

Coronavirus Speaker Series:

Sharing Knowledge to Respond with Resilience

**How smart technologies help China combat
COVID-19 and improve city resilience**

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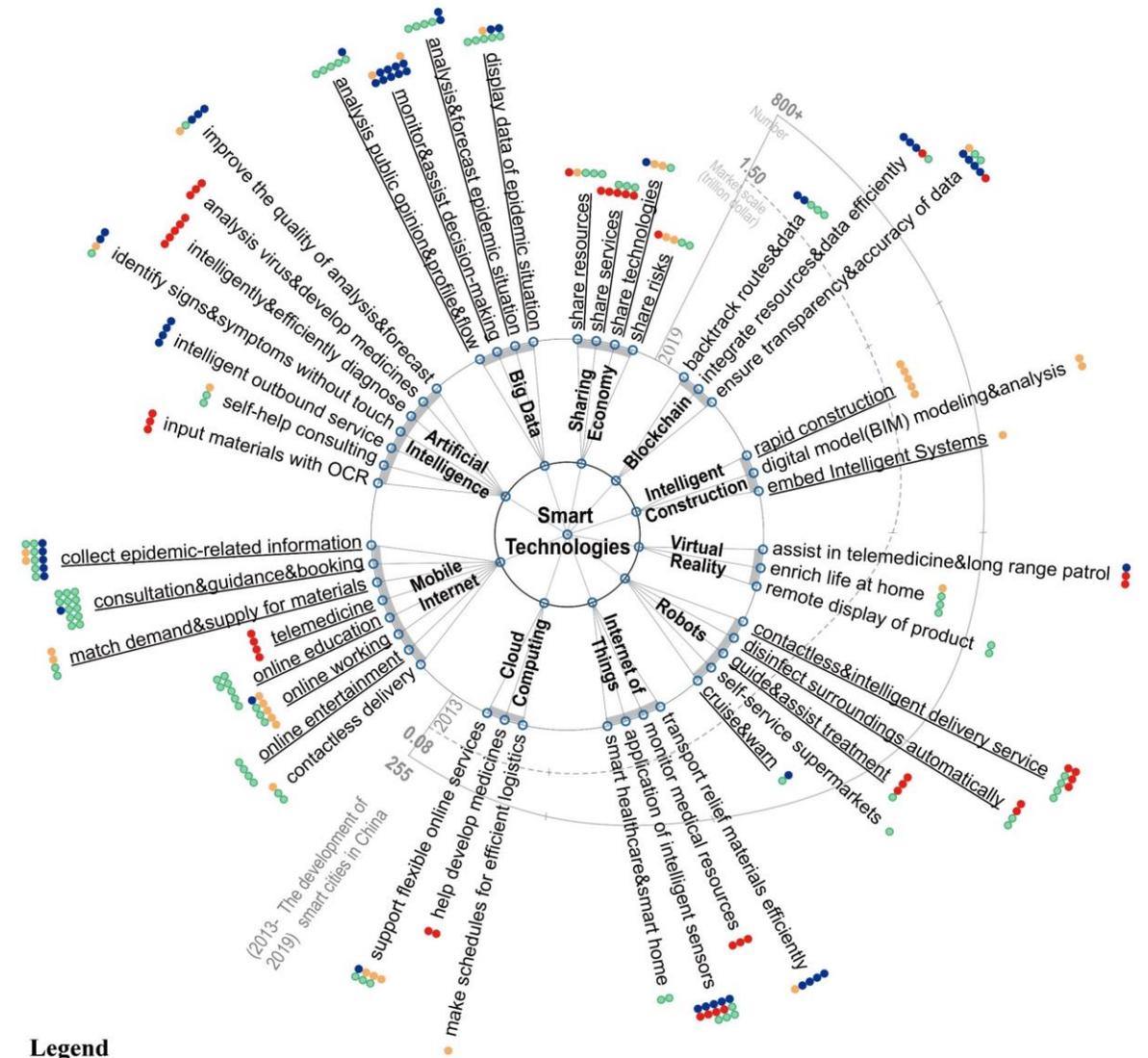
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Background

Since the outbreak of COVID-19 in China in December, 2019, the Chinese government has taken measures such as cities lockdown, home quarantine, work resumption delay, and so on. It is a pity that national productive consumption thus has been greatly affected in a short time. However, it is gratifying that smart technologies play a more positive and powerful role in facing this public health challenge and controlling the epidemic situation by comparing with the 2003 SARS outbreak, thus significantly promoting the resilience of cities.

We focus on a series of smart technologies that emerged in the background of the 4th industrial revolution. Since late January 2020, we have conducted systematic observation through official media reports, published literature, articles in Public Accounts of WeChat, and Weibo (both of them are popular social media platforms in China), resulting in our collecting application cases as combating this epidemic situation. We have collected 224 cases from ten aspects, finding that the smart technologies have been extensively applied by various parties in China for dealing with serious public health challenges as shown in the figure.



Legend

The parties applications work for: (one dot represents one case)

- Government/management
- Medical staffs
- Companies
- Citizens

△ Applications which have emerged during SARS △ Applications which haven't emerged during SARS

--- The market scale of smart cities in China — The number of smart cities in China

Figure. Applications of various smart technologies during COVID-19 in contrast with SARS



1.1 Big Data

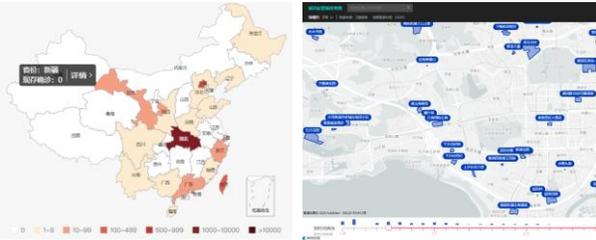
The parties applications work for: (one dot represents one case)

- Government/management
- Medical staffs
- Companies
- Citizens

- Display data of epidemic situation

Epidemic map in neighborhood scale ●

COVID-19 mapping ●



DXY

Quanturban

Source: <https://ncov.dxy.cn/ncovh5/view/pneumonia?>
Source: <https://mapmiao.com/ncov>

The Epidemic Distribution System ●



Chinese CDC: the Epidemic Distribution System was launched to display both national & worldwide epidemic situation dynamically. The Epidemic data are from the National Health Commission and Provincial Health Commission and displayed on an interactive visualization platform.

Source: <http://2019ncov.chinacdc.cn/2019-nCoV/>

- Analysis & forecast epidemic situation

Assessment and forecast map ●



Institute of Artificial intelligence for Management

Source: https://mp.weixin.qq.com/s/XPjC1_TGLyt_feQ3g-wKKA

Assessment and forecast report ●

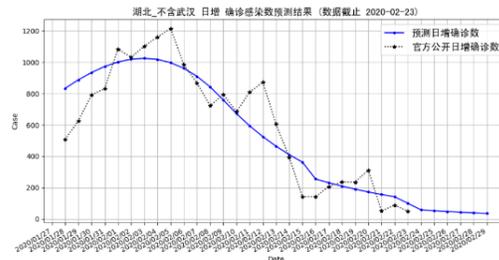


图4 湖北 (不含武汉) 日新增确诊数预测

Institute of Artificial intelligence for Management: the inflexion point, peak value and remission index of the epidemic are analyzed and predicted, and the forecast results are revised and updated daily according to the update of big data of the epidemic.

Source: https://mp.weixin.qq.com/s/U0AQyC6oPKb6b3s4_1kEmA

- Monitor & assist decision-making

Big data model platform ●



China Unicom

Source: <https://mp.weixin.qq.com/s/lKhQfSeBrRciOoakf7PVfA>

Real-time awareness and analysis system ●



Tsinghua University & Gsafety: provides real-time dynamic monitoring, collection, analysis and visualization of regional epidemic data and assists governments with the resource scheduling, situation analysis and decision-making.

Source: https://mp.weixin.qq.com/s/n2oF343uzWI70inF_5C3Rw

- Analysis public opinion & profile & flow

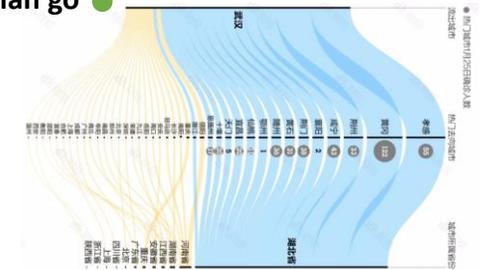
Profile of Wuhan residents via take-out data ●



Dtcaijing

Source: <https://mp.weixin.qq.com/s/yU4bYn7Y8ZATHpI18E6Crg>

Where did the 5,000,000 people who left Wuhan go ●



Dtcaijing: used the Baidu migration data to calculate the population flow to popular cities from Wuhan from Jan. 20 to Jan. 23, which roughly represents where people who left Wuhan during the Spring Festival went.

Source: https://mp.weixin.qq.com/s/gJLDu0w9yZukZr1pm5_yrA



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1.2 Artificial Intelligence

- Improve the quality of analysis & forecast

AI analysis platform for disease control



Wayz: traces back the outbreak source, identify groups in close contact and predict high-risk transmission areas.

Source: https://mp.weixin.qq.com/s/cJ2K08LVp1mdh1Tr_gV1YQ

- Intelligent outbound service

AI outbound platform (智能外呼)

场景1: 流动人口排查

点击播放语音

- Step1 询问是否返乡
- Step2 询问接触情况
- Step3 询问个人症状
- Step4 根据情况提供健康提示/短信通知关键信息

通话记录与数据统计

Baidu: automatically asks and collects the information of the epidemic situation of residents through directional or random dialing.

Source: <https://mp.weixin.qq.com/s/WgHQjUuTU9mGE0sMOQvUg>

- Analysis virus & develop medicines

AI prediction of virus RNA structure



Volume 35, Issue 14
July 2019

LinearFold: linear-time approximate RNA folding by 5'-to-3' dynamic programming and beam search

Liang Huang, He Zhang, Dezhong Deng, Kai Zhao, Kaibo Liu, David A Hendrix, David H Mathews Author Notes

Bioinformatics, Volume 35, Issue 14, July 2019, Pages I295-I304, <https://doi.org/10.1093/bioinformatics/btz375>

Published: 05 July 2019

Baidu Research: with LinearFold algorithm, the virus structure can be predicted in 27s, which improves the working efficiency of gene detection as well as vaccine R&D.

Source: <https://baijiahao.baidu.com/s?id=1657117223212538530&wfr=spider&for=pc>

- Self-help consulting

Intelligent consultation service

智能疫情助理

很高兴为您服务，少麻烦，戴口罩，个人防护很重要！控制疫情传播人人有责。请问您需要什么帮助？

新型冠状病毒肺炎自我筛查
一张图教你“读懂”新型冠状病毒
一张图教你“预防”新型冠状病毒
新型冠状病毒肺炎治疗方法了吗
新型冠状病毒肺炎确诊患者同行查询

很高兴为您服务，少麻烦，戴口罩，个人防护很重要！控制疫情传播人人有责

Dataway & JD: provides online AI automated answers to the public through government information platforms.

Source: <https://mp.weixin.qq.com/s/1lwBaPQwz4dCFahhSy0QpA>

- Intelligently & efficiently diagnose

CT images recognition algorithm



Alibaba DAMO Academy: accelerates the analysis of suspected cases via CT images within 20s, greatly reduces the time for diagnosing suspected patients.

Source: <https://mp.weixin.qq.com/s/UckIPzchKOlwwQc3Qn9YLg>

- Input materials with OCR

Identification of medical documents

Ccint: OCR will help complete accurate and efficient information recognition and extraction remotely, especially for medical documents.

Source: <https://mp.weixin.qq.com/s/xxInmcCN3kpNmKEQRvqohs>

- Identify signs & symptoms without touch

Contactless AI temperature measuring system



Baidu

Source: https://mp.weixin.qq.com/s/A_pQcuHekzBw5HTElMjvsQ

Contactless AI temperature measuring system

明眼·疑似发热人员筛查追踪系统

今日通过人数 3651 疑似发热人数 3

疑似发热人数 37.5

疑似发热人数 38.5

疑似发热人数 39.5

Megvii: assists the staffs in various public places (railway station, bus station, subway station, airport) and other high-density movement scenarios to quickly screen the abnormal body temperature, and improves the efficiency and controllability of traffic in open places after the epidemic is stable.

Source: <https://mp.weixin.qq.com/s/nkZGzj4eeg-pGLQ4VOo60g>



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1.3 Mobile Internet

The parties applications work for: (one dot represents one case)

- Government/management
- Medical staffs
- Companies
- Citizens

- Collect epidemic-related information

"Internet + supervision" platform ●



The State Council: enterprises or the public can upload problems and suggestions through the APP or Public Accounts of WeChat.

Source: https://mp.weixin.qq.com/s/Kzfc6Yax_66WaVKzLUyc-Q

- Consultation & guidance & booking

Online clinic for free ●



Alibaba: hundreds of professional doctors from all over the country are staying in front of their computers, offering free health advice to users in Hubei province.

Source: https://mp.weixin.qq.com/s/SwfW1iUsUS_a_BwA3C2INQ

- Match demand & supply for materials

Material information exchange platform ●



Wuhan University: provides a platform for matching demand efficiently for epidemic prevention and control materials and business docking services.

Source: <https://mp.weixin.qq.com/s/OKkf5GdFCFpS9n9C8zZlw>

- Telemedicine

5G remote consultation platform ●



Wuhan Telecom & Huawei: uses 5G, smart screens, HD intelligent conference terminals and Huawei cloud to realize telemedicine and consultation.

Source: <https://mp.weixin.qq.com/s/fraUaaKvAXluO-Ku6lpvfA>

- Online education

Rain classroom ●



Tsinghua University: supports MOOCs (open online courses), handwritten recording screen, videos, sound recording, PPT, exercises and other service.

Source: <https://mp.weixin.qq.com/s/b4a9SZi7sG75u0DzLz-w9g>

- Online working

DingTalk: an all-in-one mobile workplace ●



Alibaba: supports home-based meetings, 100-person video conference, 10000-person live conference, remote collaboration, online processing and approval, etc.

Source: https://mp.weixin.qq.com/s/8VAq7_26H9muv3aoVgSDqA

- Online entertainment

Mobile online game ●



MobTech: online games such as chess and card apps are sharply increasing, short videos may be the biggest winner.

Source: MobTech, 2019.1.29-2019.2.15, 2020.1.19-2020.2.6

- Contactless delivery

Contactless delivery modes ●



KFC: there is no direct contact between the users and the deliverymen. By putting the food in the designated place to avoid taking the food face to face and reduce the risk of human-to-human transmission.

Source: <https://mp.weixin.qq.com/s/9zKXZhJtRSSnvN>

1.4 Cloud Computing

The parties applications work for: (one dot represents one case)

- Government/management
- Medical staffs
- Companies
- Citizens

Support flexible online services

Flexible expansion of remote collaboration



Enterprise WeChat

Source: https://mp.weixin.qq.com/s/T5E-uL6wp_QH43NY9jwhAQ

Meet the huge demand for video web glow (美颜)

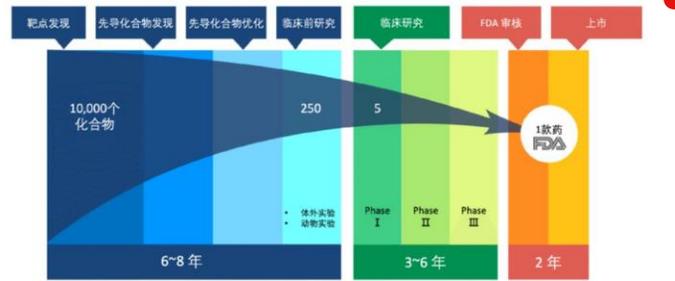


Alibaba: the number of people who can insist on washing hair, face and makeup is small, leading to a surge in demand for video web glow. Supported by its elastic scaling capacity, the cloud computing service meets the demand for peak and emergent situation.

Source: https://mp.weixin.qq.com/s/T5E-uL6wp_QH43NY9jwhAQ

Help develop medicines

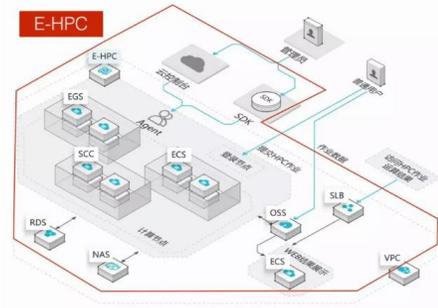
The traditional long development cycle for medicines



Traditional medicines R&D enterprises

Source: <https://mp.weixin.qq.com/s/4G0xkiTpYF3dXR76DWaiNA>

E-HPC high performance computing cluster solution

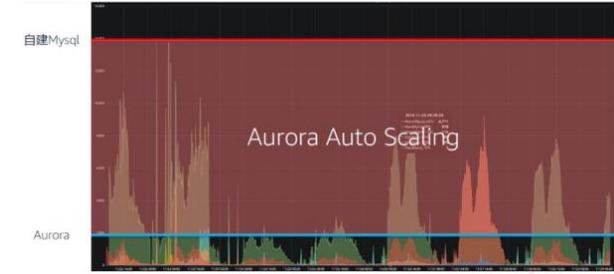


Alibaba: to help combat the epidemic, Alibaba Cloud Computing provides high performance computing free of charge to public research institutions around the world, thus greatly accelerates the speed of medicines R&D.

Source: <https://mp.weixin.qq.com/s/4G0xkiTpYF3dXR76DWaiNA>

Make schedules for efficient logistics

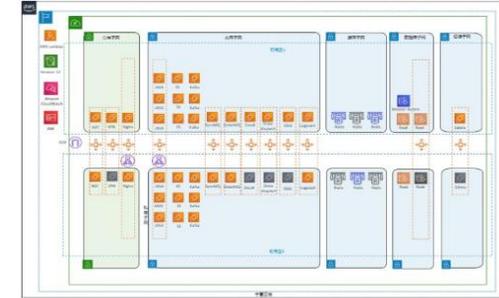
Access flow of database



Awschina

Source: <https://mp.weixin.qq.com/s/5W6sujSOPc9y5llk9I9fdw>

AWS - based system framework



Awschina: through the use of AWS cloud, the costs of enterprises are saved, efficiency, reliability and stability are improved and the efficient medical logistics services are facilitated.

Source: <https://mp.weixin.qq.com/s/5W6sujSOPc9y5llk9I9fdw>

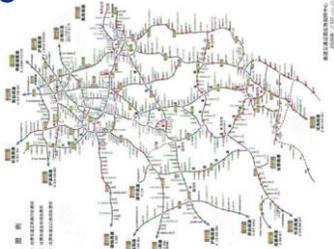
1.5 Internet of Things

The parties applications work for: (one dot represents one case)

- Government/management
- Medical staffs
- Companies
- Citizens

- Transport relief materials efficiently

Traffic control map of highway in Zhejiang province ●



Traffic operations command center

Source: <https://mp.weixin.qq.com/s/048iDKOea794xzjWqWf8pg>

Contact information of transfer stations ●

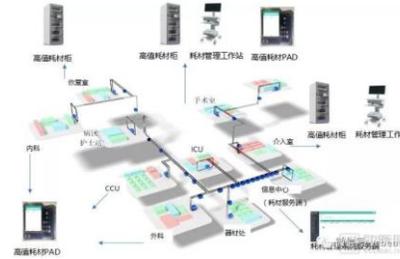
序号	单位	地址	业务联系电话
1	湖北省武汉市东西湖捷利物流园	武汉市东西湖区19支沟	139 7128 1668
2	武汉市黄陂区武湖单元冷链食品物流园	武汉市黄陂区武湖白家湾	139 7114 5189 136 0710 8192
3	武汉市汉南区宝湾物流园	武汉市汉南区通江二路宝湾物流中心	159 7222 9499 176 0715 6252
4	湖北鄂州余湾东方物流有限公司	鄂州市葛店开发区发展大道168号	187 2790 6208 151 7241 6553
5	襄阳市光彩国际物流基地	襄阳市襄州区奔流大道高速公路入口向南100米	137 9774 3808 181 0710 5593

Sinoiov: uses big data of vehicles to provide recommended routes for drivers to go to the transfer stations, so as to guarantee the green channel of epidemic materials and improve the transportation efficiency of epidemic materials.

Source: <https://mp.weixin.qq.com/s/fraUaaKvAXluOKu6lpvfA>

- Monitor medical resources

Intelligent consumable management ●



Rivamed

Source: <https://mp.weixin.qq.com/s/VTek8m6dtkugM8fe5CGsVg>

Intelligent cloud management system for medical waste ●



Ewell: relying on wireless network, mobile computing, bar code identification and other advanced technologies, each medical garbage bag, bin and recycling vehicle is monitored in real time so as to realize the whole process supervision of medical waste.

Source: https://mp.weixin.qq.com/s/OMRiPvB9_8laGyzFqQ2bXA

- Application of intelligent sensors

Intelligent mobile cabin hospitals ●



RFID technology

Source: https://mp.weixin.qq.com/s/8AGqTyVSscFjqCj761O_yw

Community smart sensor ●



4G摄像头人形检测

4G摄像头口罩检测

Alibaba: automatically identifies people without masks, real-time advise to avoid cross-infection; Quarantine community residents in and out with alarm to control the spread of the epidemic.

Source: https://mp.weixin.qq.com/s/c99MZhhJAIZPvMB5Z4K-7A_PsZRn-RacalHQ

- Smart healthcare & smart home

Smart medical products for home use ●



Zheshang Securities Research Institute

Source: https://mp.weixin.qq.com/s/Py0ss_m8aLpSZRn-RacpHQ

The content of smart healthcare ●



Zheshang Securities Research Institute: after the COVID-19, consumers' health awareness is obviously improved, and home-level smart healthcare facilities, mainly supported by internet of things, will be gradually popularized.

Source: https://mp.weixin.qq.com/s/Py0ss_m8aLpSZRn-RacalHQ



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1.6 Robots

The parties applications work for: (one dot represents one case)

- Government/management
- Medical staffs
- Companies
- Citizens

Contactless & intelligent delivery service

Food delivery robots ●



Hangzhou: robots deliver food to the quarantined groups.

Source: <https://mp.weixin.qq.com/s/-Kgt1mjlPsXMB1OC4WICQ>

Medicine delivery robots ●



One can carry out the work of three delivery persons.

Saiterobot: the robots can open and close doors and take lifts, and one robot can do the work of three deliverymen. Health care workers in charge of the medicine do not have to come into contact with patients directly, which reduces the possibility of becoming infected.

Disinfect surroundings automatically

Disinfect with unmanned aerial vehicles ●



Shandong, Chongqing, etc.

Source: <https://mp.weixin.qq.com/s/Ldx4TqbAc6dFbT8yUfxx-g>

Disinfection robots ●



TMiRob: the disinfection robots focus on high-level disinfection along the route for high-frequency active areas of patients, medical care and waste, and focus on multi-point terminal disinfection for areas where patients and medical staff are located.

Guide & assist treatment

Intelligent assistance robots ●



China Mobile & Cloudminds

Source: <https://mp.weixin.qq.com/s/Ldx4TqbAc6dFbT8yUfxx-g>

Intelligent guidance robots ●



OrionStar: it can realize unmanned guidance, automatically respond to fever inquiries, guide patients and provide preliminary diagnosis and treatments, and assist doctors to complete telemedicine.

Source: <https://www.cnbeta.com/articles/tech/936953.htm>

Self-service supermarkets

Unmanned supermarkets ●



Alibaba: no shop assistants, no cashiers, consumers can just scan the code and walk away.

Source: <https://mp.weixin.qq.com/s/SdonNuiHuSJ18ZeSZIDhA>

Cruise & warn

Cruise & warn with UAVs ●



Local police: use drones to cruise & warn in the air to avoid cross infection.

Source: <https://mp.weixin.qq.com/s/Xtduq8VnvaJ0s8>



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1.7 Virtual Reality

- Assist in telemedicine & long range patrol

5G + VR remote observation & guidance system ●



China Mobile

Source: <http://zj.people.com.cn/BIG5/n2/2020/0131/c186327-33753582.html>

5G + VR remote observation & guidance system ●



China Mobile: experts and doctors can provide all-around remote diagnosis and treatment guidance through this system. At the same time, family members can also use the system to visit patients in the isolation area in real time.

Source: <https://www.caigou.com.cn/news/202002048.shtml>

- Enrich life at home

VR fitness ●



BOX VR

Source: <https://mp.weixin.qq.com/s/Ov49ayHNQKWMPcOyTiGHA>

The panoramic palace museum ●



Vizen: at the initial stage of epidemic prevention, all major scenic spots were closed, the public also avoided going out according to the requirements. VR tourism has become a new trend, with major museums becoming popular choices.

Source: https://mp.weixin.qq.com/s/U249qM4Ei7eFSehy_dPLLg

The parties applications work for: (one dot represents one case)

- Government/management
- Medical staffs
- Companies
- Citizens

- Remote display of products

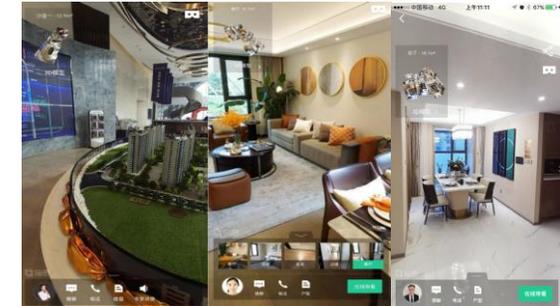
VR sales and displays vehicles ●



Toyota

Source: <https://mp.weixin.qq.com/s/89XNrbQOoKWD69SjDI9iqQ>

VR sales and displays houses ●



Anjuke: affected by the epidemic, most of the sales offices were closed. Through the use of VR, the difficulties faced by the sales for new housing projects have been solved perfectly.

Source: <https://mp.weixin.qq.com/s/OoaGY6vnf3BW3qfUw6rLGQ>



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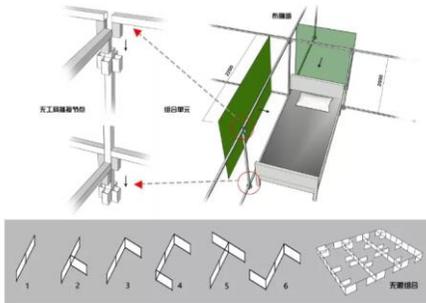
1.8 Intelligent Construction

The parties applications work for: (one dot represents one case)

- Government/management
- Medical staffs
- Companies
- Citizens

Rapid construction

Quick-install partition system



Shenyang Jianzhu University

Source: <https://mp.weixin.qq.com/s/Bag21gsGxtmg3xcSMK4R2w>

Prefabricated construction

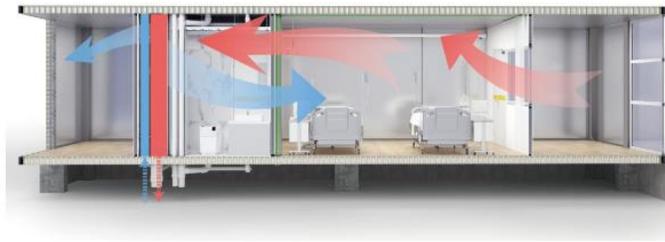


Fire-God Mountain, hospital: it is characterized by modular standard design, factory assembly line production, packaging and folding for transportation, and on-site modular assembly, which ensures the demand for short-term rapid construction.

Source: https://mp.weixin.qq.com/s/MelZ5gTZK-EnvmNZ_0Su0A

Digital model(BIM) modeling & analysis

BIM for negative pressure isolation ward hospitals



BROAD Group

Source: <https://mp.weixin.qq.com/s/9M9xBp-Y1Ao2ojsv2Tq6KA>

BIM for Fire-God Mountain, hospital



Hunan Communication Polytechnic: uses the information in BIM to simulate and visualize the buildings at all stages of design, construction, operation and maintenance, etc. It can also reduce the errors and omissions of the construction project throughout the cycle and improve accuracy.

Source: <https://mp.weixin.qq.com/s/OINehAO8FZZ5ytAG87BT5A>

Embed Intelligent Systems

Intelligent street lamps equipped with air detection system



Zhonglan

Source: https://mp.weixin.qq.com/s/H9jtdJTdVx_JrfVEFj5rQw

Urban forest system (UFS)



Zhonglan: widely used in buildings, urban infrastructures, etc. Embedded with independent monitoring, purification and fire protection, network management and other functions.

Source: https://mp.weixin.qq.com/s/H9jtdJTdVx_JrfVEFj5rQw



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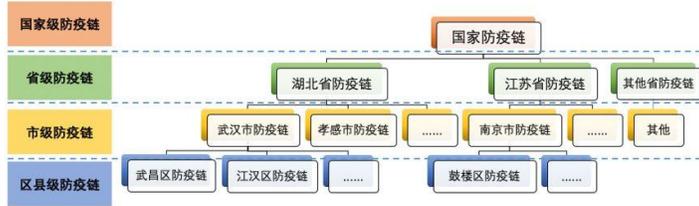
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1.9 Blockchain

The parties applications work for: (one dot represents one case)
 ● Government/management ● Medical staffs ● Companies ● Citizens

Backtrack routes & data

Framework of four-level epidemic prevention chain



Enterprise WeChat

Source: <https://mp.weixin.qq.com/s/UbZzbqITQ70HH4aFHUv-OA>

Backtrack data of MaaS



When planning trips using MaaS, it is easy to track the starting and ending points of travelers, travel paths, vehicles and time. It is also effective in finding people who have contact with the virus. At the same time, it can protect the safety of pedestrians themselves.

Source: <https://mp.weixin.qq.com/s/048iDKOea794xzJWqWf8pg>

Integrate resources & data efficiently

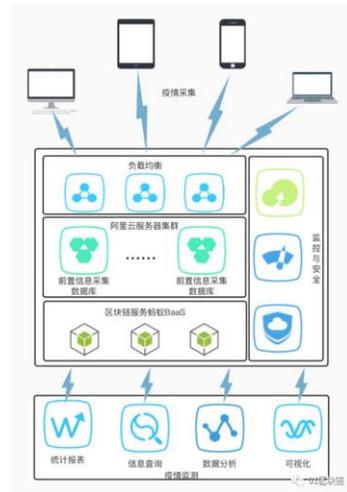
Permit with block chain



Vastchain

Source: https://mp.weixin.qq.com/s/JAggf_4_ijjSavQDm_ebbg

Epidemic collection and monitoring system with block chain



Shandong University of Finance and Economics: collects health status data, out-going situation and epidemic information of the students and staffs of the school, which is helpful for providing accurate data and technical support for the decision-making.

Source: https://mp.weixin.qq.com/s/JAggf_4_ijjSavQDm_ebbg

Ensure transparency & accuracy of data

Anti-epidemic materials information service platforms



Alibaba, China Xiongan Group & Hyperchain: the information service platforms of epidemic prevention materials use block chain to realize full traceability, guarantee the transparency of the whole process, which can be accurate and unchangeable.

Source: https://mp.weixin.qq.com/s/JAggf_4_ijjSavQDm_ebbg

1.10 Sharing Economy

The parties applications work for: (one dot represents one case)

- Government/management
- Medical staffs
- Companies
- Citizens

Share resources

Share services

Share technologies

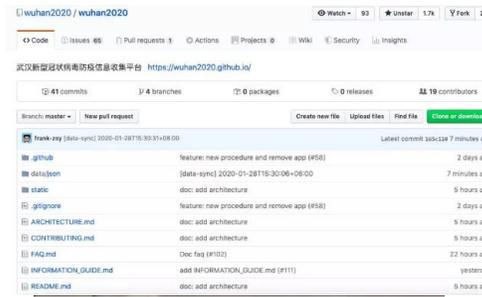
Share risks

Donate the copyright of entertainment works

Provide delivery services for medical staff

Open source project: Wuhan2020

Temporary policy of no refund fee



Byte Dance

Wuhan, Ele (饿了么)

GitHub

Booking

Source: <https://mp.weixin.qq.com/s/Hi5l4hcpDspFAPq1WvJBg>

Source: <https://mp.weixin.qq.com/s/jgOZuRTLhvjmhqqlb3dQQ>

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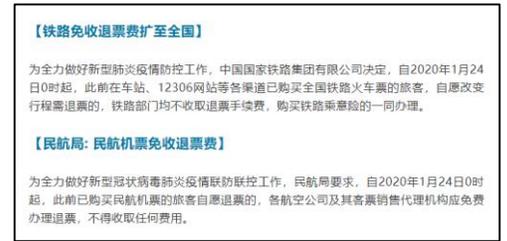
Source: https://mp.weixin.qq.com/s/iTpbBE94rX5QppExBUI_OA

Share online academic resources

"Tailored cars for medical staffs" service

Total factor scenarios assistance program

Temporary policy of no refund fee



Tsinghua University: more than 1,600 MOOCs will be open to the public for free. At the same time, it plans to open the "clone class", which supports other teachers and students to attend classes, do exercises and interact with Tsinghua students synchronously through the rain class.

Amap: since the outbreak of the epidemic, buses, subways and other public transport systems in Wuhan have been suspended. All medical workers in Wuhan can call "Tailored cars" for free through Amap.

51WORLD: provides free digital template for the CDCs, emergency offices and governments in various regions to quickly establish a visual system for monitoring epidemic data, control the flow of people in epidemic areas, and improve the speed of comprehensive emergency response.

China Railway & CAAC : in order to complete the prevention and control of the epidemic, starting from January 24, 2020, train tickets and air tickets purchased previously will not be charged for refund fee.

Source: <https://mp.weixin.qq.com/s/PNRsrbH5c-0aRqv8CW-jQ>

Source: <https://mp.weixin.qq.com/s/whbfrG6yZUQxf9RkWc8mYQ>

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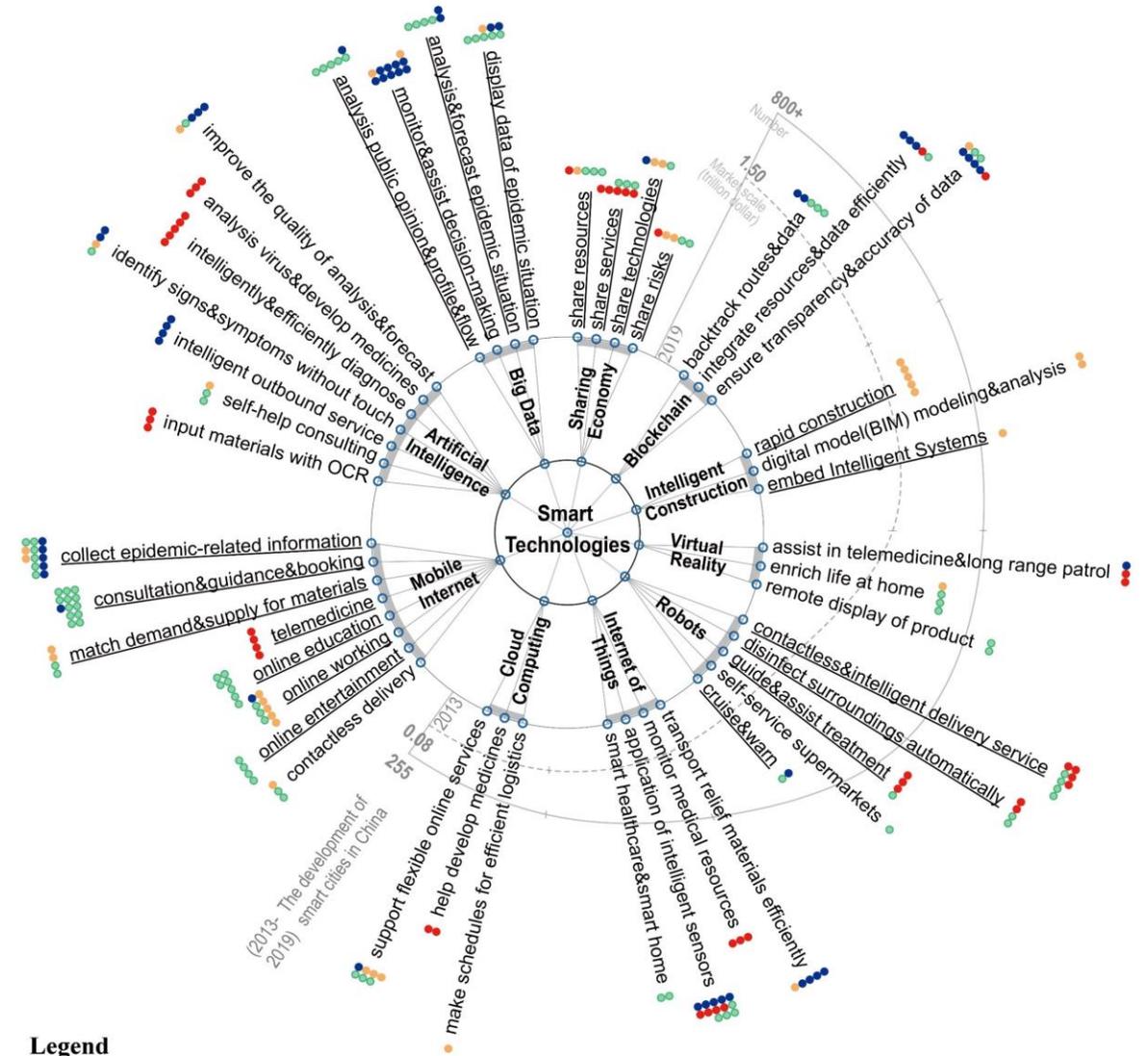
Source: <https://mp.weixin.qq.com/s/Sz8sz2kuOXWXmqIIIpf43w>



2 Conclusion

The applications of these technologies play a crucial role in high-efficient governance of governmental managers, feedback and participation of citizens, diagnoses as well as R&D of medical staffs, and remote operation & maintenance of companies during COVID-19, and have advanced more in both depth and breadth compared with those during SARS.

It's worth noting that although smart city programs supported by various Chinese ministries have been promoted rapidly during the past years as shown in the figure, there have been extensive critiques on them due to few effective applications of them during COVID-19. However, the smart technologies we are summarizing can only be partially attributed to the efforts of government. Most of them are from internet companies and innovative industries as well. We believe these technologies strongly support the disposal of this public health event and promote city resilience, and will show more prospects in the future.



Legend

The parties applications work for: (one dot represents one case)

- Government/management
- Medical staffs
- Companies
- Citizens
- △ Applications which have emerged during SARS
- △ Applications which haven't emerged during SARS
- The market scale of smart cities in China
- The number of smart cities in China

Figure. Applications of various smart technologies during COVID-19 in contrast with SARS

Thank you

