

Gamified Blood Donors System Based on Intelligent Agents

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Abstract

The population of the country of Kenya is drastically increasing thus causing the number of possible blood donors to rise. Despite this, the blood collected and stored in most blood banks is not enough to cater for the huge demand. The demand has been due to increase of number of accidents experienced in the country and the advancement in medical procedures which calls for organ transplant and blood transfusion. Even though systems have been developed which can connect the donors and recipients and location tracking, most people are dying because they don't get this vital commodity in good time. The process of donating blood has not been enticing. There is nothing that prompts a person to donate blood. This call for developing a gamified blood donor management system based on intelligent agents so as to increase the number of donors and keep the system performance at optimal level. The project adopts Goal-Oriented Methodology in the system development process. Two agents are developed: donors' agent and the blood admin agent. The intelligent agents help in profiles personalization thus improving the system performance. Gamification technique is implemented in the system so as to increase the traffic of blood donors interacting with the system and participating in the donation exercise. This increase the number of blood donors hence enough blood is collected to cater for the huge demand.

Keywords: gamification, intelligent agents, blood donation system.

1. Introduction and background

1.1 *Introduction*

This chapter covers the background information, the problem statement, the research objectives, research questions, justification and the scope of the study.

1.2 *Background information*

Gamification is a technology that is bringing revolution in many of the applications used. This refers to the use of game elements and features in the real-life situation so as to motivate the public and increase their productivity in their work places. It's is aimed at improving the peoples' attitude and behavior towards certain tasks and activities. The use of gamification leads to drastic increase in number of users interacting with certain systems. This is because the game attributes motivate them and compels them to remain being active system users. This calls for having a well-designed system that is able to hold the huge user traffic without crashing or slowing down. Each and every organization is working very hard so as to increase the number of clients or

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system users. This can only be achieved if their system is stable, efficient and has some features which makes them feel being part and parcel of the organization.

Gamification technology having succeeded in business and commerce, it has been transferred into educational settings in the recent decade. It acts as a tool to deal with learner engagement, achievement and anxiety. Gamification promotes fun and entertainment in the learning process thus making it to be related to the flow theory. The major crucial component of flow theory is anxiety which radically affects the course of playing. The concept of gamification was benchmarked from the business industry to educational settings, and it has been the trending research topic of recent years. For many years, it has been successfully used for business purposes. In business settings, game elements, such as goal, competition, rewarding story and progress, are used to keep the clients in the system. For educational purposes, it is primarily used as a tool to enhance learner engagement and achievement. Gamification studies mainly revolve around motivation and engagement variables (Yavuz et al., 2020).

Blood shortage problem is experienced globally due to the small turn up of blood donors. This is due to lack of motivation factor in the donation process. Since gamification has succeeded in improving business and education industry, it is good if applied also in the blood donation sector. Development of applications that can facilitate users to motivate each other doing voluntarily and routinely blood donors, by gamification concept can help in curbing the existing challenge. Application of gamification successfully can trigger the users to donate routinely. Users get more enjoyable experience and make it easier to donate blood routinely (PrasetyantoWibowo et al., 2017).

Blood donation sector is faced with a lot of challenges in the process of executing their mandate. Despite the greater efforts geared towards registering more blood donors, blood collected is still not enough to cater for the huge demand. Applications have been invented to help manage blood donation taking into consideration all the functional requirements but still blood donors are not attracted to participate in blood donation exercise. Development of an intelligent blood donation system using SMS, based on strong and efficient database of donors and some major human characteristics can help in streamlining the donation process. All countries have now realized the need for regulation and implementation of a quality system as well as increased their efforts towards donor recruitment and retention. To meet the growing blood demand, some countries like Bangladesh, India, and Pakistan have launched web-based donor management systems. Donors register themselves on the sites, specifying their blood types and contact information; blood recipients do the same, specifying when they need what blood type. Sometimes blood recipients must specify months in advance of elective treatments because of donation shortages. It is anticipated that the introduction of gamified blood donation system can help in attracting more blood donors and in long run help in capping the blood shortage problem (Rahman et al., 2011).

A process that brings new mechanics to push users to be more engaged in blood donation need to be put in place. Blood donation is an activity which cannot attract people due to various reasons. This creates the need of applying game elements which can motivate people to participate in the blood donation process. Gamification in health is not just playing. Applications based on gamification need to revolutionize the way patients get involved with their treatment and improving their clinical condition. Blood donors and people demanding their donation can interact, know more about the donation process, and encourage this action among friends. All users can also receive rewards for their actions (Domingos et al., 2016).

The blood transfusion industry has started embracing the technology in its daily execution of its mandate towards making sure that we have enough blood for use in our hospitals. Human being cannot live without blood as it is a vital element required by the body for normal body functioning. It is the fluid we have in our bodies and is used to transport oxygen from the

lungs to the rest of the body. It also transports waste to be removed from the body. Human beings have between 4.5 and 6 liters of blood in their bodies. Millions of people require blood every year globally. Approximately 10,000 of pints of blood are required every day to help people. Due to deficiency of blood, people suffer from serious health issue and might even die. It is not possible to manufacture blood but with the help of advancement in technology in medical science field, blood can be transferred from one person to another. We can save a lot of peoples' life if blood donors are easily available. Sick people require blood for various reasons. A person might be suffering from anemia, lost blood through operation or may have been involved in a fatal accident. These patients might die for need of blood which is always not available. Pregnant mothers also may require blood during emergency situation (Diba, 2018).

Blood needs to be made available for use at all cost. Voluntary Non-Remunerated Blood Donors is the only source of blood in the country of Kenya. There is greater need of providing a way in which the donors can feel being part and parcel of the donation exercise. By use of gamification, we can manage to increase the number of registered donors and also retain them. The population of the country of Kenya has been drastically increasing thus causing the number of possible blood donors to rise. The demand for blood in our hospital also is increasing due to the number of accidents experienced in the country increases. Despite the large number of possible donors, we are still experiencing shortage of blood at our blood banks (WHO, 2014). This has led to loss of life which would have been prevented. Various measures have been put in place in sensitizing the public on the importance of blood donation but they have not been effective. Despite having large population of possible donors, the blood collected is usually not enough to cater for the huge demand. The existing challenge can be curbed if gamification is implemented in the blood donation industry so as to motivate the public to take part in this noble activity of blood donation. It is anticipated that the number of registered and frequent donors can increase once a gamified blood donors' system which has faster processing speed and efficient is put in place. This can be implemented by use of intelligent agents who aid in classification of the data collected and personalizing of each user profile.

1.3 Problem statement

The development of systems to manage blood donation process and help in curbing the blood shortage is witnessed globally. The population of potential donors has also increased drastically. Despite this, the blood collected and stored in most blood banks is not enough to cater for the huge demand as 90% of eligible donors don't participate in donation exercise (WHO, 2014). Even though systems have been developed which can connect the donors and recipients and location tracking, most people are dying because they don't get this vital commodity in good time.

Various measures have been put in place in sensitizing the public on the importance of blood donation but they have not been effective. The conveying of the information to the public is usually done via conventional media means such as radio, newspaper or television advertisements occasionally especially when a tragic accident has occurred.

The process of donating blood has not been enticing. There is nothing that prompts a person to donate blood. This call for developing a gamified blood donor management system based on intelligent agents who motivates users to interact with the system thus increasing the number of donors and keep the system performance at optimal level. The increase in number of donors eventually lead to increase in amount of blood collected thus cabbing the blood shortage problem.

Gamification has emerged to be the solution for attracting more traffic by motivating the system users and making them fully engaged. The drastic rise of the number of system users comes in with its own challenges which may results in the system slowing down. The use of intelligent agents in the gamified system plays a big role in making sure that despite the huge

traffic accessing the system, the system performance is maintained at peak thus helping in system users' retention.

2. Literature review

2.1 Introduction

This chapter analyze related works, applications of gamification technology, gamification history, gamification drawbacks, current state of system performance, system's performance improvement via use of intelligent agents and propose a system that can help cab the existing challenges of blood shortage problem.

2.2 Related works

Several researches have been conducted on the concept of blood donation management system with most of them stating that computerization is a mechanism that help in achieving efficiency and effectiveness of the donation process. Development of blood bank data management system is seen as a solution to prevent near miss events and improve record retrieval. The computerization is aimed at fast retrieval of records which improve efficiency of blood banks operations (Bing et al., 2012).

Most of the systems used in blood banks have not been able to fulfill the purpose which they were designed for. There has been huge demand for blood globally as the number of advanced medical procedures increases (WHO, 2014). This has been as a result of the huge population in need of advanced medical procedures such as organ transplants and anemia treatment. Despite having large number of potential donors, the blood shortage is still experienced.

Technology advancement is felt even in the blood donation sectors. Applications are developed to help in managing various operations in the blood banks. New Zealand Blood application is used to schedule donation and was designed by Dialogue marketing. It is built with the capability of donor search, appointment scheduling or cancelation, registration of donors and profile management. It is a free application which is accessible to all the public (Nebraska, 2013).

The need to curb blood shortage led to development of Raspberry PI based blood bank system. This is an android application where the person who wants to donate blood needs to register so that his information is stored in the database. Application display three different screens such as Register, Query and about us screen. Donor needs to register his/her details such as Name, Gender, Address, Blood group and Mobile number. In query section patient needs to select required blood group and current address. Whole system is implemented using Raspberry PI kit. Whenever there is requirement for blood then patient enter required blood group details. Then that information is fetched from database and SMS is send to the donor directly on his number which is stored at the time of registration. Hence there is direct communication between donor and patient (Adsul et al., 2018).

Shimon Maman in the process of finding a solution to blood shortage build Bloody Help application. It was designed for connecting blood donors and patients. It has a donors' registration module which captures all his/her details. A blood search capability is added where the patient finds a possible donor and contacts them (BloodyHelp, 2016).

The existing blood shortage led to development of Life Saver App android application in which the blood donor is made available at required time. The donor who are all register in the application are displayed while searching for blood donation. The donor who are all nearby location are tracked by the GIS. The purpose of this application was to donate blood in case of emergency (Brislin et al., 2017).

Meiappane et al. (2019) proposed development of a system that help people by providing a list of blood donor and blood banks around the user at a certain radius and distance. A user can apply filters and search the specific need in the application such as availability of blood groups or donors having the same blood type. The system has an OTP verification and Validation of donor so that no third person can enter into the database as a volunteer. The system provides a donor tracking and locating system using Global Positioning System, by using Havesine Mathematical Algorithm which finds the nearest Donor.

E2M developed Blood Donation a free mobile application compatible with both android and IOS. It is used for searching hospitals addresses which have blood type compatible with the patient (E2M, 2017).

Keeping track of blood donors' records and their donation led to development of Blood Buddy which is a free iOS. It is used to remind them of the next donation period. It alerts the donors after duration of three months (BuddyBlood, 2016).

Game4Life is developed with the intention of engaging donors to schedule their next donation as they have fun collecting points for rewards. It also encourages future donors to register and donate their blood as it relays information of the importance of blood donation. After every donation, points are awarded to the donors (Sabani et al., 2016).

National Blood Transfusion Center, Khartoum having suffered from lack of central data references which was contributed by use of paper based system that was more time consuming in data retrieval and has no security prompted the development of a central blood bank management which provided real time information about blood component, grouping donor information from collection to testing and use of the blood product (Esmail & Osman, 2018).

Lack of direct contact between the donor and recipient contributed to development of blood bank database created by collection of details from various sources like Blood banks, NSS, NGOs, hospitals and through web interface. The data collected was maintained in a central server. An algorithm was designed to help retrieve the donor's information by a recipient and a call initiated. The ingress of donor and the closeness of the donor to the place from where the call is coming were accounted for in defining this algorithm. Based on the algorithm the most eligible donor were found and the blood donation process was effected (Arif et al., 2012).

Blood hero application was invented with the aim of helping curb the blood shortage. This was as result of the WHO report which stipulated that only 3% to 5% of each country population participate in the blood donation exercise. The study showed that there was need to clarify the blood donation process. This led to the development of the Blood hero system whose aim was to incorporate gamification reward attribute so as to motivate people to register as donors and eventually help in reducing the blood shortage. Gamification act as a mechanism to push users to be more engaged (Domingos et al., 2016).

2.3 How agents work?

Various researches have been conducted on how intelligent agents' function. This aimed in learning more about their behavior and their interactions. Cooperation and competition are the major techniques which are discovered to be used in their mandate execution. It clear that during cooperation, agents tend work together and draw on the broad collection of their knowledge and capabilities to achieve a common goal and they fail or succeed together. Sometimes agents may have conflicting goals, this results in competition where they work against each other and thus the success of one agent implies the failure of the other agents. Negotiation is portrayed to be a vital skill for effective agents functioning in accomplishing their task assigned. The agents

need to come to a mutually acceptable agreement on some matter which is achieved by convincing each other to undertake a certain activity depending on the conditions given. (Jennings et al., 2016)

Jennings et al. (2016) stipulates some techniques applied during the negotiation process. The techniques are Game theoretic techniques, Heuristic techniques and Argumentation based techniques. An analysis of these techniques states that agent issues a proposal which can either be accepted or rejected. During rejection, the reason for rejection is stipulated which allows the agent issuing the proposal to issue a counter offer stipulating why the other agent should accept the proposal. Coordination of agents needs to be put into consideration. A contract net protocol is used to help in agents' coordination. An agent acting as a manager decomposes its contract into subcontracts to be accomplished by other potential contractor agents. For each subcontract, the manager announces a task to the network of agents. Agents receive and evaluate the announcement. Agents with appropriate resources, expertise, and information reply to the manager with bids that indicate their ability to achieve the announced task. The manager evaluates the bids received and awards the task to the most suitable agent, called the contractor. Finally, manager and contractor exchange information together during (Jennings et al., 2016).

2.3.1 Intelligent agents in e-learning systems

The education field has not been left out. Various systems have been put in place which aids the learners in knowledge acquisition. Most of this system applies intelligent agents where by the learners' contents is personalized depending on their age, skills possessed and their learning speed. To increase the interactivity with such kind of systems, gamification is applied so as to motivate learners to keep on using the systems. Rewards and learning levels are given as the learning progresses with accessing the learning materials and covering various topics. AI makes digital systems learnable. Some of these systems have the ability to learn about its user's peculiarities like player's intentions. Artificial Intelligence which makes a digital system have the ability to learn about users is the key to making educational gamification adaptive more effective to varying human learners and trainees. Personalization of different learners and the impressive interactive platform brought about by gamification technique makes education advantageous over conventional approaches (Arnold & Jantke, 2018).

2.3.2 Gamification of businesses

Most of the businesses have embraced the use of gamification. Their main aim is to attract more clients visit their stores so as to receive services. For the advertising companies, they have been applying personalization technique where they send to clients' social media accounts goods similar to the one they had purchased. This reduces the time a client takes in search of goods in their online stores. In order for Malls and supermarkets to retain their customers, they have introduced the use of Loyalty cards. Members accrue points, normally based on dimensions of the volume, value and frequency of spend. Later on the customers are given company's product or service towards points' redemption as form of reward for their loyalty (Wathigo, 2016).

Communication companies are not left behind in the process of increasing the number of their subscribers. Safaricom introduced the issuing of Bonga points to their client on every amount of credit spent. Once the bonga points have accumulated, the customers can redeem them and in return given free airtime, SMS or even tangible goods like phones. This has greatly increased the number of Safaricom subscribers. Safaricom has gone further and introduced more activities geared towards attracting more customers by rewarding them (Safaricom, 2014). Recently we have distance system where they are rewarding their faithful customers all-over the country. This is done by randomly selecting customers from their database and the selected customer is given a token of appreciation (Safaricom, 2019).

2.4 Gamification history

The use of games has drastically changed thus introducing a new concept known as gamification into the technology field. In 1992, the first form of gamification was brought forward in form of a toy. For approximate sixty-eight years, no notable improvement took place in gamification field up to 1980. After this timeline elapsed, Richard Bartle helped in creating a multiplayer game online which was known as MUD1. It was the first online game which people could interact with globally. This was the era when computers had not evolved so much as compared to what we have today. MUD1 helped to shape the past of gamification and the its future. In 2002, a serious gamification element was introduced by bringing in board real games. Some of these games were used for training purposes via simulation. This helped in creating path for introduction of real gamification. The first platform for gamification was developed in 2007 by Bunch-ball. This allowed other organizations to start launching products which utilized the gamification technique to increase their sales and traffic. Gamification has become a very profitable field of study which has been aided by the internet in variety of devices. This has become one of the most competitive filed which everybody wants to venture in. Every organization is working hard to implement gamification in their systems (Nielson, 2018).

2.5 Gamification drawbacks

Introduction of gamification in the industry is bringing drastic changes by increasing the number of clients and customers. Despite the best part of gamification being felt, the industry is face with some few challenges which can be addressed to make it more effective (Rajamani & Sharma, 2017).

Gamification is a tool that simplifies concepts. It is designed for a purpose. Developing both the tool and purpose is extremely complex. The level of complexity involved in both designing and managing the entire gamification system is immense. The misusing gamification in a training course result in wasted resources and also the learners won't have patience with a game once they discover it has no real purpose or it was created haphazardly. If you don't have a design or technical skillset, but you know a mini-game is the one thing that elevate your course to the next level, then it's time to spend some time with a game designer. Explain the learning objectives, discuss possible execution options, and, most importantly, listen to what the designer says. The extra work you put in to this process always comes through in the final product, which translate into a better result for the learners (Rajamani & Sharma, 2017).

Gamification if introduced without seriously considering its purpose might lead to wastage of a lot of time. Not all game attributes need to be implemented on every system. Worst choice of the attributes can jeopardize the whole system. The game attributes implemented needs to be in line with the organization main objective which need to be accomplished (Jayme, 2016).

Introduction of gamification technique acts as crowd sourcing process. Huge traffic of users is drawn towards interacting with the gamified system. This calls for utilization of a lot of the system resources. As the traffic continues to grow, the system eventually slows down. No one likes interacting with systems having long response time thus once the system execution time increases, the system users feel discouraged thus making them to stop interacting with the system. There is greater need of considering the system architecture in its development so that all aspects needed to make it handle a huge traffic are implemented during its design (Werbach & Hunter, 2015).

Despite having so many applications developed to aid in blood donor management, blood shortage is still experienced. Most of these applications concentrate more on the functional requirements but do not focus on changing the blood donors' behavior (Sabani et al., 2016). Game4Life and Blood hero applications apply gamification technique to help in encouraging blood

donors to register and to be actively involved in the donation exercises though it does not provide a way to handle and manage the huge traffic of blood donors interacting with the system.

2.6 Current state of system performance

Complex applications are designed daily. This is achieved via integration of so many subsystems developed using different technologies and platforms to accomplish certain goal. Component based programming is applied in order to deliver these systems in good time without delay. The integration with other external API's helps in embedding more functionality into the system thus making it possible to provide various services using one system. Centralization of all the services increases the number of transactions conducted via use of a single application as it help save time (Simic et al., 2013).

Invention of powerful computer hardware which has the ability of supporting complex applications is witnessed. Powerful cloud-based servers which have the faster processing speed have been introduced. All this effort is aimed at increasing system performance. Technology advancement is felt globally. All the organizations are working very hard in embracing the new technology introduced. Everybody is excited by the new systems invented daily and no one wants to lag behind. This has been spearheaded by the vast usage of the internet. Most of the devices are connected to each other thus simplifying the process of communication. It is believed that in the near future, all the devices are able to communicate and share information. This is possible by the use of Internet of Things (IOT), Smart technology and also by use of Artificial Intelligence (AI). Due to the increased number of operations to be executed by the systems and also the increased number of users, the performance of most systems is affected. This has been a major concern to most of the computer hardware developing companies. These companies have worked around the clock so as to optimize their devices so as to increase the performance. Upgrading of the hardware components of the computer devices has been made and very powerful devices which have high RAM capacity, faster processors, higher graphics performance and large storage capacity have been introduced. Despite all the efforts geared towards improving the computer performance, inefficiency in the performance is still experienced. Every system developer is working hard to design and develop systems which meet the clients' functional requirements. This is implemented via Rapid Software Development methodology (RSD). The software architecture which is the aspect of systems has been neglected. Every developer is working hard to implement the clients request but not taking into consideration the software architecture. This has led to development of systems which are not able to exploit efficiently the resources provided by the computer hardware thus leading to inefficiency. Companies have opted to purchasing very expensive super computers so as to cab the performance issue but it has all been in vain. This has resulted in establishment of blame game where nobody wants to take full responsibility of the overlying performance challenge. The system developers blame the hardware and network engineers and vice versa. The number of users interacting with the systems has drastically reduced (Simic et al., 2013).

2.7 System performance improvement via use of intelligent agents

The amount of information currently available via the internet is increasing rapidly. Mining meaningful information from these huge databases of data might be tiresome. Retrieval of the information has become a major challenge as it is not easy for users to locate relevant information they need in good time. Most organizations have databases containing all the daily transactions conducted by each client. Systems have been put in place to aid the clients get access to their records from any location of the world. The systems query the main database to access

details of each user who is interacting with the system at any given time as they try to retrieve their data (Jansen, 2012).

Organizations are embracing the use of gamification technique which automatically increases the number of clients interacting with the systems. This brings success in the business as the number of transactions conducted improves. In the learning industry, the students become motivated and they engage in the learning system more often. This creates a huge traffic on the gamified systems. With the huge traffic, a lot of data is stored regarding each participant interacting with the system at any given time. Retrieval of these data in real time by each user tends to be challenging as the system slows down as a result of not able to cater for the huge traffic (Jansen, 2012).

The introduction of autonomous, intelligent agents has come to help cab the overlying system performance problem. This is done via personalizing each user’s content depending on their age, location and any other feature which identify them uniquely for easier data retrieval. This can be done via use of classification method of machine learning where the data in the databases is grouped into various classes. Each uses only interacts with data in the class holding his/her information. This makes data retrieval easier thus increasing system performance by reducing the response time. The reduced response time increases system efficiency thus helping in retaining the users interacting with the system thus the organization goal of use of gamification is achieved (Jansen, 2012).

2.8 Conceptual framework

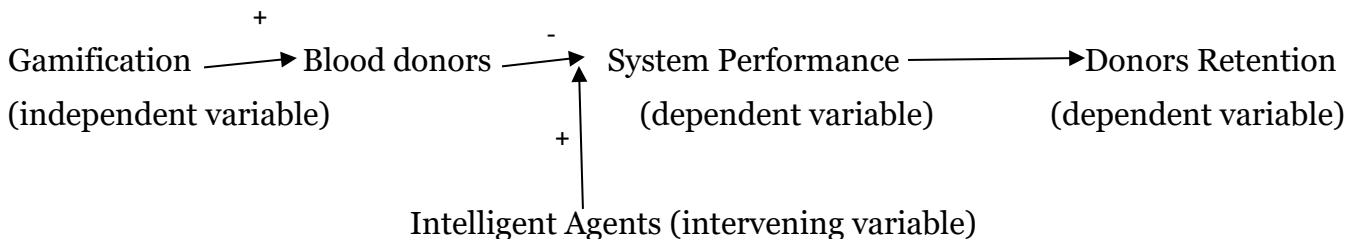


Figure 1. Conceptual framework

Introduction of gamification technique in blood donor management system increase the number of registered blood donors. This eventually increase the traffic of users interacting with the system. The increase in users affect the system performance negatively and it might slow down thus discouraging users from continuing using the system due to long response time. The introduction of intelligent agents in donor’s profile management help in system optimization thus improving its performance and hence improve blood donors’ retention rate.

3. Research methodology

3.1 Introduction

This section describes the principles, rules and stipulated procedures to be used in the project. This section focusses on project design, system requirements, and technology used, system functionality and system development process.

3.2 Research design

Qualitative design is adopted in this project in line with the research objectives which are qualitative in nature. The research is aimed at changing donors' behavior by introduction of gamification technology. This cannot be quantified thus making it suitable to use qualitative research design.

3.3 Methodology

An iterative methodology is adopted in the system development. At the beginning, a prototype of the blood donor system is designed and developed. Additional functionalities are incorporated in the system in various iterations. The design modifications are made and new functional capabilities added in every cycle. The iterations continue until the development is completed. This methodology enables the user to evaluate the system functionality periodically until the final product is delivered. This creates rooms for capturing new requirements and implementing them.



Figure 2. Iterative methodology

3.3.1 Planning phase

The methodology to be used is selected in this phase. Iterative methodology has been chosen as it helps the user acquire him/her with functionality of the system before it is fully completed. The requirements for developing an intelligent blood donor system are examined carefully. The major goal is to increase the amount of blood collected and stored in the blood bank. This involves raising the number of potential donors via using gamification technique to motivate the donors and help retain them. This is achieved via development of a gamified blood donor web system based on intelligent agents.

3.3.2 Analysis

In this phase, the specifications of the gamified blood donor system are studied based on the problems that have been identified in planning phase. Analysis is performed to point out the appropriate business logic, database models and to know any other requirements of this particular stage. The agents to be developed are identified in this stage. These agents are the blood donor agent and blood admin agent. These two classes of agents cooperate in their functionalities so as to enable the blood donor system function well. The donor agents interact with the donors' records while the blood admin agent conduct analysis on all the records received in the system.

The system architecture is stipulated in this stage. The system store records of all registered blood donors, the number of times they have donated blood, the rewards they have obtained and the level they are at. MYSQL is used as the database management system.

This is a web-based system which is developed using Laravel framework. This is powerful Model View Controller (MVC) framework which helps in creating full featured web applications. HTML5, JavaScript and CSS are used for the front end development, while the back end is developed using Object Oriented PHP.

3.3.3 Design and development

The design of blood donor prototype is produced in this phase. The requirements captured in the previous phases is used to develop the system. Laravel PHP framework is used in the development of the web-based system. The donor agent and the blood admin agents are developed in this stage. The gamification technique is embedded in the system via awarding of points to donors. Personalization of the user profiles is implemented.

3.3.4 Testing phase

After the current build iteration is coded and implemented, testing is initiated in the cycle to identify and locate any potential bugs or issues that may have been in the system. The system testing is carried out in each iteration so as to determine if all the user requirements are well captured and implemented.

3.3.5 Evaluation phase

This is the final phase of the iterative life cycle. If there are bugs and requirements not met in testing stage, the development is subjected to another iteration. If no bugs found, the blood donor system is deployed for use.

4. Conclusion

The aim of each and every organization is to increase the number of clients/customers whom they server so as to maximize on their profits. For learning institution, their main aim is to produce learners who have the required skills. Depending on the nature of activity executed in any organization, how to increase the number of users interacting with their systems and getting value of it is a big concern. Retention of the users for long also is emerging to be another challenge. For all these to be possible, there is greater need to have a system that can help in crowdsourcing so as to increase the traffic of users visit the organization system.

Gamification has emerged to be the solution for attracting more traffic by motivating the system users and making them fully engaged. The drastic rise of the number of system users comes in with its own challenges which may results in the system slowing down. The use of intelligent agents in the gamified system seems to play a big role in making sure that despite the huge traffic accessing the system, the system performance is maintained at peak thus helping in system users' retention.

It is believed that the introduction of a gamified blood donor system based on intelligent agents help in increasing the number of registered blood donors. The frequency of donation of blood also increases as the donors become engaged in the donation system. The feeling of ownership of the donation exercise is created and every citizen feel being part and parcel of the

practice. This result in having plenty of blood in all the blood bank enough to cater for the huge demand experienced. Via personalization of donors' profile by use of intelligent agents, the performance of the system won't be affected by the large number of donors interacting with the system thus improving blood donors' retention rate. The deaths caused due to lack of blood in the blood banks drastically reduce. This makes it important to research on the contribution of gamified blood bank management system based on intelligent agents in blood donation sector.

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