ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 7, July 2015

Design and Development of programming framework utilizing Biomarkers for Characterization of Rheumatic Arthritis Disease

Priyanka Premnath[1], K.B.Ramesh[2], Vidya Niranjan[3], B.P.Mallikarjunaswamy[4], E.T.Puttaiah[5]

M.Tech , Department of Biomedical Signal Processing and Instrumentation, RVCE, Bengaluru, India[1]

Associate Professor & Head, Department of E & IE, RVCE, Bengaluru, India[2]

Professor & Associate Dean, Department of BioTechnology, RVCE, Bengaluru, India[3]

Professor, Department of Computer Science and Engineering, SSIT, Tumkur, India[4]

Professor, Department of Environmental Science, Kuvempu University, Shimoga, India[5]

Abstract: Rheumatic joint inflammation (RA) is an interminable systemic immune system illness embodying irritation and lasting harm of the joints. Early treatment in RA is essential as it can avert illness movement and irreversible harm of the joints. Successful analysis and treatment of the illness is a test because of its heterogeneity. The momentum demonstrative tests are not adequately precise to describe the malady at ahead of schedule stages. Accordingly, RA is commonly analyzed just once harm to the joints has as of now started, a period at which the window for ideal treatment may have been missed. Thus, there is an in number interest for novel serological biomarkers to enhance the early determination and successful stratification of this rich illness, so that the patient is given focused on and convenient treatment. Biomarkers can redo the administration of RA by empowering the early determination, appraisal and expectation of malady seriousness, choice of treatment, and observing of reaction to treatment. Hence a software system is developed to detect Rheumatic arthritis disease at early stages using biomarkers.

Keywords: Antibodies, synovitis, biomarkers, cytokines, genes, proteins.

I. INTRODUCTION

Rheumatoid joint inflammation (RA) influences 1% of the populace over the globe. The sickness, being an incessant erosive synovitis with moderate movement into systemic illness, brings about huge weakness in personal satisfaction and decreases future. The present proof in the treatment of RA has exhibited that early and compelling mediation will lessen the occurrence of deformations, and, in a couple examples, a durable remission.[1] RA must be separated, amid right on time clinical presentation, from self-restricting viral joint pain, receptive joint inflammation, and not withstanding holding on nonerosive synovitis of systemic lupus erythematosus. Frequently, the self-constraining genuine RA should be distinguished, since it may not need long haul malady altering antirheumatic medications. Early joint pain facilities over the world have watched the accompanying realities that more than 50% of the patients who have synovitis at presentation resolve suddenly more than a time of time [2, 3] and the remaining patients with perpetual dynamic joint inflammation may add to a very much characterized disorder, for example, RA or connective tissue infection, or keep on encountering undifferentiated joint inflammation. The present test is to separate these two sorts of patients, keeping in mind the end goal to treat them fittingly. Aggravation is available in all the types of joint inflammation and, consequently, the markers of irritation get to be nonspecific to separate incendiary joint pain. Nonetheless, the trademark highlights which separate these two sorts, in prior presentation of joint pain, will significantly help with enhancing the consideration of RA with right on time mediations. This component makes early analytic biomarkers one of the effectively examined ranges in administration of RA. An indicative biomarker, by definition, ought to be a goal, quantifiable normal for organic procedures which helps in exact determination of the condition. It ought to comprise of the accompanying three attributes are diagnostic approval, capability and respective usage. The paper endeavors to examine the accessible biomarkers for analysis of early of detection of RA.

II. IDENTIFIED GENES FOR RHEUMATIC ARTHRITIS DISEASE

The tables 1 shown below details about the genes which are found responsible in genies of Rheumatic arthritis disease. The table also gives information regarding the accession number of the gene and the chromosome location they are located. The details of the gene were extracted from National Center for Biotechnology Information (NCBI).

Gene	Accession Number	Chromosome
CD19	NM_001178098.1	16
CRP	NM_000567.2	1

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 7, July 2015

CXCL13	NM_006419.2	4
CYR61	NM_001554.4	1
Ficolin	NM_173452.1	1
HLA-DRB1	NM_002124.3	6
HLA-DRB4	NM_021983.4	6
HSD11B2	NM_000196.3	16
MMP9	NM_004994.2	20
PADI4	NM_012387.2	1
PTPN22	NM_012411.4	1
STAT3	NM_003150.3	17
Vimentin (VIM)	NM_003380.3	10
MAB21L2 mab-21-like 2		4
ICAM1	NM_000201.2	19
GATA6	NM_005257.5	18
RGS16	NM_002928.3	1
MAB21L2 mab-21-like 2	NM_006439.4	4
HOXD10	NM_002148.3	2
HOXD11	NM_021192.2	2
HOXD13	NM_000523.3	2
CCL8	NM_005623.2	17
LIM homeobox 2	NM_004789.3	9

Table I: Details of RA genes

III. METHODOLOGY

The practical piece graph 3.2 beneath portrays the strides included in the usage of the venture. The Biomarker arrangement is in charge of RA is downloaded from the standard database NCBI of both typical and RA arrangements. The procedure is broken into four principle components. The first segment in the process is to outline the left and right groundworks for the distinguished biomarkers. Likewise the underlining genomics and polymorphism of the biomarkers are studies utilizing which the malady is arranged into Stage 1, Stage 2 and Stage 3. The second step includes in the handling of biomarker successions and the information DNA document of the patient. The third stage, the investigation device, is the most critical segment all the while. In this stride, the read DNA record is checked for the vicinity of these biomarkers composed. Contingent on the vicinity of biomarkers the module showcases come about as to if RA is available in the patient or not. At long last, the last step is the characterization infection into different stages relying on which all biomarkers were available in the DNA data document.

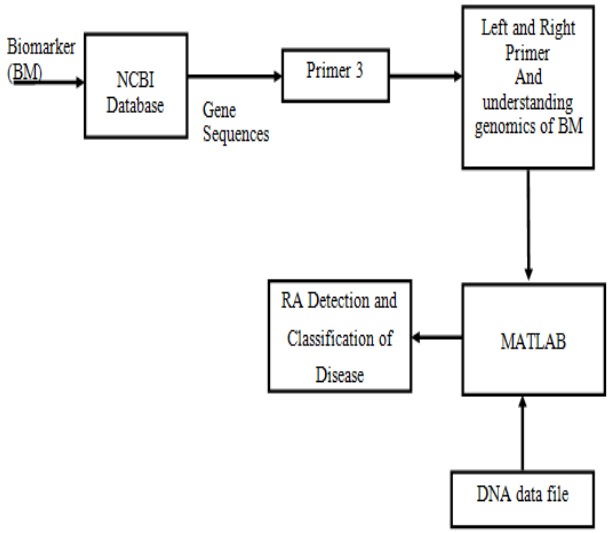

Figure 1: Block diagram of the proposed software module

IV. RESULTS

As specified over, the initial phase in building the product modules obliged an incredible measure of examination and writing review in distinguishing all the qualities in charge of RA. There are an expected thirty thousand genes in people. Among which only few qualities which are in charge of RA was recognized from Literature study and advices from master specialists. The quality information for these qualities was then gathered from NCBI database. The following are the screenshots demonstrating NCBI window from where one among the RA qualities was extricated.

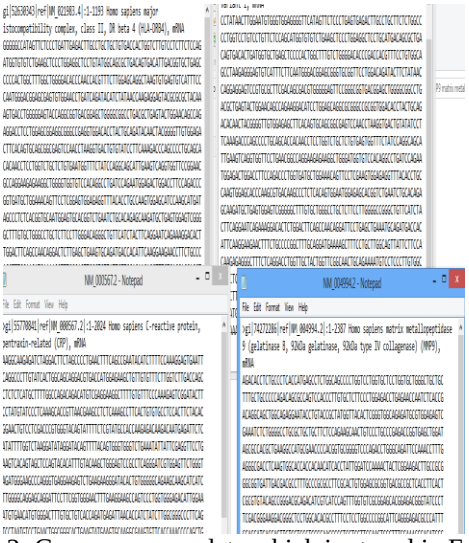

Figure 2: Gene sequence data which is stored in FASTA format.

Figure 1 shows the various genes that were downloaded from NCBI database and stored in FASTA format. The next step included the design of primers for these genes. This is shown in figure 2.

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 7, July 2015

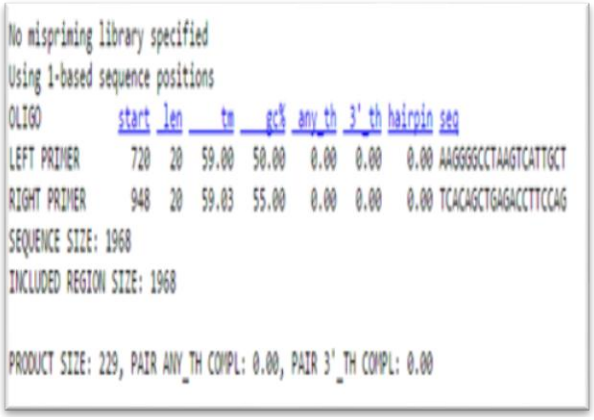

Figure 3 : Primer were designed for genes

After primers were designed a software module was developed inculcating the concepts of bioinformatics tools and techniques in MATLAB. Figure 3 shows the partial GUI designed which is reading the gene file of the subject.

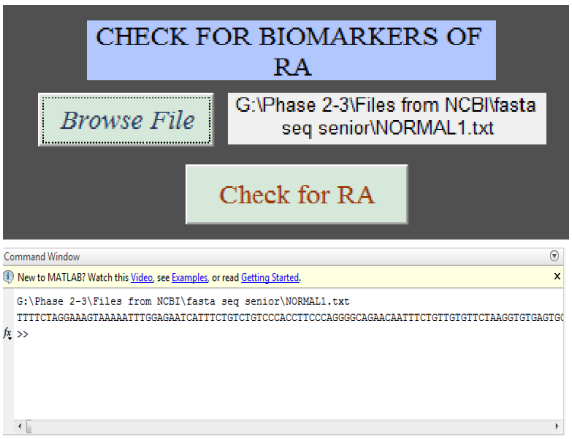

Figure 4 : Reading the Gene file in the designed software module.

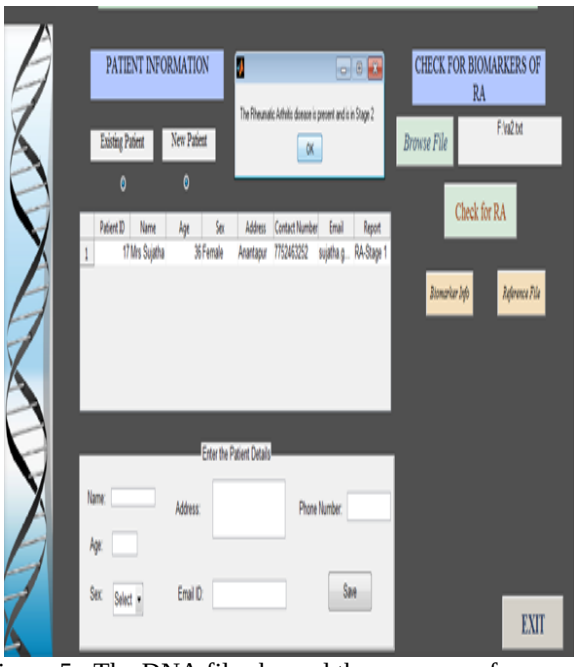

Figure 5 : The DNA file showed the presence of gene of RA

The composed GUI indicated in figure 4 has choice of putting away the patient points of interest into the database designed. Additionally showing the already put away patient points of interest is likewise given. The product module peruses the patient DNA record and checks for the vicinity of the RA qualities. In the event that they are available it shows that RA was distinguished. On the off chance that the quality points of interest are not present in the information record, it shows that RA is not identified.

V. CONCLUSION

The heterogeneity of RA makes it unrealistic to have a solitary, interesting biomarker to analyze or anticipate the advancement of sickness. Biomarkers in that capacity ought to be particular to RA, ought to anticipate the movement of illness, and spread an extensive variety of RA patients. Just a blend of elements seems to satisfy these necessities. A percentage of the potential biomarker mixes include: discovery in the change in immunological parameters like cell energy alongside the arrangement of autoantibodies, particular cytokine changes and different markers of infection powerlessness. Multicenter studies investigating these variables ought to help enhance their quality as biomarkers of right on time RA.

REFERENCES

[1] S.Chandrashekara, “Current studies of biomarkers for the early diagnosis of rheumatoid arthritis”, DovePress Journal , Current Biomarker Findings, :4 107–119 Sept 2014
[2] Agata Burska, Marjorie Boissinot, and Frederique Ponchel, “Cytokines as Biomarkers in Rheumatoid Arthritis” Mediators of Inflammation , Article ID 545493 Volume 2014 2014
[3] Leendert A. Trouw , Michael Mahler, “Closing the serological gap: promising novel biomarkers for the early diagnosis of rheumatoid arthritis” , 2012 Elsevier B.V. 318–322- Autoimmunity Reviews 12 2012
[4] Cathy M McGeough and Anthony J Bjourson ,“Diagnostic, Prognostic and Theranostic Genetic Biomarkers for Rheumatoid Arthritis”, , J Clin Cell Immunol S6:002. doi:10.4172/2155-9899.S6-002 , Clinical & Cellular Immunology 2012
[5] Tamsin M. Lindstrom and William H. Robinson, “Biomarkers for rheumatoid arthritis: Making it personal”, Scand J Clin Lab Invest Suppl. ; 242: 79–84. doi: 10.3109/00365513.2010.493406Jul 2014
[6] Sajid A.Marhon, Stefan C.Kremer “Gene prediction based on DNA spectral analysis: A literature survey,” Journal of computational biology, vol. 18, no. 4, 2011.
[7] Peter Taylor, Juliane Gartemann, Jeanie Hsieh, and James Creeden ,“A Systematic Review of Serum Biomarkers Anti-Cyclic Citrullinated Peptide and Rheumatoid Factor as Tests for Rheumatoid Arthritis”, Autoimmune Diseases (2011), Article ID 815038 , Volume 2011
[8] Morten A Karsdal, Thasia Woodworth, Kim Henriksen, Walter P Maksymowych, Harry Genant, Philippe Vergnaud,Claus Christiansen, Tanja Schubert, Per Qvist, Georg Schett, Adam Platt and Anne-Christine Bay-Jensen “Biochemical markers of ongoing joint damage in rheumatoid arthritis - current and future applications, limitations and opportunities”,, BioMed Central Ltd Arthritis Research & Therapy 2011
[9] Anna Gramling, Anna Gramling “Initial Management of Rheumatoid Arthritis”, Elsevier Inc, Rheum Dis Clin N Am 311–325, 38 (2012)
[10] Eric Ruderman, Siddharth Tambar,” Rheumatoid arthritis”,© American College of Rheumatology-2012
[11] BCGuidelines.ca: “Rheumatoid Arthritis: Diagnosis, Management and Monitoring”-2012
[12] Rohini Handa ,“New Classification Criteria for Rheumatoid Arthritis and Ankylosing Spondylitis”, Vol. 22, Medicine Update 2012

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 7, July 2015

[13] Christina H. Opava, Ralph Nisell, "Rheumatoid arthritis" physical activity in the prevention and treatment of disease,Vol 2012
[14] Min Wu, Fan-Fang Zeng, Run Wang, Wai-Key Seto, Pearl Pai, Patrick Chu and Kai-Hang Yiu2 "Atherosclerosis in Patients with Rheumatoid Arthritis", S5, ISSN: 2161-1149 Rheumatology, Rheumatol Curr Res 2013
[15] Gary S. Firestein "Etiology and Pathogenesis of Rheumatoid Arthritis", Firestein, Rheumatol Curr Res 2013
[16] Katia Chanin, Federico Vallejo-Manzur, George L. Sternbach, Robert Fromm, Joseph Varon, "Pulmonary Manifestations of Rheumatoid Arthritis C h a n i n e t a l Hospital Physician , : p p . 2 3 – 2 8, July 2001
[17] Pnina Fishman and Sara Bar-Yehuda "Rheumatoid Arthritis: History, Molecular Mechanisms and Therapeutic Applications", DOI 10.1007/978-90-481-3144-0_15, c Springer Science+Business Media B.V. 2010
[18] K.B Ramesh, S.J Shibani Prasad, Dr. B.P. Mallikarjunaswamy,Dr. E.T.Puttaiah, "Prediction and Detection of Rheumatoid Arthritis SNPs Using Neural Networks", IOSR Journal of Pharmacy and Biological Sciences , e-ISSN: 2278-3008, p-ISSN:2319-7676. Volume 9, Issue 1 Ver. V , Feb. 2014
[19] Vanja Pauni´c, Michael Steinbach, Vipin Kumar ,"Prediction of HLA Genes from SNP Data and HLA Haplotype Frequencies" 978-0-7695-4925-5© IEEE ,2012
[20] J.A. Mendonça, M.A. Yazbek, I.M.M. Laurindo and M.B. Bertolo," Wrist ultrasound analysis of patients with early rheumatoid arthritis", Braz J Med Biol Res, Volume 44(1) 11-15, January 2011
[21] James Connolly, Joan Condell, Kevin Curran ,"A new method to determine joint range of movement and stiffness in Rheumatoid Arthritic Patients", 978-1-4577-1787-1© IEEE -2012
[22] Anand A. Joshi , Richard M. Leahy, Ramsey D. Badawi, Abhijit J. Chaudhari "Morphometry For Early Monitoring Of Treatment Response In Rheumatoid Arthritis", 978-1-4673-6455-3/13 © IEEE -2013
[23] Yinghe Huo, Koen L. Vincken , Max A. Viergever , Floris P. Lafeber "Automatic Joint Detection In Rheumatoid Arthritis Hand Radiographs", 978-1-4673-6455-3/13/ © IEEE - 2013
[24] Andreas Koch, Stephanie Finzel, Andreas Kobler, Georg Schett, Reinhard Lerch and Helmut Ermert "In-vivo results for rheumatoid arthritis diagnosis with a 360_ pulse-echo imaging system" 978-1-4673-4562-0/12 © IEEE -2012
[25] Georg Langs , Philipp Peloschek , Horst Bischof, Franz Kainberger "Automatic Quantification of Joint Space Narrowing and Erosions in Rheumatoid Arthritis", IEEE Transactions On Medical Imaging, Vol. 28, No. 1, January 2009
[26] V. Goe¨b, P. Dieude´, R. Daveau, M. Thomas-L'Otellier, F. Jouen, F. Hau, P. Boumier, F. Tron,D. Gilbert, P. Fardellone, F. Corne´lis, X. Le Loe¨t and O. Vittecoq "Contribution of PTPN22 1858T, TNFRII 196R and HLA-shared epitope alleles with rheumatoid factor and anti-citrullinated protein antibodies to very early rheumatoid arthritis diagnosis"_Rheumatology 2008;
[27] http://www.arthritis.org/research/funded-research/research-update/journal-summaries/genetics-ra
[28] http://www.bio.davidson.edu/Courses/Immunology/Students/Spring 2003/Super/rheumatoidarthritis.htm
[29] http://www.redorbit.com/news/science/1112650026/epigenetics-changes-genes-in-rheumatoid-arthritis
[30] http://www.geneprediction.org/software.html
[31] Charpin C, Arnoux F, Martin M, Toussirot E, Lambert N, Balandraud N, Wendling D, Diot E, Roudier J, Auger I. New autoantibodies in early rheumatoid arthritis. Arthritis Res Ther [Internet]. Jul 2013
[32] De Winter L, Hansen W, Geusens P, Vanhoof J, Lenaerts J, Langenaken C, Stinissen P, Somers V. New autoantibodies as biomarkers for early and seronegative rheumatoid arthritis. Ann Rheum Dis ;72(Suppl3):114, 2013.
[33] Siebuhr AS, Bay-Jensen AC, Leeming DJ, Platt A, Byrjalsen I, Christiansen C, van der Heijde D, Karsdal M. Serological identification of fast progressors of structural damage with rheumatoid arthritis. Arthritis Res ,Oct 2013
[34] 4 INOVA Diagnostics. Press Release. Important development in diagnosis of Rheumatoid Arthritis: Leiden University Medical Center licenses novel diagnostic for rheumatoid arthritis to INOVA Diagnostics. Jan 2013
[35] Dong jin-rui , He ming-hao, Han mo, Gao ya-nan, Sun Yu-chong "Development of TNF-a inhibitor drugs in treatment of Rheumatoid Arthritis" IEEE 2012
[36] Seyed Javad Sajjadi, Xiaoning Qian, Bo Zeng, Amin Ahmadi Adl "Network-Based Methods to Identify Highly Discriminating Subsets of Biomarkers" EEE/ACM Transactions On Computational Biology And Bioinformatics, Vol. 11, No. 6, November/December 2014
[37] V. Goe¨b et al "Contribution of PTPN22 1858T, TNFRII 196R and HLA-shared epitope alleles with rheumatoid factor and anti-citrullinated protein antibodies to very early rheumatoid arthritis diagnosis" Advance Access publication 5 June 2008
[38] I Vallbracht, J Rieber, M Oppermann, F Fo¨rger, U Siebert, K Helmke "Diagnostic and clinical value of anti-cyclic citrullinated peptide antibodies compared with rheumatoid factor isotypes in rheumatoid arthritis" Ann Rheum Dis, 63:1079–1084, 2004
[39] Kyle Strimbu , Jorge A. Tavel "What are Biomarkers" NIHMSID: NIHMS259967-1/1/2015
[40] Jeffrey L. Browning "B cells move to centre stage: novel opportunities for autoimmune disease treatment" Nature Reviews Drug Discovery 5, 564576, July 2006
[41] Elizabeth W. Karlson1 et al "Biomarkers of inflammation and development of rheumatoid arthritis in women from two prospective cohort studies" Rheumatoid Arthritis Clinical Studies 26 FEB 2009.
[42] Jonas Jarvius and Ulf Landegren " DNA Skyline: fonts to facilitate visual inspection of nucleic acid sequences" BioTechniques 40:740 , June 2006