Multi Task Cognitive IoT Model to Enhance Smart Cities Services

Project Summary :
Revolution in Technologies led to the smart cities. Smart cities are responsible for economic development and well-being of citizens. Wireless technologies are promising to interconnect the cities. But certain challenges arise in this technology such as delay in information dissemination, effective communication channel among concerned parties, and limited resources. These resources or parameters are responsible for a network system to become dynamic and efficient. So these challenges need to be addressed to make smart cities and in turn, the citizens to be smart. On the other hand, the growing capabilities of technological devices have numerous challenges such as how to place the wireless system devices and where to place such devices to make the system efficient and effective. The feasible way to design smart cities is to integrate better degrees of intelligence within the network itself. This type of network execute autonomously . Wireless technologies are considered a talented way out for the communication infrastructure of a smart city regardless of numerous challenges, such as trade-offs between wireless coverage and capacity as well as limited spectral resources. For this reason, new communication paradigms are needed, and among these, Cognitive Radio networks (CRNs) are highly promising for providing timely wireless communications by utilizing all available spectrum resources. The cognitive network has a cognition type of ability to identify existing network situations and accordingly map the network system to the current scenario. The set-up of such network can be trained from these adaptations and utilize them to formulate future decisions and achieve the end goal. That is, considering all the network parameters that are involved during data transmission and accordingly make the design (dynamic) to achieve a faithful response. There is a necessity to develop a protocol to enhance the MTM (Machine to Machine), HTH (Human to Human) communication. In this project we will Develop a new protocol that will reduce the MTM and HTH problems in terms of sensing property; heterogeneity in order to have a wide spread of smart city application; QoS (in terms of priority, delay, data rate, reliability, and security). So in this project, a dynamic approach is proposed that can facilitate the development of smart cities on which one can rely. In the situations such as COVID-19 pandemic a) Emergency Response from ambulance and hospital services (health care services). b) Adaptive E-Learning, to continue the studies online as schools are closed. c) Smart home appliance to give alert of the groceries which are at end so as to buy them in advance d) Smart agriculture system to improve the quality and quantity of the production can be achieved in an efficient and intelligent way by this project.

Objective

The main objective of this project is

1. Design a dynamic model of traffic mechanism to guide the medical emergency.
2. Enhancement of adaptive E-learning
3. To make home appliance smart and secure
4. To improve the agricultural monitoring System

Keywords :
C-IOT; Nnetwork simulator; Smart Cities; Sensors

Expected Output and Outcome of the proposal:

This project results in the development of an efficient algorithm that can increase the usage of resources efficiently and dynamically by employing C-IoT to provide:

1. Response from health care services in the case of emergency.
2. Adaptive E-learning systems
3. Intelligent home appliance system
4. Smart farming that can improve the agriculture sector
5. Prototype of the proposed model

1. Origin of the proposal

The art of work published many works about smart cities and their applications in thereal world (such as Chourabi et al 2012, Demestichas 2014, Chugh, Damanpreet. 2020 *and* Seunghwan Myeong 2021)

The research community is trying to develop an algorithm that can meet the requirements of the persons in the smart cities. The existing approaches try to reduce the complexity of the algorithm but still, there are some issues like optimal resource utilization. This project expects the development of an efficient algorithm that can increase the usage of resources dynamically using cognitive IoT for the following purposes:

(i) Emergency response system from health care workers

Road accidents are very common and any medical emergency may emerge for people, especially old age people at home, office etc and even for the emergency situations rising due to pandemic. So, it becomes very necessary to provide the emergency ambulance services with all facilities such as information of hospital nearby with availability of expert doctors in it, and activation of traffic units all over the way to avoid the traffic congestion prior to the arrival of ambulance at that particular route and reach the hospital quickly to save the life of a person.

(ii) Adaptive E-learning System

Adaptive E-learning reduces the burden of human in online teaching, as what to be taught the next day for particular class students with related videos, materials for learning and availability of such material to the students at home through IOT technologies.

(iii) Intelligent home appliance system

The objects are consistent and independent with least human intervention in cognitive IOT. The concept of smart cities implies each house to be smart in terms of controlling their home appliances by using sensor technology. For example air conditioner (AC) can be switched on and off by sending message through a mobile phone. In similar manner other home appliances can be controlled in case of emergencies. A smart refrigerator can bring to notice that the groceries which are about to finish (calculating in terms of weight), so that one may not forget to buy it in advance.

(iv) Smart Agricultural Monitoring System

To improve the agricultural quantity and quality by measuring the nature of the soil type of crop suitable for it, requirement of water and other essentials for better productivity. So an efficient system needs to design which can analyze these parameters.

This project aims at incorporating Appliances as a Service by making use of raspberry pi processors and other smart processors that enables interaction between citizens and home appliances in an intelligent manner.

2. Review of status of Research and Development in the subject

International status

The concept of smart cities merges the Communication technology and Information and different physical devices are grouped to IOT networks to improve efficiency of city services and to connect the citizens. It allows the officials of the city to communicate both with the people and machines to have the knowledge of what is happening and also includes climate change, economic restructuring, the move to online retail and entertainment, aging populations, urban population growth and pressures on public finances (source Wikipedia).

DOB(Department of Business) *(2013)*, This work, forms part of the Information Economy theme of the Industrial Strategy, considers the challenges which cities face, the role which Smart City concepts play, the opportunities for business and the role of Government in strengthening UK capability and helping firms to exploit their expertise in global markets. In this report, they set out the enormous challenges facing cities, the size of the opportunity afforded by the focus being given, worldwide, to addressing those challenges by transforming city infrastructures and city systems, and the key actions needed to seize those opportunities.

The European economic and social committee and the committee of the regions *(2010)*, The EU has developed a range of programs under 'Europe's Digital Agenda, "Communication from the commission to the European Parliament, the council, the European economic and social committee and the committee of the regions a digital agenda for Europe"

European E-government Action Plan *(2011-2015)*, the goal of this plan was to optimize the conditions for the development of cross-border E-Government services provided to citizens and businesses regardless of their country of origin. This included the development of an environment which promoted interoperability of systems and key enablers such as E-Signatures and E- Identification. Services accessible across the EU strengthen the digital single market and complement existing legislation in domains like E- Procurement, E- Justice, E-Health, mobility, and social security, whilst delivering concrete benefits to the citizens, businesses, and governments in Europe.

Startup Israel *(2016)* the startups won a challenge to develop hig tech solutions in security, landscaping, and engineering for the future city called Croatá Laguna Eco-park in the northeastern municipality of Sao Goncalo do Amarante. In most cases, the smart technology is fitted to existing cities, but the Brazilian government decided to try a different approach and build a smart city from scratch. Twelve Israeli tech firms participated in the 3C Smart Cities Challenge held in Tel Aviv with cooperation from the Brazilian government; Italian group Planet Idea; the Tel Aviv University center for entrepreneurship, and the Israeli innovation center from global security conglomerate Tyco. "Israel has positioned itself in recent years as a hub for smart city technologies, so it is natural they would take part in this unique project, which has a significant impact for proving the feasibility of the technology and the vision," Tyco Vice President Ofir Bar Levav told the Israeli business news service Globes. The winner of the competition was Magos, which is taking part in a program by Tyco Innovation. Its technology makes available for the first time high-resolution, compact security solutions with low energy consumption and a simple installation at affordable rates to civilian clients

Yasir Mehmood, Farhan Ahmad, Ibrar Yaqoob, Asma Adnane, Muhammad Imran, and Sghaier Guizani *(2017)* presented challenges and recent advances in this work for smart cities. They discussed various issues including security, trust and privacy caused by employing IoT devices.

Ruoxi Zhang, Sara Newman, Marco Ortolani, and Simone Silvestri *(2018)* In this work the authors discussed traffic monitoring approach of network tomography which employs cameras placed at the intersections of roads for the measurement of end-to-end travelling times of the vehicles. The proposed method is flexible, requires optimal number of cameras placed at certain road intersections and is more efficient for smart cities. Belli et al *(2020)* analyzed main aspects of smart cities IoT infrastructure and discussed the successful innovations implemented in the city of Parma (Emilia Romagna region, Italy). The article mainly outlined the urban city mobilization. The authors also presented the overview and future aspects of IoT based smart cities.

National status

Indian government passed resolution of smart cities mission and provided statement and guidelines to develop urban areas as smart cities. The objective of this mission is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions. The focus is on the sustainable and inclusive development and the idea is to look at compact areas, create a replicable model which will act like a lighthouse to other aspiring cities. The Smart Cities Mission of the Government is a bold, new initiative. It is meant to set examples that can be replicated both within and outside the Smart City, catalyzing the creation of similar Smart Cities in various regions and parts of the country.

Selvakanmani.*VIT Chennai (2015),* In this approach the author discusses the economic benefits, cost of implementation and challenges towards a Smart city. It also focuses on its building blocks, history, advantages and disadvantages of Smart cities. Also, the author suggested a roadmap for the future.

Sahil Sholla, *et. al. NIT Srinagar (2016), In this work the author shows interest towards "*Quenching the Thirst of Jhelum: Internet of Things Based Smart City Perspective,'for environmental monitoring. Internet of things uses a large number of embedded sensors to monitor parameters of interest in real time, perform aggregation and processing of such data to provide valuable insights into the dynamics of environmental health and guide possible remedial measures. Given the capability of IoT to facilitate environmental monitoring, it could be effectively used to monitor and control pollution of river Jhelum. Smart city vision driven by IoT could also pave the way in addressing other key concerns like dredging and flood alert.

Krishna Nirde, Prashant S. Mulay, and Uttam M.Chaskar *(2017)* discussed a waste management scheme to keep the smart cities clean and hygienic by using IoT devices. The SMS alert is send through to the municipal office when the maximum limit of a dustbin is reached. This method is optimum and time saving as it provides the exact location information to the department.

Chugh, Damanpreet. *(2020)* presented the challenges faced by India in building of smart cities. The main challenges are hackers and bugs which may disrupt the functioning of smart cities, financially weak health care systems and lack of private body's interest as there is no guarantee of profits.

Importance of the proposed project in the context of the current status

As urban areas are facing lots of frequent challenges in the region of security, mobility, emissions, ease of access and traffic congestion. The civic resident's estimates manipulative development to increase from 54% in 2014 to 66% by 2050, stresses on city services and infrastructure are predictable to rise as fine. Smart cities focus on accelerating associated, interactive and data-driven solutions in sophisticated and dynamic manner, so as to address

needs in urban areas.
Smart cities can provide ideal solutions in COVID-19 pandemics as there is no permanent solution for it except to start living with it. People are facing many challenges in lockdown such as delay in emergency health services, studies of the children is hampered and restrictions are imposed for moving out of the house to buy necessary groceries. Smart cities will be the soul solution to meet these challenges.

Work plan

Methodology

The methodology is outlined as follows:

- To generate an effective representation of actual objects (sensors) with an equivalent Virtual Object (VO) for videos and composite virtual object (CVO) model for monitoring and making decisions.
- A prototype achievement of the architectural skeleton in a smart home scenario, targeting two functionalities simultaneously and automation based on the imposed constraints and thus responding to situations and also adapting to the user preferences.
- To develop an efficient algorithm and improve emergency services.
- To design a multitask decision fusion system to improve the agricultural productivity

In the above methods, VO or CVO is used to improve the performance of the network. However all the above mentioned methods are based on the arrival time of the service request which may not be efficient for the development of a framework for smart cities. In this project, a hybrid approach i.e. VO/VCO (Sasidharan et al 2013) will be used in which cognitive algorithm will be carried out by both the VO and CVO for comparison purpose. Also, a mathematical model will be developed to provide the security to the entire network system.

1. *Simulation*: To develop the proposed approach an advanced Genetic Algorithm will be used to simulate the network. This algorithm will be able to function dynamically i.e.as per the current scenario.
2. *Experimental Set-up*: To verify the above simulation results, by designing a prototype to validate the results.
3. *Study and Comparison*: Computer simulation and experimental results will be compared for the validation of the dynamic modelwith respect to the given algorithm.

Suggested Plan of action for utilization of research outcomeexpected from the project.

First year: Establishment of a Lab followed by one International Conference Paper.

Second year: one International Conference Paper and one International Journal Paper

Third year: one International Conference Paper and one International Journal Paper followed by simplified model of the project

Technical novelty and utility

Proposed system IoT technology uses wireless sensor nodes, Gateways, Data logger. The system constitutes of three sub-systems; Information sensing, monitoring and transmission system, Data storage centre and Data management centre Proposed system provides an effective means for monitoring of geophysical parameters and wirelessly transmitting the collected data for processing and analyze the real situation to make the decision.

Budget

Item	Qnty	Unit cost	Total Cost (Rs)
1. Materials and Components			
Sensors to acquire Physical parameters, Buzzer, Zigbee module, Text to voice converter, Speaker , RF transmitter	30	10,000	3,00,000/-
Load Cell 20T capacity	2	40000	80,000/-
VW Total pressure Cell	2	30,000/-	60,000/-
Wireless Sensor Nodes	10	20,000	200,000/-
Gateway	2	60,000	120,000/-
High speed camera with motion analysis system	4	30,000	120,000/-
Solar Cell	4	40,000	160,000/-
Soil moisture sensor	3	30000	90000
Cloud facility/year (3 x 70000)			210,000
High speed IoT processors	3	50,000	150,000
Piezometer with data logger	1	160,000	160,000
Server for processing and analysis	1	150,000	150,000
Laptop to monitor at remote place	1	100,000	100,000
Leaf wetness sensor	2	50,000	100,000
Fabrication of prototype model	1	2,00,000	2,00,000/-
Application Software	1	5,00,000/-	5,00,000/-
2. Consumables			Rs 200000/-
3. Miscellaneous Expenditure and Travelling allowance			Rs 3,00000/-
4. Project Assistant (25000/- x 36 months)			Rs 9,00,000/-
Research Associate-I (2nd year on wards) (24 x 30,000)			720,000
4. Attendant (7000 x 36)			252,000
Total			**Rs 63,32,000**

Time Schedule

Activities	Months					
	1-6	7-12	13-18	19-24	25-30	31-36
Literature survey						
Staff Recruitment						
Develop the dynamic						
Prototype design						
Experiment Development						
Validation						
Debugging & report						

Possible patentability of the research outcome

It is expected to produce UG, PG projects and journal publications as deliverables of the project. As duration of the project is 3 years we can publish one patent.

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