ISSN 1507-3858
e-ISSN 2450-0003

Przemysław Dankiewicz[1], Marcin Hernes[2], Ewa Walaszczyk[3], Piotr Tutak[4], Iwona Chomiak-Orsa[5], Artur Rot[6], Agata Kozina[7], Marcin Fojcik[8], Mykola Dyvak[9], Bogdan Franczyk[10]

SMART PAYMENT TERMINAL IN ENERGY PAYMENT FOR ELECTRIC AND HYBRID CARS

WYKORZYSTANIE URZĄDZENIA *SMART PAYMENT TERMINAL* W REALIZACJI PŁATNOŚCI ZA ENERGIĘ PRZEZ UŻYTKOWNIKÓW SAMOCHODÓW ELEKTRYCZNYCH I HYBRYDOWYCH

DOI: 10.15611/ie.2020.4.08
JEL Classification: O14, L64, L81

Quote as: Dankiewicz, P., Hernes, M., Walaszczyk, E., Tutak, P., Chomiak-Orsa, I., Rot, A. … Franczyk, B. (2020). Smart payment terminal in energy payment for electric and hybrid cars. *Informatyka Ekonomiczna. Business Informatics*, (4).

[1] Novaster So. z o.o., e-mail: dankiewicz@novaster.com.pl, ORCID: 0000-0002-3429-4487
[2] Wroclaw University of Economics and Business, Poland, e-mail: marcin.hernes@ue.wroc.pl, ORCID: 0000-0002-3832-8154
[3] Wroclaw University of Economics and Business, Poland, e-mail: ewa.walaszczyk@ue.wroc.pl, ORCID: 0000-0002-9119-2727
[4] Wroclaw University of Economics and Business, Poland, e-mail: piotr.tutak@ue.wroc.pl, ORCID: 0000-0002-0976-4037
[5] Wroclaw University of Economics and Business, Poland, e-mail: iwona.chomiak@ue.wroc.pl, ORCID: 0000-0003-3550-8624
[6] Wroclaw University of Economics and Business, Poland, e-mail: artur.rot@ue.wroc.pl, ORCID: 0000-0002-7281-8253
[7] Wroclaw University of Economics and Business, Poland, e-mail: agata.kozina@ue.wroc.pl, ORCID: 0000-0003-0447-4038
[8] Western Norway University of Applied Sciences, Norway, e-mail: marcin.fojcik@hvl.no, ORCID: 0000-0002-8109-2175
[9] West Ukrainian National University, Ukraine, mdy@wunu.edu.ua, ORCID: 0000-0002-9049-4993
[10] Leipzig University, Germany, e-mail: franczyk@wifa.uni-leipzig.de, ORCID: 0000-0002-5740-2946

Abstract: One of the most important issues nowadays is reducing environmental pollution by decreasing car exhaust fumes. Increasing the customization of services forces companies to improve the selling process. One of the innovations used worldwide is the touchscreen in self-service technology. The charging points for electric cars are often located in petrol stations so that the attendant carries out the payment process. However, there are more and more charging stations in other places, e.g. shopping centres, service stations, on-street parking, where there is no attendant. In such cases charging a car requires a mobile phone app for payment, and the app must be prepaid or have a connection to the customer's bank account. There is no possibility to pay in cash or to receive an invoice.The aim of this paper is to present the Smart Payment Terminal (SPT) as an innovation in the energy-selling process for electric and hybrid cars in places with no attendant, and show its features and advantages. The paper has a R&D character. The main contribution is developing an innovative Smart Payment Terminal that allows payment with cash, credit cards, and fleet cards, and may print a receipt or an invoice directly after the purchase.

Keywords: electric cars, hybrid cars, payment terminal, self-service technology, product innovation.

Streszczenie: Współcześnie bardzo istotnym zadaniem jest ograniczanie zanieczyszczenia środowiska dzięki zmniejszeniu emisji spalin samochodowych. Zwiększenie poziomu samoobsługi w realizacji usług przez klientów zmusza firmy do usprawnienia procesu sprzedaży. Jedną z innowacji stosowanych na całym świecie jest wykorzystanie ekranów dotykowych. Punkty ładowania samochodów elektrycznych często znajdują się na stacjach benzynowych, gdzie sprzedawca obsługuje proces płatności. Jednak coraz więcej stacji ładowania znajduje się w innych miejscach, takich jak, np. centra handlowe, stacje paliw, parkingi przy autostradzie, gdzie nie ma obsługi. W takich przypadkach doładowanie samochodu wymaga wykorzystania aplikacji mobilnej w celu realizacji płatności, często musi nastąpić przedpłata lub nastąpić połączenie z kontem bankowym klienta. Nie ma możliwości zapłaty gotówką ani otrzymania faktury. Celem artykułu jest przedstawienie urządzenia Smart Payment Terminal (SPT) jako innowacji w procesie sprzedaży energii dla samochodów elektrycznych i hybrydowych w miejscach bezobsługowych oraz pokazanie jego cech i zalet. Artykuł ma charakter B + R. Głównym wkładem jest opracowanie innowacyjnego inteligentnego terminala płatniczego, który umożliwia płatności gotówką, kartami kredytowymi i/lub flotowymi oraz może drukować paragon lub fakturę bezpośrednio po zakupie.

Słowa kluczowe: samochody elektryczne, samochody hybrydowe, terminal płatniczy, technologia samoobsługowa, innowacja produktowa.

1. Introduction

One of the most important issues nowadays is to reduce environmental pollution by decreasing in car exhaust fumes. The transport sector is responsible for 24% of global CO_2 emissions (Bobeth & Kastner, 2020; Giansoldati, Monte, & Scorrano, 2020; Gómez Vilchez, Jochem, & Fichtner, 2020). The increase of environmental pollution awareness has mobilized car manufacturers to replace combustion engines – petrol and diesel engines with new promising technologies – hybrid and electric cars which draw energy from a battery, powered with renewable energy sources.

Such vehicles have the potential to reduce air pollution (Secinaro, Brescia, Calandra & Biancone, 2020). Electric cars do not release any emissions and are considered eco-friendly. This is crucial, especially when the social costs of air pollution associated with combustion engines are about three trillion dollars per year (Gómez Vilchez et al., 2020; Milev, Hastings, & Al-Habaibeh, 2020).

Electric or hybrid cars must be recharged, which may be realized at charging stations. Depending on the country, the charging infrastructure is in a different development stage, and this is one of the most important aspects of electric cars' user-friendliness. Another issue is the charging time, which is usually too long for users and is considered a barrier to accepting electric vehicles (Bobeth & Kastner, 2020; Giansoldati et al., 2020; Gómez Vilchez et al., 2020; Milev et al., 2020).

The increasing customization of services forces companies to improve the selling process. One of the innovations used worldwide is the touchscreen in self-service technology. Many of us use it every day, e.g. cash machines, self-service cash registers in a supermarket, parcel lockers, self-checkout stations in libraries, or self-service check-ins at the airport. Self-service technology is becoming more and more popular and is increasing in importance. While using it, the customer receives an improved experience, convenience, ease of use, increased customization, and feels empowered to conduct even complex operations conveniently. In most cases the waiting time is also reduced. Service providers benefit by controlling service delivery and service standardization and reducing labour costs by serving more customers with fewer resources (Jokisuu, McKenna, Smith, & Day, 2015; Vakulenko, Oghazi, & Hellström, 2019).

Selling fuel at petrol stations in many countries is based on self-service. The only task the driver must carry out with the attendant is the payment. The charging points for electric cars are often located in petrol stations so the attendant is responsible for the payment process. However, there are more and more charging stations in other places, e.g. shopping centres, service stations, on-street parking, where there is no attendant. In such cases charging a car requires a mobile phone app for payment. The application must be prepaid or have a connection to the customer's bank account. There is no possibility to pay in cash or to receive an invoice.

The aim of this paper is to present the Smart Payment Terminal (SPT) as an innovation in the energy-selling process for electric and hybrid cars at places with no attendant, and show its features and advantages. The work has an R&D character. The main contribution is developing the innovative Smart Payment Terminal that allows payment with cash, credit cards, and fleet cards and may print a receipt or an invoice straight after the purchase.

2. Methodology

The considerations presented in the article are the result of the carried out research process.

The first stage of research consisted in conducting a critical analysis of the related works. At this stage, the authors reviewed domestic and foreign scientific studies. As a result of the systematic literature analysis, the following research questions were defined:

- Are the technical solutions indicated in the literature available on the Polish market?

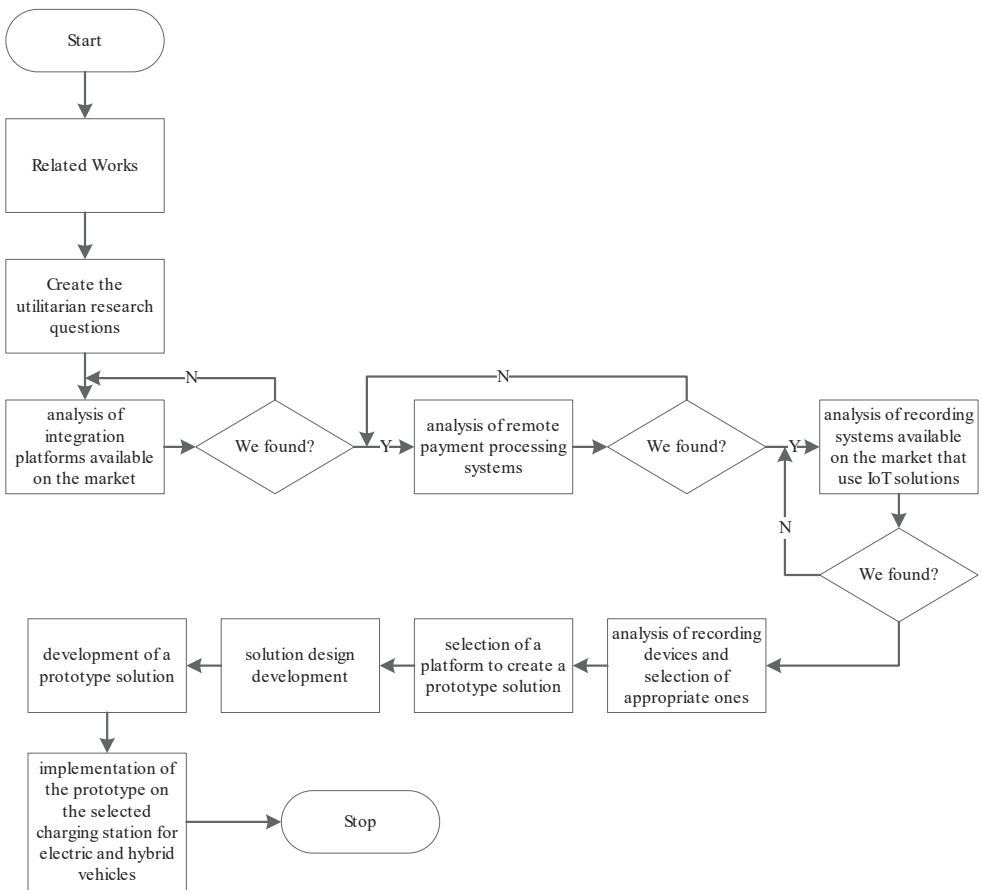

Fig. 1. Research procedure

Source: own elaboration.

- Is it technologically possible to implement solutions integrating remote payments with electric car charging systems?
- Is it possible to create a prototype of an integrating solution?

The above research questions determined the elements of research methodology, which included the following research tools:

- analysis of the integration platforms available on the market,
- analysis of the remote payment processing systems,
- analysis of the recording systems available on the market that use IoT solutions,
- analysis of the recording devices and the selection of appropriate ones,
- selection of a platform to create a prototype solution,
- solution design development,
- development of a prototype solution integrating payment systems with register systems,
- implementation of the prototype on the selected charging station for electric and hybrid vehicles.

The discussed research procedure is presented in Figure 1.

3. Related works

The article by (Walaszczyk, Dankiewicz, & Hernes, 2020) reviewed the development of self-service payment technology around the world at conventional petrol stations. In this article, the authors take it a step further by analysing the development of payment technology at charge stations of electric and hybrid cars.

Plans for the distribution of electric vehicles (EVs) and industrial developments have recently come to the forefront of transport policies both in developed countries (Japan, the United States, France, Germany, the United Kingdom, Spain, Italy, Denmark) and in fast-developing ones (e.g. China). The reason for this is the reduced environmental impact of such vehicles compared with internal combustion engine vehicles (Formánek& Tahal, 2020). Most publications on electric and hybrid cars deal with the topic of their positive impact on the environment.

The development of electro-mobility, where conventional vehicles (CVs) are replacing by electric vehicles (EVs), however, raises many issues relating to the energy, environment and industry (Kołaczek, n.d.). Moreover, electric and hybrid cars must be recharged, and it is not easy for electric car owners. Driving an electric vehicle requires scheduling battery charging sessions. Some people use fast chargers available in cities and on motor ways, while others choose to charge their car from an outlet in their own home.

However, when considering charging an electric vehicle in own garage, one should mention the costs of the entire operation, charging times, and technical aspects. There are no scientific publications on this subject. Information on charging electric and hybrid cars can be found on the Internet, and in car magazines. Only one

article was found in the Scopus database regarding the costs of charging electric cars (Pavan, Lughi, & Scorrano, 2019).

The article (Li, Khajepour, & Song, 2019] distinguished three types of charging stations: public, residential, and ultra-fast charging stations. The residential charging stations, installed at household areas, enable PEVs to be charged during the night when the energy tariff is low and the peak hour demand can be avoided. The public charging stations are placed at everyday activity places such as shopping centres, public buildings, and company car parks. These stations are generally provided by electric utility companies and integrated with payment systems. The ultra-fast charging stations are typically located at motorway and expressway rest areas. These stations have protection and control functions and can provide higher currents and voltages from the main power grid to quickly charge the PEVs, which is their advantage against other electric car charging stations.

The authors found three studies on shortcomings in Payment Terminals present on the market.

First of all, a large questionnaire study (N = 320) was conducted to evaluate potential commonalities and differences between novel fast charging and conventional petrol stations and provided on-site services (Philipsen, Schmidt, & Ziefle, 2018). Therefore, both battery electric vehicle users and drivers of internal combustion engine vehicles were questioned. The ranking of payment methods was similar for both petrol stations and charging stations. For both contexts, bank or credit cards were the preferred payment method, followed by a fully automated payment process handled by the vehicle itself. In third place was cash use. Fuel or charging cards with PINs, customer accounts at the actual provider, and prepaid cards were the three least preferred methods to pay for fuel or electric power, preferred by up to four percent of the participants.

Attention was paid to the fragmented payment systems at charging stations that are not future-proof, which highlighted that providers of charging stations should focus on payment by card and support the automated payment by car as soon as a reliable operation is technically possible. Especially BEV users showed high preference levels for this 'plug-in-and-forget' payment.

The second is the survey by Vogt (2017) *The customer perspective of a user-oriented public charging infrastructure*, in which the following categories investigated: usage of charging infrastructure, locations, access, payment, costs, and tariff modelling. The results clearly showed that the current infrastructure overall was rated as quite bad by the users and there was a real need for action in many issues.

The third was an overview of consumer preference research on plug-in electric vehicle (PEV) charging infrastructure in (Hardman et al., 2018). Studies found that more effort is needed to ensure that consumers have easy access to PEV charging. Consumers typically need to use a membership card to access public charging stations. Currently, there are several different charging infrastructure providers.

If consumers wish to access all charging stations, they may be required to hold a membership card for each company, which can cause difficulties for consumers and be a barrier to them purchasing a PEV. To reduce such complexity, policymakers and charging infrastructure companies are finding ways to ensure PEV owners can access any charging station, regardless of membership status. This has been done in the Netherlands and Portugal, is a requisite for public charging in Germany, and has been proposed as legislation in the UK. The most important consideration for the respondents was the possibility to access fast charging at public locations. In Norway, the Norwegian EV Association has issued RFID cards to their members that can be registered with the main charging infrastructure providers and used at any location. the study by (Lorentzen, Haugneland, Bu, & Hauge, 2017) found that 61% of PEV owners preferred this method of payment. Consumers believed this was easier than other solutions. Charge points are also being developed with phone identification (e.g. Android Pay, Apple Pay, Google Wallet) credit/debit card readers, or via SMS payments. The article highlights the fact that the barrier for consumers is the lack of clear information on how payments work. Payments for charging usually include one or more components: a one-off connection fee, kWh based payments, charge time-based payments, or charging cost based on parking cost. This is different from refuelling a conventional vehicle where consumers are aware of exactly what they are paying, and how much each unit of fuel costs.

In the article (Wang, He, Xu, Han, & Zhou, 2017), regarding the problem between different current charging piles of not achieving unified charge payment, the consortium blockchain was used to establish a unified payment channel without the involvement of a third party. It was emphasized that the blockchain could solve problems such as the great inconvenience to users caused by different charges and payment methods in different charging pile operators, and thus promote the rapid popularization of electric vehicles.

Ekoenergetyka Polska is Poland's largest, dynamically developing producer of infrastructure for charging electric vehicles. At green-news.pl one can read, for example, about a large order that the company will implement in Danish Aarhus. Now, Ekoenergetyka has gone a step further by introducing the first charging station with a payment terminal on the market (Piszczatowska, 2020).

The new energy charging station is called Axon Pay, and one can pay for using it, e.g. by card. Contrary to standard petrol stations, pre-paid cards are mainly used in electric chargers. In addition, each operator develops its own system, which makes travelling by electric car awkward. Therefore, the introduction of chargers in which one can pay for charging the car without cash, e.g. with a contactless card or digital wallets, such as Apple Pay or Google Pay, will actually be great progress. Ekoenergetyka plans to introduce this system, among others for the Asian market.

An electric car offers many possibilities to make payments in a simple and safe way: via an app, with a prepaid card, or a credit card. Soon, the payment credentials will also be saved in one's car (https://www.volkswagen.pl/pl/elektromobilnosc/

baza-wiedzy-id/ladowanie-i-zasieg-samochodu-elektrycznego/jak-moge-placic.html). Thanks to this, charging will only need to be connected to the charging station. Payment will be made automatically without driver participation. Interestingly, nowadays one can find charging stations where payment is not yet required, e.g. at some shopping centres or supermarkets.

A driver can choose one operator who will offer him/her a billing tariff tailored to his/her needs – similar to a subscription for a mobile phone. If a charging station is not supported by the selected operator, the driver can still use it and pay directly to that operator, e.g. by credit card. In order for the 'fuelled electricity to be billed, the charging point naturally needs to know who the customer is. Depending on the selected operator, one can log in using the charging card or app (via NFC communication or QR code). Billing takes place according to the agreed payment method (e.g. debit, PayPal, or credit card). One can also use ad hoc charging and pay by credit card directly to the operator.

Another technology is Plug & Charge (ISO 15118), where identification data are stored in the car and the charging station will automatically recognize who is using the electricity, however it raises concerns about safety (Berman, 2020).

Based on the analysis of the literature, it was found that there is a deficiency of publications on the methods and payments for vehicle charging at the self-service stations in the bibliographic databases. Most of the information on search keywords can be found in car magazines, and on the Internet. Several publications were found on the disadvantages of the current methods of payment for charging electric and hybrid vehicles. Moreover, there is no device that allows payment with cash, credit cards, or fleet cards and can print a receipt or an invoice directly after the purchase.

4. Smart payment terminal for electric and hybrid cars

The Smart Payment Terminal (SPT) is an intelligent answer to problems with staff at Polish petrol stations, being at the same time both the product and process innovation in the fuel-selling process. As a product innovation it uses touchscreen technology to self-service the payment and is a completely new product compared to the cash desk; it is user-friendly and its usability is much higher than the standard self-service at a petrol station. It is also a business process innovation because of the new payment service in the selling process. The process is more fluent and the customer feels more comfortable while using the popular touchscreen. The company is seen as innovative.

4.1. Basic Functions of SPT

Smart Payment Terminal functions:

- supporting the sale of electricity,
- 24-hour self-service retail sale of fuels and gas,
- payment with a card or own fleet card services,

- handling cash payments,
- editing and printing invoices,
- checking the discount system for groups or selected users,
- service of own fleet cards,
- use of limits and restrictions related to drivers and vehicles, groups of recipients, groups of vehicles,
- archiving transactions along with the information about the user, transaction time, quantity and value of issued fuel,
- data transfer in real-time,
- integration with any IT system,
- cooperation with management control systems,
- 24-hour self-service retail sale of fuels and gas.

4.2. Technical specifications

Smart Payment Terminal (SPT) is built in a special anti-burglary housing made of stainless steel, in which the necessary devices and protections required for correct operation have been installed. The construction of SPT is shown (see Figures 2 and 3).

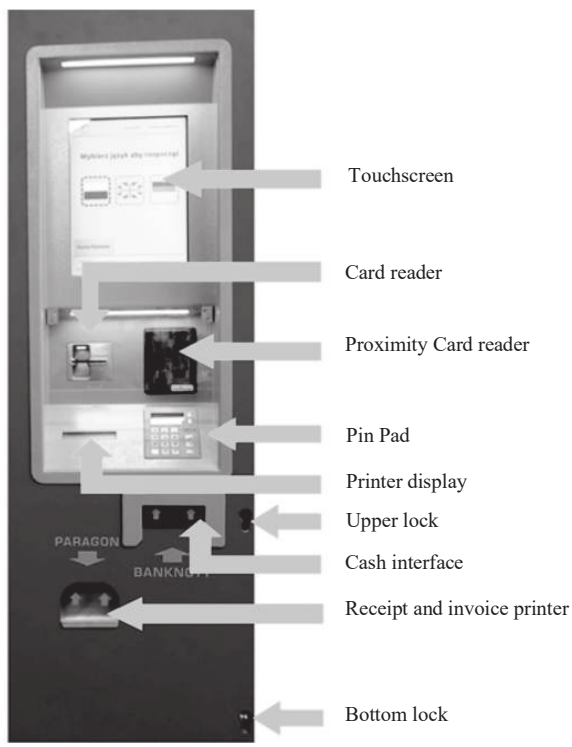

Fig. 2. SPT – front view

Source: own elaboration.

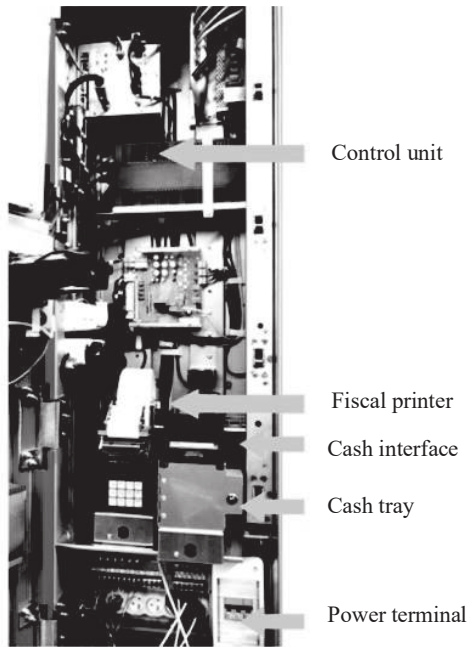

Fig. 3. SPT – inside view

Source: own elaboration.

4.3. Using the SPT

After turning on the terminal, the main screen of the application indicating available payment methods appears on the touch screen. SPT allows payment (Figure 4).

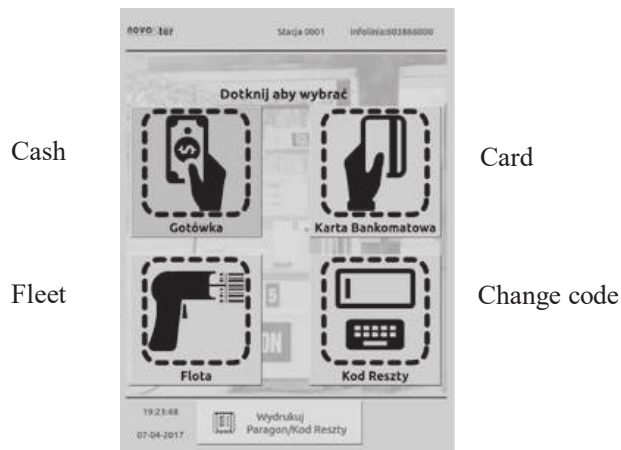

Fig. 4. SPT – Payment methods

Source: own elaboration.

- in cash with 10, 20, 40, 100, 200 PLN banknotes and combinations thereof (Figure 5),

Fig. 5. SPT – Cash payment method

Source: own elaboration.

- by credit card – selecting the amount due for refuelling (see Figure 6),

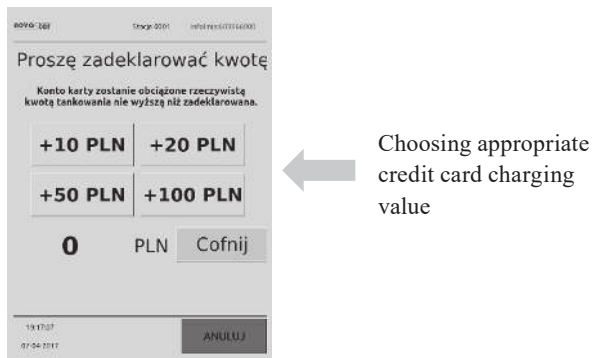

Fig. 6. Credit card payment method

Source: own elaboration.

- fleet card for regular customers – choosing the amount due for the refuelling (Figure7),

Fig. 7. Fleet card payment method

Source: own elaboration.

- using a special 'rest code' of the money remaining in advanced cash payments, as the machine does not give change (Figure 8).

Fig. 8. The 'rest code' payment method

Source: own elaboration.

After accepting payment by the SPT, the user may start refuelling. Due to safety reasons the user must start refuelling in 120 seconds. If this time is exceeded, the SPT will print the change code. SPT also allows opting out of buying fuel. After refuelling, the user may choose a refuelling confirmation in the form of a receipt or invoice (Figure 9), where the company's tax identification number needs to be provided by the user. The remaining customer data are automatically downloaded by the system.

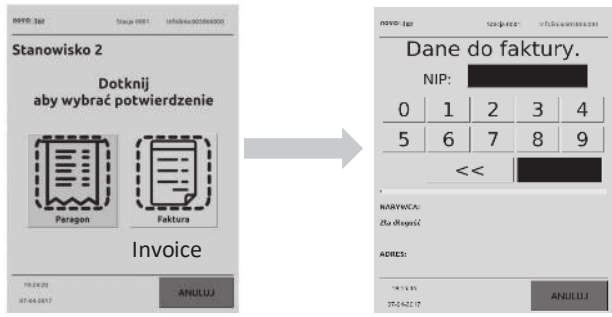

Fig. 9. Confirmation in the form of a receipt or invoice

Source: own elaboration.

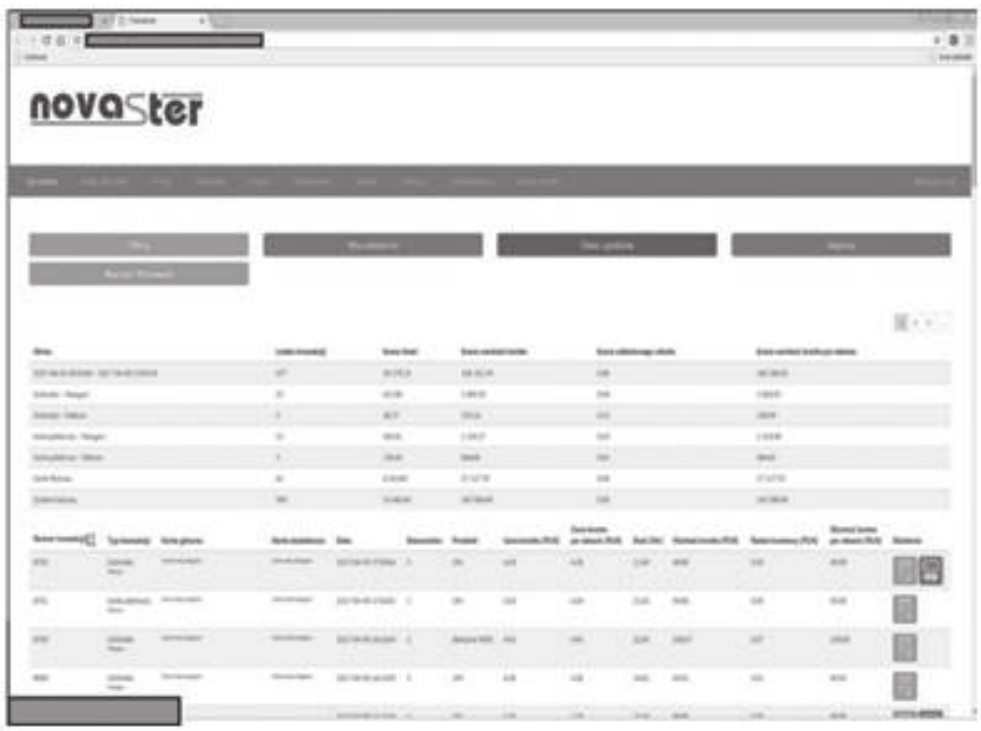

Fig. 10. SPT – management system

Source: own elaboration.

The STP also includes an IT management system (Figure 10). The system is available after logging in to the appropriate Internet address provided by the SPT supplier.

The management system consists of 10 tabs:

- Sales – summary of financial analysis and transactions,
- Fleet cards – card configuration,
- Companies – entering data for companies using SPT,
- Fuel tanks – a preview of the fuel level in the tanks,
- Stations – configuring SPT for fuels, refuelling stations, filling stations,
- Settings – entering basic data related to sales through SPT,
- Service,
- Invoices – issuing invoices,
- Users – granting rights to users,
- Change codes – accounting for unused change codes.

5. Conclusion

The management of green energy is very important especially in sustainable development processes. The electric and hybrid cars allow for reducing environmental pollution. However the energy-selling process for electric and hybrid cars requires automatization to a high degree, especially in the COVID-19 pandemic. The Smart Payment Terminal is an approach for resolving this problem. The terminal is installed mainly in petrol stations. The functionality and technical solutions of SPT allow not only for the automatization of selling energy, but also for advanced analysis of payment transactions. Future research may relate to including machine-learning methods for energy sales prediction by SPT.

Acknowledgement. The research is financed by the Ministry of Science and Higher Education in Poland under the programme "Regional Initiative of Excellence" 2019-2022 project number 015/RID/2018/19 total funding amount 10 721 040,00 PLN – the research part and by The European Regional Development Fund under: Priority Axis 1 "An innovative and competitive economy", Actions 1.2 "Strengthening the innovation potential of Wielkopolska" of the Wielkopolska Regional Operational Programme for 2014-2020 the project entitled "Carrying out research and development works in order to develop a prototype terminal for the self-service sale of fuels and gas" No. RPWP.01.02.00-30-0101 / 16-00. – development part.

References

Berman, SAE Mobilus. (2020). Retrieved from https://www.sae.org/news/2020/08/iso-ev-plug-and-charge-standard-faces-security-concerns

Bobeth, S., & Kastner, I. (2020). Buying an electric car: A rational choice or a norm-directed behavior? *Transportation Research Part F: Traffic Psychology and Behaviour*, *73*, 236–258. Retrieved from https://doi.org/10.1016/j.trf.2020.06.009

Formánek, T., & Tahal, R. (2020). Socio-demographic aspects affecting individual stances towards electric and hybrid vehicles in the Czech Republic. *Central European Business Review*. Retrieved from https://doi.org/10.18267/j.cebr.238

Giansoldati, M., Monte, A., & Scorrano, M. (2020). Barriers to the adoption of electric cars: Evidence from an Italian survey. *Energy Policy*, *146*, Retrieved from https://doi.org/10.1016/j.enpol.2020.111812

Gómez Vilchez, J. J., Jochem, P., & Fichtner, W. (2020). Interlinking major markets to explore electric car uptake. *Energy Policy*, *144*, 111588. Retrieved from https://doi.org/10.1016/j.enpol.2020.111588

Hardman, S., Jenn, A., Tal, G., Axsen, J., Beard, G., Daina, N.,…, Witkamp, B. (2018). A review of consumer preferences of and interactions with electric vehicle charging infrastructure. *Transportation Research Part D: Transport and Environment*. Retrieved from https://doi.org/10.1016/j.trd.2018.04.002

https://www.volkswagen.pl/pl/elektromobilnosc/baza-wiedzy-id/ladowanie-i-zasieg-samochodu-elektrycznego/jak-moge-placic.html

Jokisuu, E., McKenna, M., Smith, A. W. D., & Day, P. (2015). Improving touchscreen accessibility in self-service technology. In *Lecture notes in computer science (including subseries lecture notes in artificial intelligence and lecture notes in bioinformatics)* (vol. 9176, pp. 103–113). Springer Verlag. Retrieved from https://doi.org/10.1007/978-3-319-20681-3_10

Kołaczek, P. (n.d.). *ELIT Polska Information Magazine*. Retrieved from https://elit-news.pl/samochody-elektryczne-i-hybrydowe-i-ich-wplyw-na-srodowisko/

Li, Z., Khajepour, A., & Song, J. (2019). A comprehensive review of the key technologies for pure electric vehicles. In *Energy*. Retrieved from https://doi.org/10.1016/j.energy.2019.06.077

Lorentzen, E., Haugneland, P., Bu, C., & Hauge, E. (2017). *Charging infrastructure experiences in Norway – The worlds most advanced EV market* (EVS 2017 – 30th International Electric Vehicle Symposium and Exhibition).

Milev, G., Hastings, A., & Al-Habaibeh, A. (2020). The environmental and financial implications of expanding the use of electric cars – the case study of Scotland. *Energy and Built Environment*. Retrieved from https://doi.org/10.1016/j.enbenv.2020.07.005

Pavan, A. M., Lughi, V., & Scorrano, M. (2019). *Total cost of ownership of electric vehicles using energy from a renewable-based microgrid* (2019 IEEE Milan PowerTech, pp. 1-6).

Philipsen, R., Schmidt, T., & Ziefle, M. (2018). Fast-charging stations or conventional gas stations: Same difference? – variations of preferences and requirements. *Advances in Intelligent Systems and Computing*. Retrieved from https://doi.org/10.1007/978-3-319-60441-1_91

Piszczatowska, J. (2020). *Axon Pay*. Retrieved from https://www.green-news.pl/1435-pierwsza-ladowarka-samochodowelektrycznych?fbclid=IwAR11MqVCF4FNJQOmicXcEkV7n49w8biZ1x-FUAGZEtE6yRdTT2OBwC7QYUSE

Scorrano, M., Danielis, R., & Giansoldati, M. (2020). Dissecting the total cost of ownership of fully electric cars in Italy: The impact of annual distance travelled, home charging and urban driving. *Research in Transportation Economics*. https://doi.org/10.1016/j.retrec.2019.100799

Secinaro, S., Brescia, V., Calandra, D., & Biancone, P. (2020). Employing bibliometric analysis to identify suitable business models for electric cars. *Journal of cleaner production*, *264*, 121503). Retrieved from https://doi.org/10.1016/j.jclepro.2020.121503.

Sikorski, M. (2020). *Green news*. Retrieved from https://www.green-news.pl/1372-ekoenergetyka-polska-aarhus-stacje-ladowania

Vakulenko, Y., Oghazi, P., & Hellström, D. (2019). Innovative framework for self-service kiosks: Integrating customer value knowledge. *Journal of Innovation and Knowledge*, *4*(4), 262–268. Retrieved from https://doi.org/10.1016/j.jik.2019.06.001

Vogt, M. (2017). *The customer perspective of a user-oriented public charging infrastructure*. (EVS 2017 – 30th International Electric Vehicle Symposium and Exhibition).

Walaszczyk, E., Dankiewicz, P., & Hernes, M. (2020). *The smart payment terminal as an intelligent answer to process management problems in gas stations in Poland. Education excellence and innovation management: a 2025 vision to sustain economic development during global challenges.*

Wang, J., He, Q., Xu, Y., Han, Q., & Zhou, Z. (2017). An unified payment method of charging piles based on blockchain. *Proceedings of Science*. Retrieved from https://doi.org/10.22323/1.299.0085