ADVANCE RESEARCH METHODS QUANTITATIVE & QUALITATIVE TECHNIQUES

Summer Final Exam

(Time Allowed: 04 hours)

Marks:50

Q 1. What are the basic steps for conducting a research Explain with a schematic diagram. (**10 Marks)**

Q 2. Distinguish between basic and applied Research. **(10 Marks)**

Q 3. Differentiate between any two types of research methodology. **(10 Marks)**

Q 4. Give an introduction to Mixed Methods Research and identify situations in which mixed methods research can be applied. **(10 Marks)**

Q 5. Give a brief overview of your final research project. **(10 Marks)**

Q 1. What are the basic steps for conducting a research Explain with a schematic diagram.

ANS:

There are a variety of approaches to research in any field of investigation, irrespective of whether it is applied research or basic research. Each particular research study will be unique in some ways because of the particular time, setting, environment, and place in which it is being undertaken. Nevertheless, all research endeavors share a common goal of furthering our understanding of the problem and thus all traverse through certain basic stages, forming a process called the research process.

These 8 stages in the research process are;

1. Identifying the problem.
2. Reviewing literature.
3. Setting research questions, objectives, and hypotheses.
4. Choosing the study design.
5. Deciding on the sample design.
6. Collecting data.
7. Processing and analyzing data.
8. Writing the report.

Step – 1: Identifying the Problem

The first and foremost task in the entire process of scientific research is to identify a research problem. A well-identified problem will lead the researcher to accomplish all-important phases of the research process, starting from setting objectives to the selection of the research methodology. But the core question is: whether all problems require research. We have countless problems around us, but all that we encounter do not qualify as research problems, and thus, these do not need to be researched. Keeping this point in view, we must draw a line between a research problem and a non-research problem.

Step – 2: Reviewing of Literature

A review of relevant literature is an integral part of the research process. It enables the researcher to formulate his problem in terms of the specific aspects of the general area of his interest that has not been so far researched. Such a review, not only provides him exposure to a larger body of knowledge but also equips him with enhanced knowledge to efficiently follow the research process. Through a proper review of the literature, the researcher may develop the coherence between the results of his study and those of the others. A review of previous documents to similar or related phenomena is essential even for the beginning researchers. To ignore the existing literature may lead to wasted effort on the part of the researchers.

Step – 3: Setting research questions, objectives, and hypotheses

After discovering and defining the research problem, researchers should make a formal statement of the problem leading to research objectives.An objective will precisely say what should be researched, to delineate the type of information that should be collected, and provide a framework for the scope of the study. The best expression of a research objective is a well-formulated, testable research hypothesis. A hypothesis is an unproven statement or proposition that can be refuted or supported by empirical data. Hypothetical statements assert a possible answer to a research question.

Step -4: Choosing the study design

The **research design** is the blueprint or framework for fulfilling objectives and answering research questions. It is a master plan specifying the methods and procedures for collecting, processing, and analyzing the collected data. There are four basic research designs that a researcher can use to conduct his or her study;

Step – 5: Deciding on the sample design

Sampling is an important and separate step in the research process. The basic idea of sampling is that it involves any procedure that uses a relatively small number of items or portions (called a sample**)** of a universe (called population**)** to conclude the whole population. It contrasts with the process of complete enumeration, in which every member of the population is included. Such a complete enumeration is referred to as census**.** A population is the total collection of elements about which we wish to make some inference or generalization.

Step – 6: Collecting data

The gathering of data may range from simple observation to a large-scale survey in any defined population. There are many ways to collect data. The approach selected depends on the objectives of the study, the research design, and the availability of time, money, and personnel. With the variation in the type of data (qualitative or quantitative) to be collected, the method of data collection also varies. The most common means for collecting quantitative data is the structured interview.

Step-7: Processing and Analyzing Data

Data processing generally begins with the editing and coding of data. Data are edited to ensure consistency across respondents and to locate omissions, if any. In survey data, editing reduces errors in the recording, improves legibility, and clarifies unclear and inappropriate responses. In addition to editing, the data also need coding. Because it is impractical to place raw data into a report, alphanumeric codes are used to reduce the responses to a more manageable form for storage and future processing. This coding process facilitates processing the data. The personal computer offers an excellent opportunity in data editing and coding processes.

Step-8: Writing the report – Developing Research Proposal, Writing Report, Disseminating and Utilizing Results

The entire task of a research study is accumulated in a document called a proposal. A research proposal is a work plan, prospectus, outline, an offer, a statement of intent or commitment from an individual researcher or an organization to produce a product or render a service to a potential client or sponsor. The proposal will be prepared to keep in view the sequence presented in the research process. The proposal tells us what, how, where, and to whom it will be done.

Q 2. Distinguish between basic and applied Research.

ANS:

Basic research is meant to expand one's current knowledge while applied research is aiming to solve particular life problems.

Research is commonly defined as a systematic investigation with the intent to verify facts and generate updated conclusions. Regarding its utility, research is divided into two: basic and applied. Many researchers suggest that these are closely working with each other as basic research is a platform which applied research often uses to solve real life problems. Also, basic research employs technology (which was developed by applied research) to address its objectives. Thus, these inquiries form a cycle of advancement.

Generally, applied research deals with particular topics which have direct practical relevance. On the contrary, basic research is mainly motivated by the expansion of knowledge and seek to answer questions that are not related to direct applications. The following concepts delve into such distinctions.

What is Basic Research?

Basic research is also known as fundamental or pure research since it is mainly concerned with the improvement of scientific knowledge. The purpose of basic research is simply to gather more information to further understand existing phenomena specially in the field of natural sciences. Its focus is on supporting as well as challenging assumptions which aim to explain various phenomena. Pure research looks at the "big picture" in the sense that it looks for overall factors and related postulates. Hence, fundamental research is purely theoretical as it delves into basic laws and principles.

What is Applied Research?

The purpose of applied research is to know more about a certain real-world problem and take steps to solve it. It focuses on the application of natural science principles on practical difficulties as well as enhancing innovations. Such studies are often associated with the fields of business, economics, health, and politics. For instance, a company may hire an applied researcher to look into the best way of hiring applicants and placing employees in connection with the organization's various positions. Many applied researchers utilize the naturalistic observation method to verify existing social difficulties and then conduct experiments to ascertain solutions. However, data gathering challenges such as ethics and validity issues may arise specially when testing procedures may pose harm for humans and animals. Thus, restrictions are applied in employing the respective study procedures.

Q 3. Differentiate between any two types of research methodology.

ANS:

Difference between two types of research Qualitative Research and Quantitative Research?

Qualitative Methods	Quantitative Methods
Methods include focus groups, in-depth interviews, and reviews of documents for types of themes	Surveys, structured interviews & observations, and reviews of records or documents for numeric information
Primarily inductive process used to formulate theory or hypotheses	Primarily deductive process used to test pre-specified concepts, constructs, and hypotheses that make up a theory
More subjective: describes a problem or condition from the point of view of those experiencing it	More objective: provides observed effects (interpreted by researchers) of a program on a problem or condition
Text-based	Number-based
More in-depth information on a few cases	Less in-depth but more breadth of information across a large number of cases
Unstructured or semi-structured response options	Fixed response options

No statistical tests	Statistical tests are used for analysis
Can be valid and reliable: largely depends on skill and rigor of the researcher	Can be valid and reliable: largely depends on the measurement device or instrument used
Time expenditure lighter on the planning end and heavier during the analysis phase	Time expenditure heavier on the planning phase and lighter on the analysis phase
Less generalizable	More generalizable

Qualitative Research

Qualitative Research is primarily exploratory research. It is used to gain an understanding of underlying reasons, opinions, and motivations. It provides insights into the problem or helps to develop ideas or hypotheses for potential quantitative research. Qualitative Research is also used to uncover trends in thought and opinions, and dive deeper into the problem. Qualitative data collection methods vary using unstructured or semi-structured techniques. Some common methods include focus groups (group discussions), individual interviews, and participation/observations. The sample size is typically small, and respondents are selected to fulfil a given quota.

Quantitative Research

Quantitative Research is used to quantify the problem by way of generating numerical data or data that can be transformed into usable statistics. It is used to quantify attitudes, opinions, behaviors, and other defined variables – and generalize results from a larger sample population. Quantitative Research uses measurable data to formulate facts and uncover patterns in research. Quantitative data collection methods are much more structured than Qualitative data collection methods. Quantitative data collection methods include various forms of surveys – online surveys, paper surveys, mobile surveys and kiosk surveys, face-to-face interviews, telephone interviews, longitudinal studies, website interceptors, online polls, and systematic observations.

Q 4. Give an introduction to Mixed Methods Research and identify situations in which mixed methods research can be applied.

ANS:

Mixed methods research is a methodology for conducting research that involves collecting, analyzing and integrating quantitative (e.g., experiments, surveys) and qualitative (e.g., focus groups, interviews) research. This approach to research is used when this integration provides a better understanding of the research problem than either of each alone.

Quantitative data includes close-ended information such as that found to measure attitudes (e.g., rating scales), behaviors (e.g., observation checklists), and performance instruments. The analysis

of this type of data consists of statistically analysing scores collected on instruments (e.g., questionnaires) or checklists to answer research questions or to test hypotheses.

Qualitative data consists of open-ended information that the researcher usually gathers through interviews, focus groups and observations. The analysis of the qualitative data (words, text or behaviours) typically follows the path of aggregating it into categories of information and presenting the diversity of ideas gathered during data collection.

Mixed methods research can be applied

Mixed methods research is particularly suited:

When one wants to validate or corroborate the results obtained from other methods.

When one needs to use one method to inform another method. For instance, when little is known about a topic and it is necessary to first learn about what variables to study through qualitative research, and then study those variables with a large sample of individuals using quantitative research.

When one wants to continuously look at a research question from different angles, and clarify unexpected findings and/or potential contradictions.

When one wants to elaborate, clarify, or build on findings from other methods. For instance, if a causal relationship has being established through experimental research but one wants to understand and explain the causal processes involved through qualitative research.

When one wants to develop a theory about a phenomenon of interest and then test it. Usually, qualitative research is more suitable to build theory, while quantitative research provides a better way of testing theories.

When one wants to generalize findings from qualitative research.

Q 5. Give a brief overview of your final research project.

ANS:

Expanding Orbit Search (EOS) in
Ad hoc On Demand Destination Vector Protocol

Abstract- Expanding ring search suffers from redundant broadcasts that cause routing overhead and energy wastage. B-ERS eliminates redundancy of RREQs at the cost of the latency of route discovery. In this paper, we have proposed an Expanding Orbit Search (EOS) technique that eliminates redundancy of RREQs without incurring any latency of route discovery.

Keywords- Route Request Group Id; ACK Counter; Expanding Ring Search (ERS); ACK Message; Relay node; Peripheral node.

I. Introduction

Ad hoc On demand Destination Vector routing protocol is a reactive routing protocol that initiates route discovery process only when a source node needs to send packets to an unknown destination using broadcasting techniques such as Global flooding or Expanding Ring Search.

Expanding Ring Search is an efficient way to reduce the overhead of the global flooding. However, it still has some disadvantages that need to be overcome. In this paper, we propose a scheme which makes the ERS based route discovery process more energy efficient. This technique reduces the number of re-transmitting request messages in the route discovery process that reduce the network overhead and save energy consumption.

II. Related Works

(a). Expanding Ring Search [5]

The main purpose of the Expanding Ring Search is to find those intermediate nodes that have the route information to the destination node by restricted flooding of RREQs. If the source node does not have the route to the destination, it initiates the route request with smaller value of TTL. It re-initiates the route request with greater value of TTL in order to search larger area if the previous RREQ fails to find the required information of the destination node. This technique performs searching based on the Bread First Search centered at the source node.

Even with the controlled manner of flooding, expanding ring search suffers from energy inefficiency as the RREQs with greater value of TTL have to visit those nodes that have already been visited by the RREQs with smaller value of TTL in the preceding ring search.

(b). Blocking Expanding Ring Search [6]

Blocking expanding ring search does not resume its route search procedure from the source node each time a rebroadcast is required. Once an intermediate node receives an RREQ, they wait for waiting time before re-broadcasting the RREQ. The waiting time is calculated as:

$$\text{Waitingtime}=2H(\text{Node\_Traversal\_Time}) \quad (1)$$

If a node finds the route information to the destination node, this intermediate node is a route node. The route node sends the RREP message back to the source node. On receiving the RREP, the source node broadcasts ‘stop instruction’. The stop instruction message is flooded up to all the nodes, that have the same hop number as the route node that originated the RREP. Those nodes then drop RREQ and stop the route discovery process. If the intermediate nodes do not receive ‘stop instruction’ within WaitingTime, they rebroadcast the RREQ.

B-ERS introduces a waiting time at each intermediate node, thus increasing the route discovery latency. Also, extra message

(stop_instruction) is broadcasted up to the route node / destination node in order to stop the flooding of the RREQs.

III. Proposed Expanding Orbit Search (EOS)

In the proposed Expanding Orbit Search technique, the mobile nodes in MANETs are logically divided into orbits centered at the Source node [Figure 1] based on the value of TTL (Time to Live).

The Source node initiates the RREQ with initial value of TTL if it does not have the required information about the source node. If the source node does not receive the RREP within a stipulated timeout, it initiates another RREQ with larger number of TTL value. This new RREQ does not visit all the nodes in the inner orbit; rather, it will enter the outer orbit through the relay nodes and is broadcasted within the outer orbit only.

In Expanding Orbit Search, the RREQ is routed like breadth first search within an orbit and across the orbit in a depth first search manner. The relay node takes the RREQ from the inner orbit into the outer orbit.

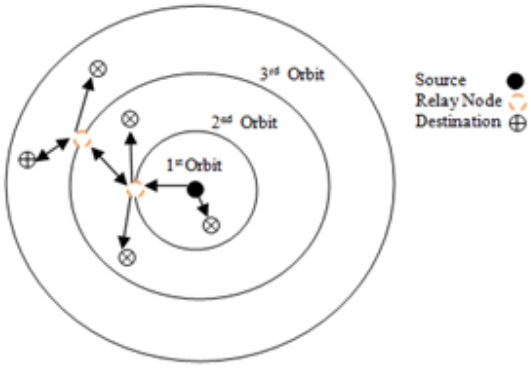

Figure 1

(a). Format of Route Request Message

The route request message has two extra fields i.e, RReq_Group_Id and Ack_Counter.

<source_addr,

source_sequence_#,

broadcast_id, dest_addr,

dest_sequence_#,

hop_cnt, rreq_group_id, ack_counter>

The set of RREQs with different values of TTL originating from the source is grouped together and assigned a unique value of Route Request Group ID. On receiving the RREQ, the intermediate node can determine the uniqueness of the RREQ on the basis of Route Request Group ID and the Source ID <Source ID, RREQ_GroupID>.

These two additional fields are also added in the routing table of the node.

(b). Calculation of the Value of Route Request Group ID and the Acknowledgement Counter

The value of the Route Request Group ID and the Ack Counter is calculated dynamically at the source node. The following table shows how to calculate these two values:

RREQ ID	TTL Value	Ack_Counter = $(\frac{TTL+1}{2}-1) \bmod 13$	RREQ_Group_ID= (ReqId-AckCount)
10	1	0	10 – 0 = 10
11	3	1	11 – 1 = 10
12	5	2	12 – 2 = 10
13	7	3	13 – 3 = 10
14	35	4	14 – 4 = 10
15	1	0	15 – 0 = 15
16	2	1	16 – 1 = 15
17	3	2	17 – 2 = 15

Table: 1

In an Expanding Ring Search, the source node initially uses a TTL =

TTL_START in the RREQ packet. If the RREQ times out without a corresponding RREP, the source node broadcasts another RREQ with greater value of TTL with increment k (k=2) till threshold value of TTL reaches (k=7). After threshold value, the TTL value is set to NET_DIAMETER (TTL=35) [2].

(c). Processing and Forwarding RREQ

The source node initiates the route discovery with initial value of TTL inside the RREQ. The intermediate node receives the RREQ and compares the value of Route Request Group Id with the value of Route Request Group Id in its routing table. If these two values are not the same, the node rebroadcasts it to its neighboring nodes. Before rebroadcasting the RREQ, the node saves the RREQ parameters in its routing table [Figure 2].

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Steps performed upon receiving the RREQ
1:  The source initiates the RREQ
2:  The intermediate node compares RREQ Group ID
3:  If comparison is false
4:      save RREQ parameters in routing table
5:      rebroadcast the RREQ
6:  If comparison is true
7:      Then compares ACK Counter value
8:          If comparison is true
9:              re-broadcast RREQ
10:             update the routing table
11:         else
12:             update the routing table
13:             discards RREQ
```

Figure 2: Steps performed by each node to process RREQ

(d). Originating and Processing ACK Message

If the relay node (boundary node) that receives the RREQ for the first ring search, has more neighbors to visit, it increments the value of ACk Counter from $ACK\_Counter_i$ to $ACK\_Counter_{i+1}$, saves it in the routing table and sends ACK message with incremented ACK Counter value back to the source. The Ack message is stopped one hop away from the source in order to avoid storming at the Source by the ack messages from different sides. The intermediate nodes along the reverse path to the source node read the value of ACK Counter from the ACK message and save it in their routing tables. If an intermediate node receives duplicate ACK message with same ACK Counter value from its two neighbors, it processes only one ACK and discards the other.

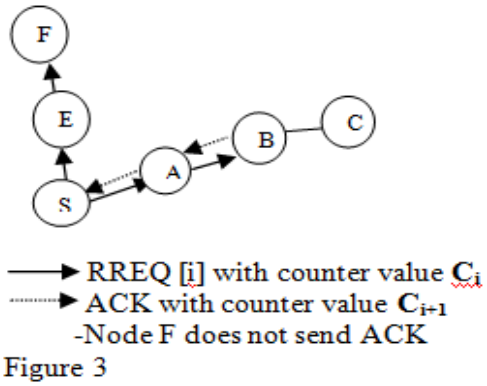

Figure 3

On the other hand, if the peripheral node does not have more neighbors to visit, it does not send the ACK message back to the source node. The subsequent ring search traversal will not visit to this path again. In this way, this technique reduces much of the network overhead [Figure 3- 4].

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Originating and processing the ACK message
1:  If the relay node has more neighbors to visit
2:      Increment the ACK Counter
3:      Save it in the routing table
4:      originate ACK with incremented ACK Counter
        along the reverse path to the source
5:      Each node along the reverse path reads
        the value of ACK Counter and saves it
        in its routing table
6:  Else
7:      Do not generate ACK
```

Figure 4: Processing ACK message by each node along the reverse path to the source

Our proposed scheme (EOS) performs better than ERS in terms of energy efficiency.

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