References

[1] Perera, I. (2009). Implementing Healthcare Information in Rural Communities in Sri Lanka: a novel approach with mobile communication [Electronic Version]. Journal of Health Informatics Developing Countires, 3(2), pp 24-29, from http://www.jhidc.org/index.php/jhidc/article/download/33/65

[2] Prof. S. B. Choudhari, Chaitanya Kusurkar, Rucha Sonje, Parag Mahajan, Joanna Vaz (2014) "Android Application for Doctor's Appointment", International Journal of Innovative Research in Computer and Communication Engineering, 2(1), pp 2472-2474

[3] R. Jaya Subalakshmi, Haleema, N. C. S. N. Iyengar (2013), "Enhancing a Traditional Health Care System of an Organization for Better Service with Agent Technology by Ensuring Confidentiality of Patients' Medical Information", [Type of medium: online], 13(3), pp 140-156, Available: http://www.cit.iit.bas.bg/CIT_2013/v13-3/11-5Jaya-CIT3-2013-Gotovo-m.pdf

[4] Yeo Symey, Suresh Sankaranarayanan, Siti Nurafifah binti Sait (2013), "Application of Smart Technologies for Mobile Patient Appointment System", [Type of medium: online] International Journal of Advanced Trends in Computer Science and Engineering, 2(4), pp 74-85, Available: https://www.academia.edu/4431964/Application_of_Smart_Technologies_for_Mobile_Patient_Appointment_System

[5] D. Isern, D. Sanchez, A.Moreno, A.Valls (2013), "HeCaSe: An Agent-Based System to Provide Personalised Medical Services", [Type of medium: online], Available: http://www.researchgate.net/publication/242283680_HeCaSe_An_Agent-Based_System_to_Provide_Personalised_Medical_Services

[6] Arthur Hylton III, Suresh Sankaranarayanan (2012), "Application of Intelligent Agents in Hospital Appointment Scheduling System", [Type of medium: online], International Journal of Computer Theory and Engineering, 4(4), pp 625-630, Available: http://www.ijcte.org/papers/545-A102.pdf

[7] Tyrone Edwards, Suresh Sankaranarayanan (2011), "Applications of Intelligent Agents in Hospital Search and Appointment System", [Type of medium: online], International Journal of E-Services and Mobile Applications, 3(4), pp 302-321, Available: http://www.igi-global.com/article/applications-intelligent-agents-hospital-search/59967

[8] Jaya Subalakshmi, N. Ch. S. N. Iyengar, Sougata Khatua, Haleema "Agent Based Secured Online Hotel Booking System", [Type of medium: online] International Journal of Computer Science Issues, 10(1), Issue 2, March 2013, pp. 59-68, Available: http://www.ijcsi.org/papers/IJCSI-10-2-1-59-68.pdf

[9] Wayne Lawrence, Suresh Sankaranarayanan (2012) "Smart Agent Learning based Hotel Search System - Android Environment", [Type of medium: online], pp. 09-21, Available: http://www.ijcsi.org/papers/IJCSI-10-2-1-59-68.pdf

[10] Glaschenko, A., Ivaschenko, A., Rzevski, G., Skobelev, P. "Multi-Agent Real Time Scheduling System for Taxi Companies", [Type of medium: online] in proceedings of eighth international. conference on Autonomous Agents and Multiagent Systems (AAMAS 2009), Decker, Sichman, Sierra, and Castelfranchi (eds.), May, 10–15, 2009, Budapest, Hungary, pp. 29-36, Available: http://www.ifaamas.org/Proceedings/aamas09/pdf/03_Industrial_Track/13_70_it.pdf

[11] Floyd Garvey, Suresh Sankaranarayanan "Intelligent Agent based Flight Search and Booking System", [Type of medium: online] in International Journal of Advanced Research in Artificial Intelligence, 1(4), 2012 pp. 12-28, Available: http://thesai.org/Downloads/IJARAI/Volume1No4/Paper_3-Intelligent_Agent_based_Flight_Search_and_Booking_System.pdf

[12] Filippo Menczer, W. Nick Street, Narayan Vishwakarma, Alvaro E. Monge, Markus Jakobsson "IntelliShopper: A Proactive, Personal, Private Shopping Assistant", [Type of medium: online], Available: www.informatics.indiana.edu/fil/papers/intellishopper.pdf

[13] Claudia V. Goldman, Amir Langer, Jeffry S. Rosenschein (1996) "Musag: an agent that learns what you mean", [Type of medium: online], Available: ftp://132.65.116.17/users/jeff/paam96musag.ps.gz

[14] Praveen Paruchuri, Alok Reddy Pullalarevu, Kamalakar Karlapalem "Multi Agent Simulation of Unorganized Traffic" in Proceedings of the First International Joint Conference on Autonomous Agents and Multiagent System, Part 1, pp. 176-183

[15] Rzevski G. "Artificial Intelligence in Engineering: Past, Present and Future", [Type of medium: online], in Artificial Intelligence in Engineering Conference, Udine, Italy, July 1995, Available: http://www.researchgate.net/publication/254927396_Artificial_Intelligence_in_Engineering_Past_Present_and_Future

[16] Hyacinth S. Nwana and Divine T. Ndumu (1999) "A Perspective on Software Agents Research", [Type of medium: online], Available: http://www.csee.umbc.edu/csee/research/aw/introduction/hn-dn-ker99.pdf

[17] Edmund H. Durfee, Jerey S. Rosenschein (1994) "Distributed Problem Solving and Multi-Agent Systems: Comparisons and Examples", [Type of medium: online], Available: http://www.agent.ai/doc/upload/200405/durf94_2.pdf

[18] Bill Anckar, Svante Olofsson, Pirkko Walden "Overcoming Online Booking Barriers With a software agent approach", [Type of medium: online] in ninth European Conference on Information Systems, Bled, Slovenia, June, 2001, pp. 385-396, Available: http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1005&context=ecis2001

[19] Gerhard Weiss (1993) "Learning to Coordinate Actions in Multi-Agent Systems", [Type of medium: online] in Proceedings of the 13th International Joint Conference on Artificial Intelligence, 1, pp. 311-316, Available: http://pdf.aminer.org/000/391/092/learning_to_coordinate_actions_in_multi_agent_systems.pdf

[20]   David C. Parkes and Lyle H. Ungar "Learning and Adaption in Multi Agent Systems", [Type of medium: online], Available: http://www.eecs.harvard.edu/econcs/pubs/learning.pdf

[21]   P. Mariano, A. Pereira, L. Correia, R. Reberio, V. Abramov, N. Szirbik, J. Goossenaerts, T. Marwala, P. De Wilde "Simulation of a trading multi agent system", [Type of medium: online] in IEEE International Conference, Tucson, AZ, 2001, pp. 3378-3384, Available: http://www.macs.hw.ac.uk/~pdw/b1/mariano%26eeii.pdf

[22]   Paolo Busetta, Mattia Merzi "An approach to the integration of peer-to-peer systems with active environments", [Type of medium: online], Available: http://www.diee.unica.it/woa03/papers/03.pdf

[23]   Tim Finin, Richard Fritzson, Don McKay and Robin McEntire "KQML as an Agent Communication Language", [Type of medium: online] in Proceedings of the third International Conference on Information and Knowledge Management, 1994, pp. 456-463, Available: http://www.upv.es/sma/teoria/sma/kqml_kif/kqmlacl.pdf

[24]   Moamin Ahmed, Mohd Sharifuddin Ahmad, Mohd Zaliman Mohd Yusoff "A Review and Development of Agent Communication Language", [Type of medium: online] Electronic Journal of Computer Science & Information Technology, 1(1), May 2009, pp. 07-12, Available: http://ejcsit.uniten.edu.my/index.php/ejcsit/article/download/3/5

[25]   Keith Decker, Katia Sycara, Mike Williamson (1996) "Modeling Information Agents: Advertisements, Organizational Roles, and Dynamic Behavior", [Type of medium: online], Available: www.cs.cmu.edu/~softagents/papers/amodeling.ps.gz

[26]   Rzevski G., (2008), "A new direction of research into Artificial Intelligence", [Type of medium: online], Available: http://www.rzevski.net/08%20New%20Directions%20in%20Searching%20for%20Artificial%20Intelligence.pdf

Appendix A:

JADE

Java Agent Development Framework (JADE) is a software framework which developed by using JAVA language. It simplifies the development of multi agent system. JADE complies with FIPA standard and it helps to debug our agents when developing the project. Systems that are developed with JADE can be distributed regardless of the underlying operating system. JADE provides a remote GUI to configure and control the systems developed with the help of JADE. JADE configurations can be changed while running the system. This may include transferring an agent from one machine to another machine without stopping the live system. Since JADE is developed purely in JAVA language, it only requires JAVA version 5 or above.

Simple but powerful task execution background and composition model are provided by JADE. Also it supports peer-to-peer message passing based on asynchronous message passing paradigm. Furthermore JADE also supports yellow pages service and with the help of yellow pages service agents can publish their services and discover other agents.

JADE-LEAP is the mobile version of JADE. It is able to support various mobile phones such as J2ME devices and Android devices.

JADE is developed in Telecom Italia. Therefore Telecom Italia is the copyright holder of JADE. But it's licensed under LGPL license.

Pseudo Code

Module: AppointmentManagerAgent

Method: updateAppointments

```
Document doc;
Connection con;
If data.size is equal to 0
        Return
EndIf
Call method pb.removeSubBehaviour with rb
Try
        For (String key : data.keySet())
                Set con to Util
                Call method con.data with "LastName", ""
                Call method con.data with "Hospital", key
                Call method con.data with "Specialty", "*"
                Call method con.data with "date1", "Any"
                Call method con.data with "vcode", "ABC"
                Call method con.data with "tvcode", "ABC"
                Call method con.data with "day", "*"
                Set doc to con.post
                Initialise infoDataTrs to doc.select with "table tbody tr"
                For (Element infoTr : infoDataTrs)
                        If infoTr.className
                                Initialise tds to infoTr.select with "td"
                                If tds.size is equal to 4
                                        Create new DoctorInfo
                                        For j is 0, j is less than 4, j increments by 1
                                                Initialise inputs to tds.get with j
                                                If inputs.size is greater than 0
                                                        For k is 0, k is less than inputs.size, k
increments y 1

                                                                Initialise hiddenElement to inputs
                                                                If hiddenElement.attr with
"name"

                                                                        Call method
di.setDoctorNo with hiddenElement

                                                                Else if hiddenElement
                                                                        Call method
di.setDoctorName ith hiddenElement

                                                                Else if hiddenElement
                                                                        Call method
di.setHospitalId with hiddenElement

                                                                Else if hiddenElement
                                                                        Call method
i.setHospitalName with hiddenElement
```

67

Else if hiddenElement
                                                                Call method

di.settEspciality ith hiddenElement

                                                        Else if hiddenElement
                                                                Call method

i.setHospitalLocation with hiddenElement

                                                        Else if hiddenElement
                                                                Call method di.setJsp

with hiddenElement.attr

                                                        EndIf
                                                EndFor
                                        EndIf
                                EndFor
                                If not lstDi.contains with di
                                        Call method lstDi.add with di
                                EndIf
                                Set di to null
                        Else
                                continue;
                        EndIf
                Else
                        continue;
                EndIf
            EndFor
        EndFor
        Call method System.out.println with lstDi.size
        Call method System.out.println with "Circle Complete"
                Create new ObjectOutputStream
                Call method oo.writeObject with lstDi
                Call method oo.close
        Catch Exception ex
                Call method ex.printStackTrace
                Call method takeDown
        EndTry
Catch SocketTimeoutException sckte
        Call method System.err.println with "Socket Timeout... Restart Refreshing"
        Call method pb.addSubBehaviour with rb
Catch Exception ex
        Call method ex.printStackTrace
EndTry

Method: getAllDoctors

Document doc;
Connection con;
If data.size is equal to 0
        Return
EndIf

Call method pb.removeSubBehaviour with rb
Try
        For (String key : data.keySet())
                Set con to Util
                Call method con.data with "LastName", ""
                Call method con.data with "Hospital", key
                Call method con.data with "Specialty", "*"
                Call method con.data with "date1", "Any"
                Call method con.data with "vcode", "ABC"
                Call method con.data with "tvcode", "ABC"
                Call method con.data with "day", "*"
                Set doc to con.post
                Initialise infoDataTrs to doc.select with "table tbody tr"
                For (Element infoTr : infoDataTrs)
                    If infoTr.className
                        Initialise tds to infoTr.select with "td"
                        If tds.size is equal to 4
                            Create new DoctorInfo
                            For j is 0, j is less than 4, j increments by 1
                                Initialise inputs to tds.get with j
                                If inputs.size is greater than 0
                                    For k is 0, k is less than inputs.size, k
increments y 1
                        Initialise hiddenElement to inputs
                        If hiddenElement.attr with
"name"
                        Call method
di.setDoctorNo with hiddenElement

                        Else if hiddenElement
                        Call method
di.setDoctorName ith hiddenElement

                        Else if hiddenElement
                        Call method
di.setHospitalId with hiddenElement

                        Else if hiddenElement
                        Call method
i.setHospitalName with hiddenElement

                        Else if hiddenElement
                        Call method
di.settEspciality with hiddenElement

                        Else if hiddenElement
                        Call method
di.setHospitalLocation with hiddenElement

                        Else if hiddenElement
                        Call method di.setJsp
with hiddenElement.attr

                        EndIf
                      EndFor
                  EndIf
                EndFor

```
                              If not lstDi.contains with di
                                   Call method lstDi.add with di
                              EndIf
                              Set di to null
                    Else
                         continue;
                    EndIf
              Else
                    continue;
              EndIf
         EndFor
    EndFor
    Call method System.out.println with lstDi.size
    Call method System.out.println with "Circle Complete"
         Create new ObjectOutputStream
         Call method oo.writeObject with lstDi
         Call method oo.close
    Catch Exception ex
         Call method ex.printStackTrace
         Call method takeDown
    EndTry
Catch SocketTimeoutException sckte
    Call method System.err.println with "Socket Timeout... Restart Refreshing"
    Call method pb.addSubBehaviour with rb
Catch Exception ex
    Call method ex.printStackTrace
EndTry
```

Method: getDoctorsByPartialName

Create new ArrayList
For (DoctorInfo di : lstDi)
        If not drs.contains with di.getDoctorName
                If calcCosSim with name.toLowerCase, di.getDoctorName is greater than 0.4
                        Call method drs.add with di.getDoctorName
                EndIf
        Else
                continue;
        EndIf
EndFor
Return drs

Method: getHospitalsThatDoctorComes

Create new LinkedHashMap
For (DoctorInfo di : lstDi)
        If di.getDoctorName
                Call method System.out.println with di.getDoctorName
        EndIf
        If di.getDoctorName
                If not hospitalsDrComes.containsKey with di.getHospitalId
                        Call method hospitalsDrComes.put with di.getHospitalId
                Else
                        continue;
                EndIf
        Else
                continue;
        EndIf
EndFor
Return hospitalsDrComes

Method: calcCosSim


```
Final ArrayList<String> str1Tokens = new ArrayList<String>(
Final ArrayList<String> str2Tokens = new ArrayList<String>(
Final Set<String> allTokens = new HashSet<String>();
Call method allTokens.addAll with str1Tokens
Final int termsInString1 = allTokens.size();
Final Set<String> secondStringTokens = new HashSet<String>();
Call method secondStringTokens.addAll with str2Tokens
Final int termsInString2 = secondStringTokens.size();
Call method allTokens.addAll with secondStringTokens
Final int commonTerms = (termsInString1 + termsInString2)
( commonTerms )
```

Module: BestDocterSelectionAgent

Method: getTotalScore

Return noOfAppointments + (noOfFullDays * fullDayScale)

Method: addNoOfAppointments

Initialise div to Math.round with nofa divided by 10 multiplied by 10
Initialise rem to nofa modulus div
Initialise full to div plus (rem)
Set noOfAppointments to noOfAppointments plus nofa
If nofa is greater than fullDayScale
        Set fullDayScale to full
EndIf

Method: DoctorSelectionBehaviour.action

System.out
Call method startRefresh
Try
        oo = new ObjectOutputStream(new FileOutputStream(ontoFile));
        For (String bestDoctor : bestDoctors)
                Call method fw.write with bestDoctor plus "\r\n"
        EndFor
        Call method fw.close
        Call method addBehaviour
Catch Exception ex
        Call method ex.printStackTrace
EndTry
Call method System.out.println with "Best docters updated"

Method: startRefresh

Initialise con to Util.getConnection with Util.BASE_URL
Document mainDoc;
Initialise alpha to 0
Thread[] threads;
Try
       Set cookies to Util.getCookies
       Call method con.execute
       Set mainDoc to con.response
       Initialise espSelect to mainDoc.select with "select[id=speciLit]"
       Initialise options to espSelect.select with "option"
       Create new CategoryData
       For (Element option : options)
              Initialise key to option.attr with "value"
              Initialise spName to option.text
              If key.equals with "*"
                     continue;
              EndIf
              Set alpha of catData to new CategoryData with spName, key
       EndFor
       Create new Thread
       For bravo is 0, bravo is less than THREADS, bravo increments by 1
              Create new Thread
              Call method th.setName with "Category Worker - " plus bravo
              Call method th.start
              Set bravo of threads to th
       EndFor
       Call method System.out.println with "Waiting for threads to complete"
       For charlie is 0, charlie is less than threads.length, charlie increments by 1
              Set charlie of threads to
       EndFor
       Call method System.out.println with "Threads completed"
Catch Exception ex
       Call method ex.printStackTrace
EndTry

Method: getChanneledPaitents

Initialise con to Util.getConnection with Util.BASE_URL, cookies
Elements dataElements;
Document doc;
Call method con.data with (Map)
Set doc to con.post
Set dataElements to doc
For i is 0, i is less than dataElements.size, i increments by 1
  If dataElements.get with i
    Try
      Return result of Integer.parseInt with dataElements.get i plus 2
    EndTry
  Catch NumberFormatException nfex
    Return 0
  EndIf
EndFor
Return 0

Method: bestDoctor

Initialise tmp to 0
String retVal[] = new String[2];
Set 0 of retVal to scores.keySet
For (String key : scores.keySet()
  Initialise tmp1
  If tmp1 is greater than tmp
    Set tmp to tmp1
    Set 0 of retVal to key
  EndIf
EndFor
Set 1 of retVal to String.valueOf with tmp
Return retVal

Module: DataAgent

Method: onTick

```
Document doc;
Connection con;
Elements emnts;
String elementName;
Try
        Set con to Jsoup.connect with
"http://www.echannelling.com/EChannel/channel_doctor.jsp"
        Call method con.timeout with 60000
        Set doc to con.get
        Set emnts to doc.select with "select"
        For (Element e : emnts)
                Set elementName
                If elementName.equalsIgnoreCase with getAgent
                        For (Element e1 : e.select("option"))
                                If not e1.text
                                        Call method lookup.put with e1.val, e1.text
                                EndIf
                        EndFor
                EndIf
        EndFor
Catch Exception ex
        Call method System.err.println with "======= Agent " plus getAgent
        Call method ex.printStackTrace
        Call method System.err.println with
"==========================================================="
EndTry
```

Module: DiseaseAgent

Method: action

Initialise received to receive
Initialise reply to null
Query q;
If null is not equal to received
       Call method Util.printACL with received
       Create new Query
       Try
              Set reply to received.createReply
              Call method reply.setPerformative with ACLMessage.CONFIRM
              If q.hasSolution
                     If received.getPerformative is equal to ACLMessage.REQUEST
                           If received.getContent
                                Create new Query
                                Create new ArrayList
                                If q.hasSolution
                                      For (Hashtable<Variable, Atom> ht : q
                                          .allSolutions()) {
                                  EndFor
                                  Call method reply.setContentObject with (
Serializable)
                                Else

                                Call method EChannelingException with "no diseases
found"
                                EndIf
                      Else if received.getContent
                            Initialise disease to received.getContent
                            Create new Query
                            Create new ArrayList
                            If not q.hasSolution
                                Throw new EChannelingException("no result
found");
                            EndIf
                            For (Hashtable<Variable, Atom> ht : q
                                .allSolutions()) {
                            EndFor
                            Call method reply.setContentObject with (Serializable)
                      Else if received.getContent
                            Initialise firstLetters to received.getContent
                            Create new Query
                            Create new ArrayList
                            If q.hasSolution
                                For (Hashtable<Variable, Atom> ht : q
                                  .allSolutions()) {
                                EndFor
                                Call method reply.setContentObject with (
Serializable)
                            Else

```
                                        Throw new EChannelingException("no results
found");
                                EndIf
                        EndIf
                Else
                        Throw new EChannelingException("unknown request");
                EndIf
        EndIf
Catch Exception ex
        Call method reply.setPerformative with ACLMessage.FAILURE
        If ex instanceof
                Call method reply.setContent with ex.getMessage
        EndIf
        Call method ex.printStackTrace
Finally
        Call method send with reply
EndTry
Else
        Call method block
EndIf
```

Module: HospitalCheckingAgent

Method: action

Set resMsg to receive
If null is equal to resMsg
        Call method block
Else
        Call method Util.printACL with resMsg
        Create new ACLMessage
        Try
                Switch on commID
                Case 0
                        For (ACLMessage msg : channelRequests)
                                If msg.getContent
                                        Call method addBehaviour
                                        Return
                                EndIf
                        EndFor
                        Call method channelRequests.add with resMsg
                        If resMsg.getContent
                                Set drName to resMsg.getContent
                                Set lng to Double.valueOf with resMsg.getContent
                                Set lat to Double.valueOf with resMsg.getContent
                        Else
                                Set drName to resMsg.getContent
                        EndIf
                        Call method sendMsg.addReceiver
                        Call method sendMsg.setContent with "hospital list for doctor " plus
drName
                        Set commID to 1
                        Set originalMessage to resMsg
                        Call method send with sendMsg
                        End of Case
                Case 1
                        Initialise hsData to resMsg as Map
                        Call method System.out.println with "FFFF " plus hsData
                        If hsData.size is equal to 0
                                Set replyMsg to originalMessage.createReply
                                Call method replyMsg.setPerformative with
ACLMessage.FAILURE
                                Call method replyMsg.setContentObject
                                Call method send with replyMsg
                                Set commID to 2
                        Else
                                Create new ACLMessage
                                Create new DataMessage
                                Call method msgToSortRequest.addReceiver
                                Call method msgToSortRequest.setContentObject with dm
                                Call method send with msgToSortRequest
                                Set commID to 4
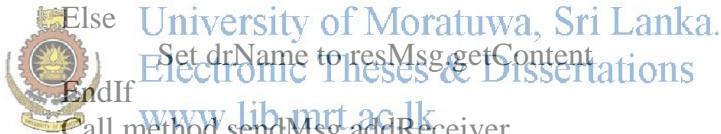
79

EndIf

End of Case

Case 4

Create new ACLMessage

Set hospitals to resMsg as LinkedHashMap

If lng is greater than 0 and lat is greater than 0

    If hospitals.size is greater than 3

        While hospitals.size is not equal to 3

            Hospitals

        EndWhile

    EndIf

EndIf

Call method msgToAppointmentAgent.addReceiver

MsgToAppointmentAgent

Call method send with msgToAppointmentAgent

Set commID to 5

End of Case

Case 5

List<DoctorInfo> lstDi;

Initialise chnlInfo to null

Initialise replyToOriginal to originalMessage

If resMsg.getPerformative is equal to ACLMessage.FAILURE

Else

    Set lstDi to resMsg as List

    Final List<ChannelingInfo> x = Collections,synchronizedList(new ArrayList<ChannelingInfo>());

    Create new ArrayList

    Initialise threadCount to 0

    For (DoctorInfo di : lstDi)

        If hospitals.containsKey with di.getHospitalId

            Final DoctorInfo fdi = di;

            Create new Thread

            Call method Runnable

            );

            Call method threadAppnCheck.setName with "Appointment Number Thread -" plus threadCount

            ThreadCount++;

            Call method threadsAppns.add with threadAppnCheck

            Call method threadAppnCheck.start

        EndIf

    EndFor

    For (Thread singleAppnThread : threadsAppns)

        Call method singleAppnThread.join

    EndFor

    If null is equal to chnlInfo

        Create new HashMap

    EndIf

    If x.size is equal to 0

        Call method chnlInfo.put with "channelData"

Else
                            Call method chnlInfo.put with "channelData", x
                    EndIf
                    Call method chnlInfo.put with "keep-alive-callback"
            Call method replyToOriginal.setPerformative with
ACLMessage.CONFIRM
                    ReplyToOriginal
                    Call method send with replyToOriginal
            EndIf
            Create new Thread
            Call method timeOutThread.start
            Set commID to 6
            End of Case
        Case 6
            Call method System.out.println with timeOut
            If resMsg.getContent
                Set timeOut to 30
            EndIf
            End of Case
        EndSwitch
    Catch Exception ex
            Call method ex.printStackTrace
    EndTry
EndIf

Method: done

If commID is equal to 2 or commID is equal to 7
        Call method channelRequests.remove with originalMessage
        Call method doDelete
        Return true
EndIf
Return false

Method: fillAppointmentNumber

Document doc;
Elements rootTables;
Initialise returnList to null
Initialise tableFound to false
Initialise loop to true
Initialise leadingSpaces to -1
Initialise lastnameIndex to 0
Initialise lastName to di.getDoctorName
Set lastnameIndex to di.getDoctorName

```
For (int i = lastnameIndex;; i--)
        If di.getDoctorName
                LeadingSpaces++;
        Else
                break;
        EndIf
EndFor
For i is 0, i is less than leadingSpaces, i increments by 1
        Set lastName to " " plus lastName
EndFor
Initialise con225 to Util
Call method con225.data with "LastName", "", "Hospital"...
Set doc to con225.post
Call method System.out.println with "HID = " plus di.getHospitalId
Set rootTables to doc.select with "table"
For (Element rootTable : rootTables)
        Initialise tbody to rootTable.select with "tbody"
        Initialise trs to tbody.select with "tr"
        For (Element tr : trs)
                If tr.className
                        Initialise tds to tr.select with "td"
                        If tds.size is equal to 4
                                Initialise hospMathc to di.getHospitalName
                                Initialise drIdMatch to di.getDoctorNo
                                If drIdMatch and hospMathc
                                        Create new HashMap
                                        For n is 0, n is less than 3, n increments by 1
                                                Initialise hiddenElements to tds.get with n
                                                If not hiddenElements.isEmpty
                                                        For (Element hiddenElement :
hiddenElements)
                                                                Call method dataMap.put
                                                        EndFor
                                                EndIf
                                        EndFor
                                        Set con225 to Util
                                        Call method con225.data with dataMap
                                        Set doc to con225.post
                                        Call method dataMap.clear
                                        Initialise tables to doc.select with "table"
                                        Initialise cookies to con225.response
                                        For (Element table : tables)
                                                Initialise tbody2 to table.select with "tbody"
                                                Initialise trs2 to tbody2.select with "tr"
                                                For (Element tr2 : trs2)
                                                        If tr2.className
                                                                Initialise tds2 to tr2.select with
"td"
                                                                If tds2.size is equal to 4
                                                                        If tds2.get with 1
```

82

with 3

to form

hiddenElement : hiddenElements)

dataMap.put

con225.request

with dataMap

con225.cookies with cookies

con225.post

false

tables)

table3

tbody3

than trs3

    .size();

tableFound2

    break;

Initialise form to tds2.get

Initialise hiddenElements

For (Element

    Call method

    EndFor
    Set con225 to Util
Call method

Call method con225.data

Call method

    Set doc to

    Set tables to doc
Initialise tableFound2 to

For (Element table3 :

Initialise tbody3 to

Initialise trs3 to

For a is 0, a is less

    EndFor
A++) {
If

    EndIf
    EndFor
EndIf
Set tableFound to true

    EndIf
    EndIf
EndFor
If tableFound
    break;
EndIf
EndFor
If tableFound
    break;

83

```
                        EndIf
                EndIf
            EndIf
        EndIf
    EndFor
    If tableFound
        break;
    EndIf
EndFor
Return returnList
```

Module: HospitalLocationAgent

Method: LocationUpdateBehaviour

Call method super with a, period
Call method msgTosgSpcForDocList.setContent with "doclist"
MsgTosgSpcForDocList
MsgTosgSpcForDocList
Call method send with msgTosgSpcForDocList

Method: onTick

Initialise msgFromMsgSpc to receive
If null is not equal to msgFromMsgSpc
        System.out
        If msgFromMsgSpc.getPerformative is not equal to ACLMessage.REFUSE
                Try
                        @SuppressWarnings("unchecked")
                        If dinfo.size is greater than 0
                                For (DoctorInfo di : dinfo)
                                        If not hosLoc.containsKey with di.getHospitalId
                                                Initialise fullLoc to URLEncoder.encode
                                                Call method System.out.println with
"https://maps.googleapis.com/maps/api/place/textsearch/json?query="plus fullLoc plus
"&sensor=false&key="plus Util.KEY
                                                Initialise ll to getLongLat
                                                Call method hosLoc.put
                                        EndIf
                                EndFor
                                Call method System.out.println with "Locations Updated"
                                Try
                                        Create new ObjectOutputStream
                                        Call method oo.writeObject with hosLoc
                                        Call method oo.close
                                        Call method removeBehaviour
                                        Call method addBehaviour
                                Catch Exception ex
                                        Call method ex.printStackTrace
                                        Call method takeDown
                                EndTry
                        Else
                                Call method send with msgTosgSpcForDocList
                        EndIf
                Catch Exception ioex
                        Call method ioex.printStackTrace
                EndTry
        Else if msgFromMsgSpc.getPerformative is equal to ACLMessage.FAILURE
                Call method send with msgTosgSpcForDocList
        Else
                Call method System.out.println with "Refuce Message"

85

Call method send with msgTosgSpcForDocList
EndIf
EndIf

Method: makeFullAddress

Set hosName to hosName.replace with '_', ' '
Initialise hosFrags to hosName.split with " "
Set hosName to ""
For i is 0, i is less than hosFrags.length, i increments by 1
        If not position i in hosFrags
                HosName += hosFrags[i] + " ";
        EndIf
EndFor
Set hosName to hosName.trim
If hosName.contains with "Central Hospital"
        Return "Central Hospital - " plus hosLoc
Else if hosName.toLowerCase
        Return hosName
Else
        Return hosName
EndIf

Method: getLongLat

Create new double array of length 2
Create new URL
Initialise con to curl.openConnection as HttpURLConnection
Create new TreeMap
Int resCode;
BufferedReader in;
String inputLine;
Create new StringBuffer
JSONObject jso, joo;
JSONArray jarr, typesArr;
LL tmp;
Call method con.setRequestMethod with "GET"
Set resCode to con.getResponseCode
If resCode is equal to 200
        Create new BufferedReader
        While (inputLine)
                Call method resp.append with inputLine
        EndWhile
        Call method in.close
        Create new JSONObject
        If jso.get with "status"
                Set jarr to jso.getJSONArray with "results"
                For i is 0, i is less than jarr.length, i increments by 1

Set joo to jarr.getJSONObject with i
                        Set typesArr to joo.getJSONArray with "types"
                        For j is 0, j is less than typesArr.length, j increments by 1
                                If typesArr.getString with j
                                        Set 0 of res to joo.getJSONObject with "geometry"
                                        Set 1 of res to joo.getJSONObject with "geometry"
                                        Call method sortedLongLat.put with Util, hosName, ' '
                                EndIf
                        EndFor
                EndFor
                If sortedLongLat.size is greater than 0
                        Set tmp to sortedLongLat
                        Set 0 of res to tmp.longi
                        Set 1 of res to tmp.lati
                        Call method sortedLongLat.clear
                        Set tmp to null
                EndIf
        EndIf
EndIf
Return res

Method: sprtHosByNearestDistance

Map<String, String> tmp;
Create new TreeMap
Double distance;
For (String key : listOfHospitals.keySet())
        Initialise hl to hosLoc.get with key
        Set distance to getDistance
        Call method distancesSorted.put with (double), key
EndFor
Create new HashMap
Call method listOfHospitals.clear
For (Double key : distancesSorted.keySet())
        Call method listOfHospitals.put with distancesSorted.get key, tmp.get
distancesSorted.get, key
EndFor
Call method tmp.clear
Set tmp to null
Call method distancesSorted.clear
Set distancesSorted to null

Method: getDistance

Final String serviceURL = "https://maps.googleapis.com/maps/api/directions/json?origin="
HttpURLConnection con;
Create new StringBuilder

```
BufferedReader in;
JSONObject jso;
String line;
Try
        Set con to new
        Call method con.setRequestMethod with "GET"
        If con.getResponseCode is equal to 200
                Create new BufferedReader
                While ( line )
                        Call method sb.append with line
                EndWhile
                Call method in.close
                Create new JSONObject
                If jso.getString with "status"
                        Initialise routes to jso.getJSONArray with "routes"
                        For i is 0, i is less than routes.length, i increments by 1
                                Initialise routeData to routes.getJSONObject with i
                                For j is 0, j is less than routeData.getJSONArray with "legs"
                                        Initialise legsData to routeData.getJSONArray with
"legs"
                                        Return result of legsData.getJSONObject with
"distance"
                                EndFor
                        EndFor
                EndIf
        EndIf
Catch Exception ex
        Call method ex.printStackTrace
EndTry
Return 0
```

Module: MessageSpaceAgent

Method: MobileReceivingBehaviour.action

Create new DFAgentDescription
Create new ServiceDescription
DFAgentDescription[] agents;
Call method sdesc.setType with "mobile-device"
Call method adesc.addServices with sdesc
Create new ACLMessage
Initialise reply to reqMsg.createReply
Call method reply.setPerformative with ACLMessage.CONFIRM
Call method messageToMobileDevices.setContent with "give all doctors for category "
Call method messageToMobileDevices.setConversationId with "m-qry"
Call method messageToMobileDevices.setReplyWith with "mqr"
Initialise mt to MessageTemplate.and with MessageTemplate, MessageTemplate
Try
     Set agents
     For (DFAgentDescription agentd : agents)
         Call method messageToMobileDevices.addReceiver with agentd.getName
     EndFor
     If agents.length is equal to 0
         Call method reply.setPerformative with ACLMessage.FAILURE
         Call method reply.setContent with "No mobile devices found"
     Else
         Call method send with messageToMobileDevices
         For i is 0; i is less than agents.length
              Initialise rm to receive with mt
              If null is equal to rm
                  Call method block
              Else
                  I++;
                  If ((Collection))
                      Call method cdata.addAll with (Collection)
                  EndIf
              EndIf
         EndFor
         If cdata.size is greater than 0
             Call method reply.setContentObject with (Serializable)
         Else
             Call method reply.setPerformative with ACLMessage.FAILURE
             Call method reply.setContent with "No data available"
         EndIf
     EndIf
     Call method send with reply
Catch Exception ex
     Call method ex.printStackTrace
EndTry

Method: DoctorFindingBehaviour.action

Try
        Switch on conv_id
        Case 0
               OpenBracket
                    Create new ACLMessage
                    Call method msgToDA.setContent with "categories " plus disease
                    Call method msgToDA.addReceiver
                    Call method msgToDA.setConversationId with "category-by-disease"
                    Set replyWith to "cbd-" plus System.currentTimeMillis
                    Call method msgToDA.setReplyWith with replyWith
                    Call method send with msgToDA
                    Set conv_id to 1
                    break;
               CloseBracket
        Case 1
               OpenBracket
                    Initialise msgBack to receive with MessageTemplate
                    If null is equal to msgBack
                         Call method block
                  Else
                         Call method Util.printACL with msgBack
                         If msgBack.getPerformative is equal to

ACLMessage.CONFIRM

                         Initialise categories to msgBack as List
                         Create new ACLMessage
                         Call method msgToBDS.setConversationId with
"doctor-for-category"
                         Call method msgToBDS.addReceiver
                         Set replyWith to "dfc-"
                         Call method msgToBDS.setReplyWith with replyWith
                         If categories.size is equal to 1
                         Call method msgToBDS.setContent with "best docter
for category "
                        Else
                           Create new StringBuilder
                           For (String cat : categories)
                              Call method sb.append with cat
                              Call method sb.append with ","
                         EndFor
                         Call method sb.deleteCharAt with sb.length
minus 1
                         Call method msgToBDS.setContent with "best
doctor among these categories " plus sb.toString
                         EndIf
                         Call method send with msgToBDS
                         Set conv_id to 2
                      Else
                         Set done to true
                         Throw new EChannelingException("category not
found");

```
                    EndIf
            EndIf
            break;
        CloseBracket
    Case 2
        OpenBracket
            Initialise msgBack to receive with MessageTemplate
            If null is equal to msgBack
                Call method block
            Else
                Call method Util.printACL with msgBack
                Call method replyMessage.setContent with
msgBack.getContent
                Set done to true
                Call method send with replyMessage
            EndIf
            break;
        CloseBracket
    EndSwitch
Catch Exception ex
    Call method replyMessage.setPerformative with ACLMessage.FAILURE
    If ex instanceof
        Call method replyMessage.setContent with ex.getMessage
    EndIf
    Call method send with replyMessage
Finally
EndTry
```

Module: MobileInterfacingAgent

Method: action

Initialise msg to receive
If null is not equal to msg
      Call method Util.printACL with msg
      Switch on msg.getPerformative
      Case ACLMessage.REQUEST
         Call method handleRequestACLMessage with msg
         End of Case
      Case ACLMessage.CONFIRM
      Case ACLMessage.FAILURE
         Call method handleResponseACLMessage with msg
         End of Case
      EndSwitch
Else
      Call method block
EndIf

Method: handleRequestACLMessage

Initialise uuidForCurrentConv to UUID.randomUUID
Create new ACLMessage
Call method msgToMsgSpc.setConversationId with uuidForCurrentConv
Call method msgFormation.put with uuidForCurrentConv, msg
If msg.getSender
      Call method msgToMsgSpc.removeReceiver
      If msg.getContent
         Call method msgToMsgSpc.setContent with "give all doctors for category "
      EndIf
Else
      Call method msgToMsgSpc.addReceiver
      If msg.getContent
         Call method msgToMsgSpc.setContent with "names of doctors please ?"
      Else if msg.getContent
         Call method msgToMsgSpc.setContent with "list hos"
      Else if msg.getContent
         Call method msgToMsgSpc.setContent with "channel doctor whose name is "
      Else if msg.getContent
         Call method msgToMsgSpc.setContent with "search for doctor "
      Else if msg.getContent
         Call method msgToMsgSpc.setContent with "cat"
      Else if msg.getContent
         Call method msgToMsgSpc.setContent with "recommended docter for "
      Else if msg.getContent
         Call method msgToMsgSpc.setContent with "keep alive - "
      Else if msg.getContent

Call method msgToMsgSpc.setContent with "chnl drngps:" plus msg.getContent

    Else if msg.getContent

        Call method msgToMsgSpc.setContent with "find doctor for disease " plus msg.getContent

    Else if msg.getContent

        Call method msgToMsgSpc.setContent with "get diseases that starts with " plus msg.getContent

    EndIf

EndIf

Call method send with msgToMsgSpc

Method: handleResponseACLMessage

Initialise orgMsg to msgFormation.get with resp.getConversationId
Initialise reply to null
If null is not equal to orgMsg
    Call method msgFormation.remove with orgMsg
    Set reply to orgMsg.createReply
    Try
        Call method reply.setPerformative with resp.getPerformative
        Call method reply.setContentObject with resp.getContentObject
        Call method System.out.println with resp.getContentObject
    Catch UnreadableException urex
        Call method reply.setContent with resp.getContent
    Catch Exception ex
        Call method ex.printStackTrace
        Call method reply.setPerformative with ACLMessage.FAILURE
    Finally
        Call method send with reply
    EndTry
EndIf

UML Diagrams
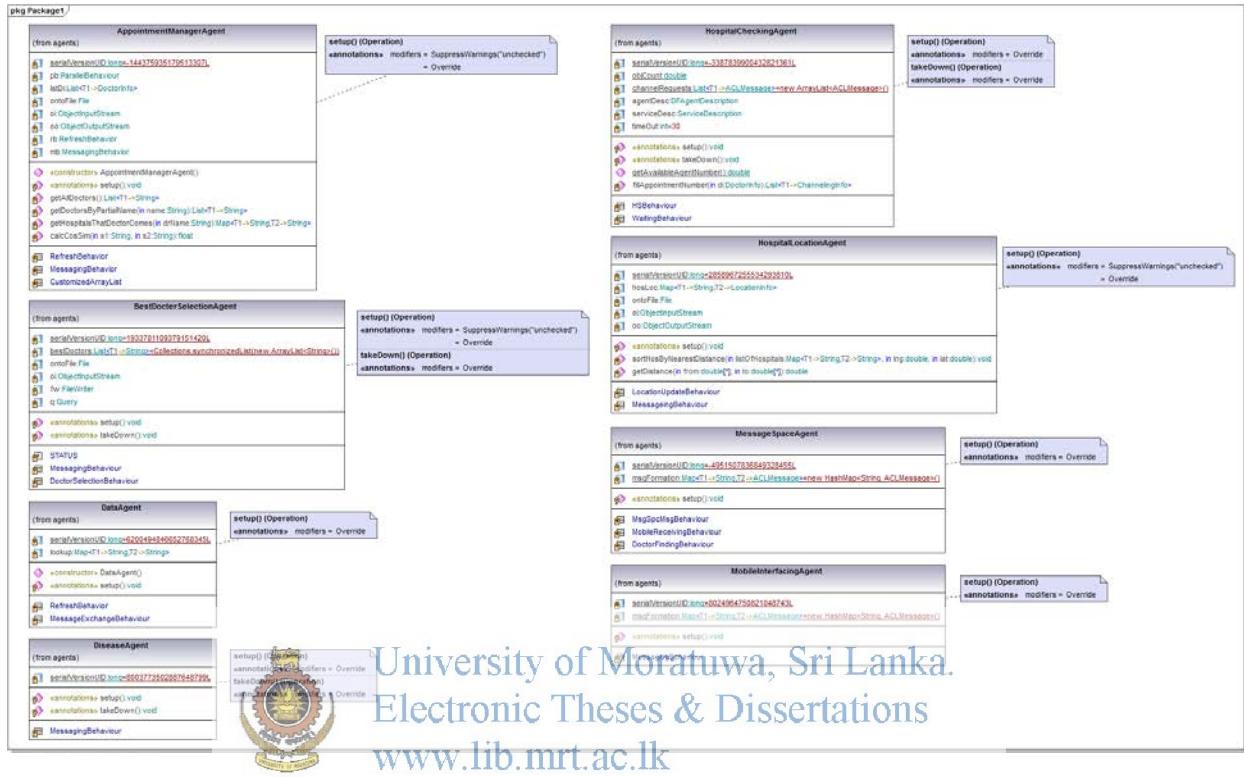
Figure C.1: Class Diagram
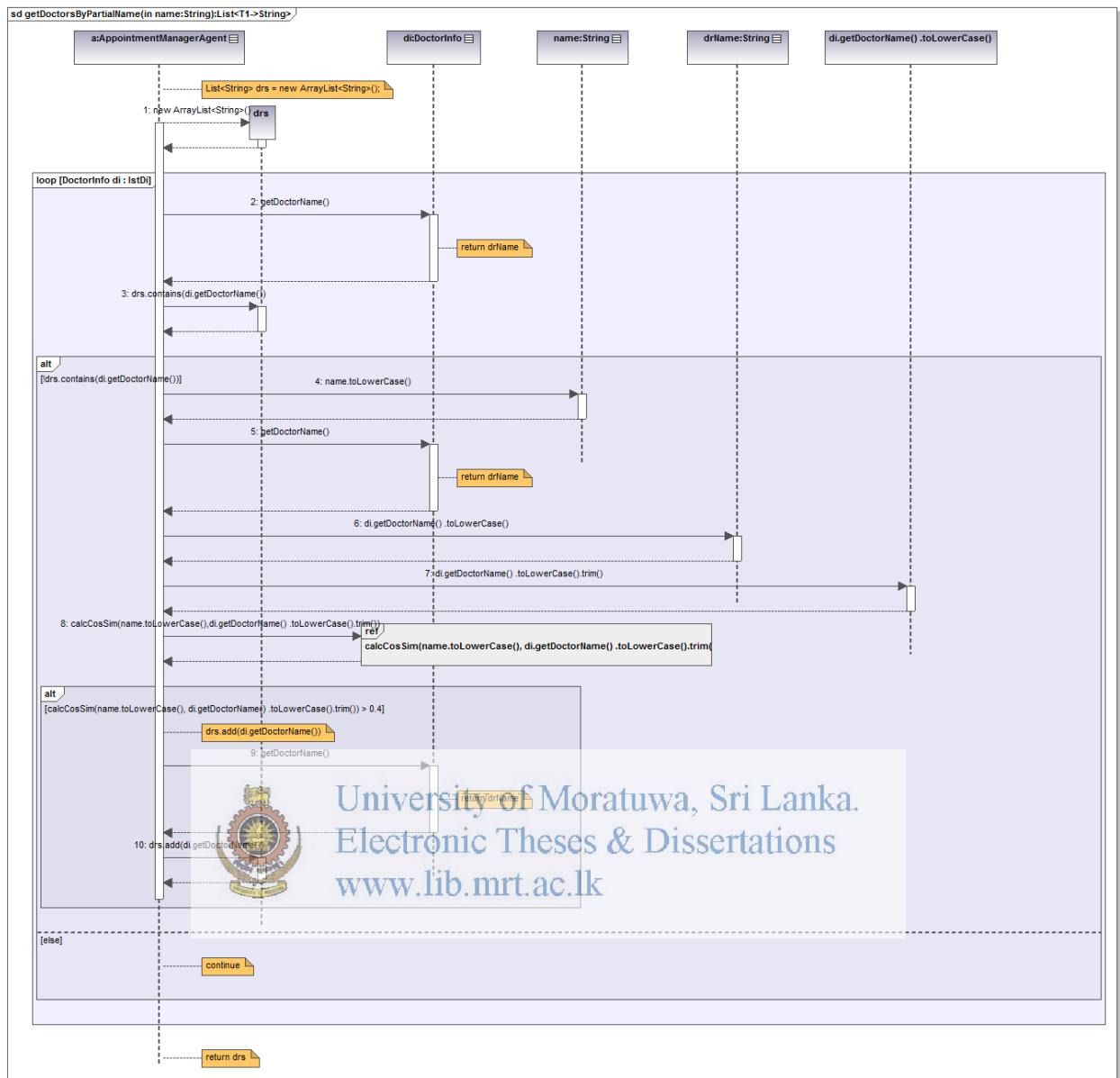
Figure C.2: Activity Diagram – Get Doctor by Partial Name
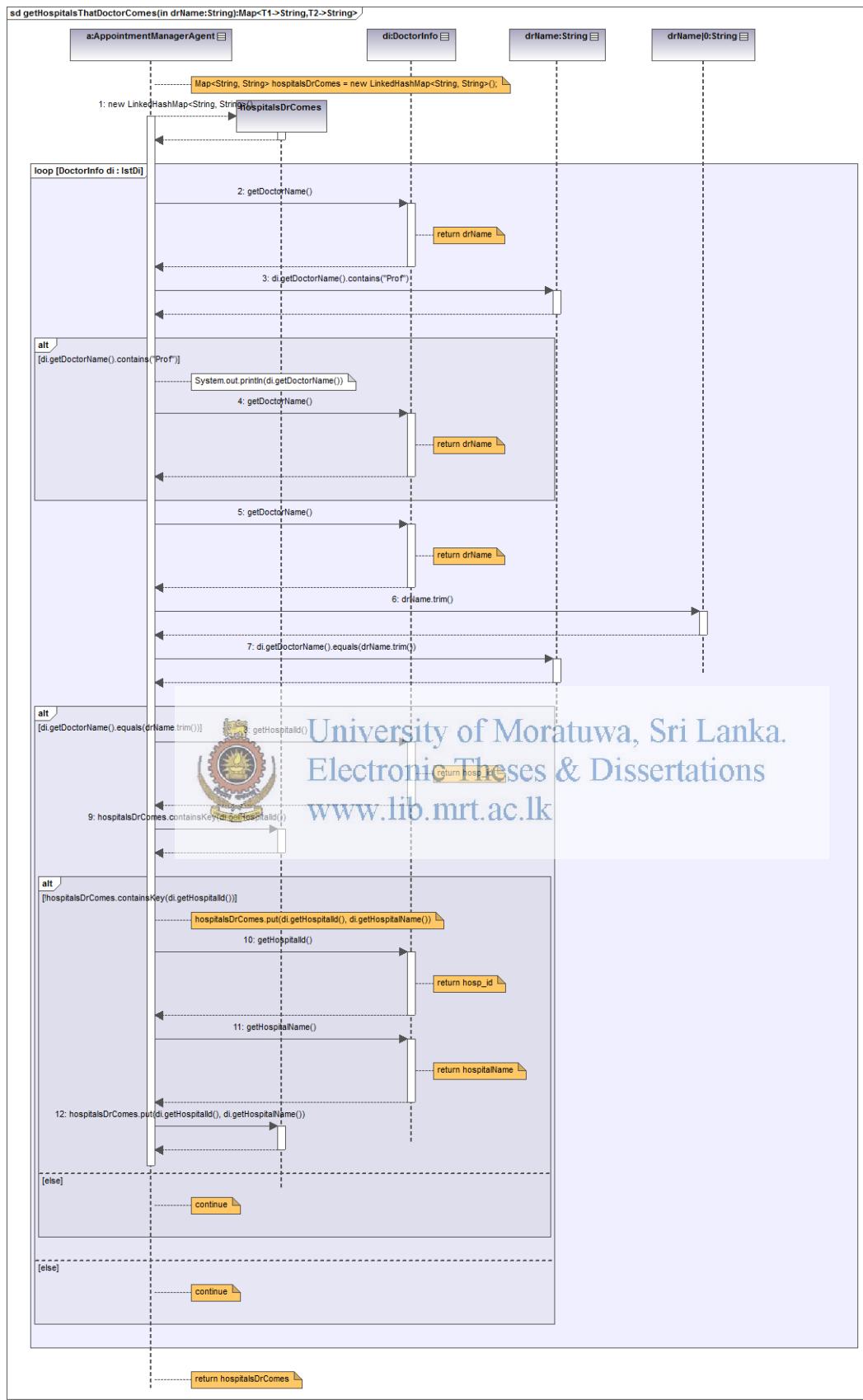
Figure C.3: Activity Diagram – Get Hospitals from Doctor
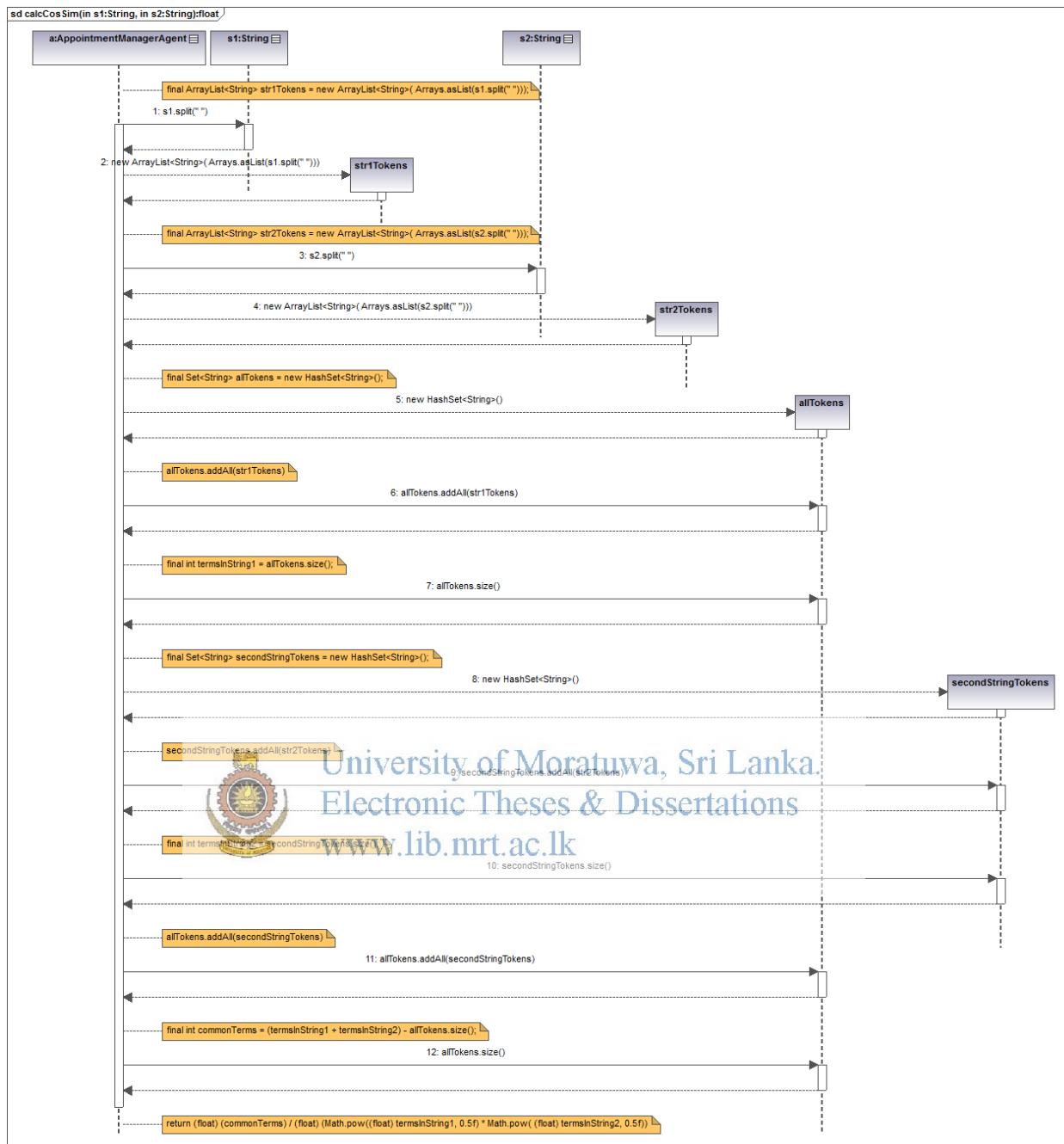
Figure C.4: Activity Diagram – Cosine Algorithm

Figure C.5: Activity Diagram – Doctor Scoring
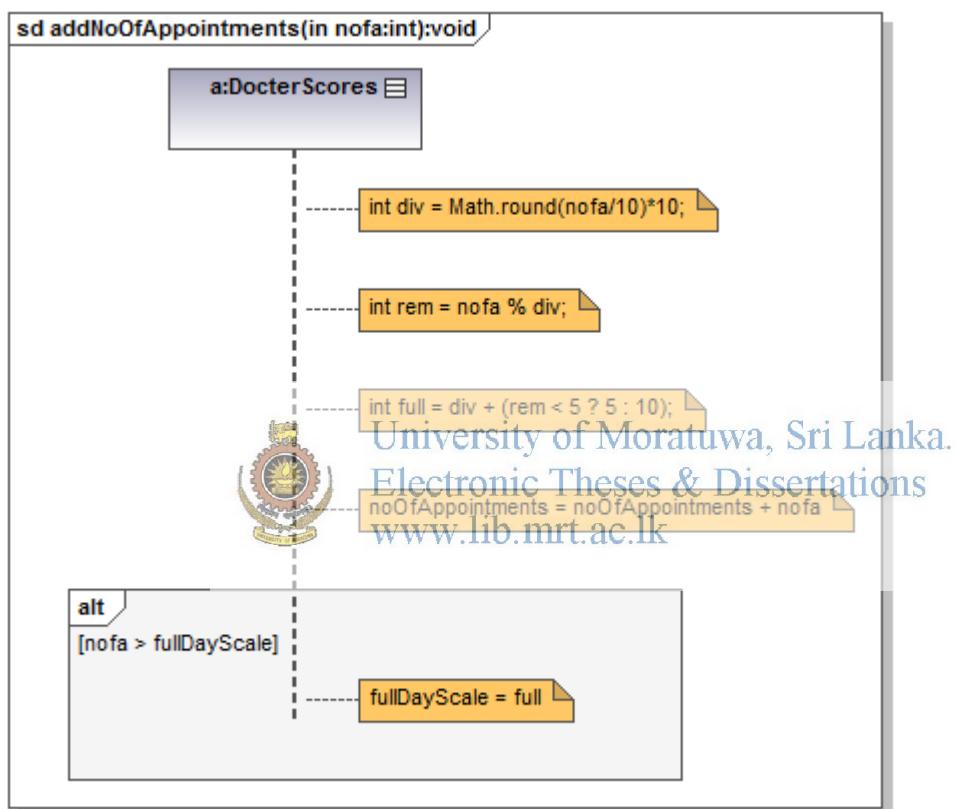
Figure C.6: Activity Diagram – Doctor Appointment Update and Full Day Scale Update

Figure C.7: Activity Diagram – Best Doctor Method
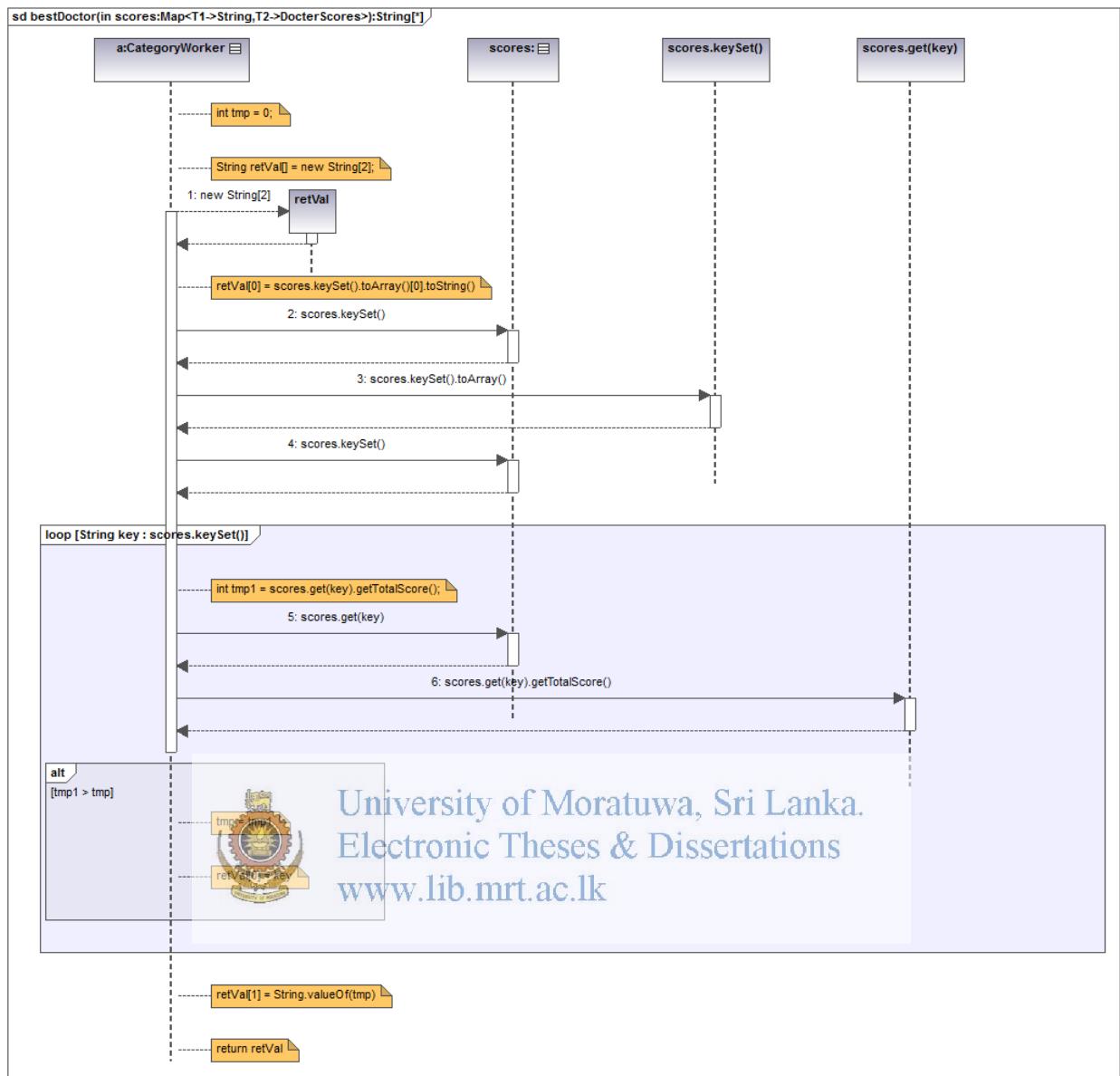
Flow Charts

Method: calcCosSim
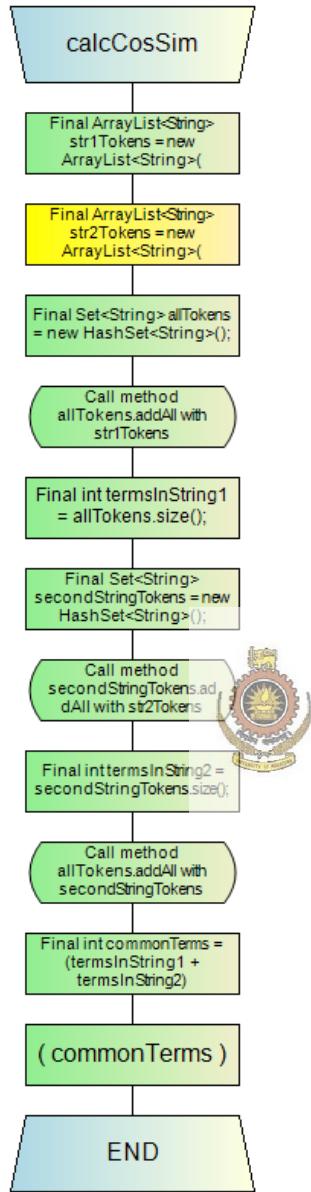
Figure C.8: Cosine Calculation Algorithm

Module: BestDocterSelectionAgent

Method: getChanneledPaitents
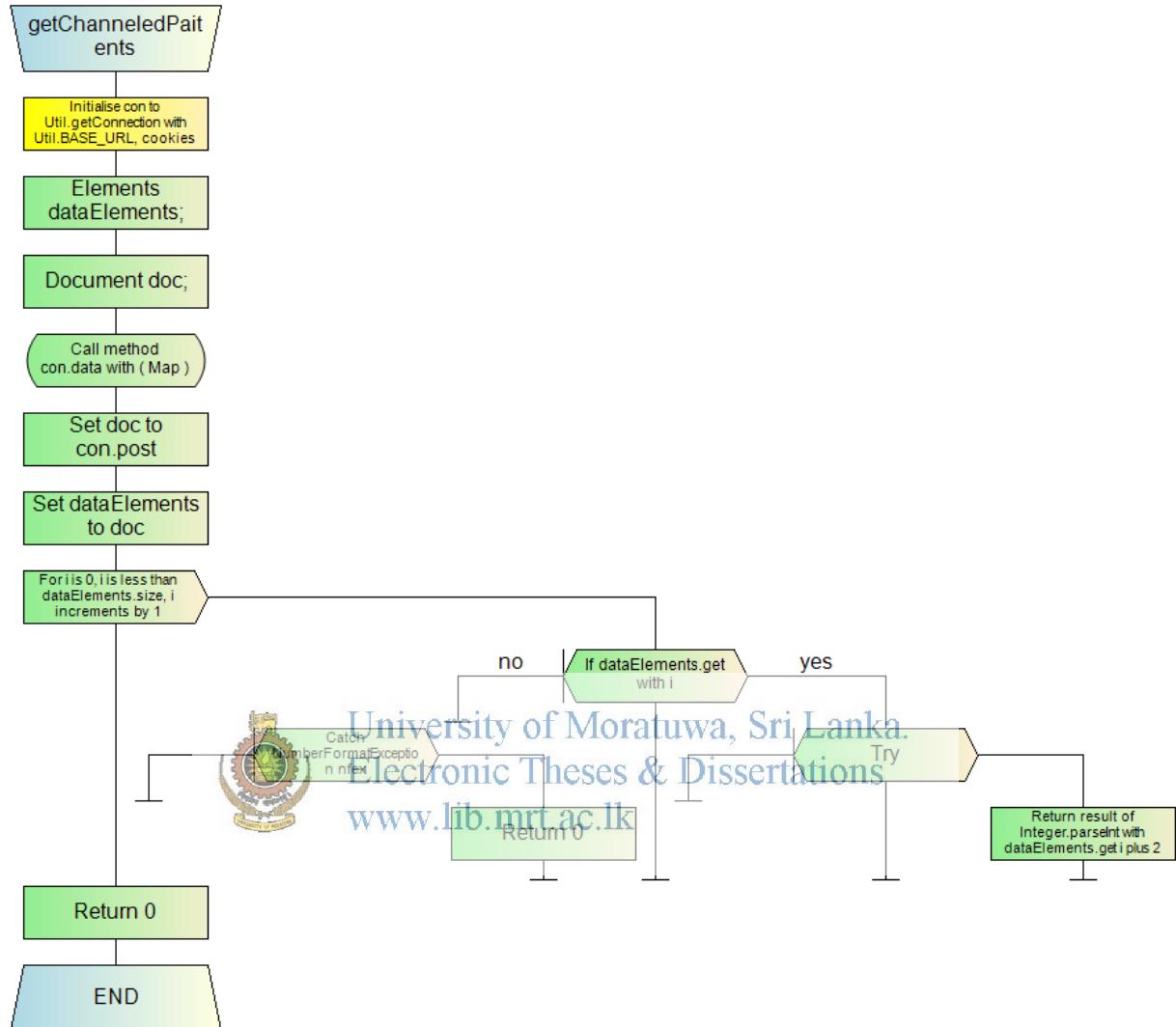
Figure C.9: Algorithm for Retrieving Appointment Numbers

Method: bestDoctor
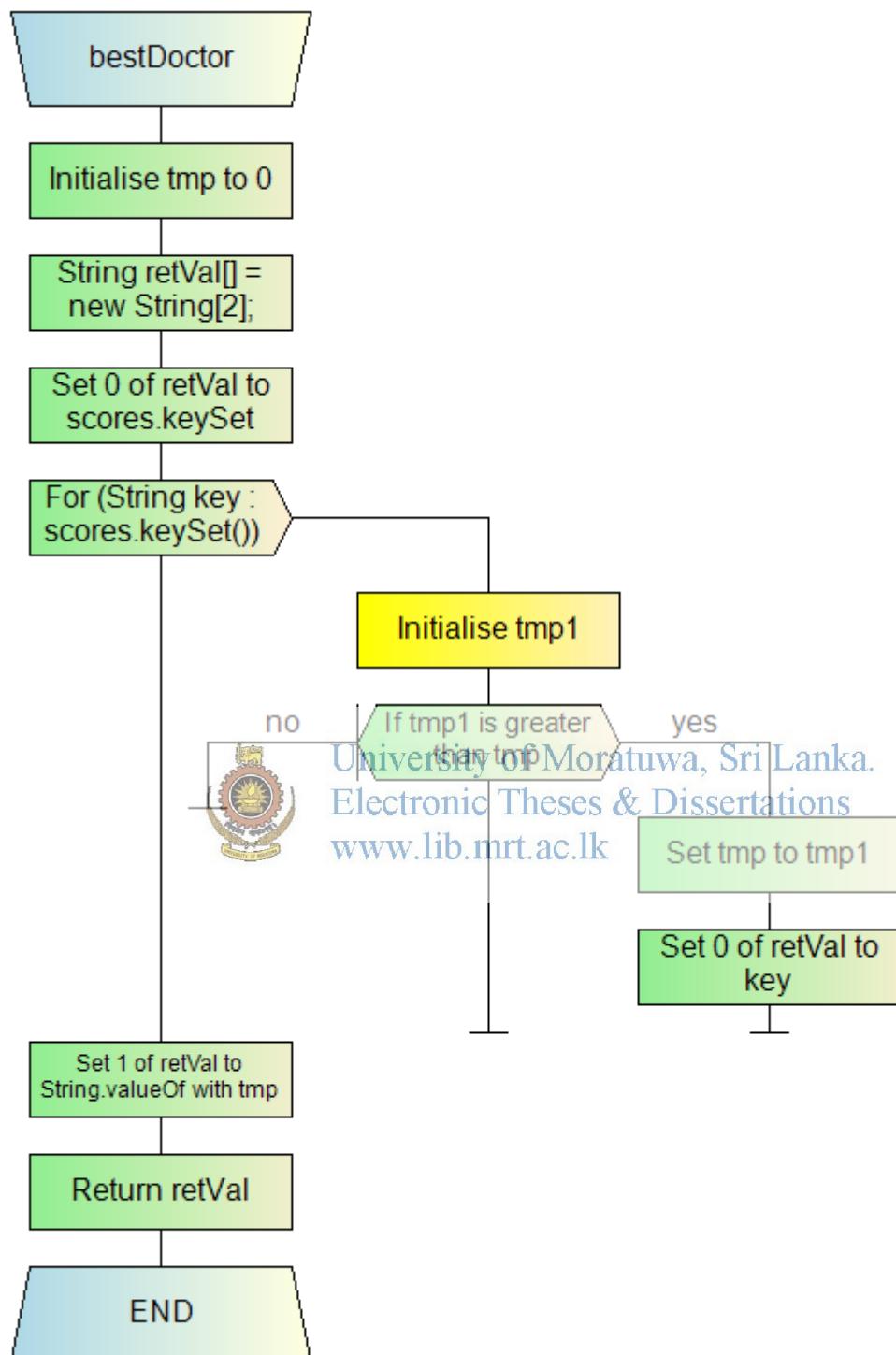
Figure C.10: Algorithm for Selecting Best Doctor

Module: HospitalCheckingAgent
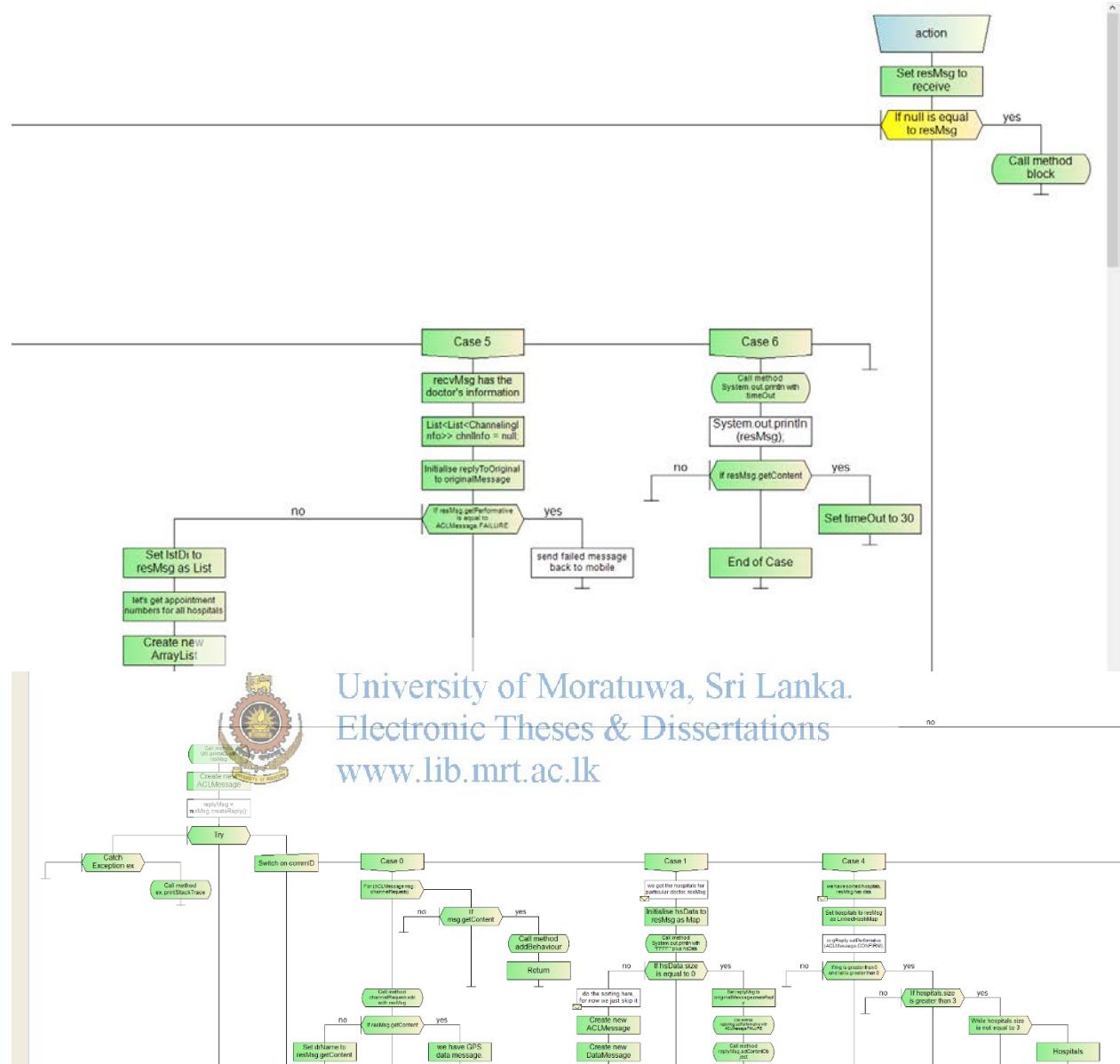
Method: action
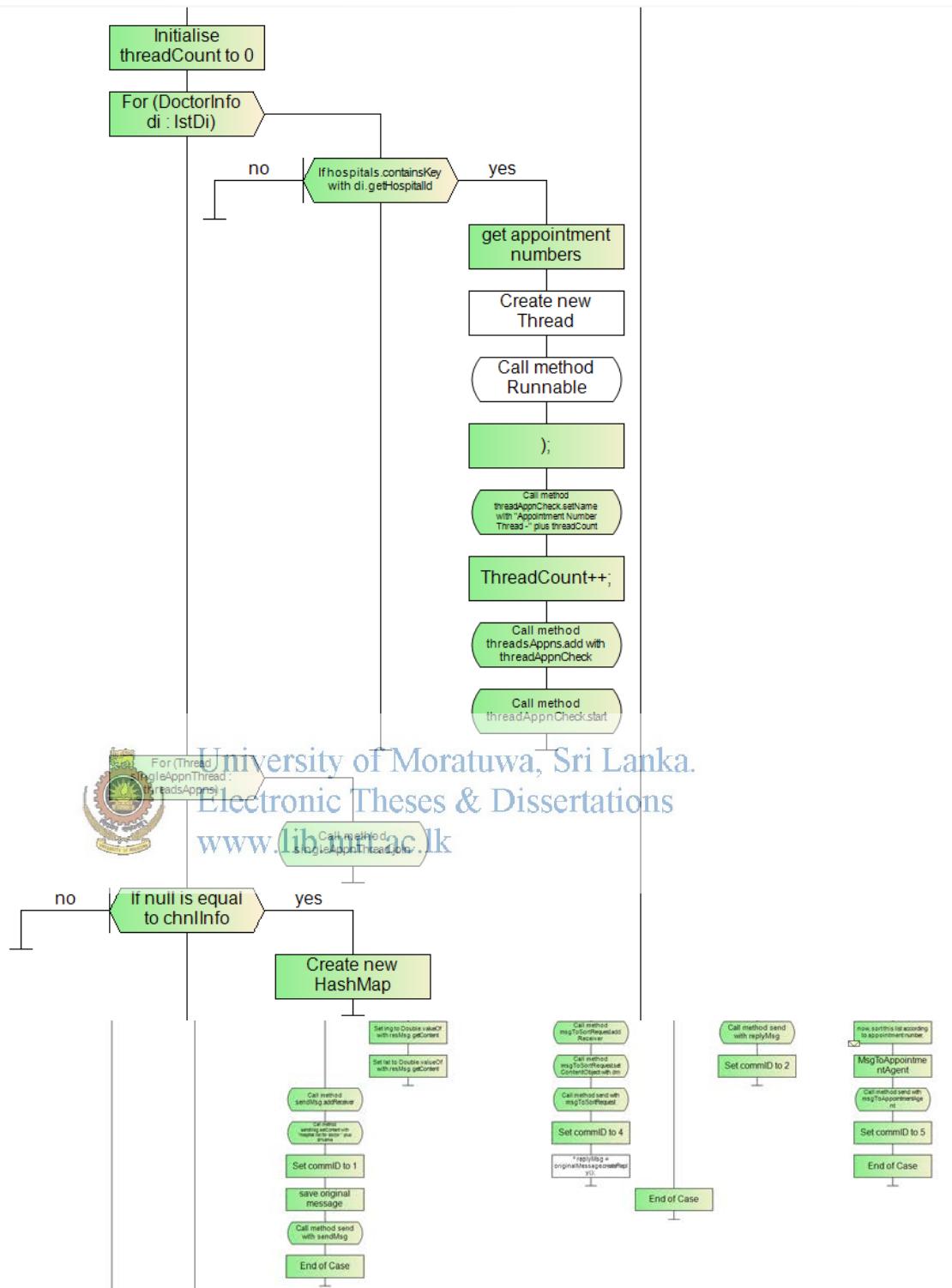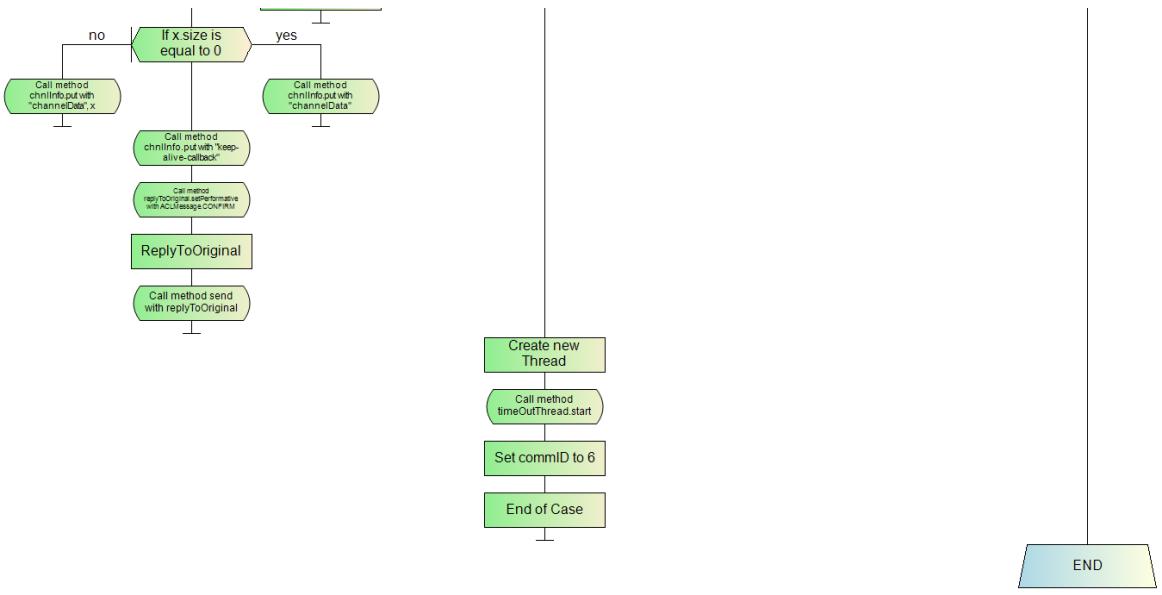
Figure C.11: Algorithm for Retrieving List of Hospitals

fillAppointmentNumber

Document doc;

Elements rootTables;

Initialise returnList to null

Initialise tableFound to false

Initialise loop to true

Initialise leadingSpaces to -1

Initialise lastnameIndex to 0

Initialise lastName to di.getDoctorName

Set lastnameIndex to di.getDoctorName

For (int i = lastnameIndex;; i--)

If di.getDoctorName
- no → break;
- yes → LeadingSpaces++;

For i is 0, i is less than leadingSpaces, i increments by 1

Set lastName to " " plus lastName

If dridMatch and hospMathc — no / yes

Create new HashMap

For n is 0, n is less than 3, n increments by 1

Initialise hiddenElements to tds.get with n

If not hiddenElements.isEmpty — no / yes

For (Element hiddenElement : hiddenElements)

Call method dataMap.put

Set con225 to Util

Call method con225.data with dataMap

Set doc to con225.post

Call method dataMap.clear

Initialise tables to doc.select with "table"

Initialise cookies to con225.response

For (Element table : tables)

Initialise tbody2 to table.select with "tbody"

Initialise trs2 to tbody2.select with "tr"

For (Element tr2 : trs2)

If tr2.className — no / yes

Initialise tds2 to tr2.select with "td" — yes

If tds2.get with 1 — no / yes

Initialise form to tds2.get with 3

Initialise hiddenElements to form

For (Element hiddenElement : hiddenElements)

Call method dataMap.put

Set con225 to Util

Call method con225.request

Call method con225.data with dataMap

Call method con225.cookies with cookies

Set doc to con225.post

Set tables to doc

Initialise tableFound2 to false

For (Element table3 : tables)

Initialise tbody3 to table3

Initialise trs3 to tbody3

For a is 0, a is less than trs3

size();

A++) {

If tableFound2 — no / yes

break;

Set tableFound to true

If tableFound — no / yes

break;

If tableFound — no / yes

break;

```
no          If tableFound          yes

                                        break;

if ((null != returnList &&
returnList.size() > 0) ||
lastName.charAt(0) != ' ')

} while (loop);

Return returnList

END
```

Figure C.12: Algorithm for Retrieving Doctor's Full Information

Mobile Phone UI
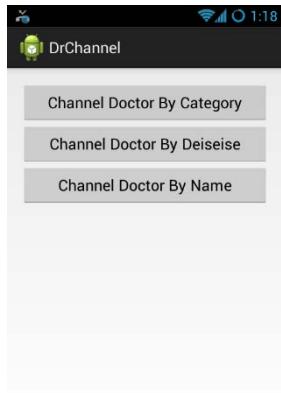
Figure D.1: First Screen of the Mobile
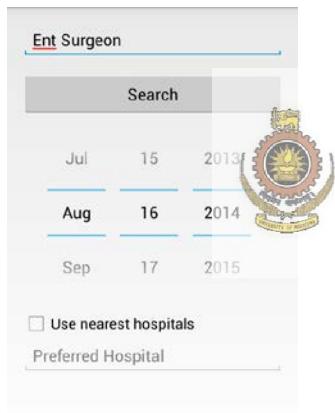
Figure D.2: Channel Doctor by Category
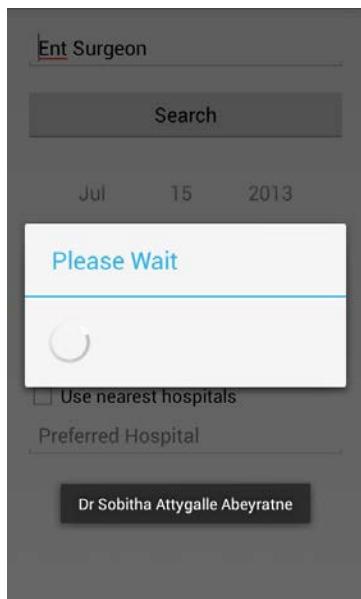
Figure D.3: Automatic Doctor selected for that category

Figure D.4: List of hospitals along with appointment numbers
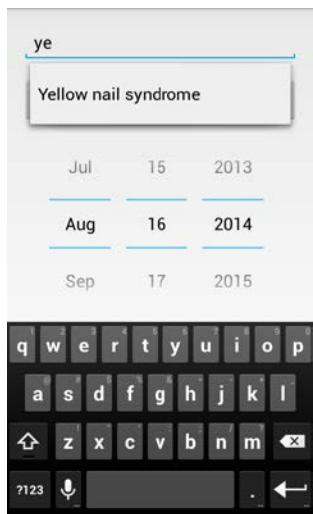
Figure D.5: Channel doctor by disease
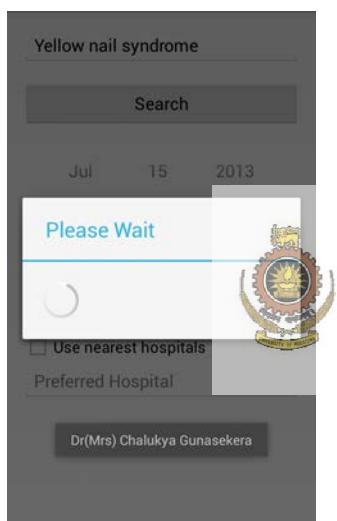
Figure D.6: Automatic doctor selected for disease

Questionnaire Samples

eChanr

Amount of th
- ⦿ Extremely
- ○ Little Amo
- ○ Medium A
- ⦿ Takes lon
- ○ Takes ext

When doing t
- ○ Extremely
- ⦿ High
- ○ Medium
- ○ Low
- ○ Almost No

Your satisfac
- ⦿ Fully satis
- ○ Partially s
- ○ Less satis
- ○ No satisfa

How simple
- ○ Simple
- ⦿ Medium
- ○ Complex

Satisfication
- ○ Excelent
- ○ Good
- ⦿ Not Bad
- ○ Bad
- ○ Worse

Satisfaction
- ○ Excelent
- ○ Good
- ⦿ Not Bad
- ○ Bad
- ○ Worse

Satisfication

- ○ Excelent
- ○ Good
- ○ Not Bad
- ○ Bad
- ⦿ Worse

Your satisfaction about mobile usage of the system
- ○ Excelent
- ○ Good
- ⦿ Not Bad
- ○ Bad
- ○ Worse

Total costs charged by operator (excluding the eChanneling fee)
- ○ Very High
- ⦿ High
- ○ Medium
- ○ Little
- ○ Extremely Little

eChann... Feed Back Form...

Amount of th...
- ⚪ Extremely
- ⚪ Little Amo...
- 🔘 Medium A...
- ⚪ Takes lon...
- ⚪ Takes ext...

When doing t...
- ⚪ Extremely
- 🔘 High
- ⚪ Medium
- ⚪ Low
- ⚪ Almost No...

Your satisfac...
- ⚪ Fully satis...
- 🔘 Partially s...
- ⚪ Less satis...
- ⚪ No satisfa...

How simple...
- ⚪ Simple
- 🔘 Medium
- ⚪ Complex

Satisfaction
- ⚪ Excelent
- ⚪ Good
- 🔘 Not Bad
- ⚪ Bad
- ⚪ Worse

Satisfaction...
- ⚪ Excelent
- ⚪ Good
- 🔘 Not Bad
- ⚪ Bad
- ⚪ Worse

Satisfication...

- ⚪ Excelent
- ⚪ Good
- ⚪ Not Bad
- ⚪ Bad
- 🔘 Worse

Your satisfaction about mobile usage of the system
- ⚪ Excelent
- ⚪ Good
- 🔘 Not Bad
- ⚪ Bad
- ⚪ Worse

Total costs charged by operator (excluding the eChanneling fee)
- ⚪ Very High
- 🔘 High
- ⚪ Medium
- ⚪ Little
- ⚪ Extremely Little

eChanneling Feed Back Form (New System)

Amount of the time duraton spend to complete a successful e-Channeling

- ⊙ Extremely Small Amount Of Time
- ○ Small Amount of Time
- ○ Medium Amount of Time
- ○ Takes long time
- ○ Takes extremely longer amount of time

When doing the e-Channelling, your interaction with the system

- ○ Extremely High
- ○ High
- ○ Medium
- ○ Low
- ⊙ Almost No Interaction

Your satisfaction with the answers generated by the system

- ⊙ Fully satisfied
- ○ Partially satisfied
- ○ Less satisfied
- ○ No satisfaction at all

How simple the system is

- ⊙ Simple
- ○ Medium
- ○ Complex

Satisfication of channeling capability by doctor's name

- ⊙ Excelent
- ○ Good
- ○ Not Bad
- ○ Bad
- ○ Worse

Satisfaction of channeling capability by doctor's speciality

- ⊙ Excelent
- ○ Good
- ○ Not Bad
- ○ Bad
- ○ Worse

Satisfication of channeling capability by disease

○ Excelent
○ Good
○ Not Bad
○ Bad
○ Worse

Your satisfaction about mobile usage of the system
○ Excelent
○ Good
○ Not Bad
○ Bad
○ Worse

Total costs charged by operator (excluding the eChanneling fee)
○ Very High
○ High
○ Medium
○ Small
○ Extremely Small

Figure E.3: Sample answers from questionnaire – new system

eChann

Amount of the

- (●) Extremely
- ( ) Small Amo
- ( ) Medium Ar
- ( ) Takes long
- ( ) Takes extr

When doing th

- ( ) Extremely
- ( ) High
- ( ) Medium
- (●) Low
- ( ) Almost No

Your satisfac

- (●) Fully satisf
- ( ) Partially sa
- ( ) Less satisf
- ( ) No satisfac

How simple t

- (●) Simple
- ( ) Medium
- ( ) Complex

Satisfication

- (●) Excelent
- ( ) Good
- ( ) Not Bad
- ( ) Bad
- ( ) Worse

Satisfaction c

- (●) Excelent
- ( ) Good
- ( ) Not Bad
- ( ) Bad
- ( ) Worse

Satisfication

- ( ) Excelent
- (●) Good
- ( ) Not Bad
- ( ) Bad
- ( ) Worse

Your satisfaction about mobile usage of the system

- (●) Excelent
- ( ) Good
- ( ) Not Bad
- ( ) Bad
- ( ) Worse

Total costs charged by operator (excluding the eChanneling fee)

- ( ) Very High
- ( ) High
- (●) Medium
- ( ) Small
- ( ) Extremely Small