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Research paper

Medical Insurance Plan Assistant Expert System

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Abstract

The increase of the uncertainty factor in future has led more and more people to seek security when they are in suffer by subscribing to insurance policy. However, purchasing an insurance policy is not something just filling in some forms and pays it this is because insurance company provides different kind of policy that suits different needs of people even it is still the same for medical insurance policies. Therefore, the Medical Insurance Plan Assistant Expert System was developed to help those who are interested in purchasing a medical insurance policy by suggesting the suitable medical or health insurance policy. This system will ask several requirements or criteria that will be the source of information for the inference engine of this system to generate answer.

Keywords: *Expert System, Insurance plan, Insurance policy.*

1. Introduction

Insurance coverage can be considered as the amount of risk that is covered for an individual or entity by any insurance services. About 50% of Malaysia's population which cover 12.5 million had life insurance coverage protection but 90% of them were under-insured. This refers to the people which their insurance coverage may be only at one or two times of their annual income [1]

If there is anything bad happens to the insurance holder, the amount of money that they can spend on their family probably will only last for a year or two [1]. Nevertheless, offering policies with higher sums assured won't work because life insurance is not a priority for most Malaysians [2]. A study in United States of America (USA) also found that most Americans do not have enough life insurance. Research by [3] shown that the most common reason given is that they have competing financial priorities thus they think that they cannot afford it. In USA, roughly 20-24 million people still lack health insurance [4]. Among the million people who neither enrolled or get coverage, 80% of them said because they could not find affordable plan. Despite those who surrendered their policy, there were also those who queue for enquiring their policy.

Some of the insurance holder also has lack understanding on their insurance policy. According to George [5], the consequences of lack of understanding among the insurance holder will cause the following issues:

i. Limited understanding is likely to lead to suboptimal decisions which lead the insurance holder to maintain with the same coverage.
ii. If consumers don't understand their own health insurance policies, it is unlikely that they will only respond to the incentives embedded in those policies.
iii. If insurance purchasers (or potential purchasers) are aware of their own lack of understanding, this may help explain widespread discontent with existing insurance options.
iv. A somewhat more subtle, but equally important, consequence of insurance complexity is that individuals will focus on the simplified information that is presented to them,

This shows how the insurance policy customers do not clear about the process of the financial system and regulations made [6]. Furthermore, they might not really know which policy suits them and relevant to their needs but not what they want.

Therefore, the objective of this project is to develop an expert system that will help users to identify the medical policy that suits them the most. It will first require user to answer every qualifiers [7]; then, it assigns confidence level to related medical policy based on these qualifiers' answers. This system displays a list of medical policies which have been assigned with confidence level higher than 20.

The system will gather user's requirements from the qualifiers displayed [8]. Then based on these qualifiers, the system will assigned figure of confidence to each choice. And finally, a list of suitable choices will be displayed according to the level of confidence; for example, the system will only display those choices which confidence is higher than 20.

Therefore, choosing a suitable insurance policy is important not only for the investor themselves, but it also important to the family members as financial protection [9]. Hence, an expert system which can assist the customer to choose suitable insurance policy can helps to the customer to choose the best suit policy [10].

2. Problem statement

There is often lack of knowledge in insurance policies among the people, either those who wish to buy or those who had bought. The

common trend in today's society is that people who wish to purchase an insurance policy will go directly to the insurance company itself or turn to the insurance agents. And those who are not interested in purchasing will remain unclear about what exactly is an insurance policy.

It is the insurance companies' and agents' responsibility to understand the needs of their customers so that the best-suited policy can be introduced to the customers. What happen is, these companies or agents have to repetitively carry out the needs-identifying process for every customer who comes to them. Hence a system that is intelligence enough to suggest customers or people about the best-suited policy should be built to ease the repetitive work of insurance companies and agents as well as to help public to know more about insurance.

3. Methodology

The implementation of this Medical Insurance Plan Assistant Expert System took place on the EXSYS Professional, Ver. 5.0.13-W, an expert system development tool. The following sections explain about the system's architecture, knowledge acquisition process, knowledge representation and knowledge base.

3.1. System architecture

The architecture of this Medical Insurance Plan Assistant Expert System is comprised of six components, which included user, user interface, inference engine, knowledge base, knowledge representation and source of knowledge.

The source of knowledge comprises all the available information about the medical insurance policies. This information is gathered through the knowledge acquisition process and then, the knowledge gathered will be represented by the production rules. All the rules about the problem domain are stored in the knowledge base, which acts as the intelligence source of the expert system. The inference engine works by selecting rules for testing and then checking if the conditions for that rule are true. Users interact with this expert system through the user interface. They input their policy's requirements by answering the question that the system provided. The most suitable medical insurance policy will be suggested to the users based on their requirements. Figure 1 shows the system architecture.

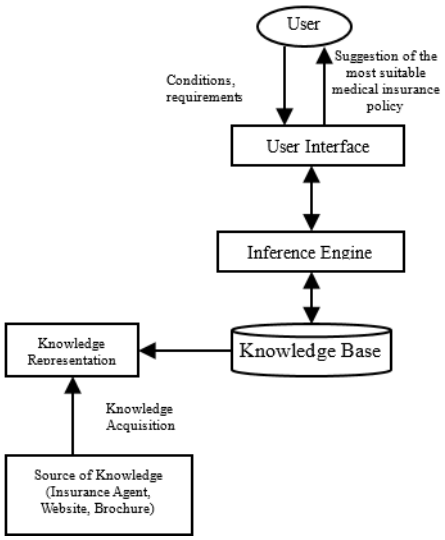

Figure 1: System architecture

3.2. Knowledge Acquisition

The information available for a particular domain of a system is usually dispersed and unstructured. It cannot be directly translated into a computer system. Therefore, knowledge acquisition and elicitation are important to represent the knowledge in an appropriate way.

First of all, the application domain of the system is determined, which is medical insurance. The knowledge about medical insurance was acquired from two insurance agents and was complemented by related sources such as brochure and website of the insurance company. In order to gain the insurance expertise, interview was carried out during the knowledge elicitation process. Interviewing an expert is essential because experts learn continuously without necessarily updating such knowledge in written document. Two unstructured interview sessions were conducted with insurance agents from Great Eastern Company, Mr. Chan Meng Yuet (on 25th August 2008) and Madam Wong Wai Yan (on 28th August 2008). During the interview sessions, information related to the medical insurance is collected, such as the number of policies and features of each medical policy.

Basically, there are six insurance policies under medical insurance, which are Medicare 100, Great Medicare, Investment Linked Health Protector, Hospitalisation Income Benefit, Great Life Essential Lady and Great Lady. All these six policies have similar and also distinct features between them. The major differences of the medical insurance's policies can be divided into gender, policy term, premium rate, investment plan, hospitalisation income, oversea protection, disease protection, medical equipment allowance, and policy extension to family members. Based on these features, a decision table as shown in Table 1 has been compiled. This decision table gathers the identified distinctness for each medical policy.

3.3. Knowledge representation

The knowledge representation technique applied in this expert system is production rules. Therefore, knowledge is represented in terms of IF-THEN-ELSE rules in EXEYS development tool. However, in this case, only IF-THEN rules are being used. A set of rules can be obtained based on the decision table in Table 1.

The reasons that production rules method was chosen is due to its simplicity and modularity. Rules form a good psychological model for knowledge representation because they are closely related to human reasoning. In addition, the blocks of rules can be independently written and added to a rule base, and checked for correctness. This feature enables knowledge base to be constructed incrementally, step by step. The IF-THEN structures of the rules provide a modular and uniform approach to knowledge representation.

3.4. Knowledge base

The knowledge base forms the system's intelligence source. In order to build the knowledge base rules, the first step is to declare the qualifiers and choices. A qualifier is declared with their possible values, which may take one or more values.

Table 1: Decision table

Policy	Gender	Policy term	Premium rate	Investment plan	Hospitalization income	Oversea protection	Disease protection	Medical equipment allowance	Policy extension
Medicare 100	Male/ female	Long term	Fixed rate	N	Y	N	Y	Y	N
Great Medicare	Male/ female	Flexi term	Fixed rate	N	Y	Y	Y	N	Y
Investment Linked Health Protector	Male/ female	Short term	Flexi rate	Y	Y	Y	N	N	N
Hospitalization Income Benefit	Male/ female	Short term	Fixed rate	N	Y	N	N	N	N
Great Life Essential Lady	female	Long term	Flexi rate	Y	N	N	Y	N	N
Great Lady	female	Long term	Fixed rate	N	N	N	Y	N	N

A qualifier-value pair forms either one condition of the rule or one conclusion. There are a total of nine qualifiers being declared in this expert system. All these qualifiers are based on the characteristics of the medical insurance policies (refer Table 1). Each qualifier is assigned with two values respectively. Each value has its confidence level. Table 2 below is the list of qualifiers with their values:

Table 2: List of qualifiers with values

Qualifier	Values
1. Client is	Male Female
2. Client prefers	Short term policy Long term policy
3. Client prefers	Fixed rate Flexible rate
4. Client would	Like to invest Not like to invest
5. Disease protection is	Important Not important
6. Hospitalisation income is	Important Not important
7. Client	Often travel to oversea Seldom travel to oversea
8. Client	Need medical equipment allowance Does not need medical equipment allowance
9. Client plans	To extend policy to family members Not to extend policy to family members

Choices are the various options that the expert system will decide among. A choice or more may be displayed as the conclusion for a particular domain of an expert system. In this Medical Insurance Plan Assistant Expert System, the choices are the medical insurance policies available in Great Eastern Company. There are six choices (medical insurance policies) in this case. Below is the list of choices:

i. Medicare 100
ii. Great Medicare
iii. Investment Linked Health Protector
iv. Hospitalisation Income Benefit
v. Great Life Essential Lady
vi. Great Lady

Thirteen rules are built in this Medical Insurance Plan Assistant Expert System. The IF part is the characteristics of the medical insurance policies; while the THEN part is made up of the possible choices of medical insurance policies, which are assigned with a confidence factor according to different condition based on the IF part. At the end, confidence factors for every choice in each rule are added up as a confidence value. Choices that are displayed at the result page will be ranked based on confidence value that indicates the relative likelihood of that choice being suitable or correct. Below is the list of rules in this expert system:

Rule 1
IF Client is Female
THEN Great Lady – Confidence =10
AND Great Life Essential Lady – Confidence =10
AND [GENDER] IS GIVEN VALUE 1

Rule 2
IF Client is Male
THEN Great Life Essential Lady – Confidence =10
AND Great Lady – Confidence =10
AND [GENDER] IS GIVEN VALUE 1

Rule 3
IF [GENDER] ==1
AND Client prefer Short Term Policy
THEN Investment Linked Health Protector – Confidence = 10
AND Great Medicare – Confidence = 5
AND Hospitalisation Income Benefit – Confidence = 10

Rule 4
IF [GENDER] ==1
AND Client prefer Long Term Policy
THEN Medicare 100 – Confidence = 10
AND Great Life Essential Lady – Confidence =10
AND Great Lady – Confidence =10
AND Great Medicare – Confidence = 5

Rule 5
IF Client prefer Fixed Rate
THEN Medicare 100 – Confidence = 10
AND Hospitalisation Income Benefit – Confidence =10
AND Great Lady – Confidence =10
AND Great Medicare – Confidence = 10

Rule 6
IF Client prefer Flexible Rate
AND Client would like to invest
THEN Investment Linked Health Protector – Confidence = 15
AND Great Life Essential Lady – Confidence = 10

Rule 7
IF Client prefer Flexible Rate
AND Client would Not like to invest
THEN Investment Linked Health Protector – Confidence = 5
AND Great Life Essential Lady – Confidence = 5

Rule 8
IF Disease Protection is important
THEN Medicare 100 – Confidence = 10
AND Great Life Essential Lady – Confidence =10
AND Great Lady – Confidence =10
AND Great Medicare – Confidence = 10

Rule 9
IF Hospitalisation Income is Important
THEN Medicare 100 – Confidence = 10
AND Hospitalisation Income Benefit – Confidence =10
AND Investment Linked Health Protector – Confidence =10
AND Great Medicare – Confidence = 10

Rule 10
IF Hospitalisation Income is Not Important
THEN Great Lady – Confidence =5
AND Great Medicare – Confidence = 5

Rule 11
IF Client often travel to oversea
THEN Investment Linked Health Protector – Confidence = 10
AND Great Medicare– Confidence = 10

Rule 12
IF Client need Medical Equipment Allowance
THEN Medicare 100– Confidence = 5

Rule 13
IF Client plans to extend policy to family members
THEN Medicare 100– Confidence = 5

4. Graphical user interface

Graphics are used in the system's user interfaces to make the system looks more user friendly, and usable. Approach used in the design of graphical user interface in this system is metaphor. We try to use the graphic that somehow related to the questions asked in order to give the system's user a rough idea what is the question about. Below are the windows that display various qualifiers with related graphics.

4.1. Qualifiers

Qualifiers play an important role in leading users to obtain the results. Medical Insurance Plan Assistant Expert System is made up by a total of nine qualifiers. These qualifiers were designed using graphics that reflect the content of the qualifiers. For example, Figure 2, a qualifier that asks about user's gender, shows the background of male and female symbol. Every qualifier was designed properly in order to give the system's user a more pleasant use of the system. Figure 3 shows the qualifier on the importance of disease protection for user.

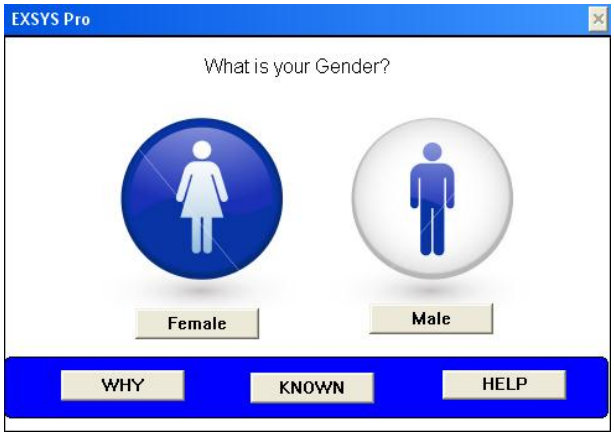

Figure 2: Qualifier on the gender of user

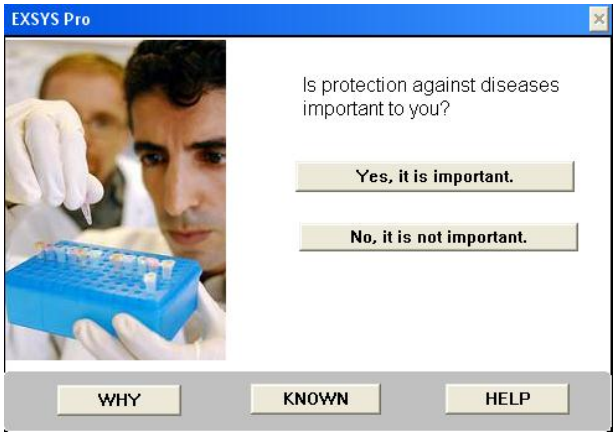

Figure 3: Qualifier on the importance of disease protection for user

4.2. The policy introduction

The medical insurance policies introduction windows will be shown before the results are displayed. These introductions are the explanations on each medical policy available in the insurance company. Figure 4 shows the introduction of Medical Insurance Plan Covered by the system.

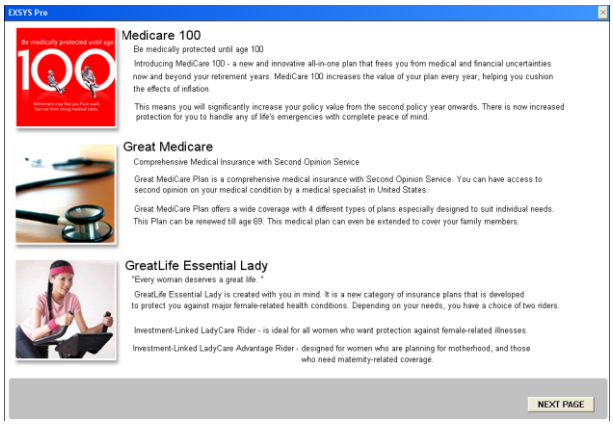

Figure 4: Introduction of medical insurance plan covered by the system

4.3. Result

The results will be displayed in a list with respective confidence level. For example, Figurer 2.12 shows that the choice Great Life Essential Lady has the highest confidence level out of six medical

insurance plans available in the company. Thus, it is the medical insurance plan that suits the customer the most. Figure 5 shows

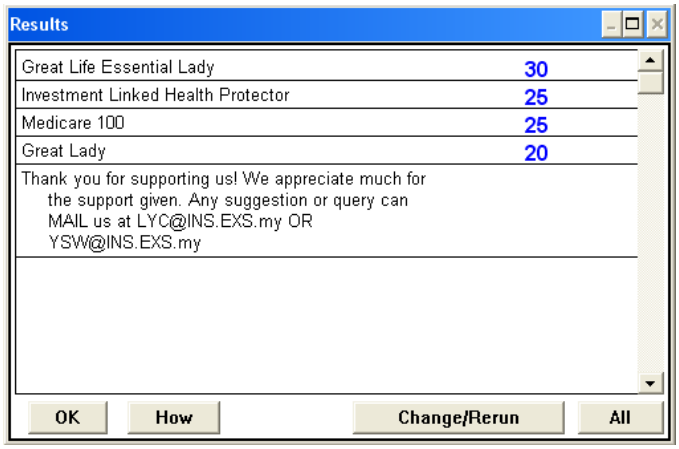

Figure 5: Example of generated results

4.4. The Miscellaneous

The miscellaneous consists of the 'Why', 'Known', and 'Help' screens. These windows will be shown once users click the button 'Why', 'Known' or 'Help' button in every qualifier's window (example Figure 2 and Figure 3).

The 'Why' screen (Figure 6) shows why the qualifier is asked; the 'Known' screen (Figure 7) shows what the system has known from the user at that moment (based on what the user keyed in in previous qualifiers); while the 'Help' screen (Figure 8) shows the explanation of the particular qualifier.

Figure 6: Example of 'Why' screen of the system

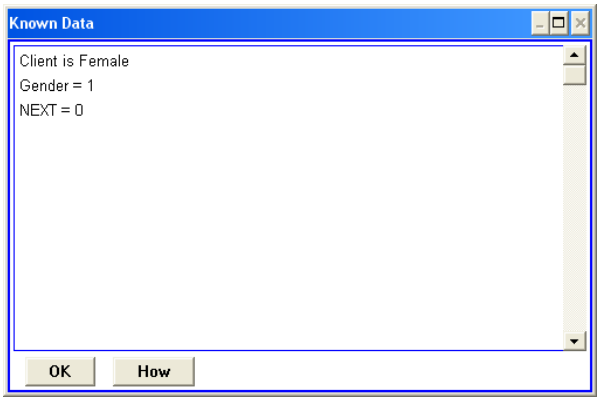

Figure 7: Example of 'Known' screen of the system

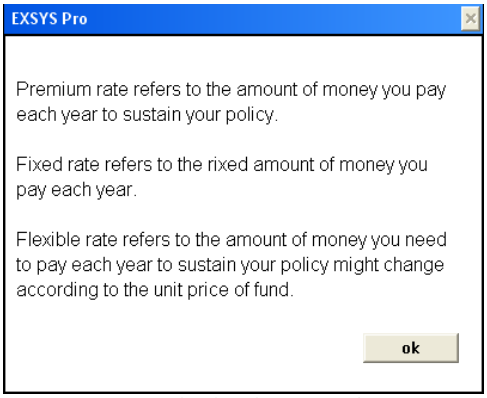

Figure 8: Example of 'Help' screen of the system

5. System evaluation

After implementation of this Insurance Plan Assistant, an evaluation had been carried out. The purpose of this system evaluation is to ensure the system has been developed serve its aims. This system evaluation divided into two main parts, which is functionality evaluation and usability evaluation. This evaluation had involved 15 students who mainly were from Faculty of Science Computer and Information System, Universiti Tun Hussein Onn Malaysia while, some of them were from other faculty.

This evaluation form consists of 8 questions and they are divided into two part. Each of the questions required the respondent to rate from one to five. The result of the evaluation as shown in Table 3 shows that this system's functionality scored an average mark at 4.083, while its usability scored slightly higher at 4.25. However, this is a good sign to show that most of the user found this system is reaching 5, which is the maximum mark.

Table 3
System evaluation result

Respondent	Gender	Functionality				Usability		
		Q1	Q2	Q3	Q4	Q5	Q6	Q7
R1	F	4	5	4	3	4	5	4
R2	F	5	5	4	3	5	3	5
R3	F	4	4	5	5	5	4	5
R4	F	4	3	5	4	5	5	4
R5	F	5	3	5	4	5	5	4
R6	F	4	3	4	3	4	5	5
R7	F	4	5	4	4	5	4	5
R8	F	5	4	4	4	4	4	4
R9	M	5	4	3	5	5	4	5
R10	F	4	3	3	4	4	5	3
R11	M	5	4	5	2	5	4	4
R12	F	5	4	4	5	4	4	4
R13	F	4	4	4	4	5	4	5
R14	F	4	4	3	3	4	4	3
R15	M	5	5	4	4	5	5	5
Sum	3M/12F	67	60	61	57	69	65	65
Average		4.47	4	4.067	3.8	4.6	4.333	4.33
Avg for Functionality		4.083333333					~	

Most of the respondent found that the system is easy to use and questions are easy to understand. They also feel that the choices provided are relevant. However, it is obvious that some respondent do not quite clear about the questions raised. This may due to the usage of jargon from insurance policy which they found not familiar. On the other hand, a few respondents do not clear about the result generated by the system and thus rated the usefulness of the result relatively low, that average scored at 3.8. This is might due to the lack of explanation of the insurance policy.

From Table 3, it shows that most of the respondent is satisfied with the font used and rated this aspect with average score at 4.6. They also agreed that the graphic used in this system is attractive enough to illustrate the question. They also found the system is user friendly which means they know what to do next while using this system. Both of these aspects scored equally at 4.33. However, they were reluctant to use this system again as this was scored at 3.73.

In short, there are some improvements to make according to the evaluation. Firstly, the explanation of system should be included and explanation for insurance policy should be provided. On the other hand, this system provides a good interface for user to use and it is also easy to use.

6. Conclusion

Medical Insurance Plan Assistant Expert System was built to help user in understanding and searching medical insurance policy that suit them the most. In this project, a series of qualifiers and rules were built for the system in order to generate the most appropriate results to the users.

To test whether the system serve its purpose of helping users, system evaluation was done among fifteen users (selected randomly). According to the system evaluation results in Section 3, most of the users are satisfy with the functionality of Medical Insurance Plan Assistant Expert System. They also think that its usability is good enough.

Hence, we can conclude that Medical Insurance Plan Assistant Expert System manage to help users in understanding medical policy that suit them the most up to a certain degree and the objective of this project is achieved.

References

[1] Bernama, "90 Per Cent Of Life-Insured Malaysians Under-Insured, Says LIAM," 14 March 2016. [Online]. Available: http://malaysiandigest.com/news/600094-90-per-cent-of-life-insured-malaysians-under-insured-says-liam.html. [Accessed 14 March 2017].

[2] Shakeel PM. Neural Networks Based Prediction Of Wind Energy Using Pitch Angle Control. International Journal of Innovations in Scientific and Engineering Research (IJISER). 2014;1(1):33-7.

[3] B. A. B. G. Corey Dahl, "The shocking statistics behind the life insurance coverage gap," 2013 August 2013. [Online]. Available: http://www.lifehealthpro.com/2013/08/30/the-shocking-statistics-behind-the-life-insurance. [Accessed 14 March 2017].

[4] Selvakumar S, Inbarani H, Shakeel PM. A Hybrid Personalized Tag Recommendations for Social E-Learning System. International Journal of Control Theory and Applications. 2016;9(2):1187-99.

[5] E. Pianin, "Here's Why 24 Million People Still Don't Have Health Insurance," The Fiscal Times, 19 August 2016. [Online]. Available: http://www.thefiscaltimes.com/2016/08/19/Here-s-Why-24-Million-People-Still-Don-t-Have-Health-Insurance. [Accessed 14 March 2017].

[6] J. Y. F. B. M. S. A. George Loewensteina, "Consumers' misunderstanding of health insurance," Journal of Health Economics, vol. 32, pp. 850-862, 2013.

[7] P. Mohamed Shakeel; Tarek E. El. Tobely; Haytham Al-Feel; Gunasekaran Manogaran; S. Baskar., "Neural Network Based Brain Tumor Detection Using Wireless Infrared Imaging Sensor", IEEE Access, 2019, Page(s): 1

[8] C. Chin, "We dont Have Enough," The Star Online, 3 January 2016. [Online]. Available: http://www.thestar.com.my/news/nation/2016/01/03/we-dont-have-enough-most-malaysians-will-struggle-to-cope-with-a-health-crisis-while-loved-ones-will/. [Accessed 14 March 2017].

[9] Preeth, S.K.S.L., Dhanalakshmi, R., Kumar, R.,Shakeel PM.An adaptive fuzzy rule based energy efficient clustering and immune-inspired routing protocol for WSN-assisted IoT system.Journal of Ambient Intelligence and Humanized Computing.2018:1–13. https://doi.org/10.1007/s12652-018-1154-z

[10] Sridhar KP, Baskar S, Shakeel PM, Dhulipala VS., "Developing brain abnormality recognize system using multi-objective pattern producing neural network", Journal of Ambient Intelligence and Humanized Computing, 2018:1-9. https://doi.org/10.1007/s12652-018-1058-y