USING HYBRIDIZED TECHNIQUES TO DEVELOP AN ONLINE WORKPLACE RISK ASSESSMENT TOOL

Anusua Ghosh[1], Andrew Nafalski[1], Jeffery Tweedale[1], Maureen Dollard[2]

[1] University of South Australia, School of Electrical and Information Engineering, [2] University of South Australia, Centre for Applied Psychology Research

Abstract: Recent research has shown that work stress has become a widespread concern in Australia and other countries. It is a growing concern across all employment sectors as well as occupational levels and reported as a common cause of occupational illness. Work stress can be prevented if it is identified, measured and changes are made to the work environment. Multi-Agent technology has been used in many applications but has not been applied in psychology for analysing data. This paper presents hybridized techniques, which have been used to develop an online tool for work stress assessment and prevention.

Keywords: work stress, agent, multi-agent system, neural network, fuzzy logic

UŻYCIE TECHNIK HYBRYDOWYCH W IMPLEMENTACJI SYSTEMU ONLINE DO OCENY STRESU W MIEJSCU PRACY

Streszczenie: Ostatnie badania wykazały, że stres w miejscu pracy stał się przedmiotem rosnących obaw w Australii i w innych krajach. Wszystkie sektory zatrudnienia doświadczają wzrostu psychicznych chorób zatrudnieniowych. Stres w miejscu pracy może być uniknięty jeśli jest identyfikowany, mierzony i stosowne zmiany są implementowane w środowisku pracy. Technologia systemów wieloagentowych jest używana w wielu aplikacjach, lecz nie była dotąd zastosowana w psychologii do analizy danych. Artykuł prezentuje techniki hybrydowe, zastosowane do oceny online i prewencji stresu.

Słowa kluczowe: Stes w miejscu pracy, intelinentny agent, system wielo agentowy, systemy neuronowe, logika rozmyta..

Introduction

Work Stress related psychosocial risks have been identified as having a direct relationship with work stress, violence, bullying, and harassment [14]. As such, psychosocial risks pose an ongoing challenge for the protection of worker psychological safety and well-being. Work-related stress affects people from all occupations and has become a widespread concern both in Australia and internationally. The negative impact of work-related stress on employee well-being can be mitigated if the associated psychosocial risks are identified by the organisation and managed in a timely fashion. Many organizations do not have evidence based methods to assess psychosocial risk factors or stress in the workplace.
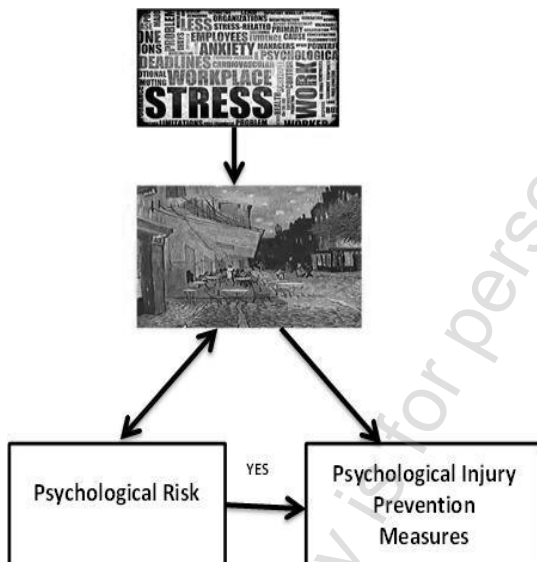

Fig. 1. Workstress level prediction via the StressCafé: E-portal

Given the influence of psychosocial risk and work related stress on psychological injury claim costs, it is important that avenues to prevent and respond to these hazards are appropriately explored. The Australian Workplace Barometer (AWB) tool has been designed to assess psychosocial risks using population based data to establish benchmarks across industries and occupations Whilst it is not common practice, it is possible for organizations to assess work related risk factors, including stress, utilizing appropriately validated risk assessment tools. The AWB tool is being adapted for use at an organisation level and psychosocial risks, worker health and work outcomes can be compared with national benchmarks to determine levels of risk [5]. Research has shown that there is a need for evidence based and easy to use methods and techniques to promote the implementation of ongoing risk assessment practices within organizations [5, 8].

Intelligent Agents may be useful in this respect, as they can aid in automatically identifying high risk factors that affect productivity and engagement. Most intelligent systems include expert systems, knowledge bases or other intelligent components. A knowledge base or Knowledge Based System (KBS) are artificial intelligence tools that represent knowledge about specific domain and can be used to provide intelligent decision with justification to solve or clarify problem. These systems are autonomous and are able to perform with minimal human intervention and can be integrated with AWB online survey tool, within the StressCafé.

The StressCafé is an interactive website that hosts on-line surveys, and provides e-feedback to aid the translation of research into policy and practice. In addition it is intended to provide a platform for the development of e-therapies and e-counseling AWB is the tool StressCafé will provide, which not only contains nationally significant workplace surveys and data information but also includes access for industry, government bodies, unions, universities, OHS organizations and the community to collect, calculate, compare and share information in relation to work psychosocial risk factors.

1. StressCafé as an online assessment tools for work-related stress

As we move toward an online world that is growing and will continue to grow, the need for internet-based psychological tools, including online assessment and e-therapy, is becoming more apparent. AllPsych Online is one of the most comprehensive and largest psychology website which provides services to the general public, mental health professionals and students of psychology [4, 13]. In some instances, using the internet as a medium for therapy has been found to be more effective than the traditional face-to-face counseling [13]. Online psychological evaluation, including personality, integrity, career, ability, and neuro psychological assessment, has been found to be successful in a variety of practical settings including recruitment and selection,

training and development, employee assistance programs, and therapeutic environments. In addition to assessment and therapy, internet-based technologies are being utilized as educational tools that provide information on techniques and interventions aimed at preventing and reducing work-related stress and other psychological health symptoms. This is evident in the growing number of websites promoting psychological health and well-being including: beyond blue, Bully online, Black dog institute, and SafeWork SA, just to name a few. In response to the growing trend toward online applications, The Centre for Applied Psychological Research along with researchers from the School of Electrical and Information Engineering based at the University of South Australia, have designed and developed an working model of the StressCafé, an online workplace stress resource and management tool for employers and employees.

1.1 StressCafé - an interactive website

The StressCafé (StressCafé, 2010) is an interactive website that will be the single point of contact for measuring work stress, generating feedback, sharing information, and bench-marking psychosocial hazards in the Australian workplace Figure 1 [17]. Within the StressCafé using the AWB Online an interactive, autonomous and smart system is developed. The autonomous interactive online website within StressCafé will provide feedback to participants who complete a work-based psychosocial risk assessment survey by comparing individual results to AWB benchmark scores. As such, the StressCafé will enable workers, employers, researchers and academics to access AWB on-line evidence-based psychosocial risk assessment tools which can be used to extrapolate individual and organizational level data and then compared, benchmarked nationally and to provide immediate feedback.
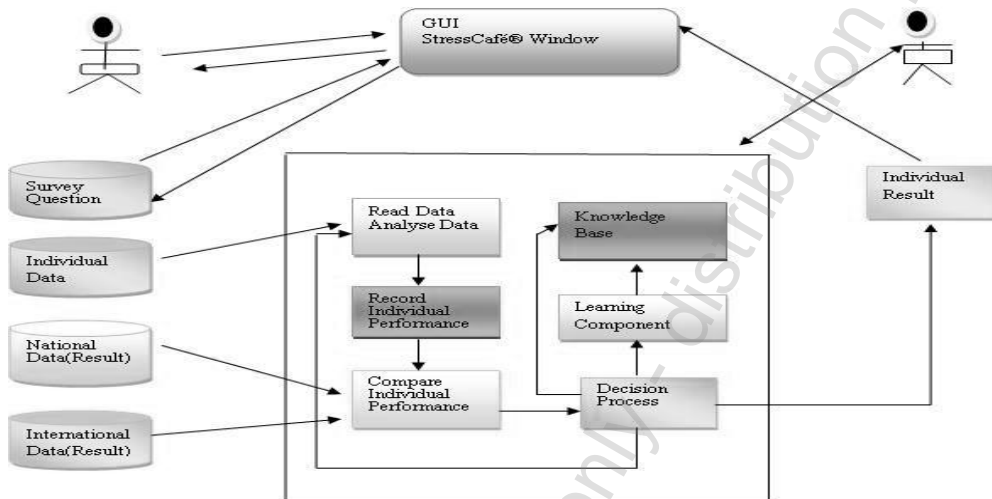

Fig. 2. Framework used in developing the StressCafé

The main business/industry/service: *Finance and insurance*
Number of recorded respondent: *108*
User responds are represented by diamonds: ◆
Benchmark responds are represented by the oval: ●

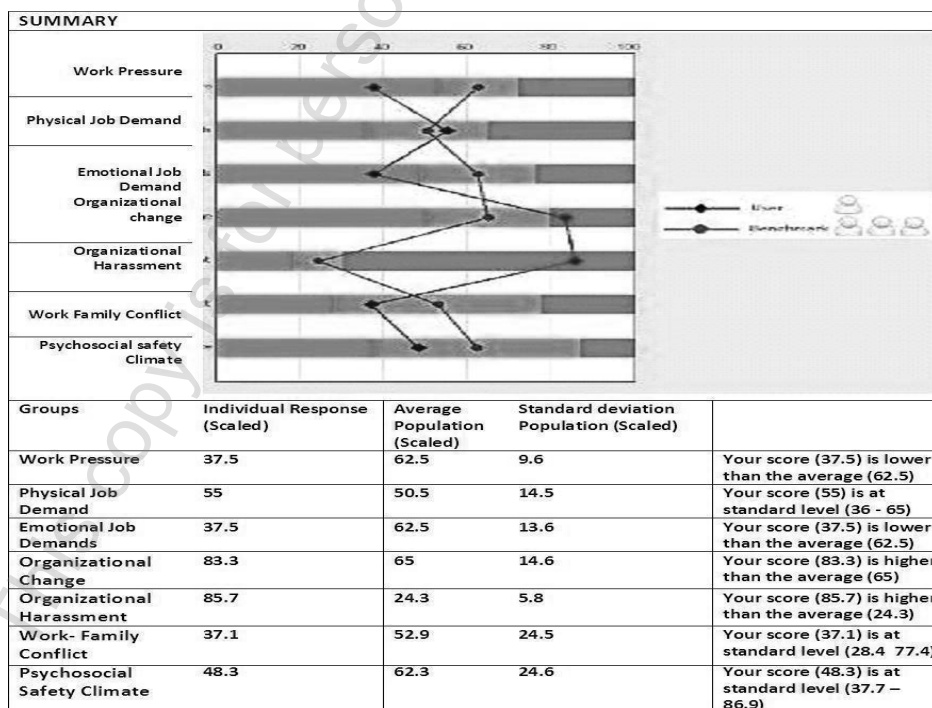| Groups	Individual Response (Scaled)	Average Population (Scaled)	Standard deviation Population (Scaled)	
Work Pressure	37.5	62.5	9.6	Your score (37.5) is lower than the average (62.5)
Physical Job Demand	55	50.5	14.5	Your score (55) is at standard level (36 - 65)
Emotional Job Demands	37.5	62.5	13.6	Your score (37.5) is lower than the average (62.5)
Organizational Change	83.3	65	14.6	Your score (83.3) is higher than the average (65)
Organizational Harassment	85.7	24.3	5.8	Your score (85.7) is higher than the average (24.3)
Work- Family Conflict	37.1	52.9	24.5	Your score (37.1) is at standard level (28.4 77.4)
Psychosocial Safety Climate	48.3	62.3	24.6	Your score (48.3) is at standard level (37.7 – 86.9)

Fig. 3. Benchmarked user feedback summary via the StressCafé

2. Development of StressCafé

The StressCafé and the interactive autonomous system were developed in stages:

Firstly the design of the framework to be utilized in the StressCafé is designed, as shown in Figure 2. The design consists of a human computer interface (HCI), databases, analyzer and feedback mechanism. The HCI will be the first point where the user can communicate with the machine, the computer in this case. The databases will store data collected nationally and internationally, online surveys as well as information pertaining to specific domain; this domain knowledge can be used for intelligent decision making, explaining, for learning etc. The analyzer will analyze and benchmark the data collected via online survey according to specified instruction. The decision based on the analysed result will be presented to the user as feed-back in the form of graphs and tables that will be presented to the user in real-time.

This is a population based longitudinal study, so data is being collected in stages from places within Australia and abroad, the collected data are stored in the respective databases; national database for storing data the survey results from the survey conducted nationally and the international database like the national database contain survey results conducted internationally. The national and the international data are being used to benchmark user scores respectively. Secondly, the interactive website was developed using PHP, MySQL and Apache, we considered Apache as a webserver as it is an open source web server, PHP and MySQL are integrated with Apache, MySQL serves as a database and PHP a programming language that communicates with the database and the website. The Decision Analyser reads in the user data then computes the required population sample mean and standard deviation from the data, and benchmark this result with the processed and calculated national data for benchmarking [6]. The feedback from the decision analyzer are presented to the user in the form of graph and tables as in Figure 3

Based on the industry selected by the user, the above benchmarked user feedback summary is presented, The user of the system can also obtain detailed feedback relating to the different categories as work pressure physical job demand etc., by clicking the appropriate links provided in the summary page.

Within this autonomous model of the StressCafé, it is intended that we use Intelligent Agent and Multi-agent, but before describe how it will be done, an overview of agent, intelligent agent, multi-agents and their applications are provided.

3. Agent and Multi-Agents

An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors [16]. Wooldridge and Jennings defines an agent as a software or hardware entity that autonomously reacts to changes in the environment through the use of sensors and actuators [20].

The role of AI is to develop an agent program that implements the agent function that is the mapping from precepts to actions: agent = architecture + program.

An agent is mainly a computer system that can act independently and autonomously on user behalf. An autonomous agent is capable of accomplishing its goal without the direct intervention of humans or other agents, and has control over its own actions and internal state [20].

Rather than being used alone, intelligent agents can be combined into a broader multi-agent system (the combination of one or more agent in a system). In a Multi-agent system the agents interact, communicate and negotiate with each other to achieve desired goal.

NASA's Deep Space 1 Mission (DS1) was the first space probe to have an autonomous, agent based control system [11]. The agent based system was able to monitor and rectify problem and eventually replaced 300 of the ground crew that was needed to monitor progress continuously.

An example of an agent and its environment is shown below in Figure 4.
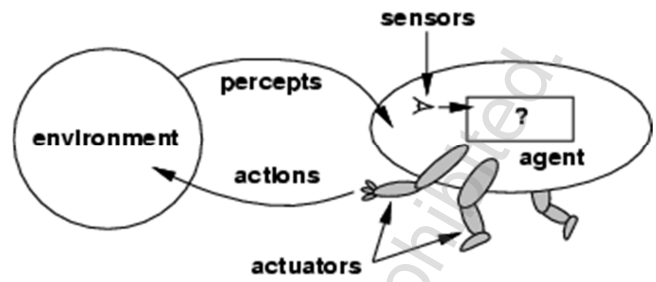

Fig. 4. Agent and its environment [20]

2.1 Application of Agents

Agent technologies are now being used in a wide range of practical settings due to the fact they provide better modularity, encapsulation, and abstraction needed for handling problems as they arise. In the field of medical science intelligent agents and multi-agent systems are an adequate tool for tackling health care problems. Intelligent agent has been used in power system, in particular for hydro-wind electricity generation control [9]. Wang and Wang applied a society of intelligent agent to work together in order to perform flexible monitoring processes based on various monitoring request [19]. Fuzzy-means clustering has been applied to generate rules, for implementing an intelligent agent that interacts with human for diagnosis establishment of the Medical Diagnostic System [12].

The use of intelligent agent-based platform is explained in [10], where the approach of combining two or more techniques is considered, to integrate their different strengths and overcome each other's weaknesses and generate hybrid solution. Agent based software system have been applied in areas as health care system, power engineering, process control application, and defence to name a few.

4. Hybrid Intelligent System for analysing work-stress data

Problem solving and decision making involves different components or subtask, each of which require different process of processing [21]. There are different techniques that are developed to solve problem as:

- Traditional hard computing techniques as operations research and expert systems.
- Soft computing techniques as neural networks, fuzzy logic and genetic algorithms.

Traditional hard computing and soft computing are referred to as intelligent techniques; these intelligent techniques have their own strength and weakness and cannot be applied to solve all problems. Thus combining or integrating two different techniques to solve complex are now widely applied. Hybrid intelligent systems are computational systems that integrate different intelligent techniques from the two categories mentioned above [21].

As a part of this research it is intended that integrating multi-agent along with neural networks and fuzzy logic to build the decision analyser will be a solution to our problem.

At present, the work stress data collected via survey are analysed using the Statistical Packages for Social Sciences (SPSS), so we propose to develop Intelligent Multi-Agent Decision Analyser (IMADA), within the Intelligent Agent Framework (IAF) for analysing work stress related data and provide feedback. The multi-agent system developed will be used to update the tables within the databases [6]. The decision analyser is being developed hybridizing Neural Network and Fuzzy Logic, as neural networks have the capability of learning, adaptation and identification and fuzzy logic deals with sharp transition between inclusion and exclusion.

The learning capability of the neural network when combined with the transparency and interpretability of the rule based fuzzy system will make the analyser more intelligent and smarter. By integrating Neural Network with fuzzy logic along with the Multi-agents we intend to develop an intelligent system that will be faster and more accurate for analysing work related stress survey data.

5. Expectations and benefits from the StressCafé

Stress is an increasingly common reaction to life stressors including psychosocial risks in the workplace. Yet recognizing the symptoms of stress may not always be recognized by the individual, thereby leading to the ineffective management of symptoms. Also how can they know their stress level and measure the stress level with people who are in the same profession in different states within Australia. These issues were investigated recently by Dollard et.al and then developed the Australian Workplace Barometer (AWB): A national surveillance system of Australian work environment [5]. This world class national survey aims to identify psychological factors that impact on people's well-being at work. The user will have their result scored, benchmarked and presented as shown in Figure 3.

The StressCafé an e-platform for assessing job stress /strain related psychological risk intends to be very useful for every worker, employer, researcher and academic, interested in stress measurement, benchmarking and management.

6. Conclusion

With the advances in technology and access to internet and online technologies, new online methods for psychological assessment are emerging. Many online websites are equipped to offer online counseling and other psychology based tools and products for example beyond blue [1], Bullyonline [3], HSE [7], Stress-Research [18], robertsoncooper [15], Black dog Institute [2] but there is a need for evidence based psychological risk assessment tool [1, 2, 3, 15, 7, 18]. The StressCafé will fulfill this need, as it is designed to provide user with feedback on their work related psychological risk to prevent and reduce job strain. Thus the StressCafé will be a highly sophisticated evidence-based online one stop for workplace psychosocial risk assessment surveillance tool promoting psychological injury prevention and intervention for use by employees and employers.

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Anusua Ghosh
e-mail: Anusua.Ghosh@unisa.edu.au

Anusua did her Bachelors with Honours in Mathematics and Masters in Applied Mathematics from India with Fluid Dynamics as a special paper. Subsequently she worked as a Researcher on Water Waves in India. Later did her Graduate Diploma and Masters in Computer and Information Science from the University of South Australia. Presently perusing her PhD at the University of South Australia using Multi-Agent Systems.

Prof. Andrew Nafalski, PhD, DSc
e-mail: Andrew.Nafalski@unisa.edu.au

Andrew's academic career spans several decades in his native Poland, Austria, Japan, Germany, UK, Canada, USA and France. His research interests encompass electromagnetism, applications of information technology, knowledge based engineering, remote laboratories and engineering education. He published in those areas some 32 books, monographs, book chapters and software sets, 100 journal papers and 213 conference papers.

Dr. Jeffery Tweedale
e-mail: Jeff.Tweedale@unisa.edu.au

Jeffrey is a Professional Scientific Engineering Officer with the Defence Science and Technology Organisation. He is a senior IEEE member and has been an adjunct staff member of the Knowledge-Based Intelligent Engineering Systems Centre. He has chaired many conference sessions. Jeff has published over 150 publications. His current research involves self-organising micro-mission systems using airborne platforms and distributed sensors.

Prof. Maureen Dollard
e-mail: Maureen.Dollard@unisa.edu.au

Maureen Dollard, PhD, is Professor in Work & Organisational Psychology at the University of South Australia. She is Director of the Centre for Applied Psychological Research and the Work & Stress Research Group of the School of Psychology, Social Work and Social Policy at the University of South Australia. Her life works have been devoted to the research of stress at work; she is an advocate for better work conditions.