys of FADSS specification, as listed below [13]:

- Autonomous execution is unmistakably integral to organization.
- Agents must act self-sufficiently in order to understand the arrangement of the objectives.
- The express prerequisite of perseverance is another and an essential expansion.
- Agents reason during an activity choice.
- Agents take part in discoursed and arrange and organize exchange of data.
- Agents are fit for independent and deliberate activity in reality.

3.1 Features of Software Agents

Agents, in a general sense, are not quite the same as programming bundles and other business programs. They should have unique qualities or traits. These attributes are as shown below [14]:

- **Adaptability:** an agent must have the capacity to work on numerous stages, systems, and programming working FADSS, in the meantime being equipped for illuminating specialized FADSS independent from anyone else, without contribution from its proprietor.
- **Mobility:** an agent must have the capacity to openly explore systems and the web, dependent on choices about where to discover data and information to accomplish its objectives which are made inside without anyone else. It must have the capacity to interface with different specialists in various systems and conditions.
- **Transparency and accountability:** an agent must be totally straightforward to the proprietor/client whenever required. However, it should have highlights for logging its course, activities, cooperation, and time. It should likewise give this data on interest.
- **Ruggedness:** if an agent is needed to cross systems, both extensive and little, it must be tough, ready to manage mistakes, low assets, underpowered servers, and fragmented information, and decipher various types of information, codes, etc. It ought to have the capacity to comprehend the greatest number of FADSS as it can without human intercession.
- **Self-starters:** an agent must have the capacity to begin and stop dependent on its own criteria and to choose to accumulate data utilizing the proprietor's needs. The agent needs the capacity to choose when to begin/stop and when to convey its outcomes and what interface to convey.
- **User focused:** the agent should act to the greatest advantage of its proprietor and as per the inclinations that have been set for it first and foremost. It must complete its endorsed obligations without deviation. An alternative is to give it the capacity to propose conceivable better approaches for considering. Likewise it may offer better approaches to accomplish results or right mindsets.

These features are extremely requested and require a very basic level and diverse way to deal with developing programming than has been endeavoured with various languages, conventions, desires or results [15].

Table 1- Properties of Agents [15]

No.	Property	Meaning
1	Reactive(sensing)	Responds in a timely fashion to changes in the environment
2	Autonomous	Exercises control over its own actions
3	Goal- oriented (purposeful)	Does not simply act in response to the environment
4	Temporally Continuous	Is a continuously running process
5	Communicative	Communicates with other agents, perhaps including people
6	Learning (adaptive)	Changes behavior based on previous experience
7	Mobile	Able to move in space
8	Flexible	Actions are not given
9	Character	Credible 'personality' and emotional state

3.2 The Use of Agent Technologies

An agent-based framework could be extremely mind-boggling and, in this manner, costly. Hence, the kinds of FADSS that legitimize the utilization of agent advancements as opposed to other programming procedures, for example (OOP) or pure artificial intelligence applications must be resolved [16].

Muller gave rules to tending to this issue. He recommended that agent innovations fitting for FADSS application should have the following accompanying properties [16].

- Highly powerful, important to be responsive and versatile to a changing domain.
- Need to manage disappointment, e.g., rescheduling, re-arranging, and reallocating of assets.
- Need to adjust long haul, objective coordination, and here and now responsive conduct.
- Complex and additionally ensured basic security responses and reaction time.
- Geographically or legitimately dispersed assets.
- Need for maintainability, reliability and robustness.
- Flexible interaction with human users [17].

4. The Proposed Model Components of Agent First Aid DSS

Searching for a model that secures the computer for trained medical agents can be an exceptionally troublesome and tedious task. The objective of this paper is developing a framework that can assist people to immediately detect the status of persons suffering from accidents.

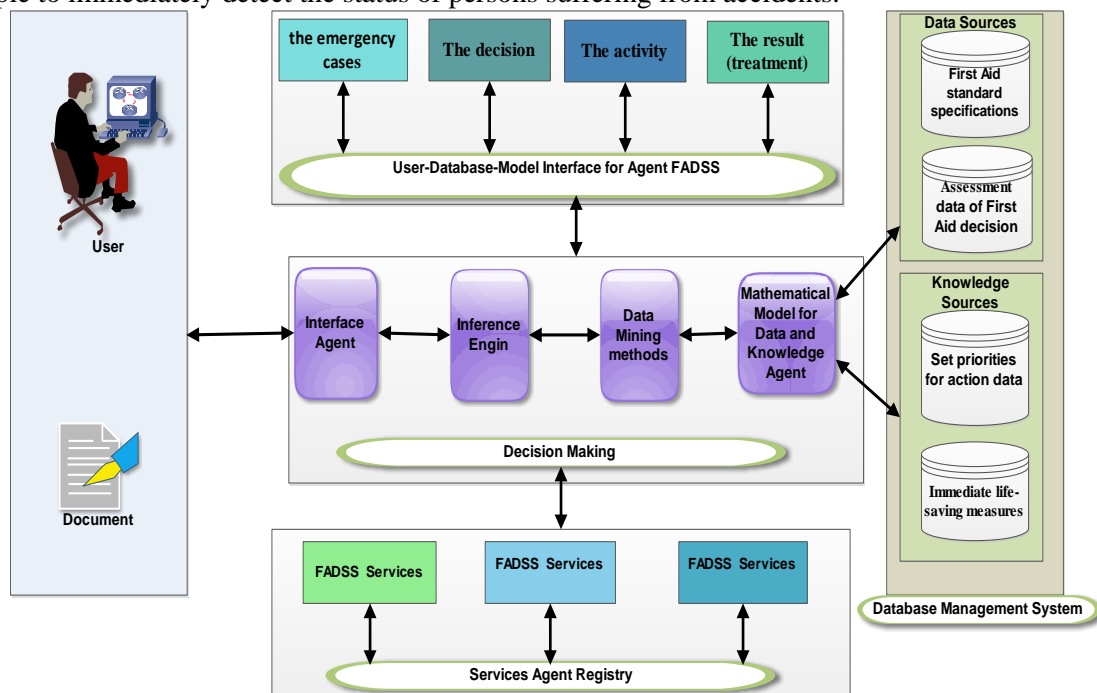


Figure 1- System architecture of agent First Aid decision support system (FADSS)

The primary goal when utilizing FADSS is to provide users with the option of referencing an automated system during the decision- making process. The FADSS incorporates an arrangement of procedures which begin with data assurance and handling, and whose end result is the generation and evaluation of alternatives.

Figure-1 demonstrates the proposed design of the agent-based FADSS. Its development followed and complied with the normal design of a DSS. The framework is divided into three levels, where the principal level is handling meta-data creation, the second level is performing hidden knowledge discovery and data mining, and the third level is enabling data distribution and visualization and providing real-time decision making support, which is the aim of the application.

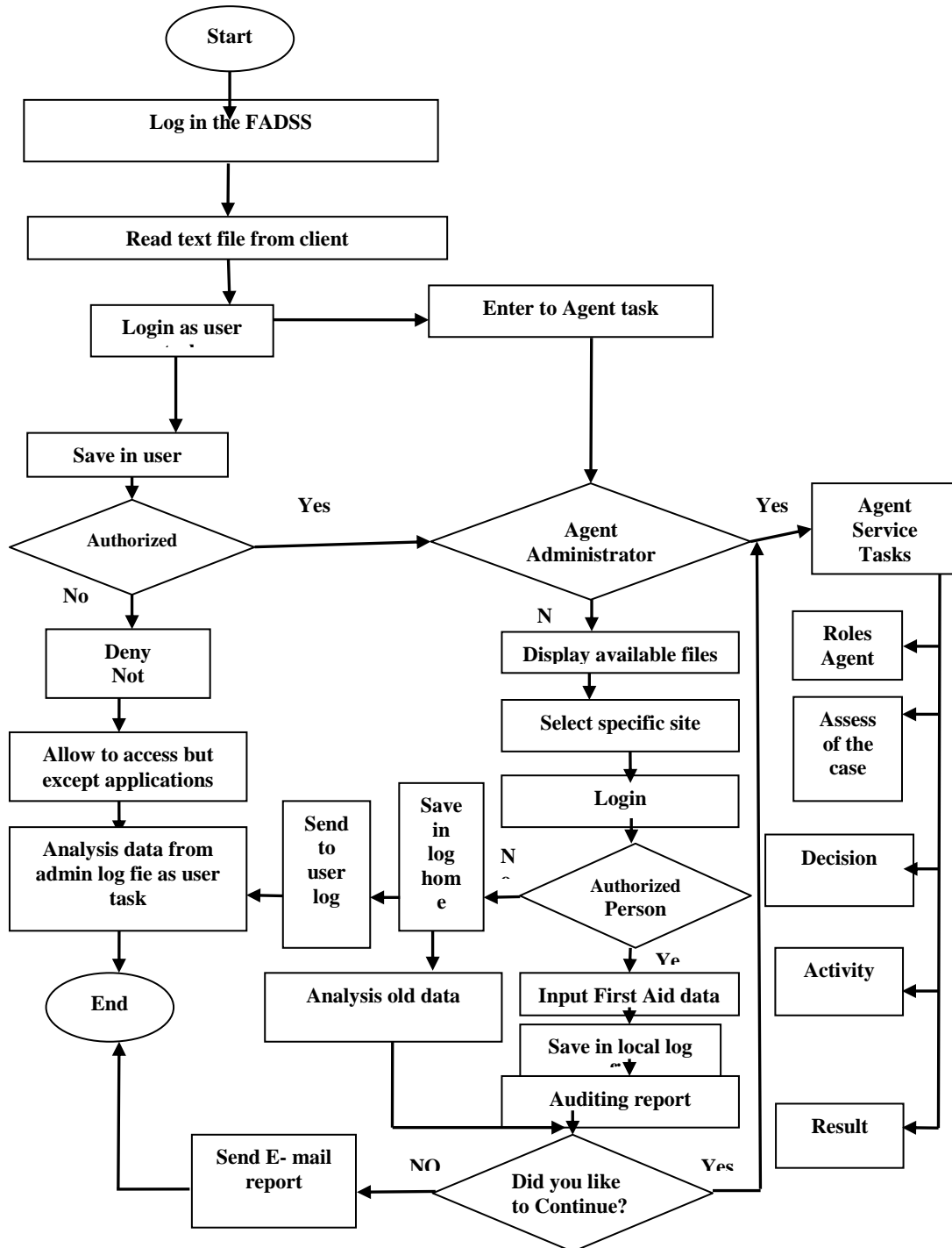


Figure 2- Data flow in the proposed system (FADSS).

Table-2 shows the essential classification and evaluation of every emergency case source and the effect of each case on health. These include fifteen principle types of important dangerous cases, each with various causes assessments, and outcomes to human health. The advised strategies are given for each sort of first aid actions.

Table 2- The Main Categories of Emergency Cases That Affect Health and Need a First Aid Action [18,19].

No .	Assessment of the case	Decision	Activity	Result
1.	Respiration	Assessment of vital functions (the ABCDE sequence): A= Airway B= Breathing C= Circulation D= Disability E= Extremities, Exposure	Set priorities for action	Immediate life-saving measures: (A) restore the casualty's airway (B) provide respiratory support (C) control external haemorrhage (D) prevent further injury to the spine (E) dress major limb wounds; immobilize joint and bone trauma; keep the casualty warm
2.	Wounded	Firstly strategies to stop bleeding	Do you strip a drenched dressing	Compression Dressing
3.	Poisoning	Should the empty container be kept?	Labeled directions for poisoning	Only safe way to induce vomiting
4.	Poisoning By Fumes		Look out: poisons may be sniffed, gulped and absorbed by the skin Better First Aid is Prohibition.	Move victim into Fresh Air
5.	Trauma	- loss of blood pressure or sudden injury caused a serious weakening of the body. - Un balances the emotional or Sudden upset of mental.	<ul style="list-style-type: none"> • Rapid, weak pulse • General Weakness • Patchy inhaling • Cold, pale, dewy skin 	-Location and why - Location if spinal rope injury dubious
6.	1 st Degree Burn	- overexposure to sun -Light contact with hot objects -Scalding by hot water or steam	-Erythema -Mild Swelling & Pain -Rapid Healing	-Cold Water notice. -Burn Lotion or Spray -Dark Vinegar -No butter or ointments
7.	2 nd Degree Burns	-Flash burns from gasoline. - Very deep sun burn. -Contact with hot liquids	-Erythema -Blisters -Wet appearance due to loss of plasma through damaged skin layers. -Open Wounds.	-Submerge in cold water NOT ice. -Apply cool compresses. -Blot dry & apply sterile gauze or clean cloth for preservation -DO NOT break blisters or strip tissue.
8.	3 rd Degree Burns	-Caused by electricity, flame, ignited clothing,	-White or Charred appearance	-DO NOT remove pieces of adhered

		saturation in hot water, and contact with hot objects.	-Deep tissue destruction -Complete loss of all skin layers -Nerve Damage -Pain or No Pain	particles of charred clothing. -Cover burn with thick, sterile or freshly laundered cloth. If hands or legs involved, elevate
9.	A break or crack in a bone	Cause: - Accident related to a fall & recreational and sports activities. - Most commonly a MVA.	- bone snap may heard -Pain & tenderness, difficulty moving injured body part -Report of grating sensation -Shortening of injured leg/arm -Unusual angle or position of body part	-Prevent motion to injured part or adjacent joints (immobilize) -Apply splint -Elevate involved extremity
10.	Neck, Head or Spinal Injury	Symptoms: -Change in consciousness. -Difficulty breathing -Weaken aired vision	-Tingling or numbness in hands, fingers, feet and/or toes -Loss of balance -Headache & vomiting	-Keep lying down -Leave in position found in -Call FADSS -If you do need to move, logroll & support head and neck
11.	Diabetic	-Too much or too little sugar in the body	-Symptoms: cool clammy skin, weak dizzy	First Aid: give sugar in form of candy or drink
12.	Frozen Body Parts	Do not attempt to rewarm if a chance the body part may freeze again	Needs to be thawed gradually	-Treat as though body part may break
13.	Heat Cramps	Painful muscle cramps	Moist-cool skin - Heavy sweating	Moist-cool skin - Heavy sweating
14.	Heat Exhaustion	Cold, clammy skin – Weak pulse Heavy sweating – Shallow breathing Nausea – Dizziness – Weakness	Move to cool place – cool by fanning	Elevate legs - Apply cool packs
15.	Heat Stroke	Hot, dry, red skin - Confusion or unconsciousness	Little or No sweating – Fast weak pulse	Move to cool place – Call FADSS Life Threatening

5. First Aid DSS Implementation

The implementation of FADSS is based on the information available in Table-2. The results available for the program user are shown in Figure- 3. There are distinctive 15 parameters that can bring about first aid causes, and standard qualities have been characterized for every particular parameter (see Table-2). In view of these, one can decide the sort of first aid treatment and subsequently the choice of reasonable guidance for the particular type of an action. The application consequently sends an email to an approved individual/gathering of people, with data to the people in charge of first aid centres. The email message incorporates data to the emergency causes, its source, and the recommended treatment. All data is put away in a meta-database.

Figure-3 demonstrates the principle window of the FADSS. The parts of the FADSS contain different buttons; Agent of First Aid: contains information about the strategies of managing first aid to protect human health. Send E-mail: The email message incorporates information regarding the emergency case causes, the origin of this case, the dangers related to this sort of case, and the proposed treatment. Exit: exit from the application.



Figure 3- Primary window of the application (FADSS).

Figure-4 demonstrates the login page to enter emergency case data. The user can enter secret key and a user name (username: user1 and password: admin) as a default value, and can change it.



Figure 4 - Authentication window to enter to the FADSS application

Figure-5 demonstrates the reactive page. The user of the application can enter the data of the emergency case and also implement the test to have a best advises about each case. The FIRST AID DSS uses standards of first aid information, as represented in Table-2, to enable the users to react with

the application. When used to question an instance of any dangerous circumstance, the instrument raises a table demonstrating the model outcomes and the information for the chosen first aid case. There are fifteen important first aid critical situations that should be having immediate actions to save lives of people. The data investigation and displaying restorative can be recovered through DBMS (MySQL) in order to demonstrate the real treatment. In other words, it is provided as an input for analyzing the medical model to acquire real advices and advantages of the unmistakable practices for evading death. Moreover, a simulation record descent service was provided to the medical centre to provide a relative examination of various conceivable arranging techniques to accomplish an ideal arrangement.



Figure 5- First window to show the emergency cases in the FADSS application.

Figure-6 demonstrates the emergency case (Diabetic) in the First Aid application. From there, the user can find information about diabetic cases, starting with the symptoms (cool clammy and weak dizzy), then decision making, and finally providing the recommended first aid (give sugar in a form of candy or drink) as shown in Table-2.



Figure 6- An example of emergency case (should take an action of first aid)

Figure-7 demonstrates the emergency case (Second Degree burns) in the First Aid application. From this part, we can obtain the information about the Second Degree burns case, starting with the symptoms, then decision making (diagnosis as a Second Degree burn), and finally providing the recommended first aid to the person (Table-2).



Figure 7- An example of emergency case (second degree burns)

Figure-8 shows the report of all information about any emergency case that should receive a first aid action (see Table-2), including all the conditions that are used to assess First Aid. Finally the program will send an email to the control centre (medical expert) containing the report of case's information.



Figure 8- Main window of data report for first aid case.

6. Conclusions

First Aid Decision Support System is proposed to assist people and workers in the field of medical management in employing a complete “one-package” methodology to handle critical emergency cases and take energetic exercises if there ought to emerge an event of risky cases. The decision support system is suitable for dealing with sorts of issues that don't have a clearly described structure, since a standard composition of computer programs is difficult to apply for first aid circumstances. Diverse causes are observed and arranged by using a logical model. The application takes into account the actual evaluation of first aid's standard parameters, which focus on the ultimate objectives of recognizing the case of first aid and providing an appropriate proposal for treatment. A decision support system is an accumulation of programming instruments, such as models, records, databases, and data administration programs that are collected together with a simple-to-utilize interface. The DSS is appropriate for taking care of sorts of issues that don't have an obviously characterized structure. The FADSS provides all the important steps to a standard decision making strategy which uses an agent. The levels of the framework design, functionally and logical association have been introduced. Real-time collaboration with the user gives a scope of potential outcomes in selecting one action from few choices, which are created by the framework through guided data mining and computer simulation. The DSS is a collection of software tools (such as models, documents, databases, and data management software) that are integrated together with an easy-to-use interface. It is well suited for solving types of problems that do not have a clearly defined structure. For decision analysis, a decision tree is used to visually and explicitly represent decisions and decision making in data mining. The decision tree describes data but not decisions; rather the resulting classification tree can be an input for decision making. The present software of the first aid decision support system is limited to 15 parameters that can bring about causes of the first aid cases. Therefore, we suggest adding further causes to improve first aid treatment. In the future, based on feedback received from users, we hope to optimize the FADSS by collecting improved datasets and addressing the additional emergency causes identified by the users.

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