Designing Autonomous Public Transporation Route in Seoul

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Abstract

To reduce passenger car traffic, realize traffic welfare, and respond to climate change, the Seoul Metropolitan Government is establishing a plan to gradually expand autonomous public transportation routes by accepting autonomous driving services as an urban transportation system. In this study, the optimal route for autonomous public transportation based on traffic big data was derived to effectively perform it in consideration of the characteristics of autonomous driving. As major indicators for optimal route design, traffic pattern analysis based on foot traffic and smart card data was conducted, and the possibility of designing optimal routes with safety such as school zones and exclusive bicycle paths was considered.

Keywords

Autonomous Bus,
Optimal Route,
Foot Traffic,
Users,
School Zone,
Bicycle Exclusive Path

Storymaps

1 Introduction

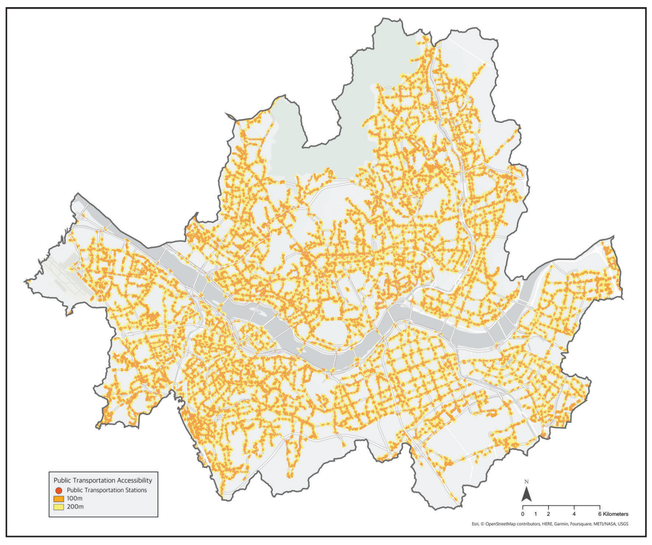
Korea has begun building smart cities and digital twins. South Korea's capital city Seoul is cruising its way to becoming smarter. One way it's doing that is through the use of autonomous, or self-driving vehicles. As a densely populated and bustling city, Seoul faces challenges related to traffic congestion and air pollution. The autonomous vehicle can help alleviate congestion by optimizing routes, reducing the number of private vehicles on the road, and improving traffic flow with connected infrastructure.

The Seoul Metropolitan Government presented the future image of autonomous driving that can be used in citizens' lives through the 'Seoul Autonomous Vehicle Vision 2030'. One of Seoul's audacious goals is to become an autonomous-driving city. Seoul Autonomous Vehicle Vision 2030 is a key plan of the Seoul Metropolitan Government to build infrastructure such as real-time precision mapping systems and autonomous vehicle lanes to realize autonomous public transportation throughout Seoul by 2026.

The autonomous public transportation project is currently operating in three locations: Sangam, Cheonggyecheon, and Gyeongbok Palace with Cheongwadae. In addition, starting with the pilot operation of self-driving late-night buses this year, it plans to promote bus services linked to non-center-city to settle public transportation for autonomous vehicles. With autonomous buses, people are moving closer to establishing an autonomous public transport network.

2 Public Transportation Accessbility

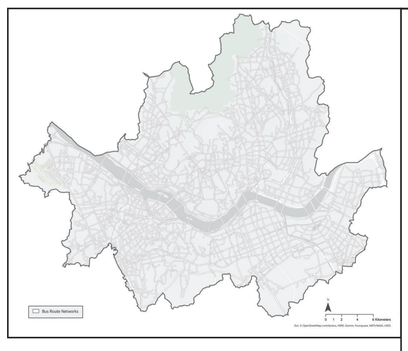
In designing autonomous bus routes, traffic-vulnerable areas were first analyzed to consider publicity. A network analysis was conducted on the accessibility of public transportation in Seoul to identify traffic-vulnerable areas. Walking networks within 100m and 200m were analyzed to determine the extent to which people can reach public transportation stops on foot. As a result of the analysis, public transportation accessibility covers the entire city except for inaccessible areas such as mountains and military units. In other words, pedestrians can reach anywhere in Seoul using public transportation, so autonomous routes should have been able to replace the existing public transportation network while maintaining excellent public transportation accessibility.

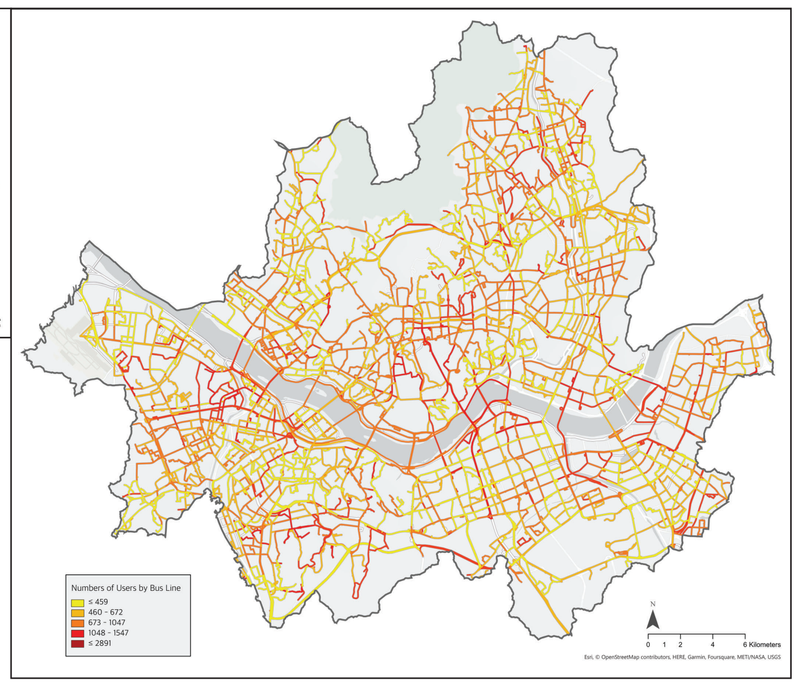


3 Analysis of Optimal Routes by Activity

(1) Network Analysis of Numbers of Users by Bus Routes

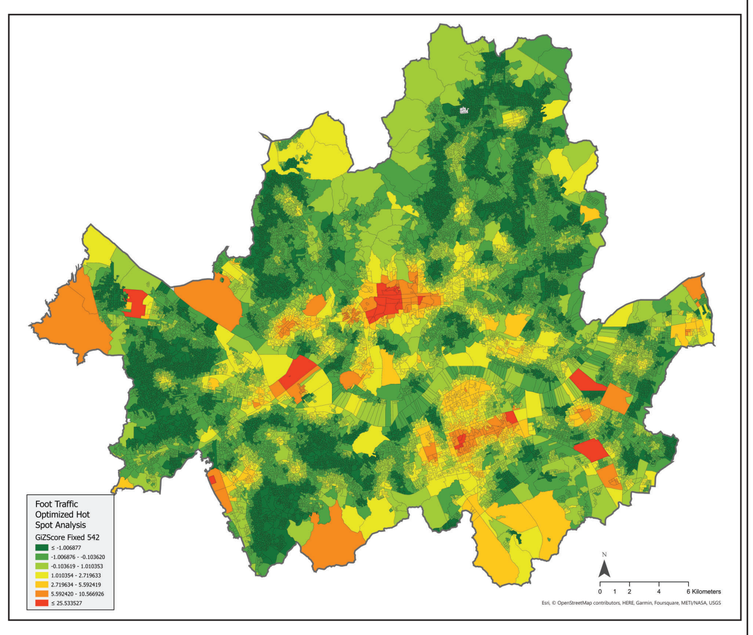
Using network analysis with each bus stop data, 732 bus routes were created, and the number of users between bus stops was collected based on smart card data from 6 a.m. to 10 p.m. in February. The top 104 routes with a large number of users were extracted by analyzing the number of users by bus route.





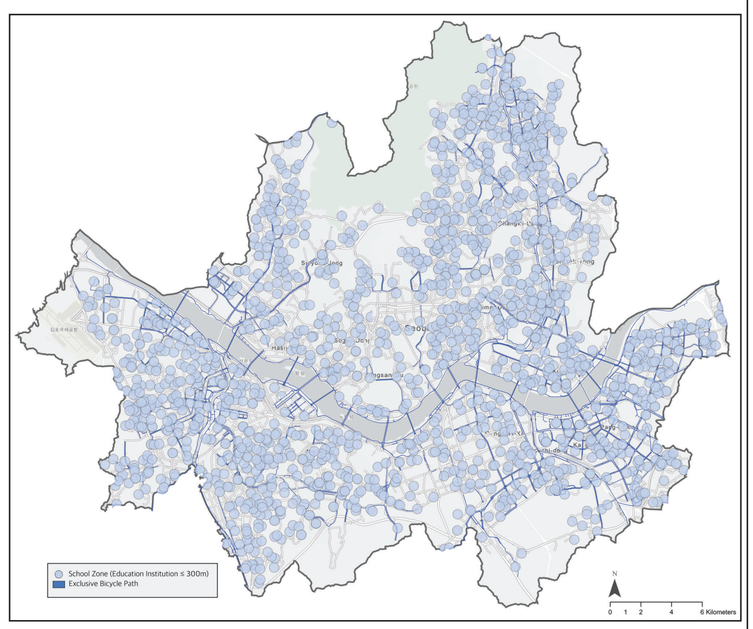
(2) Optimized Hot Spot Analysis of Foot Traffic

Foot traffic can lead to a valid user of public transportation. In order to understand the floating population, 19,153 output areas' communication big data-based foot traffic was extracted from 6 a.m. to 10 p.m. in February. Furthermore, optimized hot spot anaysis quantified patterns in aggregate pedestrian foot traffic using the Getis-Ord Gi* statistic, and 192 areas have hot spot patterns were extracted. According to the Gi* value, five cluster areas were found. Lastly, highest foot traffic aggregation zone and bus routes were cross-selected.



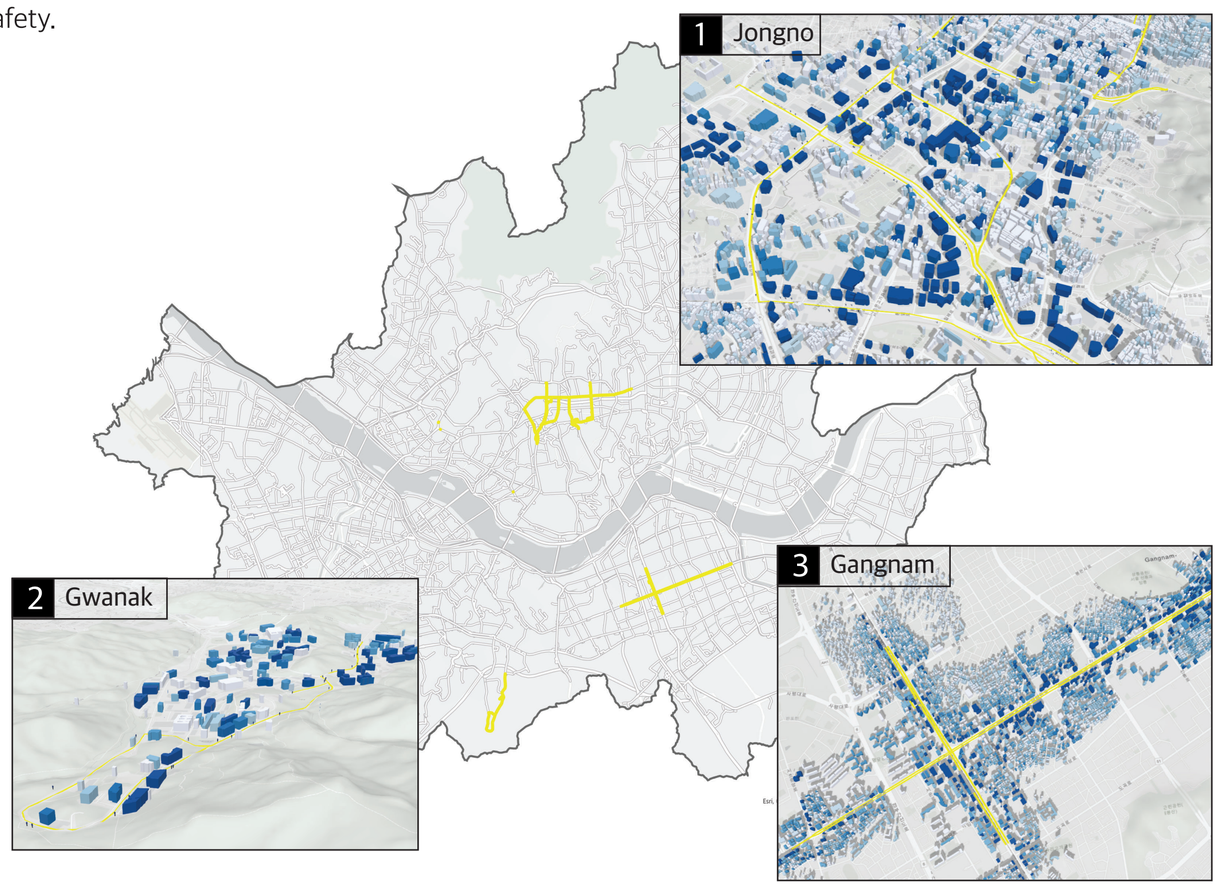
4 Analysis of Optimal Routes for Safety

Ensuring the safety and reliability of Autonomous buses will be essential to make them a viable and attractive alternative to traditional public transportation. The Seoul Metropolitan Government is using an Lv4 autonomous car that runs without driver intervention, but a preliminary driver is on board in case of an emergency. Therefore, the occurrence of a dangerous event during driving is proportional to the occurrence rate of the user's change of control. Bus routes were designed except for related sections because control changes frequently occur in child protection zones and bicycle-only roads. 300m from the entrance of kindergartens, elementary schools, and academies is a child protection zone. Also, It is a bicycle road installed separately from the roadway so that only bicycles and personal mobility devices can pass.



5 Result

Three optimal autonomous bus routes were designed. First, Jongno has Gyeongbokgung Palace, Gwanghwamun Square, and the original downtown of Seoul, where newspapers are the center of economy, culture, and administration. Second, largest university campus in Korea is located in Gwanak. Third, Gangnam has a large floating population, and Seoul's largest business district and education district are located. Each is a bus route with a large number of users in areas with highest foot traffic. In addition, it is a route of more than 4km, excluding school zones and bicycle-only roads, so that fewer user conversion events occur for safety.



6 Conclusion

Autonomous transportation that enhance safety, reduce energy use and greenhouse gas emissions, and have economic effects will revolutionize the public transport paradigm. This study designed three optimal routes considering only activity and safety, but it is hoped that research on autonomous bus routes considering various variables such as steering angle and junction will be fully developed so that these buses can operate safely, efficiently and stably in various traffic conditions and environments.