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Development of a Computerised Prostate Cancer Detection System using Artificial Neural Network

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Abstract: ***Prostate cancer has been known as one of the most deadly diseases in the world that flourished in men. History has discovered that the epidemic is a slow growing disease that occurs in the life of men without the carriers' knowledge that the disease is already in the gland. Prostate cancer is a disease that grows in the prostate which is a gland in the reproductive system. The purpose of this research paper is to use an artificial neural network to predict the occurrence of prostate cancer in men. We were privileged to have access to data of certain known cases of prostate cancer and non prostate cancers collected from government hospitals. In the proposed system, users can enter their parameters and it would be compared with the already stored parameters in the database for early possible detection of prostate. The proposed system can then predict whether there is possibility of prostate cancer from the parameters entered.***

Keywords: Prostate Cancer, Human, Men, ANN

I. INTRODUCTION

Over the years, prostate cancer has been recognized as the most frequently diagnosed cancer in the world today, and record has shown since the time immemorial that is the second most common cause of cancer related death in men (Jemal et al., 2010, American Cancer Society, 2012). Research has shown that prostate cancer is a kind of cancer that grows in the prostate (a gland in the male reproductive system). A number of prostate cancers develop slowly in different stages which eventually matured into complicated or aggressive prostate cancers. The cancer cells may propagate from the prostate to other region of the body, most especially the bones and lymph nodes (Dayhoff, 2001). Prostate cancer in men is always associated with severe symptoms like difficulty in urinating, problems during sexual intercourse (Pinto, et al., 2011) etc. Most times prostate cancer is always detected too late and when detected, doctors give over diagnoses and over treatment of this disease because they don't know the actual level of the prostate cancer in the human body hence they treat according to their assumptions (Engelbrecht et al., 2010). Before the advent of artificial intelligence and its applications, logical and predictive calculation or estimation seemed a bit cumbersome for humans to carry out.

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Most predictive algorithms were based on probabilities and ranges of values passed by some test or biopsy in case of medicine. Most medical practitioners and pioneers had to carry out series after series of test on sick people before the presence of a deadly disease (i.e. cancer) can be detected (Mills,
1993) (Panagiotaki, et al., 2015).
The conventional way of detecting and testing for deadly diseases seemed costlier and inaccurate, also early detection of this diseases and future forecast of a person having a tested disease seemed ambiguous. Sometimes doctors give results on test carried out on patients based on their assumptions and their experience which may be inaccurate and insufficient (Lisboa, 2002). When artificial intelligence was introduced into the world of computing, the world was amazed at the power of the machine in form of the human brain. From gaming, to stock exchange forecast, medical science, robotics, car manufacturing, space expedition and weather forecast, artificial intelligence has proven to be the latest technology that is closest to representing a human brain and works better than the human brain. In the past few decades, Artificial Intelligence (AI) has been applicable and widely acceptable in medical fields. This is evident by the surging increase in number of medical devices presently available on the market with embedded AI algorithms. Artificial Neural Network is a sub-division of AI which has been accepted as the new technology in computer science. Neural Networks are currently a trending research area in medicine, most especially in the fields of radiology, urology, cardiology, oncology and etc. Its numerous applications in other areas such as education, business; medical, engineering and manufacturing cannot be over-ruled. Over the years, neural network has played key role in a decision support system. Today, a lot of medical practitioners now seek the aid of ANN applications in detecting, predicting and forecasting of the presence of diseases on the human body. In computer Science and other related fields, artificial neural networks has proven to be a significant computational models which is inspired by animal nervous systems (e.g the brain) which have the properties of machine learning and pattern recognition (Ueno, et al., 2013). They are often known as systems of interconnected "neurons" which can calculate values from inputs through the information fed into it by the network. Artificial neural network have been discovered and fine-tuned to learn like the human brain, teach like humans do, adapt to situations, make logical calculation based on input and learn from past mistakes. From time past, it has been observed that most clinicians give result on detection of prostate cancer in patients based on their assumptions and experience, these results are sometimes inaccurate, insufficient and usually leads to over diagnoses and over treatments.

Traditional methods of detecting prostate cancer leads to wastage of time, it is expensive when compared to ANNs (Maarten et al, 2013). Also there are times that doctors do not seem to be able to detect the presence of prostate cancer due to its slow growth and distortion in the output value of the test carried out on a patient this makes the doctor have the feeling that prostate cancer is not present. Also doctors and medical pioneers find it difficult to make decisions based on the output gotten from physical examinations of prostate cancer. There is no guarantee and transparency in the output gotten from physical examination, biopsy on prostate cancer detection in men. Poor evaluations, typically quoting, doctors do not know the 'best model' to use with a train/test validation. Inaccessible to accurate statistical performance measures to reward for the effect of prevalence is also a big hurdle. Acosta (2010) stated that only 68% of cancer patients survived from the record obtained from 1999-2005. Cancer is the second most prevalent cause of most deaths in the United states after heart disease. Early detection is the most active ingredients against cancer since the treatment depend on how advanced the cancer has grown in the body system. Prostate cancer being the second most common cause of death in every American man, has been termed as the second most common cancer in the region. Porpiglia et al, (2017) highlighted in his research work that the American Cancer Society predicted 217,730 new cases of prostate cancer in 2010; consequently; there is a need for providing an alternative measures for screening the disease. The primary aim of this paper is to develop an artificial neural network system (ANNs) for the fast detection of prostate cancer in men. Neural network is a mathematical model normally used to mimic the pattern recognition capabilities of the brain.

The rest of the paper is organized as follows: materials and methods are discussed in section 2, Section 3 consists of Results and Discussions while Section 4 comprises of Conclusions and Section 5 has the references.

II. MATERIALS AND METHODS

The total clinical data gotten from governments' hospitals is twenty (20) clinical data with 5 patients confirmed to have cases of prostate cancer and 15 are non-Prostate Cancer. The data collected were randomly selected from the pool of 50 patients. The modality adopted for entering data for each patient include age, prostate-specific antigen (PSA), ratio of free to total prostate-specific antigen (PSA-Ratio), estimated prostate volume (TRUS) and the diagnostic result gotten from the digital rectal examination (DRE) which was considered to be binary variable (suspicious or non-suspicious). All the samples were collected before diagnostic or therapeutic procedures, and sera were left at 80^{o}C till when it was analysed. After heated at room temperature, samples were analysed between 1 to 3 hours. Prostate volume was detected by trans-rectal ultrasound using the prolate ellipse formula.

Table 1: Variables considered during the analysis by artificial neural network

	Age (in years) 1) <30 2) 31–50 3) 51–60 4) >60
2	Period of hormonal activity (in years) 1) <10 2) 11–20 3) 21–30 4) 31–40 5) >40
3	Number of childbirths 1) 0 2) 1 3) 2 4) 3 5) >4
4	Size of tumor 1) no data available 2) <40 3) >40
5	Degree of malignancy according to Bloom 1) I 2) II 3) III
6	Familial incidence of cancer 1) yes 2) no
7	Professional activity 1) intellectual 2) physical 3) no profession
8	Category 1) recurrence 2) no recurrence
9	The type of hormonal adjuvant therapy 1) no hormonal adjuvant therapy 2) tamoxifen
10	Emboli from carcinoma cells in the vessels 1) yes 2) no

Table 2: Variables considered in analysis by artificial neural network (ANN) and their values for six example patients.

Variable value for patient

Variable name	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6
Age (in years)	3	3	2	2	3	2
Period of hormonal activity (in years)	4	3	3	4	4	4
Number of childbirths	1	1	3	2	1	1
Size of tumor	2	3	3	2	2	2
Involvement of auxiliary lymph nodes	3	4	3	2	1	1
Emboli from carcinoma cells in the vessels	2	1	2	2	2	2
Degree of malignancy according to Bloom	2	3	3	1	1	1
The type of hormonal adjuvant therapy	2	1	1	2	2	1
Familial incidences of cancer	2	1	1	2	2	1
Professional activity	1	2	1	2	1	1
Category	2	1	2	1	1	2

Recurrence: (R); No Recurrence :(NR).

III. RESULTS AND DISCUSSIONS

3.1 SOFTWARE REQUIREMENTS

This section comprises of the implementation details of the proposed system. This refers to the system under development; it is a term used to describe program support which helps the system to meet up the need of users in their performance.

3.2 SYSTEM MODULES

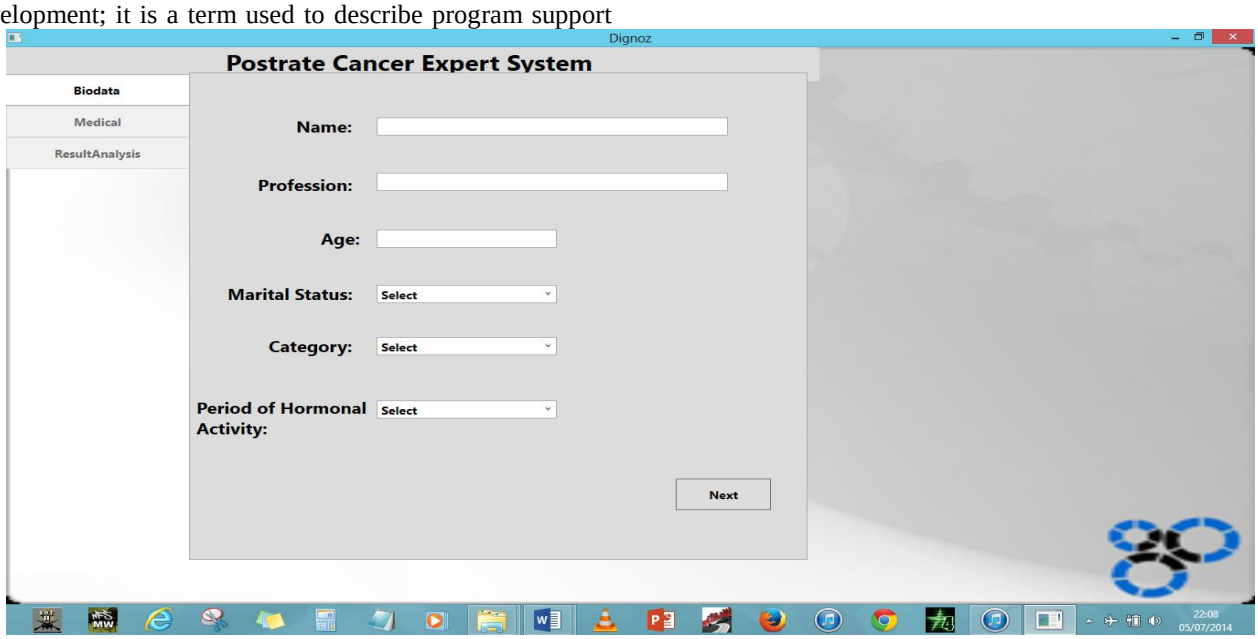

Figure 1: bio-data page to the Dignoz application

BIO-DATA PAGE: Figure 1 is a bio-data page where patients are to fill in their personal information according to the fields available on the page.

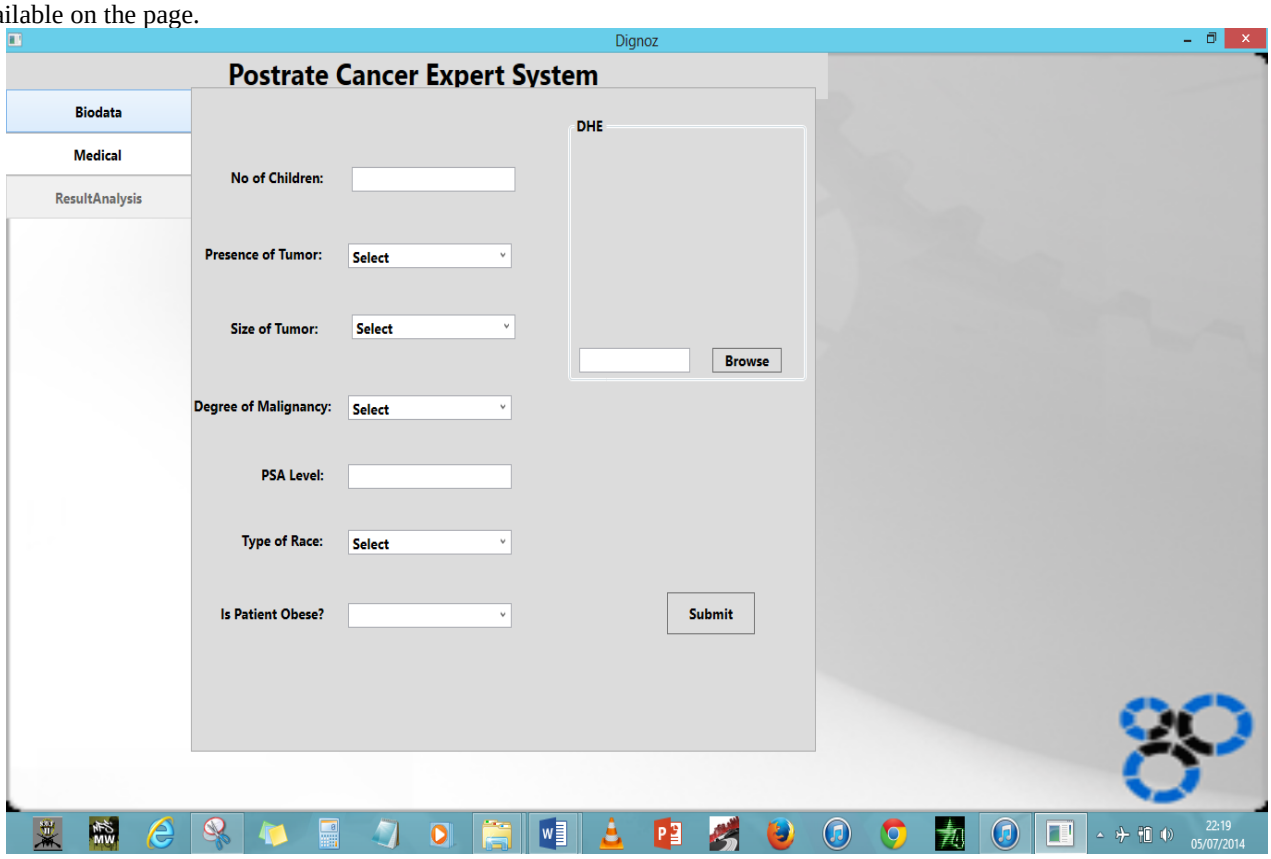

Figure 2: Medical Page to the Dignoz application

MEDICAL PAGE: On this page as shown in figure 2, patients are to fill in their medical data according to the specified field to help predict the presence of prostate cancer

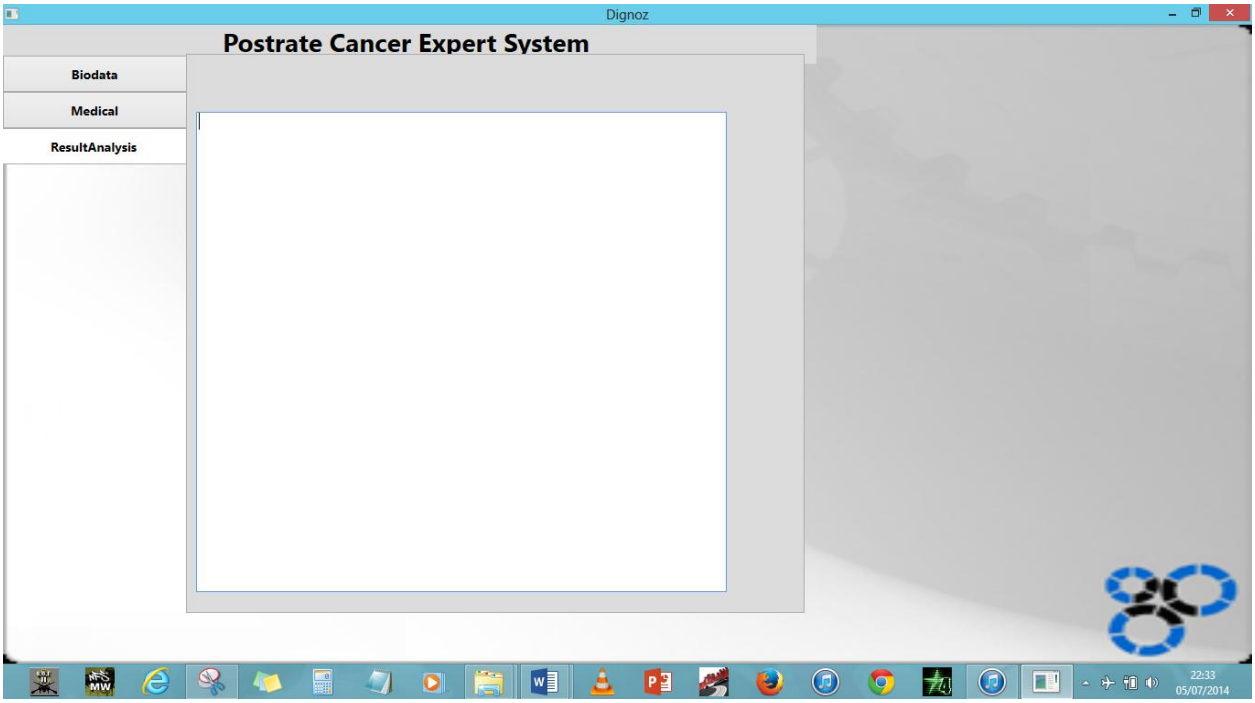

Figure 3: Result Page

RESULT PAGE: After patient's bio-data and medical details have been filled into the dignoz application as shown in figure 3, the application takes the patient's medical information and analyzes it, it compares it with the data in the system and produces a result which could be that the patient may have prostate cancer, or that a particular patient does not have prostate cancer, or further tests should be carried out on a patient.

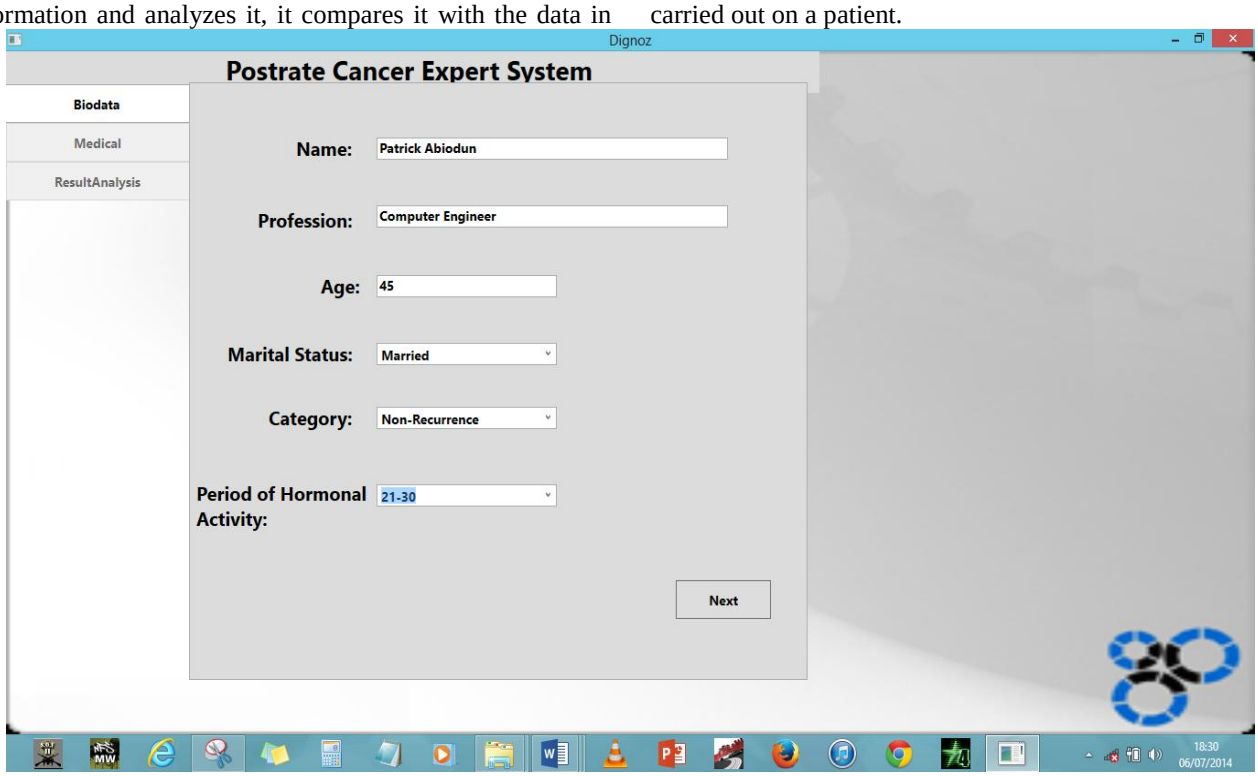

Figure 4: Patient's bio-data

Figure 4 is a patient's bio data form being entered into the system.

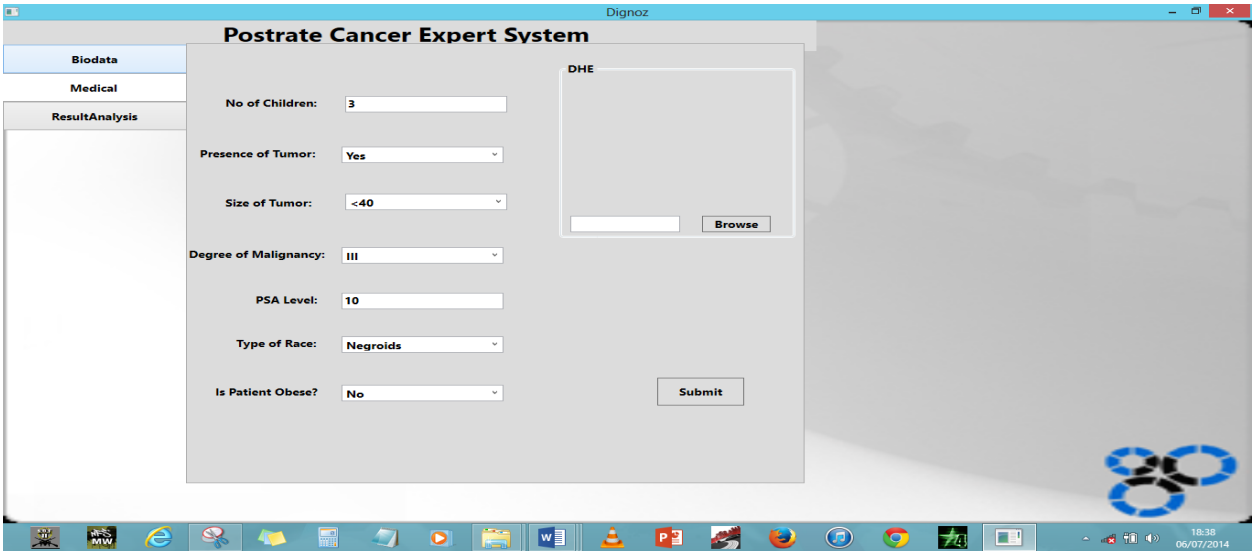

Figure 5: Patient's Medical data

Figure 5 is the patient's medical information, which is to be analyzed by the system to produce for the result to be processed.

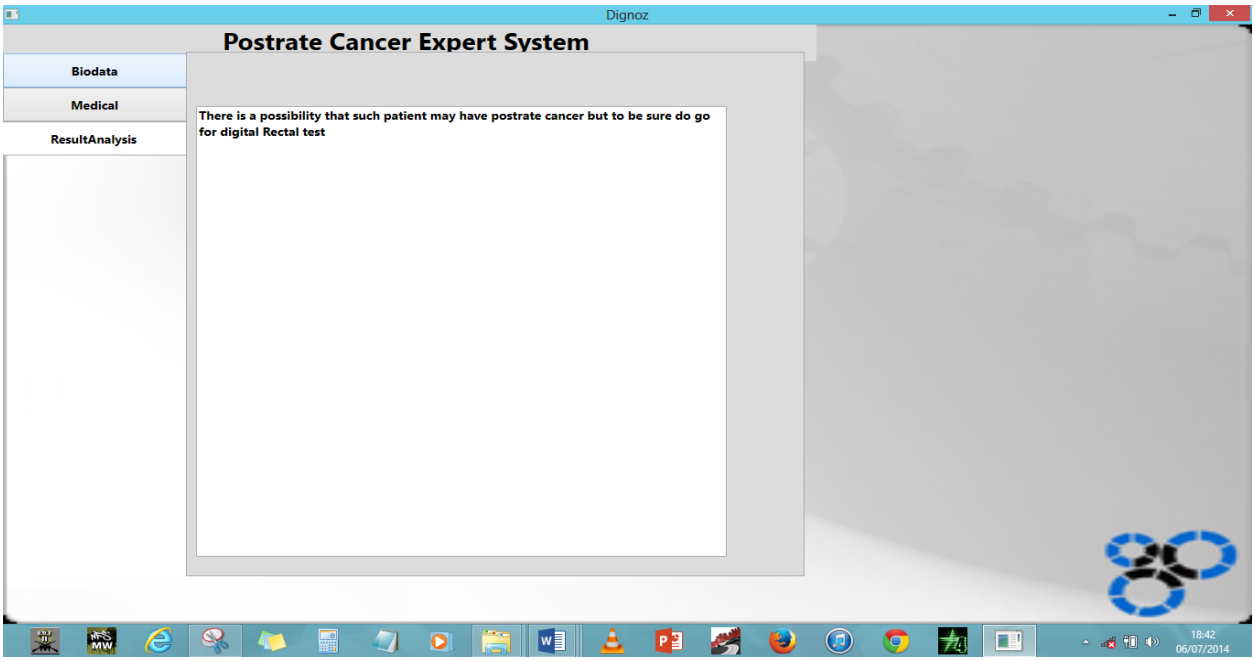

Figure 6: Result Analysis

Figure 6 shows the result analysis of the patient based on the medical information supplied by the patient on the medical page. It shows that patient may possibly have prostate cancer and should therefore carry out further tests or see medical personnel.

IV. CONCLUSION

Prostate cancer having been discovered as the second cause of cancer death in both under-developed and developed countries. Consequently, quick discovery of the disease is one of the most essential ingredients to achieve fruitful treatments. In this paper work, a desktop based medical expert system using artificial neural network for standardized prediction has been developed and implemented to forecast the traces of prostate cancer in a patient. The system alongside other medical examinations and tests would help medical practitioners predict the presence of prostate cancer.

4.1 RECOMMENDATION FOR FUTURE WORKS

This paper has been designed to help in medical sciences to forecast the possible traces of prostate cancers in a patient but the system is still dependent on some other medical examinations and tests. The system was built based on a few input and was not adopted in managing sophisticated sensory inputs. While developing an Expert System to predict prostate cancer, the developer should take care of all medical history of the patient in question to produce more accurate results and also increase the number sensory inputs.

REFERENCES

1. Jemal A, Siegel R, Xu J, Ward E. Cancer statistics, 2010. CA Cancer J Clin 2010; 60:277–300.
2. American Cancer Society. Cancer Facts & Figures 2012. American Cancer Society. 2012.
3. Dayhoff, J.E. and DeLeo, J.M.(2001). Artificial Neural Networks: Opening the black box.Cancer, 91(8 Suppl.)., 1615-1635.
4. Pinto F, Totaro A, Calarco A, et al. Imaging in prostate cancer diagnosis: present role and future
5. perspectives. Urol Int 2011; 86:373–382.
6. Engelbrecht MR, Puech P, Colin P, Akin O, Lemaitre L, Villers A. Multimodality magnetic resonance imaging of prostate cancer. J Endourol 2010; 24:677–684.
7. Mills, J.L. (1993). Data torturing. The new England Journal of Medicine,Vol 329, 116-119.
8. Panagiotaki E, Chan RW, Dikaios N, et al. Microstructural characterization of normal and malignant human prostate tissue with vascular, extracellular, and restricted diffusion for cytometry in tumours magnetic resonance imaging. Invest Radiol 2015;50:218–227.
9. Lisboa, P. J. (2002). A review of evidence of health benefit from neural networks in medical intervention. Neural Networks, 15(1), 11-39.
10. Porpiglia F, Manfredi M, Mele F, Cossu M, Bollito E, Veltri A, Cirillo S, Regge D, Faletti R, Passera R, Fiori C, De Luca S. (2017) Diagnostic Pathway with Multiparametric Magnetic Resonance Imaging Versus Standard Pathway: Results from a Randomized Prospective Study in Biopsy-naïve Patients with Suspected Prostate Cancer. Eur Urol; 72: 282-8.
11. Ueno Y, Kitajima K, Sugimura K. (2013), Ultra-high b-value diffusion-weighted MRI for the detection of prostate cancer with 3-T MRI. J Magn Reson Imaging;38:154–160.
12. Maarten de Rooij,Esther H. J. Hamoen, Jurgen J. Fütterer, Jelle O. Barentsz, Maroeska M. Rovers (2013), Accuracy of Multiparametric MRI for Prostate Cancer Detection: A Meta-Analysis, AJR:202, February 2014.

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