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"Optimal Path in Routing Additive Multi-Hop Networks"

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ABSTRACT

The problem of finding optimal path in single source to a single destination accumulative multi hop networks. If single source that communicates to a single destination assisted by several relays through multiple hops. Advanced energy accumulation transmission/Reception techniques, such as maximal ratio combining reception of repetition codes, or information accumulation with rate less codes. Accumulation technique increase

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communication reliability, reduces energy consumption, and decrease latency. The Properties that a routing metric must satisfy in these accumulative networks to guarantee that optimal paths can be computed with Dijkstra's algorithm. We model the problem of routing in accumulative multi-hop networks, as the problem of routing in a hyper graph.

Keywords: optimal, communicates, reliability, energy, accumulative

CHAPTER 1

1.1. INTRODUCTION

Introducing relay capabilities in a network has a strong effect on the information flow that extends to all communication levels, from the achievable rates to the routing strategy. A fundamental understanding of the role that relays play in wireless networks is of paramount importance for the design of efficient protocols in future communication systems. The problem of routing in traditional multi-hop (TM) communication networks, where each relay node only listens to the immediately previous node is quite well understood today. For the purpose of routing, these networks are well modeled by directed graphs. Given a routing metric criteria, the optimality conditions that guarantee that efficient path search algorithms, such as Dijkstra's algorithm, find the optimal path were studied in [1] and [2].

The problem of routing in accumulative multi-hop (AM)communication networks, in which we are instead interested here, is however far from being understood today. simplest accumulative multi-hop network, a single source communicates to a single destination assisted by several relay nodes that can accumulate the received energy/information from previous relay transmissions. In practice, there are two main accumulation mechanisms at

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relays: energy and mutual-information accumulation. Energy accumulation can be performed at the receiving nodes, e.g., through space time coding or repetition coding [3], [4]. Mutual-information accumulation [5], [6] can be realized using ratelesscodese.g. fountain or raptor codes [7].

Accumulation mechanisms are considered in current and next generation standards since they increase communication reliability and reduce energyconsumption.The work presented here builds, mainly, on top of the works conducted in [1] and [2]. We show that the AM network communication routing problem cannot be represented using graphs, and thus, the optimality conditions derived in [1] and [2] for routing over graphs cannot be invoked .We instead show that, in general, the AM routing problem needs to be modeled using hyper graphs. We then find new conditions to guarantee the optimality of Dijkstra's algorithmic hyper graphs. These conditions are only sufficient but not necessary.

Equipped with these optimality conditions, we discuss the optimality of Dijkstra's algorithm for the minimum energy routing problem in static AM networks. To that end, we focus mainly on decode-and-forward (DF) based relaying strategies. DF relay nodes decode the source message completely by accumulating energy, or information from all previous transmissions. This routing problem has been previously addressed in [3], [4], and [7]–[10].. From [3] and [4], we already know that finding the optimal transmission order for these networks is an NP-complete problem. Our approach here consist instead on identifying particular AM network situations for which the routing problem can be represented either using graphs that satisfy Dijkstra'soptimality conditions in [2], or using hyper graphs that satisfy the new optimality conditions found here.

First, motivated by the observation that the TM network can be seen as a particular DF AM network where relays can only accumulate energy/information from the intermediately previous relay, we identify two other DF AM networks for which the routing problem can be also represented using graph. We refer to them as the DF Source Accumulative Multi-hop (DF SAM) and the DF Destination AccumulativeMulti-hop (DF DAM) networks. In the DF SAM network, relays and destination nodes decode the source message by accumulating the energy/information coming from the immediately previous relay and the source. Instead, in the DAM network relay nodes decode the source message by accumulating the energy/information coming from the Immediately previous relay, whereas the destination accumulates the energy/information from every node in the path.

We then consider the cut-set bound (CB) for AM networks [11, Th. 14.10.1]. The CB outperforms any possible forwarding strategy. For the CB, we show that the routing problem is modeled by a hyper graph and satisfies the new sufficient condition for optimality. Motivated by this success, we show that for the DF AM network there exist a subset of paths also satisfying the new optimality conditions. In that case,we are able to keep all the energy/information accumulation at nodes at the cost of possibly finding a suboptimal path. Finally, besides the DF relaying, we also consider the parity forwarding (PF) strategy introduced in [7] applied to the DAM network. We show that in the PF DAM network, the routing problem can be represented using a graph and satisfies Dijkstra's optimality conditions. We have presented the Dijkstra's optimality conditions for hyper graphs previously in [12].

Here, we provide a more detailed derivation. There, we also studied the minimum energy routing problem for the TM, DF AM and CB networks. However, the DF SAM, DF DAM, PF DAM and DF EAM networks are first discussed here. Finally, while this work deals mostly with optimal path search algorithms for AM networks, we propose in [13] good heuristic path search algorithms for the DF AM network. The remainder of the paper is organized as follows. The AM network model is presented in Section II. In Section III, the minimum energy accumulative path weight function for DF, PF relaying and for the CB are derived. The optimality of Dijkstra' algorithm in AM networks is discussed in Section IV, and particularized for the minimum energy accumulative routing metrics in Section V. Finally, conclusions are drawn in Section VII. the path other than the intended ones. These nodes ignore or treat as interference the non intended received signals. In TM routing problems, the network is well modeled by a directed graph G(V,E), as the one shown in Fig. 2, where V is the set of nodes and E is the set of edges representing the existence of links between pairs of nodes.

Let eu,v denote the edge between nodes u and v. A path p exits if ep[i],p[i+1] ∈ E for all i = {0,...,L}. Associated to each edge, there can be one or several fixed metrics, e.g. the link distance, the link bandwidth, the channel magnitude, the transmission delay, etc. For simplicity, let us as assume that there is only one metric per edge, then β (eu,v) = βu,v denotes the metric associated to edge eu,v. In Fig. 2, we depict a TM graph model for routing in wireless communications from a source node S to a destination node D using two possible relay nodes A and B. Observe that the source node can only transmit to every other node but cannot receive from them. Contrary, the destination can only receive from every other node. Relays can transmit toevery other node (except the source) and receive from every other node (except destination). In TM routing the objective is to find the better path, or lightest path, between a source and a destination according to some network metric

1.2 EXISTING SYSTEM

A large number of studies on multi-hop wireless networks have been devoted to system stability while maximizing metrics like throughput or utility. These metrics measure the performance of a system over a long time-scale. For a large class of applications such as video or voice over IP, embedded network control and for system design; metrics like delay are of prime importance. The delay performance of wireless networks, however, has largely been an open problem. This problem is notoriously difficult even in the context of wireline networks, primarily because of the complex interactions in the network (e.g., superposition, routing, departure, etc.) that make its analysis amenable only in very special cases like the product form networks. The problem is further exacerbated by the mutual interference inherent in wireless networks which, complicates both the scheduling mechanisms and their analysis.Some novel analytical techniques to compute useful lower bound and delay estimates for wireless networks with singlehop traffic were developed in. However, the analysis is not directly applicable to multi-hop wireless network with multi hop flows, due to the difficulty in characterizing the departure process at intermediate links. The metric of interest in this paper is the system-wide average delay of a packet from the source to its corresponding destination.

1.3 PROPOSED SYSTEM

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The Proposed System Internet of Things (IoT) is attracting considerable attention from the universities, industries, citizens and governments for applications, such as healthcare, environmental monitoring and smart buildings. IoT enables network connectivity between smart devices at all times, everywhere, and about everything. In this context, Wireless Sensor Networks (WSNs) play an important role in increasing the ubiquity of networks with smart devices that are low-cost and easy to deploy. However, sensor nodes are restricted in terms of energy, processing and memory. Additionally, low-power radios are very sensitive to noise, interference and multipath distortions. In this context, this article proposes a routing protocol based on Routing by Energy and Link quality (REL) for IoTapplications.To increase reliability and energy-efficiency, REL selects routes on the basis of a proposed end-to-end link quality estimator mechanism, residual energy and hop count. Furthermore, REL proposes an event-driven mechanism to provide load balancing and avoid the premature energy depletion of nodes/networks.Performance evaluations were carried out using simulation and testbed experiments to show the impact and benefits of REL in small and large-scale networks.The results show that REL increases the network lifetime and services availability, as well as the quality of service of IoT applications. It also provides an even distribution of scarce network resources and reduces the packet loss rate, compared with the performance of well-known protocols.

CHAPTER 2

WORK DONE IN PHASE TWO

2.1 SYSTEM ARCHITECTURE DESIGN

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System Design is a solution, how to approach to creation of a new system. This important phase is composed of several steps. It provides the understanding and procedural details for implementing the system recommended infeasibility study. Stress in on translating performance requirement into design specification design goes through logical physical stages of development. Logical design reviews the present physical, prepare input and output specification. These steps are as follow:

- Problem definition.
- Input output specification.
- Data based designed.
- Modular program design.
- Preparation of source code.
- Testing and debug.

INPUT DESIGN

Input Design plays a vital role in the life cycle of software development, it requires very careful attention of developers. The input design is to feed data to the application as accurate as possible. So inputs are supposed to be designed effectively so that the errors occurring while feeding are minimized. According to Software Engineering Concepts, the input forms or screens are designed to provide to have a validation control over the input limit, range and other related validations.This system has input screens in almost all the modules. Error messages are developed to alert the user whenever he commits some mistakes and guides him in the right way so that invalid entries are not made. Let us see deeply about this under module design. Input design is the process of converting the user created input into a computer-based format.

The goal of the input design is to make the data entry logical and free from errors. The error is in the input are controlled by the input design. The application has been developed in user-friendly manner. The forms have been designed in such a way during the processing the cursor is placed in the position where must be entered. The user is also provided with in an option to select an appropriate input from various alternatives related to the field in certain cases. Validations are required for each data entered. Whenever a user enters an erroneous data, error message is displayed and the user can move on to the subsequent pages after completing all the entries in the current page.

OUTPUT DESIGN

The Output from the computer is required to mainly create an efficient method of communication within the company primarily among the project leader and his team members, in other words, the administrator and the clients. The output of VPN is the system which allows the project leader to manage his clients in terms of creating new clients and assigning new projects to them, maintaining a record of the project validity and providing folder level access to each client on the user side depending on the projects allotted to him. A new user may be created by the administrator himself or a user can himself register as a new user but the task of assigning projects and validating a new user rests with the administrator only.The application starts running when it is executed for the first time. The server has to be started and then the internet explorer in used as the browser. The project will run on the local area network so the server machine will serve as the administrator while the other connected

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systems can act as the clients. The developed system is highly user friendly and can be easily understood by anyone using it even for the first time.

Choosing the right output method for each user is another objective in designing output. Much output now appears on display screens, and users have the option of printing it out with their own printer. The analyst needs to recognize the trade-offs involved in choosing an output method. Costs differ; for the user, there are also differences in the accessibility, flexibility, durability, distribution, storage and retrieval possibilities, transportability, and overall impact of the data.

One of the most common complaints of users is that they do not receive information in time to make necessary decisions. Although timing isn't everything, it does play a large part in how useful output will be. Many reports are required on a daily basis, some only monthly, others annually, and others only by exception.

Designing Output to Serve the Intended Purpose

All output should have a purpose. During the information requirements determination phase of analysis, the systems analyst finds out what user and organizational purposes exist. Output is then designed based on those purposes. You will have numerous opportunities to supply output simply because the application permits you to do so. Remember the rule of purposiveness, however. If the output is not functional, it should not be created, because there are costs of time and materials associated with all output from the system.

Designing Output to Fit the User

With a large information system serving many users for many different purposes, it is often difficult to personalize output. On the basis of interviews, observations, cost

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considerations, and perhaps prototypes, it will be possible to design output that addresses what many, if not all, users need and prefer. Generally speaking, it is more practical to create user-specific or user-customizable output when designing for a decision support system or other highly interactive applications such as those using the Web as a platform. It is still possible, however, to design output to fit a user's tasks and function in the organization, which leads us to the next objective.

Delivering the Appropriate Quantity of Output

Part of the task of designing output is deciding what quantity of output is correct for users. A useful heuristic is that the system must provide what each person needs to complete his or her work. This answer is still far from a total solution, because it may be appropriate to display a subset of that information at first and then provide a way for the user to access additional information easily.

The problem of information overload is so prevalent that it is a cliché, but it remains a valid concern. No one is served if excess information is given only to flaunt the capabilities of the system. Always keep the decision makers in mind. Often they will not need great amounts of output, especially if there is an easy way to access more via a hyperlink or drill-down capability.

2.2 SYSTEM REQUIREMENTS

2.2.1 HARDWARE REQUIREMENTS

Processor : Pentium dual core

RAM : 1 GB

Hard Disk Drive : 80 GB

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Monitor : 17” Color Monitor

Key Board : 108 Keys

Mouse : 3 Buttons

2.2.2 SOFTWARE REQUIREMENTS

Front End/GUI Tool : Microsoft Visual studio 2012

Operating System: Windows Family

Language : C#, ASP.NET

Application : Web Application

Back End:SQL server 2005

CHAPTER 3

SYSTEM ORGANIZATION

3.1 USE CASE DIAGRAM

The use case diagram that was finally designed for the Student Admissions system can be seen in Figure The most important step to fully understanding the requirements and scope of this system was the creation and subsequent refinement of this use case diagram. Many changes were made to the initial diagram before a consensus was met on the final design used.

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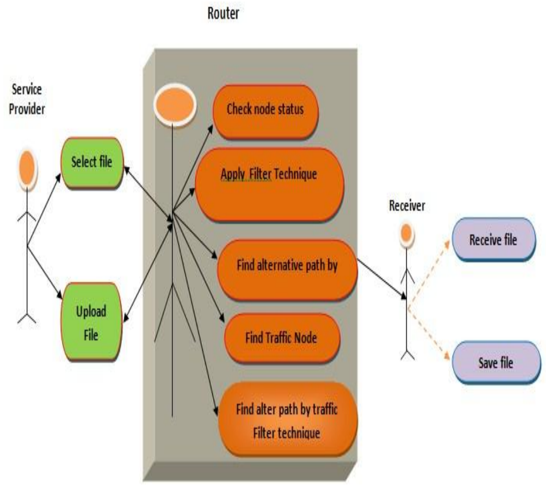

Figure 3.1: Use Case Diagram

3.2 COLLABORATION DIAGRAM

A collaboration diagram, also called a communication diagram or interaction diagram, is an illustration of the relationships and interactions among software objects in the Unified Modeling Language (UML). The concept is more than a decade old although it has been refined as modeling paradigms have evolved

A collaboration diagram resembles a flowchart that portrays the roles, functionality and behavior of individual objects as well as the overall operation of the system in real time. Objects are shown as rectangles with naming labels inside. These labels are preceded by colons and may be underlined. The relationships between the objects are shown as lines connecting the rectangles. The messages between objects are shown as arrows connecting the relevant rectangles along with labels that define the message sequencing.

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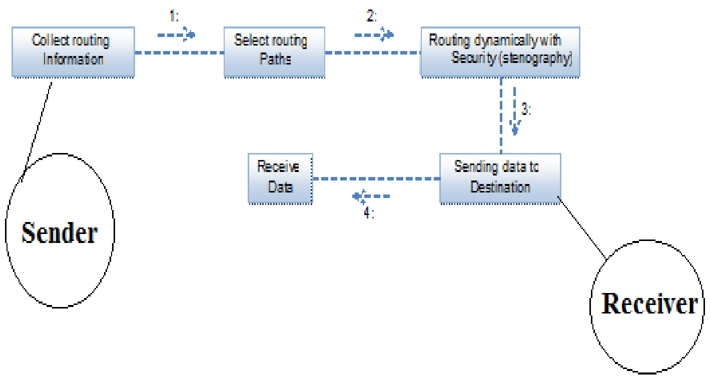

Figure 3.2: Collaboration Diagram

3.3 SEQUENCE DIAGRAM

Sequence diagrams are used to help quickly picture how the objects in a use case interact during the sequence of events in a use case . They do this by showing the behavior of the objects in the use case and the messages they pass. The main strength of sequence diagrams is the clarity with which they show what objects are making what calls and to whom, and which objects are doing what processing .

3.4 STATE CHART DIAGRAM

State chart diagram is one of the five UML diagrams used to model the dynamic nature of a system. They define different states of an object during its lifetime and these states are changed by events. State chart diagrams are useful to model the reactive systems. Reactive systems can be defined as a system that responds to external or internal events. State chart diagram describes the flow of control from one state to another state. States are defined as a condition in which an object exists and it changes when some event is triggered.

The most important purpose of State chart diagram is to model lifetime of an object from creation to termination. State chart diagrams are also used for forward and reverse engineering of a system. However, the main purpose is to model the reactive system.

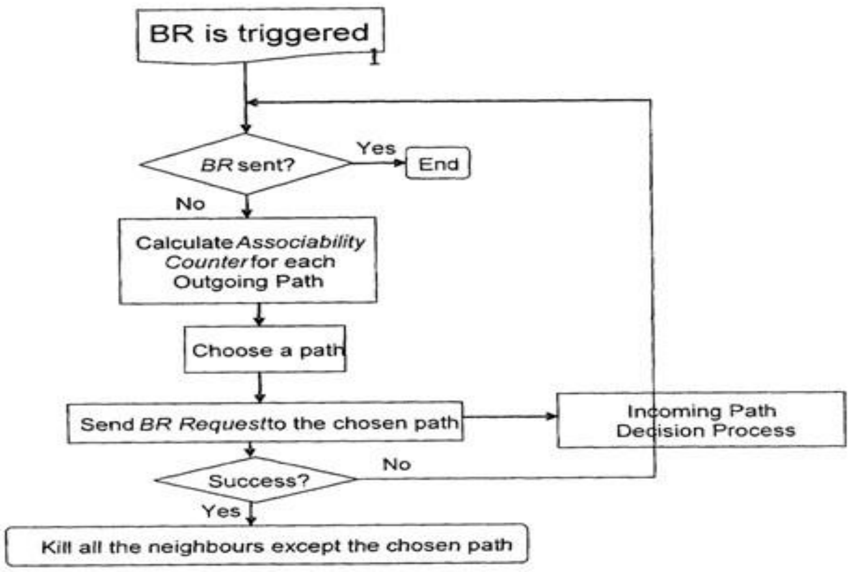

Figure 3.3: State chart Diagram

3.5 CLASS DIAGRAM

Class diagrams are probably the most widely used of all the UML diagrams. Not only are they the most common but compared to any other UML diagram they have the largest range of concepts to deal with Although there are concepts that could be used to create deeper, more highly detailed class diagrams this project will only deal with the basics

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concepts that are most commonly encountered as this will instead create the simple, easy to understand models suggested by AM.

There are three possible perspectives to take when creating class diagrams, these are conceptual, specification and implementation. When looking at a class diagram from a conceptual perspective the language used is that which anyone in the business domain of the system can follow. The class diagram is created with no regard to the programming language it will be implemented in. On the other hand there is the implementation perspective which is the opposite of the conceptual perspective and is created solely with how it will be implemented in a programming language in mind.

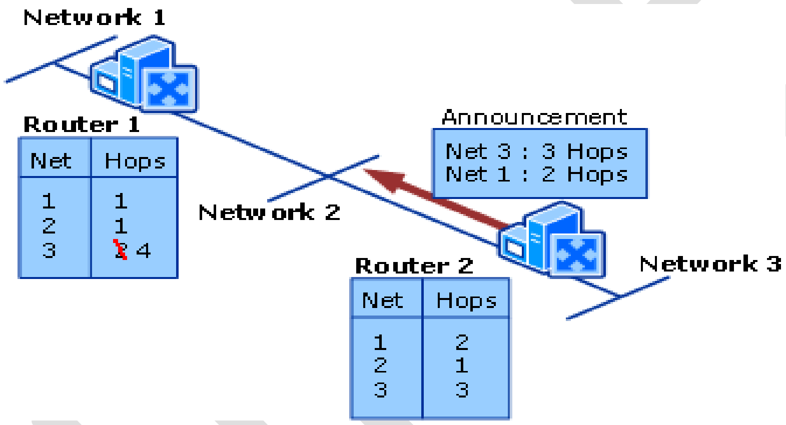

Figure 3.4: Class Diagram

CHAPTER 4

IMPLEMENTATION AND RESULTS

4.1 IMPLEMENTATION

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Implementation is the stage of the project when the theoretical design is turned out into a working system. Thus it can be considered to be the most critical stage in achieving a successful new system and in giving the user, confidence that the new system will work and be effective. The implementation stage involves careful planning, investigation of the existing system and it's constraints on implementation, designing of methods to achieve changeover and evaluation of changeover methods.

The following chapter looks at how the system implementation progressed over the course of the build. It starts off by detailing the plan that was used to order how the implementation would progress. The chapter then covers some of the important aspects of implementation that were carried out throughout the building of the system. The data-tier and then the web tier will be looked at in turn, and for the web-tier the implementation of each aspect of the Model-View-Controller will be considered. Finally, the testing that was carried out on the system will be examined and the effect the results had on the system will be looked.

Designing Plan

As was stated in the Technology and Literature Survey chapter the methodology being followed for the development of this system is the Dynamic Systems Development Method (DSDM). Many of the core principles of the DSDM come about from the idea that the designing and building of a system should be an incremental process. To benefit most from the methodology being used it was decided that the implementation phase of the development would be carried out in an incremental fashion and to do this the system would

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have to be split into distinct sections. Due to the manner in which the requirements were gathered it was very easy to view the system in such a way. It was decided that the best way to split the system up would be by the main tasks that the system was required to achieve and it was hoped that by doing so each increment of the build would be kept to a manageable level.

The testing for the system will also be carried out as it is built with a slightly more thorough test at the end of each cycle. It is hoped that by doing this the system will nearly always be in a relatively stable state, and that if when it gets to the deadline not all the functionality is present this would not cause major problems with the final implementation.

Data-Tier – Implementing the Database

The implementation of the database for the system was carried out continuously as the system was constructed. Before each aspect of functionality was coded the database was looked at to make sure that all the necessary data that would be required for the new piece.

Functionality could be stored, and if this was not the case then new tables or fields were added to the database. By carrying out the implementation in this way it meant that the initial design of the database was the first area to be implemented for the system.

Throughout the course of the implementation phase many of the tables in the database had many minor alterations made on them. The was especially obvious on the application table, which probably had the most changes over the course of the system build, starting out with less than 10 fields and ending up with over 30.

Web-Tier – Controller - Implementing the Security

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Once the initial implementation of the database had been carried out it was decided that the next step to take would be creating the security features that would be present throughout nearly all of the pages of the system. The security of the system will have two main areas, these are, checking whether a user is logged in and so allowed to use the system and checking whether a logged in user has the correct user level to access certain areas of the system.

The first task needed to be carried out to implement this had already been completed with the initial creation of the database, this was the setting up of the users table which contains the username, password, and user level for each user of the system. The next step was to decide how to check whether a user was logged in or not. It was initially decided that each user class, i.e. the applicant class, the officer class, and the tutor class, would all have a valid user attribute that would be set to 1 if the user had logged in successfully, and this would be checked on every page. Later on in the development it was found that the valid user check and the user access level check could be merged by changing the way in which users were considered to be logged in.

The do Login () function, shows how logging in is carried out in the final version of the system. If a valid user of the system logs in a session variable is created depending on what level of user they are, and the appropriate user object is initialized and stored in this session. If an invalid user logs in no session variable will be created thus when the code in executes they will be sent back to the login page also shows how the users are redirected to the appropriate is the check User () function that is carried out on every page of the system

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that you have to be logged into to access, how it is used with the pages to stop them being displayed if check User () fails.

This method is where both the valid user and user access level checks are carried out, because of this it means that each user area of the system has a slightly modified check User () function. For example, is the check User () function for the applicant area of the system,

And it checks to make sure the current user is an applicant by checking to see if an applicant session variable has been created, however the function for the officer area will check to see if an officer session variable has been created and the tutor area for a tutor session variable.

As with at login if there is no session variable for any of the user levels of the system, it is known that the user has not logged in and so a page is displayed explaining this and gives a link to log in. At times an extra level of security had to be added to some pages, such as the page to edit an application that an applicant can use. This is because the page to edit an application uses the HTTP GET method to pass data about which application is being edited.

Web Tier – Model

The model for the system is made up of many different classes created using the built in object-oriented functions available in PHP. The model was once again implemented as needed by the specific piece of functionality being produced at the time, but throughout the build a fairly good idea of how the model would look was known from the class diagram constructed in the design stage. As was expected, the class diagram only gave a basic look at the model and many objects that were not considered in the design were created for the final system.

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The main area that was not looked at when designing the class diagram were general functions such as the database connection class and security classes. By the time the model was fully implemented there were three distinct types of classes available to the system, these were, general and system-wide functions, user classes, and finally object classes.

General and System-wide functions

The main classes in this subset of the model are the classes that deal with security over the system and the database function class. The security classes are those that were looked at in the previous section of this chapter. The database function class, called down, was created to help manage the implementation of the database connections within the model of the system.

Every time you create a connection to a database you have to give the database details, such as, where to find the database, what database you are using and the password to access the database. If you were to do this for every connection to the database in the model then if at some point the database was changed, or moved, it would mean that many lines of duplicate code within the model would have to be rewritten. By creating the down class, see Figure , it is possible to connect to the database throughout the model without needing to know any of the details about the database, and if these details ever changed only the down class would have to be altered. As can be seen,

The down class also contains a garcon() method, by supplying this method it means that the classes within the model that use the down functions can still carry out methods on the connection as normal.

4.1.1 Data Flow diagram

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The DFD was first developed by Larry Constantine as a way of expressing system requirement in a graphical form. A DFD also known as bubble chart has a purpose of clarifying system requirement and identifying major transformation that will become the program in the system design.The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of the input data to the system, various processing carried out on these data, and the output data is generated by the system.

- The data flow diagram (DFD) is one of the most important modeling tools. It is used to model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.
- DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output.
- DFD is also known as bubble chart. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail.

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MODULES DESCRIPTION

4.2.1 SOURCE MODULE

- All data transmissions are routed through the sockets. To effect the data transfer the source machine primarily establishes a connection with the socket machine for the transmission of packets.
- Then the address of the machine that is selected to receive these messages is obtained from the user. Usually addresses are the IP of the destination machine.
- This destination address is used to find out the subnet to which the destination machine belongs to. The message is transmitted in the form of packets. For this purpose the ATM concept is used. The message is divided into packets of 48 bits and then sent to the socket.
- The source machine checks whether the buffer of the socket machine is free and then transmits the message packets. If the source finds any congestion occurred in the socket is clear and the socket is free for transmission.

4.2.2 SOCKETS

- Now that sockets are understood to be used to forward packets of data between devices that aren't necessarily connected to the same local network, the process of routing assumes significance.
- Routing is the cumulative processes that discover paths through the network to specific destinations, compare redundant routes mathematically, and build tables that contain routing information.
- Any packets received by one of its interfaces was either delivered to the other interface or discarded as undeliverable.

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4.2.3 DESTINATION MODULE

- This could also be viewed as the receiving module. The data received from the socket is discrete and needs realignment which is done in this module. The destination machine accepts the connection from the socket machine and waits for the message packets to arrive.
- Once the message packets arrive at the Destination machine they are combined to form a full message that was sent from the source machine. Then the message is saved in a text file in the Destination Machine. This completes the data transfer with security issues duly taken care of.
- This accomplishes the prime objective of the project of utilizing the socket in lieu of hardware or software based firewall. This reduces the cost and also enhances the utility value of the existing infrastructure.

4.2.4 MULTI-HOP WIRELESS NETWORK MODULE

- Multi-hop wireless network with multiple source-destination pairs, given routing and traffic information. Each source injects packets in the network, which traverses through the network until it reaches the destination.

CHAPTER -5

CONCLUSION & FUTURE WORK

The routing problem in accumulative multi-hop networks provide that as opposed to traditional multi-hoping where the network is well modeled by a graph, for routing in accumulative networks, the network needs to be modeled by a hyper graph. The properties that guarantee that Dijkstra's algorithm finds the optimal path in such networks, and

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presented sufficient conditions for the optimality. These conditions are particularized for the minimum energy routing problem with decode and forward relays, parity-forwarding relays, and for the cut-set bound may distribute his/her secure keys to the unauthorized ones. In the future works, we will try to improve the SE scheme to handle these challenge problems.

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