Smart charging of mobile electric vehicles

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Abstract. The paper proposes to create a digital economy for the development of electric charging networks of mass-use road transport in a business environment, in fact, these are mechanisms of public-private partnership. To go along the path of purchasing electric charging stations of Korean, Japanese, and German manufacturers and placing them for their own money on communications of Federal or territorial highways or in organizations and enterprises of various forms of ownership is a poorly managed and not rational process. It is proposed to move away from the schemes of location of specific electric charging stations and switch to the schemes of non-powered sockets or plugs. The technical solution refers to the technical means of electric charging (recharging) of mobile electric vehicles. The goal is to reduce the cost of creating a network electric charging infrastructure for electric vehicles. The technical result is the ability to ensure the charging mode of the electric vehicle directly from the existing distributed power supply system in space, by using the phase state modes of the electric connector cable that is powered or not powered by electric current. Based on the materials of the paper, patents of Russia and Kazakhstan were obtained.

1. Introduction. Relevance

It is proposed to create a digital economy for the development of electric charging networks of mass-use road transport in a business environment, in fact, these are mechanisms of public-private partnership. If there is a general desire of government and business to develop the industry, the market, to develop the volumes that arise if the consumer’s desire to spend money on these solutions, in some point, and government and business must agree on the reclamation of financial resources development of electric charging infrastructure.

It is proposed to move away from the schemes of location of specific electric charging stations and switch to localized schemes of non-powered sockets or plugs.

2. Review of the literature on the research topic

A patent study was conducted to investigate the technical level and prospects for the development of charging infrastructure for electric vehicles in the Russian Federation [1-30]. The technical level refers to the achievement of certain technical and economic indicators due to the implementation of promising scientific and technical solutions in the equipment objects.
A charging station is an infrastructure element that provides electricity for charging battery of electric vehicles, and is an electrical device that is equipped with the necessary sockets and connectors for connecting electric vehicles and allows charging electric vehicles in various modes [1].

The purpose of this research is to identify effective ways to develop charging infrastructure for electric vehicles in the Russian Federation based on the development of a monitoring and management software package.

The patent research on this topic was conducted in order to study the technical level and prospects for the development of charging infrastructure for electric vehicles in the territory of the Russian Federation. The research was carried out based on the set tasks and includes the search for available scientific and technical information, including normative and technical documentation, scientific papers, current patents for inventions and utility models, and information about advanced production technologies. The depth of information search was limited only by the ability to access an open publication.

Patent research was conducted on full electronic Databases of the USSR countries, including information up to 1993, and the Russian Federation, including information from 1993. (the FIPS’ website www.fips.ru).

Via the website of the European patent organization (http://ep.espacenet.com) patent documents of the European patent organization (EPO), the World intellectual property organization (WIPO), Japan, Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Liechtenstein, Luxembourg, Monaco, Netherlands, Portugal, Spain, Sweden, Switzerland, England and other countries were searched. Based on site search results http://ep.espacenet.com patent information was searched in the corresponding national patent databases that have open access.

The reliability of the results is guaranteed for the patent documentation funds available in the electronic Databases of the listed countries.

The search for scientific and technical documentation was conducted using the Internet. The array of scientific and technical information includes State standards (GOSTs), technical specifications, reference books, catalogs, books, papers, reviews, advertising materials.

Patent research was carried out in relation to: systems for monitoring and managing charging infrastructure for electric transport; software for the monitoring and management complex; information exchange systems; systems for registering, authenticating and authorizing users and applications; solutions for integrating the complex with related systems; software for billing systems for electronic payment; systems for interacting with users (Internet portal); mobile applications.

3. Results of search queries for patent information

Database of the Russian Federation since 1993
Request “charging electric vehicles” - 129 documents were found

Database of the European patent organization (espacenet.com).
Query “charging electric vehicles” and B60L1 - 7 documents were found
Query “charging electric vehicles” and B60L11 - 182 documents were found
Query “charging electric vehicles” and G06Q10 - 11 documents were found
Query “charging electric vehicles” and G06Q20 - 5 documents were found
Query “charging electric vehicles” and G06Q30 - 12 documents were found
Query “charging electric vehicles” and G06Q50 - 41 documents were found

In well-known technical solutions, systems for monitoring and managing charging infrastructure for electric vehicles are designed: based on the use of a navigation device (patent KR No 20140015740); based on the use of an Internet connection (patents US No 2014074523, WO No 2008135043); based on the use of a mobile device, cloud server, server devices, cellular network (patents US No 2014191722, 2014074523, 2016362016, 2013020992, 2016364658, 2016364776; KR patents No 20120088162, 20130094919, 20140109568; patents WO No 2015032583, 2017144135); based on the use of software engineering technologies (patents WO No 2017106104, US No 2016300170); based on the use of modular applications, smart charging (patent KR No 20130047901, 20140031500; US No 2013132270, 2012150360, 2012253531; JP No 2012213316); based on Global
Positioning System usage (patents WO No 2012041902, AU No 2012202444, KR No 20140017278); based on the use of Global Positioning System (US patent No 2015025730); based on the use of centralized computing systems (patent WO No 2017066790); based on the use of various means of communication (patents JP No 2011209869; US No 2013328525, 2013138542; WO No 2011044543, 2014127849; KR No 20120073674, 20150070485).

The information exchange system of the electric vehicles charging infrastructure provides information interaction between consumers and suppliers of electric energy on the issues of determining the battery charge status of an electric vehicle, charge capacity, charging time, charging station reservation services, payment services for consumed electricity. Information exchange is carried out with the involvement of geographically distributed public, private and corporate computer networks, telecommunications networks; special-purpose and general-use systems, networks and channels for data transmission, means of switching and information flow management.

Access to information resources is usually carried out after registration, identification and authentication of the user. Identification and authentication are interrelated processes for recognizing and authenticating subjects (users).

Well-known technical solutions for electric vehicle charging infrastructure exchange systems, registration, authentication and authorization of users and applications are complex systems that are implemented, for example: by interfacing communication channels between a charging station and an information storage center (patent WO No 2012025311); by providing two-way communication between data exchange management servers, charging infrastructure management, server sharing management and information exchange on vehicle movement, vehicle status, status and location of charging stations (patents KR No 20130082957; WO No 2011154218; JP No 2011209869); by interacting the data interface in the power plant with the retail customer’s credit or debit card interface (patent WO No 9601518); by using the vehicle’s on-board devices to detect and activate it at the charging station, via wireless communication or a radio beacon for charging payment (patents PT No 2362362, 2362363).

The settlement system includes three main processes: payment initiation – the process by which one of the participants in a settlement operation (the client) instructs the settlement institution serving it to make payments between settlement participants; the process of exchanging payment instruments between participants in the payment system, which consists in transferring payment documents that are the basis for transferring or debiting funds; the settlement process between participants, which are operations that debit or credit funds (settlement assets) into its accounts.

Well-known technical solutions for the electric vehicle charging payment system include: combining payment for a charging session at an electric vehicle charging station (EVCS) or vehicle electrical equipment (“EVSE”) with payment for parking services using computing equipment that combines the parking session ID with the charging session ID generated by EVSE / EVCS to form a data set that can be used to process a combined payment (patent US No 2014067493); performing calculation and management of the vehicle accounting book by transferring the charging cost to the server, as well as for charging an electric vehicle by reading a barcode on an electric vehicle (patent KR No 20110056958); building a system for calculating monetary payments depending on the amount of charged electricity through the charge control unit and the communication unit with the electricity supplier (patents KR No 20110084634, 201110124186, 20120075610, 20130051132); construction of a system for calculating monetary payments depending on a certain time of day for a charging and a specific geographical location of the car (patents US No 20153677740, 2017337646).

Of interest is a technical solution under patent US No 2012203726, which claims systems and methods for determining the location of an electric charging station infrastructure built from scratch.

Some execution examples provide systems and methods for developing a deployment plan for one or more electric vehicle charging stations. The method includes: collecting data for a specific geographic area and predicting demand for electric vehicles for that area; modeling driving patterns in that area using available data and improving the toll infrastructure model based on the traffic model and demand forecast information for that area; create and provide recommendations for the electric vehicle
charging infrastructure and deployment strategy for the specified area based on the improved charging infrastructure model.

In some examples, a support and decision support system may be subscribed based on widespread market distribution from city governments and municipalities (for example, installing charging stations in public parking areas, paying for board, etc.), utilities and individuals (for example, retailers, shopping centers, fast food and restaurant chains, garage owners, etc.).

Some examples provide a way to create a deployment plan for one or more electric vehicle charging stations. The sample method involves collecting data for a specific geographical area and predicting demand for electric vehicles in that area. The sample method includes modeling driving patterns in a specified area using available data and improving the charging infrastructure model based on the traffic model and demand forecast information for the specified area. The sample method involves creating and providing recommendations for an electric vehicle charging infrastructure and deployment strategy for the specified area based on an improved charging infrastructure model.

Some examples provide machine-readable data media, including computer program code that must be executed by the processor. The computer program code when executed consists of implementing a system to create a deployment plan for one or more electric vehicle charging stations.

A charging station information management system is provided. The charging station information management system includes at least one processor. The set of modules that must be executed by at least one processor includes the information acquisition module and the corresponding module. The information module receives information about the location of the electric vehicle. The matched module identifies one or more suitable charging stations whose positional information corresponds to the received positional information of the electric vehicle and receives information about the location of one or more suitable charging stations.

Search and analysis of publicly available information on the Internet revealed normative and technical documentation, papers, dissertations related to the topic under study. The main directions of well-known developments related to the development of electric vehicles charging infrastructure are:

- development of technical solutions in the monitoring and management system for electric vehicles charging infrastructure;
- development of technical solutions in the information exchange system for electric vehicles charging infrastructure;
- development of technical solutions in the system of registration, authentication and authorization of users and applications of the electric vehicles charging infrastructure;
- development of technical solutions in the system of payment for charging an electric vehicle of the electric vehicles charging infrastructure.

The electric vehicles charging infrastructure monitoring and management system is a process of tracking, checking and regulating performance to determine the battery charge status of an electric vehicle, charge capacity, charging time, charging station management, charging station reservation services and so on.

Monitoring includes collecting, measuring and disseminating performance information, as well as evaluating changes and trends to influence process improvement. Continuous monitoring makes it possible to understand the overall state of the charging infrastructure for electric vehicles and determine which areas should be paid special attention to. Management involves identifying corrective or preventive actions, or re-planning and tracking plans to determine whether the problem has been resolved through the actions taken.

In well-known technical solutions, systems for monitoring and managing charging infrastructure for electric vehicles are designed: based on the use of a navigation device (KR No 20140015740); based on the use of an Internet connection (US No 2014074523, WO No 2008135043); based on the use of a mobile device, cloud server, server devices, cellular network (US No 2014191722, US No 2014074523, KR No 20120088162, KR No 20130094919, US No 2016362016, WO 2015032583, US No 2013020992, US No 2016364776, WO No 2017144135, KR No 20140109568, US No 2016364658); based on the use of software engineering technologies (WO No 2017106104, US No 2016300170); based on the use of module-based applications, smart charging (KR No 20130047901, US No 2013132270, KR No 20140031500, US No 2012150360; US No 2012253531, JP No
2012213316); based on central processing unit usage (WO No 2012041902, AU No 2012202444, KR No 20140017278); based on the use of Global Positioning System (US No 2015025730); based on the use of centralized computer systems (WO No 2017066790); based on the use of various means of communication (JP No 2011209869, US No 2013328525, WO No 2011044543, KR No 20120073674, KR No 20150070485, US No 2013138542, WO No 2014127849).

The information exchange system of the electric vehicles charging infrastructure provides information interaction between consumers and suppliers of electric energy on the issues of determining the battery charge status of an electric vehicle, charge capacity, charging time, charging station reservation services and payment services for consumed electricity. Information exchange is carried out with the involvement of geographically distributed public, private and corporate computer networks, telecommunications networks; special-purpose and general-use systems, networks and channels for data transmission, means of switching and information flow management.

Access to information resources is usually carried out after registration, identification and authentication of the user. Identification and authentication are interrelated processes for recognizing and authenticating subjects (users). It is up to identification and authentication to decide whether a particular user or process can be allowed access to the system’s resources. After the subject is identified and authenticated, it is authorized.

Well-known technical solutions for electric vehicle charging infrastructure exchange systems, registration, authentication and authorization of users and applications are complex systems implemented, for example, by interfacing communication channels between a charging station and an information storage center (WO No 2012025311.), by providing two-way communication between data exchange management servers, charging infrastructure management, server sharing management, and information exchange about vehicle movement, vehicle status, information about the status and locations of charging stations (KR No 20130082957, WO No 2011154218), by interacting the data interface in the power plant with the interface of a retail customer’s credit or debit card (WO No 9601518), by using the vehicle’s on-board devices to detect and activate it at the charging station, by using a wireless connection or a radio beacon for charging payment (PT No 2362362, PT No 2362363).

The calculation system includes three main processes:

- payment initiation – the process by which one of the participants in a settlement operation (client) instructs the settlement institution serving it to make payments between the participants in the settlement;
- the process of exchanging payment instruments between participants of the payment system. It consists of transmitting payment documents that are the basis for crediting or debiting funds;
- settlement process between participants, these are operations that debit or credit funds (settlement assets) into its account.

The payment system for electric vehicle charging services is based on the use of wireless communication and must meet the following requirements: to account for the balance on the User’s personal account; to account for the volume of charging Services consumed and the time intervals for their provision based on the Operator’s pricing rules; to collect statistics on User accounts and transmit it to the Customer’s systems; to ensure the transfer of data necessary for the provision of the service or refusal of it and the user’s relationship with the service provider; when calculating with the user, take into account the pricing rules depending on the terms of the agreement, time of day, place of Service provision (individual tariffs for electric charging stations or groups of electric charging stations), User loyalty programs, etc.; monitor and generate reports on user activity and load on the electric charging stations.

4. The authors’ experience in creating electric charging stations
The authors conducted bench tests of the stationary charging station “ELZA” developed by them to determine the possibility of charging the traction battery of an electric bus (trolleybus) TROLZA-
5265.08. Stationary charging station “ELZA” is recommended for charging traction batteries of electric buses. The charge was performed on nine trolleybuses with different levels of charge of the traction battery, from 6% to 43%. The charge current of the traction battery in all cases was - 30 A. The charge time was from 125 to 210 minutes, depending on the level of charge of the traction battery. The manufacturer of the traction battery does not recommend to discharge below 40%, therefore, in normal operation, the maximum charge time will be no more than 2 hours. During bench tests of the layout of the stationary charging station “ELZA”, it was determined that the traction batteries of the electric bus TROLZA-5265.08 are charged from an external charge source “ELZA”.

A project for an electric charging station with solar power generation was also developed (figure 1).

**Figure 1.** 3D model of an electric charging station with solar energy generation.

5. **Project description**

A small-sized socket or socket complex is built in or attached, power lines with a capacity of 220 to 500 V, and, if necessary, the wires of the information system are connected to socket or socket complex on an object of road or municipal infrastructure, for example, on a curb, in a wall, on a post, on a sub-spring system, from a road surface, from any object, product or structure.

Fast or slow charging is performed after the voltage is applied in an adjustable mode.

Identification of the location of the electric vehicle, the driver and the nearest socket of the electric charging infra-structure, management of all charging states and modes is performed by using special mobile phone options and management in a remote node of the automatic mobile phone with feedback.

In this case, the vehicle (electric car) pulls up to the parking lot for example, where there is a sign that there is a charging connection. The driver, while in the car, turns on the mobile phone (iPhone, iPad) and presses the option “Electric charging”. The charging mode is displayed, then the parking program algorithm scheme works.
The navigator identifies the driver’s seat, the place of the car and the location of the nearest electrical charging infrastructure socket. The iPhone shows a map of the location and possibilities of the nearest socket.

The “Electric charging” option includes setting the time and setting modes, messages from the bank, local operators of this electric charging socket, and setting tariffs. The driver selects the fare, time, and how much money he is willing to spend on this charge (notionally 100 rubles for 15 minutes of parking time). Turns on the payment mode, clicks the “Pay” option button.

Automatically from the remote switch, which is located at a remote distance, the voltage is applied to this socket, charging is performed. After the charging mode is over, we will receive the SMS to mobile phone after the set time with a notification that “Charging is over, pick up the electric car from the parking lot (free up space)”.

6. First patent [14, 15]
The technical solution refers to digital technical means of electric charging (recharging) units of mobile electric transport, such as electric buses, hybrid trolleybuses, electric cars, hybrid transport using battery energy, electric motorbikes, electric bicycles, electric motorcycles and others.

System of distributed network infrastructure of electric charging of mobile electric vehicles was devoted including a device that provides electricity to charge the electric transport, equipped with mobile means of communication through a remote system control center charging device providing electricity, with the mobile communication facility is equipped with the mobile application, wherein the device that provides electricity to charge the electric transport, made in the form of a complex containing the electrical system of reception/transmission, conversion and distribution of electric energy supplied remotely controlled automatic load switch circuit, at least one electrical power cable and at least one remote electrical connector, each power cable with one end is connected to the load switch circuit, and the other end through the normally open contacts is connected with the corresponding electrical connector.

The technical result is the possibility of providing the electric vehicle charging mode directly from the existing distributed power supply system, by using the phase state modes of the electric connector cable that is powered or not powered by electric current.

Using the claimed dynamic system of electric charging network infrastructure at various objects of transportation systems, residential and public complexes will allow to solve following actual problems: delete the hard reference of the electric vehicle to an existing network of charging stations to reduce time needed for charging the electric vehicle; minimize costs for maintenance of the charging process of the electric vehicle. To ensure the charging mode of an electric vehicle, the phase state of a cable that is powered or not powered by an electric current is used, connecting an existing power supply system, in the form of an electric substation, with a remote electrical connector, which eliminates the need for specialized stationary electric charging stations.

When we first launch, the app will offer to register for a personal account which later will be charged the amount to pay for electric vehicle charging, and get a PIN code to enter the system.

Payment for the service is the purchase of a certain amount of electricity, which can then be obtained using any smart charging included in the distributed electric charging infrastructure. Smart charging can be physically located either singly within the range of connectivity in places that are allowed to stop electric vehicles (walls of houses, poles, racks embedded in asphalt in indoor and outdoor parking lots, car parks near public areas, hotels, restaurants, supermarkets, shopping centers, etc.), or grouped into electric charging stations (for example, on the basis of existing gas stations).

7. Second patent [16]
The technical result is achieved due to the fact that electric charging complex for mobile electric vehicles that contains the electric power storage, device connections storage of electricity with electric vehicle and device for recording the consumed when charging electric power, the complex included a microprocessor, unit of the visual display and displaying information about the charging, the unit set
charging mode, with at least three discrete and (or) variable levels of output voltage, the identification unit for diagnostics of the battery state and the unit of automatic billing and collection of payments for charging, and all units are double-sided connected to the microprocessor with the ability to transfer and store the accumulated information of the microprocessor in a remote “memory cloud” of the global Internet system.

Mobile electric vehicles enter the territory of the complex for charging in the area of its technical identification means (video cameras). After identifying the type of electric vehicle from the existing database by the number of the battery from the electronic “memory cloud” of the Internet, requests its charging history from the start of operation to the present moment. The required charging mode is selected, and a power socket is assigned. The express-diagnosis of the battery electric vehicle, to do this, before applying a strong current, a weak test signal determines the current real state of the battery, forecasts the remaining life of his work, determines the required amount of charging. The payment rate is assigned (preferential or normal) and the amount of the payment is determined based on the readings of the metering device for electricity consumed during charging. The driver receives a message in the form of SMS or via social networks about the completion of the charging procedure, after which, 10-15 minutes after the completion of charging the electric vehicle, driver must leave the area of the complex, otherwise, the status of the electric vehicle will be changed from “charging” mode to “parking” mode and the payment will be recalculated. The entire charging procedure is displayed on the mobile device monitor.

8. Digital economy smart charging software complex for mobile electric transport

The author’s proposed monitoring and management software complex includes: complex software; software system navigation and localization of electric vehicle and electric charging; the information exchange subsystem; subsystem of registration, authentication and authorization of users and applications; complex of integration solutions complex with adjacent systems; software of billing system payment by electronic payment; subsystem of interaction of the complex with users (Internet portal); set of mobile apps.

Smart chargers can be physically located either singly within the range of connectivity in places that are allowed to stop electric vehicles (walls of houses, poles, racks embedded in asphalt in indoor and outdoor parking lots, car parks near public areas, hotels, restaurants, supermarkets, shopping centers, etc.), or grouped into electric charging stations (for example, on the basis of existing gas stations). Next to the smart charger is an information board with its individual number in the system, by which it is identified for activation. In other words, this number indicates which smart charging system that is part of the distributed electric charging infrastructure needs to be enabled remotely at the moment in order for a specific customer to start the process of charging their electric vehicle using prepaid electricity. When we select a specific smart charger on the map or from the list, a map of the area is displayed indicating the selected smart charger or electric charging station, the user’s current location, and the shortest route to reach it. If we select “REGISTRATION” item, a window will appear for registering a new user of the distributed electric charging infrastructure. If we select “Charge payment”, the corresponding window will appear.

We can not register or authorize, but by clicking on the “CONTINUE WITHOUT REGISTRATION” button, we can make a single unauthorized charge with payment using a bank card, but in this case the system will not be able to keep statistics on the purchased electricity and the amounts spent, since there will be no binding of the charges made to a specific user. We will also not be able to use personal account. Next, we will consider how the program works with a registered user.

A two-level authorization system with a password and PIN code allows to protect ourselves from intruders. The user is logged in using the phone number that is used as the username. Accordingly, the user can only log in from the phone number that the user specified as their ID. If the user has more than one phone number, additional numbers are registered in the user’s personal account.

After sending an SMS message from a registered number to a short number, we receive an authorization code (PIN) in response. Next, enter the user’s password and the received authorization code,
and click on the “LOG IN” button. If the “remember” item in the checkbox is set, then in case of successful authorization, this page does not appear during subsequent launches of the program, and we immediately proceed to paying for the electric car charging service.

Payment for the service is the purchase of a certain amount of electricity, which can be in future obtained using any smart charger included in the distributed electric charging infrastructure. The screen shows the status of the account, with a button that allows to top it up, the amount of previously prepaid and unused electricity and the approximate time it can be consumed when charging the car. For payment of additional electricity is required to select the desired number of kilowatt-hours and click the button “PAY”. In this case, the required amount will be debited from the account, and the amount of prepaid energy will increase, and a window will appear on the phone screen that allows to start the process of charging an electric car.

Smart charging can be physically located either singly within the range of connectivity in places that are allowed to stop electric vehicles (walls of houses, poles, racks embedded in asphalt in indoor and outdoor parking lots, car parks near public areas, hotels, restaurants, supermarkets, shopping centers, etc.), or grouped into electric charging stations (for example, on the basis of existing gas stations). Next to the smart charging is an information board with its individual number in the system, by which it is identified for activation. In other words, this number indicates which smart charging system that is part of the distributed electric charging infrastructure needs to be enabled remotely at the moment in order for a specific customer to start the process of charging their electric vehicle using prepaid electricity.

If an electric car is physically located near a smart charger and we do not need to search for it on the streets of the city, we just need to connect to it with an electric charging cable, enter its number in the corresponding field at the top of the screen and click on the power button. In this case, the icons of the button, smart charging and electric car will change color, indicating that the charging process is underway.

The screen also shows the time that has passed since the start of the charging process, the amount of used and remaining prepaid energy. The registration number of the vehicle being charged is displayed at the bottom of the screen. To disable smart charging, just press the same button again, or wait for the prepaid amount of energy to be generated.

In the upper-left part of the screen, there is an icon in the form of three short horizontal lines. Clicking on it will take us to the main menu. If we do not know where the nearest smart charging station or electric charging station is located and we need to find them, we can do this using one of the two main menu items: “Map of charging stations” or “Nearest stations”.

When we select the “Map of charging stations” menu item, a zoom able map of the area centered on the user’s location is displayed on the phone screen with icons of smart charging and electric charging stations superimposed on it, indicating the selected smart charging or electric charging station, the user’s current location, and the shortest route to reach it. When we select the “Nearest stations” menu item, a list of the nearest smart charging and electric charging stations is displayed on the phone screen, indicating the distances to them.

After the user has arrived at a single smart charging or an electric charging station, it is necessary to return to the main menu, select “Charging an electric vehicle” and start charging.

Other items in the main menu of the program. “My electric vehicles” -displays a list of registered electric vehicles in the system, and allows us to choose which one we will charge at the moment. Using the “History” menu item, we can see where, when, and for what amount we were previously paid for charging. The “Personal account” is used for managing account. In it, we can edit personal data, change the list of used electric vehicles, and phone numbers (add or delete). Allow or deny receiving SMS notifications to mobile phone. Also, in personal account, we can view various statistics on previously made charging, such as the amount of electricity consumed and the amount of money spent for the selected period of time, etc. We can log in to personal account either from phone directly from the app, or from personal computer via a special page on the site of the distributed electric charging infrastructure.
The “Settings” menu item is used to configure the app interface, allow or prohibit automation app updates via the Internet, allow news to be displayed when the app is launched, and change the interface language. We can also view the instructions for using the app there.

The “Support service” menu item allows to submit a complaint or suggestions about the service provided.

The menu item “Information” contains brief information about the application, the number used is our version of the app, as well as relevant links to different information resources distributed electric charging infrastructure - the main page of the system website, description of payment methods, map of electric charging stations and on-line smart charging, on-line governing documents, etc.

9. Conclusion
Using the claimed “digital economy” of the system of electric charging network infrastructure for various transportation facilities, residential and public complexes will allow to solve following actual problems: delete the hard reference of the electric vehicle to an existing network of charging stations to reduce time needed for charging the electric vehicle; minimize the cost of the service charging process of electric car.

Based on the materials of the paper, patents were obtained in Russia and Kazakhstan, as well as a certificate of registration for the trademark “SMARTZARYADKA” [15-17].

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