Developing Indian Smart Cities: Insights from Social Media

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Abstract. Smart cities play an important role in overall development of a nation by progressing with economic, environmental and social domains. India has projected to create 100 smart cities in near future. The purpose of the paper is to identify the key influencing components and the social media users' expectations for smart cities development in India. The Twitter social media content of smart cities council and the user posts on smart cities are collected through Twitter application programming interface. The collected tweets are cleaned by pre-processing methods and analyzed for insights. Technology, infrastructure, innovation, transport, mobility and management are the key influencing components for smart cities development in India. The social media users are expecting to emphasize on combating the issues like Covid-19 and use of IoT technology for the success of smart cities project. The integration of different components could increase the success of the project. The analysis of the content shared by the groups (smart cities council and the social media users) which are at different sides of smart cities' development project, increases the novelty of the study.

Keywords: Smart cities, urbanization, social media, Twitter, India.

1   Introduction

Smart cities try to attain different objectives such as economic, environmental and societal for overall development of the nation. Therefore, countries across the globe are transforming their cities into smart cities. The population in cities exceeds the 50 percent of the world population (Falconer and Mitchell, 2012). With increased population, the administration of the cities for providing necessary services to public could be difficult. The administrative difficulties of the cities can be reduced by adopting information and communications technology (ICT). The cities which uses ICT for public service are referred as smart cities (Bakıcı et al., 2013; Falconer and Mitchell, 2012). The usage of ICT may improve the economic, environmental and social conditions of a country. The Internet of things (IoT) can be used to connect different components of a city to provide smart services (Zanella et al., 2014)

The concept behind the smart city is to mitigate the problems of increased urban population (Chourabi et al., 2012). The urban development of a nation is multifaceted and depends on infrastructure (physical capital), knowledge associated with the people (human capital) and societal relations (social capital) (Caragliu et al., 2011).

Collectively, all these capitals can improve the economic condition of a country. Overall, the smart cities administration should try to meet changing expectations of people.

The Indian government is working towards the creation of 100 smart cities in near future (Chatterjee et al., 2018a). Smart cities council India is a team which keeps updating the developments related to smart cities in India. Indian smart cities working concept is based on three core values such as livability, workability and sustainability. The Kanpur city administration has established a tool based on artificial intelligence to monitor activities in the city during the lockdown (SCC India Staff, 2020a). The Europe's infrastructure development company A & M has announced to initiate the activities towards smart cities and low-cost housing in India (SCC India Staff, 2020b).

With this information, the study aims to identify the key influencing components and the social media users' expectations for smart cities development in India. The rest of the paper is structured as follows. In section 2, the brief literature review on smart cities is made. Section 3 outlines the methodology adopted in the study. The results of the analysis are presented in section 4. Section 5 interprets and discusses the results. In the end, section 6 concludes the work.

2   Literature Review

Cities do not have sufficient budget for developmental activities and other services. The application of smart city concept increases cost consciousness and competency level of cities while reducing complexity of the functions to be performed (Anttiroiko et al., 2014). Sometimes, to solve a problem, we need to be at higher level than the level in which the problem originated. The limited technology may not solve the problem of urbanisation, so needs to be go beyond and adopt full pledged technology solution (Goodspeed, 2015). The city environment condition can be improved by implementing wireless sensor networks at different locations in the city (Jamil et al., 2015). Domain-wise select researches on smart cities are presented in Table 1.

Table 1 Domain-wise research on smart cities

Authors/year	Purpose/development domain	Remarks
Angelidou, 2015; Anttiroiko et al., 2014	To improve economic status of smart cities	Smart city development needs smart solutions as well as smart service platforms. Smart city development needs four forces such as urban future, innovation economy, technology push and demand pull.
Jamil et al., 2015; Mitton et al., 2012	To improve environmental status of smart cities	A system to monitor and control air pollution in the environment. A design to provide interaction between the services and the environment.

Anttiroiko et al., 2014; Bibri and Krogstie, 2017	To improve societal status of smart cities	Smart cities can shape socio-cultural practices in the society.

The Indian smart city project is initiated in 2015 with an aim to meet infrastructural requirements of growing population (Wray, 2020). Apart from the IT infrastructure, the success of smart city mission depends on multiple factors. The human factors such as skills of IT staff and participation of citizens to use IT services are important to consider for the success of Indian smart cities project (Chatterjee et al., 2018b). Some of the select researches on smart cities in Indian context are summarized in Table 2.

Table 2 Smart cities research in India

Authors/year	Purpose	Methodology	Result
Anand et al., 2017	To identify sustainability indicators for smart cities	Experts' views are collected and analysed with fuzzy, analytical hierarchy process	Economic and energy development policies are important for the growth of a nation
Praharaj et al., 2018	To identify the issues associated with the complex planning for smart cities	A case study is conducted with smart city and local body plans	Lack of integration, conflicts with master plans and neglecting local governance bodies are drawbacks of smart city planning
Chatterjee and Kar, 2018	To understand the effects of IT services in smart cities	Data is collected using questionnaire and analysed with statistical tools	There are social/ technological effects and security/safety threats
Chatterjee et al., 2018a	To identify factors which influences information system adaptation in Indian smart cities	Data is collected using questionnaire and analysed with statistical tools	The use of IoT is influenced by its benefits and the quality of information being accessed
Jawaid and Khan, 2015	To evaluate need of smart city projects	Census data is analysed	There is rapid urbanization but lack of basic services such as infrastructure

The review shows that like the efforts of government, the research is also active towards the smart cities' development in India. To support smart cities project, the researchers are trying to identify the challenges and possible solutions using quantitative as well as qualitative studies.

3   Methodology

Methodology is a three-phase activity. First, the Twitter developer account is created and login credentials are authenticated. The Twitter social media content of smart cities council, India and the user posts on smart cities are collected through Twitter application programming interface. To collect data from smart cities council, the Twitter handle "SmartCitiesIn" is used with the userTimeline function in R. This function returned 464 tweets, which are posted by smart cities council in a timeline from 2017 to 2020. Further, to collect opinions of social media users about smart cities development in India, the Twitter is queried with the keywords set "smart cities". This search/query returned 2,791 tweets for the duration of about a week.

Second, after collecting the tweets, the pre-processing approach is applied to clean both the datasets. Pre-processing is done with the help of functions in R such as tolower(), removePunctuation(), removeNumbers(), stripWhiteSpace() and removeWords(). The outcome of pre-processing is the set of tweets without upper case letters, punctuations, numbers, whitespaces and stop words.

Third, both the data sets are combined together to form a single dataset. This combined dataset is analysed and evaluated for common and dissimilar words. The common words are represented by wordcloud and a pyramid graph and the dissimilar words by a wordcloud. Further, to draw the insights from opinions of social media users, the emphasis is made on users' posts dataset analysis. The users' posts are analysed for association among the words and represented through table and a graph. Finally, the resulted are interpreted for inference.

4   Results

The common similar words which are expressed by smart cities council and the general social media users about the development of smart cities in India are shown as wordcloud in Figure 1. The words smart, city and cities are used most of the times during the sharing of information about the smart cities' development. Other developmental components such ad technology, infrastructure and transport are highlighted during the discussion over social media.

The most common dissimilar words from both the information sharing groups are shown in Figure 2. The words expressed by smart cities council are shown with orange colour and the words by social media users are shown with blue colour. Urbanation is a very common and dissimilar word in the tweets shared by smart cities council. Similarly, cities is a common and dissimilar word in the tweets shared by social media users.

Figure 3 shows the common words and their frequency of occurrence in each information sharing group as a pyramid. The most frequent words are located at the bottom of the pyramid. The left-hand side of the Figure 3 shows the frequency of words in smart cities council's posts and the right-hand side shows the frequency of words in social media users posts.
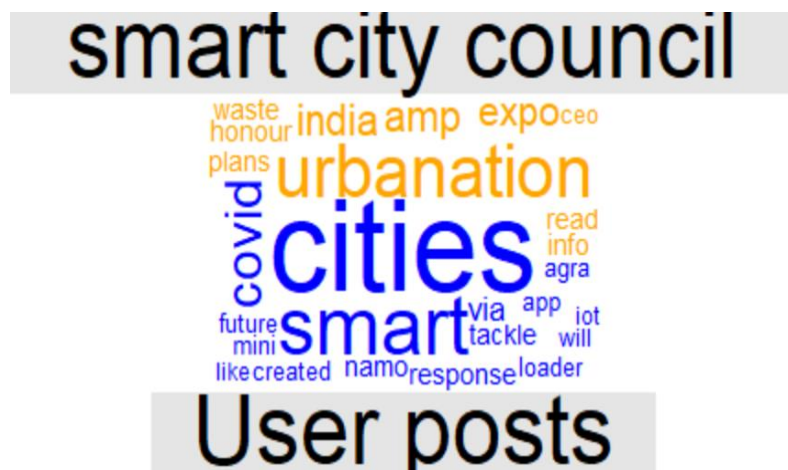
Figure 1 Wordcloud of common similar words

Figure 2 Wordcloud of common dissimilar words

After analyzing the tweets combinedly, the social media users' posts are analyzed for association among the words. The adjacency graph shown in Figure 4 represents association of words. A node represents a word in Twitter dataset and an edge represents the relation between the words. The distance between the nodes in the graph shows the level of association (frequency of their occurrence together) between those words. The overlapping nodes reveals that they occur mostly together in the tweets.
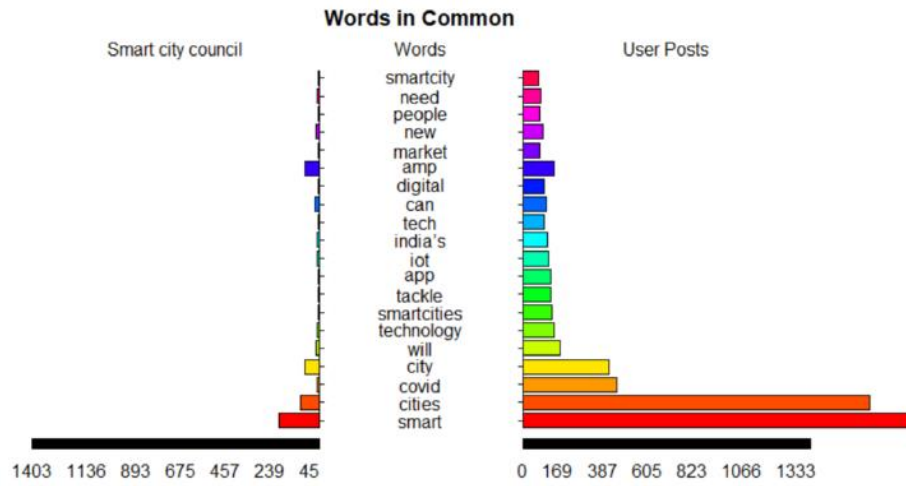
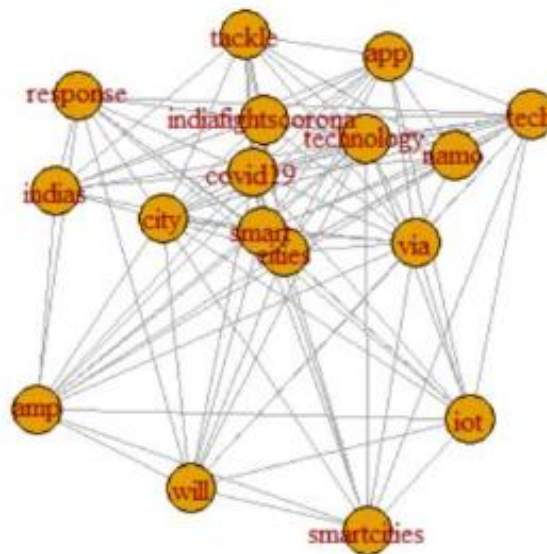Figure 3 Pyramid of common words

Figure 4 The adjacency graph for users' posts

5   Discussion

The analysis results are represented in the previous section. In this section will discuss more on the results and the interpretation form the results.

Common similar words: As the Figure 1 shows the common similar words present in the combined tweets, the smart, cities and city are the most frequent words. The frequent occurrence of these words indicates that the discussion taking place on social media is about the smart cities. Some of the select words to discuss from the wordcloud are technology, infrastructure, innovation, transport, mobility and the management. The occurrence of technology in the discussion indicates its necessity for the development of smart cities. The technology may involve IoT, social media and any other ICT tools. For examples, the tweets "ISRO is working on the 100 smart cities. Karnataka has been using remote technology in a big way" and "I invite entrepreneurs in the area of cyber-security for the police department. We need experts, we need technology" highlights the importance of technology for smart cities development.

Often, the word infrastructure is occurring in the discussion about the smart cities. This indicates that the infrastructure is also an essential component of the smart cities project in India. This statement can be supplemented by the tweets "Government sanctions Rs 15k cr to boost health infrastructure" and "India is no longer a learner, but now a contributor for infrastructure". Similarly, the innovation component is also important for the smart cities' development. The occurrence of the term innovation during the discussion about the smart cities indicates its importance. The innovation can improve the quality of infrastructure. A tweet "Digital Innovation will be the key to ramp up Healthcare Infrastructure to allow for predictive analysis going hea…" reveals the power of innovation backed infrastructure.

Another important component for smart cities development is public transport. The term transport occurred several times in the discussion. The example tweets "Rapid urbanisation is putting tremendous pressure on our transportation" and "Smart IoT in Transportation and Logistics is the Key Tech to Improve Cities in Motion #SmartCities" reveals the importance of transport component for smart cities development in India. Often, the term mobility is also occurred in the discussion and indicates its importance for smart cities development. This is supported by the tweets "#Amravati goes mobility friendly! The city plans the upgradation and development of its roads and walking areas…" and "India has been leveraging #technology to enable #smart mobility in #cities. Supporting #governments in this drive,…" .

Finally, the management component is also equally important like other components for smart cities projects. The tweets "Uttarakhand's cleanest city is now fighting with waste management" and "Now, Goa to introduce waste management in school syllabus". In this way, the different components play an important role smart cities development in India.

Common dissimilar words: In Figure 2, the dissimilar words from both the groups are shown in different colours. The smart city council, usually, posts the information on smart cities development in India. Urbanation is the most frequent word used in the discussion and indicates that the smart cities development project is emphasizing on the urbanization of the country and related issues. The urbanation is supported by the tweets "India's Premier Smart City Event - Smart Urbanation 2019 at Hotel Shangri-La, Bengaluru" and "It's an honour to have t-hub as our innovation partner at Smart Urbanation, Convention and Expo 2019".

On the other hand, the social media users' group posts the information on completed and expected tasks towards the development of smart cities projects. Smart and cities are the most frequent words shared by the group. Apart from this, the group emphasizes on the use of IoT for the smart cities project. The tweet "Impact of Covid-19 Internet of Things (IoT) in Smart Cities Market Expected to Witness the Highest Growth 2024" highlights the importance of IoT for smart cities development. The group also shares the information on Covid-19 outbreak and suggests its control as prioritized one. The tweets "Researchers explore effects of COVID-19 on urban mobility | Smart Cities Dive" and "COVID-19 to Accelerate Adoption of Technology-Enabled Smart Cities Resilience Approaches" from the users' posts reveals the influence of Covid-19 outbreak on smart cities development. Some of the other tweets emphasizes on control of Covid-19 to resume the smart cities developmental activities. In entirety, the social media users group expects to combat deadly outbreak Covid-19 and use of IoT for smart cities development in India.

Common words and frequency: As mentioned in results section, Figure 3 shows the common words and their frequency form both the groups. The word smart appeared in both the groups discussions but with varying frequency. With the posts from smart cities council, the term smart occurred around 200 times whereas with the posts from social media groups appeared around 2000 times. This huge difference is not only due to the different tweets size, could be due to social media users' expectations towards smart cities development in India. Similarly, the words city and cities are occurred with varying frequency between the groups.

The term covid is also occurred most frequently with users' posts than the smart cities council posts and indicates that combating of covid-19 is most important for smart cities development to succeed. The increased frequency of occurrence for the term technology with users' posts reveals that technology adoption and upgradation are essential for smart cities projects. The word IoT is used frequently in discussion to indicate its importance for smart cities development. As most of the terms occurred frequently with users' posts, the users' expectations towards smart cities are revealed with higher magnitude.

Association among words: As shown in Figure 4, the association among the words indicates the bonding between the words and their occurrence in the tweets together. In the graph, the nodes with words smart and cities are overlapping each other and indicates that most of the times their occurrence is together (higher association between the words). Similarly, the word technology is associated with most of the terms in the tweets. The nodes with the words Indiafightscorona and covid-19 are very close to each other in the graph as they occurred together most of the times in tweets.

6   Conclusion

India has projected to create 100 smart cities in near future. With this intention, the concerned governance authorities are trying their best for the development of smart cities in India. The smart cities council team is created to update the information on

smart cities development for public. This team serves through the web portal and different social media accounts such as Twitter, Facebook and LinkedIn. To analyze the content posted by the council, the Twitter social media is queried with council's Twitter handle. Apart from the smart cities council's posts, the Twitter social media users' posts are also collected and analyzed for information on smart cities development in India.

The observation of the wordcloud for common words and the discussion form the example tweets shows that technology, infrastructure, innovation, transport, mobility and the management are the important components for smart cities development in India. The innovation backed infrastructure development could be sustainable in future. The information shared by smart cities council reveals that the team emphasizes on urbanization of the country and addressing related issues. On the other hand, the information shared by Social media users revealed that the people expecting to combat the covid-19 like outbreaks first for the success of smart cities project. People are also expecting the use of IoT for successful implementation of the smart cities project.

The association among the words reveals that often, working collectively with different components yields success in the smart cities project. Emphasizing on key influencing factors and users' expectations during design of future smart cities solutions, the possibilities of project success can be increased. The study used only smart cities council's timeline tweets and the Twitter content of social media users to analyze smart cities development in India. Therefore, the results reported may lack generalization. In future, the study can be extended to incorporate the posts shared through other social media platforms such as Facebook and LinkedIn by both the groups.

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