Context Awareness for Service Desk Management

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***Abstract*—This paper presents a customization of a service desk tool inserting some context-aware computing elements based on location, temporal and expertise awareness. As main result, a context-aware service desk system, that also allows access from mobile devices and improves technical calls distribution based on professional expertise and geographical location, was concept.**

Keywords-Help Desk; Service Desk; Context-Aware; Location Awareness

I. INTRODUCTION

Modern organizations are becoming more dependent on Information Technology (IT) day by day, fact that turns necessary the implementation of effective IT management to justify high investments on this sector and to aggregate values for these companies [1]. Second [2], 88% of financial executives assert that the existing IT services operation efficiency are more worrisome than the attendance of new necessities. For Cusick and Ma [3], the “Impact on revenues is directly related to system availability” that can be proven with facts like the 10 million dollars Symantec company prejudice suffered after a sales systems fail [4]. Another example is of E-Bay company that had around U$ 3 and 5 million dollars decrement on its founds and a 26% decline on its actions after a 22 hours stop caused by a system fail [2]. Thus, when a problem arises that causes abnormal functioning of IT services, it is expected that the user has a quick response and clear support staff in order to minimize the damage that can be caused. The team responsible for resolving IT issues, was initially named Help Desk [5], but due to its importance and new services added to your area, now called Service Desk [6].

According to Zahedi et al. [7], time is an important parameter considered for the help desk so that the technicians of this activity, precisely because of time constraints to solve all kinds of problems, often refer to the help desk as "hell desk". To [2], one of the key factors for the success of a service desk is the allocation of human resources that have the appropriate profile for solving different types of problems. A service desk technicians whose work without any planning, attending calls disorderly, or whose technicians are assigned to calls that they do not have the expertise (and practical experience) to solve the problem, it may cause: for technical loss of time offset by unnecessary, for the user to idle due to lack of solution of the incident on the first call, and the company recorded losses by stopping the services.

This paper presents the adaptation of a service desk tool developed in the program Graduate of Federal University of Santa Maria (UFSM) in Brazil. The adjustments involve characteristics of computing context-sensitive location, adding the time and technical expertise to the context. As main results, we obtained a context-sensitive service desk system Context Aware Service Desk (CASD), which enables your access via mobile devices, with the optimization of the distribution of calls across the geographical location and expertise of the technician. To validate were inserted dummy data so that it was possible to test the behavior and operation of the system. The tests were conducted on the campus of UFSM with smartphone that had integrated GPS.

This article is organized as follows: Section 2 presents aspects of ubiquitous computing, emphasizing sensitivity to context. Section 3 discusses the related work. Section 4 presents the proposed project, and the changes made to the service desk tool. Experiments and discussion of the tests are presented in Section 5 and Section 6 presents the conclusions.

II. UBIQUITOUS COMPUTING AND CONTEXT AWARENESS

In 1991, the term Ubiquitous Computing was defined by Mark Weiser as a paradigm that enables integration and communication of multiple devices and resources (software and hardware) in a real environment that would enable the user to perform activities without awareness of this usage [8][9]. Other paradigms have emerged as Pervasive Computing, which provided access to information and computing resources for users anywhere, anytime and using any device. Currently, the terms Pervasive Computing and Ubiquitous Computing are used as synonyms by many researchers and so will be considered in this text.

One of the main research areas of ubiquitous computing is Context-Aware Computing in which you want to obtain inputs, called contexts, which are current user information, contextualizing the environment where it is located and the device computational used [10]. To Dey [11], context is any information that can be used to characterize the situation of an entity where the entity can be a person, place or object that is considered relevant to the interaction between a user and an application, including the user and the application itself. According to the author, a system is context-aware if it uses context to provide information and / or services relevant to the user, where relevancy depends on the user's task. According to Satyanarayanan [9], a system of pervasive computing that strives to be minimally intrusive has to be

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context sensitive and be aware of the state and around its user to, based on this information, change their behavior.

A key component of ubiquitous computing is the location awareness that uses a positioning system for the location of the user [12]. To Loureiro et al. [10], "a positioning system is a tool used to determine and record the location of an object on Earth's surface." With the trying to add services and business models for ubiquitous devices in the network, the World Wide Web Consortium (W3C) established in March 2007, the working group Ubiquitous Web Applications that defined an API for Geolocation. This API has a high level interface to location information (latitude and longitude) and provides support for mobile browsers and applications of Location Based Services (LBS) [13] [14].

III. RELATED WORK

The search by related work showed that many authors approach aspects of how to improve the control of the management of incidents or address issues of how best to implement the Information Technology Infrastructure Library (ITIL). As far where we investigated, there were not found studies with different approaches on the optimization of the work team to reduce the cost of diagnosis by technicians lacking the expertise ideal for the reported incident. Following some of the studies reviewed.

Zahedi, Rahimov and Soleymani [7], proposed a help desk that simulates a technical support center via a web site, where visitors ask questions and receive advice automatically. Already Jäntti [15], explored which are the basic functional requirements for an incident management system. Bartolini, Stefanelli and Tortonesi [16], present HANNIBAL software, a decision support tool for business impact analysis and incident management improvement. In Marcu et al. [17] it is proposed a method to correlate with user called open call by automatically opened monitoring systems to avoid loss of events for diagnostic time with the same problem. References [3] and [18] discuss what is the best way to implement the Information Technology Infrastructure Library (ITIL) processes.

IV. CONTEXT AWARE SERVICE DESK - CASD

This paper proposes to adapt a service desk system that minimizes the occurrence of a second call to the same calls that had not been closed for lack of expertise of the technician who performed the first service. The Context Aware Service Desk (CASD) was designed for smartphones and mobile phones with great computing that, in addition to the original functionality, have an integrated GPS. In addition to this feature, the system proposes to reduce the loss of time with unnecessary travel and enable access from anywhere at anytime and with any device. Amaral [19] presents a service desk system that was integrated into a corporate portal for the realization of incident management and access rights of the user (authentication, authorization, auditing) with collection of data for decision support, based on technical multivariate statistics. This was the system used for the adaptation in this paper.

The CASD is divided into two main tasks: Task 1 - responsible for identifying a context C and Task 2 - responsible for adapting the system to the context. The context C is defined by the time the coach makes the access to the system and it is composed of location data (latitude and longitude) and technical profile and the time of access to the system.

A. Task 1 - Identification of Context

The proposed work deals with the suitability of a Service Desk to provide services relevant to technical support by identifying a context C. The system consists of a finite technicians set defined as $t \subset \{t_1, t_2, \dots, t_n\}$ with $n > 1$; expertises defined as $e \subset \{e_1, e_2, \dots, e_n\}$ with $n > 1$; buildings defined as $P \subset \{P_1, P_2, \dots, P_n\}$ with $n > 1$; profiles defines as $pf \subset$ {Rating, Attendance, Administrator, Rating_and_Attendance} and priorities defines as $pr \subset \{1,2,3,4,5\}$.

1) Getting the Geographic Location of the Technician

The proposal with the W3C Geolocation API is a site that, when visited, can get the coordinates (latitude and longitude) of the device that is accessing it without any client application is installed on this device. This mechanism was implemented in the service desk so that when a technician logs in to the system, the script runs Javascript: navigator.geolocation.getCurrentPosition (position), which returns an object by positioning function position.

2) Access Time

The access time, to the system, is used to verify if the technician is at his work time. The temporal context entered here is to allow the support teams distribution per shift scales to meet on call 24x7, works like most IT teams.

3) Technical Profile

Based on division that occurs in the Central Appointments User (CAU) UFSM, technicians are mapped into four profiles: Technical Classifier, Service Technician, Technician and Administrator Meets and Sorts. The Technical Classifier is one that is allowed to sort the calls by setting the priority and the expertise necessary to solve the problem reported. The Technical Assistance will be allowed only to view and meet the tickets already sorted. The Technician Meets Sorts and builds the permissions of the two previous roles and the last technician is one who has administrator profile.

4) Internal or External Access

It's possible determine if a technician t_i will have access to the system when outside the building of the central services (external environment) or if it will only have access at building's vicinity (indoor). The location inside or outside of the coach is given by calculating the distance d, in miles, between the technical and building services center. For this work, it was found that at a distance of up to 300m ($d \leq 0{,}3$), which is almost the distance between a building and the other on campus, the system will consider that the technician is called the internal environment. Otherwise, it is considered that the technician is in the external environment.

5) Distance Calculation between t_i and p_j

When reporting an incident, the user has to enter the building and room where the problem occurred. The buildings must be first registered with their respective coordinates. The calculation of the distance between a technician t_i and a building P_j is used both to verify that the technician is in internal or external environment as to sort the list of calls that the technician will attend. Knowing the points formed by the t_i and P_j, coordinates, apply the formulas of spherical trigonometry to calculate the distance d in degrees formed by circular arcs between these points and these points at point A (Figure 1) [20].

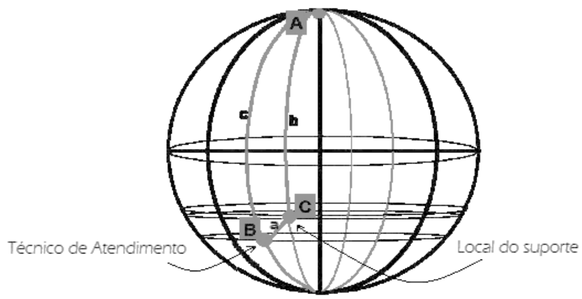

Figure 1. Arcs to calculate the length between two points using spherical trigonometry.

To calculate the distance will be used three equations. The first equation is given by the expression:

$$\cos(a) = \cos(b) * \cos(c) + \sin(b) * \sin(c) * \cos(ABC) \quad (1)$$

where,

- a = BC arc formed by the longitude difference of the two coordinates
- b = AC arc that is equal to 90 - latitude of the building support
- c = AB arc that is equal to 90 - latitude of technical assistance

The coordinates values in (1) must be reported in decimal values and the values received to invoke the W3C Geolocation method are in degrees, minutes and seconds, so it is necessary to convert to radians. Found the value of cos(a) in (1), applies (2) that calculates the arc cosine of the value found:

$$Arc = arc\cos(\cos(a)) \quad (2)$$

Unlike what happens in (1), the value found in (2), which represents the arc formed between the building and technical and which is in radians, must be converted to degrees to apply in (3). After obtaining the value of the arc in degrees, to calculate the distance d in km, you should apply a rule of three between this value and the value of the full arc of the circumference of the Earth. Knowing that the radius of the Earth is 6371 km, the Arco_T= 2 * π * radius = 40,030 k. Obtained the value of the full arc of the earth, applies (3) to calculate the distance in kilometers of the two points:

$$d = (40.030 * Arco)/360 \quad (3)$$

6) *Algorithm of Task 1*

The algorithm shown in Figure 2 represents the execution for task 1 and is subdivided in three sub-tasks, which are inExpedient, inPlace and length, as detailed below:

```
Task 1 – Identify Context
initialize lat ← 0; Lng ←0;
∀ authentication do
  if getLocate do
    if t_i ∈ t then
      if t_i.pf = sorter then
        if inExpedient(t_i) and inPlace(lat, lng) then
          applyContextSorter();
        else
          write (" user outside of working hours or without
                  permission to access this area outside the
                  place of service.");
      else if t_i.pf = attendant then
            if inExpedient(t_i) then
              applyContextAttendant();
            else
              write (" user outside of office hours");
          else if t_i.pf = sortAndAttends then
                if inExpedient(t_i) then
                  if inPlace(lat,lng) then
                    ApplyContextSorter();
                  else
                    ApplyContextAttendant();
                else
                  write (" user outside of office hours");
              else if t_i.pf = admin then
                    applyContextAdministrator();

Task 1.1 – inExpedient(ti)
  initialize now ← 0; Lng ←0;
  now ← accessTime;
  if (t_i.inputShift1 ≤ now and now ≤ t_i.outputShift1) or
     (t_i.inputShift2 ≤ now and now ≤ t_i.outputShift2) then
     return true;
  else
     return false;

Task 1.2 – inPlace(lat,lng)
  if length(lat, lng, P_1.lat, P_1.lng) ≤ 0,1 or t_i.outside then
     return true;
  else
     return false;

Task 1.3 – length(plat, plng, q.lat, q.lng)
  initialize a←0; b←0; c←0; cosA←0; arcCosA←0;
  a = math.radians(plng – qlng);
  b = math.radians (90 – qlat);
  c = math.radians (90 – plat);
cosA=math.cos(b)*math.cos(c)+math.sin(b)*math.sin(c)*
         math.cos(a);
  arcCosA = math.degrees(math.acos(cosA);
  return (40030.00 * arcCosA)/360;
```

Figure 2. Algorithm for Identify Context

B. *Task 2 - Application of the Context*

Defining the profiles of the technician, also defined the contexts that should be applied to each of them. It is through the Task 2 that the system will suggest the actions the user can do.

1) Context for the Rating Technician

The rating technician is who has permission only to classify the tickets. This way the system must allow access only to view the calls that have been reported, but haven't yet been classified. In addition to this permission, the system will react differently if the technician is not in your expedient time or if some company considers relevant to this technician should not access the system outside of the building of center service and define him without permission to extern access.

2) Context for Attendance Technician

Unlike that what happens with the rating technician, even outside of the expedient time, the technician with profile to attendance should be able to access the system, provided that it is to complete a ticket or to inform the progress of the call and put it on availability to another technician, what is being called a shift change. This peculiarity was created for cases where the technical have not completed the service, must overcome their expedient time to fulfill the Service Level Agreement (SLA). This condition is only allowed if the technician has any call that is not finished yet.

3) Context for the Rating and Attendance Technician

The rating and attendance technician is who can classifier and attend the calls. It is during the identification of the context that the system will suggest, based on the location of the technician, the interface to be used. When it is identified that the technician is out of the building of center service, the system automatically will show a list of calls for attend, suggesting that he is in the external environment and probably is consulting new calls to attend. If the technician is in the building of center service, the system will direct you to the screen of the classification of the calls. Though the system suggests a feature, anytime the technician can switch between the two options.

4) Context for the Administrator Technician

The technical who has the administrator profile can view all calls classified or not, those in attendance and those already completed. Apart of observing, the administrator technician can classify calls and register the buildings and their locations. For this context, the system will show a screen with the not attended calls and provide other options.

V. Experiments and Results

This study makes part of a major project and in this part of the project the objective was identification of context. In this way, the CASD was developed with the Django framework [21], which uses the Python programming language [22]. The implementation occurred in Eclipse [23], by installing the Pydev plugin that integrates the Python programming language and Django framework in the Eclipse development environment. For data persistence were used the MySQL database and web server like Apache HTTP Server. For the tests registered a set of expertises, with buildings and technical profile for classification, attendance, grading and attendance and administrator profile. A mass of data for the different incidents buildings with different priorities and expertise was fed.

The initial tests focused on the consolidation of the mechanism for obtaining the location of the technician via the mobile device. Figure 3 shows capture screens in this initial test phase.

Figure 3. Solicitation of permission to access the device localization.

In the figure, can be seen several devices that are displaying the message that prompts the user for permission to access your location. The tests proved that the W3C Geolocation method is effective and it works effectively across multiple devices. The second set of tests aimed to validate the formula for calculating the distance between the technician and the buildings with calls for service. At this stage it created a parallel application with only two functions: registering buildings with their coordinates and perform a comparison between the buildings registered. The register of buildings invoked the W3C Geolocation API and comparator used the formula of spherical trigonometry to display the registered buildings ordered according to the distance between them and a building used as a reference. Tests showed that the formula had always used the buildings in the correct order of distance from smallest to largest. The final stage was used to validate the operation and behavior of the system.

At this last phase, classification, customer attendance and administration functionalities have been joined. By admin functionality was possible to register the buildings and track instances of reported calls in the system. By the classification, the technicians defined the priority and expertise required for each ticket. About the costumer attendance, the tickets were presented to technicians according to their expertise and ordered according to the priority and the shortest distance between the building and location to meet the technician;

VI. Conclusion

The delay in diagnosis of incidents have generated higher losses for organizations and one of the factors that has generated this delay is the recurrence of care that is caused by the allocation of technicians who do not have the right expertise to solve the reported incident. To solve this problem were included characteristics of ubiquitous computing at the service desk system adaptation. The tests were done with six technicians registered at the system with different profiles and with five tickets, which were attended at the buildings marked on Figure 4, by different technicians with different profiles according to the test plan already created. The tests show that using a context that considers the location of technical expertise minimizes the recurrence of calls since the technicians were allocated according to their knowledge to the solution of the problem reported. During testing, 100% of calls were allocated to technicians with the proper expertise. Even if one has obtained the maximum percentage, it is noteworthy that in this case the data were fed into the simulation and behaved as expected. In a real environment, for this to occur, it is necessary that the technician, who will make the classification of tickets, is highly qualified for the correct classification of so-called reported.

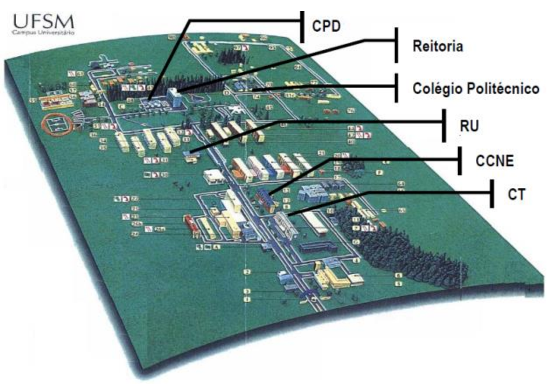

Figure 4. Identification of the buildings with registered tickets for attandance. Image adapted from the website of the Federal University of Santa Maria.

Another system's built-in capability is the ability to automatically direct the technician to answer calls geographically closer, reducing the waist of time with unnecessary travel by technician, leaving a building A to building B and then was informed that there was another call in building A. During testing nearby buildings, facing each other, were called were registered and reported in two buildings. By the time that a technician, with the called expertise, made access to the system and is called for the two calls on each side of the street and with equal distances for each building, it was identified that the CASD had called the building that stood on the same side of the street which was positioned the technician. It shows that the implementation of context awareness, to reduce unnecessary travel, gave greater flexibility in attendance, which enables the company to earn by having a lower downtime, and by reducing diagnosis time of the incidents.

Comparing with other similar systems available up to date, it is observed that the applications that have some mechanism for direct calls triggered by the user, present several problems, precisely the user's lack of technical support. Another feature present in these softwares is that the assignment of the priority of the call is also performed by the user. In this case, for the same reason of lack of technical knowledge or by having interest in the prompt resolution of your problem, users can sort it's calls always with the highest priority, impacting on the performance of the IT industry. In CASD case, the technical service center has the profile classifier that has the responsibility for determining the priority and expertise necessary to resolve the reported problem. The features like sorting the call according to the location of the technician and the definition of work time for the technical definition of scales, that are present in CASD, were not found in other softwares studied. Considering the point of view of implementation, tests have shown that the system is technically feasible and that the adjustments made in this paper can easily be implemented in different types of systems in the same category.

The results of this study bring expectations for new research and future work such as the creation of a knowledge base consisting of problems and solutions that help both accelerate the process of diagnosing problems as to "retain" the knowledge generated by the company. Another point that could be addressed in a future work concerns the allocation of expertise for calls. It would be interesting to evaluate the content of the text entered, in the system, in the description of the problem and that before that there were automatically determine the expertise required to solve this incident, conducting a self-rating of the tickets.

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