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BloodHero: The Power of Gamification in Social Habit

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Abstract

The lack of blood in hemocenters is an intermittent problem in the Brazilian health system; due to the difficulty of attracting blood donors, according to the World Health Organization (WHO), each country must maintain 3–5% of its population as regular blood donors. However, the number of regular donors in Brazil, in recent years, has not reached 3% of the population. In order to attract periodic volunteer blood donors, the objective of this study was to develop a mobile application, called BloodHero, to work as a social network, with a game methodology, known as gamification, to encourage blood donation. Initiatives and interactions favorable to blood donation, within the application, will generate points that will be used for in-game competitiveness. Another contribution given to those that use this software is the interaction between users who can donate blood and patient users, where these second ones can share their stories or use this software as a tool to find someone compatible with their blood type for donation.

Keywords: social habits, blood donation, app, social network, gamification

1. Introduction

Blood transfusion is one of the fundamental pillars for large elective surgeries, for urgent care, and for the treatment of oncological or chronic diseases. In Brazil, in 2014, according to the Health Portal of the Unified Health System, only a number of elective surgeries increased by 11.7%, in relation to the previous 2 years, representing about 2.4 million procedures performed with the need for blood transfusion [1].

Blood is an important tissue for the survival of other tissues and, so far, cannot be replaced by any other liquid or be artificially produced [2], what makes blood donation a fundamental practice for the performance of transfusions.

However, the collection of blood bags in Brazil is insufficient, caused by the lack of voluntary donors. According to the World Health Organization (WHO), for a population to maintain stocks of blood bags, at a satisfactory level, 3–5% of the population has to donor, at least once a year, but Brazil's annual average is 1.8% [3]. Translating in numbers, Brazil, with its population of about 210 million people, would need 6.3 million people to donate blood, at least once a year, but the average donation recorded, in previous years, was about 3.7 million.

The difficulties in attracting new blood donors are evidenced mainly by five reasons that repel the individual from the cause [4]:

- Misinformation—People do not understand the process, what is its purpose, and its importance.
- The fear of donating blood—Some myths created about the donation process and reactions prevent the attraction of new donors.
- Medical disqualification—Here there are two points: The first one is related to hematopoietic diseases, sexually transmitted diseases, and other diseases, which can be transmitted through donation, and the second, people who are momentarily unable to donate blood, often do not donate anymore.
- Apathy—People who do not care about the cause.
- Convenience—People who understand the need for donation, support the cause, but are not drawn to moving to practice.

On the other hand, when analyzing the reasons that lead to the practice of blood donation, we find [4]:

- Altruism—Donors who understand the need for donation and propose to help the cause.
- The replacement—When, for a surgical procedure of a close person, requires the donation.
- Social pressure—When an entire community engages in a cause, the individual feels motivated to participate as well.
- Advertising—The individual is pushed by the advertising appeal.
- Reward—When the donor materially and/or spiritually benefits from the process.

Some different strategies, such as demythologization and clarification and awareness about the process [5, 6], tax incentives, benefits, transport to donation site, and campaigns [7, 8], are used in several countries for attracting new donors, but it is still necessary to mobilize large capital and personal investments.

With this problem of the lack of blood donations, we developed some strategies to try to engage more people with the cause. The first step was to identify the best channel for propagation of the tool to be developed. From this need, the creation of an app was chosen, added to the social network, aimed at encouraging blood donation. Social networks reach about 1.5 billion people. In Brazil, social networks reach about 80% of the population [9].

However, the elaboration of this work, by this way, would be just another social network application focused on blood donation. In order to contribute positively to this development, the concept of gamification, for project implementation, was applied. Therefore, the objective of this work was to develop a mobile application, called BloodHero, whose main purpose is to attract and retain new blood donors, arousing empathy through virtual social networks, encouraging, and educating through gamification methodology. This application will promote interaction between users (donors, people able to donor, and patients who need donors) in publications and chats through bonus points, achievements—rewards—and levels of experience.

2. Theoretical aspects

2.1 Blood donation

Blood is responsible for the entire distribution of molecules to tissues. Its functions include gas exchange through the red blood cells, defense against foreign bodies by leukocytes, transport of nutrients and hormones by plasma, and coagulation through platelets. It is produced by the red bone marrow or hemocytopoietic tissue, found in long bones [10].

The blood type is conditioned by multiple alleles, the main ones being the ABO system and the Rh factor (+ and -). It causes the possibility of existing eight main possibilities: A+, A-, B+, B-, O+, O-, AB+, and AB-. Each one of these types is characterized by the presence of agglutinogens (A, B, and Rh) and agglutinins (anti-A, anti-B, and anti-Rh). They are directly linked to the compatibility used when blood transfusion is required, observed in **Table 1** [11].

Blood donation is the process of collecting blood from a volunteer to, after a series of treatments and examinations, be stored in a blood bank and, when needed, used in a transfusion [12–15].

According to the WHO, blood donation should be voluntary and unpaid, to avoid risk [3]. Before the donation, the candidate undergoes two previous stages, called screening: an interview/questionnaire, where questions are asked to check blood-related diseases, in order to improve the safety of the donor and patient, and a clinical examination, aiming at ascertaining the health conditions of the donor and if there is something that will harm him at the time of donation [2]. Any identified risks will lead to the donor's temporary or final rejection.

Being fit, the donor passes to the collection stage, where 400–450 ml of the blood tissue is withdrawn. The average collection time is 10 minutes, and reactions rarely occur. The blood volume of an adult is 62.4 ml per kg, that is, a normal adult male, weighing 75 kg, has the total volume of 4680 ml of blood.

Replacement of the blood volume by the organism occurs within 24 hours, for the blood plasma, and 4 weeks, for the red blood cells; however, the recovery of iron can take 8 weeks for the man and 12 weeks for the woman. Because of this, the maximum frequency of donation of blood for men is four times a year, with a minimum interval of 2 months between donations. For women, the maximum frequency is three times a year, with a 3-month interval between donations. Donors must be between 16 and 69 years old and weigh, at least, 50 kg [1].

In Brazil, Ministerial Order No. 158, of February 4, 2016, regulates the entire chemotherapy process, emphasizing that blood donation should be voluntary,

Blood type	Agglutinogene	Agglutinins	Receives from	Donates for
A+	A	Anti-B	O–, O+, A– e A+	A+, AB+
A–	A	Anti-B e anti-Rh	A–, AB–	A–, A+, AB– e AB+
B+	B	Anti-A	O–, O+, B– e B+	B+, AB+
B–	B	Anti-A e anti-Rh	O– e B–	B–, B+, AB– e AB+
AB+	A e B	None	All	AB+
AB–	A e B	None	All the –	AB+ e AB–
O+	None	Anti-A e anti-B	O+ e O–	All the +
O–	None	Anti-A, anti-B e, anti-RH	O–	All

Table 1.
Blood characteristics and compatibility.

anonymous, and altruistic and the donor should not, directly or indirectly, receive any remuneration or benefit by his donation.

2.2 Blood donation incentive methods

Several strategies are used to attract and retain new blood donors; [7] divide these strategies into three categories: host, campaigns, and educational strategies.

“Reception” refers to the donors’ care, removal of barriers that hampers donation, to the easy access to donation, training of vein puncture technicians, to minimize needle fear, and donor awareness to encourage family and friends, which have brought great results [7].

Campaigns are contingent strategies that occur for a particular purpose. Results are very expressive, as the campaign of the soccer clubs of the Minas Gerais, a Brazilian State, which disputed a championship of blood donation. Their campaign attracted 22 thousand donors in the first quarter of 2014. Solidary hazing, promoted by several universities, has also brought positive results. Some strategies seek to raise awareness among companies and institutions to promote campaigns and improve the donor recruitment system [7].

Educational strategies seek to raise awareness in new donors, based on information about the need for donation. As in South Africa, the creation of Club 25 seeks the motivation of young donors with education about donation [3]. According to [7], educational strategies are more effective, based on the encouragement of future donors and should participate in the youth’s habit as a social responsibility.

Other strategies are based on psychology, sociology, and anthropology, in order to understand the values, beliefs, and attitudes of the donor, in the formation of awareness about the donation, since child. There are incentive strategies with health workers, with partnerships in various sectors to favor the cause [7].

In Europe, the population is well aware of blood donation. Therefore, many countries include benefits to donors, such as tax incentives, donation days, transport to donation centers, and meals, what is reflected in numbers: 37% of Europeans are blood donors [8].

A study by Johns Hopkins University, in the United States, suggests that reward strategies such as gift cards and gifts can contribute to the growth of donation numbers, without compromising the quality of the collected blood.

2.3 Mobile devices

Mobile devices, more precisely the smartphones, according to [16] are defined as a “mobile phone that offers advanced features similar to those of a notebook.” In 2007, its arrival, along with the onset of Internet accessibility, was the beginning of a new era, driven by significant changes in interpersonal relationships, market, and in the use of services. Brazil has a continuous growth in the number of active smartphones, what made it the fourth country, in the world, in number of smartphones, with around 198 million handsets [17], and according to data from the National Telecommunications Agency, it accounts with almost 300 million active lines, about 1.4 lines per inhabitant.

The technological evolution has made smartphones become real portable computers and already occupies the first position as a personal tool. Smartphones are used in several areas, such as communication, entertainment, information, medicine, education, security, transportation, commerce, and services [18].

Data from Nielsen [19] show that smartphones are well distributed across classes, with 35% of users in class C, 50% in class B, and 12% in class A. Its main uses are for news applications, music, videos, social networks, communicators, and e-mail.

2.3.1 Native development

According to Silva [20], applications with native development are those that are intended for a specific platform. Platforms differ in the following aspects: operating system (OS), programming languages, and integrated development environment (IDE). Although native implementation takes longer, native applications are recommended for more demanding audiences, who are looking for agility and reliability.

2.3.2 Operating system mobile: Android

According to Sobell [21], the operating system (OS) is defined as a program that manages the capabilities of the computer. The OS manages the hardware resources and schedules tasks, as well as provides the user with a pleasant interface.

In Brazil, the mobile operating systems that have a considerable part of the market are Android (developed by Google), iOS (Apple), and Windows Phone (Microsoft). According to Conceição [22], by the abundance of devices with its OS, Android leads sales with 93.5% of the slice, followed by iOS, with 4.8%, and Windows Phone, with 1.6%.

Android is a Linux-based OS, with a direct-manipulation interface, designed primarily for devices with touch screens, but it also has interfaces for television, car, and watches. Google makes the Android OS code available under the open-source license [23], what reflects worldwide usage, and makes it a sales leader since 2013, and, according to Google, it has more than 2 billion active users, which consume more than 1.4 million applications.

Android has a wide guide for the development of the virtual environment of the application, the Material Design. According to Google, the guide is beyond a visual standardization of applications in Android, because it is also a varied library of common objects, tested to promote a better user experience [24]. The Material Design provides the guide to color palette, flow of screens, themes, fonts, object style, scaling, animations, and any other features related to the application design.

Google offers the free IDE for Android application development, Android Studio, the environment, as well as a code editor, which offers features to optimize the developer's implementation for Android applications such as Gradle—the compilation system flexible; emulator; unified environment for all versions; Instant Run monitoring; integration with GitHub, test tools, and frameworks; code verification tools; and compatibility with other programming languages and with Google development services [25].

2.4 Social networks

One of the main exponents for the use of smartphones is social networks. They are defined as the environment where personal relationships are developed and maintained by individuals with the same interests, which exchange experiences [26]. These environments are not necessarily virtual, i.e., most of them are still face-to-face. Therefore, what we call social networks are actually virtual social networks (VSN).

According to Marteleto [27], social networks are spaces that represent “[...] a set of autonomous participants, uniting ideas and resources around shared values and interests.” The author complements that over the years, networks are taking a role as organizational tools. According to Tomaél [26], social network is a place where each individual has its function and its cultural identity, which encourages coexistence with other individuals and promotes a coherence of the network

environment. It is a dynamic, nonlinear, flexible, self-organized, and decentralized environment, established by egalitarian cooperative relationships.

Given their characteristics, social networks are environments where the sharing of information and knowledge works consistently.

2.4.1 Elements of a VSN platform

The survey of the most popular VSNs, such as Facebook, Instagram, LinkedIn, YouTube, and Pinterest, intuitively shows several common elements that are related both to social dynamics and to the theme proposed for each VSN. Among these elements, it stands out:

- The profile—It is the space destined to identify a user for the virtual community, usually contains the relevant information of the user to the interested public, where the most common are name, photograph, date of birth, e-mail, and city, but also, according to the topic covered and the consent by the user, there may be more personal, professional, and educational information.
- Publication—This is the element where some subject will be presented on the subject of VSN. It is one of the main activities for user interaction. They can use various media or even the set of them in their display. Generally, they are produced by VSN users and have common characteristics, such as subject text, date and time of publication, media (image or video), and interaction buttons.
- Tags—They are keywords that produce a common connection between publications or a reference to the user. Typically, publications are included to identify a relevant subject or a notable person on the subject.
- Interaction buttons—These are the key points for dissemination and thermometer of relevance of the subject of the publication. The buttons are used mainly for evaluation, discursion, and propagation of publications in the VSN or in other virtual environments.
- Chat—It is the place where two or more users can exchange instant messages, simultaneously, which can be public or private to the participants.
- Groups—They are user group formations that have a common interest, even this one disagreeing with the main theme of a VSN.
- Notifications—It is the registration system about activities involving the user. They are usually invitations for new friends/followers, interaction with user publications, invitation to any event, direct messages, and updates in the chat, being usually informed to the user by the user application.

2.4.2 VSN in support to social causes

It is noteworthy requests to support social causes, campaigns (September yellow, October pink, November blue, vaccination), blood donation [37], financial support to charities, animal adoption campaign, and others, in VSN publications [38]. Publications have a remarkable power to raise awareness, as they are a

platform for the use of appealing strategies, and awaken the emotional side of many users, especially cause activists.

According to Navarro [39], the use of VSN for the support of entities on community issues is growing, because the young public is largely connected to VSN and a significant proportion, 54% according to Lynx [40], believe that the responsibility to solve social problems belongs to everyone who owns the networks. Linked to this, some companies take advantage from the VSN, according to [38], founder of Curtida. Social—start-up that unites companies to community issues in RSV, entities that support social campaigns obtain immediate results, besides having the brand linked for a long time to the supported actions.

2.4.3 VSN in support to blood donation

Empathy on the subject makes many individuals, who are part of VSN, especially those with a broader subject and usually with a large user base, such as Facebook, Instagram, and WhatsApp, use their resources to promote the cause. It is common to see, in these networks, shared messages requesting donation, supporting publicity pages, and profiles for blood donation.

Not very evidenced, there are VSNs, or services for VSNs, which explore more directly this issue. Among them, “Salve Mais Um” [41] is a VSN that was born from the observation of a patient’s difficulty in finding blood donors and the reach of VSNs in social issues. “Salve Mais Um” interfaces people who are in need of donation and social networks, so donors are encouraged to donate by getting to know the patients.

2.5 Gamification

One of the methodologies that has been gaining notoriety is gamification. It is defined as the use of game dynamics to motivate actions that are often difficult to achieve, such as learning, engaging people, and problem solving [42]. As the basic principle of gamification is having fun, the method allows a remarkable experience, and its playful form turns, what was not attractive to the most, in a single moment. All this implies a greater participation of users and collaborators [43].

Gambling can be implemented in a variety of ways; according to Webster and Watson [44], games can be based on points, classifications, achievements/icons, levels, history, goals, feedback, rewards, progress, and/or challenges. These rewards make users of the platform, to which gamification has been implemented, re-interact again. Hamari et al.’s review [42], about the efficiency of gamification, shows that this methodology yields positive results both in behavior and in the psychology of individuals.

According to Almeida [43], the success of gamification is due to the experience that the user has beyond the acquisition of the product. Strategy turns gaming into a strong brand-customer relationship strong enough to keep them loyal.

2.5.1 Types of players

According to Zichermann [45], the more you get to know your players, the easier is to model an experience that will guide their behaviors along the path you want. Bartle [46] classifies players into four main types, such as socializers, explorers, achievers, and killers:

- Socializers are players interested in relating to others, characterized by having the goals of prestige only by interaction between players.
- Explorers are interested in unraveling the game environment, and they are characterized by the knowledge of the mechanics of the game, even if they distance themselves from interacting with other players or have not completed the game's challenges.
- Achievers are motivated by the challenges of the game, and they aim to complete all the activities of the game, especially those of greater difficulty and those of greater rewards.
- Killers are the most overrated players in games, as their goals are focused on being more skilled than other players, focused on winning the best scorecards and/or powers disputes. The killer tends to publicly display his glories, not momentarily satisfied.

2.5.2 Elements of gamification

Games, despite their distinctions in relation to the gaming experience, have in common the very remarkable characteristics. Among these elements, it stands out [45]:

- Points: These are the main rewards for the player's performance, as it is a numerical reward multiplied by their difficulty in relation to other tasks. They are widely used in sports games but also in point-of-use mechanics and role-playing experiences (RPGs).
- Feedback: It is the statistical and quantitative disposition of the performance of the player; the efficiency in the goal achieved is passed on to the player for his incentive and consequently is converted into engagement.
- Levels: They show experience, indicate progress, effort, engagement, and wisdom of the player with the game. Levels give status to the player, referring to his disposition to the proposal of the game; in this way, many platforms prioritize the players of higher levels, making this become the main objective of the beginners.
- Achievements: They are the collectable rewards of the game, usually with some visual characteristic identity and achieved when certain specific activities are performed in the game. According to Zichermann [45], this type of reward is one of the best options for social incentive, because it is done as the goal of players who do not crave competition and cherish the social appeal of strategy.
- Rankings: The forms of competition where the points or other quantifiable element of the game are classified in an order that indicates success.
- Quiz: The question-and-answer game, as they are known, is used with an interesting method to support education. The technique of learning from error is widely used in this type of game. In addition, the quiz has the ability to incorporate other elements of play and become a memorable experience.

The gamification, in the context of health, has been beneficial in several areas, being one of them its use in the development of new treatment tools for both children and adults [47].

The gamification, in the BloodHero, is the core of the differential that it presents. Every action taken on the application results in points to the user, that is, from each donation of blood, each acquired point becomes the currency of exchange for benefits and products presented within the application.

3. The BloodHero application

At BloodHero, the concept of social networking and gamification comes together to produce a new tool linked to blood donation. The social network applied to BloodHero serves as a channel for publicizing the project, the history of patients who need donors, brands that link themselves to social causes, such as blood donation, and various other pieces of information related to this topic.

Gambling brings a new range of benefits to the user, among them the exchange of points for products. The adoption of rewarding the user with points for the actions taken throughout the application brings engagement and fidelity to the use of the app.

The application was proposed in order to guarantee a great commitment of the users. The bibliographic research, data observed in visits to blood centers, statistical analyzes of sites of some institutions, and mobile applications that use gamification, were the pieces of information taken into account for the production of the proposed app.

3.1 Data acquisition

The visits to blood centers aimed at understanding the profile of new and veteran donors and strategies for donor acquisition. Psychologists responsible for the donor acquisition sectors in “Hemominas,” the public blood center of Minas Gerais, Ana Carolina Ferreira, and the “Hemoservice,” the private blood center of Belo Horizonte, Cinara Sá de Araújo, were prepared to answer doubts about the motivation of the donors, about donation incentive programs, recurrent campaigns and costs involved, and the entire process from donation to transfusion.

In the analysis of institutions, it was researched sites of 20 institutions, which include target audiences, between 16 and 30 years old, in different segments: McDonalds, Chiquinho, Hemonorte, Hemominas, Hemoservice, Hering, Lacoste, Adidas, Nike, CVC, Blue, Gamestation, Amazing Pixel, Netflix, TelecineNow, Cinemark, UCI Cinemas, Rastapé, Pink Elephant, Samsung, and Apple. The model of interaction with users and information about the corporation were transcribed.

Additionally, the analysis of web and mobile applications was carried out with eight mobile applications, related to the theme “blood donation,” “Hemoliga,” “DoeSempre,” Blood 24/7, blood donor, “Partiu Doar Sangue,” “Eu curto doar,” Hemogram, and Doe Blood Mobile, with the aim of quantifying systems and verifying methods and philosophies in common.

It also analyzed 12 web and mobile game applications and some other apps that use gamification: Asked [28]; FlappyBird [29]; Fruit Ninja [30]; HayDay [31]; Pokemon GO [32]; Angry Birds [33]; PasseiDireto; Skoob [34]; Icatu Insurances, “vivendoeAprendendo” [35]; Nike [48], NikePlus [48]; Google Maps [25]; and Cartola FC [36]. It analyzed the characteristics in common of games and how they are arranged to the players.

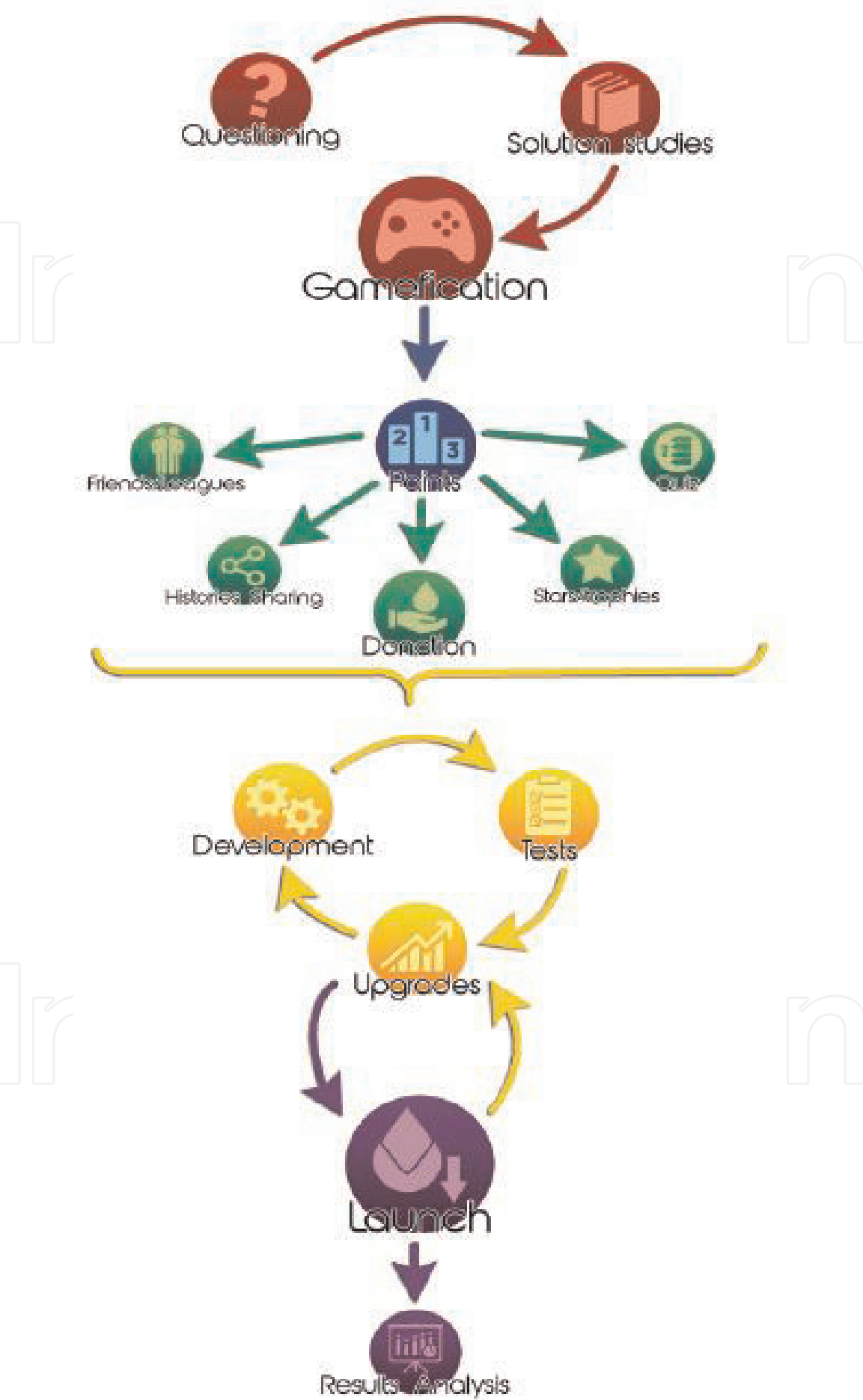


Figure 1.
Descriptive block diagram of the app.

Android OS was chosen as the target platform, for the ease of content for supporting development, as well as for the broader reach of users on the platform. Therefore, application dynamics and visual identity were designed to be developed in the Android Studio IDE, using Java and XML programming languages, following material design standards.

3.2 Application flowchart

Results from the data acquisition were relevant to the application design, although they did not escape from the expected bibliographic review; the information was taken into account in the construction of the modules and the interactive environment. Those results were applied to define the public, to model the social network, the information system for blood donation, and to the gamification system. For the design, it was based on the observation of the systems, the material design, and the tools made available for development.

For improving the application, an initial Portuguese version was designed, called version 1 (**Figure 1**), illustrated by the block diagram, which contains the



Figure 2.
BloodHero login screen.

fundamental activities of the complete idealization of the application. Once the whole project is finished, the intention is translating the app to other languages. Based on the interviews in the blood centers, and the forms of public research, obtained from the bibliographical references, the answers showed that the ideal target audience (those who are interested both in social causes, VSNs, and games) are young people of the Z and Y generation, specifically people between the ages of 16 and 30, regardless of their ability to perform blood donation. To do this, the application should promote direct interaction between users.

The user's first contact with BloodHero will be through the Log in task, shown in **Figure 2**. From that screen, the registered user will include log in information and password to access the application, for those who are not registered yet, the screen will offer the option of registering himself (herself).

For registering and joining the application, the user will have to provide the following information: name and surname, genre, city, blood type, date of birth,



Figure 3.
Profile on BloodHero.

date of the last donation, picture/photo of the user, e-mail/telephone, nickname/login, and password. Once the registration is performed, the user is taken to the screen where he (she) can invite/request friends to have access to all the activities of BloodHero. The application will identify the user as a “Hero.”

In the profile screen (**Figure 3**), the information with the authorization of the Hero, relevant to the VSN dynamics, will be made available to the users who access it. He (she) will see the photo, name and surname, whether he is logged in, city, blood type, points, level, past achievements, leagues, and friends. The profile will be the main screen, from where the user will be taken to other activities, update his (her) personal information, and access credentials. When viewing another user’s profile, the option to request friendship will be available.

As the interaction between “Heroes” and publications (called “Stories,” by the app) receive points, which will be explained in the following topics, it was necessary modeling a mechanism to fit the content, in a way that publications should only contain subjects related to blood donation. From this, the production of a story can be done as follows: A story requesting a donation—Here the user can insert text and media (image and video) for personal support, the information of the user will be made available to other users who have interest in helping (**Figure 4**).

This publishing form (**Figure 4**) has interaction buttons. The “Assist”—by checking this option, the user may have access to more information about the patient and the activity of connecting donors; the “Comment,” this option leads to an interaction activity with the subject of the publication; and “Share,” which causes the user to include the story in the list of his (her) friends’ posts and/or to spread it in external VSNs. Additionally, when the user selects the “Assist” option, in a publication, the user is sent to the Assist activity, where the information of the patient that needs donation is made available to the Hero, as well as the button “connect donor,” where he (she) can send the Hero to an activity where he (she) can indicate friends with a blood type compatible to the interested patient.

Publications will have a list of comments related to the stories, but each hero may comment only once in each story. Comments will have the “Like” button, which indicates approval of the message by other users.

The groups, named by the app as “Leagues” (**Figure 5**), will bring Heroes with similar interests together. The goal is to get users to interact using their common interests for blood donation. The Hero can join in many Leagues, as he (she) wants; however, it will be allowed to be created only one League per Hero. The user who creates the league will be the Leader of the group. In the league registration activity, the following information should be provided: league title, description, representative image/photo, and classification—closed (when the Hero participation in the league requires the leader’s invitation), open (when any hero can participate the

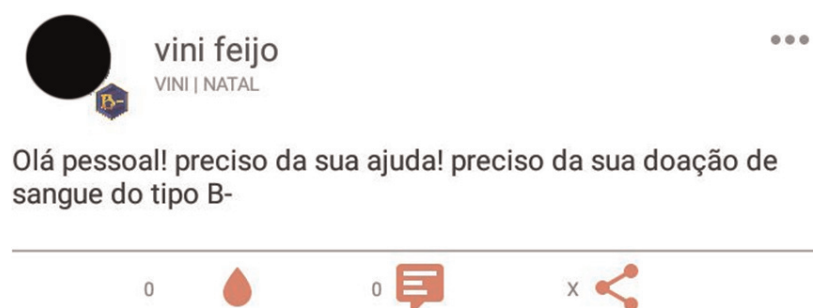


Figure 4.
 A story for requesting blood donation in BloodHero.



Figure 5.
Representation of a “League” in BloodHero.

league), and open to requests (when league participation can be requested from the leader). Once created, the user is requested to send participation invitation to other Heroes, in a way that any registered user can be invited.

3.3 BloodHero in donation support

The application will also keep information about blood donation. The purpose is to facilitate the Hero’s access to the cause. The application will show maps, all the information, and rules necessary for the practice of the blood donation.

In the map screen (Figure 6), markers will indicate all the blood centers in the city and possible campaigns for donation, present and future. Clicking on each of the markers, individual information of each blood center or event will be shown.

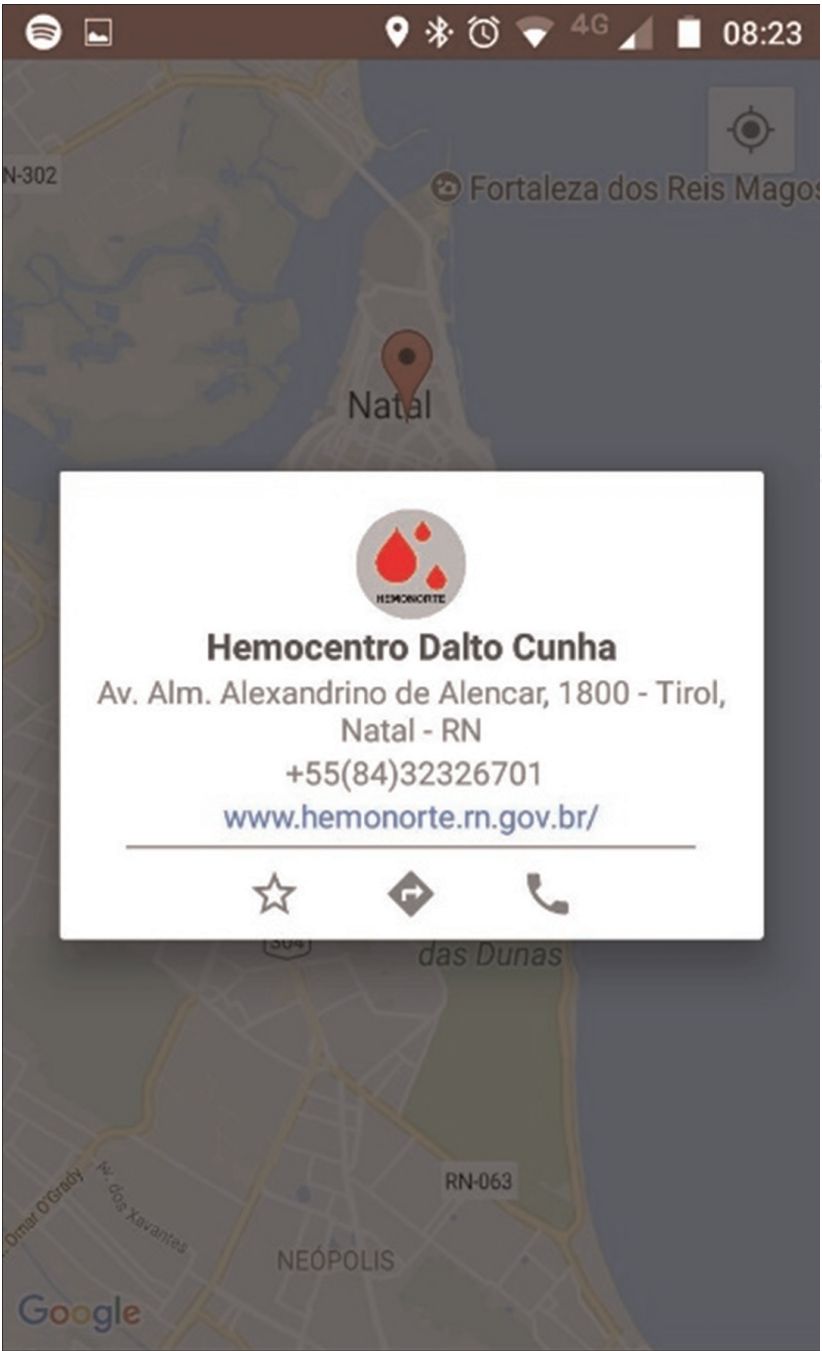


Figure 6.
Maps and information about blood centers and blood collection sites.

In the case of blood centers, the click will show the name, address, contact information, e-mail, and telephone number.

The information reached by the “I Want to Donate” activity, made available in the application, will guide the donor to the donation preparation. Information about how the donation process is carried out will be provided, how important it is, what care the donor should take before donating, what situations will impede the donation, the physiological process of blood replacement, blood types, the ABO system and the RH factor, and the Ministry of Health regulations related to the donation.

3.4 BloodHero gamification

The mechanics behind the game, at BloodHero, were based on the statistical analyses of mobile electronic games and sites of institutions using gamification. Mechanics were modeled for points, levels, feedback and achievements, and quiz and competitions, among Leagues.

Action	Rule	Points	Frequency
Registration	Record all the information required by the application	+400	Unique
To assist	Check the “Assist” option on a story	+5	By history
Comment	Comments on stories, since that they are well evaluated by other Heroes	+1	By “like”
Indicate a Donor	Indicate compatible donor to a publication (request)	+100	By compatible donor indicated
Quiz	Hit the right alternative	+200	For each correct alternative
	Participate in the game of questions	+10	By participation

Table 2.
Table of quotation and rules of points.

3.4.1 Rules for points

The rules for accumulating points are based on the Hero’s interactions with the application, on promotions to attract new users, and attitudes in favor of blood donation. The rules for punctuation are divided into the tables: quotation of points and publication rules.

The basic quotation of the points follows the rules described in **Table 2**.

3.4.2 Rules and mechanics for quiz

The game of questions and answers aims at maintaining a frequency of access of the hero to the application, but also promoting learning about blood donation, and is named “Quiz.”

BloodHero will provide at least one question per week. Questions will be about the process, importance, curiosities, and facts about blood donation. Each question will be objective and will have four alternatives, from where only one will be true. If the hero hits the question, he (she) will receive the correct points, and more information about the question will be provided in case of errors, although the points will not be counted. The correct alternative will be evidenced, and the information about the subject will be made available.

3.4.3 Calculation and title for levels

The levels will be calculated by the application and each one of them will have a title, shown in **Table 3**. The profile will be made available for viewing and will show the Hero’s experience and involvement with blood donation. They will have a limit of 20, where the points needed to reach each the level are expressed by Eq. (1), adapted from the game strategy equation [49].

$$\text{Required Points} = \left(20 * (\text{level} - 1)^3 \right) - \left(10 * (\text{level} - 1)^2 \right) + \left(1 * (\text{level} - 1) \right) \tag{1}$$

where the coefficient “20” represents the maximum level reached by each player, the coefficient “10” describes half of the maximum possible level reached by each player, and the coefficient “1” characterizes the player’s initial level. The term (level 1) was used to make the initial score equals to zero, when starting the game.

Level	Title	Points required
1	Newbie Hero/Newbie Heroin	0
2	Unknown Hero/Unknown Heroin	11
3	Started Hero/Started Heroin	122
4	Adept Hero/Adept Heroin	453
5	Benevolent Hero/Benevolent Heroin	1124
6	Courageous Hero/Courageous Heroin	2255
7	Brave Hero/Brave Heroin	3966
8	Fearless Hero/Fearless Heroin	6377
9	Strong Hero/Strong Heroin	9608
10	Super Strong Hero/Super Strong Heroin	13,779
11	Incredible Hero/Incredible Heroin	19,010
12	Super Incredible Hero/Super Incredible Heroin	25,421
13	Bright Hero/Bright Heroin	33,132
14	Scintillating Hero/Scintillating Heroin	42,263
15	Great Hero/Great Heroin	52,934
16	Excellent Hero/Excellent Heroin	65,265
17	Super Excellent Hero/Super Excellent Heroin	79,376
18	Majestic Hero/Majestic Heroin	95,387
19	Powerful Hero/Powerful Heroin	113,418
20	Super Powerful Hero/Super Powerful Heroin	133,589

Table 3.
Table of level titles.

3.4.4 Rules for league competition

Leagues will have points that will be calculated from the sum of points of each player, given by Eq. (2). The app uses the calculation to get the overall score of users belonging to the Leagues and uses that score to show the competition of the best among them.

$$\text{League Points} = \sum_{N=0}^{\text{Number of league users}} \text{Player points } N \tag{2}$$

where the overall score of the league is given by the sum of the scores of all the players who joined it. For example, if League A has 10 players, each one with 100 points, the league will have 1000 points.

The League ranking (**Figure 7**) will be available on BloodHero, which can be filtered by location (neighborhood, city, state, country, and continent) or by keywords in each League.

3.4.5 Rules for achievements

To satisfy the conquering players, BloodHero will feature several collectibles [49]. Achievements will be the rewards for activity in supporting the application dynamics. They will be gradually delivered, while the user increases his (her) interaction

indicatives by depicting the individual effort. The goals for achieving them are predefined by the application (**Figure 8**).



Figure 7.
League ranking.



Figure 8.
BloodHero application achievement examples.

Once the required codes are reached, achievements are added to the user's list of collectibles. They have a representative image, a title, and a brief description.

4. Conclusions and expectations

Brazil has a deficit of 2.5 million donations a year, that is, people who are able to donate, because of the lack of information, lack of custom, fear, or other factors, do not donate. Adding the value and benefits of gamification to blood donation, the increasing amount of blood donations and, consequently, increase blood stocks is expected.

About 50% of the Brazilian population is able to donate blood; however, there is a lack of connection between people who can donate and the act of donating blood. Bringing new technologies to stimulate new donations and reduce this lack of donor connection is essential to modify the current Brazilian scenario.

This application will not totally change this reality, but it can increase donor/donor numbers, saving more lives and proving that the health area is always open to receive new technologies and developments, aimed at improving the quality of life of the population.

The expectations with this project are to increase blood donations, to engage the population with this social cause, and show that new technologies can be applied in the health area [47].

Another expectation is concluding the development to launch the BloodHero application, which is in the prototype stage.

Acknowledgements

The authors thank LabSIM and LabSIS labs, at the Federal University of Rio Grande do Norte, for their support in this research.

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