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Proffering Ranks to the Smart Cities based on the Data Received from IoT Devices using Visualization Techniques

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Abstract—Innovative lifestyle in cities upgraded the smart infrastructure and sustainable significance in the countries worldwide. A new approach is proposed to analyze the smart-city indexing across the world based on the key features to proffer the city ranking. The key features like smart-mobility refers to the Intelligent movement of citizens, smart environment refers to improvement in the efficiency of inhabitance within the city, smart governance used in applying innovative technological implementation to provide service, smart economy refers to the improvement in various urban aspects and livelihood. Proposed approach focuses on classifying the smart innovative infrastructural implementation in the urban livelihood for city data visualization and proffering cluster ranks by validating the proffering with Convolutional-Neural Network (CNN). To collect the data, we used IoT sensors information by integrating the sensors of six feature metrics in city-hubs. The huge data collected from the sensors are utilized to perform the smart-city visualization. Data are analyzed using statistical procedure by grouping the similar data to applying folium cluster techniques and fuzzy mapping. A detailed description and analysis of smart indexing are grounded by proffering effectively, in addition the subsequent research analysis is recommended for the researchers.

Keywords-Smart-City, Fuzzy Mapping, Convolutional-Neural Network (CNN), Data Visualization, Folium Cluster.

I. INTRODUCTION

Smart city is one of the innovations in the present technological world. Functionalities of this innovation mainly[1] describes improvement in the quality of government services and efficiency in citizens' welfare. Smart-city emerged to enhance the quality-of-lifestyle and ameliorate the economic functionality by smartening the services. Smartness in the city is improved with the implementation of IoT devices networks for communication, interaction and data analysis. The information exchanged between the sensors are used for data analysis and user interface[2] connectivity.

IoT technology is introduced in smart-city to enhance the smartness in the usage of regular commodities. IoT is implemented in smart-city to resolve the challenges faced by the citizens and to improve the economic growth in the country. IoT technology is used to improve the security[3] related to public safety, city data, smart buildings, emergency preparedness, early warnings of climatic threats, smart homes, gas-leak detection, urban farming energy efficiency, traffic analysis, amenities and infrastructure to improve the quality of citizen lifestyle. IoT works initially by collecting the data from sensors in real-time, then the collected data is analysed to communicate and to take necessary actions related to the problem identified by gathering the effective information of the smart-city.

Smart-city technology implementation in the city hubs is carried out to automate the urban-living. People are interested to live in highly developed cities with advanced features and high security. Smart-cities are built with less infrastructural cost in the urban environment [4]. Improvement of efficient facility services increased the citizens migration from urban-city to smart-city. Smart application in the city with advanced operational features at low cost of living gained a key insight for the development of smart-cities in the world. According to smart-city index analysis the Smart-city technologies [5] had implemented in 102 countries out of 195 countries in worldwide with respect to IMD-SUTD Smart City Index (SCI).

A new approach is proposed to analysis the smart-city data based on the six key metrics. The metrics are characterized based on the smart pillars of the city. Six main metrics are based on the smart-mobility within the city, environmental conditions termed as smart-environment [6], government assessment in the

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city termed as smart-government, smartness in the people termed as smart-people and smart-living [10] to analyse people's lifestyle. These six metrics acts as the main building block to categorize city's ranking [8].

A detailed description and analysi" of 'mart Indexing are grounded by proffering effectively to improve the smart-city technology [9]. Proffering of country ranks are performed using the percentage visualization of each and every metric with respect to the countries. Clustering techniques are used for dividing 102 country and the visualization, Convolutional-Neural Network (CNN), fuzzy mapping techniques are implemented. By including plugins like fastmarker cluster, folium & packages like numpy, pandas, matplotlib, seaborn, pyplot.

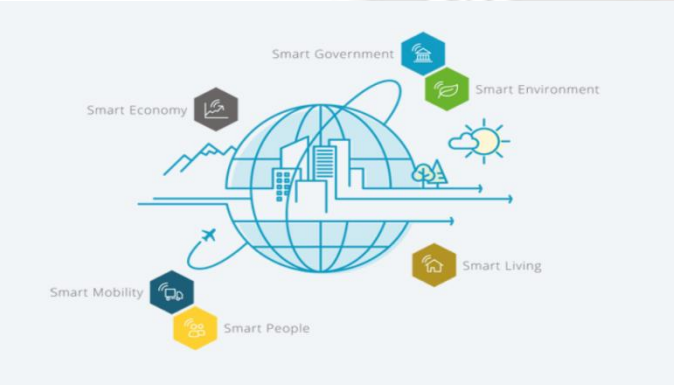

Figure:1 Smart Metrics[11]

II. LITERATURE SURVEY

The critical city analysis was performed in the year 2014 and the detailed description on differentiation of smart and digital city [1] information was provided by RobertasJucevicius et al. The dimension analysis based on the conceptual model are performed to evaluate the importance between the cities. Predictive analytical logics were applied on various dimensionalities to evaluate the smartness of a city. Author has collected the data from various data sources to apply the fuzzy cognitive logics to measure the dimensionality between digital and smart city. Dynamic model proposed by the author helps in investigating the complete city dimensional critical analysis.

Smart city ranking based on the e-Governance techniques in India was discussed by Bhaswati Sahoo et al., in 2022. The Authors worked on providing information related to the cyber secured public service [2] architecture. The betterment of the e-Governance is directly proportional to the decisions implemented in the economy. The Authors identified key multi factors that are responsible for the effective decision making, some of the models are identified and listed in the research paper. Authors performed the experimental analysis by comparing three main decision-making technological models like WSM-Weighted Sum Model, WPM -Weighted Product Model and TOPSIS-Technique for Order of Preference by Similarity to Ideal Solution. The comparative study of these models by considering all the e-Governance key attributes revealed a priority approach in decision making.

Smart-city Ranking Mismatch was identified by Osama A.Marzouk in 2022. The statistical analysis to understand the mismatch were described clearly by normalizing the city index based on seven feature evaluations. This paper completely relays on six scopes to classify and analyse the city to be either smart or not-smart by considering the existing ranking studies. The mismatches are identified by comparing the rank scores and the raw score obtained by the analysis based on the quantitative assessments. The author has used the statistical analysis has identified the city ranking mismatch with effective evaluators.

The importance of Sustainability in smart-city dimensions is discussed using several strategies by Dora Szendi in 2022 [4]. As the technology is getting updated day-by-day the living circumstances are also getting enhanced with new challenges. Author examined the technological aspects related to the smart city, mainly concentrating on the city sustainability and its connections within the city. The best examined practice was based on international strategy to obtain a solution. Using this strategy the author had examined the European union's city sustainability in environmental perspective.

Smart-city marketing investigation was carried out by PariaSamadi-Parviznejad et al. in 2022 [5]. The author has gathered the statistical information that influences the sustainability aspects in city development. Investigating, identifying, and ranking the components that contribute to affect Tabriz's efforts to become a sustainable smart city. All the information gathered using a typical questionnaire with criteria from Randomly selected was "A unique taxonomy of smart sustainable city indicators." Additionally, statistical methods that were descriptive and inferential were employed to drive the strong effective development influencing parameters.

A new integrated smart-city model was proposed by Houbakht Attaran et al., in 2021[6]. Information and communication technology are employed in smart city architecture to raise the standard of living and the government's ability to administer it. As a result, it would seem that new subcomponents and generic extra components should be added to the existing models to create an integrated structure within them, much like how executive projects are assigned to their proper positions in this structure, which would also create and guarantee integration for smart cities. The author integrated graph in a particular way that will completely cover the integration and engineering requirements and procedures for the future smart city besides from maintaining and upgrading the smart city model and existing models.

Smart-city index analysis investigation was carried out by Chai KeongToh in 2022 [7]. There are numerous smart city

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rankings and indices. However, the majority of city rankings have their own unique evaluation methodology and criteria. There are currently not regulary and broadly accepted techniques for a thorough and impartial evaluation of smart cities. No rating is commonly acknowledged and agreed upon, which is an issue. This not only causes turmoil, but it also confuses the information it indexes. The IMD-SUTD Smart City Index, AT Kearney Global Cities Index, IESE Cities in Motion Index, EasyPark Cities of the FutureIndex, Mori Foundation Global Power City Index, and Smart EcoCity Index are just a few of the six current smart city indexes listed by the author.

Evidence for assessing the smart-city were listed by AristotelisNtafalias et al., in 2022 [8]. The number of people living in cities around the world has been rising quickly in recent years. In order to ensure sustainable development, cities are transforming their infrastructure in a smarter and more effective way as part of their long-term strategy. However, due to number of issues, including the lack of societal acceptance, lack of holistic design, and the emergence of unilateral therapies, this change does not always produce the desired results. There is a lack of comprehensive approach for evaluating the effects of smart city actions, according to an analysis of related scholarly literature. Assessment, in order to accurately assess the intended and actual impact of any smart solution, it is crucial to concentrate on the energy domain when evaluating the deployed smart solutions. The author suggests a seven-step process for evaluating the impact of smart city interventions and represents a use case for the city of Espoo.

The smart-city resilient model for Polish cities were proposed by Malgorzata Baran et al., in 2022 [9].One of the most popular concepts in management right now is the Smart City (SC) idea. In terms of sustainable development, Polish cities have also started to prioritise it. The author's identified SC control models which represent shared components that come from the definitional basis as well as other crucial characteristics for SC that come from their uniqueness and managers' management styles. Polish resilient smart city development according to the author's model. The components of these models and documents profiling SC strategies were identified using a systematic examination and study of the existing SC management models around the world.

Australian city ranking based on smart-cities were addressed by Muhammad Atiq Ur Rehman Tariq et al. in 2020 [10].The issues brought on by rising uestionnair are addressed by smart cities. Australia has made it clear that, it is strongly committed to the creation of Smart Cities. The nation's urban development has, however, experienced unequal growth. The author sought to compare and categorise the major Australian cities' levels of development in terms of their intelligence. According to evaluation findings, recent government initiatives in a number of urban regions to create smarter cities by enhancing city[11] smartness have had positive construction consequences.

The Insights on smart education wa" pro'osed by Andreea-Molnar in 2021. This paper deals with finding out the drawbacks of the existing smart cities and focuses [12] on providing the smart education referring to smart cities for solving the real-world challenges. The Authors have worked on three main areas in identifying the and addressing the existing smart city needs, negative consequences and problems in smart cities. The smart education methodology was implemented by selecting the smart city database and classifying the database to predefine the conceptual framework. The smart education is used to solve the three challenges using the five stages of framework like familiarization of dataset, identifying the thematic framework, indexing the classified data, charting and mapping the smart city data. The drawbacks of existing models are also addressed in this paper.

Deepti Prasad et al. provided a detailed description on the analysis of smart-cities in 2020. The Author has investigated the definition of smart cities and their rapid growth increase in India. It investigates on the smart-city-proposals followed by the approaches and typologies [13] plan in implementing the practices of smart urbanism in south global countries. The rapid growth of smart city urbanization in India are analysed based on four main pillars like institutional, social, economic and physical infrastructures. These four pillars play a major role in reframing the urban ecosystem, urban planners and smart services in India. The strategies developed by the author deals with area-based and pan-city development by ranking the cities.

Martin Lnenicka et al. provided a detailed description on smart-city transparency by analysing the resilient of 22 cities[14]. The ranks are identified based on the level of transparency maturity according to the four specified stages of maturity: developing, defined, managed, and integrated—through the expert evaluation of 34 portals representing 22 smart cities and their 36 characteristics. Additionally, suggestions for locating and enhancing the Specific characteristics and the current maturity level have been supplied. In the context of smart cities, an open data ecosystem has been uestionnaire , and its essential elements have been identified by adopting technologically enhanced innovations.

Adeoluwa Akande et al. provided a detail description using the 28 capital cities of Europe data based on four ranking components [15]. The 28 European capital cities were evaluated on their level of sustainability. The authors combined 32 indicators into 4 components using principal component analysis (PCA) and hierarchical clustering, and then generated rank scores. This rank score used as the foundation for ranking the capital cities of Europe routed towards sustainability and

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intelligence. While the association between our city rank ratings and city size, population and the cities' GDP per resident, which is a measure of their economic health, by correlating significantly.

Huaxiong Jiang et al. provided a detailed description on smart-city analysis by comparing it with urban issues. This implies that generally similar urban problems in various circumstances call for varied approaches, and as a result, for particular smart city technology. The Authors worked on the function of three smart city contexts for the use of smart city technologies in the resolution of urban challenges projects: Singapore Smart Nation, Amsterdam Smart City, and Hangzhou City Brain (China). The findings show that various contextual factors have an impact on urban city development intended with technology.

Prince Antwi-Afari et al. provided a detail description on various levels of city transformations of smart-city. The study used FSE to model eight indicators for each of the six[17] dimensions to calculate each dimension's smartness/smart development level index, which was used to calculate the developing country's overall smartness/smart development level index of city. The developing country is city and each of the six criteria used to define it were examined later. The city was judged to be moderately developed. The results of such ranking implied that there should be improvements done because the city's smart city status is below what is considered acceptable. The Applications of the policy along with the 48 indicators outlined, such as empowering human resources, were use of sustainable resources, etc., to advance the six dimensions toward a smart city. Authors have provided a potentially theoretical framework for estimating the levels of intelligence and sophistication of cities in the developing countries. The report also identifies parts of the urban framework that planners and developers may focus on to advance cities' levels of smartness and smart development toward the status of smart cities.

Hisham Abusaada et al. worked on a systematic smart-city framework by reviewing the urban designs. The Authors have provide a comparative study based on the words that appeared in the titles, abstracts, and keywords of 44 articles published in these journals between 2012 and 2020, a random selection procedure was carried out. Competitiveness, distinctiveness, urban forms, and ordinary lifestyles were the four terms that emerged[18]. The conclusions reached with 22 guidelines for building smart city uniqueness. The framework of three steps for achieving the singularity of Smart cities shed the light on how urban stakeholders and players in the Global South might alter conventional smart cities by combining the placemaking principles (i.e., urban shapes and daily routines) with the urban economic principles through urban distinctiveness and competition. The findings indicated reviewing the criteria for rating smart cities and taking into account placemaking ideas that can improve the smart city uniqueness.

Vinicius Mendes provided a detail description about the analysis of the Brazil smart-city climate. After the analysis of political goals and economic forces it led to Rio de Janeiro, the second-largest city in Brazil, to become climate-smart city. In this paper, I have created a novel definition of a "techno-utopian smart city" [19] and use this model to examine the instance of Rio. A theme content empirical analysis, which involves the coding of policy documents, participant observation, interviews that are semi-structured, etc. According to the findings, the smart city agenda is still just intended to solve the problems caused by climate change. While climate policy and smart cities have only sometimes been combined, "smart" uestionnair has uestionnai the financial, political, and economic benefits of a technologically-driven urban change rather than concentrating on the protection against and adaptation to climate change. The Authors conceptualization and empirical analysis indicate that Rio de Janeiro has been I framing climate governance as a technical issue rather than a complicated social challenge, (ii) ignoring the environmental impact of smart technologies, and (iii) amassing data on the use of smart technologies without considering their environmental impact.

EsraAytacAdali et al. provided a detail description on European smart-cities with an integrated approach [20]. The Authors have used integrated grey-based approaches to quantify the extent of smartness in cities. This has led to the proposal of a grey extension of the integrated Level Based Weight Assessment (LBWA) & Evaluation Based on Distance from Average Solution (EDAS) technique. With LBWA-G, six factors are weighted. The EDAS-G approach is used to evaluate the performances of 17 European cities. The standards and city. Information related to this is taken from the Global Power City Index (GPCI). Furthermore, comparative analysis and sensitivity analyses are carried out to show how reliable the suggested methodology is. The results of this approach research provide several managerial ramifications for implementing corrective measures in order to advance and build their city.

III. MOTIVATION

Standards of living in a habitat is changing from generation to generation. To enhance the living habitat people are preferring to migrate from local areas to highly developed cities for the betterment of their next generations. These migrates mainly focus on smartness in the urban lifestyle. The analysis of this smartness in the city are manually performed based on the Institute for Management Development (**IMD**) and the Singapore-University of Technology & Design (**SUTD**). IMD-SUTD Smart City Index (SCI) ranking. To categorize the

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sustainability aspects in smart-city our approach works on systematic analysis of measuring the city smartness. The smart-city systematic analysis can be performed based on the information collected through IoT devices. To collect the data, we used multiple sensors information by integrating in city-hubs. The huge data collected from the sensors are utilized to perform the visualization with the help of IoT connectivity in smart-cities using folium cluster techniques. A detailed description and analysis of smart indexing are grounded by proffering effectively, in addition the subsequent research analysis is recommended for the researchers.

IV. EXISTING WORK

The Present day extant of smart-city research reveals the fact of manual practical analysis based on the four key metrics. The Benchmark analysis in this research area worked on-manual ranking performed by comparing and predicting the usability of these key metrics in the worldwide cities are represented in the figure 2. The city smartness is measured based on the data collected through surveys and uestionnaire patterns related to people beneficial amenities. Manual analysis of smart-city ranking works on measuring the city standards related to mobility of people with in smart-city, people sustainability, health & safety maintenance emergency services and government management.

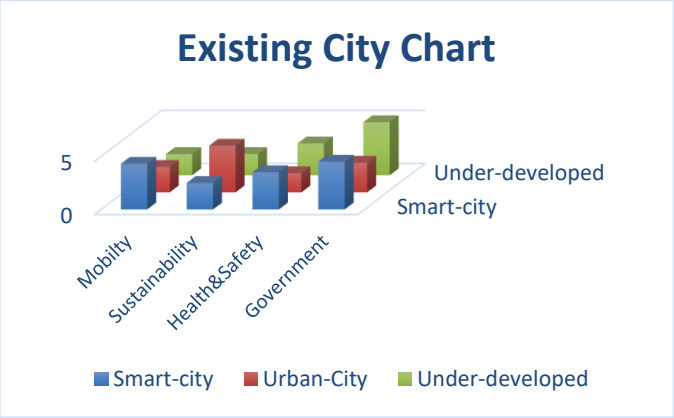

Figure:2 Smart City Existing Representation

V. PROPOSED WORK

This novel approach represents the existing raw data in various different formats to predict the best smart-city existence in the world by considering the six parametric key features. Initially the paper describes about the visualization of the data. The analysis of this smartness in the city are manually performed based on the Institute for Management Development (**IMD**) and the Singapore-University of Technology & Design. IMD-SUTD Smart City Index (SCI) ranking. To categorize the sustainability aspects in smart-city our approach works on systematic analysis of measuring the city smartness. The smart-city systematic analysis can be performed based on the information collected through IoT devices. To collect the data, we used multiple sensors information by integrating in city-hubs. The huge data collected from the sensors are utilized to perform the visualization with the help of IoT connectivity in smart-cities using folium cluster techniques. A detailed description and analysis of smart indexing are grounded by proffering effectively, in addition the subsequent research analysis is recommended for the researchers. The present-day scenarios in the analysis of the smart-city works based on the human analysis or paper back records. Usage of technology solved the huge complex problems solutions easier with the enhancement in the innovative world. Analyzing world data using paper back is time consuming, resulting in low efficiency and security threat. To resolve this issue our approach works with visualizing the data using enhanced techniques for analyzing the countries data collected by IoT devices. Techniques like clustering, folium, fuzzy mapping in python is used for the prediction and proffering of the smart city ranking in the countries by mapping the smart countries. The benchmark results obtained using convolutional-neural network(CNN) for predicting the accuracy of country proffering to rank the world-wide countries. The accuracy in the rank analysis was predicted and analyzed using the confusion matrix with CNN outcomes. Proffering helps the statistical Country analysis that is used to gather the information to improve the transformations from urban to smart-city. Proffering rank analysis helps the developing country to understand the effectiveness of the key features and their impact in building smart-city. Countries can obtain the improvement in smart-city development by enhancing the effectiveness in the identified parametric key features in the act of people sustainability.

S.NO	Smart Metric	Applications
1.	Smart_Environment	Temperature and humidity
		Air quality
		Radiation
		Water quality
2.	Smart_Government	Water Management
		Energy Management
		Smart Streetlights
		Transport Management (Smart Parking)
		Waste Management
		Real-time Pollution Management
3.	Smart_Mobility	Rail-based Mass rapid transportation systems
		Light-rail Transport system
		Bus-rapid transport system
		Electric Vehicles
4.	Smart_People	City lighting controls
		City transit

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5.	Smart_Economy	Telecommunications
		Public Safety
		Payments and Finance
		Energy Infrastructure
6.	Smart_Living	Smart infrastructure
		Surveillance cameras
		Electronic billboards
		Wi-fi coverage

Table 1: Smart-city Metric applications

Smart metric Table-1 displays the various application areas where the IoT data are collected throughout the world for proffering and predicting the smart-city ranks using CNN algorithm.

VI. EXPERIMENT AND RESULTS

Visualization of worldwide smart countries are listed in the pictorial representation describe the frequency of each and every smart country and their smartness with other competitor in the countries worldwide. The analysis from the data received from IoT devices arranged in smart cities is visualized initially to understand how many countries can be marked under the smart-city countries. In our first step we had worked on describing the number smart-cities count that are available in the country. The count of cities availability can be termed as the frequency of the each and every country. The frequency is performed on a scale of 10 to measure the cities count, color differentiation is used for easy analysis of smart-city count. The frequency of all over the countries are represented in the figure3.

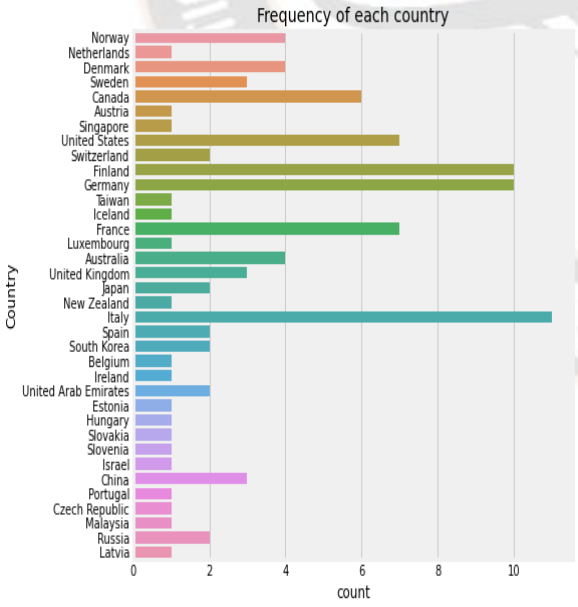

Figure:3 Overall Country Frequency

In addition to the initial step smart-city count the smart-city challenge survey report represents the main smart building blocks of the city to become smart-city. The survey perusal reveals the six key features that to be maintained by the smart-city for the development of enhanced technological innovation in transformation of urban-city to smart innovative city. In this novel approach the complete data are collected using the IoT devices by arranging them in various cities. The smart countries with respect to the key features are analyzed based on the IoT deceive data collection. The foremost pillar of this project lies with the initial analysis of people mobility in the city. The mobility of the people in the city are termed as smart-mobility. The top 10 cities that are capable in providing advanced features to the citizen to move from one place to another place, in using enhanced transportation to improvise the citizen travelling experience. The top smart-cities that are present in the world-wide countries are represented in the pictorial representation(Figure4).In smart mobility analysis Chicago ranks the highest percentage in usage of smart-transportation in the world.

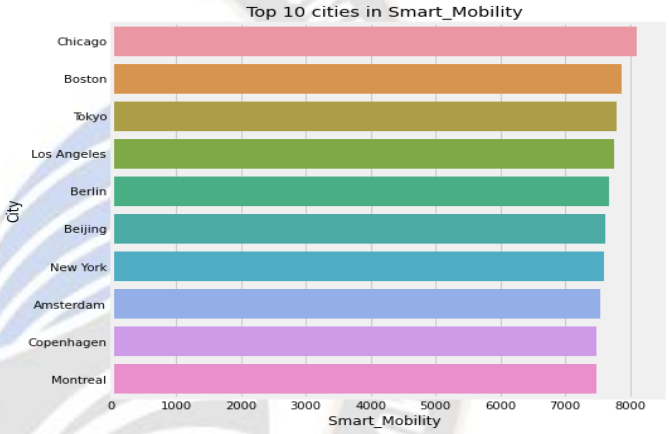

Figure:4 Overall Country Smart-Mobility Frequency

Environment plays a major role in improving the citizens lifestyle. IoT devices are used for collected the information related to the environment pollution percentage and high-end devices for simplifying the daily functioning in the city. The analysis of the sensor data collected in the city are used to predict the percentage of the smart-environment availability. Smart-Environment deals with the city specifications and the people's livelihood in the city. The continuous development in the people's habitation in the pollution free environment added an additional support for the people to migrate from urban city to smart-city. The top smart-cities that are present in the world-wide countries are represented in the pictorial representation(figure 5). In smart environment analysis Zurich ranks the highest percentage in maintaining smart techniques to protect environment in the world.

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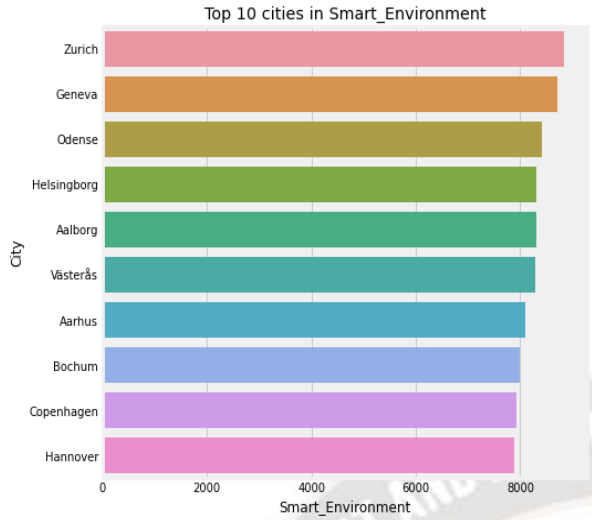

Figure:5 Overall Country Smart-Environment Frequency

Government is the main building block of the city to maintain a transparency between the people by providing friendly legitimacy rules. Strong governance results in enhancing smart city executional work efficiency. Working procedure of the city can be analyzed using the city government activities in improving the citizens welfare. Decision-making plays a vital role in city governing-bodies, usage of high-end technologies for the implementation innovative support and facilities to the citizens. The continuous development the citizen inhabitant living in transparency government policy added an additional support for the people to migrate from urban city to smart-city. The top smart-cities that are present in the world-wide countries are represented in the pictorial representation(figure 6). In smart-Government analysis Copenhagen ranks the highest percentage in maintaining smart techniques to protect and simplify the government rules in the world.

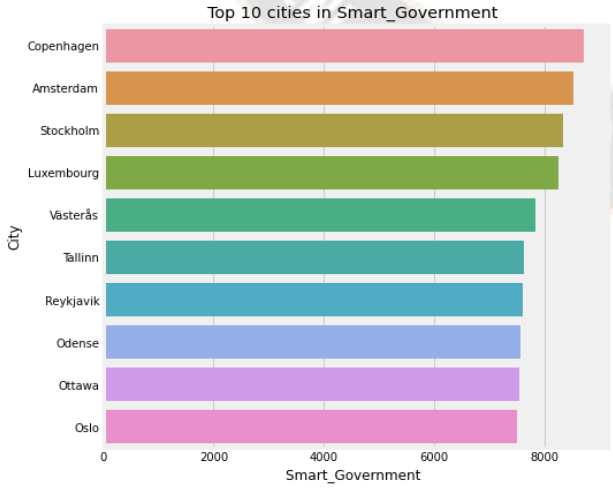

Figure:6 Overall Country Smart-Government Frequency

Smart economy acts as the back-bone for city development and play a vital role in the citizen lifestyle. People's interest towards the smart-city are based on the key factors like resources efficiency, infrastructure, data security and fore mentioned smart-city resources are attracting the citizens to simplify their lifestyle. The continuous development in the citizen's habitation living in efficient and innovative economy added an additional support for the people to migrate from urban city to smart-city.The top smart-cities that are present in the countries world-wide are represented in the pictorial representation(figure 7). In smart-economy analysis Reykjavik ranks the highest percentage in maintaining smart techniques to protect and simplify the economy in the world.

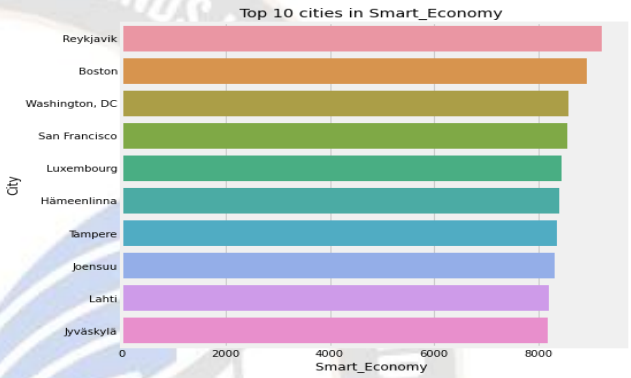

Figure:7 Overall Country Smart-Economy Frequency

People's interest in finding innovative and transforming solutions in the day-to-day lifestyle. This has become a scope for the smart-cities to attract the people from transforming urban lifestyle to smart-city lifestyle by implementing digital and creative interactive solutions. Enhancement in the demographic location in smart education form facilities, innovative participation in city development and improvement in the prosperity in smart-city made people think out-of-the box in migrating from urban locality to a highly sophisticated smart-city making people smarter. The continuous innovative development the citizen inhabitant policy added an additional support for the people to migrate from urban city to smart-city. The top smart-cities that are present in the world-wide countries are represented in the pictorial representation (figure 8). In smart-people analysis Singapore ranks the highest percentage in maintaining smart technique for solving innovative challenges in the world.

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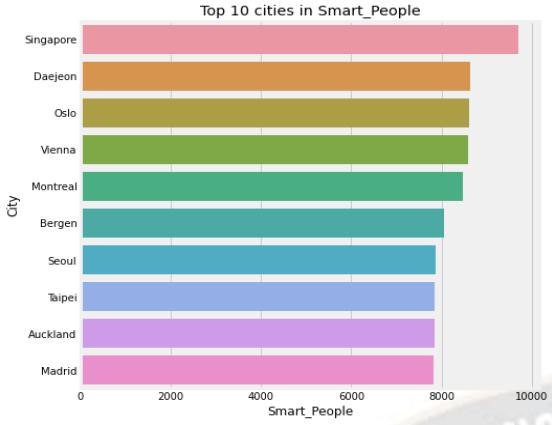

Figure:8 Overall Country Smart-People Frequency

Smart living aims at the transformation of urban-city to a highly developed demographic residents by optimizing the stakeholders and maximizing the transparency in the government. Livability in the city is enhanced by implementing the innovative and digital inclusive connectivity by leveraging social and civil methodologies with the digital techniques. The continuous development the citizen inhabitant living in demographic management of the city added an additional support for the people to migrate from urban city to smart-city. The top smart-cities that are present in the world-wide countries are represented in the pictorial representation(figure 9). In smart-Government analysis Singapore ranks the highest percentage in maintaining smart techniques to protect and simplify the smart living-habitation in the world.

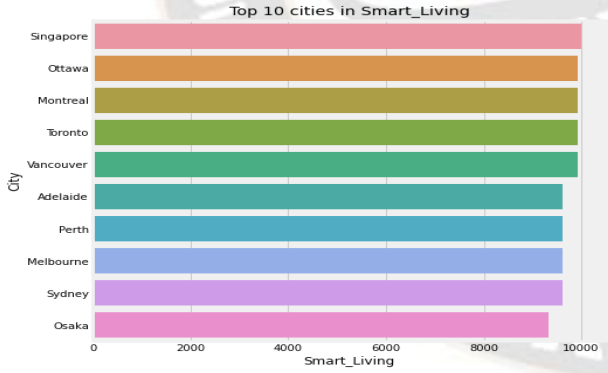

Figure:9 Overall Country Smart-Living Frequency

Visualization of all the countries with respect to the six key features are represented for all the countries in the graphical format where each and every country are represented using different colors. Smartness in all the considered smart-cities is ranked using the key feature metrics. The Ranking is based on smart environment, smart-Government, smart economy, smart-people and smart living. IoT sensor data are used for measuring the percentage of analysis in the city to be called as smart-city. Overall country ranking is done by considering all the key features ranging from 0 to 50000 according to the analysis and fuzzy mapping the proffering of the rank is visualization in the graphical representation (figure 10). According to our analysis Singapore ranks in first place when considering the worldwide scenarios.

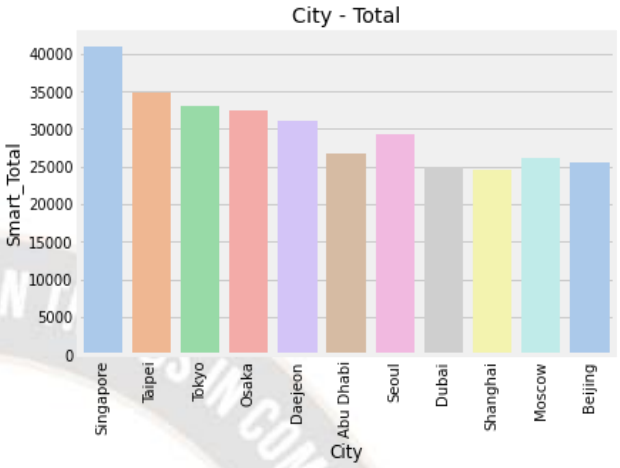

Figure:10 Overall Country rank proffering

The bar-plot represents(figure 11) the top sequential ranking of the smart-city in the world with each and every metric graphical analysis is been investigated are the ranks are proffered in the cities.

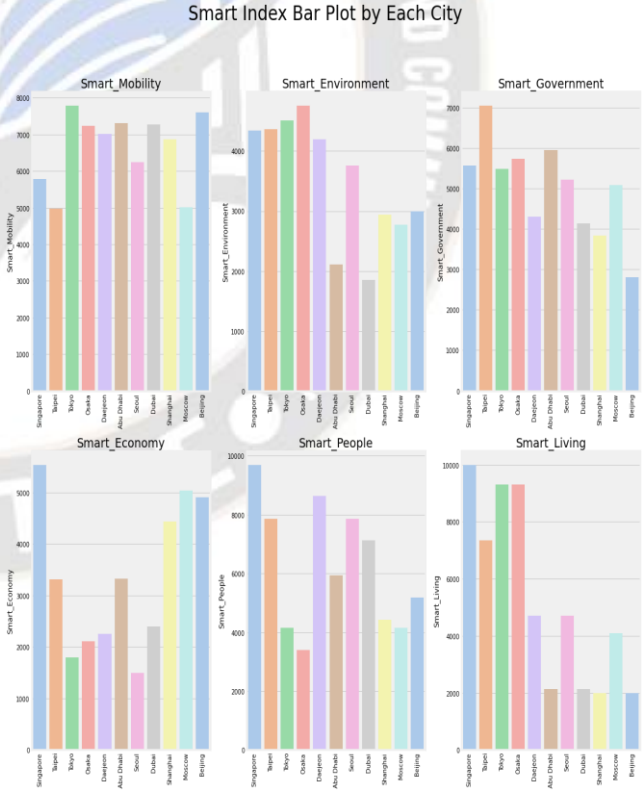

Figure:11Overall Country Smart-metric rank proffering

For validating the smart-city ranks by our algorithmic analysis the experimentation for predicting accuracy in proffered city ranks are performed using the Convolutional-Neural Network

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(CNN). Convolution operation is the initiative of performing the CNN algorithm for extracting the features based on our six key features metrics for analyzing the IoT data. Using the test set and the training set statistics, the proffering of the city ranking is classified and predicted. Max-pooling operation is used for mapping the optimized six-feature outcomes in a fully connected-network. Accustomed operations like batch-normalizations, flatten-layers, dropouts, softmax activation, dense layers and Relu-operations are used for optimizing the feature metrics and for enhancing the parametric outcomes. The table represents the overall description of CNN implementation. The epoch is used for amphetamine and validate the ranks proffered based on the feature extractions using CNN. The pictorial representation (figure 12) for the F-measures result analysis for smart-city rank proffering validated.

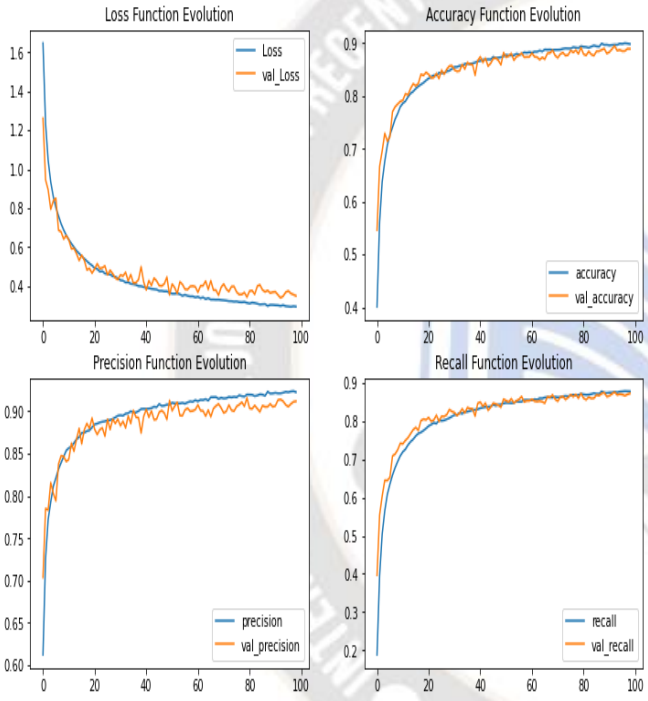

Figure:12 Overall Country Validation metric graph

The test accuracy in validating the proffered smart-city ranks in worldwide countries are predicted at an accurate percentage of 98.05% resulting in a valid smart-country ranking catalog.The CNN test accuracy is represented in the figure 13.

```
10000/10000 [==============================] - 2s 209us/step
Test loss: 0.06909727230984718
Test accuracy: 0.9805999994277954
```

Figure:13 CNN Test Accuracy

The smart-cities are divided into several clusters by performing clustering techniques, packages like fastmarker cluster, folium, numpy, pandas, matplotlib, seaborn, pyplot and map are used for clustering 102 countries IoT data. Fuzzy Mapping techniques are used for mapping the CNN validated proffered ranks for identifying the top smart-cities in the world. The fuzzy-mapping are represented in the map. Overall Country Fuzzy-Mapping Frequency are represented in the figure 14.

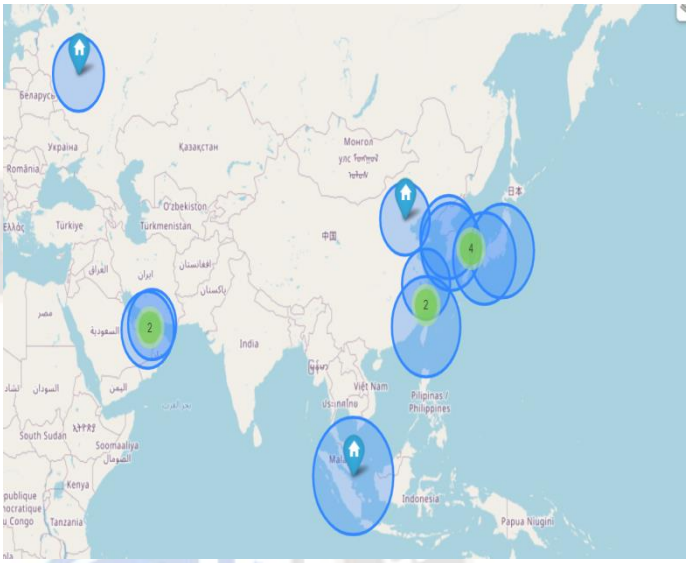

Figure:14 Overall Country Fuzzy-Mapping Frequency

CONCLUSION

By positioning all the feature attributes allied to the smart city cultural interpretations, our analysis shows worldwide country rankings. Country rankings are performed using latest IoT device wind-up data to analyze and investigate on the “smartness”. Our key main features like mobility, economy, government, environment, living and people are used to derive the effective closures to rank the country. Techniques like clustering, fuzzy mapping, folium, fast marker and Convolutional-Neural Network (CNN)are used to upgraded the smart infrastructure and sustainable significance in worldwide countries. The proposed approach focuses on classifying the smart innovative infrastructural implementation in the urban livelihood for city data visualization and proffering cluster ranking effectively. Statistical Country analysis is used to gather the information to improve the transformations from urban to smart-city by predicting the accurate city ranking and validating it using CNN. Our experimental analysis results in a benchmark accuracy in proffering city rank at rate of 98.05%. Proffering rank analysis helps the developing countries to understand the effectiveness of the key features and their impact of developing smart-city. Future subsequent research directions are suggested to work in the existing challenges allied to the six key metric in smart-cities.

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