Francisco José García-Peñalvo ·
Alicia García-Holgado
Editors

Proceedings TEEM 2022: Tenth International Conference on Technological Ecosystems for Enhancing Multiculturality

Salamanca, Spain, October 19–21, 2022

Springer

Editors
Francisco José García-Peñalvo
GRIAL Research Group
Universidad de Salamanca
Salamanca, Spain

Alicia García-Holgado
GRIAL Research Group
Universidad de Salamanca
Salamanca, Spain

ISSN 2196-4963 ISSN 2196-4971 (electronic)
Lecture Notes in Educational Technology
ISBN 978-981-99-0941-4 ISBN 978-981-99-0942-1 (eBook)
https://doi.org/10.1007/978-981-99-0942-1

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

TEEM 2022 Preface

We celebrated the tenth edition of the Technological Ecosystems for Enhancing Multiculturality (TEEM) International Conference in the University of Salamanca, the institution in which it was born. Nine years ago, this academic conference project started. We had the goal to create a new interdisciplinary event in which the new advances in technology would be reflected in the resolution of the problems of Education and the Knowledge Society. We pursued the establishment of a new research community with a strong aim to help Ph.D. students to have opportunities to know and collaborate with consolidated researchers worldwide.

Looking back, we are very satisfied with the obtained results. We are a consolidated research community that has grown, many research projects were born in the previous editions, many collaborative papers in prestigious books and journals have been published, many international internships have occurred, but we are very proud because tens of new Ph.D. participated in the previous editions of TEEM Doctoral Consortium track and contribute to help the future Ph.D. to be part of the TEEM family.

This edition is a reunion event, fully face-to-face, after two editions in virtual and hybrid mode due to COVID-19. More than one hundred and ninety researchers shared their scientific advances in this tenth edition. Some of them were new, but most of them were regular participants in this conference, which reinforces the original idea of forming a solid scientific community.

It is also important to say that this TEEM tenth edition was within the European Campus of City-Universities (EC2U) Alliance (https://ec2u.eu/), co-funded by the Erasmus+ Programme of the European Union. The EC2U is a multi-cultural and multilingual Alliance consisting of seven long-standing, education- and research-led, locally and globally engaged universities from four diverse regions of the European Union: the University of Coimbra, the University of Iași, the University of Jena, the University of Pavia, the University of Poitiers (Coordinator), the University of Salamanca and the University of Turku.

TEEM 2022 has had 210 submissions from which 145 full papers were accepted; that is, there is a 30% rejection rate. These papers have involved 424 authors from 26 countries.

The TEEM 2022 was organized in 16 thematic tracks that covers research areas such as Educational Assessment and Orientation, Human–Computer Interaction, Computers in Education, Communication Media and Education, Medicine and Education, Learning Analytics, Engineering Education, Robotics in Education, Diversity in Education, Gamification and Games for Learning, Smart Learning and Laboratory-Based Education.

In addition to the regular sessions, the TEEM 2022 edition featured three prestigious guest speakers. Firstly, Gema Parreño Piqueras, Developer Advocate at Iterative, gave the inaugural keynote entitled “Alignment of language agents in video games.” Dr. Oriol Borrás Gené, Professor at Universidad Rey Juan Carlos (Spain), gave a keynote entitled

"3 years escaping from a room, learned lessons." The closing lecture was given by Dr. Ricardo Colomo-Palacios, Full Professor at the Østfold University College (Norway), with the title "Academia-Industry collaboration: a view from IT."

We would like to thank the members of the Steering Committee for their counsel and the International Scientific Committee for their accurate and timely reviewing. We would also like to thank the Track Chairs for their efforts in organizing the academic issues related to each track and the Organizing Committee for their huge effort in all the associated tasks that an international conference involves. We would like to do a special mention for the Editors-in-Chief of the linked journals that have offered special issues or slots in their regular issues for those selected and extended papers of TEEM 2022 conference that will have another in-depth review following the guidelines of each journal. Last, but not least, we would like to thank the participating organizations: University of Salamanca, Research Institute for Educational Sciences at the University of Salamanca, GRIAL Research Group and European Campus of City-Universities (EC2U) Alliance for their support.

Next year, we will continue with eleventh edition of TEEM Conference that will be held at Bragança, Portugal, organized by Instituto Politécnico de Bragança.

October 2022

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Mobile Application Development for Human Veterinary Resources Management in a Low Density Population Context: Promoting Students Engagement by Working with the Community

Paulo Matos[1(✉)], Helena Velasco[2], and José Gonçalves[1]

[1] CeDRI-Research Centre in Digitalization and Intelligent Robotics, Polytechnic Institute of Bragança, Bragança, Portugal
{pmatos,goncalves}@ipb.pt
[2] Câmara Municipal de Bragança, Bragança, Portugal
helena.velasco@cm-braganca.pt

Abstract. This paper describes a mobile application, developed in an educational context, by the students of the Degree in Computer Engineering of the Instituto Politécnico de Bragança, allowing them to develop skills, based on real-world community problems solving, promoting by this way its engagement, and, at the same time, provide a solution to an effective need of the local community. The developed application has as goal to support the Human Veterinary Resources Management in a Low Density Population Context.

1 Introduction

Bragança is a small town from the northwest of Portugal that struggles with dimension and scale problems, being the only district capital that do not has an Veterinary Hospital that can provide a service 24/7 service. The need for this application arises from this very specific, uncommon context, characterized by areas of low population density, where it is not sustainable to maintain a full-time public service. The solution found resorts to several private providers of veterinary services to, as a whole, ensure this service to the population on a full-time basis. The particularity and rarity of this scenario makes the creation and commercial exploitation of this type of product unfeasible. It was in this context that the challenge was posed to the students of the Degree in Computer Engineering at the Instituto Politécnico de Bragança, allowing them to develop skills with real problems and, at the same time, provide a solution to an effective need in the region, promoting by this way its engagement [1–3].

However, this requires considering unusual aspects in the development - which are related to the fact that students will not be available to meet future

F. J. García-Peñalvo and A. García-Holgado (Eds.): TEEM 2022, LNET, pp. 292–303, 2023.
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management entity, that is, as long as the veterinarians involved in the exchange agree, it must be possible to do this by themselves.

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Figure 1 illustrates the architecture of the solution, where the three types of users (actors) can also be identified:

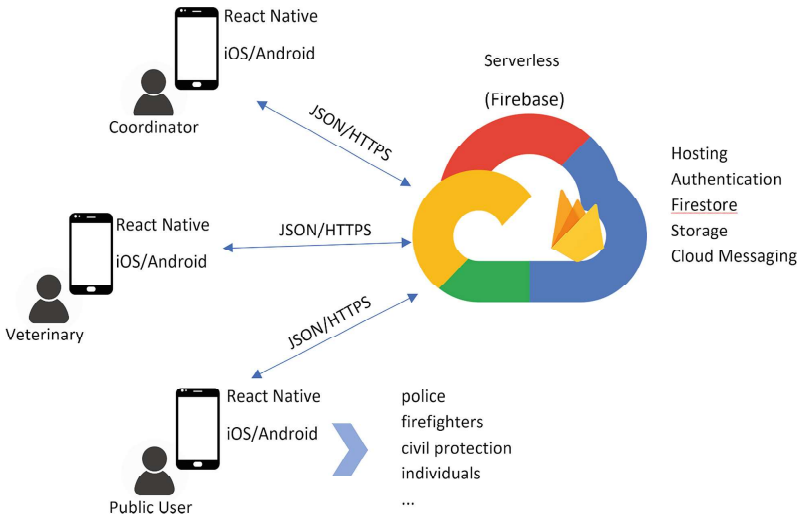


Fig. 1. Solution architecture.

Public User - Named for having access only to the public component of the application. Represents any person who needs to contact the veterinarian on duty, it can be a police officer, civil security officer or any other person.

Veterinarian - They are the ones who provide veterinary services. Access requires registration and subsequent acceptance by the Coordinator. The veterinarian can request to change shifts with a colleague and register the services provided.

Coordinator - Entity that admitted/removes veterinarians and that can upload the file with the duty shifts.

Only the last two can consult the entire schedule. The Public User only sees the contact of the veterinarian on duty for the day in question (the day he uses the app to request support from the on-call veterinarian).

All usage profiles are ensured through a single application - which, depending on the profile, provides more or less functionalities.

4.1 Veterinary Registration

Figure 2 illustrates the procedure for registering veterinarians. Anyone can register as a veterinarian. However, access to the veterinary features is impossible until the Coordinator admits him/her. The idea is that the person makes a registration, providing the name, email and telephone contact. A code is sent to

the email to verify email ownership. Later, the user can enter more data, such as the business name of the company he represents and the like.

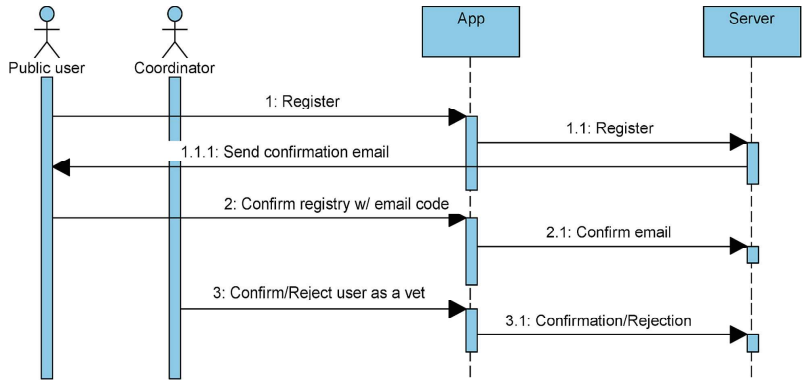


Fig. 2. Sequence diagram of the vet registry and acceptance.

Once the email has been verified, the candidate appears on the Coordinator's dashboard - The Coordinator can view the registration data to confirm their veracity and can accept or reject the registration. If rejected, all information from the veterinarian candidate's record is removed. If accepted, the veterinarian will be able to access the features of this profile.

4.2 Shift Exchange

The veterinary should have access to a calendar showing their duty shifts, as well as information on who is assigned to the other days. Trading for the purpose of exchange is extra-application, that is, it is the interested party who contacts the colleagues to find out if anyone is available to exchange and thus ensure the service for the day in question. Once agreed, anyone involved can go to the application, choose the days between which the exchange will take place. User can only do it for days that are allocated to him and always for future dates. The veterinarian on duty for the day to be changed receives a notification that can be viewed in detail in the application itself, signaling the change request. He can reject or accept. Upon acceptance, the exchange takes place between both and becomes visible to all others involved. The Coordinator also has access to this information on the exchange list, but only to be aware of. If the exchange is rejected, the applicant receives this indication by notification and can consult the status of the request on the application (that will appear as rejected).

5 Implementation

The implementation is not yet in the desired state, but it already provides almost all the intended features. In Fig. 3 it is possible to visualize the layout of the

public screen - when opening the application, the user (regardless of the profile) sees which veterinarian is on duty for the day in question. By clicking on the mobile number, the call is immediately initiated.

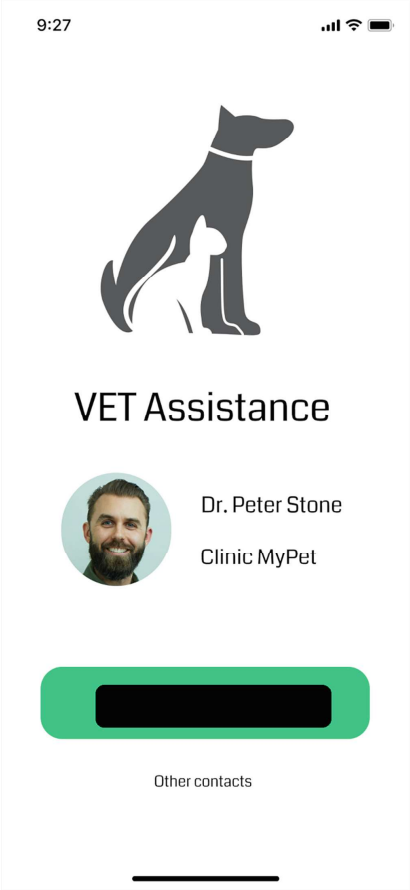
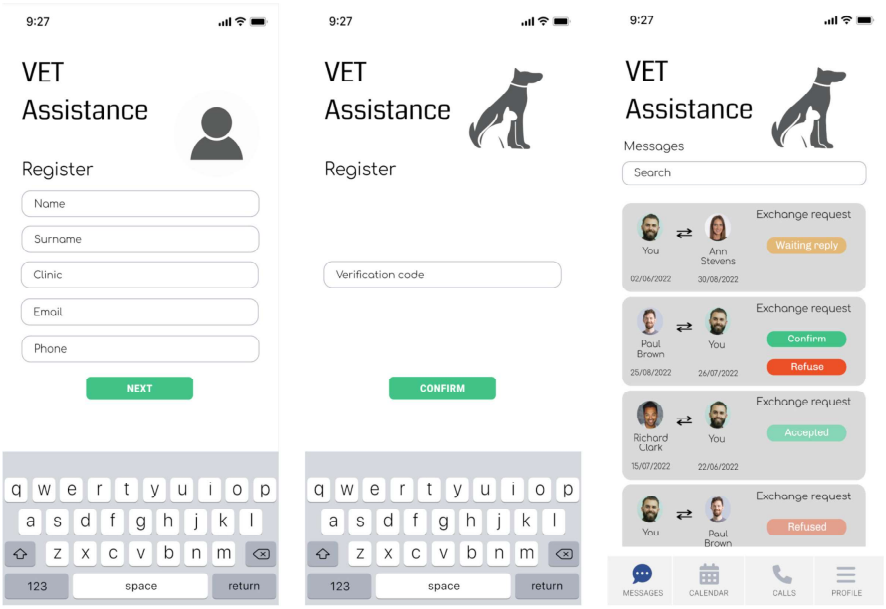


Fig. 3. Public screen

The long press on the application's logo allows access to authenticated functions, that is, those intended for veterinarians and coordinator. If there is no previous registration, the user is sent to the screen Fig. 4a, where he/she must fill in his/her data. From here, an email is sent with a confirmation code that should be introduced on the app (see Fig. 4b) - this way the email is validated as belonging to the user in question.

The user, a potential veterinarian, will stay on a pending condition - not being able to do anything else until the coordinator effectively admits him as a veterinarian.

If the user is already registered and confirmed by the coordinator, he goes directly to screen of Fig. 4c, where he can view past and present shift change requests, namely those awaiting by response. On the leftmost side of each request it is the veterinary that have requested the exchange. On the right, it appears



(a) Registry. (b) Verification. (c) Messages.

Fig. 4. Screens 1

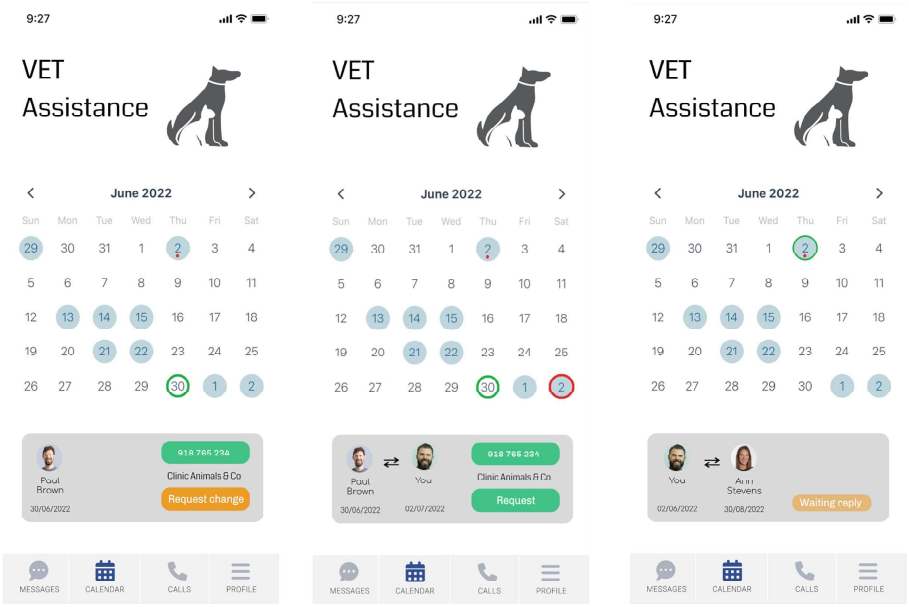
to whom the request was done. In both cases, with the respective date (days for the exchange). Note that the user can either appear on the leftmost side, requesting the exchange to a colleague; or more to the right, in case a colleague has requested him to change shifts.

When the request is made by the user to a colleague, the indication of Waiting Reply appears. On the side of the colleague, there is the possibility of accept or reject.

The screen of Fig. 5a (Calendar) allows the user to know which days he has a shift (signalled in light blue); and consult who is on duty for a given day, simply by selecting the day. Whenever this is done, for the veterinarian on duty it appears the respective telephone contact and the possibility of requesting the change for the selected day. The idea is that user uses the contact to speak personally with the colleague to arrange the exchange. Then through the application formalizes this exchange.

When making Request change, it is possible to select a second day (the day to change) - Figure 5b - circled in red. Once this is done, user can then definitively request the exchange (Request). The process proceeds as previously explained. The days with pending trade requests are indicated by the small red dot and the detailed information shows Waiting reply (see Fig. 5c).

The veterinarian can also register the services performed through the Call option (Fig. 6a). Here you have the possibility to view records already made or to be filled in, as well as request the creation of a new record. In the latter case, it is automatically sent to the cell phone camera, in order to register the service through a photo of the animal in question (see Fig. 6b). Once the photo is taken,



(a) Calendar. (b) Exchange request. (c) Waiting reply.

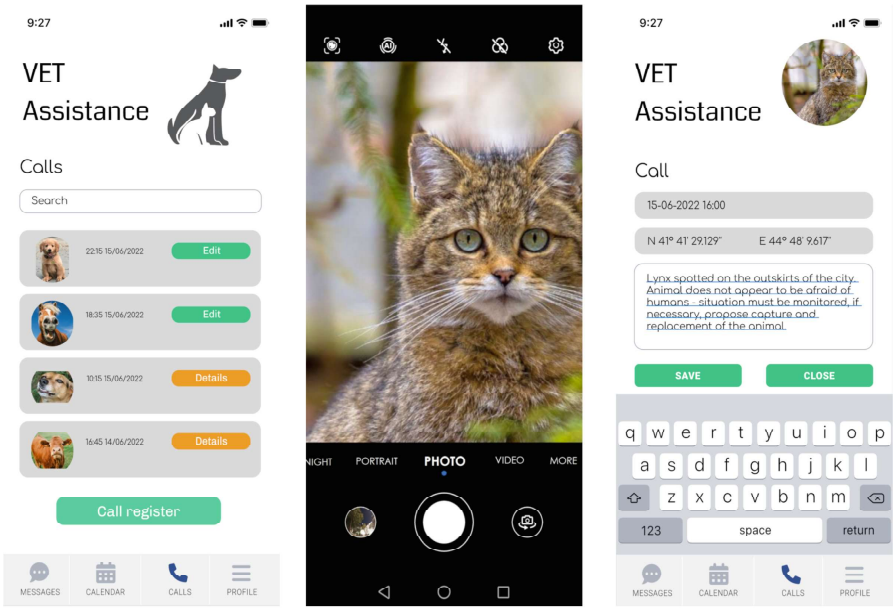
Fig. 5. Screens 2

the date, time and GPS coordinates of the location are also obtained. The record can be left in edit mode to be finished later or finished immediately (Fig. 6c).

According to Fig. 7a, the vet also has the Profile option available to edit their data (name, clinic, cell phone contact and photo).

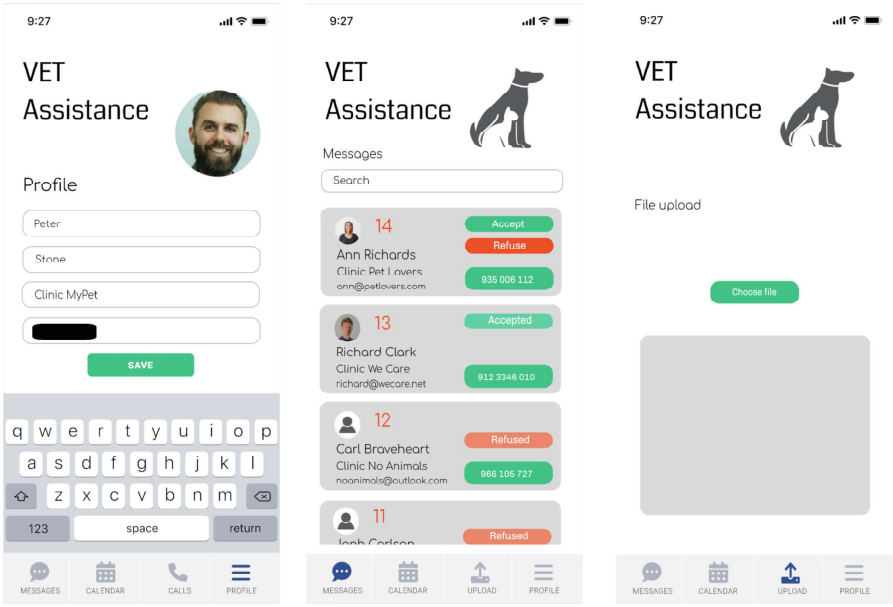
The coordinator accesses the private part in the same way - but it is supposed to already be registered, which is done directly on the back-end (Firebase console). The coordinator has the option to view messages, for now only regarding requests for admission of users on the platform as veterinarians. For this purpose, he has access to the name, clinic, email, mobile phone and, eventually, photo (see Fig. 7b). He can accept or decline the request. Note that for each request an identifier is generated - which is essential to identify veterinaries in the upload option.

In the upload option, the coordinator can upload the file with the shift assignments. The file must be in CSV format, containing, for each day assigned, the user ID and the day (in YYYYMMDD format). Figure 1 illustrates one of these files. With this solution, the administrator makes the planning, namely for extended periods of time, and then easily makes that information available. This service assignment is normally carried out with the prior consent of the veterinarians. In any case, the objective of the solution is precisely to provide the possibility for veterinarians to exchange days of service and that this is reflected in the information provided to the common user.



(a) Calls. (b) Photo. (c) Call registry.

Fig. 6. Screens 3



(a) Profile. (b) Coordinator messages. (c) File upload.

Fig. 7. Screens 4

Table 1. CSV file format

Day	ID
20220615	5
20220616	3
20220617	1

6 Conclusions and Future Work

In functional terms, the created solution complies with the defined and the necessary goals - although there are already more ideas and improvements identified. For this purpose, a serverless service was used, Firebase, which is a Platform As A Service - PaaS (more precisely a Back-End As Service - BeaS) - with this, the need for servers, services (HTTP and database), configuration and maintenance were significantly reduced.

Thus, a solution was obtained that can be immediately made available to the community, fully manageable by the community itself and that does not require the continued involvement of students for its maintenance. The production of an application that is effectively necessary and that will be used for the benefit of the community, namely veterinarians, but also of all those who use their services as public service providers, is undoubtedly a way to put students in practical situations, with the natural demands of the applications for effective use, promoting the experience, the acquisition of competences and even the professional curriculum of the students. The authors believe that the experience should be extended, bringing new challenges, namely for situations like the present, where it is possible to build in the available time and with the skills that students have, functional solutions that can be effectively used and for a long time.

Acknowledgements. This work has been supported by FCT - Fundação para a Ciência e Tecnologia within the Project Scope: UIDB/05757/2020.

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Mobile Application Development for Human Veterinary Resources Management in a Low Density Population Context: Promoting Students Engagement by Working with the Community

Paulo Matos[1(✉)], Helena Velasco[2], and José Gonçalves[1]

[1] CeDRI-Research Centre in Digitalization and Intelligent Robotics, Polytechnic Institute of Bragança, Bragança, Portugal
{pmatos,goncalves}@ipb.pt
[2] Câmara Municipal de Bragança, Bragança, Portugal
helena.velasco@cm-braganca.pt

Abstract. This paper describes a mobile application, developed in an educational context, by the students of the Degree in Computer Engineering of the Instituto Politécnico de Bragança, allowing them to develop skills, based on real-world community problems solving, promoting by this way its engagement, and, at the same time, provide a solution to an effective need of the local community. The developed application has as goal to support the Human Veterinary Resources Management in a Low Density Population Context.

1 Introduction

Bragança is a small town from the northwest of Portugal that struggles with dimension and scale problems, being the only district capital that do not has an Veterinary Hospital that can provide a service 24/7 service. The need for this application arises from this very specific, uncommon context, characterized by areas of low population density, where it is not sustainable to maintain a full-time public service. The solution found resorts to several private providers of veterinary services to, as a whole, ensure this service to the population on a full-time basis. The particularity and rarity of this scenario makes the creation and commercial exploitation of this type of product unfeasible. It was in this context that the challenge was posed to the students of the Degree in Computer Engineering at the Instituto Politécnico de Bragança, allowing them to develop skills with real problems and, at the same time, provide a solution to an effective need in the region, promoting by this way its engagement [1–3].

However, this requires considering unusual aspects in the development - which are related to the fact that students will not be available to meet future

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The decision fell on the use of React Native ensuring that with only one line of development it was possible to produce applications for both platforms: Android and iOS. Also enabling the possibility of having a web version, namely with the information about the veterinarian on duty.

The third technical decision was about application support services. In a more traditional model, it would be necessary to have a database server and a server to host REST/SOAP or equivalent services. From the explanation given for the NFR01 requirement, this was to be avoided. Thus, a serverless solution was chosen. Not that this means there is no server, but that the server belongs to a third party and works for simply as a place in the cloud where the the back-end services are hosted. There are thus no worries about installing, configuring and maintenance of services and servers.

Figure 1 illustrates the architecture of the solution, where the three types of users (actors) can also be identified:

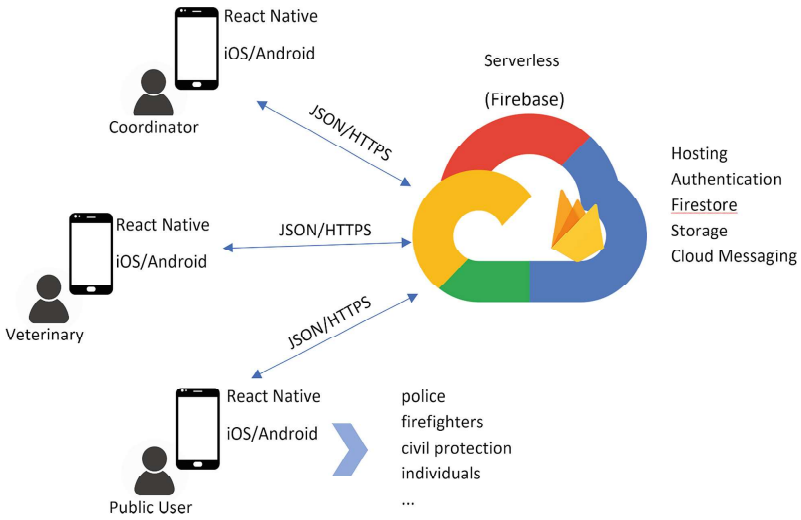


Fig. 1. Solution architecture.

Public User - Named for having access only to the public component of the application. Represents any person who needs to contact the veterinarian on duty, it can be a police officer, civil security officer or any other person.

Veterinarian - They are the ones who provide veterinary services. Access requires registration and subsequent acceptance by the Coordinator. The veterinarian can request to change shifts with a colleague and register the services provided.

Coordinator - Entity that admitted/removes veterinarians and that can upload the file with the duty shifts.

Only the last two can consult the entire schedule. The Public User only sees the contact of the veterinarian on duty for the day in question (the day he uses the app to request support from the on-call veterinarian).

All usage profiles are ensured through a single application - which, depending on the profile, provides more or less functionalities.

4.1 Veterinary Registration

Figure 2 illustrates the procedure for registering veterinarians. Anyone can register as a veterinarian. However, access to the veterinary features is impossible until the Coordinator admits him/her. The idea is that the person makes a registration, providing the name, email and telephone contact. A code is sent to

the email to verify email ownership. Later, the user can enter more data, such as the business name of the company he represents and the like.

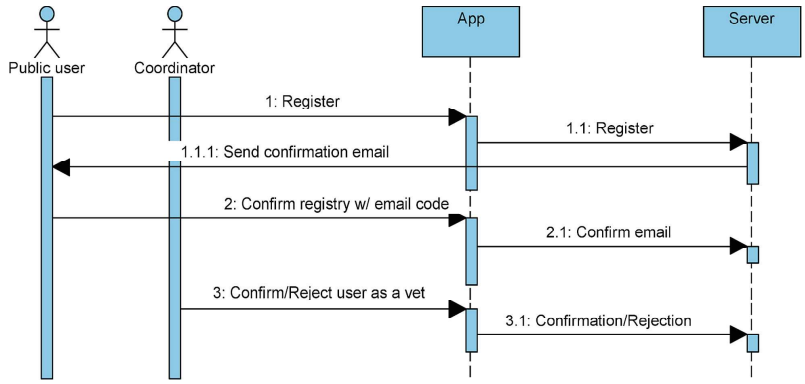


Fig. 2. Sequence diagram of the vet registry and acceptance.

Once the email has been verified, the candidate appears on the Coordinator's dashboard - The Coordinator can view the registration data to confirm their veracity and can accept or reject the registration. If rejected, all information from the veterinarian candidate's record is removed. If accepted, the veterinarian will be able to access the features of this profile.

4.2 Shift Exchange

The veterinary should have access to a calendar showing their duty shifts, as well as information on who is assigned to the other days. Trading for the purpose of exchange is extra-application, that is, it is the interested party who contacts the colleagues to find out if anyone is available to exchange and thus ensure the service for the day in question. Once agreed, anyone involved can go to the application, choose the days between which the exchange will take place. User can only do it for days that are allocated to him and always for future dates. The veterinarian on duty for the day to be changed receives a notification that can be viewed in detail in the application itself, signaling the change request. He can reject or accept. Upon acceptance, the exchange takes place between both and becomes visible to all others involved. The Coordinator also has access to this information on the exchange list, but only to be aware of. If the exchange is rejected, the applicant receives this indication by notification and can consult the status of the request on the application (that will appear as rejected).

5 Implementation

The implementation is not yet in the desired state, but it already provides almost all the intended features. In Fig. 3 it is possible to visualize the layout of the

public screen - when opening the application, the user (regardless of the profile) sees which veterinarian is on duty for the day in question. By clicking on the mobile number, the call is immediately initiated.

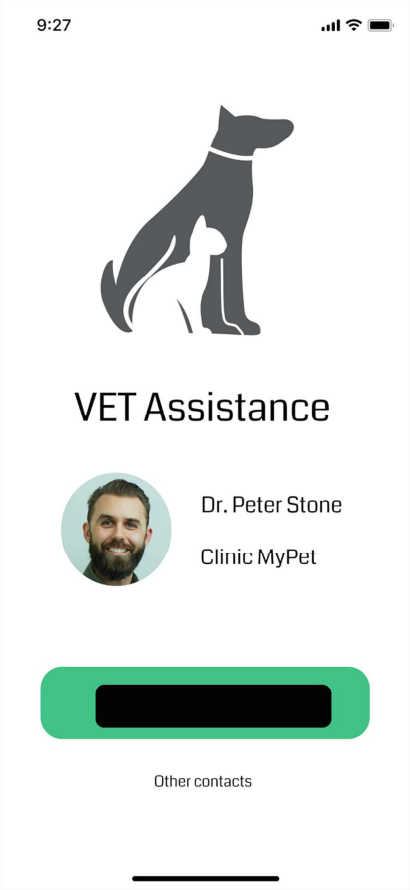
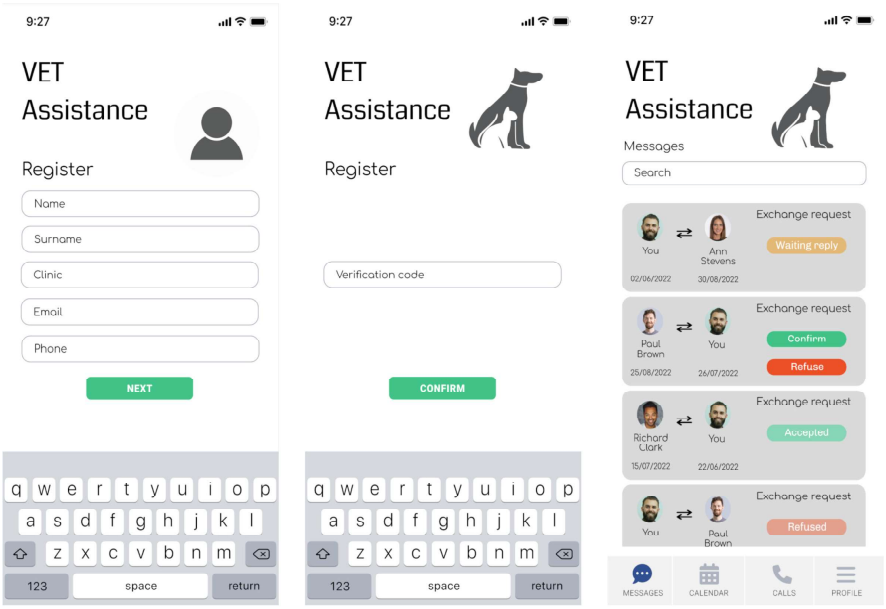


Fig. 3. Public screen

The long press on the application's logo allows access to authenticated functions, that is, those intended for veterinarians and coordinator. If there is no previous registration, the user is sent to the screen Fig. 4a, where he/she must fill in his/her data. From here, an email is sent with a confirmation code that should be introduced on the app (see Fig. 4b) - this way the email is validated as belonging to the user in question.

The user, a potential veterinarian, will stay on a pending condition - not being able to do anything else until the coordinator effectively admits him as a veterinarian.

If the user is already registered and confirmed by the coordinator, he goes directly to screen of Fig. 4c, where he can view past and present shift change requests, namely those awaiting by response. On the leftmost side of each request it is the veterinary that have requested the exchange. On the right, it appears



(a) Registry. (b) Verification. (c) Messages.

Fig. 4. Screens 1

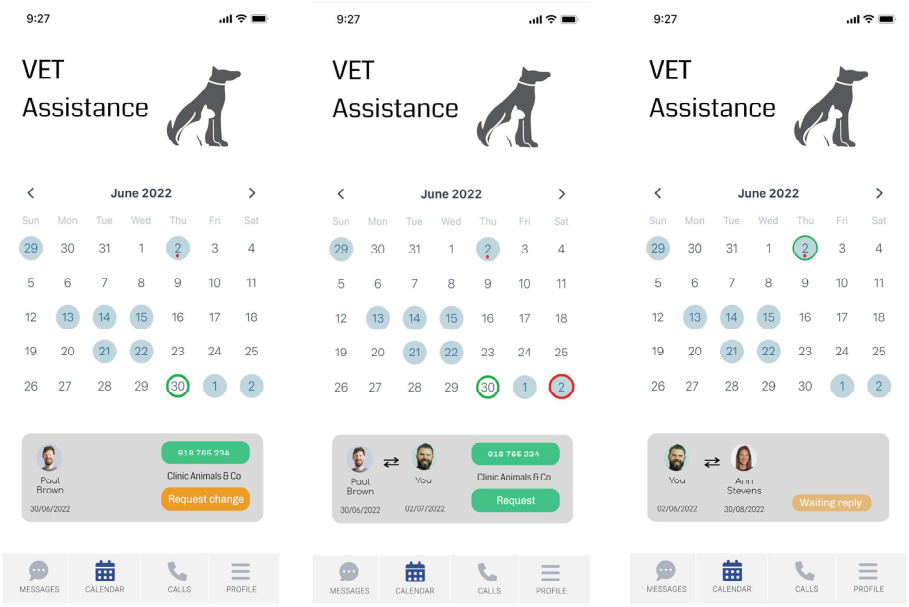
to whom the request was done. In both cases, with the respective date (days for the exchange). Note that the user can either appear on the leftmost side, requesting the exchange to a colleague; or more to the right, in case a colleague has requested him to change shifts.

When the request is made by the user to a colleague, the indication of Waiting Reply appears. On the side of the colleague, there is the possibility of accept or reject.

The screen of Fig. 5a (Calendar) allows the user to know which days he has a shift (signalled in light blue); and consult who is on duty for a given day, simply by selecting the day. Whenever this is done, for the veterinarian on duty it appears the respective telephone contact and the possibility of requesting the change for the selected day. The idea is that user uses the contact to speak personally with the colleague to arrange the exchange. Then through the application formalizes this exchange.

When making Request change, it is possible to select a second day (the day to change) - Figure 5b - circled in red. Once this is done, user can then definitively request the exchange (Request). The process proceeds as previously explained. The days with pending trade requests are indicated by the small red dot and the detailed information shows Waiting reply (see Fig. 5c).

The veterinarian can also register the services performed through the Call option (Fig. 6a). Here you have the possibility to view records already made or to be filled in, as well as request the creation of a new record. In the latter case, it is automatically sent to the cell phone camera, in order to register the service through a photo of the animal in question (see Fig. 6b). Once the photo is taken,



(a) Calendar. (b) Exchange request. (c) Waiting reply.

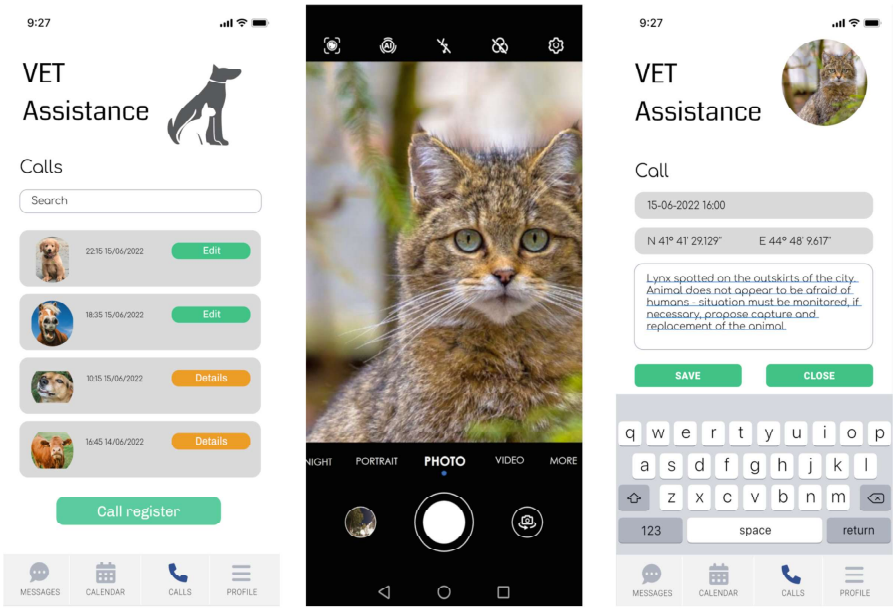
Fig. 5. Screens 2

the date, time and GPS coordinates of the location are also obtained. The record can be left in edit mode to be finished later or finished immediately (Fig. 6c).

According to Fig. 7a, the vet also has the Profile option available to edit their data (name, clinic, cell phone contact and photo).

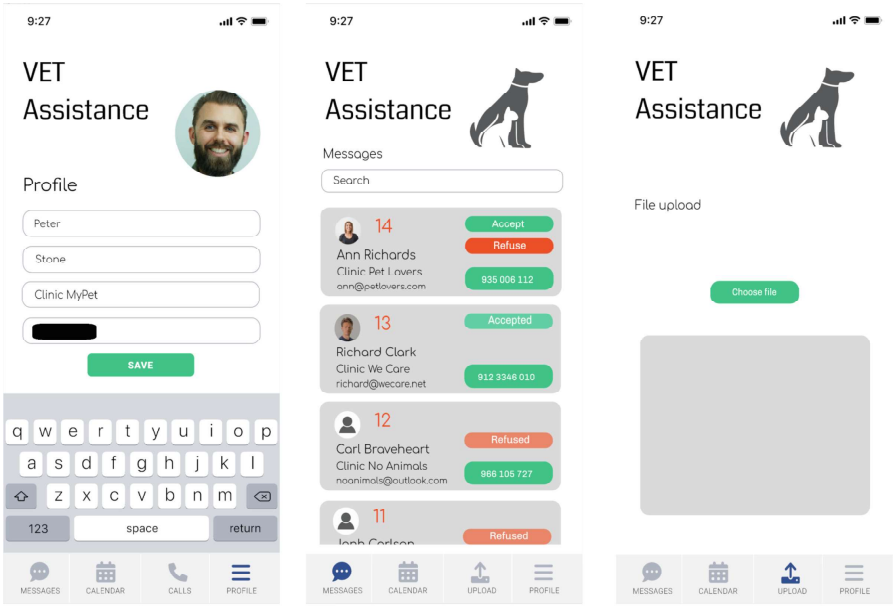
The coordinator accesses the private part in the same way - but it is supposed to already be registered, which is done directly on the back-end (Firebase console). The coordinator has the option to view messages, for now only regarding requests for admission of users on the platform as veterinarians. For this purpose, he has access to the name, clinic, email, mobile phone and, eventually, photo (see Fig. 7b). He can accept or decline the request. Note that for each request an identifier is generated - which is essential to identify veterinaries in the upload option.

In the upload option, the coordinator can upload the file with the shift assignments. The file must be in CSV format, containing, for each day assigned, the user ID and the day (in YYYYMMDD format). Figure 1 illustrates one of these files. With this solution, the administrator makes the planning, namely for extended periods of time, and then easily makes that information available. This service assignment is normally carried out with the prior consent of the veterinarians. In any case, the objective of the solution is precisely to provide the possibility for veterinarians to exchange days of service and that this is reflected in the information provided to the common user.



(a) Calls. (b) Photo. (c) Call registry.

Fig. 6. Screens 3



(a) Profile. (b) Coordinator messages. (c) File upload.

Fig. 7. Screens 4

Table 1. CSV file format

Day	ID
20220615	5
20220616	3
20220617	1

6 Conclusions and Future Work

In functional terms, the created solution complies with the defined and the necessary goals - although there are already more ideas and improvements identified. For this purpose, a serverless service was used, Firebase, which is a Platform As A Service - PaaS (more precisely a Back-End As Service - BeaS) - with this, the need for servers, services (HTTP and database), configuration and maintenance were significantly reduced.

Thus, a solution was obtained that can be immediately made available to the community, fully manageable by the community itself and that does not require the continued involvement of students for its maintenance. The production of an application that is effectively necessary and that will be used for the benefit of the community, namely veterinarians, but also of all those who use their services as public service providers, is undoubtedly a way to put students in practical situations, with the natural demands of the applications for effective use, promoting the experience, the acquisition of competences and even the professional curriculum of the students. The authors believe that the experience should be extended, bringing new challenges, namely for situations like the present, where it is possible to build in the available time and with the skills that students have, functional solutions that can be effectively used and for a long time.

Acknowledgements. This work has been supported by FCT - Fundação para a Ciência e Tecnologia within the Project Scope: UIDB/05757/2020.

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