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RESEARCH ARTICLE

DIGITAL MANAGEMENT OF CITIZENSHIP THROUGH THE FAMILY TREE: CASE STUDY OF TOGO

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ABSTRACT

This article raises the importance of the use of ICT in the management of citizenship and especially the identification of the individual in a lineage based on biometric elements. To do this, we propose a modeling platform of the family tree that associates the blood group and an inherited disease, sickle cell disease. These two elements are typical examples used to identify a descendant or establish the descent of an individual in ancestry or descent. These elements can be known at the birth of an individual and mentioned in his personal file in the construction of the family tree. They would be able to prove at this stage his filiation with his ancestry already knowing the similar information of his ascendants. This same information could also be very useful for medical services, documentation or police and serve a variety of purposes.

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INTRODUCTION

If the world population was only 1 billion in 1800, it crossed the threshold of 7 billion in 2017 and has about 7.6 billion in 2019. Africa has experienced population growth of more than 2%. fifty years ago, it reached 1.1% in 2017 and this trend should continue, which does not prevent the growth of the African population, which is expected to be 1.286 billion today, 2.5 billion in 2050 and 4 billion in 2100 (Germaine, 1972 ; Gilles, 2017; Cécile, 2018). This increase of the population and the different links that are created between various individuals of the earth, provoke in the man, questions on its origins. To do this, the quest for information on ascendants, or on the links or relationships that may exist between this or that aspect of his life, that of his parents or his ancestors is a fight because, this search for information pushes Man to turn to sources of documentation such as town halls, civil status, police or national documentation, etc. And again, should these data exist and be found in the mass of information of thousands or millions of individuals. It is easy to understand that without the help of information technology, such a search for information is an ordeal for the actors concerned, and managing such volumes of data would be almost impossible without IT. Currently in Togo, almost all vital registration services have a citizen data management application ranging from the declaration of birth, marriage and death, to the issuance of the various certificates.

This application is networked in each registry office independently of other agencies. So it's not a centralized system for citizen data (Palanga *et al.,* 2009). This tool currently used in the Togolese registry is no longer suitable for an electronic administration architecture where several factors such as hospitals, police, civil registration services, national documentation services families, etc. must be in contact for the sharing and use of information concerning citizens. The current system is developed with the Visual Basic tool and uses the SQL database, so the system evolves completely in a proprietary environment. The deployment is done either in a network or in a single station in several Togolese civil states with independent operation of each other. This slows the time of access to citizen information. Despite some efforts made among other things the deployment of the public services platform (Fig.1) that provides online and available to citizens access procedures to various public services (issuance of birth certificates, card application nationality, passport, or obtaining Togolese nationality, etc.), these procedures themselves have not been simplified. The procedures for archiving and storing data have not changed much in civil states either. The problems associated with major changes in citizens' habits are not technological, but rather related to the openness of individuals and their willingness to change their habits and to take responsibility for making these changes happen (Driss Kettani *et al.,* 2014). The introduction of the computer tool with an approach focused on e-government will not only find a

Fig. 1. Extract from public services

lasting solution to the management of the relationship to the citizen by providing the necessary information and services, but at the same time, the State would benefit from the availability of information from citizens that it can use for its needs in case of investigations or information of a medical nature or in some cases, when it is a matter of establishing a relationship between individuals.

Problems related to the current system

In trying to exploit the existing system to produce the genealogy component, which is an important aspect in the management of Togolese citizenship, we encountered several shortcomings, notably:

- The proprietary character of the tools used which does not allow to maintain the software and to integrate other functionalities if the licenses of these tools are not acquired;
- The software has been developed to be used in each civil status agency and thus a certain independence in the management of information relating to citizens. There is no information sharing between civil states, and therefore the same information is duplicated in several civil states;
- The structure of the entities to take the information is not adapted to avoid duplicates. Information about the father and mother is repeated in the database as many times as they have children;
- The database does not take into account birth prefectures.

A model focused on open tools

To take into account the different aspects of genealogy and aware that the database of the civil registration software does not take into account a certain number of parameters, we propose a solution approach based on the development of a genealogy platform.

The development of this platform would be based on the use of free tools:

PHP: PHP is a popular web programming language that builds dynamic websites. As part of the platform, the PHP language was used for its simplicity, popularity and security (Cyril Pierre de Geyer, 2018).

Symfony: Symfony is a framework (work tool) designed in PHP that accelerates web development. Until 2012, it was the simplest, most extensible, most popular, most secure and most reliable PHP framework. Many of the components of popular Frameworks nowadays use Symfony components. It has been used as the main design tool of the e-citizen platform. The entire server part is based on the latter which is itself written in PHP.

JavaScript: JavaScript is a programming language that runs in the browser to provide interactivity (liveliness) to HTML pages. In e-citizen, it was mainly used to manage the responsiveness of the platform against user events such as clicks, form validation and AJAX (Asynchronous JavaScript and XML) operations. An AJAX operation is a way to refresh the information on a web page without triggering a complete Hypertext Transfer Protocol (HTTP) request. It's a way to reload the parts of a page without reloading the entire page.

jQuery: Jquery is an easy-to-use JavaScript library that provides better Document Object Model (DOM) management. It also contains other extensions in several areas. In e-citizen, it has mainly been used in DOM manipulation, user interaction management and AJAX loading.

MySQL: MySQL is a Structured Query Language (SQL) database management system designed by ORACLE to implement the OLTP (OnLine Transaction Processing) standard (Christophe Reboul, 2016). In e-citizen, it is mainly used for storing genealogical data.

Citizen relationship management: The establishment of a family tree platform at the civil registry level is necessary to overcome the various problems mentioned above. This platform is a central work tool, in other words, a dashboard that will provide information about people, their birth, death, descent and their descendants, as well as all the events that may occur in their lives. It must be able to start from any person, produce the list of his ascendants, as well as that of his descendants. It must also be able to make known the spouses of any person and the order in which these couples existed, etc. This platform will include a module for entering various reference information such as family names, people, cities, events (marriage, obtaining a certificate, etc.), types of events and documents relating to a particular subject. given event. Another module will be used to search for all kinds of information about people, generations, places of birth, death or marriage, in short, the production of different statistics on the recorded data. Finally, we will have the interface of automatic generation of family trees according to previously entered information about different families, descendants or ascendants. The platform will offer the possibility to search by geographical area. The last names are unique in the database, which would avoid redundancies. As birth information is populated, the family trees of the different families are automatically built under a very user-friendly interface. The

way of digitizing the population of Togo certainly also passes through the offer of electronic services to citizens limited today to the use of mobile phones limited to mobile banking among others. While already in 2009, a survey found that 83.8% of people out of a sample of 358 across Togo would prefer to see online administrative services, (Palanga Modélisation). To this end, we already propose an e-administration focused on the basic services of civil status which compels the citizen to make use of digital because, as Hélène MICHEL reminds us in (Michel Hélène): "Thus, we could seek opportunities in ICT to generate new citizen practices or make existing practices more effective, in order to involve citizens more strongly in the public decision-making process and to improve the services provided by the public organization. These tools seem particularly appropriate for "citizen-consumers" gradually accustomed to the quality of service offered by ICTs and become more demanding and more critical of public organizations (Carcenac, 2001; Berman, 1997). "

Citizenship Management Platform

Conceptual study

Description of use cases: We distinguish two main users: the simple user and the administrator as shown in Figure 2.

- **Management of a family tree:** A simple user is any citizen with the ability to create and manage a family tree that is to say, create a root person and raise his complete descent.

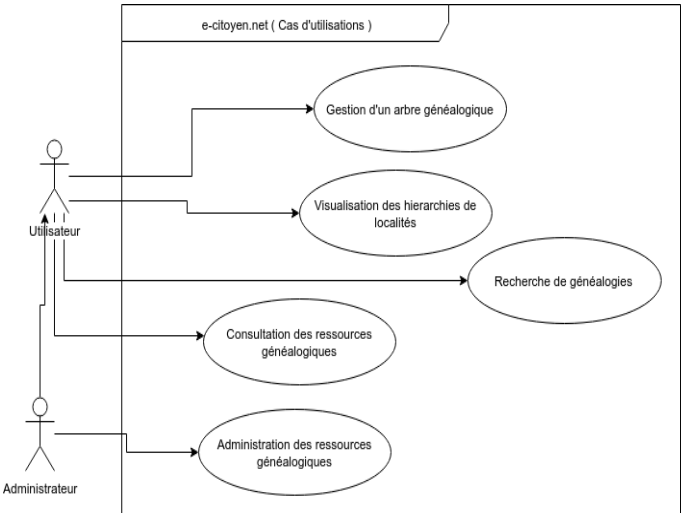


Fig. 2. Diagram of use cases

In the process of building the family tree, he can add, modify, consult the people present in the genealogy.

- **Visualization of the hierarchies of the localities:** The geographical areas managed by the application contain a hierarchy modeled on the administrative division of Togo and constituted as follows:

Hierarchically, the country is composed of regions that are formed of prefectures. The latter are composed of communes, themselves composed of cantons which contain localities.

- The search for genealogies Genealogical research includes all research operations involving people involved in family trees. People can be searched for by name, first name, comment, and family.

- **Consultation of genealogical resources:** The consultation of genealogy resources is the visualization of genealogical information. In this context, we can visualize the ascending, descending, agnatic and cognatic trees of the people involved in a genealogy. In addition one can edit the genealogy of a person through a visual model called "ascending ascending" to add a father and a mother in the family tree.

- **Management of genealogical resources:** The management of genealogical resources contains all the operations performed by the administrator in order to maintain the consistency and integrity of the genealogical information contained on the platform.

Presentation of the elements of the class diagram: The class diagram (Cf.: Fig.3) is organized around the main element of the genealogy which is the person. A person is primarily characterized by name, first name, sex, date of birth, place of birth, date of death, place of death, reason for death and comment. Each person has in addition to a Sosa number to locate it in his family tree in relation to his relatives (Principle Sosa). The places of birth and death of a person are geographical areas. People also have reflexive ties of optional kinship where one parent is the father and the other is the mother. The father or mother may also have parents and the cycle continues. Each person belongs to a family. People are grouped together by their last names.

Example of identification of an individual in the family tree by hereditary data: The identification of an individual in a lineage can be done through DNA, a tool that offers the opportunity to understand our genealogical history as explained Nathalie J-F in (Nathalie Jovanovic-Floricourt, 2019). Several tests are possible to attest to belonging to a descent, for example the mitochondrial and the autosomal. We will simply rely on a few things, such as blood group or sickle cell disease, a hereditary disease. These two elements are also examples among many others such as the color of the eyes, skin, hair, etc. or diseases such as familial hypercholesterolemia, myotonic dystrophy type 1 (DM1), etc.). If we first take the case of the blood group, it is easy to identify the parentage of a person by reconstituting the combination of alleles inherited from parents (see Table 1). It goes without saying that a child from parent X with AO alleles and from another Y with O alleles, for example, cannot be group B. The children of this union can only be in group A or O.

In the case of sickle cell disease (Fig.4), as explained by Dr. F. Galactéros *et al.* in, the presence of abnormal hemoglobin (hemoglobin S) in an individual is due to a genetic abnormality. Transmission of the disease is autosomal recessive, which means that the two genes involved in the disease are not located on the sex chromosomes (X and Y) but rather on one of the other 22 pairs of chromosomes, the "autosomes". The disease can therefore appear as well in a girl as in a boy. In Fig. 4, both parents carry the mutated gene ("S"), but they are not sick (they are said to be heterozygous). The child S / S has recovered the two mutated genes of his father and mother: he has sickle cell disease (he is said to be homozygous). Children A / S are not sick but carry the mutated gene and may transmit it to their offspring.

Table 1. The different possibilities of blood groups

Parents	AA			BB			AB					AO					BO					OO		
AA	AA				AB		AA	AB				AA		AO				AB	AO			AO		
BB		AB		BB				AB	BB				AB		BO		BB			BO			BO	
AB	AA	AB		BB	AB		AA	AB	BB			AA	AB	AO	BO		BB	AB	AO	BO		AO	BO	
AO	AA		AO		AB	BO	AA	AB		AO	BO	AA		AO		OO		AB	AO	BO	OO	AO		OO
BO		AB	AO	BB		BO		AB	BB	AO	BO		AB	AO	BO	OO	BB			BO	OO		BO	OO
OO			AO			BO				AO	BO			AO		OO				BO	OO			OO

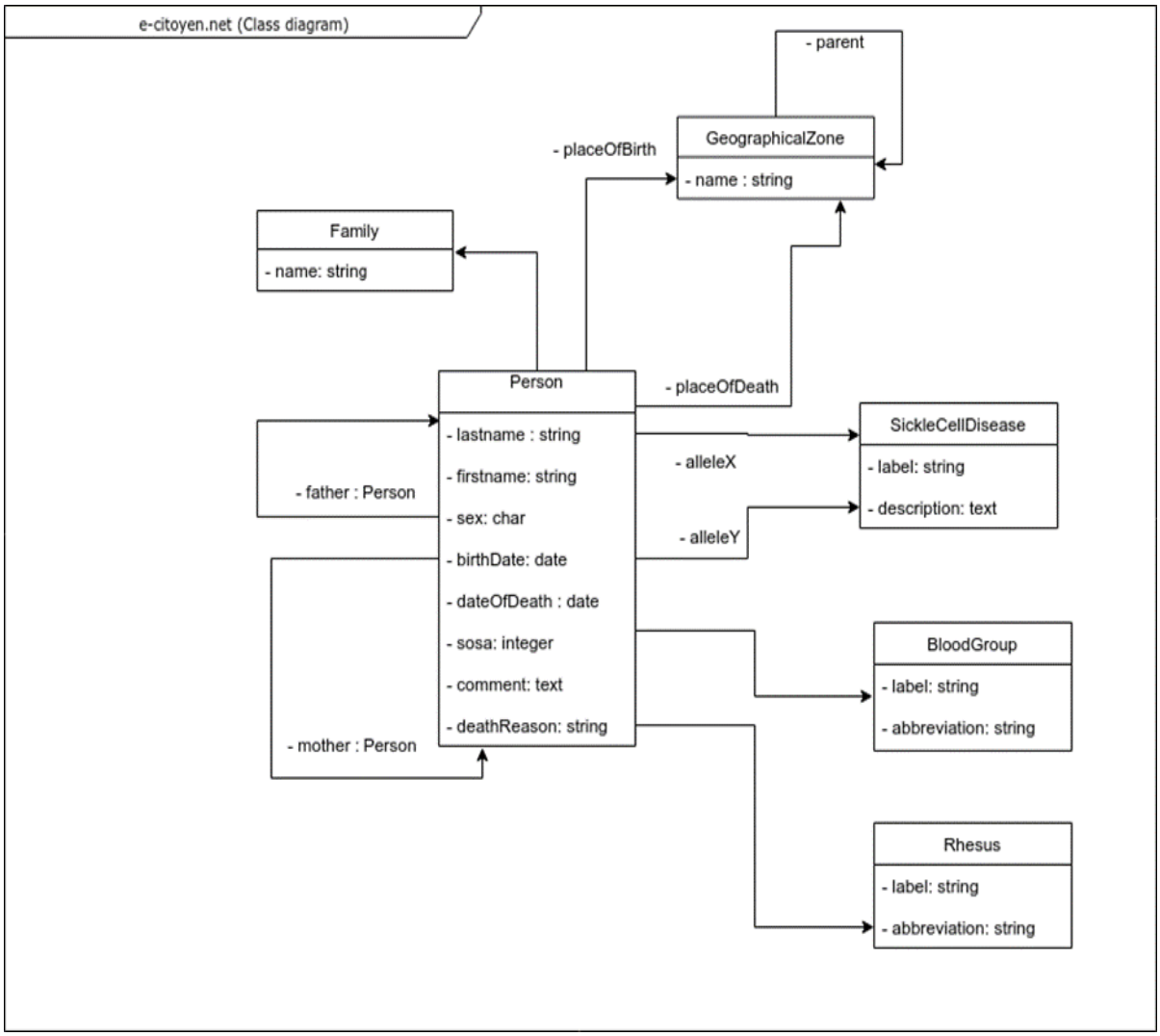


Fig. 3. The class diagram

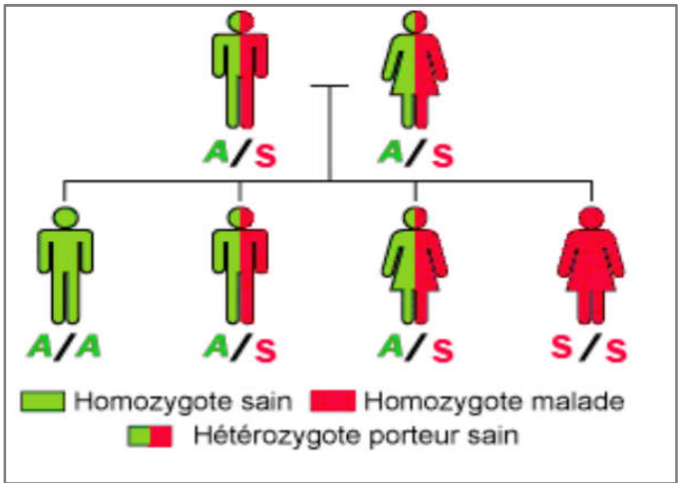


Fig. 4. Illustration of autosomal recessive inheritance

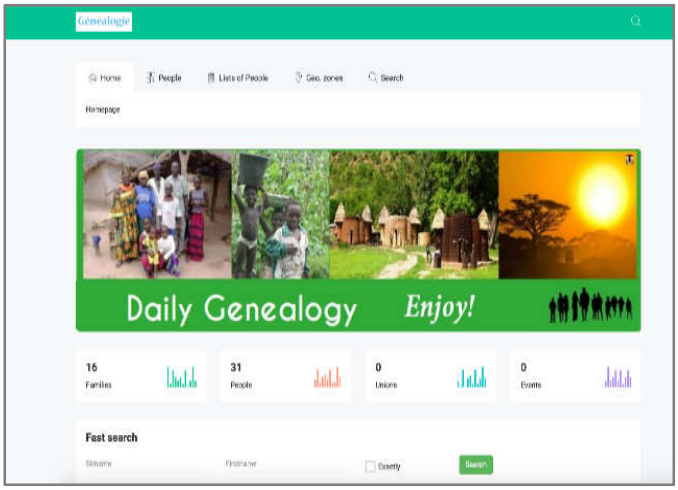


Fig. 5. Home interface

The A / A child did not inherit any mutated gene, either from his mother or from his father: he is not sick and is not at risk of transmitting the disease. Thus, a person can be AA, AS or SS. In each red cell, in AS individuals, half of the hemoglobin is A, the other half is S; there are no special symptoms because normal hemoglobin A "compensates" for the presence of hemoglobin S. In SS people, all the hemoglobin in the blood cells is abnormal: the disease is present. In the management of citizenship, it would be interesting to mention elements concerning the blood group, a possible hereditary disease or any other specific element linked to an individual in his personal file which allows at a given moment to be able to trace or identify him. in the population and find his ascendants or descendants for one reason or another.

Presentation of the platform

The docking interface of the platform (Fig. 5) offers several features ranging from the recording of an individual's data to the creation of his genealogy tree.

The registration interface of a citizen is in the form of Fig.6.

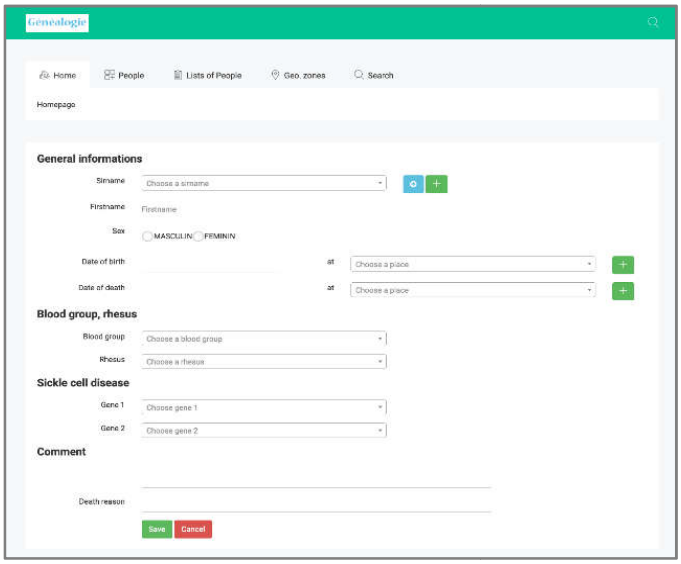
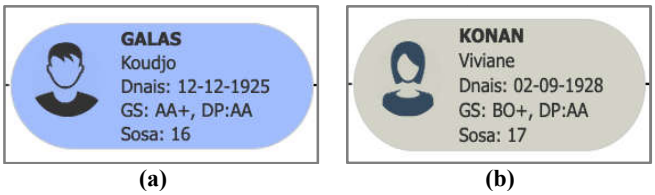


Fig. 6. Recording interface

This interface contains information classified into four categories. On the one hand, general data: the surname and first names of the individual, his sex, his date of birth and possibly death, the place of birth and possibly death. The second and third categories concern the elements that make it possible to identify, verify or prove the belonging of an individual to a lineage. In this paper, it is the blood group and the hereditary disease, sickle cell disease. The fourth category is for comments on the individual. Fig.8 shows the ascending tree of citizen Galas Joseph who is of the fifth generation. He is the descendant of Galas Koudjo and Konan Viviane considered in our example as individuals of the first generation whose data are provided in Fig.7 a) and b).



(a) **(b)**

Fig. 7. Data from galas koudjo and konan viviane

For a good reading of the figures, we adopt the following legend

Dnaiss: date of birth, GS: Blood group, DP: sickle cell disease.

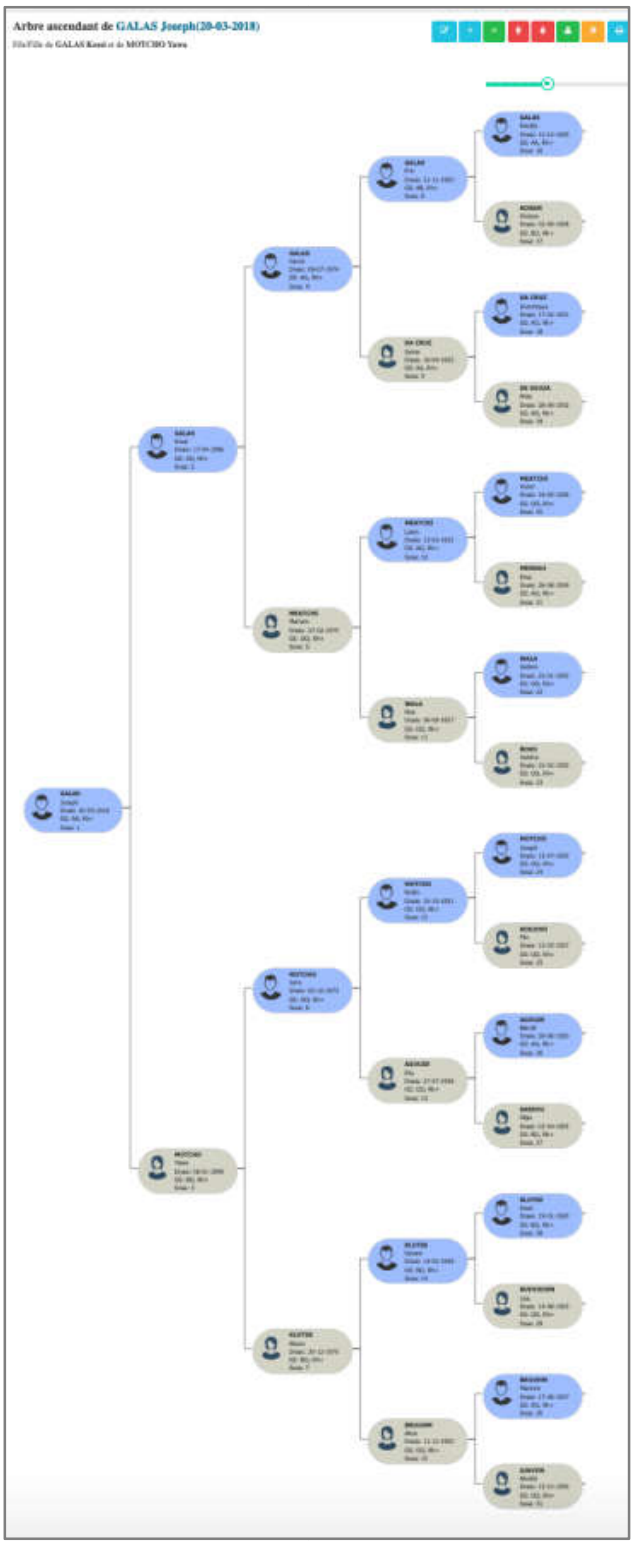


Fig. 8. Ascending tree of Galas Joseph

Considering the blood groups of Galas Koudjo (AA) and Konan Viviane (BO), and the gene for sickle cell disease (S), and following the ascending genealogical tree of Galas Joseph (Fig. 8), we note that this the last one cannot have another blood group than AB + or AO +, or cannot be homozygous (SS) so sick, but rather heterozygous (AS) since carrying a gene S. His great-grandparents of the first generation being healthy (AA), so he inherited the S gene from one of his parents or grandparents.

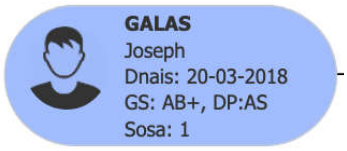


Fig. 9. Data from Galas Joseph

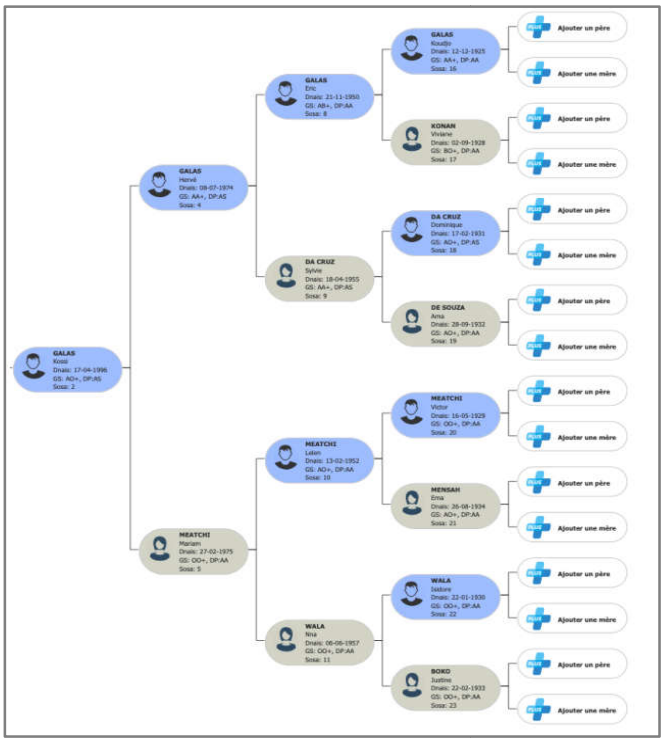


Fig. 10. Expandable ascending tree

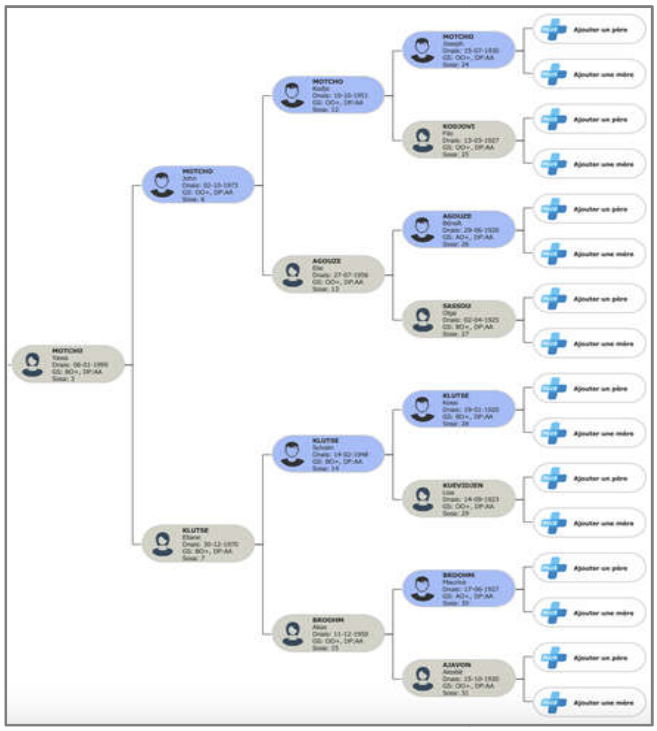


Fig. 11. Extensible ascending tree of Motcho Yawa

We could also display the descending tree of Galas Joseph or continue the construction of its ascending tree to the first known ancestor. In FIG. 10, we present the extensible ascending tree of Galas Kossi, father of Galas Joseph, and in Fig. 11, that of his mother. Another feature of the platform is the integration of the 5 regions, 39 prefectures, 116 communes, 386 townships and 3630 localities of Togo according to the last administrative division. This integration facilitates the identification and search of the place of birth or death of an individual. For a citizen born abroad, the addition of the country and the place of birth is done manually.

Conclusion

The purpose of our work was to propose a model of citizenship management based on the principle of the family tree. The aim was not only to draw up the composition of a family, but also to propose a mechanism for verifying on the basis of hereditary data the authenticity of the affiliation between the members of a family. It is then possible to discover the origin of a disease of an individual in a genealogy since this disease is hereditary based on the personal data of his ancestors. The work undertaken in this paper will continue with the integration of other significant data that highlights an individual's genealogy and the reasons for the characteristics that identify them in this family group.

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