Smart lock system for Airbnb Platform using global navigation satellite system services

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Abstract. Over the last two decades, the world changes have occurred faster and faster. The services provided by GNSS represent major business drivers. Innovative and effective GNSS applications such as location-based smart-phone and hand-held device apps, navigation services and fleet management represent value-added services. The smart lock system is based on the Airbnb [1] platform for lease or rent short-term lodging and solves both a technical/operational limitation and trustfulness issue [2]. The solution is to link the housing, the reservation number and the mobile phone of the customer so that, with the help of localization services, the smart lock of the apartment could be opened only by the person wearing the mobile device, when that person reaches the destination, and only in the specified period of time when the reservation is made. The proposed solution adds value to the already implemented idea, and the targeted market is almost worldwide and can be extended also for car rentals and other rent services.

1. Introduction
The modern world as we know it today represents the result of all major changes that happened in what we simply name “industry” over the past 300 years. Until now, 3 industrial revolutions completely changed the planet and the way of life for the humankind. The first industrial revolution started in the 18th century when mechanical machines powered by steam and water became part of the mass production. The second one began after 1870, lasting for a century, in this period electricity, electrical grid lines and the division of labor helping the huge increase of productivity. Finally, the third revolution initiated in the early ‘70s of the 20th century with the appearance of electronic components and computers that added extra value to manufacturing facilities, by automation. Satellites were launched and helped the rapid development of telecommunications and the man stepped for the first time on the moon. The Internet and the World Wide Web connected the planet, sharing resources and knowledge.

However, over the last two decades since the humankind stepped into the 21st century, the world changes have occurred even faster and faster everyday. The Internet digitized access, connecting people to email and web services, then digitized the networked economy enabling e-commerce, e-business and so on, then digitizing interactions by widely spreading video and social media content over mobile connections and finally digitizing a world where intelligent machines are communicating with each other without human monitoring and intervention, the “Internet of Things - IoT” era.
New ideas, new concepts and new paradigm apparently coming out of the blue appeared with the
development of technology, bringing comfort and safety in people’s lives, increasing global wealth
and adding value to the economy. It is only the beginning of the 4th industrial revolution [3].

2. Global navigation satellite system services

According to the European GNSS Supervisory Authority - GSA [4], the Global Navigation Satellite
System - GNSS is referring to a constellation of satellites with global coverage which are transmitting
signals about position and real-time data from the outer space to GNSS servers on the ground, in order
for the receivers of this data to precisely determine location and whereabouts.

Among the key players in this field may be counted the NAVSTAR Global Positioning System -
GPS developed by the United States of America, GLONASS - developed by Russia, BeiDou
Navigation Satellite System developed by China and GALILEO, developed by the European
Community and the European Space Agency - ESA.

The performance of a GNSS system is analyzed in terms of accuracy, integrity, continuity and
availability. Accuracy refers to the precision of estimated/measured receiver position, velocity and
time compared to the real-case, integrity is defined by the ability of the system to provide a reliable
threshold that detects positioning data anomalies and triggers alarms, the continuity represents the
capability of the system to work continuously for a given period of time and finally, the availability
refers to the amount of time in percentages that signals provided by the satellite system fulfil the above
mentioned criteria. The performance of the satellite systems may be enhanced by regional Satellite
Based Augmentation Systems - SBAS which target correction of signal measurement errors and
integrity check of the signal.

The services provided by GNSS represent major new businesses drivers, more and more innovative
and effective GNSS applications such as location-based smart-phone and hand-held device apps,
navigation services and fleet management as value-added services and new user technologies being
currently developed.

Smart-phone based innovations like Uber, Seamless, Venmo, Foursquare or Google Maps, as well
as shipment tracking and subscriptions to weather reports have become a part of our life that was not
even imagined three decades ago.

The newly appeared global GNSS market comprises both terminals/devices and augmentation
services, these added-value services being expected to diversify and rapidly grow in number in the
upcoming context of Internet of Things, 5G Communications, self-driven vehicles and Smart Cities
[4]. Possible integration with Next Generation Network (NGN) architectures in order to meet their
QoS requirements and specific optimization schemes to improve QoS is also a potential subject of
interest [5].

3. AirBnB - a global online hospitality service

Initially called Air Bed and Breakfast due to the fact that the founders of the company installed an air
mattress in their living room to turn their apartment into a bed and breakfast space [6], AirBnB
represents today a 25 Billion USD business, acting like a lodging broker and connecting millions of
people via its websites and mobile applications for a fee.[1]

The brokerage platform provided by AirBnB helps quests and hosts connect via a search form that
uses filters for lodging type, hosting dates, location of the housing and price per night/week.

In order to book an apartment, guest users previously must have an account on the platform where
personal information, bank account and payment data is required, sometimes detailed verification on
mobile phone, ID photo from passport or driver’s licence and Facebook/LinkedIn being necessary for
security purposes.

On the other side, hosts are required to provide details on the rental facilities, the price being
established by estate holders in accordance to AirBnB recommendations for the
area/city/neighborhood.
4. Description of the identified technical limitation and a potential solution using GNSS

The Airbnb platform for lease or rent short-term lodging has to solve both a technical/operational limitation and trustfulness issue. As it is currently known, a client using Airbnb finds an accommodation place worldwide, books it and pays an amount of money. After that, it receives a reservation acknowledgment and access codes or check-in information for the booked housing. Sometimes cancellation appears and the property is re-booked, or the access codes may fall in somebody else hand and thus, misunderstandings may appear. Also, in cases of empersonment, other people with potentially bad intentions and a potential threat to the security of a society may become a vulnerability/limitation of the Airbnb services.

My solution is to link the housing, the reservation number and the mobile phone of the customer so that, with the help of localization services, the smart lock of the apartment could be opened only by the person wearing the mobile device, when that person reaches the destination, and only in the specified period of time when the reservation is made. The solution can be extended also for car rentals and other rent services.

The key features are a mobile phone with a SIM card inside, the SIM is linked to the phone unique IMEI. The association between the phone IMEI and the reservation number, plus period can be made by a computer software application. Then, the tracking of the customer based on location services through GNSS can be made and a validation and green light for the access in the housing / car etc will be made exactly when the customer reaches the address of the rented facility.

The suggested solution improves existing solutions adding confidence for both the customer and the property owner, bringing a more secure way for businesses around the world and providing and enhancement for the world security. It also adds simplicity because the customer doesn't have to carry with him vouchers, access codes and so on. Nevertheless, the identity of the person could be established on a more secure basis then in current situations.

In the new trending of upcoming Internet of Things, smart-locks with embedded software to remotely manage the connections/rental codes/calendar represents a handy solution. Starting with 2004, the start for a significant change in order to expand the “Things” from simple data generated by devices to physical objects, based on a multi-level reference architecture and a model consistent of the physical world, the virtual world and the mental world. As explained by the model of Zhuge [7], at the bottom level lies nature and devices, at the mid-level one can find the Internet, the sensor and the mobile network and, finally, at top-level, there are the intelligent human-machine communities, able to support users in a wide geographical region in order to cooperate and accomplish various tasks, or solve problems with the help of the network. As a final objective, the worldwide community works together to promote in an active manner the flow of information and services on the planet. Smart-locks represent just a simple example in this global equation.

From the economic point of view, the proposed solution adds value to the already implemented idea, and the targeted market is almost worldwide (except for countries where Airbnb is not supported). Among the new potential clients could be real estate companies, travelers, car rental companies, financial services (banks, payment services), smart lock manufacturers, software designers and GNSS suppliers. Market value is estimated to be over 10.000.000 USD and any enterprise with this idea could become a competitor. The investment needed is relatively small and includes costs for software realization to link the housing/reservation/mobile device/client, access to GNSS, construction of the smart lock prototype and the necessary testing and promoting of the solution.

5. Conclusions

The solution I propose relies on GNSS to provide a more secure and more reliable association between the customer and the housing he/she reserves through the Airbnb application. The customer's mobile device is linked to the reservation and the rented housing facility address so that the customer can be tracked and location services are used to certify that the costumer has arrived at the location and thus to unlock the smart lock of the apartment. More reliable identification of the paying costumer is provided and also a safer way to unlock the rental facility only to the designated person. Further
extension for the solution can be made also for car rentals and other rent services. Automation and machine-learning based algorithms may also add extra-value in the context of upcoming Internet of Things.

6. References
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