A Review of Pervasive Healthcare from Prevention to Emergency Rescue: Systems, Tools, Platforms and Techniques

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Abstract: Due the increasing of mobile devices usability, pervasive healthcare nowadays is becoming an emerging technology worldwide and has proven the efficiency to control, to assist and to save patient lives round-the-clock. In this article, we perform a comparison and a classification of various health care systems, platforms, applications and health care techniques depending on the patient state; from the assistance, control and prevention of the anomalies which arise on patient's state, until the rescue action further to an emergence or a critical state. We have also included a comparative study of various techniques and application related to different context that allowed us to criticize each one to extract the points that have been neglected or poorly studied. As continuity to this work, we want to mention that this literature review has opened the door to our future work which is interested in setting up a new pervasive system exceeding all limits we talked about to make human's life more secure.

Key words: Pervasive healthcare, emergency systems, prevention techniques.

1. Introduction

Nowadays, rapid growth in communication technology has spurred the emergence of new concept in various fields which largely benefits from these technologies. One of the domains which are interested in the improvement of life quality and which takes advantage of these technologies is the medical domain. In fact supporting and assisting users in technological environments is a phenomenon widely answered in the last decade. It is the fact of breaking all spatial and temporal barriers and all things which may hinder monitoring, assistance and especially reaching patient in critical state. We are talking about pervasive health care systems. The latter is one of the cornerstones of Telemedicine; the fact that it is essentially based on the idea of continuous exchange of information and medical data between the patient and the medical caregiver regardless their positions. The health condition is unstable, the patient risk to have always deteriorations which can arise at any time of the day and anywhere. Having a handheld device that allows direct communication and transfer of medical data that saves time elapsed to move or to transfer a report to the doctor, can undoubtedly allow making secure human's life. Time is the first and worst enemy of health in general and a patient in critical condition in particular. Cite the example of a person in need confronting a heart attack which requires direct contact with the health care provider. Such a critical condition requires immediate medical intervention. So what if the doctor is out of reach? In general, unlike the Telemedicine, health care traditional applications do not provide the opportunity for exchange of medical information in an environment where the patient or the care provider is in movement. Then, using a mobile device; a mobile phone for example the patient's condition and the scenario can be communicated

and explained away. In emergencies, communication and information exchange between a patient and a care provider that do not in the same place becomes possible with these new technologies. A property that traditional health care systems lack. Such a practice and such a system with such a property is therefore called a pervasive healthcare system. We present here knew literature survey on pervasive health care systems that can be classified into two categories: pervasive prevention and assistance health care systems and emergency rescue pervasive health care systems. Our paper is a discussion and comparison of different techniques, pervasive systems and platforms used in the medical care field. The paper is organized as follows: We present a literature review of the different systems according to the deterioration of the health state; from the control and assistance to the emergence cases. The comparison results are summarized in the last section as a comparative table with a small discussion.

2. Pervasive Systems

Recently, the use of computers marks a significant increase from day-to-day in all aspects of our life. Such as, services offered on-line (in the purchase, the sale, in communication, education, the medicine and full of other domain). The development and the continuous progress in the wired and wireless networks like internet, intranets, local area networks, mobile ad hoc wireless networks and sensor networks on the one hand and adaptation of these types of networks in computing and communication on the other hand has given rise to several pervasive computing environments. To the best of our knowledge, technology is omnipresent everywhere we go. With the arrival of new technologies, human became able to accomplish tasks and to serve himself anywhere and anytime (7days*24 hours). This is what we call ” pervasive computing ” [1]. In fact, pervasive computing permits to moving users to use their mobile devices like PC, PDA, Cell phone... and via any network to access any service (such as checking E-mail, contacts, inbox, calendar, notifications, location)regardless the change in the location. As a matter of fact, the main objective of pervasive computing is to permit any user equipped with his device(which obviously has an access right)to access to any data or any service. Indeed, there are others equipments appliances in the home which may come into play. Such as home appliances that are connected to a network like the internet fridges, light switches, washing machine etc. For example, imagine in a living room you can use a customized TV remote equipped with a Track Point pointing stick to bring up a Web page on a large-screen television. In this way, the world tends to mobility in our daily life activities that takes us in a direction where all services are available and accessible anywhere and anytime; it is the direction of ubiquitous computing [2].

The idea behind ubiquitous computing [2], is to enable users to be surrounded by many computer equipments, easily accessible connected to a network infrastructure and who are dedicated and carefully tuned to provide discreet assistance through it we navigate through our professional and personal life activities. This pervasive infrastructure will obviously enable us to improve existing communications and allows user to overcome time and space constraints. These mobile devices are interconnected via a network; thus ubiquitous computing will bring the internet in our daily life with less effort. Via handheld devices (PDA (personal digital assistant), laptops, etc.), human became able to access to any data regardless place and time. Today this trend is required in our life by its simplicity and flexibility to integrate high performance computers and sensors in every device, appliance, and piece of equipment in buildings homes, workplaces, and even clothing. According to such a context, the attributes of a particular situation vary considerably, and can include the location of the user, his role (daughter, commercial manager, coach, doctor, football trainer, doctor, etc.) the past activity, and the current state. In addition, the context may include date and time, as well as other objects and people who belong to the environment. For example, supposing that a user is in the following context: It is away from home, does not have a meeting, it is

interesting to offer him a guide of nearby restaurants if he or she makes such a demand. Indeed, computers should be able to accurately anticipate the user's needs and accommodate his natural communication modes and styles. Ubiquitous computing is a revolution in human-computer interaction and information access technologies for interacting with small devices, distributed, and often shipped facilitating the resolution of daily tasks. During the last decade, technological progress known on a global scale, gave us all kinds of devices other than computers, laptops, phones, printers, robotic arm, cameras, pagers, handheld devices (PDA, laptop, etc.). On the other hand, wireless access in the internet has known an unpredictable and remarkable growth that has given us the opportunity to check our emails for example while we are on the way of our work. In our days, we become too much occupied by life concerns. Thus, we do not find necessary time to use the computer, or in the worst case to move on space to accomplish some daily life activities. And sometimes, our site does not allow us to solve some problems unless if we are really on the ground of this problem. It is here that appears the importance of pervasive systems. For example, in the medical field, it is very important even extraordinary to allow to a doctor on the road equipped with a mobile device, to control patients and to follow their states. This is what we can do as a system for a mobile doctor. This is what we call "pervasive health care system" [3] which can be based on the Telemedicine phenomenon [4]. In reality, handheld devices, or computers will be able to understand sufficiently the current situation of users to provide them with services, resources or information that they need in a well defined context.

2.1. Pervasice Healthcare Systems

Newer, many technologies are on the horizon aiming to achieve healthcare functionalities and to reduce mortality. Pervasive healthcare systems are on the top of list. Many studies have shown that early prehospital management largely contributes to save human life. Commonly, within a fraction of time, medical parameters may change and health status can undergo deterioration. That's why assisting and controlling patient with measuring every now and then their biological parameters like pulse rate, blood pressure, body temperature etc can really grieve a global idea about the health state to take the appropriate in time treatments and to prevent and to anticipate any hazards which have serious risks on the human health. But it is not enough, actually many are systems which detect abnormalities and allow to formulate the script and to specify the action to be taken to manage that. But there are many other factors which may hamper or even prevent these actions. For instance, everything about the good management of ambulances, problems that may occur on the road, the best route through which the patient or the physician can pass and the acceleration of information speed passage etc. In case all these factors were not taken into consideration, it can complicate the situation. So, switching from prevention and anticipation of changes in health states parameters to emergency rescues (see figure 1). Therefore, we can view Final Stage the pervasive health care systems classified into two main categories. The first one is "Control and Assisting for Prevention systems" concerning measurement and control of biological parameters and the second is "Rescue in Emergencies" involving acceleration and ambulances good management and information speed acceleration.

When you submit your final version, after your paper has been accepted, prepare it in one-column format, including figures and tables.

2.1.1. Control and assisting for prevention

a. Towards an affordable real-time cardiovascular emergency detection system

El Shafee in [5] introduced a prototype for a real-time emergency detection and response of critical heart conditions. The idea behind the proposed system is to take care with elderly un-capable patients with chronic heart diseases. It is a solution for emergency accidents especially for people who have chronic

diseases for instance the heart attack. The idea is getting proper treatment on time to the suffering patient since it is able to expect the patient's health status and respond in a timely manner. Indeed, the system consists of a wearable strap able to measure the patient's heart beat rate and it can draw the heart ECO signal using the accompanying application. Using a Bluetooth/ WLAN/GPS/GSM enabled mobile device the communication between the monitored patient and healthcare provider is possible. On the one hand the smart phone receives the heart beat rate signals via Bluetooth and updates its local application database, on the other hand these information are communicated to the service provider web service to update the patients electronic medical record using internet connection. Actually, three types of alerts are provided by the smart phone: the first is an SMS alert containing the location of the monitored patient. The second is an alarm when the monitored heart beat rate exceeds the optimal, then a third alert is sent to the emergency unit in the hospital to send an ambulance with equipments and medics needed to rescue the patient in critical state. The last component is the server application responsible for the decision making according to received data analysis. And this server is directly connected to the emergency center to react in time and save the suffering patient. According to the prototype presented in this paper, the system is able to give good immediate results but from our point of view the system capabilities are limited and it needs some more extensions to cover more patients and physician needs.

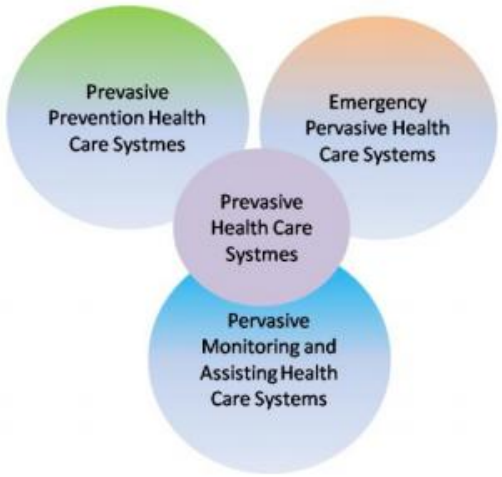

Fig. 1. Classification of pervasive healthcare systems.

b. Sentara healthcare

In [6] authors presented a platform called "Sentara Healthcare". It is an integrated health care delivery platform used to serve as Virginia, North Carolina and beyond. It aims to reduce the risk of harm to the patient by providing him the access from his position. In fact, the access is not limited to the patient; the doctor also can access to the patients information. The employee also has the possibility to authenticate. The main features of this platform are as follows: The search for a doctor near to the current location. The search can be done by name or specialty. The choice of medical services (cancer, maternity, therapy, cardiac and vascular ...) The research of hospitals and centers (hospitals, emergency, primary care, emergency care, therapy and fitness) since employees and doctors have the access to this platform, it enables them to be attentive to patients call to reduce risk. In addition the physician can act and participate in the health care process by providing him several features as cited above. However this platform suffers from the following drawbacks: although research through this platform is customized and involves different actors, the access is limited to users of an only a part of the region. Adding to that, this platform does not allow the doctors to have all needed information for a complete diagnosis.

c. A proposed mobile based health care system for patient diagnosis using android OS

In [7] a monitoring system for diabetics has been proposed. The general idea of this system is to monitor and control the settings and psychological data of patients with chronic diseases mainly diabetics patients. The authors have implemented mobile technology integration in the sense that the patient can perform self control, self-monitoring by measuring the level of glucose in the blood. So, people who have chronic diseases like diabetes can perform self monitoring using their mobile phones and somehow reduce the probability of deteriorating health conditions. The idea is to make several check-up on the patient's condition using mobile phone or using medical devices that are used to provide information for instance weight, blood pressure measurement, pulse oximetry, the glucose level. On another part, the report went back to the server where an expert offers precautions and appropriate diagnostic. The system simply consists of three parts: a data report sent by the patient in real time, an Android mobile phone that transmits the received data to a central server and then the server responsible for storing and analyzing this data by the expert system. According to analysis of the received data, the system will make a judgment on the possibility of the disease (high level, very high level, diabetic or not). This system provides a rapid diagnosis of patients in remote areas but does not address mobile patients who have a higher probability of deterioration of the conditions than stable patients.

d. A mobile agent framework for remote patient monitoring

In this paper [8], a framework to improve healthcare service delivery is proposed. In this work a novel remote patient monitoring framework is presented with the aim of modeling a remote patient monitoring space in which mobile agents are in communication using vital signals from patients to care givers and vice versa. This framework involved many components and many human actors: These are patient(s), emergency eservices / care givers, personal medical personnel and readers. The patient is in a remote location with a non constant medical state and which needs constant monitoring to prevent him from complication which pose a threat on his life, so a rapid medical intervention is needed. As an actor, the patient is assumed to be logged with an ID. The patient's body vitals are constantly read using bio-sensors. These devices are connected to a smart phone and provided data will be transported to an online central server. Using vital sign and measured values such as: body temperature, blood pressure, health care givers can define and specify severity level: emergency, medium, low and info. According to these several levels, an immediate action must be taken and emergency response providers respond to critical situations triggered by the system. Personal medical personnel respond to body readings and he is responsible to maintain the patient in the best medical state possible. In fact, from our point of view the system capabilities are very limited, and it requires much more development efforts to reach what AKOMOLAFE Oladeji and EMUOYIBOFARHE are trying to do.

2.1.2. Rescue in emergency state

To the best of our knowledge, in the medical field patient's life is the only interest of both physicians and medical staff. Taking into account the importance and the dangerousness of temporal aspect, it is very important to enable patients to be treated immediately. In this way, many lives can be saved. In fact, a good health rescue system is based mainly on a good emergency state's management. This means that these systems are based mainly on a good management of emergency services (EMS) [9] and particularly the management of emergency vehicles in (EMV). The management of emergency medical services is a set of chronological steps and actions, and each action requires precision in determining the priority to take a good decision. There is no doubt that the decision is based on several axes. To ensure a good quality of service to the patient, there is no question of waiting for an ambulance when a patient is faced with an emergency situation like a heart attack. Its thus here that appears the importance of a good management of

emergency vehicles (EMV). The two main components of the emergency management vehicles (EMV) are: The vehicle fleet management and route guidance. Managing emergency vehicles tends to reduce the waiting time interval that summarizes the reception of a call or event until the arrival of emergency vehicle (ambulance in our case) on the site of a patient facing an emergency state.

a. Global system for telematics

Pervasive health care system is a phenomenon which was the object of several researches in the medical field. Several are systems for routing emergency calls were proposed in [9]. The author has given an overview of GST system. In fact, GST is a system integrated into an emergency service vehicle (ESV) and has for role the real-time data processing while taking into account traffic information which reache continuously. The main idea behind the use of this system is the construction of a chain of immediate, fast and efficient answers to comer incidents. Since the GST rescue system guide the ESV as quickly as possible to the incident point while ensuring a fast route and facilitating interaction between emergency vehicles and other road users circulating in the same area. Besides, there is an exchange of information between units and emergency control rooms ensuring obviously a good decision. Communication is vehicle to vehicle and vehicle to control center to accelerate speeds and quickly reach the scene of the incident. Main involved components are:

The Emergency Vehicle Client System (EVC).

Control Center (CC).

Telematic Control Unit (TCU).

Public Vehicle (PV).

Mobile Device.

Nevertheless, this system suffers from a major drawback, is the high computational cost due mainly to the use of Dijkstra's algorithm as a routing algorithm.

b. Advanced spatial technological system for emergency situations

A second system has been described in detail in [10]. This system contains four components which are as follows: An ESV, a traffic management system, a geographic information system (GIS) and a conference program. The main objectivesbehind the use of this system are:

To reduce the time required for the arrival of the ESV to the place of the accident.

To reduce the overall time required to transfer the Patient (in an emergency state) to a health care center.

To provide high quality care to the patient in the ESV.

In fact, this system seems to be one of the best real systems; this is because it contains a sub-route guidance system that gives good results. However, this system suffers from a major drawback is the high cost of storing information in the server related to the network traffic for example speed limits, direction of travel, traffic parameters, etc.

c. Cooperative freight and fleet applications system

A third system has been described in [11], which aims to provide a high level of safety and efficiency of transport. On the other hand, this system is designed to meet users needs (doctors and patients). This rescue system provides effective supervision and guidance of the ESV with managing the traffic flow in sensitive areas. The major problem with this system is that there are many restrictions and requirements related to areas Parking which returns this system very difficult to set up.

Sensor-based Pervasive Healthcare System.

Another system has been proposed in [12]. The SPH system aims to the development of a psychological

automatic detection which in turn helps to ensure good telemedicine, emergency medicine and good health care environment in which users are still followed and surrounded by experts of medical field in a remote way and can quickly and efficiently receive high quality health care services . This system is composed of: The Home Healthcare End system (HHE). E-healthcare Service Provider (ESP). This system is based on the Embedded Wireless Mobile Networks, Wireless Sensor Networks (WSNs), Session Initiation Protocol (SIP), and Pervasive Computing technology. The system hardware includes internet protocol (IP) cameras, vital sign sensors, and various handheld appliances.

d. M-healthcare emergency monitoring system

Geetha and Revathi proposed a system [13] for mobile health care emergency monitoring based on Smartphone. This system provides the user with more knowledges that enable him to manage health problems. Their system consists of: a GPS, Google Search and Google Maps functionalities that allow the user to specify the current location, including address, phone number, address of the selected hospital and a view of routes to the selected hospital. The system also includes a PEC (privacy preserving emergency call) allowing the patient in case of an emergency to quickly send emergency data to the nearby healthcare provider. And that is using mobile health social networks (MHSNs). In fact the principle of this program is as follows: Once the patient faces an emergency situation, the tablet (PDA) triggers the CEP scheme. The latter is responsible for collecting emergency information such as: the emergency location, the patient health record, as well as the physiological state of the patient. With these data, the PEC triggers an emergency call. If a doctor may be nearby, CEP ensures that the time required to inform this doctor by this emergency is the shortest. This system gives good results and the access to emergency data is controlled.

e. Pervasive assistance system for mobile physicians on the road

A fifth system [14]is a pervasive assistance system for mobile physician on the road. It is a system that allows locating a physician in a given location in a map to determine the K closest institutions from his position. It is a system based on the trigonometric technique ”Delaunay Triangulation”. The major drawback of this system is that it takes a long time to give a result checking the availability of resources required for a given treatment. This is due the fact that it does not make a distinction between the step of searching nearest neighbor and checking resources availability step. Consequently, to have a full answer about the appropriate point of interest, we need a lot of time that can result in losing patient’s life. In addition, this system does not take into account problems that can occur on the road which makes the situation more delicate.

f. Novel emergency telemedicine system based on wireless communication technology ambulance

Authors in [15] presented a system as a portable medical device that allows telediagnosis, long distance support and teleconsultation of mobile health care providers by expert physicians. The device allows the transmission of vital biosignals and still sending images of the patient from the emergency site to the consultation site using the GSM mobile telephony network. The device can telematically bring an expert specialist doctor at the site of the medical emergency; allow him to evaluate patient’s data and issue directions to the emergency personnel regarding treatment procedures until the patient is brought to hospital. The performance of the system has been validated in four different countries using a controlled medical protocol and a set of 100 patients per country treated has been collected and analyzed.

g. Pervasive system for searching the appropriate road: A mobile physician on road network case study

In [16] authors presented a pervasive assistance system for finding the most suitable road without obstacles that may appear on it. Its an approach provided by a new algorithm based on the largest empty

circle geometric technique. Thanks to it, the doctor can protect his patient from complications which pose a threat on his life since it successfully facilitate finding the appropriate route by which he can go in minimum of time. In contrast, this system suffers from a major drawback; this approach doesnt treat the case when the doctor is not available meaning he is on the road to another patient. Adding to that mobile obstacles which can appear on the road were not taken into account.

h. Location-based mobile cardiac emergency system (LMCE)

Location-Based Mobile Cardiac Emergency System (LMCES) proposed in [17] is an emergency system which consists of geographically locating the patient in an emergency state while activating the emergency medical service to find the nearest medical unit. Indeed, the recovery of the patient's geographic coordinates is conducted using GPS which will be sent to the health care center using a GPRS and also transmitted to the LMCES server to retrieve closest health care units. In reality, the Djikestra algorithm is used to specify the closest path between the patient's location and health care unit to be followed by the ambulance. This system is a health monitoring system for people having heart problems like hypertension and arrhythmia. The main idea behind the use of this system is to monitor blood pressure and arrhythmia in order to avoid complications in case of emergencies. LMCES consists of three main subsystems: (1) a monitoring system for the hypertension and arrhythmia patient, (2) an emergency system to track the location of the hypertension and arrhythmia patients in emergency situations and to guide them to the nearest hospital for Emergency Medical Services (EMS), (3) HP locator system to show the nearest healthcare points (HP) to the patient. Certainly this system suffers from some drawbacks which return it the topic of some researcher's critics. In fact, as i said this system is mainly based on the Djikestra's algorithm and to the best of our knowledge this algorithm suffers from the high computational cost.

i. Secured Framework for pervasive Healthcare monitoring systems

A portable parameter monitoring and analysis system for physiological studies for assisting patient-centric health care management is developed in [18]. The system uses network approach to acquire the data from sensors and transmit them to a server through wireless means. The system automates the acquisition of physiological parameters by continuous display on the monitor screen. The use of Bluetooth and wireless LANs has been proposed with four different monitoring devices to meet the requirements of medical personnel. The design of a processor which samples signals from sensors on the patient is presented in [19]. It then transmits digital data over a Bluetooth link to a mobile telephone that uses the General Packet Radio Service. An integration of sensors and actuators to a Wireless Body Area Network (BAN), followed by 2.5 (GPRS) and 3G (UMTS) technologies is proposed in [19].

j. Intelligent routing and notification system for emergency services vehicles

The proposed system in [20] is an auto routing and notification one and has as goal; to alert drivers in the vicinity of an emergency vehicle to clear the way and that is through smart techniques to determine which vehicle is in the emergency vehicle's path in order to relay the siren. The system presented in this article aims to accelerate the speed of the emergency vehicle to reach the area or the point of interest in a short time by notifying the vehicles in emergency areas to clear the road. The principle behind the use of the system described in this article is as follows: When an incident is triggered, an emergency vehicle is sent and followed, and if the route of the emergency vehicle is known the vehicles in the area will be notified. In case the route is not known, the most probable routes are estimated based on several information, so that the vehicles in the vicinity of the emergency vehicle will be notified, in other words the sirens are triggered to notify users of the vehicles in the same area. Obviously, notifications cease once the destination is reached. In fact, to trigger the siren as a ringtone to the mobile device, an SMS or a call is sent to the driver

of the emergency vehicle. The system then continues to inform users around the vehicle until the destination is reached.

k. Hand held emergency wireless telemedicine system

In [21] authors introduced a portable telemedicine system which is mainly implemented to serve people distant rural communities to enhance access to medical services that would often not be available in order to protect patients lives especially in critical and emergency cases that bears no delay whether in access to medical data or in taking the appropriate actions on the incident fields. This emergency system was introduced as a collaboration of a set of telecommunication techniques: Wireless Local Area Network (WLAN) and Bluetooth. This system targets diabetics, heart problems and accidents victim's people. If we talk about main functionalities, apart from the GPRS used to track patients, the GSM has been also used as a base component. Based on the new technique introduced in GSM called HSCSD (High Speed Circuit Switched Data) that increases data transmission of up to 43.3 kbps, the system was able to guarantee an excellent speed of issuance of medical data and emergency data and guaranteeing reduction in mortality percentages following emergency situations. The idea of this system is to work with new technologies which are characterized by a high endurance, very high computing performance and very high data transfer rates. On top of the list of components of this portable system, we mention the PIC18F46K22, which work in collaboration with these technologies and it is characterized by a high performance computing. Adding to that, in an emergency state the doctor can communicate with the patient through another component which is the microphone-loudspeaker which is incorporated in the device in order to send an ambulance if it's necessary.

2.2 . Pervasive Healthcare Systems Comparative Study

After presenting different research works in the area of pervasive healthcare systems, a summary is shown in the following table. Thanks to this table we are capable to identify the limits of every system so that we emphasize the axes of improvement to build a system which surpasses these limits and to guarantee good results.

Table 1. Pervasive Healthcare Systems Comparative Study

System	Health Care Application	Connection between patient and rescue staff	Reaching rapidly the patient (road deliberation)	Reaching rapidly the best point of interest	Limitations and Comments
Ketan Bodhe1 and Sawant (2014)	Mobile Based Health Care System for Patient Diagnosis using Android OS	Good Connection	No	No	The system needs extensions to make it suitable for wireless health monitoring.
Faiez and Akaichi (2014)	Pervasive System for Searching the Appropriate Road: A Mobile Physician on Road	No connection	Yes	No	The subsystem does not take into account moving obstacles and mobile points of interest.
Khayat and Akaichi (2008)	Pervasive assistance system for mobile physician on the road.	Bad connection	No	Yes	The system takes a long time to give a result checking the availability of resources required for a given treatment .
Douglas McCarthy and Sarah Klein (2011)	Sentara healthcare	No connection	No	Yes	Only based on research of doctors, needs extensions to take into account spatial and temporal criteria.

Hsu-Yang and all (2007)	Sensor-based Pervasive Healthcare System	Good Connection	No	No	Many restrictions and requirements related to areas Parking which returns this system very difficult to set up.
Niclas Nygren (2006)	Cooperative Freight and Fleet Applications	Bad Connection	Yes	Yes	High cost of storing information in the server related to the network traffic.
Alessandro Murro (2005)	Global System for Telematics	Good Connection	No	Yes	A high computational cost due mainly to the use of Dijkstra's algorithm as a routing algorithm
El Shafee (2015)	Towards an Affordable Real-Time Cardiovascular Emergency Detection and Response System.	Good Connection	No	No	Able to give good results but the system capabilities are limited and it need some more extensions to cover more patients and physician needs.
AKOMOLAF Patrick and EMUOYIBO FARHE (2014)	A MOBILE AGENT FRAMEWORK FOR REMOTE PATIENT MONITORING.	Good Connection	No	No	Requires much more development efforts to reach what AKOMOLAFE and EMUOYIBOFARHE are trying to do.
Sotiris Pavlopoulos And all (1998)	A novel emergency Telemedicine system based on wireless communication Technology AMBULANCE	Very Good connection	No	No	ECG signals suffer from lacking clarity and relevance .
Pantea and all (2012)	A Proposal to Design a Location-Based Mobile Cardiac Emergency System (LMCES)	Good connection	No	Yes	Suffer from the high computational cost due mainly to the use of Dijkstra's algorithm as a routing algorithm.
Suganthi and all (2012)	Hand Held Emergency Wireless Telemedicine System.	Bad connection	No	No	The system does not allow the patient to be aware that he is in critical condition, the connection is purely software and the alarm raised following a critical state is visible only from the doctor.
Alexander Smith (2009)	Intelligent Routing and Notification System for Emergency Services Vehicles.	Bad connection	Yes	No	Focuses only on other road users and how to notify them to liberate the road and does not take into consideration other problems that can prevent the ambulance to pass like bottling and any kind of obstacle on the road.
Fazlur Rahman and all (2014)	A portable parameter monitoring and analysis system for physiological studies and for	Bad connection	No	No	The wireless connectivity was limited to only between monitors and receiver.

	assisting patient-centric health care management.				

3. Pervasive Discussion and Desirable Properties of a Pervasive Health Care System

There are some properties, which are desirable in a mobile health care system and in their presence the system will perform better and allows us to get a high percentage of rescue of patients in emergency and very critical situation. Here some properties that we are trying to answer them in the next work.

- Privacy and Data Security: Privacy and security of patient data is a major concern that must be addressed and should never be overlooked.
- Completeness and speediness: The system must work on multiple criteria simultaneously; rapid diagnosis of the patient's condition is meaningless if the doctor is not able to reach him quickly. Same for the care provider; if the patient's diagnosis was made rapidly and without delay but the ambulance was blocked on the road by an incident or obstacle, the patient loses his life despite all the efforts. The system must consider several factors to ensure the achievement of the patient or health care provider is in the smallest delay.
- Reliability: This type of medical system does not support a high failure rate. Therefore, it must include a failure detection system so that whenever the system fails, it must inform the user about its failure and quickly find a replacement solution and the system must be restored.
- Robustness: The system should be able to send the data in its correct shape, intact for the server, although a definite failure occurs.

4. Conclusion

In this paper, we have presented a comprehensive survey of different tools and techniques used in pervasive healthcare and based on two main axes namely prevention en emergency health care services delivery. We have discussed several systems for the aim i mentioned earlier as a comparative table containing the principle of each system and improvement axes. Several are the open challenges related to the services offered by pervasive systems in the health care field. The research topic of our future work focuses on the development of a pervasive system which support in time both of prevention.

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