**NITTE MEENAKSHI INSTITUTE OF TECHNOLOGY**

(AN AUTONOMOUS INSTITUTION, AFFILIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM, APPROVED BY AICTE & GOVT.OF KARNATAKA

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**LA-2 REPORT**

on

**HPC in the Era of Smart Cities**

*Submitted in partial fulfilment of the requirement for the award of Degree of*

*Bachelor of Engineering*

*in*

*Computer Science and Engineering*

*Submitted by:*

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Department of Computer Science and Engineering

**(Accredited by NBA Tier-1)**

2020-21

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**CERTIFICATE**

This is to certify that the Report on **HPC in the Era of Smart Cities** is an authentic work carried out by Nagarigeri Sai Charan Reddy (1NT18CS104) V Venkata Sree Harsha **(**1NT18CS181**),** Poorna Vikas A S (1NT18CS113**)** bonafide students of **Nitte Meenakshi Institute of Technology**, Bangalore in partial fulfilment for the award of the degree of ***Bachelor of Engineering*** in COMPUTER SCIENCE AND ENGINEERING of Visvesvaraya Technological University, Belagavi during the academic year ***2020-2021.*** It is certified that all corrections and suggestions indicated during the internal assessment has been incorporated in the report.

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**DECLARATION**

We are hereby declare that

(i) The project work is our original work

(ii) This Project work has not been submitted for the award of any degree or examination at any other university/College/Institute.

(iii) This Project Work does not contain other persons’ data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.

(iv) This Project Work does not contain other persons’ writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:

a) their words have been re-written but the general information attributed to them has been referenced;

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**ABSTRACT:**

High Performance Computing technology supports the development of smart cities and proposes a conceptual model relying on this technology. Smart urban development has been a research subject for many years as digital services have the potential to improve residents’ quality of life. Many developments have been made throughout time but in different domains and up to this moment we cannot state that there has been developed any Smart City integrated system for a specific city on the globe. One major shortcoming in accomplishing this task is the fact that it would require a massive infrastructure with enough storage and processing power. HPC has the potential to overcome this as it combines both storage and processing power

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**1.INTRODUCTION:**

High-performance computing (HPC) is the practice of using parallel data processing to improve computing performance and perform complex calculations. HPC achieves these goals by aggregating computing power, so even advanced applications can run efficiently, reliably and quickly as per user needs and expectations

In the modern world, ground breaking discoveries and inventions can only happen with technology, data and advanced computing. As cutting-edge technologies like [artificial intelligence](https://www.techtarget.com/searchenterpriseai/definition/AI-Artificial-Intelligence) (AI), [machine learning](https://www.techtarget.com/searchenterpriseai/definition/machine-learning-ML) (ML) and [IoT](https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT) evolve, they require huge amounts of data. They also need high-performance computing because HPC systems can perform quadrillions of calculations per second, compared to regular laptops or desktops that can perform at most 3 billion calculations per second (with a 3 GHz [processor](https://whatis.techtarget.com/definition/processor)).

HPC is specifically needed for these reasons:

It paves the way for new innovations in science, technology, business and academia.

It improves processing speeds, which can be critical for many kinds of computing operations, applications and [workloads](https://searchdatacenter.techtarget.com/definition/workload).

It helps lay the foundation for a reliable, fast [IT infrastructure](https://searchdatacenter.techtarget.com/definition/infrastructure) that can store, process and analyse massive amounts of data for various applications.

**Benefits of HPC**

HPC helps overcome numerous computational barriers that conventional PCs and processors typically face. The benefits of HPC are many and include the following.

HPC is mainly about lightning-fast processing, which means HPC systems can perform massive amounts of calculations very quickly. In comparison, regular processors and computing systems would take longer days, weeks or even months to perform these same calculations.

**2.HISTORY OF SMART CITIES:**

The 21st Century is frequently referenced as the “Century of the City,” reflecting the unprecedented global migration into urban areas. Urban areas are driving and being affected by factors ranging from economics to health to energy to climate change.

The notion of a “smart” city is one that recognizes the use and influence of technology in cities. It is the wave of the future only made possible by high performance computing (HPC).

**3.HPC IN SMART CITIES**

Intelligent devices enabled with HPC “at the edge” have the potential to optimize energy generation and delivery, emergency response, the flow of goods and services, and to allow urban infrastructures to adapt autonomously to changes and events such as severe storms or traffic congestion

Smart cities leverage data from connected devices and powerful analytics tools to keep traffic flowing, protect public safety, reduce pollution, maintain public assets and improve the delivery of city services. Use cases for smart city technologies range from tracking the condition of roads and bridges and detecting water levels in flood-prone areas to optimizing the usage of street lights and giving citizens around-the-clock access to city services via mobile devices.

Use cases like those highlighted here generate enormous amounts of data from sensors and connected Internet of Things (IoT) devices spread throughout the city. In many cases, this data must be analyzed in a timely manner, if not instantaneously, and this is where high performance computing systems enter the smart city picture.

Emergency response or the flow of goods and services, and to allow urban infrastructures to adapt autonomously to changes and events such as severe storms or traffic congestion.

Smart city technology can even improve food safety inspections and help identify children most at risk for lead poisoning.

**4.APPLICATIONS OF HPC IN SMART CITIES:**

1- Get Smarter Design and more Effective Planning. Supercomputers can make the best use of limited spaces, as city planners must make just the right decisions during the design and planning stage.

2- Weather Forecasting. ...

3- Augmenting Transportation. ...

4- Monitoring Air Pollution.

5- Traffic and Pedestrian Control

Ultimately, the smart city movement is leading us to urban communities that can better manage user expectations, optimize the allocation of limited resources, provide a safer and more sustainable environment, foster innovation, and give residents a personalized, always-on end-user experience. But to get there, we need more than connected devices that generate constant streams of data. We need HPC systems to help us analyse all that data at lightning-fast speeds. And that’s why HPC matters in the smart city.

**5.ARCHITECTURE:**

Diagram

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PAC is already playing a key role in helping cities pursue objectives of The information collected by the sensors installed in the city (air quality monitoring, intelligent lighting management, intelligent water distribution metering, etc.) from the public data sets available at the level of local and central authorities are aggregated in the HPC platform. It allows the addition of new information from any type of sensors. HPC technology can be implemented not only in dedicated data centres but also it can be combined with cloud services or it can be provided as a service to stakeholders as, for example, public administration, academia and research institutes. A smart city would require a federation of systems and applications connected through a fast communication system. All participating systems will be required in creating a “continuum” of computing. The figure below describes the components of a smart city, where HPC functionality is combined with cloud systems.af

**6.USE CASE MODEL:**

A close-up of a light post

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1.In Chicago an instrument called “Array of Things” is available to the science community.

2.An incredible amount of computing is done right there where data is generated and process the data that comes out.

3.This “Array of Things” automatically measures and understands the performance of the urban land-scape with the help of sensors.

4.Imagine an intersection that can calculate the trajectory of all the vehicles that are coming at it and notice that one car is coming too faster so that they may pass through the red light.

5.what they do is hold of on the walk sign and green light goes in other way so that an accident is avoided, essentially let all the four directions stay red while that car passes through the intersection.

6. All these calculations require HPC since there won’t be time to send back the data to some server and wait for it to answer.

7.A local decision is made very quickly and it never get transmitted back or stored in some database.

8.When we open a phone camera we can see yellow circles around the faces, our phone is recognizing faces.

9.This loop of being able to train machine learning , understanding things and send that back is the new age cycle for high performance computing.

**7.CONCLUSION:**

The HPC, IoT and data-analytics concepts have entered into a new era with the rise of smart cities by integrating existing services with computerized intelligence which minimizes human intervention. Smart city applications in healthcare, transportation, utility, safety, and environmental health are some of the beneficiaries of this new era, which are the candidates to significantly improve their usefulness by utilizing machine intelligence and the continuous progress in IoT technology.

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the help of sensors.

4.Imagine an intersection that can calculate the trajectory of all the vehicles that are coming at it and notice that one car is coming too faster so that they may pass through the red light.

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, efficient use of resources, and an overall better all better quality of life.

Intelligent devices enabled with HPC “at the edge” have potential to optimize energy generation and delivery. he 21st Century is frequently referenced as the “Century of the City,” reflecting the unprecedented global migration into urban areas. Urban areas are driving and being affected by factors ranging from economics to health to energy to climate change. The 21st Century is frequently to energy to climate change.