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LANDSCAPE STUDY ON SMART PARKING

Image Courtesy

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Sample Exemplary Report by IIPRD

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1. Smart Parking

Vehicle Parking: A Herculean Task

The number of vehicles out there on roads and looking for parking spots is rapidly outpacing the areas meant to park vehicles. To add to this, there are deeply rooted ignorant parking habits. Even though parking management is in place, yet parking remains an issue, for the most of us.

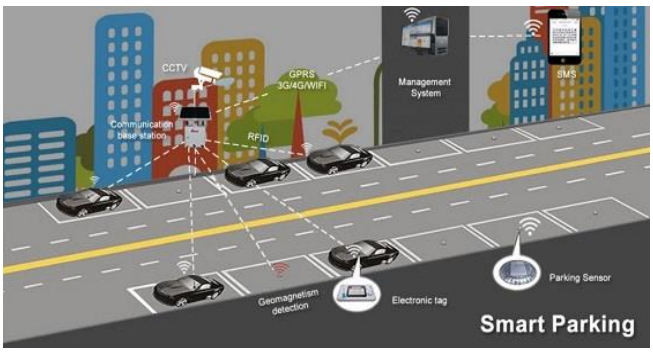
Aside to this, studies have estimated that at any given point in time, a whopping 30 percent of drivers actively struggle as to how to park without crashing into their own vehicles, or the others. This leads to an increase in the time/hours spent on the road. On an average, a driver has to spend at least 3.3 minutes to park the vehicle.

Also, driver start to look for free/available parking spaces before their vehicle come to the standstill position. This habit makes them prone to get into crashes/collisions. According to a survey, one in every five traffic accidents occurs in or around a parking lot. Reason?? Distracted driving---drivers pay more attention to identify parking spots rather than judging what's in front or behind them. When this happens, drivers risk themselves to get into fender-benders, or end up injuring pedestrians.

To address at least some of these issues, Smart Parking Systems have started to evolve. In some well-known instances, Smart Parking Systems are designed to assist drivers in identifying parking spots, booking parking spots, automated parking, locate the position where one parks his vehicle, etc. For example, for automated parking, parking slots are marked with machine identifiable signs and/or symbols, wherein the trained systems/softwares/algorithms/Artificial Intelligence (AI) identifies the markings and assist the user in parking.

Smart parking isn't meant just for the best possible and precise space utilization, it's about holistic approach to assist amateur as well as trained drivers in every aspect of driving—be it spot identification, booking a parking spot, automated parking, so and so forth---so that parking doesn't become a herculean task to the drivers even in tighter parking spots.

A myriad of Smart Parking Systems is now in place and frequent addition has been seen in recent years. Let's go into details….



Smart Parking: offerings

Eliminates Distractions

Implementing smart parking technology can reduce traffic congestion and can lower the risk of distracted driving. While different cities use this technology in different ways, many leverage it to make empty parking spaces more apparent to drivers. Some parking garages and heavily traveled roads now have lights or other indicators installed above parking spaces to signal the drivers whether a space is available or not. Sensors in the lights can detect whether a car is currently in the space, turning green if the space is empty and red if the space is occupied. These lighted spaces can be seen from blocks away, which reduces drivers' distraction.

Rather than scanning the side of the road for empty spaces, many of which aren't clearly marked, the driver can look straight ahead and see available, "green-lighted" parking. This also allows them to plan their parking maneuver well in advance i.e. warn the driver behind them that they are going to pull into the space.

Reduces Driving Time

Smart parking increases parking safety, but its greatest impact on traffic congestion comes from the fact that it makes parking much faster. If city planners install sensor lights on every space, this gets drivers off the road more quickly because they can see whether a street or lot has parking available blocks in advance. In parking garages, you can even list the number of spaces available at the entrance, before drivers pull into the garage. This information receives constant updates from the sensors, ensuring that drivers always have the latest information. For instance, if a driver sees that there are no available parking spaces on a particular road and that the closest parking garage is full, rather than travelling along on the same road for blocks and blocks, they can turn onto a parallel street that does have parking available. This saves time on the driver's commute.

Smart parking technology can go even further than sensors and lighted spaces. Using the latest advances in the Internet of Things (IoT), we can sync these sensors to a cloud platform that feeds the information into mobile apps or online parking websites. In theory, a driver could have a GPS app on their phone providing audio directions to the next available parking space or garage. The driver can keep their eyes on the road and spend far less time driving around looking for spaces.

Better Space Management

Another way that smart parking technology will reduce traffic volume in cities is by making it easier for drivers to pay for parking. Technology that syncs with a mobile app

allows drivers to pay for parking on their phones instantly, which saves time. A parking space might become available to the next driver more quickly when the first driver can pay for parking digitally—they're not wasting minutes looking for a ticket machine.[Source]

Smart Parking Market Overview:

The global smart parking market reached a value of US$ 4.93 Billion in 2018. A smart parking system (SPS) optimizes parking spaces through automated access control systems, parking guidance systems (PGS), parking reserving barriers and ticketing systems. It utilizes mechanical arrangements to transport cars from one parking space to another and eliminate the wasted space in a multistory or single-story garage. It uses vehicle counting equipment, video cameras, automatic number plate recognition readers (ANPR) and pavement sensors to determine the occupancy of a parking lot and transmit the data to the control center in real time. It aims to assist in the smooth flow of traffic in congested areas and provide a systematic parking operation. It also guides users to available parking slots by navigating them via a smartphone application. When positioned as a system, smart parking saves time, decreases management costs and limits the cases of illegal parking in an area. Looking forward, the market is expected to reach levels worth US$ 11.59 Billion by 2024 exhibiting a CAGR of 13.4% during 2019-2024.

Rapidly increasing traffic congestion leading to limited space for smooth flow of traffic is the key factor contributing to the market growth. With growing urbanization and rising disposable incomes, there has been a rise in the preference for comfortable and luxurious cars. This has escalated the problem of on-road car parking, consequently resulting in the demand for smart parking systems. Additionally, an increase in governmental regulations for the development of green and smart cities, industrial parks and economic zones to reduce carbon dioxide emissions have also contributed to the demand for SPS. Moreover, the system is extremely convenient for the users as it reduces unnecessary paper consumption by replacing cash payments for parking with digital invoices sent directly on the user's smartphone. Furthermore, the thriving international tourism industry is expected to drive the market as these systems can aid in smooth parking operations in popular and congested tourist destinations.[Source]

2. Objectives

- To perform detailed analysis of granted patents and published applications pertaining to Smart Parking and to understand underlying technologies.
- In depth analysis of patents/applications, in order to categorize them and to understand focusing areas of applicants.
- Graphical representation of trends (Filing, Publication, etc.) from the mined data of relevant patents/applications.

Image Courtesy

3. Search Methodology

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The first step is to create and define a patent set that will serve the basis of the study. Using renowned patent databases *viz.* 'Questel Orbit' and 'Derwent Innovation' as our data sources. Search was carried out in Abstract, Title, and Claims fields of patent specifications by incorporation of Keywords and International Patent Classes.

4. Executive Summary

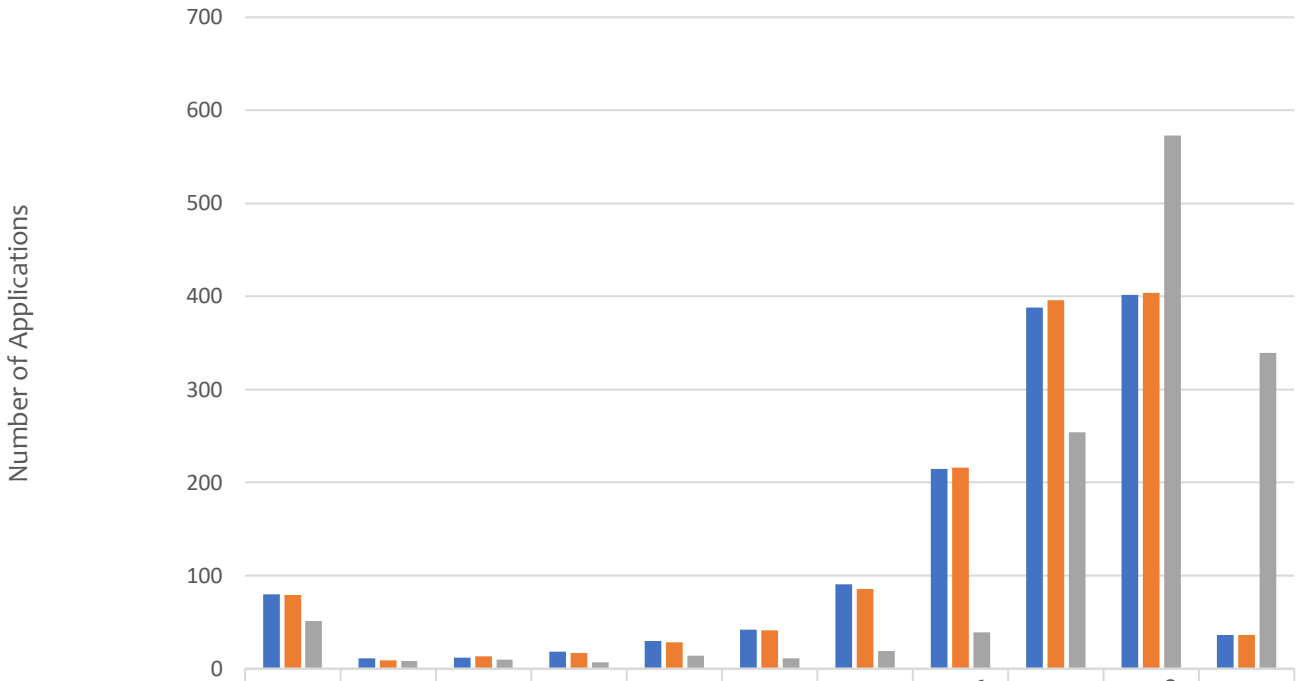
- This report explores the global landscape of patents and/or patent applications pertaining to Smart Parking.
- A set of 1325 patent families (that bifurcates to a total of 2476 individual patents/applications) filed in the Smart Parking domain were analyzed.
- As inferred from the analyzed dataset, there is a rise in patent filing activities in Smart Parking domain. The year 2017 has witnessed maximum number of patent application filings.
- From of analyzed dataset, Robert Bosch (37 patent families) emerges out as the leading patent applicants; followed by Hyundai (30 patent families). Other applicants that have significant numbers of patent/patent application are BMW, Shenzhen Shenglu IoT Communication Technology, Xi An Irain Iot Technology Services, Guangzhou Xiaopeng Motors Technology, and Chengdu Changdao Technology among others.
- From of analyzed dataset, Inventors Xiao Zhiguang and Jiang Shaofeng are the leading innovators in Smart Parking domain. Zhang Xuefei, Lai Jianming, and Chen Shengjun also have significant contributions.
- From of analyzed dataset, China registers itself as the country with most numbers of innovation. Over 1000 patent applications were first filed in China itself, followed by Korea (99 patent applications).
- Patent publications particularly have focus on Sensors (388), Parking Vacancy Prediction (315), Parking Guidance (306), License Plate Recognition (300), Payment (272), Parking Reservation (217), Navigation/ GPS (188), Wi-Fi/ GPRS/ 3G/ 4G/ 5G (187), Parking Space Lock (175), Automated Parking (89), Mobile App (67), RFID (66) , Vehicle Charging (44) , Parking Space Sharing (35), Parking Meter (34) , V2X (28) , and Others (348).

5. Non-Technical Analysis

5.1 PRIORITY, FILING, PUBLICATION YEAR BASED TREND ANALYSIS

5.1.1 ANALYSIS BASED ON REPRESENTATIVE MEMBER PER INPADOC FAMILY

Below graph represents priority year, application year, and publication year trends for the patent applications pertaining to Smart Parking.



	<2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Priority Year	80	11	12	18	30	42	91	215	388	402	36
Application Year	79	9	13	17	28	41	86	216	396	404	36
Publication Year	51	8	10	7	14	11	19	39	254	573	339

Note: Attributed to non-published patent applications, there may be a higher count in the years 2015-2018.

INSIGHT:

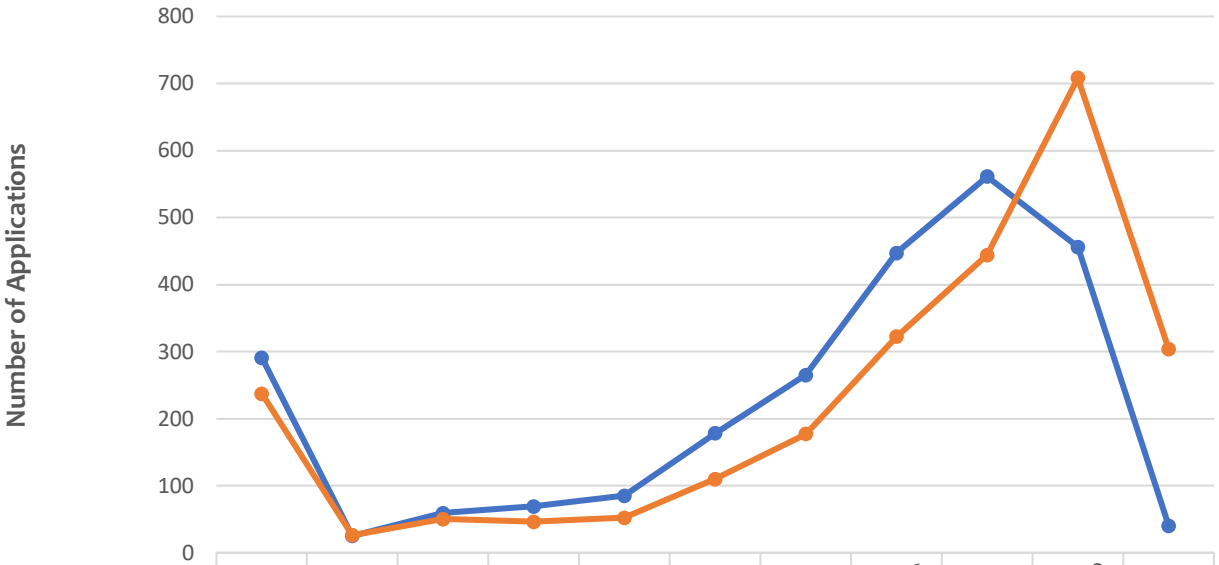
- Priority year trend provides insights related to priority years of the patent applications. Most patent applications claim priority from the years 2015-2018.

- Filing year trend provides insights for the number of applications filed across the years. As depicted in the graph, there is a gradual rise in patent applications filing over the years, wherein maximum numbers of patent applications were filed in the years 2015-2018.

- Publication trend provides insights for the number of applications published across the years. As indicated in the graph, there is a gradual rise in publication over the years, wherein maximum numbers of patent applications were published in the years 2017-2019.

5.1.2 FILING AND PUBLICATION TREND ANALYSIS BASED ON EXPANDED FAMILY DATA

The below graph shows trends for the application against publication years, wherein we have considered each family member of a particular patent family.



	<2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Application	291	25	59	69	85	178	265	447	561	456	40
Publication	237	26	50	46	52	110	177	322	444	708	304

Note: Attributed to non-published patent applications, there may be a higher count in the years 2015-2018.

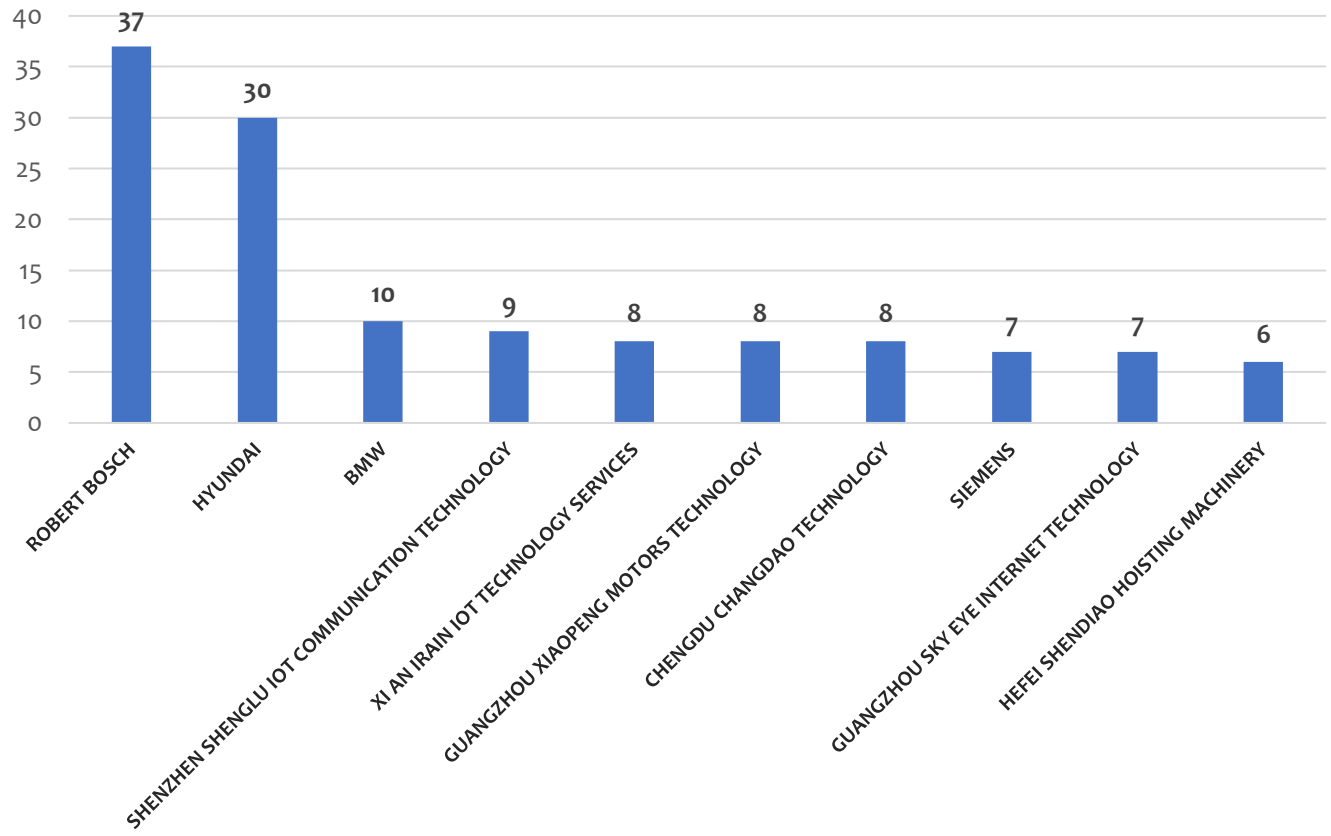
INSIGHT:

As evident from the above trends, there is a continuous rise in the patent application filing and patent application publication over the period of time, wherein the maximum number of applications (561) were filed in the year 2017 and the maximum number of applications were got published (708) in the year 2018.

5.2 ASSIGNEE BASED TREND ANALYSIS

5.2.1 MAJOR ASSIGNEES (BASED ON REPRESENTATIVE MEMBER PER FAMILY)

The below graph represents major assignees in the domain.



Note: Attributed to non-published patent applications, there may be a higher count in the years 2015-2018.

INSIGHT:

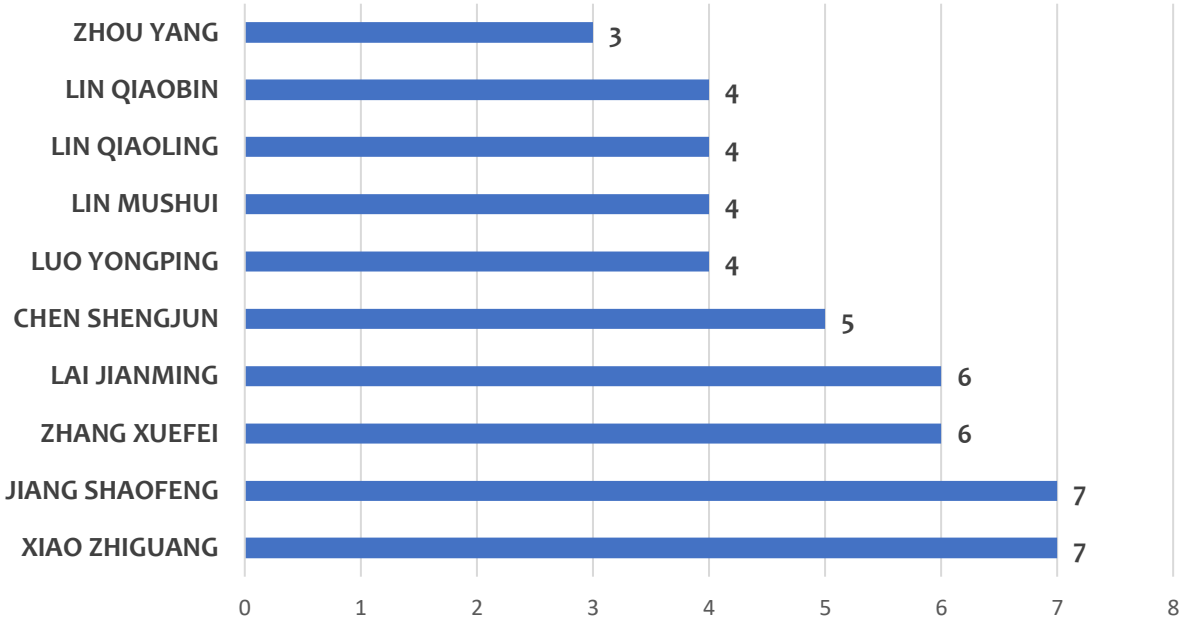
As evident from the chart herein above, "Robert Bosch" (37 patent families), "Hyundai" (30 patent families), "BMW" (10 patent families)" and "Shenzhen Shenglu IoT Communication Technology" (9 patent families) are key applicants/assignees with significant filing activity worldwide.

THE TOP ASSIGNEES ARE:

- ROBERT BOSCH
- HYUNDAI
- BMW
- SHENZHEN SHENGLU IOT COMMUNICATION TECHNOLOGY
- XI AN IRAIN IOT TECHNOLOGY SERVICES
- GUANGZHOU XIAOPENG MOTORS TECHNOLOGY
- CHENGDU CHANGDAO TECHNOLOGY
- SIEMENS
- GUANGZHOU SKY EYE INTERNET TECHNOLOGY
- HEFEI SHENDIAO HOISTING MACHINERY

5.3 KEY INVENTORS

The below graph names the inventors with most number of innovations on their name.



Note: Attributed to non-published patent applications, there may be a higher count in the years 2015-2018.

INSIGHT:

The chart demonstrates top inventors, wherein 'Xiao Zhiguang' and 'Jiang Shaofeng' emerges out as the leading inventors in Smart Parking Technology followed by Zhang Xuefei, Lai Jianming, and Chen Shengjun.

5.4 GEOGRAPHY BASED TREND ANALYSIS

5.4.1 GEOGRAPHICAL DISTRIBUTION OF PATENT APPLICATION FILINGS

Priority Year ➡ Priority Country ⬇	<2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Grand Total
CN		1			7	15	52	148	350	398	35	1006
KR	21	4	7	5	5	5	14	27	9	2		99
DE	20	2	1	6	6	13	14	15	12			89
US	7	3	2	3	7	9	5	10	5			51
FR	11	1		1	1		2					16
TW	1			1				3	6	1	1	13
JP	4				3		1	3	2			13
WO				1				7	1			9
EP	4		1					1				6
NL	4							1				5
Others	8		1	1	1		3		3	1		18
Grand Total	80	11	12	18	30	42	91	215	388	402	36	1325

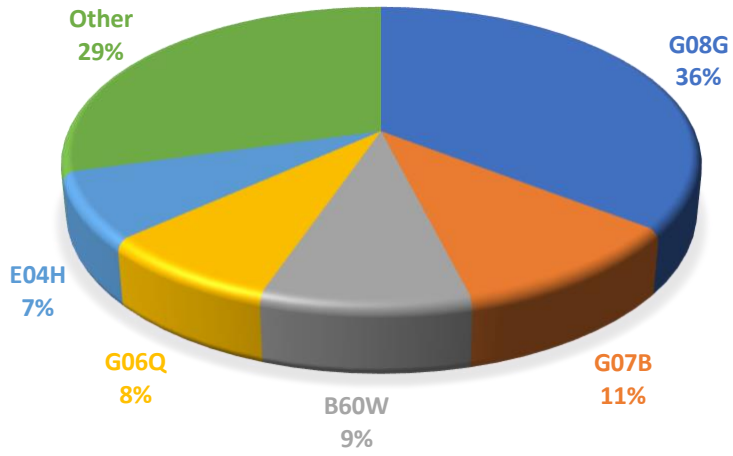
Note: Attributed to non-published patent applications, there may be a higher count in the years 2015-2018.

INSIGHT:

Trend related to Geographical filing demonstrates that the maximum number of filings were originated from China (CN) followed by Korea (KR) and Germany (DE) jurisdictions.

5.5 INTERNATIONAL PATENT CLASSIFICATION BASED TREND

The below graph represents frequently assigned international patent classes.



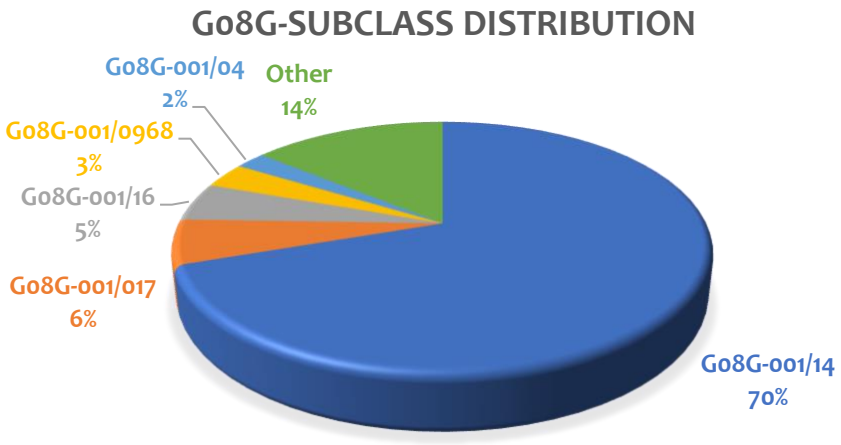
INSIGHT:
Majority of patent applications were assigned with IPC "G08G" followed by "G07B".

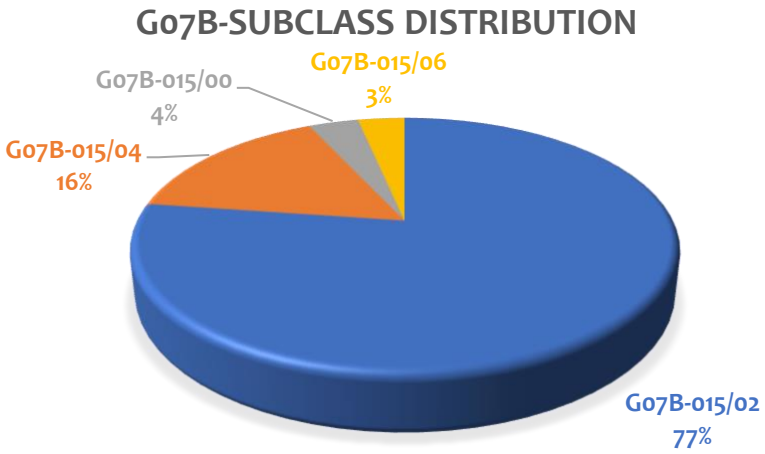
IPC DEFINITIONS

IPC	Definition
G08G	Traffic control systems
G07B	Ticket-issuing apparatus; taximeters; arrangements or apparatus for collecting fares, tolls or entrance fees at one or more control points; franking apparatus
B60W	Conjoint control of vehicle sub-units of different type or different function; control systems specially adapted for hybrid vehicles; road vehicle drive control systems for purposes not related to the control of a particular sub-unit
G06Q	Data processing systems or methods, specially adapted for administrative, commercial, financial, managerial, supervisory or forecasting purposes; systems or methods specially adapted for administrative, commercial, financial, managerial, supervisory or forecasting purposes, not otherwise provided for
E04H	Buildings or like structures for particular purposes; swimming or splash baths or pools; masts; fencing; tents or canopies, in general

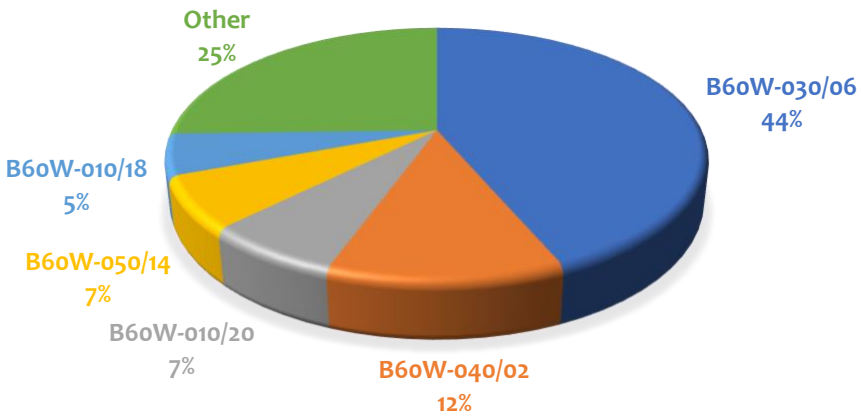
5.6 INTERNATIONAL PATENT SUB-CLASSIFICATION BASED TREND

The below graph represents sub-classes pertaining to one of the top/main patent classes.

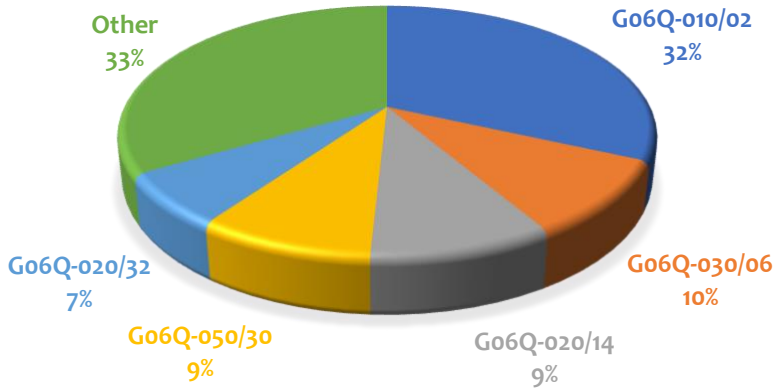




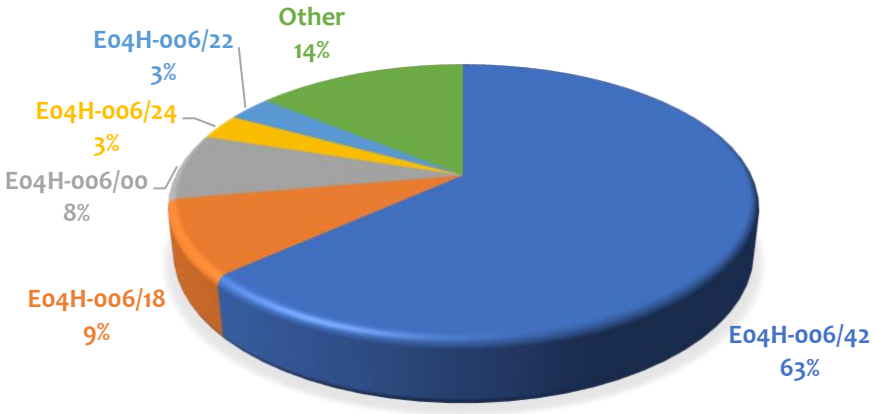
B60W- SUBCLASS DISTRIBUTION



G06Q-SUBCLASS DISTRIBUTION



E04H- SUBCLASS DISTRIBUTION



IPC DEFINITIONS:

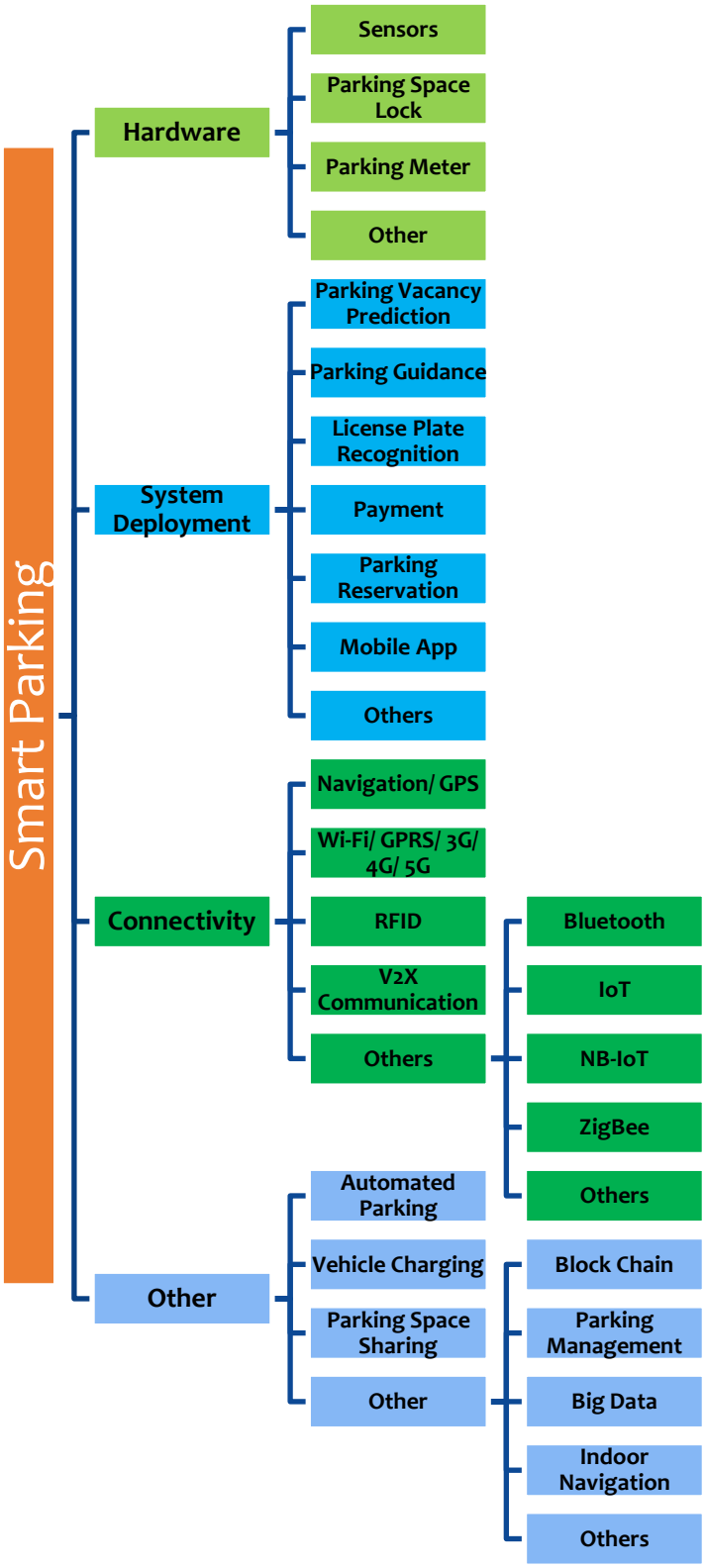
IPC Subclass	Definition
G08G	Traffic control systems
G08G-001/14	indicating individual free spaces in parking areas
G08G-001/017	identifying vehicles (G08G1/015, G08G1/054 take precedence)
G08G-001/16	Anti-collision systems
G08G-001/0968	Systems involving transmission of navigation instructions to the vehicle (navigation or navigational instruments specially adapted for navigation in a road network G01C21/26)
G08G-001/04	using optical or ultrasonic detectors
G07B	Ticket-issuing apparatus; taximeters; arrangements or apparatus for collecting fares, tolls or entrance fees at one or more control points; franking apparatus
G07B-015/02	taking into account a variable factor such as distance or time, e.g. for passenger transport, parking systems or car rental systems (G07B 15/06 takes precedence; taximeters G07B 13/00; parking meters per se G07F 17/24)
G07B-015/04	comprising devices to free a barrier, turnstile, or the like (turnstiles with registering means G07C 9/02) [2006.01]
G07B-015/00	Arrangements or apparatus for collecting fares, tolls or entrance fees at one or more control points (handling coins or valuable papers, e.g. banknotes, G07D; apparatus for vending or hiring articles or services activated by coins, credit cards, paper currency or the like G07F 7/00, G07F 17/00)
G07B-015/06	Arrangements for road pricing or congestion charging of vehicles or vehicle users, e.g. automatic toll systems
B60W	Conjoint control of vehicle sub-units of different type or different function; control systems specially adapted for hybrid vehicles; road vehicle drive control systems for purposes not related to the control of a particular sub-unit
B60W-030/06	Automatic manoeuvring for parking
B60W-040/02	related to ambient conditions
B60W-010/20	including control of steering systems
B60W-050/14	Means for informing the driver, warning the driver or prompting a driver intervention
B60W-010/18	including control of braking systems
G06Q	Data processing systems or methods, specially adapted for administrative, commercial, financial, managerial, supervisory or forecasting purposes; systems or methods specially adapted for administrative, commercial, financial, managerial, supervisory or forecasting purposes, not otherwise provided for
G06Q-010/02	Reservations, e.g. for tickets, services or events
G06Q-030/06	Buying, selling or leasing transactions
G06Q-020/14	specially adapted for billing systems
G06Q-050/30	Transportation; Communications
G06Q-020/32	using wireless devices

E04H	Buildings or like structures for particular purposes; swimming or splash baths or pools; masts; fencing; tents or canopies, in general
E04H-006/42	Devices or arrangements peculiar to garages, not covered elsewhere, e.g. securing devices, safety devices
E04H-006/18	with means for transport in vertical direction only or independently in vertical and horizontal directions (E04H 6/14 takes precedence)
E04H-006/00	Buildings for parking cars, rolling-stock, aircraft, vessels, or like vehicles, e.g. garages (tents for use as garages E04H 15/00; bicycle stands B62H; storing of vessels on land B63C 15/00; construction of ground-supported surfaces E01C; marking of parking areas on the ground E01F 9/00; building construction in general E04B 1/00)
E04H-006/24	characterised by use of dollies for horizontal transport
E04H-006/22	characterised by use of movable platforms for horizontal transport

6. TECHNICAL ANALYSIS

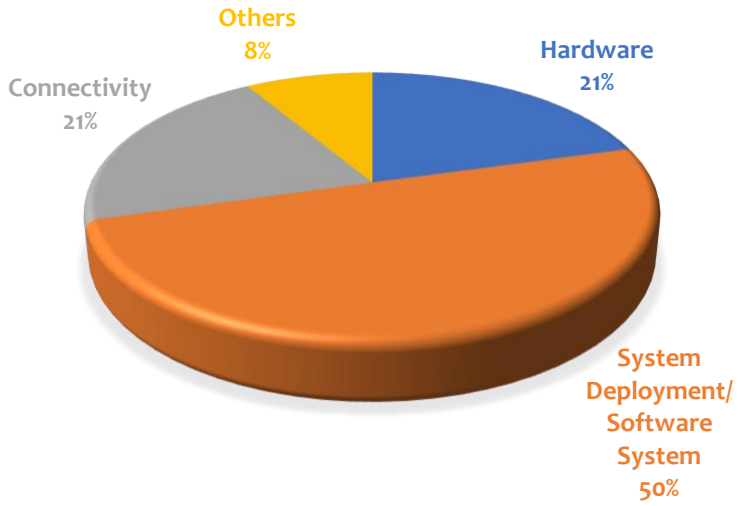
6.1 TAXONOMY DEVELOPED FOR BUCKETING OF RELEVANT PATENT DOCUMENTS

A set of 1325 patent families were analyzed in depth to identify the focus areas of the patents related to Smart Parking.



6.2 DISTRIBUTION OF PATENTS/APPLICATIONS PERTAINING TO SMART PARKING

This category deals with patents/applications pertaining to dissection of smart parking technology. Below representation shows the dissection in terms of Hardware, System Deployment/Software System, Connectivity, and others.



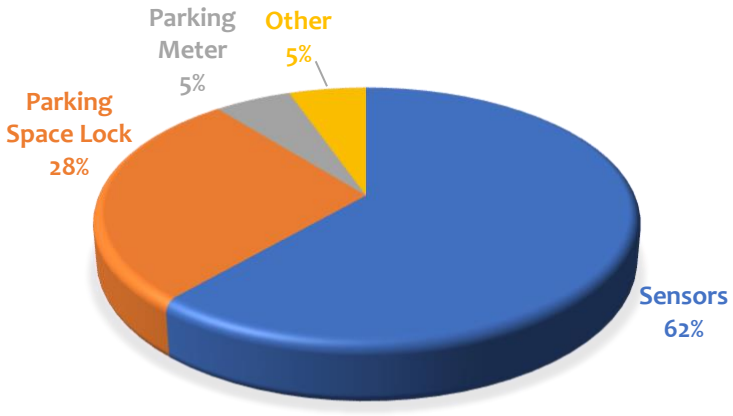
INSIGHT:

As evident from the graph, maximum number of patents/applications are falling under System Deployment/ Software System (50%) followed by Hardware (21%), and Connectivity (21%).

*The 'Other' category includes Patents/Applications related to Automated Parking, Charging, and Parking Space Sharing, and others.

6.2.1 BIFURCATION OF PATENTS/APPLICATIONS PERTAINING TO 'HARDWARE'

This category deals with patents/applications pertaining to hardware being incorporated in the Smart Parking. Below representation shows sub-categories, such as, Sensors, parking Space Lock, parking Meter, and others.

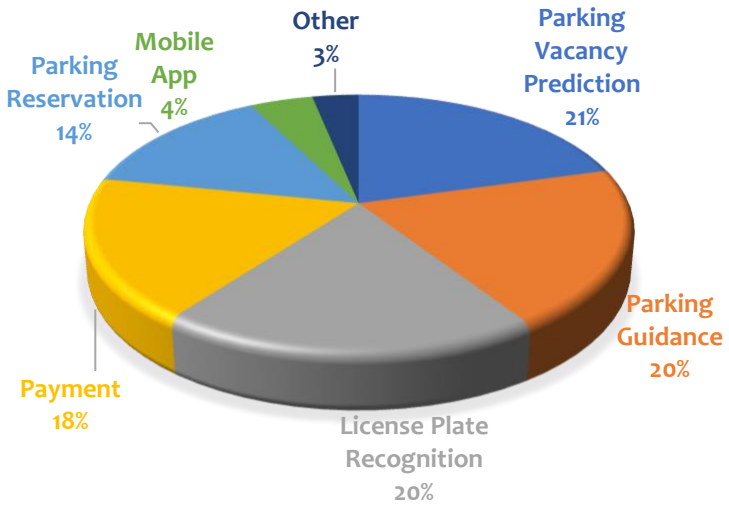


INSIGHT:

As evident from the graph, maximum number of patents/applications are falling under Sensors (62%) followed by Parking Space Lock (25%), and Parking Meter (5%).

6.2.2 BIFURCATION OF PATENTS/APPLICATIONS PERTAINING TO 'SYSTEM DEPLOYMENT/ SOFTWARE SYSTEM'

This category deals with patents/applications pertaining to software systems being incorporated in Smart Parking Technology. Below representation shows sub-categories such as Parking Vacancy Prediction, Parking Guidance, License Plate Recognition, Payment, Parking Reservation, Mobile App, and others.



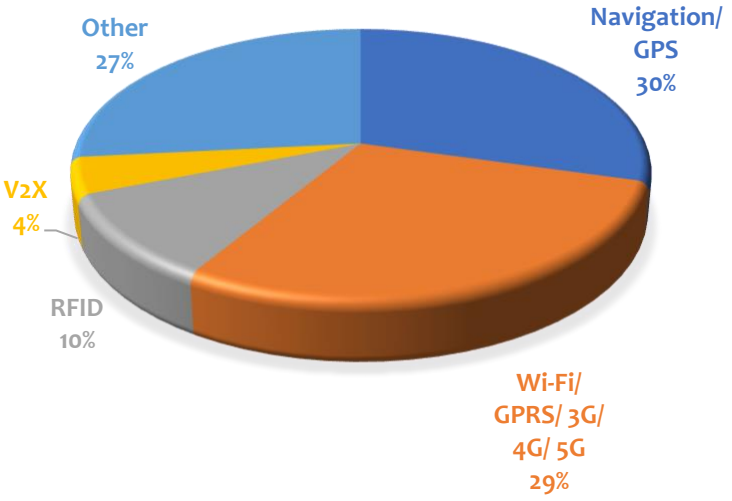
INSIGHT:

As evident from the graph, maximum number of patents/applications are falling under Parking Vacancy Prediction (21%) followed by Parking Guidance (20%), and License Plate Recognition (20%), and Connectivity (21%).

*The 'Other' category includes Patents/Applications related to Automated Parking, Charging, and Parking Space Sharing, and others.

6.2.3 BIFURCATION OF PATENTS/APPLICATIONS PERTAINING TO 'CONNECTIVITY'

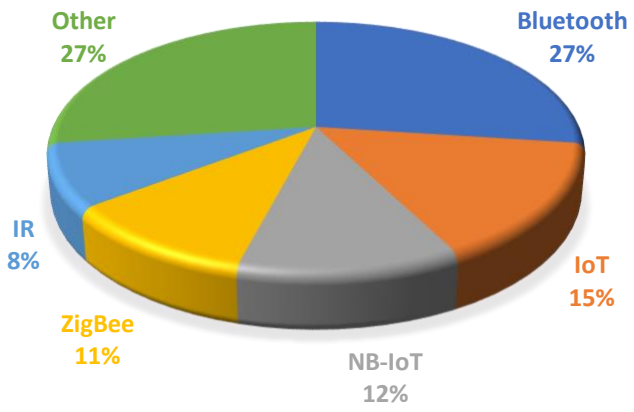
This category deals with patents/applications pertaining to connectivity technology being incorporated in Smart Parking Technology. Below representation shows sub-categories such as Navigation/ GPS, Wi-Fi/ GPRS/ 2G/ 3G/ 4G/ 5G, RFID, V2X, and others.



INSIGHT:

As evident from the graph, maximum number of patents/applications are falling under Navigation/ GPS (30%) followed by Wi-Fi/ GPRS/ 3G/ 4G/ 5G (29%).

6.2.4 BIFURCATION OF PATENTS/APPLICATIONS PERTAINING TO 'OTHERS'

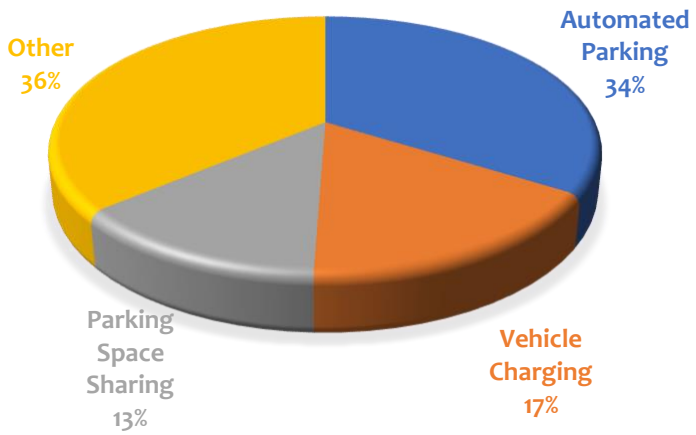


INSIGHT:

As evident from the graph, maximum number of patents/applications are falling under Bluetooth (27%) followed by IoT (15%).

6.2.4.(a) REDISTRIBUTION OF PATENTS/APPLICATIONS PERTAINING TO THE 'OTHER' CATEGORY OF SECTION 6.2.4

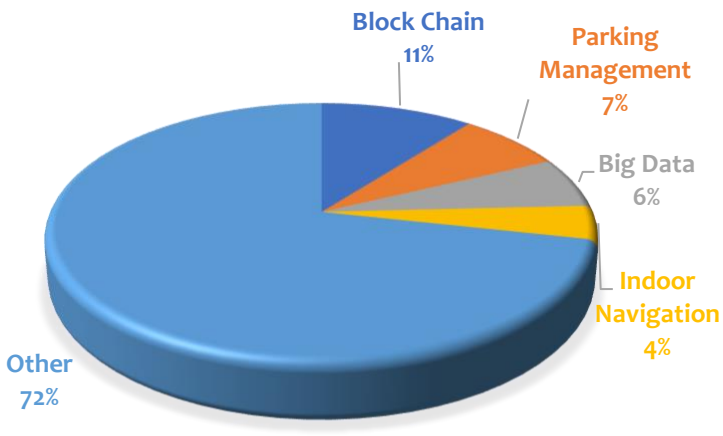
This category deals with patents/applications pertaining to other systems being incorporated in Smart Parking Technology. Below representation shows sub-categories such as Automated parking, Vehicle Charging, Parking Space Sharing, and others.



INSIGHT:

As evident from the graph, maximum number of patents/applications are falling under Automated Parking (34%) followed by Vehicle Charging (17%).

6.2.4. (a.1) DISTRIBUTION OF PATENTS/APPLICATIONS PERTAINING TO THE 'OTHER' CATEGORY OF SECTION 6.2.4.(a)



INSIGHT:

As evident from the graph, maximum number of patents/applications are falling under Block Chain (11%) followed by Parking Management (7%).

7. CONCLUSION

- This report explored the global landscape of patent and/or patent applications pertaining to Smart Parking.
- A set of 1325 patent families (that bifurcates to a total of 2476 individual patents/applications) filed in the field of Smart Parking were analyzed.
- As inferred from the analyzed dataset, there is a rise in patent filing activities in Smart Parking domain. The year 2017 has witnessed maximum number of patent application filings.
- From of analyzed dataset, Robert Bosch (37 patent families) emerges out as the leading patent applicants; followed by Hyundai (30 patent families). Other applicants that have significant numbers of patent/patent application are BMW, Shenzhen Shenglu IoT Communication Technology, Xi An Irain Iot Technology Services, Guangzhou Xiaopeng Motors Technology, and Chengdu Changdao Technology among others.
- From of analyzed dataset, Inventors Xiao Zhiguang and Jiang Shaofeng are the leading innovators in Smart Parking domain. Zhang Xuefei, Lai Jianming, and Chen Shengjun also have significant contributions.
- From of analyzed dataset, China registers itself as the country with most numbers of innovation. Over 1000 patent applications were first filed in China itself, followed by Korea (99 patent applications).
- Patent publications particularly have focus on Sensors (388), Parking Vacancy Prediction (315), Parking Guidance (306), License Plate Recognition (300), Payment (272), Parking Reservation (217), Navigation/ GPS (188), Wi-Fi/ GPRS/ 3G/ 4G/ 5G (187), Parking Space Lock (175), Automated Parking (89), Mobile App (67), RFID (66) , Vehicle Charging (44) , Parking Space Sharing (35), Parking Meter (34) , V2X (28) , and Others (348).

8. DISCLAIMER

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