



DIGITAL STUDENT ID, IDENTITY MANAGEMENT AND INTERNET OF EVERYTHING IN EDUCATION DURING COVID-19

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Abstract: In the conditions of the new reality imposed by COVID19, certain organizational problems of online teaching are noted worldwide. These problems can be classified into two main categories. The first category includes ICT support of the online educational processes, such as internet grants and appropriate hardware and software, for general and individual usage. The second category includes the creation of digital identities through a special category of smart cards, known as digital ID cards or e-ID cards. Starting with an overview of the different types of smart cards, this paper explores the potentials of applying e-ID cards to students in educational processes and beyond. Different stages of development and implementation are considered, such as linking the personal data included in the student eID cards with management systems and the Internet with everything. As an integral part of this paper, a questionnaire was made about the opinions of students, regarding the possibilities and areas of using student e-ID.

Keywords: e-ID cards, IoE, ID management, Covid19

1. INTRODUCTION

The concept of smart cards was created in response to the need for electronic transfer of personal data during various personal digital activities. Despite changes over time, smart cards have retained some basic features present since their first appearance. The evolution of smart cards dates back to 1968 when a plastic card with a built-in chip was first promoted, and in 1996 was the first deployment of chip cards on an university campus. Since the beginning of the 21st century, the use of smart cards has been expanding due to the widespread use of the internet and mobile telephony. The major advantage of the smart card over the classical ID card is its capacity to store a larger amount of information, and its programmability for various use, such as ID validation, data authentication, financial transaction, loyalty marketing programs, secure computer networks (Praveen et al, 2018). These cards are available in a variety of formats, physical and digital, and are used by banks, shops, government and educational institutions, service offices, in order to perform a variety of transactional activities. Regarding the realization of smart cards, various applications, communication and manufacturing specifications, developed by the International Organization for Standardization (ISO) are used, such as: ISO7816-1, for physical characteristics, ISO7816-2, for electronics contacts, ISO7816-3 for electrical signals,

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ISO7816-4 for communication protocols and ISO7816-7 for commands of query language (Heichlinger&Gallego, 2010; Praveen et al 2018). According to the infrastructure and standards for smart cards (Shelfer et al, 2014), the following categories stand out: standard chip cards and digital identification (e-ID) cards, both smart cards used for all of the aforementioned applications.

The chip cards, can be recognized in one of the following main categories:

- Contact cards - the most common type of smart card, which has external contacts available to interact with the card reader;
- Contactless card - these are smart cards that use technologies such as radio frequency (RFID) or Near Field Communication (NFC) between the card and the reader without without physical insertion of the card;
- Multicomponent cards - these types of cards are for certain predefined business needs, such as the application of biometric solutions, built-in fingerprint sensors, generating a one-time password for Internet banking applications.

The digital ID card can be described as a card that stores digital identity data and enables digital identification and verification wherever needed. Digital identity is primarily a question of “digital user ID” in which data security is the dominant concern and primarily of interest to businesses and public administrations. Digital identification, is a digital solution for proving the identity of citizens or organizations, such as online authentication and login, and the use of a digital signature. In this context, a digital ID card is the electronic equivalent of an individual ID card.

The digital ID can be submitted electronically to prove the identity of the individual and their right to access information or services over the internet (Geteloma et al., 2019). Digital ID card or e-ID is a concept that allows the card to be non-physical, which means that the data it contains can be completely cloud based (Bart, 2019). This digital form of card is especially convenient because it allows access to mobile devices, such as smartphones, through appropriate software. Depending on the country and the scope of application, digital ID cards, as a separate category of smart cards, are used under different names, such as e-ID Card, Citizen Card, National ID card (Lentner & Parycek, 2016), and more recently the term e-ID global passport, in a geopolitical context (Dijck&Bart, 2019).

Depending on the applications available for installing a smart device or logging in to the cloud, the possible areas of separate or combined use, follows: National ID card, e-Banking, e-Education, e-Government services, e-Voting, European travel card (Dijck &Bart, 2019). When enhanced authentication and security measures are required, the use of PIN (Personal Identification Number) and OTP (One Time Password) is preferred over the classic password.(Geteloma et al 2019; Nivetha et al 2015). Smart card technologies include ID management systems in charge of rights and privileges that individual users and service providers have mutually agreed upon as a work paradigm.

2. HIGHER EDUCATION ITEMS IMPOSED BY COVID-19 REALITY

The widespread presence of Covid-19, during the 2020, and the half of 2021, has changed many traditional ways of communicating towards their partial or complete digitalization, in many areas of human living including higher education. In addition to the digitalization of educational processes, organizational problems arose that needed to be addressed.

The digitalization of higher education, in addition to the digitalization of educational content, also includes the organization of educational processes. Some of these processes are indirectly educational and require interactive work and knowledge assessment processes, which should be related to the each student digital identity. On the other hand, working in virtual classrooms imposes the need for management of rights and privileges for access to content and tools for practice and evaluation, as well as the need for full tracking of student activities. Another category of digitized activities are the administrative procedures related to the educational processes, as well as the records of the students' behaviour and progress during the semesters. Around the world, governments in many countries have provided relief to the student population by awarding various vouchers, promotions and discounts to help and facilitate the social aspects imposed by the Covid-19 situation. The previous introductory explanations lead to the conclusion that digital e-ID cards are especially suitable for students and applications in higher education. Their advantages are enhanced by the effects of the Covid-19 situation.

2.1. DIGITAL STUDENT e-ID – RESEARCH QUESTIONNAIRE

During the first semester of 2021, the students who were enrolled on the Advanced Programming course at the Faculty of ICT - Bitola, filled in an anonymous voluntary questionnaire on the topic of Digital students e-ID cards use during the crisis COVID-19 and in general. The questionnaire was completed by 60 students, which is 78% of the total number of students. The purpose of the questionnaire is to get an informative overview of the trends in the answers. The reason for the analysis of the student e-ID card are the intensified online activities in the pandemic, but after the analysis the many reasons for its comprehensive application are seen. The following is a brief overview of the findings.

According to Fig. 1, when asked about the familiarity and attitudes on the smart card and e-ID card, the students gave the following answers:

- From the total number of students who answered the questionnaire 88% of them are familiar with classic smart cards, versus 67% which are familiar also, with e-ID cards.
- Student e-ID card as more appropriate for the needs of students is assessed by 76.3% versus 23.3% who prefer a smart card with physical realization card
- Regarding the use of various types and formats of smart cards, which are in circulation for different uses, when asked if they use them personally or know someone who uses them, the students answered positively, as follows: 96,7% bank electronic cards; 73,3% , ID cards for discounts and promotions, and sets of various conveniences, offered by shops for various types of appliances, jewellery, drug and cosmetics drug-stores, food, IT equipment, medicines and cosmetics pharmacies, food, IT equipment; 40% reported using smart cards for membership in various clubs, such as fitness clubs, beauty salons and much more; and finally only 1% answered with none of them.
- According to the applicability and usefulness, specifically on the student e-ID card, 98.3% of students think that it is useful as a product and need of the new time, regardless of covid-19

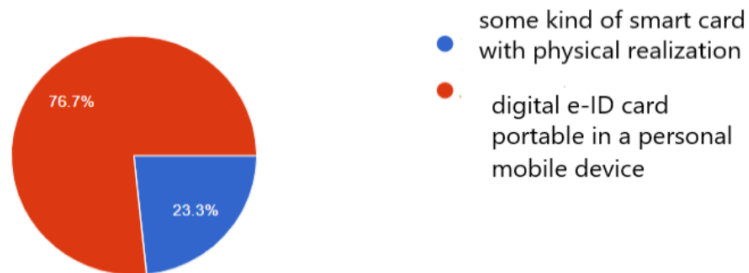
Which of the terms do you know?

60 responses



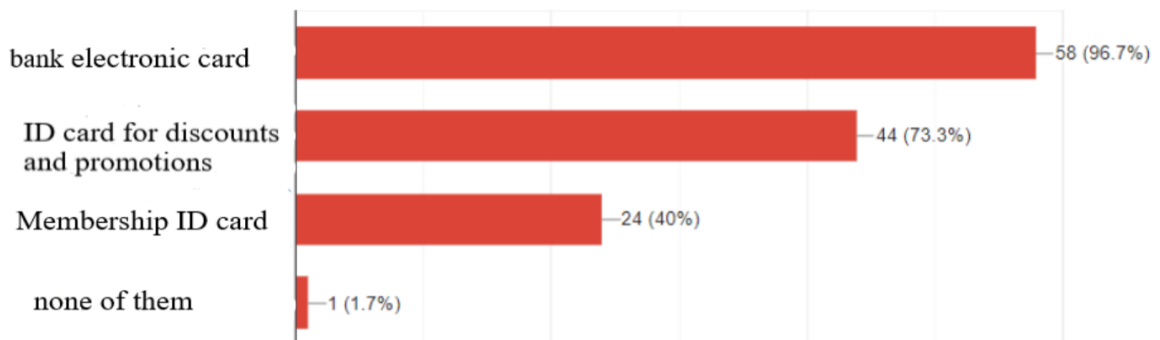
Which card is more suitable for the student needs

60 responses



I use one of the listed smart cards, or I know someone who uses it

60 responses



Applicability and usefulness of student e-ID card

60 responses

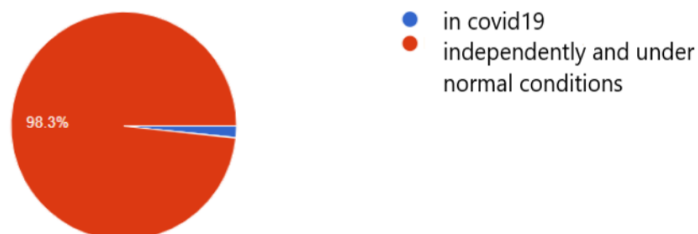
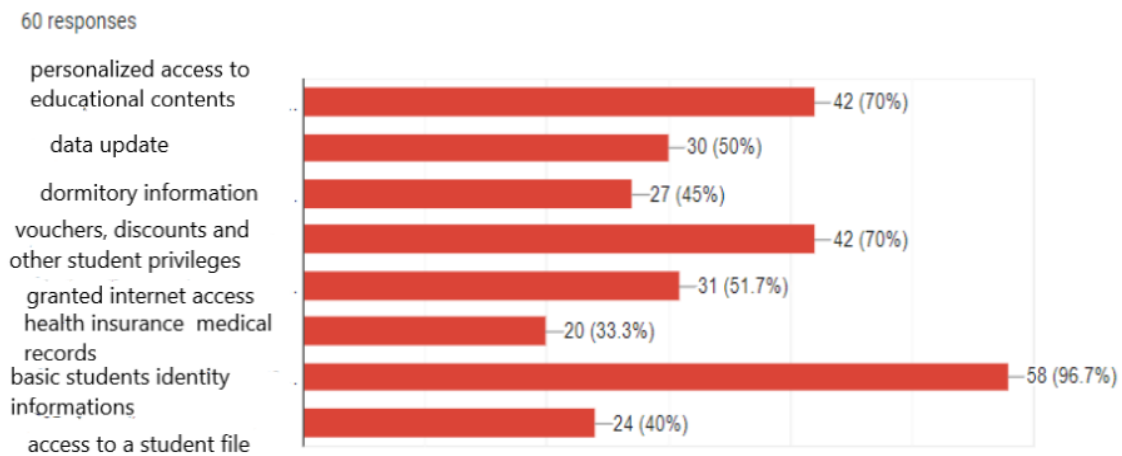


Figure 1: Basic review of familiarity and attitudes about a student e-ID card

The previous findings mostly referred to the direct information and experiences with the e-ID card, as well as to some basic views on its use. The following remarks represent the student e-ID card, from the point of view of the functionalities and the most convenient ways of its realization, according to the opinions of the students.

Cloud Data and functionalities that should be available on a student e-ID card, housed on a smart personal device



Problems that e-ID can prevent (online and / or physical presence)

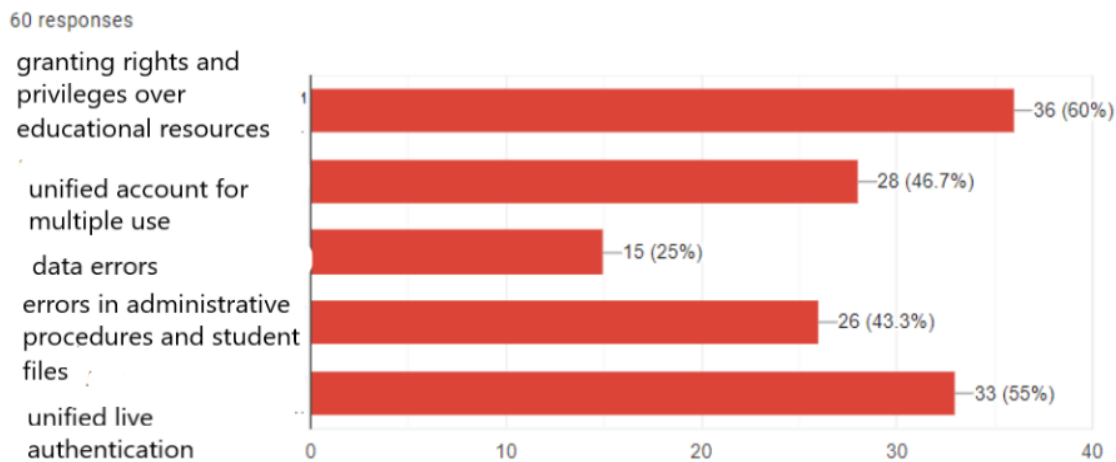


Figure 2: Functionalities and solutions offered by the use of the student e-ID card

In terms of students' expectations for a student e-card, they can be classified into the following main categories: functionalities it may have, problems it may solve, and how data is stored to be customizable and accessible. The most appropriate solution is for the data of interest for the students to be placed on the cloud management system and to be available on a personal smart device. A new trend, which is growing, is connecting data and combining it in different ways through new and up-to-date functionalities.

According to Fig.2, the expectations and functionalities seen by the students, their perception is as follows:

- For 96.7% of the surveyed students, an e-ID card should contain basic information about the student.
- A significant 70% of students find it useful to have a student e-ID card to provide personalized access to educational content in terms of assigned rights and privileges, as well as monitoring the activities to be evaluated
- An identical percentage, 70% of students find it useful to have access to the card and information on various student discounts, vouchers, promotions of IT equipment, and other student offers and privileges, with the possibility of replenishment, as given to students as an opportunity
- Almost identical percentage of 50%, respondents think that they should be given the opportunity to update the data, compared to 51.7% who think it is good when travel to different universities and various student campuses, to have free access to the Internet
- 45% of the respondents think that the information about the dormitories is welcome, 40% that there should be an option for connection with the student dossier, and some of the students, more precisely 33.3% find it useful for accommodation of medical data and health insurance.

The availability and organization of data from a student e-ID card can solve and prevent many of the occasional and potential problems, in the following context, according to Fig.2:

60% of students see student e-ID card as a solution to inconsistencies and problems in accessing educational content, when in different places there is a discrepancy in the assigned rights and privileges.

In the previous context, 55% of respondents believe that an e-ID card would prevent problems with unified identification, and

Almost the same percentage, 46.7% believe that it is good to integrate and merge multiple different accounts into one contained on the card.

25% of respondents believe that with good data management, a student e-ID card use will prevent data errors.

The received information is only a framework direction, towards the preparation of a conceptual solution for student e-ID card development.. The following are theoretical and practical analyses of the potential solutions that can to the greatest extent possible meet the expectations and needs of the students who should be users of the student e-ID card.

2.2. INTERNET OF EDUCATIONAL THINGS AND STUDENT E-ID CARD

During the last decade the term Internet of Things (IoT), as a networking of physical objects, has been recognised as a widespread concept in many areas of everyday life. Furthermore, as the next stage of evolution in the use of smart object-interconnected things in which the line between physical object and digital information about is blurred, the Internet of Everything (IoE) concept appear. As the use of new technologies to acquire generally new knowledge becomes more and more widespread, the transition from IoT to the IoE concept is gradually taking place, which basically means networking of people, processes, data and things (Selinger et al, 2013). In the particular case where data, processes and people are related to educational activities, and things are general purpose, the Internet of Everything (IoE) concept grows into Internet of Education (Aldowah, 2017).

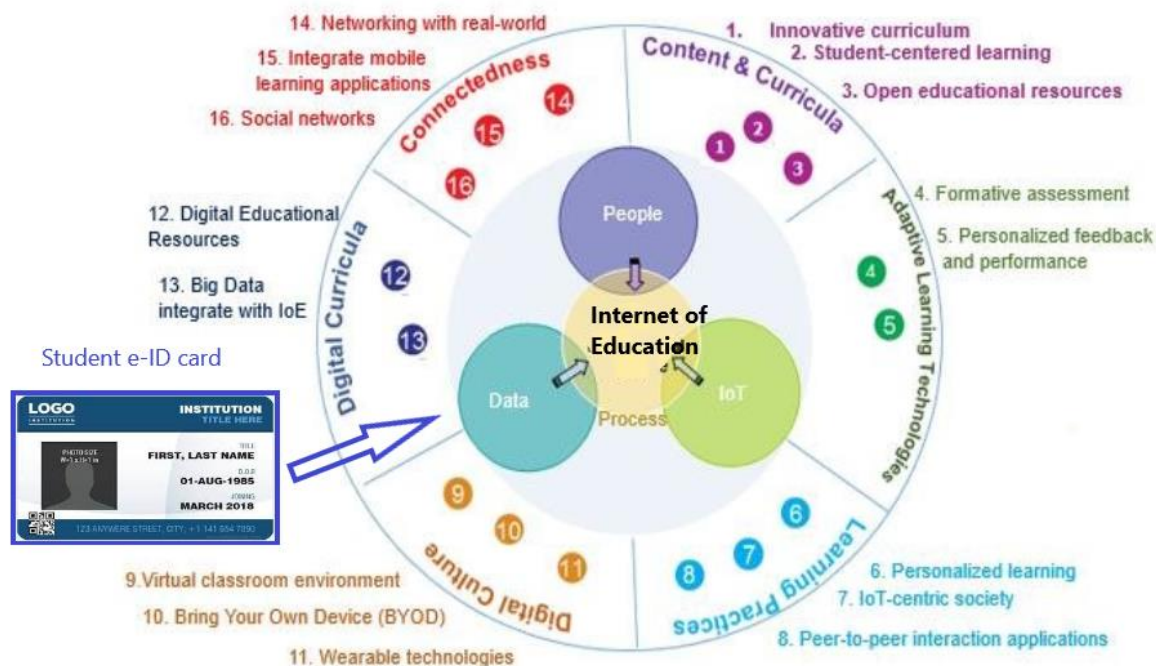


Figure 3: Internet of Educational Things and e-ID card (adapted from Bandara & Ioras 2016).

The permanent growth and changes of educational contents, create an endless demand for new forms of learning. New technologies such as cloud computing, mobile learning, learning analytics, open content, virtual and remote laboratories, games and gamification, tablet computing, and wearable technology is instilling a new digital culture, where a new educational paradigm called Internet of Education appear (Bandara, 2016). The Internet of Education, in theory and practice, (Putjorn et al., 2015) to distinguish itself from the Internet of Everything (IoE), is also known as the Internet of Educational Things (IoET). In the IoET concept, the digital student e-ID card fits in perfectly, as a very appropriate digital identity in a digital work environment. The digital student e-ID card and the Internet concept of education, developed and used before, have gained their full meaning and applicability in conditions of pandemic COVID-19. Certain solutions and educational practices may have been conditioned by the pandemic, but the positive experiences and real relief they have brought will no doubt remain in place after the COVID-19 crisis.

3. DEVELOPMENT CONCEPT OF DIGITAL STUDENT E-ID CARD

The reason for making this paper and studying the subjects in it, was the idea of using digital identity in a digital environment, including digital education, imposed by COVID-19. As research and insights have progressed, it has become clear that COVID-19 is just an occasion, and the reasons for using student digital ID cards are much greater, due to the conveniences and scalability they offer. The student e-ID card can be analysed from two aspects: the requirements it needs to meet, in terms of data and functionalities, and the digital identity protection it needs to provide.

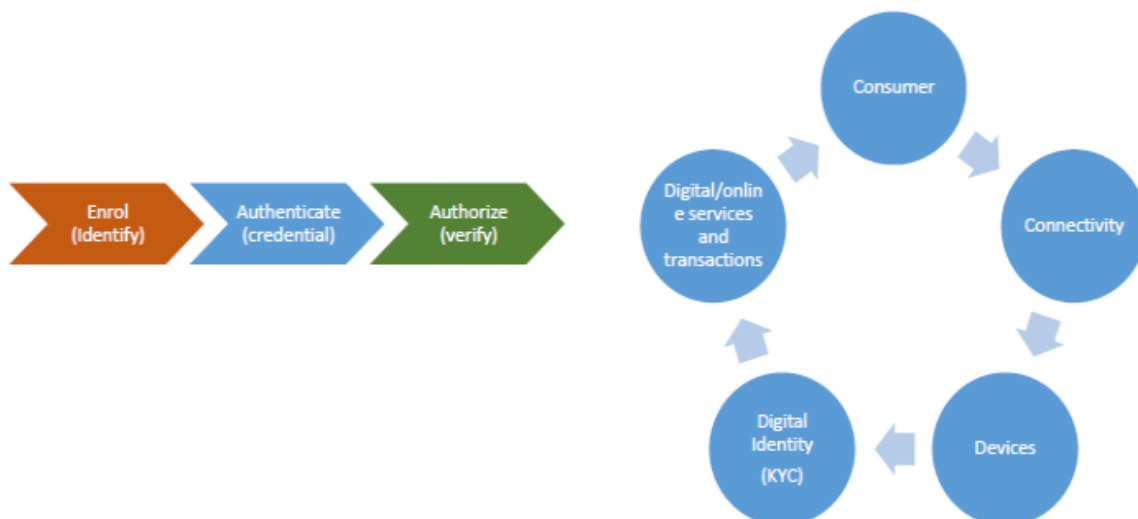


Figure 4: ICT ecosystem for Digital identification (ITU,2018)

In continuation, the basic items for the development of an open source student e-ID card will be reviewed. The following is an overview of the main functional and non-functional requirements of the lightweight open e-ID Card application (Hühnlein et al., 2012) stored on a personal smart device: Support for all popular platforms (Windows, Linux or Mac OS, NFC enabled mobile devices, Android); Modularity, open interfaces and extensibility; Architecture based on related ISO standards; Browser integration; Security components; Open source capable; Transparency; Stability; High usability; Accessible GUI; Event manager, with function to return the state of a monitored terminal, or cloud data, after an event has occurred; and Card recognition options.. As shown in Fig.4 the identity identification process consists of three stages: Enrolment(identification); Authentication(credential) and Authorisation (verification). After that, the circle of requests is approached, which is given in general form not only for student e-ID but also, but also for other activities (Lentner&Parycek, 2016; Ratakonda et al., 2020) necessary for everyday life. This circle contains digital network services and transactions (International Telecommunication Union, 2018), related to digital identity, most often accessed on a specific consumer's smart device.

3.1. STUDENT E-ID CARD -SOLUTION COMPONENTS AND REALISATION WAY

In the last decade, digital identity, realised on scalable platforms, has been available in several European countries under different names, such as: smart ID, in Estonia (www.e-estonia.com), German e-ID (www.bsi.bund.de), E-card of Malta, with a trend of expanding use. Furthermore, assessing the importance of these trends, the European Commission has adopted a Regulation on Electronic Identification, Authentication and Trust Services (eIDAS) providing the basis for cross-border electronic identification, authentication and certification of a website within the EU. The European Commission has set a number of goals and milestones for the electronic identification of its borders and beyond. For example, by 2030, all key public services should be available online, including a significant amount of open source content and offers for higher education. On the other hand, worldwide, services are available for creating digital eID cards, for optional purposes, accompanied by content management systems, with the possibility to be tested and used in a trial period and then leased by of institutions.

3.1.1. Digital ID Card application and ID Management System – ID123

The following is a description of software for creating a digital student e-project, as one of the offered options, with a cloud management system and an application available for installation on a smart personal device. As a pilot software, for the description of the required items and components, completely rounded from application to ID management system, the cloud software ID123 (available on <https://www.id123.io/>), is taken.

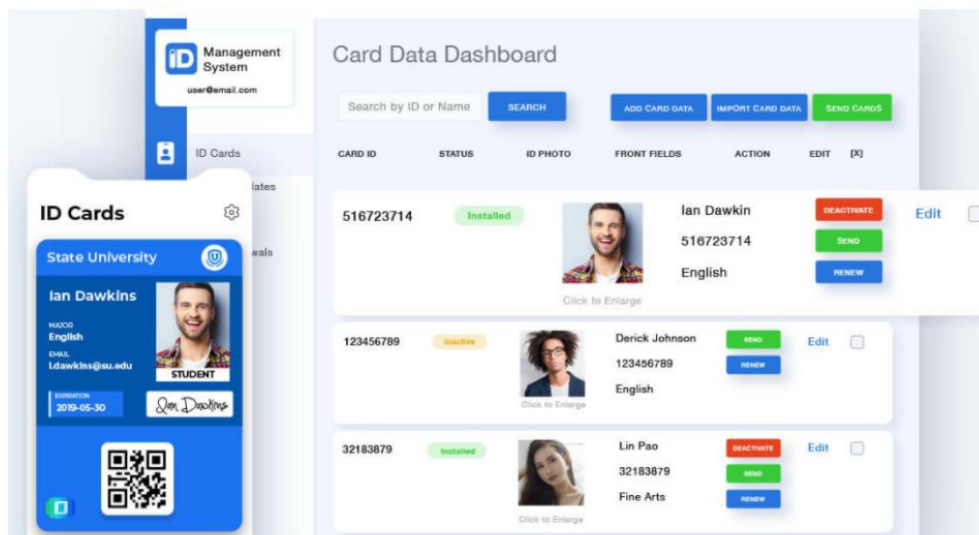


Figure 5: ID123 - Student e-ID card and ID management system

Possibilities for creating various ID cards are provided, including Digital Student ID Cards, briefly described as student e-ID. There is an opportunity for subscription at the level of institution, for example, faculty and university and the opportunity to create and administer various accounts- student e-ID cards. The application available on Google Play and Apple store is equipped with the following features: Offline work mode; In-App ID photo submission; Cardholder signature setting; Scannable barcode with third-party barcode scanner; Multiple digital ID cards storage in the app; Up to 12 fields to add important card information; Notifications when to receive important messages from their institution; System offers multiple layers of security to protect user identity and prevent ID fraud, such as: Two-factor authentication; App activity alerts; Encrypted cloud storage; Screenshot and recording prevention and Automatic card expiration. Cloud ID management system enables all data transactions and security mechanisms at the level of digital identity, including the validity, renewal of each e-ID card or change of rights and privileges in it. The following main specific features are included: ID cards issues management: deactivate, activate, archive, and renew installed e-ID cards; Card data import options via CSV, API or through an integration.

4. CONCLUSION

The transition to a digital society at all levels of human life inevitably brings with it a need for a digital identity. By analogy with the real world, digital identity can also be tailored to a particular set of communication needs, and can be scalable. The main idea for the analysis of the potentials for using the student e-ID card originates from the COVID-19 situation, but during the research, the analyses showed that the student e-ID as a concept, is

very suitable for moderated specific purpose independent of imposed pandemic. In modern ICT solutions, as software solutions are developed and hardware devices are modernized, the concepts of their application are growing. Thus, over time, the concept of IoT has grown into IoT, and with the adaptation to the specific widespread ICT educational ecosystem, IoET has emerged. All of these solutions have been created and are constantly growing, thanks to scalable open source offers and cloud applications and concepts, which have made ICT solutions more accessible than ever before. The findings provide a recommendation for the active introduction and application of the concept of student e-ID card, as a part of the overall digital identity, which technology is striving for in the near future.

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