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A Seminar Report  
On

***Smart City as a Smart Service System***

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of*

**Bachelor of Engineering  
in  
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**CERTIFICATE**

Certified that the Technical Seminar Entitled "**Smart city as a smart service system**" carried out by **AMRUTHA K**, bearing USN **1GA18CS194**, bonafide student of Global Academy of Technology, is in partial fulfillment for the award of the **BACHELOR OF ENGINEERING** in Computer Science and Engineering from **Visvesvaraya Technological University, Belagavi** during the year 2021-2022. The report has been approved as it satisfies the academic requirements in respect of the Technical Seminar work prescribed for the said degree.

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## **ABSTRACT**

Smart city services, smart applications and smart devices form an ecosystem of tools and artifacts that challenge, and times even disrupt, conventions, norms, and rites of behavior, thus prompting diverse behavioral changes at the level of the individual, the group, and the society at large. In this view, smart city may be viewed as a – one of its kind – laboratory to query the complex human-computer relationship from a multi-dimensional perspective. By adopting this perspective, this paper queries the existing smart city surveillance systems to identify their key limitations and sources of frequently justified controversies. It is argued that to bypass these – first – the value of mesh-technology should be explored. It is also argued that – second – it is necessary not only to bring citizens back in the discussion on smart city, but also to highlight the mechanisms by means of which they might be involved in the codesign of smart city solutions and in urban decision-making. To bridge these two imperatives, smart city is conceptualized as a smart service system and, consequently, a wireless integrated mesh-technology enhanced (WIMTE) smart city surveillance system is elaborated.

## **TABLE OF CONTENTS**

<b>Sl No.</b>	<b>Sections</b>	<b>Pg No.</b>
1.	<b>Acknowledgement</b>	I
2.	<b>Abstract</b>	II
3.	<b>Table of Contents</b>	III
4.	<b>Introduction</b>	1
5.	<b>System Architecture</b>	
5.1	<b>Smart City as a Smart Service System</b>	2
5.2	<b>Surveillance Operations in Cities</b>	3
5.3	<b>A Wireless Integrated Mesh Technology – Enhanced (WIMTE)</b>	5
5.4	<b>The Reinterpretation of WIMTE In Smart Service System</b>	8
6.	<b>Implementation</b>	10
7.	<b>Results</b>	12
8.	<b>Conclusion</b>	13
9.	<b>References</b>	14

## INTRODUCTION

Smart city services, smart apps, and smart devices make up an ecosystem. Individual, social, and societal behavioral changes are prompted by an ecology of tools and artefacts that challenge, and at times even disrupt, established conventions, norms, and rites of behavior. In this light, the smart city can be considered as a one-of-a-kind laboratory for probing numerous elements of the complex human-computer relationship that emerges in the daily process of creating and operating the smart city. This multidisciplinary research challenge is addressed by examining the hotly debated smart city surveillance technologies. To that end, two imperatives drive the argument in this paper.

First, because the scope of streaming video and data in traditional smart city surveillance systems is limited and, in essence, does not lend itself to active real-time monitoring and assessment of risks, threats, and infrastructure maintenance needs in cities, new solutions that overcome these limitations are urgently needed. Second, given the rate at which technology pervades city space, supporting the transition of cities to smart cities, it is critical that the resulting human-computer interaction be rethought, re-examined, and re-learned in order to restore citizen centrality in smart city design, decision making and policy making.

Smart cities are reread as smart service systems according to a socio-technical view that analyses the impact of technology in the co-creation of economic, social, and cultural value to investigate the evolving human-computer interaction and the active role of citizens in contemporary decision - making. On the one hand, it is argued that the traditional top-down approach to technology adoption in the fields of safety and security raises legitimate worries that civic rights and liberties may be jeopardized. Approaching smart cities from the perspective of a smart service system allows us to bridge and avoid these issues.

Cities can be viewed as complex systems through the perspective of service science, in which people's active engagement, including human-computer interactions and information sharing with organizations, can lead to the co-development of innovative solutions for the system's stakeholders' well-being. The use of a systems viewpoint highlights the necessity to examine how digitalization in urban environments can benefit not only a city's technological advancement, but also people's lives, as demonstrated by existing research on smart cities.

## SYSTEM ARCHITECTURE

### 5.1 SMART CITY AS A SMART SERVICE SYSTEM

Smart service systems are defined as the synergistic integration of people, technology, organizations, and information through the so-called 4Cs: connection, communication, collection of data and computation. By increasing the speed of information exchange and the transparency and efficiency of communication, information and communication technology (ICT) can enhance the already existing multi-layered relationships (connections) between the defined actors and between actors and technology (human-computer interactions). Continuous data collecting is made possible by ICT enhanced tools and solutions.

Recent approaches to smart city research imply that the smart city should be viewed from three perspectives: as an analytical idea, as an artefact, and as a policymaking goal. In this interpretation, the smart city becomes the focal point for information management that is both efficient and long - term. Given the smart city's multi-layered and networked character, as well as the importance of the 4Cs, i.e., relationships/connections, data gathering, information processing/computing, and information sharing/communication, it's reasonable to think of the smart city as a smart service system.

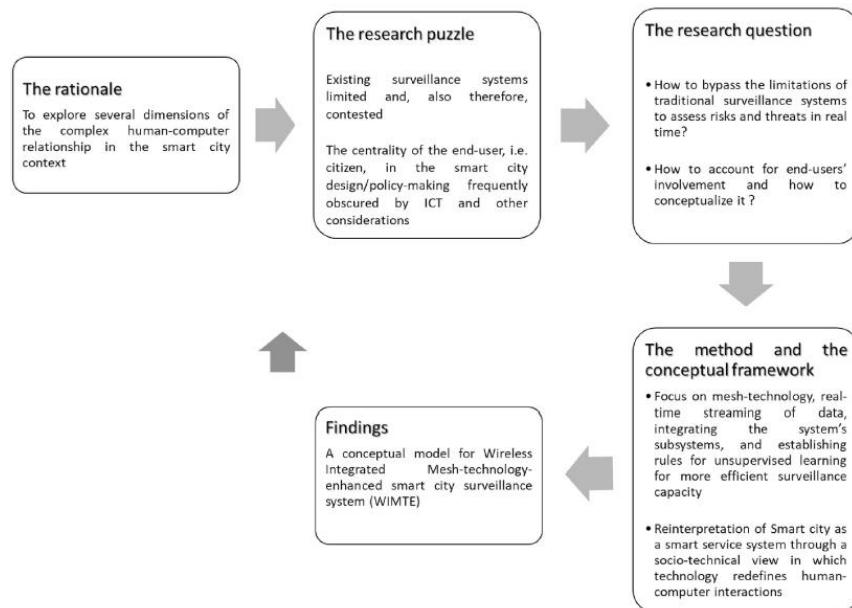
Furthermore, using the smart service system lens to the study of the smart city focuses the search on the processes that help/hinder efficient ways of dealing with rising difficulties and threats that smart cities face. The study's systems perspective aims to investigate how the implementation of integrated wireless mesh technology can redefine human-computer interactions in smart cities as systems by improving user decision-making and assisting cities in avoiding risks, surviving crises, and developing resilient attitudes.

The use of a wireless mesh technology-based integrated system in urban smart service systems can allow researchers to look into:

- 1) How WIMTE can activate human-technology interaction and enable diffused decision-making and bottom-up collaborations among users

2) How collaboration and cocreation can lead to the development of innovative solutions in the city.

As a result, the key thesis made is that bottom-up communication and cooperation mechanisms are critical for smart city sustainability. In this context, sustainability also means safety, inclusion, and resilience.



**Fig 1: The research model**

## 5.2 SURVEILLANCE OPERATIONS IN CITIES

The keywords that define smart surveillance networks are: effective data aggregation, seamless integration/transmission across wired and wireless channels and meaningful data analytics. Using artificial intelligence capabilities that overlay real-world and stored data in command centers repositories, video and data analytics platforms automate the process of analyzing and identifying resources needed to tackle emergencies. Cities are increasingly using video surveillance (CCTV: Closed Circuit Television) to supplement their police forces and community watch programs. The

mere presence of surveillance cameras in public places is thought to be a deterrent to criminal activity. The mere presence of surveillance cameras in public places is thought to be a deterrent to criminal activity. Criminal behavior studies refer to this phenomenon as “situational crime prevention” method that psychologically heightens the probability of arrest for intending or would-be offenders. Research in both the UK and the US reported statistically significant crime reductions due to the visibility of surveillance video cameras in parking lots and public transit facilities.

Effective data collection, seamless assimilation across wired and wireless channels, and significant data analytics are the keywords that describe smart surveillance networks. The capacity of a network to receive live and recorded video feeds from various sources, such as fixed position cameras or onboard vehicle cameras, is referred to as effective aggregation. The ability of networks to transfer bits of information from different sources across wired and wireless nodes with persistent roaming at high speeds is referred to as seamless integration/transmission. Most cities currently rely on unconnected communication networks, which include landline, cellular, and mobile radio networks, for security and emergency operations.

These networks become overburdened and unable to deliver adequate services during emergencies, especially when physical infrastructure components are affected by natural or man-made catastrophes. Traditional networks bandwidth and overall functioning may be harmed, and they may not be able to handle demanding multi-media applications like high-resolution video sharing among security and recovery staff. Various cities throughout the world have built the infrastructure for smart surveillance networks and are gradually but steadily adding the building components. The city of Nice, France, has pioneered a four-layer architecture smart parking project. Sensors and networked devices make up the first layer. The second layer consists of data receivers and processors scattered around the city. Central data repositories and analytics are housed at the third tier.

The wireless mesh network that streams all types of data across the entire system is provided by the fourth layer. Smart surveillance networks aid in the synchronization of public agency and law enforcement decisions at command centers with real-world emergencies, resulting in increased preparedness and efficacy in dealing with problems. They consist of a network of nodes and transmitters that send video and data at fast speeds from node to node. Through a huge number of stationary and mobile surveillance sensors, wireless mesh networks, and video/data analytics

platforms, smart network components must have an intense multisensory capacity. Instead of depending on traditional traffic actuation methods, connectivity will allow smart traffic management platforms to collect data directly from automobiles.

As a result, by enhancing HCI and stakeholder participation, numerous automotive services can be integrated into smart traffic management, providing greater convenience for automobiles through smart parking services. Benefits in terms of technology, economics, and relationships can all be acquired this way. Furthermore, a wireless mesh architecture can help with crisis decision-making by increasing information flows and disaster recovery communication. The integration of several devices, which promotes real-time interactions between various stakeholders, can aid in public safety monitoring and event detection.

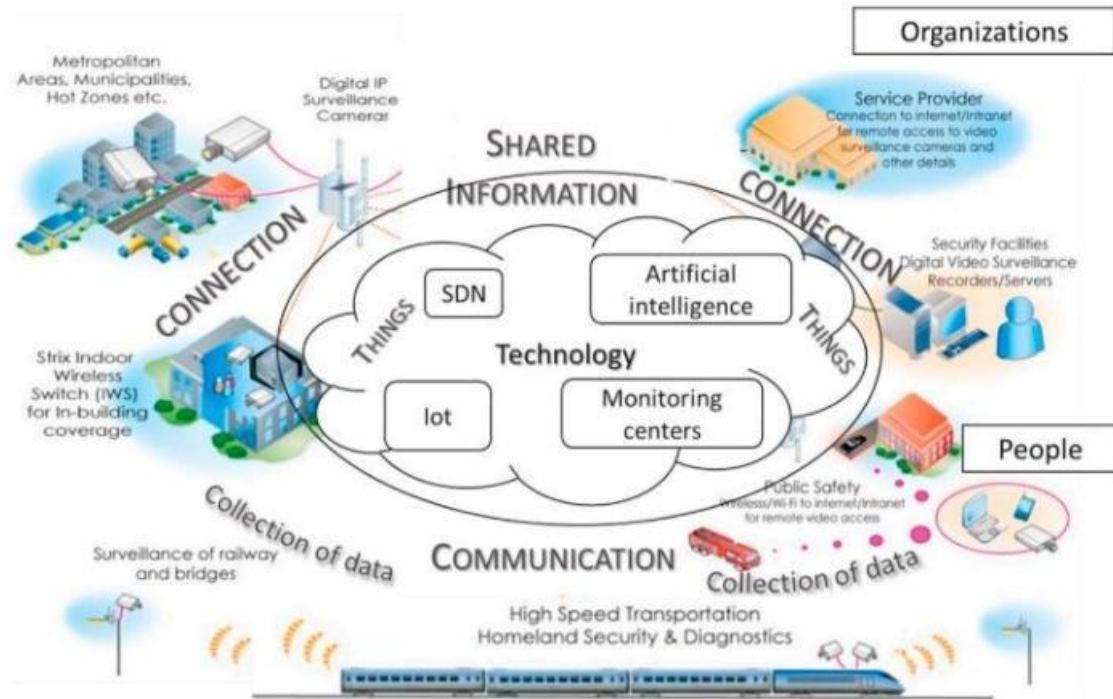
This study considers the smart city as a smart service system to account for these difficulties. This method sheds light on how the creation and acceptance of novel solutions in the field of smart city surveillance may be co-created and encouraged through active collaboration among all system actors. Smart cities as smart service systems allow for the detection of various technologies and human behaviors (intentions, attitude, citizens' digital competencies, and willingness to use technology) that can act as key enablers for the creation of new rules to coordinate exchanges and interactions, as well as the transformation of crises into opportunities, innovation, and social change. The conceptualization of smart cities as smart service systems allows detecting the different kinds of technologies and human behaviors.

### **5.3 A WIRELESS INTEGRATED MESH TECHNOLOGY-ENHANCED (WIMTE)**

The transformation of the city into a smart service system should be viewed as a response to the rapid pace at which technology is infiltrating people's lives, as well as the need to make cities more inclusive, safe, resilient, and sustainable. Service science can be used to determine:

- 1) The integrated set of technologies that can improve safety and security in cities through key tools like multiple surveillance systems and wireless mesh technology
- 2) The transformations introduced in human computer interaction (HCI) and communication

- 3) The impact of these transformations on individual and organizational behaviors



**Fig 2: An integrated model for WIMTE: smart cities as smart service systems**

The WIMTE conceptual model presented in this paper has three interrelated operational stages:

- 1) To detect, record, and transmit a wide range of video and audio signals, as well as other essential sensory data
- 2) To gather data from video, audio, and other environmental sensors and send it to central station computers for high-level data aggregation, computing, and analysis. The automated video analytics performed in the second stage represent a major breakthrough in data fusion and integration from various sources
- 3) To establish a communication network that ensures timely and reliable transmission of information to first responders and other security personnel involved in public safety and crime control.

WIMTE has a lot of potential in terms of mitigating and controlling epidemics of infectious diseases. If hazards to public health are to be avoided and concerns to citizens' health addressed quickly, the case of Covid-19 demonstrates that more flexible and efficient solutions are required.

The gradual construction and interconnection of network clouds in shopping malls, worship centres, transportation venues, hospitals, industrial facilities, office parks, and other locations would aid in the detection of virus outbreaks, the transmission of notifications/warnings, and the deployment of medical emergency/control resources.

Multiple surveillance and sensory instruments could be combined into full networked systems that provide wireless real-time viewing and communication, video analytics, and automated response/action capabilities. Smart information solutions, termed the Internet of Things (IoT), aim to promote scalable networks that gradually but steadily embed intelligence into city physical environments, as opposed to fragmented high-tech applications in cities today. The proposed WIMTE will not only enable smart cities to deter/reduce crime rates, but also optimize transportation operations, enhance infrastructure services, and improve city resiliency in the face of infectious disease pandemics, thanks to multisensory capacity, AI (Artificial Intelligence) evolving cognition capabilities, and wireless real-time/broadband connectivity.

Over multi-level connection systems that include point to point inside/outside buildings, neighborhoods, and cities, WMNs host a wide range of stationary and/or roaming client nodes. Nodes in a wireless mesh network can detect the existence of other nodes in the same coverage area and automatically expand their networks. Data is passed from one device or node to the next until it reaches a destination node. The network may scale up and down as needed, adapting to ad hoc groups of nodes with self-organizing characteristics. Integrating cellular and web technologies with WMNs opens up a world of possibilities.

It's essentially a huge network of smaller networks connected by a routing algorithm that sends data packets between them. The establishment of a network of interactions between actors and technology (HCI) as well as among distinct groups of actors can benefit a variety of stakeholders:

- 1) To the government, which receives real-time information on the evolution of the pandemic and citizens' acceptance of technology and restrictions
- 2) To citizens, who can stay in touch with public administration and other citizens to share relevant information on the evolution of pandemics and contagion
- 3) To private and public organizations, which can more easily locate people in need of assistance, medical care, or general services

The continuous collection of data in WMNs permits not only to monitor users' and citizens'

behavior but to orient people's attitude toward technology and willingness to use technology.

## 5.4 THE REINTERPRETATION OF WIMTE IN SMART SERVICE SYSTEM

The actors in the system are:

- 1) Service providers (organizations): provide a cloud storage environment for large-scale data storage in order to execute complicated video analysis algorithms and flexibly modify the system to user and computing needs
- 2) Public space, hospitals, and transportation systems (organizations): channels, city highways, airports, water supply networks, and other infrastructure components that act as a "workforce multiplier," extending government and perhaps reducing response time to emergencies
- 3) Users (people): final users who collect and analyze the data provided by providers; 4) citizens (people) who are monitored in the smart city public area

The smart city, reframed as a service system, can be seen as a collection of technology, people, and shared information and resources that are linked by many relationships at three levels:

- 1) Micro-individual level: set of individuals with specific intentions, attitudes, cognitive processes, value perception, skills, and resources
- 2) Meso-relational level: networks of relational and social connections between groups of actors
- 3) Macro-relational level: networks of relational and social connections between groups of actors
- 4) Macro-relational level: networks of relational and social connections between groups of actors
- 5) Macro-relational level: networks of relation
- 6) Macro-collective level: the broader community in which cocreated value can be converted into new meanings, social behaviours, and culture.

As a result, value co-creation and co-development of new value, new practises, and innovation are dynamic processes resulting from the interaction of multi-levelled alterations at the

individual, relational, and communal levels of exchange. Furthermore, wireless technologies enable the building of a wireless broadband mesh cloud with connective versatility across many networks such as the internet, cellular, and other radio frequency-based devices using a system of routers and gateways. In this approach, not only users' and residents' conduct may be tracked, but also people's attitudes regarding technology, changes, and entire cities, as well as their intention and willingness to use technology and follow the Pandemic's official norms. The use of wireless mesh technology can aid in the development of smart solutions in a variety of cities throughout the world.

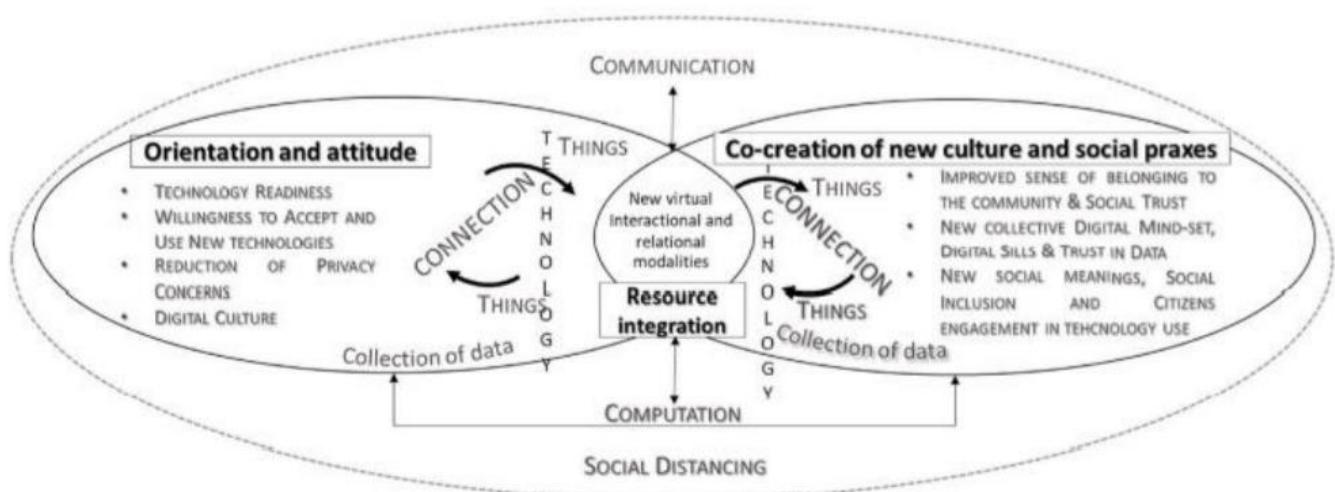
Through a variety of mobile devices and content, as well as cloud services, instruments like IoT (Internet of Things) and SDN (Software-Defined-Networking) stimulate dynamic and programmatically efficient network design in order to increase network performance and monitoring. Artificial intelligence systems can improve the analysis of audio and images from video surveillance in order to recognize humans, vehicles, objects, and events, as well as provide tools that allow analytics platforms to collect data and make more informed decisions that analyze and predict changes in object/human behavior. Shared information combines data from a variety of sources and allows for successful two-way live streaming of events as well as summative analytical reports. Event details and reports can be collected and shared via different wireless communication channels thanks to secure data repositories in the service provider network.

The entire system is based on data collection, with analytics software coordinating video/audio streams and sensory data to build aggregate situational awareness reports that are delivered via real-time multichannel communication. Fixed monitoring stations in offices or other mobile communication devices in the field (laptops, phones, and other digital transmitters) are the recipients of such reports. Detecting technological changes in relational modalities and interactional patterns among people mediated by technology allows for the identification of enablers for the management of these relationships. Through the readaptation of interactions between users, which can lead to the emergence of societal transformation and social changes in citizenship behaviour through diffused decision-making, the integration of technology and people (intended as human attitude and intentions at an individual level) can challenge social crisis and pandemic (collective level).

## IMPLEMENTATION

Smart cities can improve their competitive advantage and people's living standards by using smart solutions and service systems. City governments and concerned organizations should invest in nourishing their human/social capital, natural ecosystems, and providing rich opportunities for participatory governance to sustain economic growth, social cohesion and responsibility, and a reasonable level of equity among citizens in order to maintain economic growth, social cohesion and responsibility, and a reasonable level of equity among citizens. Privacy and security of personal data are critical factors in increasing people's adoption of smart devices.

Individuals can be assured of the confidentiality and security of their information with the appropriate use of "Blockchain" technologies in smart applications. Raising people awareness of the fine line between sharing and abusing private data of others is imperative for successful implementation of smart systems. Individually, the development of integrated systems for WIMTE can help to reduce conventional barriers to technology adoption and, as a result, improve users' preparedness to embrace and use technology. Users are encouraged to create a positive attitude toward new technologies by reducing technological anxiety and privacy worries about the exploitation of personal data from a psychological aspect. Fear and uncertainty, which drive players to reject technological progress, can be reduced in this way.



**Fig 3: The impact of WIMTE on the redefinition of users' attitude, interactions and behaviors.**

The proposed conceptual model identifies:

- 1) The main technological drivers for smart surveillance to redefine smart cities infrastructure to combat epidemics
- 2) The complex process of redefinition of actor interactions and communication modalities among actors
- 3) The key determinants of social change as a result of citizens' changing attitudes toward technology and behaviour

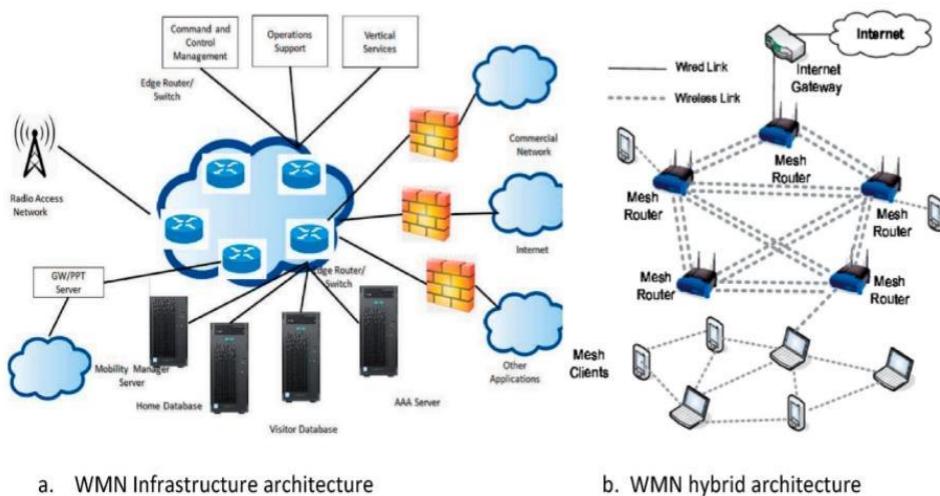
Rather than focusing on whether or not to use personal data sources, future research might look into how data can be used wisely and effectively while remaining ethical. As a result, if technologies are implemented in a transparent manner, with citizen participation and reliable public communication that shares and justifies decisions made, not only can the value of data be exploited efficiently and strategically, but policymakers can also strengthen citizens' trust in the government's strategy. The integrated WIMTE framework proposed in this study helps to illuminate how ecosystems can combat social and economic crises by integrating technologies with human attitudes and individual intentions (individual level) to detect how the readaptation of user interactions (relational level) can lead to the emergence of innovation and well-being (collective level).

The co-creation of culture and citizen adoption of a "digital culture" can result in a new cultural status that is recognized collectively and based on new routines and rules for human-computer interactions, general usage of technology, and transforming social structures at the conclusion of the process. Cities can offer technical skills training that improve citizens' access to technology and allow people from all educational and cultural backgrounds to embrace new technologies if they have a strong awareness of citizen problems and demands. The overarching goal of governance should be to involve people as end-users, citizens, and contributors to the smart city's innovative strength. The classification of enablers that foster citizens' and organizations' acceptance of technology can help identify key features for managing strategically smart cities infrastructure, as well as classify the main drivers for monitoring, managing, and challenging users' technology anxiety, increasing their acceptance of technologies, and predicting citizens' behavior, as well as managing technological tools for transactional citizenship (distance learning, smart workplaces).

## RESULTS

The infrastructure mesh (Fig. a) incorporates passive client nodes that communicate through Ethernet interfaces connected to mesh routers. Conventional client nodes (e.g., phones, desktops, laptops, PDAs, etc.) and the mesh router optimally operate under the same radio range. In the case of different radio frequencies, client nodes use the Ethernet to reach mesh routers via an intermediate communication with the base server station. The second WMN configuration is based on peer-to-peer connected client nodes. Each and every node in the network acts as a host and transmitter with no mesh routers mediating the reception/transfer process of data packets. The third WMN type offers a hybrid architecture in which the mesh clients act as both hosts and routers and together form the backbone of the entire operation (Fig. b).

It is simply a large network of smaller networks with a routing function that transfers data packets between the different networks. As a way of example, the devices inside command centers form a network of nodes that host/route data packets internally and use dedicated mesh routers to connect externally to other networks of handhelds in the possession of field operators and first responders. A flexible communication between nodes boosts the architecture of wireless mesh networks that can collect and extract data automatically from different interconnected sources, that range from monitoring centers to healthcare organizations to citizen's personal devices and public transportation systems.



**Fig 7.1: WMNs architecture configurations**

## CONCLUSION

Companies, public institutions, and non-profit organizations must adapt to a digital and distant method of conducting business, which is drastically transforming people's daily experiences and connections with other people and technologies, as well as their engagement in public life. A large number of experiments are used to test the effectiveness of the proposed rolling bearing fault diagnosis method, and the results show that the proposed method not only achieves a faster model training and fault diagnosis speed, but it can also diagnose multiple different rolling bearing faults and achieve a higher fault diagnosis accuracy.

In the aftermath of the Covid-19 epidemic, situational intelligence and automated targeted interventions are projected to improve worldwide public health safety. Sophisticated surveillance systems can be implemented using a coherent set of data-driven services provided by IoT devices, such as IP surveillance, cameras, sensors, and actuators, to estimate and prevent the negative consequences of a pandemic, to monitor systematically and systematically social distancing, mask wearing, and to locate individuals for safety or health reasons. This study outlined the components of a high-tech, cutting-edge smart city surveillance system (WIMTE) that can improve smart city safety and security while also serving as a vital tool for infrastructure management and disease prevention.

WIMTE's successful implementation necessitates increased broadband bandwidth and coordinated/seamless communication across public and private domains. The components provide situational awareness and real-time access to location-based data by allowing users to share and receive live video streams and other crucial data that aids in the analysis and reconstruction of occurrences. The WIMTE architecture includes embedded artificial intelligence that allows the system to think, learn, and relearn as streams of data are analysed and synthesised to generate automated responses that can be shared in real time with command centres, and a variety of other stakeholders. The current research can be viewed as a first step toward laying the theoretical groundwork for developing an integrated model for smart surveillance in city management from a systems perspective.

As a result, the conceptualizations presented can be implemented through a qualitative exploratory method that can extend and redefine the enabling characteristics and drivers of social change mentioned in this context based on observations and semi-structured interviews.

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