IMRAS

Indonesian Journal of Scientific Education

ISSN: 2654-8259

MULTIDISCIPLINARY SCIENTIFIC JOURNAL

MODERN EDUCATIONAL TECHNOLOGY

ACADEMIC SCIENTIFIC RESEARCH

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SIMULATION AND IMPLEMENTATION OF NETWORK TOPOLOGY USING NS2

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ABSTRACT

Data communication and networking are changing the way we do business and the way we live.The development of the personal computer brought about tremendous changes for business, industry,science and education.A similar revolution is occurring in data communication and networking.Technological advances are making it possible for communication links to carry more and faster signals.As computer networks evolved, it has changed whole idea of communication which provides lot of benefits to the user.Research in data communication and networking has resulted in number of new technologies.One of the most popular technology of computer network is internet.The internet was invented with goal of exchanging data such as text,audio,video and image to any part of world. For interconnectivity between end users, network topology describe the physical appearance and interconnection between arrangement of computers, cables and other component in a data communication network.So we can say network topology is the backbone of any computer network.In this paper, computer networks with different types of topology is implemented and simulated using network simulator NS2.

KEYWORDS:

Computer Network, Network Simulator NS2,Ethernet.

INTRODUCTION

A Computer Network is the group of computers connected together to share resources.The resource can be hardware or software, if it is hardware example is printer shared between number of computers and if it is software example can be application program shared between number of clients.To design the computer network the important component are sender who generates the information, receiver who receives the information, link that connects between two stations, information which travels on link e.g. image, audio, text, video etc , and protocol which is set of rules defined for successful communication.

NETWORK TOPOLOGY

It is the way in which number of computers connected together to share information or it is geometric representation of number of computers connected together.

Types Of Network Topology:

1. Star Topology:

It is the topology in which number of devices are connected to the central hub by point-to-point link i.e. dedicated link between each device.In star topology, all the cables run from the computer to central location where they are connected by a device called Hub.Hub is a device for connecting multiple Ethernet devices together and making them act as single network.If one device wants to send data to another ,it sends the data to the Hub , which then sends that data to all other devices.This is the most common type of topology used in offices, computer labs.

Advantages-
- Easy to install & reconfigure
- Easy troubleshooting
- Failure of any node does not affect system

Disadvantages-
- Failure of hub affects whole system
- Each device requires its own cable

2. Ring Topology:

It is the topology in which each computer is connected to the next computer, with last one connected to the first computer in circular fashion. When any device wants to send data , then data is passed along the ring in one direction , from device to device, until it reaches its destination. In ring topology, each device consist of repeater which regenerates the bits and passes them along. Ring topology are used in high performance networks where large bandwidth is necessary.

Advantages-
- Easy to find cable failure
- To add and remove device requires changing only two connections

Disadvantages-
- Failure of one computer affects whole network
- Unidirectional traffic

3. Bus Topology:

It is the topology in which one long cable acts as a backbone to link all the devices in a network. In bus topology , multiple devices aare connected one by one by means of single cable called as bus. Nodes are connected to the bus cable by drop lines and taps. A drop line is a connection running between the device and the main cable. A tap is a connector that either splices into main cable to create a contact with the metallic core.

When any computer wants to send data to other computer, then it will send that data to bus first, all the computers on the network receives the information but only destination node accepts it and all other reject that information.

Advantages-

- Easy to install
- Easy to use
- Low cost

Disadvantages-

- Difficult to troubleshot bus topology
- Heavy network traffic can slow down bus
- Failure of cable affects all devices

4. Mesh Topology:

It is the topology in which every device has a dedicated point-to-point link to every other device. The term dedicated means that the link carries traffic only between the two devices it connects.

Here Node 1 must be connected to n-1 nodes, Node 2 must be connected to n-1 nodes, finally node n must be connected to n-1 nodes. Therefore for mesh topology we need n(n-1)/2 duplex mode lines.

Advantages-

- Privacy and security
- Easy fault identification & fault isolation

Disadvantages-

- Difficult to install

SIMULATION IN NS2

1.Star Topology Implementation

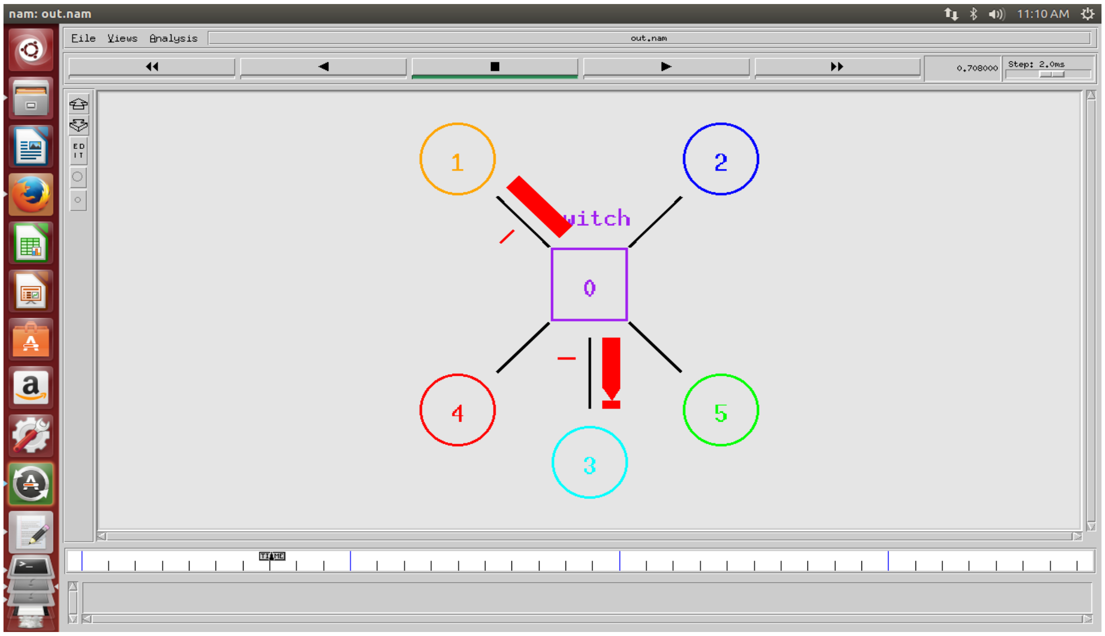

Figure 1. Star Topology

The simulation and implementation of star topology using NS2 is shown in figure 1. Here switch is used as central device instead of hub. Five nodes are connected to switch with duplex links. Node 1 is the source node and node 3 is the destination. Node 1 will forward the data to switch first and then switch will send that data to specific destination i.e. node 3. Node 3 then will send acknowledgement to node 1. Here CBR traffic is assigned between node 1 & 3 shown by red color.

2. Ring Topology Implementation

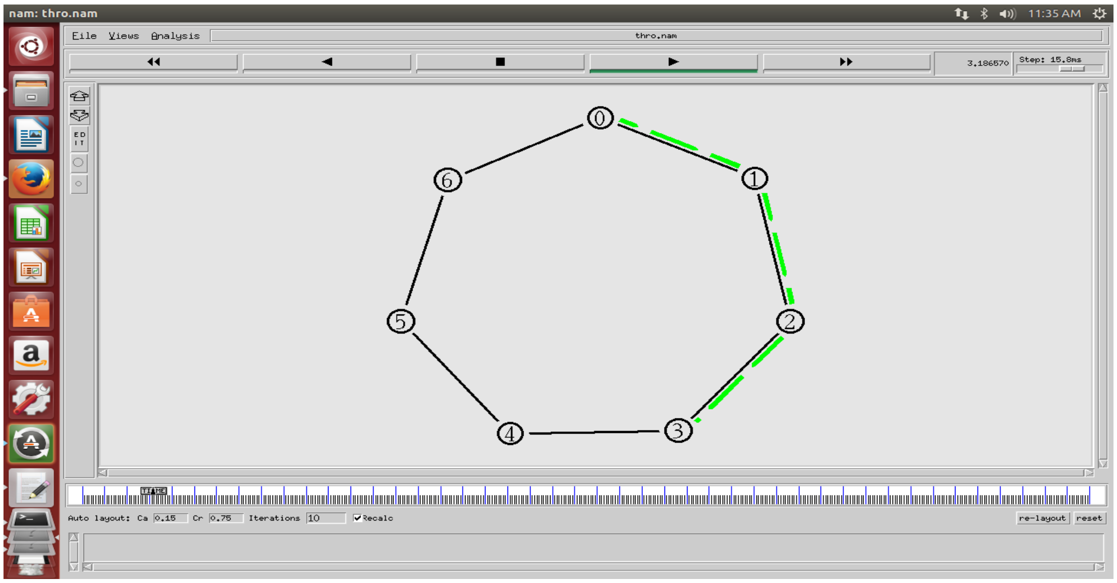

Figure 2. Ring Topology

The simulation and implementation of ring topology using NS2 is shown in figure 2. Here seven nodes are used in ring topology. Node 0 is the source and Node 3 is the destination and data is send from node 0 to node 3 via node 1 & 2.

3. Bus Topology Implementation

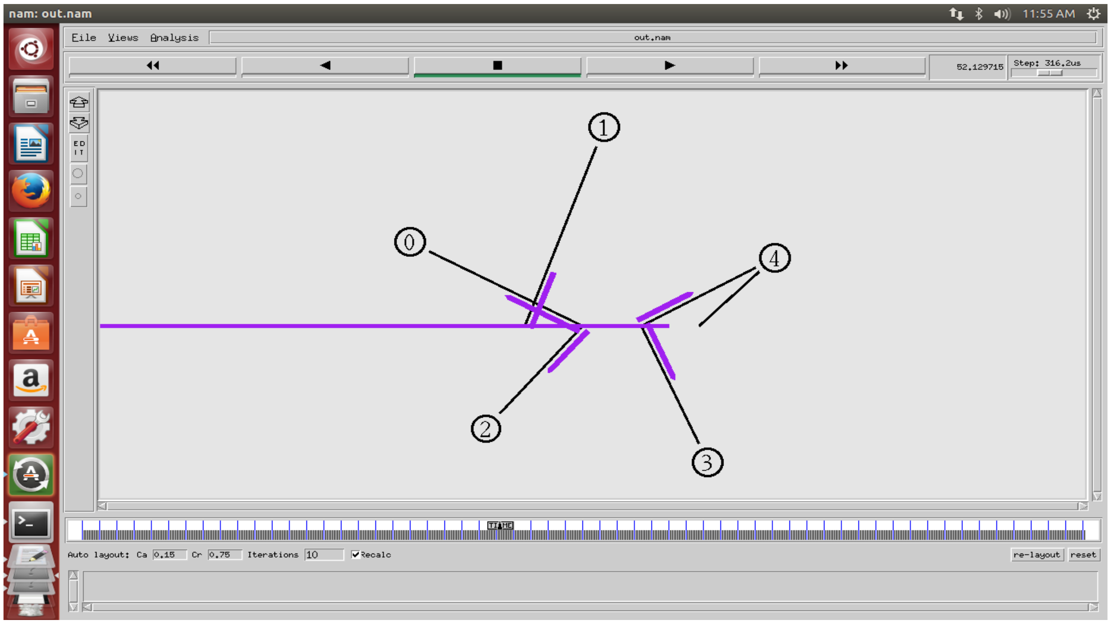

Figure 3. Bus Topology

The simulation and implementation of bus topology using NS2 is shown in figure 3. Here five nodes are connected to central bus link. When any node wants to send data then that data will be send to all other nodes connected to bus via bus link and only destination node will accept data ,other all nodes will reject data.

4. Mesh Topology Implementation

The simulation and implementation of mesh topology using NS2 is shown in figure 4 below. Here five nodes are connected using dedicated point-to-point link. Node 1 must be connected to n-1 nodes, Node 2 must be connected to n-1 nodes, finally node n must be connected to n-1 nodes. Therefore for mesh topology we need
n(n-1)/2 duplex mode lines.

As five nodes are used therefore duplex mode links required will be 10.In this simulation node 1 is source and node 4 is destination. Here FTP traffic is assigned between node 1 & node 4 shown by blue color.As dedicated link are used this topology provides better security and privacy.

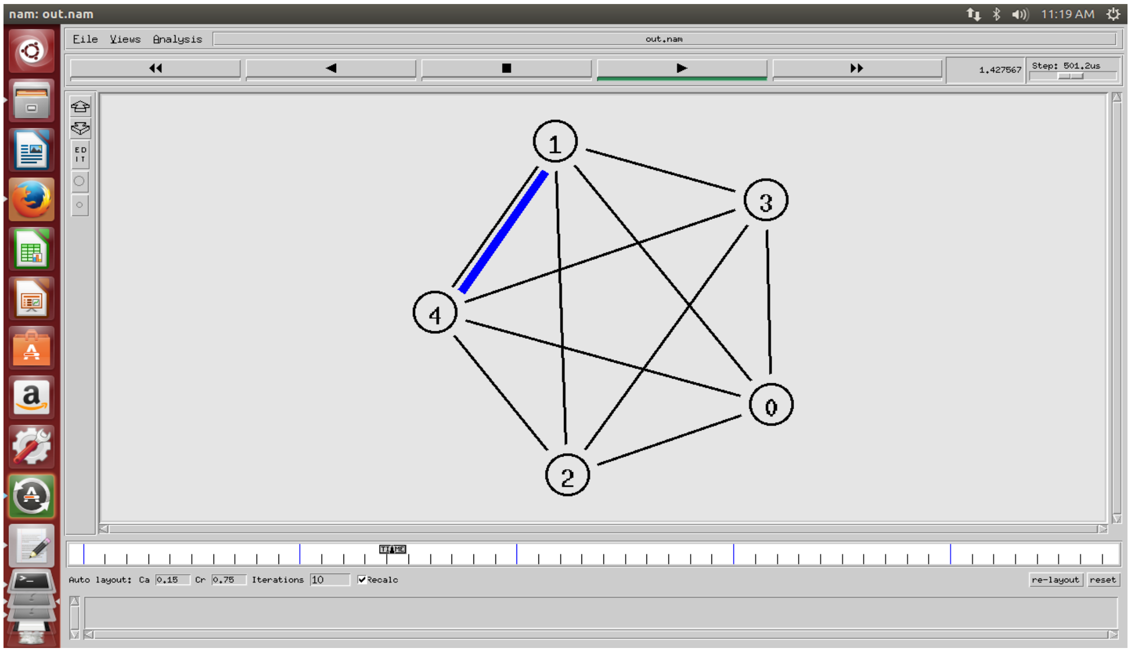

Figure 4. Mesh Topology

CONCLUSION

In this paper, i have simulated the different types of network topology by configuring the number of nodes and network devices to it and shown how packets can be transmitted from node to node based on type of topology.

Here i have used network simulator NS2 to simulate the different network topology and understand the practical concept of data communication over different network topology.

REFERENCES

[1] Forouzan, Data Communication and Networking 5th Edition.

[2] The Network Simulator ns-2:Documentation : http://www.isi.edu/nsnam/ns/ns-documentation.html

[3] Marc Greis's tutorial.

MICROROBOTIC SWARMS AND THEIR ROBOTIC DELIVERY APPLICATIONS OFFER NEW VENUES FOR GENE THERAPY DELIVERY

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ABSTRACT:
Over the past decade, microrobotic swarms and their robotic delivery applications have evolved substantially. This review looked at the current advances in microrobotics swarming, navigation, and localization, as well as their applications for targeted imaging-guided distribution. While a substantial effort has been proposed towards in-vivo controlled administration, several restrictions remain. Research opportunities and challenges are presented, with probable solutions on the horizon. Microrobotic Swarm, Controller and Integration of Imaging Modality. Integrating the swarm controller with in vivo imaging technologies is a requirement for in vivo delivery jobs. Trading between imaging and control systems, as well as developing a swarm control scheme based on current imaging systems, is hard to do. Research should focus on integrating swarm navigation and imaging into the same energy source. The toxicity threshold needed depends on where microrobotic swarms are employed. Before establishing therapeutic procedures, the swarms' biocompatibility and toxicity should be evaluated. Swarms in endovascular delivery applications may require a more complete toxicity evaluation, including a range of parameters such as materials, dose, and block size. Research opportunities include bridging customized therapy/delivery and imaging-guided swarm control.

Collective behavior is a rather common phenomenon in the natural world of biology. Individual organisms can communicate with one another, allowing hundreds, thousands, or even millions of them to assemble into a swarm, in which case the individuals engage in a variety of cooperative behaviors. (13) Each collected swarm has the ability to move as a single entity and drastically alter its form in response to environmental stimuli or to meet the requirements of specific tasks. Ants connect their bodies to construct rafts that can withstand floods and carry large-size food in a collecting mode, whereas honeybee swarms increase collective stability by actively altering their morphology. (4). (5,6) Different types of swarming intelligence and emergent behaviors have served as inspiration for the development of artificial robotic systems that are able to regulate their collective behaviors on demand in order to do tasks that require coordination and are difficult to complete with a single agent. (7,8)

It is now possible to scale down remotely controlled robots that are able to carry out duties on demand. This is made possible by the rapid developments that have been made in nanotechnology and manufacturing. Because of their small size, micro and nanorobots are able to traverse through a variety of physiological environments in a regulated manner by utilizing either external power sources, self-propulsion, or hybrid propulsion (1818). (1922) Thanks to recent developments in manufacturing, actuation, and functionalization, there are now more biocompatible and biodegradable micro and nanorobots accessible on the market. These robots also have a variety of capabilities. (2326) These micro- and nanoscale robots have the potential to be utilized in a wide range of biomedical applications, including minimally invasive surgery, targeted delivery, biosensing, and micromanipulation. Micro and nanorobots, on the other hand, experience challenges when it comes to carrying out practical applications. The small size and volume of micro and nanorobots means that their imaging and control capabilities are severely restricted. Because the technologies used for in vivo imaging have their limitations in terms of resolution and contrast, it might be challenging to image and localize these extremely small micromachines in real time. Due to the fact that they have such a low driving force, microrobots are challenging to control in dynamic environments like blood arteries. The navigational efficiency is hindered by environmental disturbances, which also makes the application method more time demanding. In addition, as a single micro or nanorobot has such a small size and volume, it is possible that it cannot be used as an effective end effector or drug carrier. When compared to the use of individual agents, employing microrobotic swarms in delivery activities has a number of advantages. First and foremost, there is a higher tolerance for the structural and material simplicity of the construction components. When scaling down to the sub-millimeter or micro/nanometer scale, it is possible that an individual micro/capacity nanorobot will be damaged, but the capabilities of the group as a whole can be improved. The greater capacity to carry out one's assigned delivery responsibilities is the second advantage. Individual microrobots and nanorobots are incapable of completing delivery tasks that may be completed by collective microrobots and nanorobots. These tasks include managing a large number of objects in a batch, transporting large payloads, and engaging in many activities at the same time.

The third advantage is a greater capacity to adjust to difficult circumstances. The change of a collective pattern in in-vivo conditions enables improved job performance in restricted, constricted lumens (for example, blood arteries, bile ducts, and pancreatic ducts). Finally, increased medication and material distribution capability. In contrast, because to the size limitation, the amount of medications or materials that an individual agent may load may approach a critical limit. This limit may be reached when the agent reaches its maximum capacity. A number of imaging devices have seen improvements to their contrast, which brings us to the fifth point. A gathered microrobotic swarm has the potential to improve the contrast of medical imaging (for example, ultrasound imaging or magnetic resonance imaging), and microswarms made of mixed or heterogeneous building blocks are suitable for multiple imaging modalities, indicating significant promise for localized therapy.

Before putting microrobotic swarms to use in real-world scenarios, there are several crucial steps that need to be investigated first. Interactions between building blocks subjected to a variety of energy inputs have a significant impact on pattern development and control, which includes collective construction and motion control in a variety of contexts. Movement as a group and morphological change both facilitate an increased potential for adaptation to a wide variety of environments.

Pattern localization is required in order to carry out practical applications, and the imaging system must be compatible with the control system in order for those systems to work together. In conclusion, it is possible to build image-guided delivery depending on the application location and the delivery objects by combining an awareness of the fundamental differences between the various forms of microrobotic swarms with the incorporation of imaging modalities. In order to exploit active-matter swarms from a robotic delivery point of view, recent breakthroughs in the collective behavior of externally power-driven micro/nanorobots and their applications in imaging-guided distribution are being evaluated and addressed. This is being done in order to utilize active-matter swarms. In the context of swarm formation in response to external fields (such as magnetic fields, light, acoustic fields, and electric fields), the fundamental interactions between building blocks and agent-boundary interactions are described and studied. The next topic of conversation will be about the collective motion and pattern navigation of microrobotic swarms, as well as the interactions between the swarm and its surrounding environment. In order to localize a swarm in biological and opaque contexts, a summary and comparison of swarm localization in various imaging modalities is presented, and the integration of control systems with imaging approaches is investigated. In conclusion, the current state of remotely driven microrobotic swarm delivery is presented through an overview of research activities on imaging-guided delivery of swarming micro and nanorobots. By putting an emphasis on the work that is being done right now on the collective behaviors of external-power driven micro/nanorobots, it is our goal to provide practitioners with some useful information that they can use to bring external power-driven microrobotic swarms to imaging-guided targeted delivery and localized treatment.

The environment is the primary driver of pattern formation and navigation.

Collective behaviors in micro- and nanorobots are the result of fundamental interactions between the individual robots. In a variety of contexts, the capacity for customisable interaction provides a mechanism for the formation of swarms, navigation, and pattern change. This section will begin with a general discussion of the effects that external fields, such as magnetic fields, light, acoustic fields, and electric fields, have on the interactions that take place between microrobots and nanorobots. There is also some discussion of hybrid field interactions, such as the coupling of magnetic and acoustic fields, among other examples. Following this, a comparison and summary of the creation and navigation of swarms under a variety of field inputs is presented.

Swarm of magnetically driven microrobots

Their ability to dynamically grow into a variety of patterns is made possible by the interactions between magnetic agents, which are magnetized by the presence of external magnetic fields. Magnetic agents are materials that can be either ferromagnetic or paramagnetic, and their magnetic properties are considerably altered when magnetic fields are applied to them. According to the magnetization curve of ferromagnetic materials (such as Fe, Co, and Ni), the hysteresis is evidence that ferromagnetic materials (such as Fe, Co, and Ni) retain their magnetism after being magnetized by an external field. The magnetic moments have a tendency to align themselves with the external field when a weak magnetic field is added to the system. The magnetism of paramagnetic materials disappears when an external field is removed from the system. Nanoparticles of iron oxide, for instance, are a material that is frequently used in microrobotic manipulation and targeted distribution techniques. (84,85) The adjustable interactions that occur between the paramagnetic particles provide a mechanism for organizing them into complicated patterns, which may then be analyzed. Magnetic interaction-induced swarms, hydrodynamic interaction-induced swarms, and weakly interacted swarms are the three categories that we use to classify magnetic-field-driven microrobotic swarms. These categories are based on the formation methods that are used to govern the swarm's formation.

Magnetic interactions can cause swarms of particles.

The formation of magnetic interaction-induced swarms is determined by magnetic agent-agent interactions, which may be controlled by the magnetic field that is applied to the system. The subjected magnetic force F is determined by the induced magnetic moment m of a single magnetic agent as well as the field gradient B. The magnetic moment m is dependent on the materials and volume of the agent, as is the magnetic permeability, where 0 is the permeability of free space and V is the volume of the magnetic materials. During the process of swarm formation, a number of agents are brought together one by one, and each agent is subjected to the magnetic force exerted by the other magnetic agents. (87)

The magnetic force that exists between two agents can be reduced to the interaction of two magnetic dipoles (mi and mj, located at Pi and Pj), where rij = Pi - Pj and r is the unit vector that connects the two dipoles. The use of rotating magnetic fields has allowed for the introduction of interactions between the agents. The formula for an in-plane rotating field looks like this: B (t) = B [cos (2 ft) x – sin (2 ft), where B denotes the field strength and f denotes the frequency. The magnetic force that exists between the microrobots shifts throughout the actuation process, reaching its peak value when the two moments mi and mj are perpendicular to rij and becoming repulsive when they are normal to rij. Due to the prolonged interaction, attraction is developed over time, which leads to the accumulation of magnetic microrobots. In the presence of a rotating magnetic field, the paramagnetic particles will arrange themselves into a pattern that is circular and revolves on itself. (53) When the external field is withdrawn, the dipole-dipole interactions disappear, which results in the formed pattern becoming disassociated.

In addition to the direct interactions between particles, microrobotic patterns that were formed by interactions between particle chains have been discovered in a precessing magnetic field. These patterns were observed in a precessing magnetic field. Particle chains are established as a result of magnetic attraction between individual particles, and swarms are generated when magnetic dipolar attraction and magnetic multipolar repulsion between individual particle chains are brought into equilibrium. The precession angle of the input field is used as a part of the adjustment process for the magnetic dipolar interaction. The magnetic interaction can be both repulsion (0° 54.7°) and attraction (54.7° 90°), depending on the angle it makes with the spinning axis. The mean interaction between mi and mj throughout a cycle is given as (88), where it is the precession angle to the spinning axis. When equal to 54.7 degrees, the dipolar interaction is considered to have an average value of zero (the magic angle). In order to create particle chain attraction, it is set between 68 and 72 degrees, and the pairwise distance is adjusted so that it converges to a range that is dynamically stable. At an angle of 61.5 degrees, the dipole-hexapole interaction predominates the repulsive multipolar interaction, which results in attraction over a long range and repulsion over a short range. (89) At the nanoscale level, magnetic building components can likewise be gathered into swarm states. An oscillating field causes the interaction between nanoparticle chains, which results in the formation of a microswarm in the shape of a ribbon. (43,52)

The magnetic chain-chain interactions are affected by the input parameters, which include field intensity, frequency, and field ratio. Field ratio is defined as the ratio of alternating to constant fields. Other input parameters include field frequency. In a regime with a low Reynolds number, an actuated particle chain can be produced by striking a balance between the principal two torques, which are the magnetic torque m and the hydrodynamic drag torque d from viscous fluids. The sum of the magnetic torques that are exerted on the chain's center (N particles with a radius a) can be calculated by combining the torques of the particles that surround the chain's center, where ri is the distance between the first particle and the chain's center and m2 (t) is the induced dipole moment of a particle. This calculation yields the total magnetic torque that is exerted on the chain's center.

The viscous drag of a chain moving at an angular velocity (t) can be determined by applying the formula (90), where the viscosity of the fluid that the chain is moving through serves as the variable. Calculating chain length requires the use of the Mason number, which is defined as the ratio of the two torques (RT = d/m). This ratio is employed. If the RT is greater than one, then the chain is not stabilized by the magnetic torque. When one goes beyond the state of oneness, the enormous viscous drag that results creates fragmentation. Examining a vital case in which the two torques balance each other out prior to chain fragmentation (RT = 1) allows for the determination of the chain length, which is denoted by the equation L = 2Na. During the process of swarm formation, the nanoparticle chains are produced, destroyed, and collected in a dynamic manner. There are time-dependent interactions between chain chains. At long last, a ribbon-like swarm pattern is created using the arrangement of millions of nanoparticles.

Swarms Resulting from the Interaction of Hydrodynamic Forces

Contact with the hydrodynamic environment is an essential step in the creation of microrobotic systems. The actuation of building blocks causes disturbances in the surrounding fluid and deforms interfaces (such as the air-liquid interface and the liquid-liquid interface), which in turn has an effect on the collective state and the interaction between patterns and their environments. Microrobotic swarms are known as hydrodynamic interaction-induced swarms, and they are formed primarily as a consequence of interaction that is imposed by means of the medium (for example, hydrodynamic flow and interface). When the Reynolds number of the surrounding environment is low, a vortex will form around a chain of spinning nanoparticles. It is able to attract adjacent chains from a great distance away, hence decreasing the distance that separates them. The accumulation of nanoparticles is the consequence of the combination of two vortices that rotate in the same direction and meet after a predetermined distance. After a situation of equilibrium has been reached, a circular pattern will begin to take shape over time. (51) The vortex-based analysis can also be utilized in the process of determining the collective state of the swarm. Because of the activation of the external rotating magnetic field, the turbulence that is currently present in the core region of the swarm will not diminish. (91) As a consequence of this, the vorticity (z) and velocity (u) distributions inside the core of the vortex become, where the circulation of the vortex is represented by 0 and the radius of the vortex is represented by R. Because of the viscosity of the fluid, the level of vorticity diminishes with increasing distance from the core.

In the domain with a low Reynolds number, inertia forces are not taken into account. Where v is the kinematic viscosity of the fluid being modeled, the vorticity and velocity distributions outside of the vortex center become. Because of this, the size of a swarm that resembles a vortex is determined by the inner interactions that take place between the core area and the nanoparticles. At the same time, the particle chains revolve around their own axis and orbit the center of the swarm. Even though both are controlled by rotating magnetic fields, a swarm that is produced by hydrodynamic interactions is very different from a swarm that is guided by magnetic interactions. The magnetic interaction that governs the swarm causes it to behave like a rolling disk. This is caused by the strong magnetic attraction that exists between the various construction components.

It is possible to compute the velocity distribution by using the formula ui = 2fRci, where Rci is the distance that exists between the first particle and the center of the pattern. After being driven upward by a rotating magnetic field, a swarm of helical microrobots reaches the upper air-liquid interface and forms a co-rotating swarm pattern there. In this particular instance, the rotation-translation coupling, which can be compared to the dynamic self-assembly of spherical particles, predominates the hydrodynamic effect. (93) The hydrodynamic interactions may be adjusted in such a way as to bring about a change in the collective state. Significant hydrodynamic repulsion between rotating ferromagnetic microparticle chains leads to the production of dynamic lattices rather than a highly concentrated collected state. This is because dynamic lattices are more stable than highly concentrated collected states. (94) A magnetic field that alternates in direction can also form vortices; the particle density of the constructed pattern can be altered by modifying the field parameters in order to achieve the desired result. (95) The interface is a one-of-a-kind area for the development of swarms, which is significant since capillary contact is present there. At the interface of two different liquids, microparticles can be pushed by an alternating magnetic field to transform into dynamic atoms. (46) The formation of atoms depends on both the magnetic repulsion that exists between chains and the consequent hydrodynamic streaming fluxes. The chains regularly oscillate as a response to the external field, and an excited circular wave is responsible for the establishment of radial ordering of the chains. The distribution of these chains on different slopes of the same wave is what creates the pattern that looks like a field of asters. The presence of top liquid has a profound impact on the hydrodynamic interactions and force balancing occurring within the interior of the system. As a consequence, the development of swarms at the air-liquid interface takes on an entirely different dynamic pattern. Swarm with Only Weak Interactions (97)

DETERMINANTS OF TIMELY INITIATION OF COMPLEMENTARY FEEDING AMONG MOTHERS WITH CHILDREN AGES 6 TO 24 MONTHS AT BANADIR HOSPITAL IN WADAJIR DISTRICT, SOMALIA

Mohamed Abdisalam Dahir
Zakariye Ahmed Jama

ABSTRACT:
Inadequate and inappropriate complementary feeding contribute to excess morbidity and mortality in young children living in low-income households. Before the age of six months, the early or late introduction of complementary feeds can cause displacement of breast milk and an increased risk of infections such as diarrhoea, which contributes to weight loss and malnutrition. As a result, the objective of this study is to identify the determinants that influence the timely initiation of complementary feeding among mothers with children aged 6 to 24 months who visit Banadir hospital.
A descriptive cross-sectional study was conducted in Banadir hospital. The study was conducted on 92 mothers and caregivers with young children aged six months to 2 years, using a non-probability convenient sampling method and a questionnaire to collect data. SPSS statistical software version 20 was used to conduct the analysis. 97.8% of the participants had a normal delivery during childbirth, while 2.2% of the participants had a cesarian section (C-section). The majority of those who took part in the study had regular deliveries. The researchers recommend that all visitors, mothers, and parents to MCHs and other antenatal care (ANC) service centres be counselled on infant and young child feeding practices in order to increase their awareness of feeding issues.
KEYWORDS
Complementary, Semisolid, Weaning, Determinants, Timely initiation

INTRODUCTION

The stage of life when meals and liquid milk are fed to newborns and young children in addition to breast milk is referred to as the complementary feeding phase. The non-breast milk food products ingested at this time are referred to as complementary foods (Agedew and Demissie, 2014). Within the first two years of life, the timing of the introduction of nutritionally adequate, safe, and age-appropriate supplemental feeding is critical for the child's optimal growth, development, and health. Despite several interventions aimed at improving infant and young child feeding patterns and nutritional status, acceptable feeding practices remain far below the recommendation (Agedew, 2014).

At six months of age, complementary feeding consists of giving young children extra foods or fluids in addition to breast milk (WHO, 2002). Around the age of 6 months, a baby's energy and micronutrients begin to surpass what bosom milk can provide. They are formatively prepared to start eating more (reciprocal) food, which is necessary to meet their increased energy and nutritional requirements (WHO, 2010). In addition, the transition period of 6 months to 2 years is a critical window of opportunity to enhance the survival and optimal growth of the child (Khanal, 2011).

Poor complementary feeding practices mean that many children continue to be vulnerable to irreversible outcomes of stunting, poor cognitive development, and a significantly increased risk of infectious diseases such as gastroenteritis, diarrhoea, and acute respiratory infections (Shumey, Demissie, and Berhane, 2013). Undernutrition results in 3 million child deaths annually, accounting for 45% of all causes of mortality (Shumey, Demissie, and Berhane, 2013). Over two-thirds of these deaths are often correlated with inappropriate feeding practices and occur within the first year of life (WHO and UNICEF, 2003).

The World Health Organization (WHO) has highlighted the characteristics of complementary feeding to include a timely introduction, availability, sufficiency, and security. According to the WHO, supplementary feeding should begin at the age of 6 months, with the frequency of non-milk feeding gradually increasing until the child reaches the age of 24 months. It is critical to understand which aspect of complementary feeding is most essential in the development of malnutrition in children. Global complementary feeding practice has been suboptimal (Ogunlesi et al., 2014).

The rate of timely initiation of complementary feeding in South Asian countries is as per the WHO recommendation for lifelong practice (80% - 94%). In this regard, about 71%, 70%, 55%, and 39% of newborns in Bangladesh, Nepal, India, and Pakistan, respectively, are reported to have had timely initiation of complementary feeding (Shumey, Demissie, and Berhane, 2013).

General Objective

The general objective of the study is to identify determinants that influence the timely initiation of complementary feeding among mothers with children aged 6 to 24 months who frequent Banadir hospital in Wadajir district, Somalia.

Specific objectives

1. To determine socio-demographic factors that influence the timely initiation of complementary feeding in children aged 6 to 24 months who attend Banadir hospital in Wadajir district, Somalia.
2. To identify the physiological parameters that influence the timely initiation of complementary feeding among children aged 6 to 24 months who attend Banadir hospital in Wadajir district, Somalia.
3. To evaluate the parental factors that influence the timely initiation of complementary feeding among children aged 6 to 24 months who attend Banadir hospital in Wadajir district, Somalia.

Methods and Materials Research design

This study was descriptive in design because it was intended to describe the determinants of the timely initiation of complementary feeding among children aged 6 to 24 months who attended Banadir hospital in Wadajir district, Somalia. The study was also designed in a cross-sectional manner because the research data was collected in one locatio. The study was also quantitative in design, which enabled the researchers to obtain the numeric value of specific characteristics.

Study area

Banadir Hospital is a public multidisciplinary facility located at the centre of Mogadishu along Banadir Street. Banadir hospital offers a vast range of maternal and pediatric medical services in order to serve the population within its reach adequately.

Research population

Mothers and caregivers with children aged between 6 to 24 months will be the target population of this study.

Sample size

Mothers and caregivers with children aged between 6 and 24 months who are willing to participate in this study during the data collection period.

Sampling procedure

In order to determine sample size, the Slovenes formula is the most suitable method for determining sample size. After calculating, we got 92 participants for the sample size.

Research instruments

In order to acquire research data from the target demographic, a questionnaire was used as a data collection tool.

Validity and Reliability

Validity refers to the relevance of the research instruments to the objective of this study. To establish validity, the questionnaire will be presented to five experts who will rate the relevance of the questions. The content validity of the questionnaire will then be calculated in order for it to be accepted as legitimate.

On the other hand, reliability refers to the respondents' consistency when answering the questionnaire questions. In other words, the instrument can only be reliable if it produces the same results whenever it is repeatedly used to measure the same phenomena with the same participants by other researchers. Reliability was measured using test-retest and stability reliability. Therefore, reliability is the extent to which the same individuals' scores on the same test are consistent over time.

Data gathering procedures

The significant data collection instrument used in this study was primary data, which included a questionnaire and data as study documents. During data collection, the selection of these instruments was guided by the data requirements and the objectives of the study questionnaire. The researchers were determined to gather reliable and valid data.

Data analysis

Data were analysed using the statistical package for social science (SPSS) version 20. A descriptive analysis was conducted, and the results were presented using frequency tables and charts.

Ethical considerations

Respect: The researchers respected respondents' privacy when entering their private sphere and asking questions.

Confidentiality: The researchers guaranteed maximum confidentiality to the participants. Their information will only be used for the purpose of the study.

Freedom to participate: Participants were informed that they were free to participate. They were also informed that they had the right to withdraw from the research.

Informed consent: Consent was secured from the participants after fully informing them of the nature, potential risks, and benefits of the study.

Result

As shown in Table 4.1 above, 37 (40.2%) children were between 11 and 15 months, followed by 32 (34.8%) children who were between 6 and 10 months. Children between the ages of 16 and 20 months were 14 (15.2%), and 9 (9.8%) children were between 21 and 24 months.

45 (48.9%) mothers and caregivers were between 18 and 27 years old. Interesting enough, a similar number of 45 mothers and caregivers were between 28 and 37 years old. Only 2 (2.2%) participants were between 38 and 47 years old. The gender of the children was 53 (57.6%) male and 39 (42.4%) female.

The majority of the respondents, 73 (79.3%), had no formal education, while 17 (18.5%) had primary level education, and 2 (2.2%) had attained a secondary level of education. 80 (87%) participants were unemployed, 12 (13%) were employed, while 78 (84.8%) were married, and 14 (15.2%) were divorced.

Breast problems play a significant influence on the timely initiation of complementary feeding

Strongly disagree	8	8.7
Disagree	18	19.6
Neutral	4	4.3
Agree	52	56.5
Strongly agree	10	10.9
Total	92	100

Over letdown has not played any role in the timely initiation of complementary feeding

Strongly disagree	16	17.4
Disagree	36	39.1
Neutral	8	8.7
Agree	24	26.1
Strongly agree	8	8.7
Total	92	100

To rate the determinants of physiological factors in table 4.2, the Likert scale was used to measure the level of agreement from strongly disagree to strongly agree.

Table 4.2 shows that 90 (97.8%) of the participants had normal childbirth, whereas the remaining 2 (2.2%) had C-sections.

47 (51.1%) participants agreed that postnatal care is a contributing factor to the timely initiation of complementary feeding. 18 (19.6%) participants disagreed, 13 (14.1%) strongly agreed, 11 (12%) strongly disagreed, and 3 (3.3%) were neutral.

A total of 52 (56.5%) participants agreed that breast problems have a substantial impact on the timely initiation of complementary feeding. 18 (19.6%) of them disagreed, 10 (10.9%) strongly agreed, 8 (8.7%) strongly disagreed, and 4 (4.3%) were neutral in their responses.

36 (39.1%) responders disagreed that over letdown had not played any role in the timely initiation of complementary feeding. 24 (26.1%) of the participants were in agreement, whereas 16 (17.4%) strongly disagreed. 8 (8.7%) strongly agreed, while the remaining 8 (8.7%) were neutral in their responses.

Table 4.3 Determinants of parental factors

Antenatal care visit	Frequency	Percent
Yes	72	78.3
No	20	21.7
Total	92	100
If you answered "yes," how many times have you visited?		
1-3 times	49	53.3
4-5 times	19	20.7
6 and more times	4	4.3
Non	20	21.7
Total	92	100
Maternal frequency of feeding per day		
1-2 times	36	39.1
3-4 times	50	54.3
5 and more times	6	6.5
Total	92	100

Place of delivery		
Health facility	62	67.4
Home	30	32.6
Total	92	100
Type of first weaning food		
Cow milk	9	9.8
Potatoes	21	22.8

Powder milk	22	23.9
Other	40	43.5
Total	92	100
Do you visit postnatal care?		
Yes	65	70.7
No	27	29.3
Total	92	100
How many times have you visited a postnatal care clinic?		
One time visit	12	13
Two time visits	17	18.5
Three time visits	23	25
Four time visits	13	14.1
Non	27	29.3
Total	92	100

The data in table 4.3 above shows that the majority of respondents, 72 (78.3%), believed that antenatal care had an effect on the initiation of complementary feeding, whereas only 20 (21.7%) believed that there was no effect.

Those who visited the antenatal care clinic between 1 and 3 times were 49 (53.3%) respondents. 20 (21.7%) of the respondents were not visitors to the antenatal care clinic. Those who visited 4 to 5 times were 19 (20.7%), and 4 (4.3%) had visited six or more times.

50 (54.3%) of the participants stated that their maternal frequency of feeding per day was between 3 and 4 times. 36 (39.1%) of them did it once or twice per day, and 6 (6.5%) participants' maternal feeding frequency was five or more times per day. 62 (67.4%) of the respondents gave birth at a health facility, and 30 (32.6%) gave birth at home.

Other forms of weaning food that was not specified in the questionnaire were chosen by 40 (43.5%) participants. Powder milk was the first weaning food according to the 22 (23.9%) participants. 21 (22.8%) participants stated that potatoes were the first weaning food, while 9 (9.8%) had cow milk as the first weaning food. 65 (70.7%) participants reported that they had gone for postnatal care, whereas 27 (29.3%) had not yet gone.

Out of the 65 participants who had gone for postnatal care, 23 (25%) had visited postnatal care three times. 17 (18.5%) had gone twice, those who had visited four times were 13 (14.1%), and 12 (13%) had visited only once.

Discussion

Using several variables, this study investigated the determinants influencing the timely initiation of complementary feeding among mothers with children aged 6 to 24 months. According to the data analysis, the educational level of the mothers is a contributing factor that impacts the initiation of complementary feeding. The inappropriate introduction of supplemental feeding by illiterate mothers will cause their children to complain.

In this study, postnatal care visits determined that higher postnatal visits, as well as antennal attendance, were positively associated with the infant's prompt introduction of complementary feeding. The frequency with which mothers visit antenatal care is also important because it greatly supports the timely initiation of complementary feeding. The more mothers visit antenatal care, the more they get information related to complementary feeding. Also noted is that over letdown has not played any role in the initiation of complementary feeding as the more the mother's production, the more timely initiation starts because this is related to her knowledge.

This study shows that the type of food initiated first for the infants as complementary feeding food varied and depended upon what they could get or afford to buy. The researchers received the most feedback from participants who had children aged 11 to 15 months. They played a big role in analysing the data collected and summarising the results.

The results with higher rankings were as follows: 37 (40.2%) children were between 11 and 15 months. A total of 90 (97.8%) mothers and caregivers were between 18 and 37 years old, and the gender of male children was 53 (57.6%). The majority of the respondents, 73 (79.3%), had no formal education, and 80 (87%) of the participants
were unemployed. 78 (84.8%) were married, and 90 (97.8%) of the participants had normal childbirth. 47 (51.1%) participants agreed that postnatal care is a contributing factor to the timely initiation of complementary feeding. A total of 52 (56.5%) participants agreed that breast problems have a substantial impact on the timely initiation of complementary feeding. 36 (39.1%) responders disagreed that over letdown had not played any role in the timely initiation of complementary feeding. 72 (78.3%) participants believed that antenatal care had an effect on the initiation of complementary feeding. Other forms of weaning food that was not specified in the questionnaire were chosen by 40 (43.5%) participants, and 27 (29.3%) of the participants mentioned that they had not visited the postnatal care clinics.

Conclusion

The main objective of the study is to identify determinants influencing the timely initiation of complementary feeding among mothers with children aged 6 to 24 months. The research specifically focused on determining socio-demographic factors, identifying physiological factors, and parental factors influencing the timely initiation of complementary feeding among children aged 6 to 24 months. As a result, the evidence in this study reveals that level of education, occupation, mother's age, style of delivery, breast problems, excessive letdown, antenatal care visits, venue of delivery, and postnatal care are all factors to consider.

According to the study's results, as summarised by some of the participants' feedback, the majority of them had an informal educational level. This component, which reduces the optimal commencement of complementary feeding, can be empowered with important health information. This underlines the importance of improving information, education, and communication (IEC) systems and procedures.

45 (48.9%) of the participants were between the ages of 18 and 27. Similarly, 45 (48.9%) of the same group were between the ages of 28 and 37. The majority of the respondents, 47 (51.1 %), agreed that postnatal care is a contributing factor to the timely initiation of complementary feeding. The majority

of the respondents, 52 (56.5%), agreed that breast problems play a significant influence on the timely initiation of complementary feeding.

Recommendations

Depending on the finding of this paper, the principal study recommends the following: -

1. Health professionals should focus on providing advice and counselling sessions to mothers and caregivers on the timely initiation of complementary feeding during prenatal, delivery, and postnatal periods.
2. Special emphasis should be given to mothers with low educational status, including those over 30 years of age, by giving them continued health education to change their wrong attitudes and perception.
3. Creating motivators for mothers, such as a prize in the media for those who begin complementary feeding at six months, to create awareness and promote the timely initiation of complementary feeding.
4. In government institutions, establishing a baby centre is an alternative solution to improve the timely initiation of complementary feeding for government employees.
5. Furthermore, additional research should be conducted using a qualitative study design to deeply understand socio-cultural and behavioural factors related to complementary feeding in order to develop and implement a better complementary feeding strategy.

REFERENCE:

1. Agedew, E. and Demissie, M. (2014) 'Early Initiation of Complementary Feeding and Associated Factors among 6 Months to 2 Years Young Children, in KambaWoreda, South West Ethiopia: A Community-Based Cross-Sectional Study', Journal of Nutrition & Food Sciences, 04(06). DOI: 10.4172/2155-9600.1000314.
2. WHO. Indicators for assessing infant and young child feeding practices Part 3 Country Profiles.
3. Khanal V, Sauer K, Zhao Y. Determinants of complementary feeding practices among Nepalese children aged 6–23 months: findings from demographic and health survey 2011. BMC Pediatr. 2011
4. Shumey, A., Demissie, M. and Berhane, Y. (2013) 'Timely initiation of complementary feeding and associated factors among children aged 6 to 12 months in Northern Ethiopia: An institution-based cross-sectional study, BMC Public Health. DOI: 10.1186/1471-2458-13-1050.
5. WHO, UNICEF: Global strategy for infant and young child feeding. Geneva: World Health Organization; Geneva, Switzerland. 2003
6. Ogunlesi, T. A. et al. (2014) 'Determinants of timely initiation of complementary feeding among children aged 6-24 months in Sagamu, Nigeria', Nigerian Journal of Clinical Practice, 17(6), pp. 785–790. DOI: 10.4103/1119-3077.144399

UNDERSTANDING DETERMINANTS OF CLOUD COMPUTING ADOPTION: A REVIEW OF TECHNOLOGY ADOPTION MODELS

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A B S T R A C T:

The adoption and usage of cloud computing have become a competitive weapon for achieving organizational or business sustainability and maintaining a strategic position in a marketplace or in the eyes of its clients, even though it has been facing various impediments as a result of inadequate understanding of appropriate models to be applied and the users' perception of CCA. Consequently, this study aims to investigate and analyze the current state of the literature on cloud computing adoption (CCA) with various technology adoption models in different areas. However, inappropriate models could not explain the factors determining the adoption determinants and little research attention has been paid to the adoption of cloud computing. For this reason, a systematic literature review (SLR) with a total of 204 and 40 (samples) articles were employed. The four. The findings of the study revealed that the TOE was the most adopted adoption model, followed by the DOI model. This study also identified 23 determinants of CCA that have been extracted from these four models as significant factors determining the adoption of cloud computing. Out of these determinants, security and privacy (SP) were found as the most dominant factors influencing CCA. SME is the major area where CCA has been used, especially from the year 2015 to 2020. There is a need to invest more in ICT in other sectors of the economy.

K E Y W O R D S

Adoption models, Adoption technologies, Cloud computing, Users' perception,

INTRODUCTION

The quickest growing digital revolution is providing businesses with previously unheard-of chances to boost performance through improved operational efficiency (Vu et al., 2020), greater customer service (Tella et al., 2020), market expansion (Lawan et al., 2020), and innovation. In order to take advantage of these prospects, businesses need to have digital infrastructure and skills. Cloud computing is hosted on the Internet rather than a user's actual machine. The information kept in the cloud is accessible from anywhere, at any time (24/7). There are only a select few factors that affect the adoption of cloud computing (Hajizadeh & Navimipour, 2017; Aharony 2015; Low and Chen 2011; Maqueira-Marin, Bruque-Camara & Minguela-Rata, 2017). However, companies may find it expensive and ineffective to create these competencies in-house (Alvarez et al., 2022; Senyo et al. 2018; Lynn et al., 2020). Therefore, it is essential to build a solid cloud service knowledge of the factors that influence business and non-business sectors' cloud computing adoption in a variety of developmental and geographic situations. However, the determinants that influence or prevent the adoption of an acceptable model or theory may be best explained by the CCA that results in poor comprehension (Sabi, Ukoza, Langmia, & Njeh, 2015). According to Aharony (2015), there is a sizable body of work on cloud computing that makes use of diverse technological adoption models in various economic sectors. But there are also quite a few similar problems with selecting an inappropriate or uncommon model or theory that cannot adequately explain the crucial elements of the CCA. The factors affecting the CCA are little discussed in the literature. The use of cloud computing in education and other fields has received minimal study attention, which has an impact on how contextual variables might affect the acceptance and dissemination of cloud computing (Sabi et al., 2015).

LITERATURE REVIEW

Regarding acceptance, the notion of CCA is a new phenomenon in fields including small and medium-sized businesses (SMEs), business, education, as well as private and governmental organisations. According to Low and Chen (2011), a type of computer application service known as cloud computing makes use of ubiquitous resources that may be shared by business associates or trade partners and includes services like e-mail, office software, and enterprise resource planning. In addition, cloud computing was defined by Gangwar, Date, and Ramaswamy (2015) as a method for delivering information technology (IT) enabled services in the form of software, platforms, and infrastructure through the Internet.

Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) are the three main service models used in cloud computing (Gangwar et al., 2015). The notion of software as a product has been replaced by that of services as a result of the advent of software as a service (Gangwar et al., 2015). Additionally, there are four fundamental deployment methods for cloud computing, including public, private, hybrid, and community clouds. As suggested by the name, the public cloud offers services to everyone. In contrast, the private cloud offers better and more secure services than the public cloud does, but only to a small group of private persons and organisations (Gangwar et al., 2015). Cloud service companies like IBM, Amazon, and Google Cloud, among others, can provide computer services (Senyo, Effah, and Addae, 2016). A new paradigm for organisational operations and procedures is provided by switching from an organization's current practise to cloud computing, where software, platforms, and infrastructure are provided as services rather than goods (Ramchand et al., 2021; Ramchand et al., 2021).

Technology adoption models

Technology organization and environment (TOE)

The majority of organisational tasks are now automated, and information is available 24/7 from anywhere and anytime thanks to technology. As a result, the spread of technology-enabled devices, programmes, and apps as well as the Internet causes an organisational turnaround classified as part of the technological dimension (TD). Only under TD were relative benefits, compatibility, and complexity seen (Ahmad and Waheed 2015).

Table 1: Proposed technology adoption models

Theory/Model	Acronyms	Developed by
Technology, Organization & Environment	TOE	Tornatzky and Fleisher (1990)
Technology Acceptance Model	TAM	Davis, (1989)
Unified Theory of Acceptance & Use of Technology	UTAUT	Venkatesh et al. (2003)
Diffusion of Innovation Theory	DOI	Rogers (1962)

Technology Dimension (TD): The ability of technology, organisational factors, and environmental factors all play a role in how certain public organisations' IT departments use cloud computing. Consequently, the Technology-Organization-Environment (TOE) model by Tornatzky and Fleischer will be modified in this study due to its applicability in including the three variables (1990). Relative Advantage (RA): According to Rogers (1983), relative advantage refers to the extent to which technical aspects are viewed as being more advantageous for businesses. Compatibility (COM): The degree to which an invention is compatible with the values, customs, and requirements of the potential adopter (Rogers 1983; Vu, Hartly, & Kankalli, 2020). Organizational Dimension (OD): An organization's dimension is all the assistance provided by the top management team, employees, and size of both human and non-human resources that work together to accomplish the intended goals. Organization Size (OS): In this context, the prior study revealed that a firm's attribute size was significant. Additionally, the outcome suggests that one of the factors affecting CCA is business size (Senyo et al. 2016). Organization Objectives (OOs): OOs are the projected goals and objectives that an organisation hopes to accomplish at the time cloud computing is adopted and successfully used (Amron et al., 2019). Top Management Support: The phrase "top management support" (TMS) refers to any assistance leading to the reengineering of processes and the integration of resources, which will be a significant factor in determining CCA. Environmental Dimension (EO): Therefore, providers of cloud services must ensure a high degree of security from all types of external threats. The cloud providers and their respective clients have to come to a firm and mutual agreement (Rad & Rana, 2017). Competitive Pressure (CP): For the purposes of this study, "CP" refers to the outside force that compels an organization to adopt new, current, and developing technologies in order to satisfy the demands of stakeholders (Tahir et al., 2015). Concerned Parties Pressure (CPP): With regard to this study, the CPP refers to the middle and high-level management's (internally) and clients' (outside service beneficiaries') pressure to make it difficult to access some services, which will lead many clients to accept the process innovation for efficient service delivery. Regulatory Support (RS): Senarathna et al. (2018) defined RS as the government regulations that regulate the affairs and usage of a certain technology and either encourage or dissuade people to utilize it appropriately or to avoid it.

Technology Acceptance Model (TAM) original and modified The TAM is a socio-technical paradigm that seeks to explain user acceptance of an information system, in accordance with Devis (1989). It comes from the Theory of Reasoned Action (TRA, Fishbein and Ajzen, 1975), which describes how individuals want to behave in a certain way. Devis (1989) stated that "an individual's views, attitudes, and intention might be understood as their adoption of technology."Unified Theory of Technology Acceptance and Use (UTAUT) One of the most current models for evaluating the factors that influence technology adoption was developed by Venkatesh, Morris, Davis, and Davis (2003). Bakkabulindi (2014), however, emphasises that the UTAUT paradigm falls short when compared to the TOE and IDT. While not all inventions are technological, the UTAUT was found guilty of prejudice toward technology adoption (Rogers, 2003 as sighted in Bakkabulindi, 2014). Khayer et al. (2019) found that performance expectation, effort expectancy, absorptive capacity, data security, and privacy, and perceived trust were the most important determinants of CCA.Theory of diffusion of innovation Rogers created the DOI hypothesis in 1962. Top management support, organisational readiness, and technology readiness are some examples of organisational DOI variables. The environmental DOI variables, which also include competitive pressure, regulatory support, and many more, have recently gained popularity among researchers (Abdullahi et al., 2021; Awa et al., 2016; Damali et al., 2021; Mohamed & Anter, 2018; Shahzad et al., 2018).. The determinants of CCA, however, could not be explained by using a poor model. As a result, little is understood about the elements influencing the uptake and use of cloud computing.

OBJECTIVES

The goals of this study are to: investigate the current state of the literature on the most common adoption model of cloud computing; identify the critical factors that influence adoption; look into the sectors that adopt cloud computing most frequently; and examine the distribution of studies on cloud computing adoption over time. Additionally, the current study concentrated on identifying and assessing the important factors influencing the CCA using data from the various literatures.

METHODS

The results have been presented as charts, tables, and figures using the descriptive statistics. It was especially useful for aspiring researchers since it gave them a simple method to understand how the data on a particular topic was carefully handled for analysis. This research approach was based on SLR, and it used measured investigation to extract some facts from that information.

Design

This employed a systematic literature review (SLR). Moreover, the study employed various techniques such as Boolean operator (see Data Collection Procedures Section) and inclusion and exclusion criteria (see Table 2).

Secondary data source

A total of 204 articles were sourced, of which n = 204 were recruited for screening and evaluation, n = 164 were rejected because they didn't fulfil the criteria for reliability and validity (Chophel, 2022), and only n = 40 passed the test. N = 40 articles were therefore utilized as research samples (Ibidunni et al., 2021). Initially, about 693 articles total were retrieved for this study from different databases.

Figure 1. SIFRIA flow chart adapted from (Ahmed et al., 2022)

Table 2. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Include relevant articles from the year 2016 to 2020	Exclude irrelevant articles below 2016
Add literature related to CCA	Exclude literature not related to CCA
Add articles from reputable journal or conferences databases	Exclude all articles that are not from reputable journals or conferences databases

Ethical considerations

In order to give sufficient information appropriate for this study, the researchers made sure that the earlier studies in the form of articles or conferences and their contents were considered for the review based on the titles, abstracts, keywords, and primary contents. Additionally, all of the sources consulted for this study were acknowledged in accordance with research ethics.

Data collection

After the data were carefully examined, 204 papers were chosen with 40 articles as sample size of the study. However, based on the major determinants (factors) of CCA with regard to title, keywords, abstracts, and entire contents of the articles. Research Gate, Science direct, Emerald, IEEE, Google Scholar, Springer, and conference proceedings were used to acquire the research data. Other sources included top journals and conference proceedings. The stories we've chosen to highlight were released between 2015 and 2020. Boolean search operators using title as the key, including AND, OR, and mixed. Cloud computing AND Adoption (Determinants) and (Factors Influencing AND Adoption (Cloud computing)) are the first steps in the process (Amron et al., 2019; Kim et al., 2022; Jie et al., 2021). The study includes abstracts and keywords as well.

ENHANCING COMMUNITY CONNECTIVITY THROUGH PEDESTRIAN NETWORK DESIGN IN DADONG

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ABSTRACT:
Enhancing community connectivity through pedestrian network design is crucial for creating sustainable and livable urban environments. This case study focuses on Dadong, a community in China, where the pedestrian network is analyzed and optimized to promote efficient and low-carbon mobility. The study employs urban network analysis techniques to assess the connectivity and accessibility of existing pedestrian infrastructure and proposes design interventions to enhance connectivity within the community. By prioritizing pedestrian-friendly design principles and integrating active transportation modes, the aim is to create a well-connected and walkable community that encourages sustainable mobility choices and improves the overall quality of life for residents. The findings and recommendations from this study can serve as a valuable resource for urban planners and designers seeking to enhance community connectivity through pedestrian network design.
KEYWORDS:
community connectivity, pedestrian network design, urban network analysis, sustainable mobility, low-carbon living, walkability, active transportation, urban planning, Dadong, China.

INTRODUCTION:

The concept of community connectivity plays a crucial role in creating sustainable and vibrant urban environments. A well-designed pedestrian network is essential for enhancing community connectivity, promoting active and sustainable transportation choices, and improving the overall quality of life for residents. This case study focuses on Dadong, a community in China, where the importance of pedestrian network design is examined as a means to enhance community connectivity and support low-carbon living.

Dadong is a rapidly growing community facing challenges related to transportation, congestion, and air pollution. By prioritizing pedestrian infrastructure and employing urban network analysis techniques, this case study aims to analyze the existing pedestrian network, identify areas of improvement, and propose design interventions to enhance community connectivity. The goal is to create a pedestrian-friendly environment that encourages walking and cycling, reduces dependence on private vehicles, and promotes sustainable mobility choices.

The introduction of this case study provides an overview of the significance of community connectivity and the role of pedestrian network design in achieving sustainable and low-carbon living. It highlights the specific context of Dadong, including its transportation challenges and the need for improvements in pedestrian infrastructure. By integrating urban network analysis techniques, the study seeks to provide evidence-based recommendations for enhancing community connectivity and creating a more walkable and accessible environment. [1]

The findings and recommendations from this case study can serve as a valuable resource for urban planners, designers, and policymakers involved in community development projects, particularly those interested in improving pedestrian infrastructure and promoting sustainable mobility options. By prioritizing pedestrian network design and fostering community connectivity, Dadong can become a model for other communities striving to create sustainable, livable, and low-carbon urban environments.

Literature Review:

The literature review section of the case study on enhancing community connectivity through pedestrian network design in Dadong explores relevant scholarly research and existing studies related to pedestrian network design, community connectivity, sustainable mobility, and low-carbon living. It aims to provide a comprehensive understanding of the current knowledge and best practices in these areas, serving as the foundation for the case study's analysis and recommendations. The literature review covers the following key themes:

1. Pedestrian Network Design:
   - Principles and elements of pedestrian-friendly design
   - Factors influencing walkability and pedestrian infrastructure
   - Design interventions to enhance pedestrian safety and comfort
   - Case studies highlighting successful pedestrian network design projects
2. Community Connectivity:
   - Importance and benefits of community connectivity
   - Social and economic impacts of connected communities
   - Factors influencing community connectivity
   - Strategies for enhancing community connectivity through urban design and transportation planning
3. Sustainable Mobility:
   - Concept and importance of sustainable mobility
   - Role of active transportation modes (walking, cycling) in sustainable mobility
   - Integration of sustainable transportation options in urban planning and design
   - Benefits of promoting sustainable mobility for community health, environment, and social equity
4. Low-Carbon Living:
   - Definition and principles of low-carbon living
   - Strategies for reducing carbon emissions in urban areas
   - Integration of sustainable transportation in low-carbon communities
   - Benefits and challenges of adopting low-carbon living practices

The literature review synthesizes the key findings, methodologies, and insights from previous research, providing a comprehensive understanding of the existing knowledge in the field. By drawing upon the established literature, the case study can identify gaps, make informed analyses, and propose recommendations for enhancing community connectivity through pedestrian network design in Dadong. This synthesis of existing research serves as a valuable reference for urban planners, designers, and policymakers seeking evidence-based strategies to promote sustainable and connected communities.

Pedestrian Network Design

- Principles and elements of pedestrian-friendly design

Pedestrian-friendly design is essential for creating safe, accessible, and inviting environments for pedestrians. The principles and elements of pedestrian-friendly design guide the planning and implementation of pedestrian networks. This subsection explores relevant literature on the principles and elements of pedestrian-friendly design, including: [2]

1. Pedestrian-Oriented Design Principles:

- The principle of walkability, emphasizing the importance of designing environments that are attractive and conducive to walking.
- The principle of safety, focusing on measures to ensure pedestrian safety, such as well-marked crosswalks, pedestrian-friendly signal timings, and traffic calming techniques.
- The principle of comfort, considering factors such as sidewalk width, shade, seating, and amenities that enhance the pedestrian experience.
- The principle of accessibility, addressing the needs of diverse users, including people with disabilities, by providing accessible infrastructure and eliminating barriers.

2. Elements of Pedestrian-Friendly Design:

- Sidewalk design, including considerations for width, surface materials, continuity, and amenities like benches, lighting, and greenery.
- Pedestrian crossings, examining different types of crosswalks, signalization, and pedestrian refuge islands to ensure safe and efficient crossing.
- Pedestrian plazas and public spaces, highlighting the importance of creating inviting gathering spaces that prioritize pedestrians and promote social interaction.
- Streetscape design, considering elements such as street furniture, landscaping, and street trees to create an attractive and comfortable walking environment.
- Pedestrian signage and wayfinding, emphasizing the importance of clear and intuitive signage to guide pedestrians and provide information about destinations.

By reviewing the literature on pedestrian-friendly design principles and elements, the case study can gain insights into best practices and evidence-based strategies for designing pedestrian networks that prioritize safety, accessibility, comfort, and walkability. This knowledge will inform the analysis of Dadong's pedestrian infrastructure and support recommendations for enhancing the community's pedestrian network design.

- Factors influencing walkability and pedestrian infrastructure

Factors influencing walkability and pedestrian infrastructure are essential considerations in creating pedestrian-friendly environments. Understanding these factors helps identify the barriers and opportunities for promoting walkability and enhancing pedestrian infrastructure. This subsection explores relevant literature on the factors influencing walkability and pedestrian infrastructure, including:

1. Land Use and Density:

- Mixed land use: The presence of a mix of residential, commercial, and recreational areas within close proximity encourages walking and reduces the need for long-distance travel.
- Higher density: Higher population density promotes walkability by supporting a greater number of destinations within walking distance and creating a critical mass of pedestrians.

2. Connectivity and Network Design:

- Street connectivity: A well-connected street network with a grid pattern allows for shorter and more direct walking routes, reducing travel distances.
- Pedestrian network design: The presence of continuous sidewalks, well-marked crosswalks, pedestrian bridges, and underpasses enhances the pedestrian experience and promotes safety.

3. Safety and Security:

- Pedestrian safety measures: Safety measures such as traffic calming techniques, clearly marked crosswalks, and pedestrian-friendly signal timings contribute to a safer walking environment.
- Crime prevention: Ensuring well-lit areas, clear lines of sight, and a sense of security through proper urban design elements reduces concerns about personal safety.

4. Comfort and Amenities:

- Sidewalk quality: Well-maintained and adequately wide sidewalks that are free from obstacles and in good condition enhance pedestrian comfort.
- Shading and seating: Providing shade elements, trees, and seating options along walking routes creates a more comfortable walking experience.

5. Accessibility and Universal Design:

- Barrier-free infrastructure: Pedestrian infrastructure that accommodates the needs of all individuals, including people with disabilities and older adults, promotes inclusivity and accessibility.
- Universal design principles: Incorporating universal design principles ensures that infrastructure is usable, safe, and convenient for a diverse range of pedestrians.

Understanding the factors that influence walkability and pedestrian infrastructure helps inform the analysis and recommendations for enhancing the pedestrian network in Dadong. By considering these factors, the case study can propose strategies to overcome barriers and create a pedestrian-friendly environment that promotes walkability, accessibility, and the overall quality of life for residents. [3]

- Design interventions to enhance pedestrian safety and comfort

Design interventions play a crucial role in enhancing pedestrian safety and comfort within a community. This subsection explores relevant literature on design interventions aimed at improving pedestrian safety and comfort, including:

1. Intersection Design:

- Pedestrian crossings: Designing well-marked crosswalks with clear visibility, appropriate signage, and advanced pedestrian signalization improves safety at intersections.
- Pedestrian islands: Introducing refuge islands within wide roadways provides a safe space for pedestrians to stop midway while crossing and improves visibility for both pedestrians and drivers.

2. Traffic Calming Measures:

- Speed reduction: Implementing traffic calming measures, such as speed humps, chicanes, and raised crosswalks, helps reduce vehicle speeds and create a safer environment for pedestrians.

• Narrowing roadways: Reducing the width of roadways through techniques like curb extensions or road diets creates a sense of enclosure, slowing down traffic and improving pedestrian safety.

3. Sidewalk Design and Amenities:

• Sidewalk widening: Increasing sidewalk width allows for greater pedestrian capacity and provides space for amenities such as seating areas, trees, and landscaping.

• Lighting: Adequate lighting along sidewalks and at intersections enhances visibility and promotes a sense of safety for pedestrians, especially during evening hours.

• Seating and rest areas: Providing benches, seating areas, and rest stops along walking routes allows pedestrians to take breaks and enhances their comfort and enjoyment.

4. Pedestrian-Friendly Street Design:

• Complete Streets: Designing streets with a focus on accommodating all users, including pedestrians, cyclists, and transit users, ensures safer and more comfortable environments.

• Traffic calming through design: Incorporating elements such as textured pavements, bollards, and street furniture creates a physical buffer between pedestrians and vehicles, enhancing safety.

• Landscaping and greenery: Integrating trees, green spaces, and landscaping along walking routes improves the visual appeal, provides shade, and creates a pleasant pedestrian experience.

5. Accessibility Considerations:

• Curb ramps and tactile indicators: Installing curb ramps and tactile indicators at intersections and crossings ensures accessibility for people with disabilities and enhances overall safety.

• Clear path of travel: Ensuring unobstructed pathways free from obstacles, such as street furniture, parked cars, or construction, improves pedestrian comfort and safety.

By reviewing the literature on design interventions to enhance pedestrian safety and comfort, the case study can identify effective strategies and recommendations for improving the pedestrian network in Dadong. These interventions aim to create a safer, more comfortable, and inviting environment for pedestrians, promoting walkability, and encouraging sustainable mobility choices within the community.

Community Connectivity

• Importance and benefits of community connectivity

Community connectivity plays a vital role in creating sustainable, resilient, and livable communities. This subsection explores relevant literature on the importance and benefits of community connectivity, including: [4]

1. Social Cohesion and Sense of Belonging:

• Community interaction: Connectivity fosters social interactions among community members, leading to increased social cohesion, a sense of belonging, and stronger community ties.

• Community identity: Connected communities often develop a shared identity and pride, promoting a sense of place and fostering community engagement.

2. Access to Amenities and Services:

• Convenient access: Connectivity allows residents to easily access essential amenities and services such as schools, healthcare facilities, parks, shopping centers, and cultural venues.

- Economic opportunities: Well-connected communities attract businesses, create job opportunities, and stimulate economic growth by facilitating the movement of goods, services, and labor.

3. Active and Healthy Lifestyles:

- Active transportation: Community connectivity encourages active transportation modes like walking and cycling, promoting physical activity and contributing to healthier lifestyles.
- Recreational opportunities: Access to parks, green spaces, and recreational facilities through a connected network enhances opportunities for leisure activities and outdoor exercise.

4. Reduced Dependence on Cars:

- Sustainable mobility: Connected communities with accessible public transportation systems and well-designed pedestrian and cycling infrastructure reduce dependence on private vehicles, leading to lower carbon emissions and improved air quality.
- Transportation equity: Community connectivity ensures equitable access to transportation options for all residents, regardless of their age, income, or mobility limitations.

5. Resilience and Emergency Preparedness:

- Disaster response: Well-connected communities can better respond to emergencies and disasters by facilitating the movement of resources, emergency services, and evacuation routes.
- Community support networks: Connectivity strengthens community support networks, enabling faster information sharing and coordinated response during times of crisis.

Understanding the importance and benefits of community connectivity provides a foundation for analyzing and enhancing connectivity within Dadong. By prioritizing community connectivity, planners and policymakers can create more vibrant, sustainable, and resilient communities that prioritize social interaction, promote health and well-being, facilitate access to essential services, and foster a sense of belonging among residents. The findings from the literature review inform the case study's analysis and recommendations for enhancing community connectivity in Dadong.

- Social and economic impacts of connected communities

Connected communities have significant social and economic impacts that contribute to their overall sustainability and well-being. This subsection explores relevant literature on the social and economic impacts of connected communities, including:

1. Social Impacts:

- Social interaction and cohesion: Connected communities foster social interactions, creating opportunities for community members to engage with one another, build relationships, and establish social networks.
- Sense of belonging: Strong community connectivity promotes a sense of belonging and pride among residents, leading to increased community involvement and a shared commitment to the community's well-being.
- Social capital: Connected communities often exhibit higher levels of social capital, including trust, cooperation, and collective action, which are valuable resources for addressing community challenges. [5]

2. Economic Impacts:

• Economic growth and development: Well-connected communities attract businesses, investors, and employment opportunities, leading to economic growth and improved local economies.

• Job creation: Enhanced connectivity facilitates access to job opportunities within and outside the community, reducing commuting distances and fostering local employment.

• Increased property values: Communities with better connectivity, including access to amenities and transportation options, often experience increased property values, benefiting homeowners and the local tax base.

3. Accessibility to Services and Amenities:

• Access to education and healthcare: Connected communities provide convenient access to educational institutions, healthcare facilities, and other essential services, ensuring residents' well-being and quality of life.

• Cultural and recreational opportunities: Well-connected communities offer easier access to cultural venues, parks, recreational facilities, and community events, enhancing residents' quality of life and promoting social and cultural engagement.

4. Health and Well-being:

• Active and healthy lifestyles: Connected communities encourage active transportation modes such as walking and cycling, promoting physical activity and contributing to better health outcomes for residents.

• Access to green spaces: Community connectivity facilitates access to parks, green spaces, and natural environments, providing opportunities for recreation, relaxation, and improved mental well-being.

The social and economic impacts of connected communities highlight the importance of prioritizing community connectivity in urban planning and design. By fostering social interaction, facilitating economic opportunities, improving accessibility to services and amenities, and promoting well-being, connected communities can create sustainable and resilient environments that enhance the overall quality of life for residents. The findings from the literature review inform the case study's analysis and recommendations for enhancing social and economic impacts through improved community connectivity in Dadong.

Sustainable Mobility

• Concept and importance of sustainable mobility

Sustainable mobility refers to transportation systems and modes that are environmentally friendly, socially equitable, and economically viable. This subsection explores relevant literature on the concept and importance of sustainable mobility, including:

1. Concept of Sustainable Mobility:

• Environmental sustainability: Sustainable mobility aims to minimize the negative environmental impacts associated with transportation, such as carbon emissions, air pollution, and energy consumption.

• Social equity: Sustainable mobility emphasizes providing accessible and affordable transportation options for all individuals, regardless of their income, age, or physical abilities.

• Economic viability: Sustainable mobility considers the economic efficiency and long-term viability of transportation systems, promoting cost-effective solutions and minimizing resource consumption.

2. Importance of Sustainable Mobility:

• Climate change mitigation: Transportation is a significant contributor to greenhouse gas emissions. Sustainable mobility plays a crucial role in reducing carbon emissions, mitigating climate change, and achieving global sustainability goals.

• Improved air quality and public health: Sustainable mobility options, such as walking, cycling, and efficient public transit, reduce air pollution and promote healthier, cleaner environments. This contributes to improved public health outcomes, including reduced respiratory illnesses and increased physical activity levels.

• Reduced congestion and travel time: Sustainable mobility options help alleviate traffic congestion by promoting alternatives to private car use. This leads to reduced travel times, improved traffic flow, and increased efficiency in transportation systems.

• Enhanced livability and quality of life: Sustainable mobility creates more livable communities by providing convenient access to amenities, reducing dependence on cars, and promoting active transportation modes that improve the overall well-being and quality of life for residents.

• Social inclusion and equity: Sustainable mobility ensures that transportation options are accessible and affordable for all community members, bridging social and economic disparities and promoting equal opportunities for mobility. [6]

Understanding the concept and importance of sustainable mobility is crucial for guiding transportation planning and design decisions. By prioritizing sustainable mobility options, such as walking, cycling, and efficient public transit, communities can reduce their environmental footprint, improve public health, enhance accessibility, and create more livable and equitable environments. The findings from the literature review inform the case study's analysis and recommendations for promoting sustainable mobility and enhancing low-carbon living in Dadong.

• Role of active transportation modes (walking, cycling) in sustainable mobility

The role of active transportation modes, specifically walking and cycling, is significant in achieving sustainable mobility. This subsection explores relevant literature on the role of active transportation modes in sustainable mobility, including:

1. Environmental Benefits:

• Reduced carbon emissions: Active transportation modes produce little to no carbon emissions, making them environmentally friendly and contributing to the reduction of greenhouse gas emissions.

• Energy efficiency: Walking and cycling require less energy compared to motorized transportation, resulting in reduced energy consumption and resource conservation.

2. Health and Well-being:

• Physical activity promotion: Walking and cycling are forms of physical activity, providing numerous health benefits such as improved cardiovascular fitness, weight management, and reduced risk of chronic diseases.

- Mental well-being: Active transportation modes contribute to mental well-being by reducing stress levels, improving mood, and enhancing overall mental health.

3. Urban Congestion and Traffic Reduction:

- Alleviation of traffic congestion: Encouraging walking and cycling helps reduce the number of vehicles on the road, leading to reduced traffic congestion, improved traffic flow, and shorter travel times for all road users.
- Parking space reduction: Active transportation modes require minimal parking space, freeing up valuable land that can be utilized for other community needs.

4. Improved Livability and Community Connectivity:

- Enhanced social interactions: Walking and cycling create opportunities for social interactions among community members, fostering a sense of community and connection.
- Accessible and inclusive transportation: Active transportation modes provide accessible and inclusive transportation options for people of all ages, abilities, and socioeconomic backgrounds.

5. Economic Benefits:

- Cost savings: Walking and cycling are cost-effective modes of transportation that require minimal or no expenses for fuel, parking, or vehicle maintenance, resulting in savings for individuals and the community as a whole.
- Local economic development: Promoting walking and cycling can boost local businesses, as pedestrians and cyclists have increased exposure to local shops and establishments.

The role of active transportation modes, such as walking and cycling, in sustainable mobility is instrumental in reducing environmental impact, promoting health and well-being, alleviating traffic congestion, enhancing community connectivity, and generating economic benefits. By prioritizing and investing in infrastructure and policies that support active transportation, communities can foster sustainable mobility and create healthier, more livable environments. The literature review provides insights into these benefits and informs the case study's analysis and recommendations for promoting active transportation modes in Dadong to enhance sustainable mobility and low-carbon living.

Conclusion:

In conclusion, the literature review highlights the importance of community connectivity, sustainable mobility, and pedestrian-friendly design in promoting low-carbon living and creating livable, sustainable communities. By examining the relevant literature, we have gained valuable insights into the principles and elements of pedestrian-friendly design, factors influencing walkability and pedestrian infrastructure, the social and economic impacts of connected communities, the concept and importance of sustainable mobility, and the role of active transportation modes like walking and cycling.

The findings emphasize the significance of prioritizing community connectivity in urban planning and design, as it fosters social cohesion, enhances access to amenities and services, and promotes active and healthy lifestyles. By integrating sustainable transportation options and designing pedestrian-friendly environments, communities can reduce carbon emissions, improve air quality, and reduce congestion, leading to a more sustainable and resilient future.

The literature review serves as a foundation for the case study's analysis and recommendations in Dadong. It provides evidence-based insights and best practices to guide the enhancement of community connectivity, pedestrian network design, and sustainable mobility in the context of low-carbon living. By incorporating these findings into the planning and design processes, Dadong can become a model for sustainable and walkable communities, where residents can enjoy improved quality of life, enhanced accessibility, and reduced environmental impact.

The case study will build upon this literature review, utilizing urban network analysis techniques and community engagement to propose specific design interventions and strategies tailored to Dadong's unique context. By adopting a holistic and participatory approach, the aim is to create a low-carbon community regeneration plan that prioritizes pedestrian-friendly design, promotes sustainable transportation options, and fosters a sense of community and connectivity among residents.

By implementing the recommendations from this case study, Dadong can move towards a more sustainable future, where community connectivity, sustainable mobility, and pedestrian-friendly design are at the forefront of urban development. The benefits will extend beyond environmental sustainability to encompass social equity, economic vitality, and improved overall well-being for residents.

REFERENCES:

1. Fang, K., Azizan, S. A., & Wu, Y. (2023). Low-Carbon Community Regeneration in China: A Case Study in Dadong. Sustainability, 15(5), 4136.
2. Lv, Y., Bi, J., & Yan, J. (2018). State-of-the-art in low carbon community. International Journal of Energy for a Clean Environment, 19(3-4).
3. Yuan, H., Zhou, P., & Zhou, D. (2011). What is low-carbon development? A conceptual analysis. Energy Procedia, 5, 1706-1712.
4. Fang, K., Azizan, S. A., & Wu, Y. (2023). Low-Carbon Community Regeneration in China: A Case Study in Dadong. Sustainability, 15(5), 4136.
5. Du, H., Shen, P., Chai, W. S., Nie, D., Shan, C., & Zhou, L. (2022). Perspective and analysis of ammonia-based distributed energy system (DES) for achieving low carbon community in China. Iscience, 25(10).
6. Yang, X., Sun, H., Huang, Y., & Fang, K. (2022). A framework of community pedestrian network design based on urban network analysis. Buildings, 12(6), 819.

ASSESSING THE POTENTIAL OF LOW-CARBON COMMUNITY REGENERATION IN DADONG, CHINA

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ABSTRACT:
This study aims to assess the potential of low-carbon community regeneration in Dadong, China, through an analysis of urban network patterns and the design of a community pedestrian network. By integrating urban network analysis into community design, this research explores strategies for enhancing community connectivity, promoting sustainable transportation, and reducing carbon emissions. The study utilizes a case study approach, focusing on Dadong as a representative community in China. Through a comprehensive analysis of the existing urban network and transportation patterns, this research identifies opportunities and challenges for low-carbon community regeneration in Dadong. The findings highlight the importance of pedestrian network design and provide valuable insights for policymakers and urban planners seeking to promote sustainable living environments.

KEYWORDS:
Low-carbon community regeneration, Dadong, China, urban network analysis, community design, pedestrian network, sustainable transportation, carbon emissions, community connectivity, urban planning.

INTRODUCTION:

Rapid urbanization and the associated increase in carbon emissions have become significant challenges for cities worldwide. In China, a country experiencing unprecedented urban growth, addressing these challenges is of paramount importance. The concept of low-carbon community regeneration has gained prominence as a means to create sustainable and livable urban environments. By focusing on the transformation of existing communities, this approach aims to reduce carbon emissions, enhance community connectivity, and promote sustainable transportation. [1]

Dadong, a community in China, serves as a compelling case study for low-carbon community regeneration. As an urban area facing urbanization pressures and environmental concerns, Dadong presents an opportunity to explore strategies for sustainable development. By conducting an analysis of urban network patterns and proposing a framework for community pedestrian network design, this study assesses the potential for low-carbon community regeneration in Dadong.

Urban network analysis, which examines the physical and functional relationships between different elements of urban infrastructure, plays a crucial role in understanding and optimizing urban systems. By applying this analytical approach to Dadong, we can gain insights into the existing urban network and identify opportunities for improvement. This analysis encompasses various aspects, including transportation patterns, pedestrian connectivity, and carbon emissions.

Furthermore, community design is a vital component of low-carbon community regeneration. By considering factors such as land use planning, street design, and transportation infrastructure, community design can facilitate sustainable living and reduce reliance on carbon-intensive modes of transportation. The integration of urban network analysis into community design enables a comprehensive and data-driven approach to develop a pedestrian network that promotes sustainable transportation and community connectivity.

This study aims to contribute to the existing body of knowledge on low-carbon community regeneration by providing insights into the potential of Dadong as a sustainable living environment. By analyzing the urban network patterns, proposing a framework for community pedestrian network design, and assessing the associated benefits and challenges, this research offers valuable guidance for policymakers, urban planners, and community stakeholders involved in promoting sustainable and low-carbon urban development. [2]

In the subsequent sections, this study will delve into the methodology employed, present the findings from the urban network analysis, discuss the proposed framework for community pedestrian network design, and highlight the implications and recommendations for low-carbon community regeneration in Dadong, China. By combining theoretical perspectives with practical insights, this research aims to contribute to the ongoing efforts to create sustainable and livable urban environments.

Literature Review:

1. Low-Carbon Community Regeneration: The concept of low-carbon community regeneration emphasizes the transformation of existing communities towards sustainable and low-carbon living. It involves the integration of various strategies, such as sustainable transportation, energy efficiency, and green infrastructure, to reduce carbon emissions and enhance the overall quality of life within communities (Seyfang & Haxeltine, 2012). The literature highlights the importance of community engagement, participatory planning, and multi-stakeholder collaboration in successful low-carbon regeneration initiatives (Hodson & Marvin, 2010).
2. Urban Network Analysis: Urban network analysis provides a valuable tool for understanding the spatial structure and functional characteristics of urban areas. By examining the relationships between different elements of urban infrastructure, such as roads, public spaces, and pedestrian pathways, urban network analysis helps identify opportunities for optimizing connectivity, reducing travel distances, and promoting sustainable transportation modes (Jiang, 2013). The literature emphasizes the use of network analysis techniques, such as centrality measures and connectivity indices, to assess the efficiency and accessibility of urban networks (Crucitti et al., 2006).
3. Community Design and Pedestrian Networks: Community design plays a critical role in shaping the physical environment and influencing residents' behavior and mobility patterns. Designing walkable communities that prioritize pedestrian networks can reduce the reliance on private vehicles, promote physical activity, and create social and economic opportunities (Cervero & Kockelman, 1997). The literature highlights the importance of factors such as mixed land use, street connectivity, and pedestrian-friendly design principles in creating vibrant and sustainable communities (Ewing & Cervero, 2010).

4. Sustainable Transportation and Carbon Emissions: Transportation is a major contributor to carbon emissions in urban areas. Promoting sustainable transportation modes, such as walking, cycling, and public transit, can significantly reduce carbon emissions and improve air quality (Kenworthy & Laube, 2001). The literature emphasizes the need for integrated transportation planning, including the provision of pedestrian infrastructure, bike lanes, and efficient public transit systems, to encourage modal shifts and reduce car dependency (Litman, 2019).

5. Case Studies in Low-Carbon Community Regeneration: Several case studies worldwide have demonstrated successful low-carbon community regeneration initiatives. Examples include Vauban in Freiburg, Germany, where sustainable transportation, energy-efficient buildings, and community participation have transformed the neighborhood into a model of sustainability (Seyfang, 2009). The Beddington Zero Energy Development (BedZED) in London, UK, is another notable case that showcases sustainable design, renewable energy systems, and community engagement (Holmes, 2007). These case studies provide valuable lessons and insights for similar regeneration efforts. [3]

Low-Carbon Community Regeneration

A. Definition and principles of low-carbon community regeneration

Low-carbon community regeneration refers to a comprehensive approach aimed at transforming existing communities into sustainable and low-carbon living environments. It involves the integration of various strategies, policies, and practices to reduce carbon emissions, enhance resource efficiency, and improve the overall quality of life within communities. The principles underlying low-carbon community regeneration revolve around the following key aspects:

1. Carbon Emission Reduction: The primary objective of low-carbon community regeneration is to achieve a significant reduction in carbon emissions. This involves transitioning from carbon-intensive practices to cleaner and more sustainable alternatives in areas such as transportation, energy consumption, waste management, and construction.

2. Sustainable Transportation: Promoting sustainable transportation modes is a crucial element of low-carbon community regeneration. This includes encouraging walking, cycling, and the use of public transit, while reducing reliance on private vehicles. By improving accessibility, connectivity, and infrastructure for sustainable transportation, communities can reduce emissions from transportation and enhance mobility options for residents.

3. Energy Efficiency: Enhancing energy efficiency is fundamental to low-carbon community regeneration. This encompasses measures such as improving building insulation, implementing energy-saving technologies, utilizing renewable energy sources, and promoting energy conservation practices among residents. By reducing energy consumption and relying on clean energy sources, communities can significantly decrease carbon emissions.

4. Green Infrastructure: Integrating green infrastructure, such as parks, green spaces, and urban forests, plays a vital role in low-carbon community regeneration. Green spaces provide multiple environmental benefits, including carbon sequestration, improved air quality, and enhanced urban resilience. They also contribute to the overall well-being and quality of life of community residents.

5. Circular Economy: Adopting principles of the circular economy is essential in low-carbon community regeneration. This involves reducing waste generation, promoting recycling and reuse,

and designing products and systems with a focus on durability, repairability, and resource efficiency. By minimizing waste and maximizing resource utilization, communities can reduce their ecological footprint and contribute to a more sustainable future.

6. Community Engagement and Participation: Low-carbon community regeneration requires active engagement and participation from community members. This includes involving residents, businesses, local organizations, and other stakeholders in decision-making processes, fostering a sense of ownership, and promoting behavioral changes towards sustainable practices. Collaborative efforts and partnerships are essential for the successful implementation of low-carbon initiatives.

By adhering to these principles, low-carbon community regeneration aims to create sustainable, resilient, and livable communities that prioritize environmental stewardship, social well-being, and economic prosperity. Through the integration of various strategies and the engagement of stakeholders, the transformation of existing communities towards low-carbon living becomes achievable, paving the way for a sustainable future.

B. Importance of community engagement and participatory planning

Community engagement and participatory planning are vital components of successful low-carbon community regeneration initiatives. They play a crucial role in fostering a sense of ownership, building social cohesion, and ensuring that the needs and aspirations of community members are considered in decision-making processes. The importance of community engagement and participatory planning in low-carbon community regeneration can be understood through the following aspects:

1. Empowering Communities: Community engagement allows community members to actively participate in shaping their living environment. By involving residents, businesses, local organizations, and other stakeholders, community engagement empowers individuals to have a voice, express their concerns, and contribute their ideas to the regeneration process. This empowerment creates a sense of ownership, leading to increased commitment and support for low-carbon initiatives.

2. Local Knowledge and Expertise: Community members possess valuable local knowledge and expertise that can inform the planning and implementation of low-carbon strategies. Their understanding of the community's unique characteristics, challenges, and opportunities can help identify appropriate solutions and ensure that interventions are context-specific. Involving the community in decision-making processes allows for the integration of local knowledge and enhances the effectiveness and relevance of regeneration efforts.

3. Social Cohesion and Collaboration: Community engagement and participatory planning foster social cohesion and collaboration among community members. By working together towards a common goal of low-carbon regeneration, residents and stakeholders develop a shared sense of purpose and strengthen community bonds. This collaboration promotes mutual support, social interactions, and the exchange of ideas, which are crucial for the long-term sustainability and resilience of the community.

4. Behavioral Change and Adoption of Sustainable Practices: Community engagement plays a vital role in encouraging behavioral change and the adoption of sustainable practices. By involving community members in discussions, awareness-raising campaigns, and educational programs, individuals can be empowered to make informed choices and modify their behaviors towards low-

carbon living. Through collective action and shared responsibility, communities can achieve significant reductions in carbon emissions and create a culture of sustainability.

5. Transparency and Trust: Community engagement and participatory planning foster transparency and trust between stakeholders involved in low-carbon community regeneration. Open communication, active listening, and the inclusion of diverse perspectives build trust among community members, local authorities, and other relevant entities. Transparent decision-making processes ensure that decisions are accountable and responsive to the needs and aspirations of the community, enhancing the legitimacy and acceptance of regeneration initiatives.

6. Long-term Sustainability: Community engagement and participatory planning contribute to the long-term sustainability of low-carbon community regeneration efforts. By involving the community in the design, implementation, and monitoring of projects, the likelihood of success and the continuity of sustainable practices are increased. This participatory approach creates a sense of ownership and responsibility among community members, leading to the long-term maintenance and stewardship of low-carbon infrastructure and practices.

In conclusion, community engagement and participatory planning are essential for effective and inclusive low-carbon community regeneration. By empowering communities, leveraging local knowledge, fostering social cohesion, promoting behavioral change, ensuring transparency, and supporting long-term sustainability, these processes facilitate the successful implementation of low-carbon initiatives and contribute to the creation of resilient and livable communities.

C. Multi-stakeholder collaboration in low-carbon regeneration initiatives

Multi-stakeholder collaboration plays a crucial role in driving successful low-carbon community regeneration initiatives. It involves engaging and coordinating various stakeholders, including community members, government authorities, businesses, non-profit organizations, and academic institutions, to work together towards common sustainability goals. The importance of multi-stakeholder collaboration in low-carbon regeneration initiatives can be understood through the following aspects:

1. Comprehensive Expertise and Resources: Each stakeholder brings unique expertise, knowledge, and resources to the table. Collaboration allows for the pooling of diverse perspectives, skills, and capacities. Government authorities can provide regulatory frameworks and financial support, businesses can contribute technological innovations and investment, academic institutions can offer research and analysis, and community members can provide local insights and grassroots support. By harnessing the collective expertise and resources of multiple stakeholders, low-carbon regeneration initiatives can benefit from a comprehensive and integrated approach.

2. Holistic Approach: Low-carbon regeneration requires addressing various interconnected aspects, such as energy, transportation, buildings, waste management, and social equity. Multi-stakeholder collaboration enables a holistic approach to regeneration, ensuring that different dimensions are considered and integrated into the overall strategy. By engaging stakeholders from different sectors, a more comprehensive and balanced perspective can be achieved, leading to more effective and sustainable solutions.

3. Shared Responsibility and Accountability: Multi-stakeholder collaboration promotes shared responsibility and accountability for the success of low-carbon regeneration initiatives. When multiple stakeholders are involved, there is a collective sense of ownership and commitment to achieving sustainability goals. Each stakeholder recognizes their role and contributions, which enhances the sense of responsibility and increases the likelihood of sustained action and long-term impact.
4. Enhanced Innovation and Creativity: Collaboration among diverse stakeholders fosters innovation and creativity. By bringing together individuals with different backgrounds, expertise, and perspectives, new ideas and approaches can emerge. Collaborative processes encourage open dialogue, brainstorming, and co-creation, leading to innovative solutions that may not have been possible through isolated efforts. This interdisciplinary and collaborative environment promotes continuous learning and adaptability, enabling the development of cutting-edge solutions for low-carbon regeneration.
5. Improved Stakeholder Engagement and Acceptance: Involving stakeholders in the decision-making processes increases their understanding, acceptance, and support for low-carbon regeneration initiatives. Collaboration allows for effective communication, consultation, and active involvement of stakeholders throughout the planning, implementation, and evaluation stages. Engaged stakeholders are more likely to embrace and champion sustainability measures, leading to higher levels of public acceptance and community buy-in for low-carbon initiatives.
6. Scaling Up and Replication: Multi-stakeholder collaboration can facilitate the scaling up and replication of successful low-carbon regeneration initiatives. By sharing experiences, best practices, and lessons learned, stakeholders can support the dissemination of successful models to other communities and regions. Collaboration networks enable knowledge exchange, capacity building, and the transfer of expertise, accelerating the adoption of low-carbon practices and contributing to broader sustainability transitions.

In conclusion, multi-stakeholder collaboration is a key driver of successful low-carbon community regeneration initiatives. By harnessing the expertise and resources of diverse stakeholders, adopting a holistic approach, promoting shared responsibility, fostering innovation, improving stakeholder engagement, and enabling scaling up and replication, collaborative efforts can maximize the effectiveness, acceptance, and impact of low-carbon regeneration initiatives. [4]

III. Urban Network Analysis

A. Concept and objectives of urban network analysis

Urban network analysis is a methodological approach that examines the spatial structure, connectivity, and functional relationships of urban infrastructure elements within a city or community. It involves the systematic examination and assessment of transportation networks, pedestrian pathways, road systems, public spaces, and other elements that constitute the urban fabric.

The objectives of urban network analysis are to gain insights into the characteristics of urban networks, evaluate their efficiency and accessibility, identify opportunities for improvement, and inform decision-making processes related to urban planning, transportation, and infrastructure development. By analyzing the configuration and performance of urban networks, urban network analysis aims to achieve the following:

1. Understanding Spatial Structure: Urban network analysis provides a means to comprehend the spatial structure of an urban area. It examines the layout, connectivity, and hierarchy of transportation networks, road networks, and pedestrian pathways. This understanding helps identify patterns of movement, connectivity between different areas, and the distribution of resources and amenities within the urban environment.
2. Assessing Efficiency and Accessibility: Urban network analysis evaluates the efficiency and accessibility of transportation systems and pedestrian networks. It involves analyzing metrics such as travel distances, travel times, connectivity, and congestion levels. By assessing these factors, urban network analysis helps identify bottlenecks, inefficiencies, and areas with limited accessibility, which can inform planning and design interventions to improve transportation efficiency and promote sustainable mobility.
3. Optimizing Connectivity: One of the primary objectives of urban network analysis is to optimize connectivity within urban areas. This involves identifying gaps or missing links in the transportation and pedestrian networks, improving connectivity between different parts of the city, and enhancing accessibility to key destinations such as schools, hospitals, commercial centers, and public transit hubs. Optimizing connectivity supports efficient and sustainable mobility patterns, reduces travel distances, and promotes active modes of transportation.
4. Supporting Sustainable Transportation: Urban network analysis contributes to the development of sustainable transportation systems. It helps identify opportunities for promoting and prioritizing sustainable modes of transportation, such as walking, cycling, and public transit. By analyzing the connectivity and accessibility of pedestrian pathways and cycling infrastructure, urban network analysis supports the planning and design of safe and convenient active transportation networks, reducing reliance on private vehicles and carbon emissions.
5. Informing Urban Planning and Design: Urban network analysis provides valuable insights for urban planning and design processes. It helps inform decisions related to land use planning, road network design, location of amenities and facilities, and the integration of green spaces within the urban fabric. By considering the efficiency and connectivity of urban networks, urban planners and designers can create more sustainable, accessible, and livable urban environments.

In conclusion, urban network analysis is a valuable tool for understanding and optimizing the spatial structure, efficiency, and accessibility of urban networks. By assessing the performance of transportation systems and pedestrian networks, urban network analysis informs decision-making processes, supports sustainable transportation planning, and contributes to the development of vibrant and connected urban communities.

B. Network analysis techniques for assessing urban infrastructure:

Urban network analysis employs various techniques to assess and analyze the characteristics and performance of urban infrastructure. These techniques provide insights into the connectivity, efficiency, and functionality of transportation networks, pedestrian pathways, and other urban elements. Some commonly used network analysis techniques for assessing urban infrastructure include:

1. Centrality Measures: Centrality measures assess the importance and influence of specific nodes or links within a network. These measures help identify key nodes that play a critical role in urban connectivity. Examples of centrality measures include degree centrality, which measures the number of connections a node has, and betweenness centrality, which identifies nodes that act as important intermediaries in the network flow.
2. Connectivity Indices: Connectivity indices quantify the level of connectivity within an urban network. These indices assess how well different areas or nodes are connected and how easily individuals can navigate through the network. Examples of connectivity indices include the closeness centrality, which measures how quickly a node can reach other nodes in the network, and the clustering coefficient, which measures the level of interconnectedness among neighboring nodes.
3. Network Density Analysis: Network density analysis examines the density of connections within an urban network. It quantifies the number of links present in the network relative to the maximum possible number of links. Higher network density indicates a more connected and accessible urban environment.
4. Route Analysis: Route analysis techniques evaluate the efficiency and accessibility of transportation routes within an urban network. This analysis involves determining the shortest paths between origin and destination points, considering factors such as travel distances, travel times, and mode of transportation. Route analysis helps identify optimal routes for various modes of transportation and supports decision-making processes related to transportation planning, infrastructure design, and traffic management. [5]
5. Multi-Modal Network Analysis: Multi-modal network analysis considers multiple modes of transportation within an urban network, such as walking, cycling, and public transit. It assesses the integration and connectivity of different transportation modes and evaluates the efficiency and accessibility of multi-modal transportation systems. This analysis helps identify areas where modal transfers can be improved, where infrastructure for specific modes may be lacking, and where enhancements can be made to support seamless and sustainable multi-modal journeys.
6. Spatial Analysis: Spatial analysis techniques, such as Geographic Information Systems (GIS), are employed to analyze and visualize urban networks. GIS enables the integration and visualization of various spatial data, including transportation networks, land use patterns, and demographic information. Spatial analysis provides valuable insights into the spatial relationships, patterns, and characteristics of urban infrastructure, facilitating evidence-based decision-making for urban planning and design.

These network analysis techniques, among others, assist in understanding the structure, efficiency, and connectivity of urban infrastructure. They support informed decision-making processes, helping urban planners, policymakers, and stakeholders identify opportunities for improvement, optimize connectivity, and design sustainable and efficient urban environments.

C. Application of centrality measures and connectivity indices

Centrality measures and connectivity indices are powerful tools used in urban network analysis to assess the importance, connectivity, and efficiency of urban infrastructure. These measures provide valuable insights into the characteristics and performance of transportation networks, pedestrian pathways, and other elements of the urban fabric. Here are some common applications of centrality measures and connectivity indices:

1. Identifying Key Nodes: Centrality measures, such as degree centrality and betweenness centrality, are applied to identify key nodes within an urban network. Degree centrality measures the number of connections a node has, indicating its level of connectivity and influence within the network. Nodes with high degree centrality may represent major transportation hubs, central intersections, or key destinations. On the other hand, betweenness centrality identifies nodes that act as crucial intermediaries in the flow of movement. These nodes often serve as critical transfer points or strategic locations for efficient navigation within the urban network.
2. Assessing Network Efficiency: Connectivity indices, such as closeness centrality, are used to evaluate the efficiency and accessibility of urban networks. Closeness centrality measures how quickly a node can reach other nodes in the network. Nodes with high closeness centrality have shorter average travel distances to other nodes, indicating better accessibility. This analysis helps identify areas within the urban network that may lack efficient connectivity or where improvements can be made to reduce travel distances and enhance overall network efficiency.
3. Evaluating Network Resilience: Centrality measures and connectivity indices are also applied to assess the resilience of urban networks. By identifying nodes with high centrality and connectivity, it becomes possible to determine the critical points that, if disrupted or congested, may significantly impact the overall functioning of the network. This analysis helps in identifying vulnerable areas and formulating strategies to enhance network resilience, such as implementing redundancy measures, improving alternative routes, or strengthening key infrastructure.
4. Supporting Transportation Planning: Centrality measures and connectivity indices are valuable for transportation planning and decision-making processes. These measures can assist in determining optimal routes for public transit systems, identifying locations for new transit stations, or evaluating the effectiveness of existing transportation infrastructure. By considering the connectivity and centrality of nodes, planners can focus on improving connectivity gaps, enhancing accessibility to key destinations, and promoting sustainable transportation options, such as walking and cycling.
5. Informing Infrastructure Design: The application of centrality measures and connectivity indices helps inform the design of urban infrastructure. By identifying key nodes and assessing connectivity patterns, designers can prioritize the allocation of resources, such as pedestrian-friendly infrastructure, cycling lanes, or public spaces. This analysis enables the integration of connectivity and accessibility considerations into infrastructure design, leading to more efficient and user-friendly urban environments.
6. Assessing Impact of Interventions: Centrality measures and connectivity indices are useful in evaluating the impact of interventions or changes in the urban network. By conducting before-and-after analyses, planners can assess how modifications to the network, such as the addition of new roads, pedestrian pathways, or public transit lines, have affected connectivity, accessibility, and

overall network efficiency. This evaluation helps refine future interventions and optimize the performance of the urban network.

In summary, centrality measures and connectivity indices play a significant role in urban network analysis by providing valuable insights into the characteristics and performance of urban infrastructure. Their applications range from identifying key nodes and assessing network efficiency to informing transportation planning, infrastructure design, and evaluating the impact of interventions. By utilizing these measures and indices, urban planners and policymakers can make informed decisions to enhance the connectivity, efficiency, and sustainability of urban networks.

Conclusion:

Low-carbon community regeneration in Dadong, China, presents a significant opportunity to create sustainable and livable urban environments. Through the integration of urban network analysis and community design, the potential for transforming Dadong into a low-carbon community can be assessed and realized. This case study has highlighted the importance of pedestrian networks, sustainable transportation, and carbon emissions reduction in achieving low-carbon community regeneration. [6]

The concept of low-carbon community regeneration involves a comprehensive approach that addresses various aspects, including energy efficiency, sustainable transportation, green infrastructure, and community engagement. By adhering to the principles of low-carbon regeneration, Dadong can reduce carbon emissions, enhance community connectivity, and improve the overall quality of life for its residents.

Urban network analysis plays a critical role in understanding the spatial structure and functional relationships within Dadong. It provides insights into transportation patterns, connectivity, and opportunities for optimizing community design. Through the application of network analysis techniques, such as centrality measures and connectivity indices, key nodes, efficient routes, and areas for improvement can be identified, informing decision-making processes related to infrastructure design, transportation planning, and sustainable mobility.

Community engagement and participatory planning are essential components of low-carbon community regeneration. By involving community members, businesses, local organizations, and other stakeholders, the regeneration process becomes inclusive, empowering, and responsive to the needs and aspirations of the community. Collaboration among diverse stakeholders fosters social cohesion, innovation, and shared responsibility, leading to long-term sustainability and acceptance of low-carbon initiatives.

The role of community design in shaping sustainable urban environments cannot be understated. By promoting walkability, mixed land use, green infrastructure, and inclusive design, community design fosters active transportation, accessibility, social cohesion, and a sense of place within Dadong. Participatory planning ensures that the community's unique characteristics, values, and aspirations are considered, resulting in a built environment that reflects the needs and desires of the residents.

In conclusion, the assessment of low-carbon community regeneration in Dadong, China, through urban network analysis and community design, offers valuable insights and recommendations for policymakers, urban planners, and community stakeholders. By prioritizing sustainable transportation, pedestrian networks, and community engagement, Dadong has the potential to become a model for low-carbon living and a sustainable urban environment. The integration of these strategies will contribute to reduced carbon emissions, enhanced community connectivity, and the creation of a vibrant and resilient community for the present and future generations.

REFERENCES:

1. Fang, K., Azizan, S. A., & Wu, Y. (2023). Low-Carbon Community Regeneration in China: A Case Study in Dadong. Sustainability, 15(5), 4136.
2. Lv, Y., Bi, J., & Yan, J. (2018). State-of-the-art in low carbon community. International Journal of Energy for a Clean Environment, 19(3-4).
3. Yuan, H., Zhou, P., & Zhou, D. (2011). What is low-carbon development? A conceptual analysis. Energy Procedia, 5, 1706-1712.
4. Fang, K., Azizan, S. A., & Wu, Y. (2023). Low-Carbon Community Regeneration in China: A Case Study in Dadong. Sustainability, 15(5), 4136.
5. Yang, X., Sun, H., Huang, Y., & Fang, K. (2022). A framework of community pedestrian network design based on urban network analysis. Buildings, 12(6), 819.
6. Du, H., Shen, P., Chai, W. S., Nie, D., Shan, C., & Zhou, L. (2022). Perspective and analysis of ammonia-based distributed energy system (DES) for achieving low carbon community in China. Iscience, 25(10).

Vol. 3, Issue 03, July(2020)

HAEMODYNAMIC CHANGES FOLLOWING SPINAL ANAESTHESIA: A COMPARISON IN PATIENTS UNDERGOING TURP BETWEEN PRELOADING WITH CRYSTALLOIDS AND COLLOIDS

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ABSTRACT:
Spinal Anaesthesia, TURP, bupivacaive, hypotensio Spinal anesthesia consists of temporary interruption of nerve transmission within the subarachnoid space produced by injection of a local anesthetic solution into cerebrospinal fluid. Used widely, safely and successfully for more than 100 years, spinal anesthesia has many potential advantages over general anesthesia, especially for operations involving the lower abdomen,the perineum and the lower extremities. The advantages claimed with spinal analgesia for such operation include reduced blood loss and better operating conditions , minimal effect of arterial oxygen and carbon dioxide tensions of the patient , preference by surgical and nursing staff and a generally comfortable recovery. The technique can permit early detection of complications such as TUR syndrome and bladder perforation.[1,2]

INTRODUCTION

Background

Spinal anesthesia consists of temporary interruption of nerve transmission within the subarachnoid space produced by injection of a local anesthetic solution into cerebrospinal fluid. Used widely, safely and successfully for more than 100 years, spinal anesthesia has many potential advantages over general anesthesia, especially for operations involving the lower abdomen,the perineum and the lower extremities. The advantages claimed with spinal analgesia for such operation include reduced blood loss and better operating conditions , minimal effect of arterial oxygen and carbon dioxide tensions of the patient , preference by surgical and nursing staff and a generally comfortable recovery. The technique can permit early detection of complications such as TUR syndrome and bladder perforation.[1,2]

The injection of local anesthetics solutions into subarachnoid space produces important and often widespread physiologic responses.

The most important physiologic responses to spinal anaesthesia involve cardiovascular system. They are mediated by combined effects of autonomic denervation and with higher levels of autonomic blockade, the added effects of vagal nerve innervations. [3]

Sympathetic denervation produces arterial and more important arteriolar vasodilatation. Because peripheral vascular resistance decreases only 15 to 18 per cent, mean arterial pressure decreases only 15 to 18 percent in the presence of normal cardiac output.[2,4]

Heart rate decreases during spinal anesthesia in the absence of autonomically active drugs and medications. The bradycardia is due in part to blockade of preganglionic cardiac fibres arising from T1 – T4. The bradycardia is also mediated by significant decreases in right atrial pressure and pressure in great veins as they enter right atrium. This can be seen during fixed levels of spinal anesthesia. Placing the patient in slightly head-down position increases venous return which increases right atrial pressure.[4,5,6].

Slight decreases in arterial pressure in normovolemic patients can be ascribed to decreases in after load. Severe hypotension can be due to decreases in cardiac output secondary to decreases in preload associated with peripheral pooling of blood in vasodilated capacitance vessels or to hypovolemia, or both.[7,8]

Decreases in systolic blood pressure to levels 33 per cent below resting control levels need not be treated during spinal anesthesia in healthy, asymptomatic patients.

If physiologic measures need to be supplemented by vasopressors, the most useful are ephedrine and mephentermine. Both have venoconstrictive properties without major undesirable effects on the ratio between myocardial oxygen supply and demand.[8,9]

Restoration of blood pressure alone is not the sole objective of treating hypotension. The objective is restoration of tissue oxygenation, especially myocardial oxygenation.[10,11]

Studies have shown that colloids decrease the extent of hypotension but do not prevent it.

The present study was conducted in the Department of Anesthesiology, SKIMS, wherein the effects of fluid preloading (crystalloid and colloid) and no preloading on haemodynamic parameters in 80 male' patients undergoing TURP operation (45 to 75 years) were studies.

The crystalloid selected was Ringer's lactate which is a balanced salt solution.The Colloid (Hemaccel) contains large molecules which remain intravascular for a longer period of time and maintains intravascular volume.

Bupivacaine was selected for spinal anesthesia in these patients. It combines the properties of an acceptable onset, long duration of action, profound conduction blockade, and signification separation by sensory anesthesia and motor blockade.

We use 0.5 per cent hyperbaric bupivacaine for producing spinal anesthesia in our study.

Methods

This prospective randomized study was carried out in the Department of Anaesthesiology and critical care. SKIMS between December and September 2006. After institutional ethics committee approval and written informed consent, 80 male patients of ASA grade I-II, aged 45-75 years, scheduled for elective transurethral resection of prostate (TRUP) were studied.

Patients with a history of hypertension, congestive cardiac failure, any active medication for cardiovascular system or any other absolute/relative contraindications to spinal anaesthesia were excluded from the study.

Patients were randomly allocated to two groups of 40 each.

i. Group I : Received 7 ml/kg of crystalloid preload (Ringers lacate) over 10-15 minutes ten minutes before spinal anaesthesia.

ii. Group II : Received 7 ml/kg of colloid preload (Haemaccel) over 10-15 Minutes ten minutes before spinal anaesthesia.

No premedication was given to any patient. On arrival in operation theatre, a 18 cannula was secured in a peripheral vein, and an infusion by Ringers lactate 5 ml/kg hr was give to all patients during the procedure. Patient was connected to Datex monitor for electocardiogram (ECG),SPO2 and non-invasive blood pressure (NIBP) monitoring.

Baseline heart rate, systolic, diastolic and mean blood pressure were recorded with the patient in a semi-recumbent position. Baseline blood pressure was taken as mean of three readings soon after arrival in the operation theatre.

Patients were then placed in sitting position and under all aseptic precautions, a lumbar puncture was performed with a 24 G Quinckes spinal needle in L3-4 intervertebral space. All patients received 3 ml of 0.5 per cent heavy bupivacaine intrathecally. After withdrawal of the spinal needle, an antiseptic seal was applied at the site of lumbar puncture and patients placed in supine position with a slight head up tilt not exceeding 200. Haemodynamic variable : Heart rate, systolic blood pressure, diastolic blood pressure ad mean arterial pressure were recorded at 5 minutes intervals upto 20 minutes after commencement of spinal anaesthesia.

Hypotension was defined as a fall in baseline systolic blood pressure by 30 per cent of baseline or ≤ 90 mmHg which is in accordance with most studies in the literature. If hypotension occurred it was promptly treated by intravenous ephedrine in 5 mg boluses to raise the systolic blood pressure upto above 80 percent of the baseline value. The total amount of ephedrine used was recorded.

The data obtained was analysed using standard statistical methods including student t-test and chi-square test.

Results

Hypotension is the commonest problem following spinal anaesthesia. Rapid administration of crystalloid solutions to correct established hypotension was first advocated by Greiss and Crandell in 1965.

We randomly allocated the patients to two groups of 40 each:

I. Group I : Receiving 7 ml/kg of Ringer's lactate over 10-15 min
Before spinal anaesthesia.
II. Group II : Receiving 7 ml/kg of Haemaecel.

Hypotension defined as a fall in baseline systolic arterial pressure by 30% or ≤ 90 mm Hg was treated by boluses of ephedrine in doses of 5 mg.

The following indices were taken and statistically analysed:

I. Systolic blood pressure – baseline, at 5 min 10 min, 15 min. and 20 min.
II. Diastolic blood pressure - at 5 min 10 min, 15 min. and 20 min.
III. Mena arterial pressure – baseline, at 5 min 10 min, 15 min. and 20 min.
IV. Need for vasopressors between the two group.

The statistical analysis of the data was done by using Student's t-test for different of means and chi-square test. These test were two sided and were referenced for p-value for their significance. Any p-value less than 0.5 ($p<0.5$) are taken to be significant.

The analysis of the data was performed as Statistical Package for Social Science (SPSS version 10.0) Chicago, USA, for windows.