

Large Scale Civilian Digital Identification Systems- A Technological Perspective



Dharam Pal Singh, A. J. Singh

Abstract: *Human identity is a notion that takes into consideration the philosophical and physiological aspects. Philosophical aspects of identity narrates specifically the sentiments of humans that arises from the social status of an individual and identify individuals as belonging to a particular group. However, the physiological aspects takes into account the identification of the humans on the basis of some physical parameters such as height of an individual or the biometric traits. The Issues of national importance have steered the need for the setting-up of the formal identification system for the establishment of the physiological identity of the residents of a country, especially the digital identity. The issues of national importance include national security, border security and delivery of the government services to the residents of a country in an electronic mode etc. Before the advent of the Information and Communication Technology (ICT), documents such as passport, driving license and ration card etc. were used to establish the human identity in order to avail various services of the government and non- government organizations. ICT has enabled the government across the world to devise digital identification systems for providing the digital identity to the individuals as well as mechanisms for the authentication of the digital identity. Depending upon the national policy, some of the countries have made it compulsory and some others have made it voluntary to enroll the residents of the country into the digital identification system. The digital identification systems can take different technological shapes depending upon the variables such as the state of the art of the digital infrastructure in a country, population of a country, literacy rate in the country and the geographic dimensions of a country. The paper discusses the large scale civilian identification systems of the countries that are the pioneer in the setting up of the large scale civilian digital identification system and the technological issues involved therein.*

Keywords: *Centralized Database System, Digital Identity, Federated Database system, Human Identity.*

I. INTRODUCTION

If an individual wishes to enroll into an identification system to avail identity, it requires first to have legal identity. Non-existence of legal identity of the residents of a country

leads to serious ramifications both socially and economically. Identification is a pivot element that facilitates communication between the residents of a country and the government and the non-government entities. Lack of identity causes exclusion from the critical services such as socio-economic services offered by the government and non-government organizations and hinders the individual's participation in the government. Identification of the individuals has been in practice from the early civilizations. The use of biometric traits such as fingerprints, height etc. find mention dating back from the era of Before Christ (BC). The prehistoric records of China reveals the use of fingerprints in investigation to unveil the suspects. In the ancient Babylon, fingerprints were in practice for the business transactions [1]. In 1684, Dr. Nehemiah Grew, published his work on the ridges on the skin of hands, palms and feet [2]. In ancient Greek, the height was used to identify individuals. Though, the identification of the individuals in ancient times was limited for the specific purposes such as criminal investigation and business transactions etc. With the expansion of the civilizations and interaction of people among various civilizations, the identification of the individuals took a whole new picture. People have identified one another as belonging to a particular ethnic group. With the invention of money and its participation in the transactions, it had become necessary to know with whom an individual is dealing and executing a transaction. Pre ICT era, the nature of the most of the transactions was happened to be face to face, therefore, a piece of paper or knowledge of the secret question was enough to establish the identity of an individual. Successively, the emergence of ICT has turned out to be the game changer in determining the economy of a country. A piece of paper as an identity document has become obsolete. Most of the transactions have started taking place in an online mode, where people sitting on one corner of the geographic location communicate with the people sitting on a terminal on the other end of the geographic location. The physical presence of an individual to carry out various types of transactions had become history. Governments worldwide have changed the way the governance was delivered to the residents of the country and shifted to the novel models of delivery of the governance to the residents that would employ the applications of ICT. It has resulted in the emergence of e-governance. Along with, the factors of national importance such as the national security, border security, social security, economic security of the residents, illegal migration, increasing rate of terrorism and nation's development have aroused the need to set up a formal system to provide identity to the residents of a country,

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specifically the Digital Identity and to authenticate the identity thereof [3]. According to the global dataset released in the year 2018 by the World Bank's Identification for Development (ID4D) program, one billion people across the world do not have an official proof of legal identity [4]. The following figure (Fig. 1.) represents the population in numbers worldwide, without any legal proof of identity.

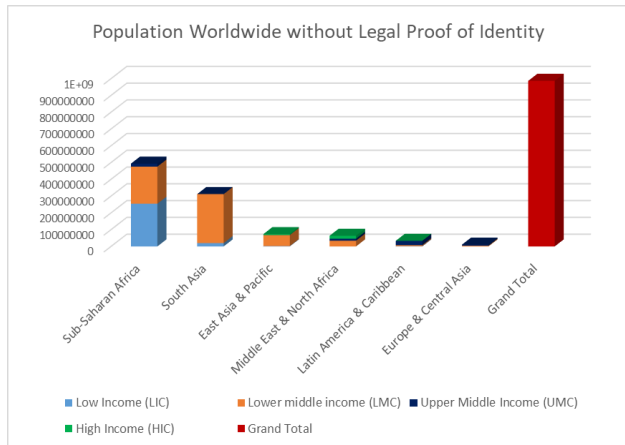


Fig. 1. The Number of People Worldwide, Not Having Legal Proof of Identity

Source: World Bank Group, ID4D Data: Global Identification Challenge by the Numbers, 2018 [4]

A. Digital Identity, Human Identity and Human Identification

The attributes associated with an entity distinguish it from other entities within context and/or classify him/her as belonging to a particular group. Such attributes constitutes the identity an entity. Human identity is the representation of an individual's identity in the form of an attribute or attributes so that he/she can be distinguished uniquely from other individuals within context or whose resemblance can be established to a particular group. The general attributes about an individual can include the parentage and height etc. and the specific attributes can include the demographic and biometric details. The digital identity of an entity, therefore, is the representation of the attributes of an entity in the digital form, so that it can be uniquely distinguished from other entities within the digital context [5]. Human Identity refers to the fact of being a particular person and not other. Human identification is the practical notion and refers to the establishment of the identity of an individual and verifies the claim of an individual of being oneself to be true or false with high degree of certainty [6]. The following figure (Fig. 2.) illustrates the digital human identity.

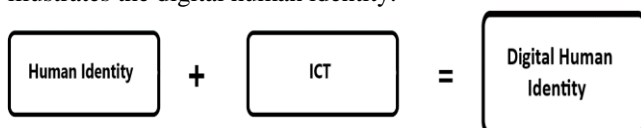


Fig. 2. Human Identity and Applications of ICT Constitutes the Digital Human Identity

(Source: Compiled by Authors)

B. Large Scale Civilian Digital Identification System

An identification System dedicated to provide legal

identity to the residents of a country, capable to verify the identity of the residents in a reliable and secure manner, helps to achieve the goals of the national importance and which is backed by the law is a candidate system for the large scale civilian identification. The term 'Large Scale' specifically refers to the population of a country [7]. With the unprecedented advancement in ICT, the term 'Large Scale Civilian Identification System' has become more synonym with the biometric based digital identification system such as a National Identification System. The identification system in a country can be either Foundational, Functional or Transactional [5]. The Foundational Identification System is developed by the government of a country and it is a formal national identification system in the country responsible to provide identity to the residents of the country. Such a model of identification system results in a unified system that fulfils entire needs of the government such as the delivery of the governance in an online mode, border security, national security and in other matters of national importance. The Functional Identification System is designed and developed by the government or by the non- government organizations to meet a particular theme such as the identification of the residents for the electoral purpose, healthcare system, telecom system and education system etc. The Transactional Digital Identification System is developed to facilitate the financial transactions among various government and/or non-government organizations and residents of the country. In order to develop the Large Scale Civilian Identification System in a country, it needs necessarily to be the Foundational Identification System.

II. TECHNICAL ISSUES IN THE DESIGN OF THE LARGE SCALE CIVILIAN DIGITAL IDENTIFICATION SYSTEM

In any of the digital identification systems whether foundational, functional or transactional; the identity of an individual can be established through any one or combination of the following such as knowledge based i.e. "what someone knows" such as a secret question or password or by producing something that an individual holds such as a smart card and/or what individual possess such as biometric traits. Among knowledge based, card based and biometric based identification systems, the one that operates with biometrics of an individual as identity attributes is deemed to be more secure because biometrics is something that is hard to fake as compared to knowledge based and card based identity attributes [8], [9]. In order to establish the digital identity of an individual, two types of processes take place. a) Identification and b) Authentication. The process of identification is the one time process in the life time of an individual and it takes place at the time of the enrolment of an individual into the identification system in order to provide him/her the unique identity. Whereas, authentication is a multi-time process and it takes place as many times the services are extended to the individuals by the government and the non- government organizations; in order to verify the unique identity of the individuals,

so that the services/benefits could reach the intended beneficiaries. Biometrics is vitally employed technology that the countries' are adopting worldwide in order to provide digital identity to the residents of the country [10]. However, it is plagued with the concerns of privacy and security issues [11], [12]. Another major technical issue in the design of the large scale civilian digital identification system is the storage of the citizen centric data¹ that specifies the architecture of the identification system. Most of the countries have adopted centralized architecture for the development of the large scale civilian digital identification system [3]. The examples of the identification systems with the centralized architecture include Aadhaar in India, Population Register in Estonia and RENIEC in Peru. The following figure (Fig.3.) illustrates the centralized architecture to develop an identification system in which the centralized database system is employed to store and process the citizen centric data.

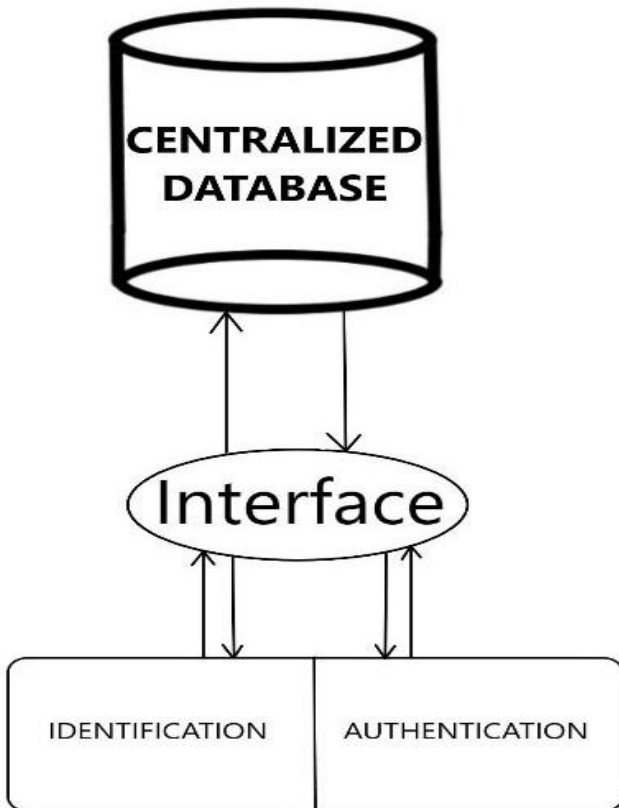


Fig. 3. Centralized Architecture for the Development of the Large Scale Civilian Digital Identification System
(Source: Compiled by Authors)

Another architectural consideration for the design and development of the foundational digital identification system is the Federated architecture. The Government of United Kingdom has adopted the federated architecture for the development of the large scale civilian digital identification system, known as “GOV.UK Verify” [13]. The operational difference between the architectures of civilian digital identification systems lie in the manner of the execution of the processes of identification and authentication i.e. whether, the

¹Biometric Data and Demographic Data of the whole population of the county, who have enrolled in to the foundational digital identification system.

operations of authentication and identification are executed simultaneously by the one and the same database system (the centralized architecture) and/or executed simultaneously by multiple database systems (the federated architecture). The following figure (Fig.4.) illustrates the federated architecture for the development of the large scale civilian digital identification system in a country.

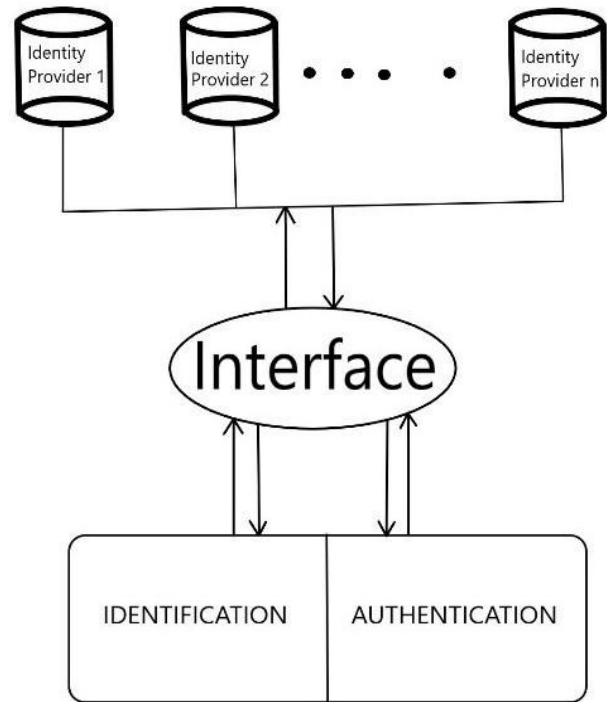


Fig. 4. Federated Architecture for the Development of the Large Scale Civilian Digital Identification System in which Government Accredited Entities are Involved in the Process of Providing Identity to the Residents of the Country and Authentication Thereof.

(Source: Compiled by Authors)

In the large scale civilian digital identification system of India i.e. Aadhaar, the Central Identity Data Repository (CIDR), which is a single centralized data repository, stores and processes the biometric and demographic data of the residents of the country, executes both the processes of authentication and identification simultaneously [14]. In the identity system of United Kingdom, GOV.UK Verify, the processes of identification and authentication are executed by the same database system, however, the number of database systems executing the processes of identification and authentication are multiple in numbers. It provides the opportunity to the residents of the country to enroll in to more than one identity provider to avail digital identity [13].

III. INTERNATIONAL DEVELOPMENTS IN PROVIDING IDENTITY TO THE RESIDENTS OF THE RESPECTIVE COUNTRIES

The United Nations Development Programme (UNDP) “Sustainable Development Goals” have addressed the world’s identification gap to be a huge hurdle in the sustainable development of a nation and of the world as a whole.

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The Goal 16 of Sustainable Development Goals of UNDP has recognized the stern need to provide legal digital identity to every individual on earth including registration of births by 2030, in the target 16.9, in order to achieve the goals of inclusive and sustainable development [15]. Pre ICT era, irrespective of the purpose, if it is the issues of national importance or the criminal investigation, the countries around the globe have in place the paper based mechanisms for establishing the identity of the residents. The proliferation of ICT has prompted a paradigm shift in: i) governance to e- governance, ii) the models for the socio- economic development of the citizens by the government and iii) the functioning of the government and non-government organizations. It has become a top priority of the government's worldwide for the development of a formal identification system to provide identity to the residents of the country and more specifically the digital identity. The World Bank Group's Identification for Development (ID4D) global dataset released in 2018 shows that 161 Economies in the world have opted for the electronic identification (eID) system [4]. Based on the architecture of the large scale civilian digital identification system, the present paper has selected the large scale civilian identification systems of India, United Kingdom, Estonia and Peru. The identification systems developed by these countries have acted as the guiding examples to other countries in the world to develop and set up the identification system.

A. Aadhaar in India

In 2009, the Government of India has established Unique Identification Authority of India (UIDAI) to provide every resident of India, a biometric based unique digital identity, commonly known as Aadhaar [16]. Aadhaar, the twelve digit unique identity number is envisioned as a foundational digital identity system to serve the purpose of large scale civilian digital Identification of the residents of India. The credentials of the resident's (i.e. biometric data and demographic data) captured by the UIDAI authorized entities are sent to the centralized database system, known as Central Identity Data Repository (CIDR) for storage and processing. The CIDR carries out both the processes of identification and authentication. The service provider agencies across the country communicate with CIDR, every time, the services are extended to the residents of the country in order to establish unique identity of the individuals through the process of authentication, so that the benefits could reach the intended beneficiaries. On the other hand, in order to enroll an individual into the identification system to provide her/him the unique digital identity, the enrolling agencies communicate with CIDR [14].

B. GOV.UK Verify in United Kingdom

The Government of United Kingdom has launched GOV.UK Verify as its identity program in the country in the year 2016 [17]. GOV.UK Verify was established to provide digital identity to the residents of UK to prove individual's identity online in order to avail various government services and to provide access to government and non- government online portals. The government is not the identity provider here, however, the government has followed the federated database approach and has accredited private companies to

carry out the operations of identification and authentication. At the time of launch of verify, seven private companies² were selected to provide identity to the individuals of the country. The residents of the country can enroll themselves in one or more identity provider entities. The federated architecture with multiple identity providers extends privilege to the residents to use different identity providers to interact with distinct service provider agencies and thereby allow further segmentation of the online interactions of the individuals with the service provider agencies [13].

C. Population Register in Estonia

Estonia stands at the forefront among the countries who have vowed to extend transparent and responsive governance to the citizens by harnessing the potential of ICT. The government of Estonia offers numerous public services³ to the citizens of the country in an online mode. Estonia is the first country in the world to conduct national elections in an electronic mode using internet [18]. Behind every digital service offered by the Estonian Government, the enabling factor is the digital identification provided to the residents of Estonia by the government in the form of ID-Card, Digi-ID and Mobile-ID. The core building block of the digital identity of the Estonian citizens is the Personal Identification Code (PIC). PIC was introduced in the year 1992 by the Population Register Act and a Regulation on the Generation of Personal Identification Codes [19]. The Personal identification code is stored centrally in the population Register. The Population Register is the largest central database system in the country that holds the Personal Identification Code and other personal details about the citizens such as the biographical details [20], [21]. Personal identification Code is used as a primary key in most of the public and private database system's that contains the personal data about the Estonian individuals. The centralized population register is connected to various government registries/database systems such as criminal record database, e-business register, European business register, e-land register, health register etc. through X-Road. X-Road is a data exchange layer that provides interface among database systems of different domains of services offered by the Estonian Government to the residents in an online mode [19].

D. RENIEC in Peru

"Documento Nacional de Identidad (DNI)", the National Identity Document is the official document of citizenship for the Peruvians that enables the individuals of the country to verify their identity to avail various types of the government and non-government services. In 1995, the government of Peru has established "Registro Nacional de Identificación y Estado Civil," the National Identification and Civil Registry System of Peru commonly known as RENIEC as a Foundational Identity System in the country [3], [22].

² Barclays, Citizen Safe, Digidentity, Experian, Post Office, Royal Mail and Secure Identity were the seven private companies accredited by the UK Government to carry out the functions of identification and authentication.

³ The public services such as e-health, e-tax filing, public safety, e-governance, i- voting and e-residency etc.

RENIEC is responsible for the registration of the individuals of the country into the identification system i.e. RENIEC, in order to provide them the unique identity in the form of DNI and to execute various civil registry services such as to issue the birth certificates and marriage certificates. RENIEC started issuing electronic ID (DNIe) in the year 2013 [23]. Prior to the creation and establishment of RENIEC, the civil registry services were carried out by the municipal offices. The local government offices were responsible for the storage and protection of the citizen centric data. The political violence in the period of 1990 to 2000 had severely affected the civil registry records. In the early 2000s, the Peruvian Government has started to work to improve the entire ecosystem of providing identification to the individuals of the country, especially to the most vulnerable segment of the population such as poor and indigenous communities, in order to avoid the errors of inclusion and errors of exclusion in the targeted social programs of the government. After the year 2007, the Peruvian Government has made it mandatory to all the civil registry offices to send the civil registry records with them, to the centralized electronic data repository, RENIEC for the purpose of digitization of the civil registry records and in the year 2011, a law has been enacted to this effect to ensure the replication of all the civil registry data to the centralized data repository in a timely manner [24].

IV. CONCLUSION

Digital Identification of residents of a country has got prominence in the recent past. Effective delivery of government services and specifically to achieve the state of the art of e-governance have required the establishment of the formal national identification system for providing legal digital identity to the residents of a country. To provide digital identity to the residents of a country is not the concern of a particular country, however, it has become a top priority of majority of the countries across the world. Various variables decide the performance of the identification systems such as population density, geographic terrains, state of the art of ICT infrastructure and the rules and regulations in a particular country. A further study can be explored in the direction to study the need of a universal large scale civilian digital identification system to provide digital identity to the individuals of the world to address the issues of forced migration that takes place within country or inter-country due to a number of instabilities such as poverty, natural disasters, militant attacks, political violence and military attacks etc., that forces people to shift from one place to other, having nothing to place on record to reveal their identity.

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