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Automatic Accident Alert and Retrieval of Medical Records of Accident Victims from Cloud

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***Abstract*--- In the present decade, even after technological advancements that we have come through in wireless communications, it is still difficult to improve the survival of accident victims in case of mass transportation vehicles. Cloud computing is the trend in which resources are provided to a local client on an on-demand basis, usually by means of the internet. The major and most prevalent application of cloud is storage. The idea is to use cloud to store adequate medical information of people for easier retrieval in case of accidents. This paper provides a conceptual idea, implementation perspectives and also the problems that are prone to be faced in the implementation of cloud storage to store medical records.**

***Index terms*: Cloud storage, sensors, GPS, accident identification.**

I.Introduction

Cloud computing is defined as the trend in which resources are provided to a local client on an on-demand basis, usually by means of the internet. Cloud computing has grown rapidly in the past few years due to the increasing network bandwidth, mature virtualization techniques, and emerging cloud based business demands. Mass transportation vehicles on undergoing accidents may lead to heavy loss of life. On such circumstances, the major problem lies with the identification of the location of occurrence of accident and the collecting of victim information.

Hence, if the identification of the accident and basic medical information of the victims are known at an earlier rate, it would increase the survival of the victims to a higher rate. To achieve this, this paper focuses on a simple conceptual idea on storing the basic medical information of people in electronic health record (EHR), uploading it to cloud in times of travel, retrieving it in case of accidents and the implementation of the same. This paper discusses cloud computing as a currently exploring way to provide EHR of accident victims and GPS location of the vehicle to the nearby hospitals and dedicated ambulances through internet, providing a remedy to the increased time consumption to identify accidents and to begin treatment to the accidental victims. This idea is achieved by tracking the vehicle continuously through GPS and transmitting accident information to hospitals in case of accidents.

II.Background

The retrieval of EHR and location of accident through GPS involves the understanding of smartcards, sensors, GPS system and cloud.

A. Cloud Storage

Cloud Computing is a general term used to describe a new class of network based computing that takes place over the Internet. Basically, it is a step on from Utility Computing. A collection/group of integrated and networked hardware, software and Internet infrastructure (called a platform). Using the Internet for communication and transport provides hardware, software and networking services to clients. These platforms hide the complexity and details of the underlying infrastructure from users and applications by providing very simple graphical interface or API (Applications Programming Interface).

In addition, the platform provides on demand services that are always on, anywhere, anytime and anyplace. Pay for use and as needed, elastic. Scale up and down in capacity and functionalities. The hardware and software services are available to general public, enterprises, corporations and businesses markets. The major function of a cloud computing system is storing data on the cloud servers, and uses of cache memory technology in the client to fetch the data. Cloud computing is a parallel and distributed computing system, which is combined by a group of virtual machines with internal links. Such systems dynamically offer computing resources from service providers to customers according to their Service level Agreement (SLA). Cloud computing is an umbrella term used to refer to Internet based development and services.

Basic cloud Characteristics

The "no-need-to-know" in terms of the underlying details of infrastructure, applications interface with the infrastructure via the APIs. The "flexibility and elasticity" allows these systems to scale up and down at will utilizing the resources of all kinds of CPU, storage, server capacity, load balancing, and databases. The "pay as much as used and needed" type of utility computing and the "always on anywhere and any place" type of network-based computing.

Cloud are transparent to users and applications, they can be built in multiple ways such as branded products, proprietary open source, hardware or software, or just off-the-shelf PCs. In general, they are built on clusters of PC servers and off-the-shelf components plus Open Source software combined with in-house applications and/or system software.

Features

The features of Cloud Computing are as follows:

a) Virtualization: The 'Cloud' can be considered as a virtual resource pool where all bottom layer hardware devices is virtualized. VM technology allows multiple virtual machines to run on a single physical machine.

Virtual workspaces: An abstraction of an execution environment that can be made dynamically available to authorized clients by using well-defined protocols .Resource quota (e.g. CPU, memory share). Software configuration (e.g. O/S, provided services).

b) Purpose and benefit: Cloud computing enables companies and applications, which are system infrastructure dependent, to be infrastructure-less. By using the Cloud infrastructure on "pay as used and on demand", all of us can save in capital and operational investment! Clients can put their data on the platform instead of on their own desktop PCs and/or on their own servers. They can put their applications on the cloud and use the servers within the cloud to do processing and data manipulations etc.

c) Cloud-Sourcing: Using high-scale/low-cost providers, Any time/place access via web browser, Rapid scalability; incremental cost and load sharing, Can forget need to focus on local IT.

d) Cloud Storage: Several large Web companies are now exploiting the fact that they have data storage capacity that can be hired out to others. Allows data stored remotely to be temporarily cached on desktop computers, mobile phones or other Internet-linked devices. Amazon's Elastic Compute Cloud (EC2) and Simple Storage Solution (S3) are well known examples.

B. Electronic Health Record Storage and Retrieval

The use of clinical data for research is a widely anticipated benefit of the electronic health record (EHR). Clinical data stored in structured fields is relatively straightforward to retrieve and use; however, a large proportion of EHR data is "locked" in textual documents. EHR chart notes are typically stored in text files, which include the medical history, physical exam findings, lab reports, radiology reports, operative reports, and discharge summaries. These records contain valuable information about the patient, treatment, and clinical course. This "free text" data is much more difficult to access for secondary purposes. In order to use this data, we must be able to retrieve records accurately and reliably for a desired patient population, usually through the use of natural language processing (NLP). While NLP has been applied to EHR data for decades, the performance of these systems has been variable across the techniques used, as well as the clinical task.

Historically, the field of information retrieval (IR) has studied the retrieval of documents and other content. However, IR has tended to place a greater focus on presenting content to users for human interpretation, rather than on extracting the specific information they contain. This task is typically referred to as information extraction or text mining. IR also has a long tradition of system evaluation, especially involving the use of test collections that contain fixed assemblies of content, query topics, and relevance judgments, a "gold standard" defining which content items are relevant to which topics. Such test collections are important, because they allow direct comparison of results obtained by different IR systems.

The field of IR also has a tradition of advancing knowledge by hosting challenge evaluations, in which the same test collection is used by many groups to compare the efficacy of different approaches. One of the best-known is the Text Retrieval Conference (TREC), an annual challenge evaluation hosted by the US National Institute for Standards & Technology (NIST). TREC is a long-standing event that allows different tasks and approaches to be assessed in an open, collegial, and comparable manner. Each year, TREC holds a number of "tracks" devoted to different aspects of IR, such as Web searching or cross-language IR. While TREC is focused on general-purpose IR, there have been some tracks dedicated to specific domains, including genomics.

In 2011, TREC launched a Medical Records Track (TRECMed) to develop an IR challenge task pertinent to real-world clinical medicine. The track was made possible by access to a large corpus of de-identified medical text from the University of Pittsburgh Medical Centre. De-identified clinical documents in the collection are organized according to patient visits. The task in the first year of TRECMed was to retrieve cohorts of patients fitting criteria similar to those specified for participation in clinical studies. Retrieval topics were derived from an Institute of Medicine list prioritizing conditions for comparative effectiveness research and modified to be unambiguous and to generate an appropriate quantity of visits relevant to the tasks. Funding from NIST allowed organization of the topic development and relevance assessment processes of the track.

C. Global Positioning System

The **Global Positioning System** (**GPS**) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil, and commercial users around the world. The United States government created the system, maintains it, and makes it freely accessible to anyone with a GPS receiver.

The GPS concept is based on *time*. The satellites carry very stable atomic clocks that are synchronized to each other and to ground clocks. Any drift from true time maintained on the ground is corrected daily. Likewise, the satellite locations are monitored precisely. GPS receivers have clocks as well—however, they are not synchronized with true time, and are less stable. GPS satellites continuously transmit their current time and position. A GPS receiver monitors multiple satellites and solves equations to determine the exact position of the receiver and its deviation from true time. At a minimum, four satellites must be in view of the receiver for it to compute four unknown quantities (three position coordinates and clock deviation from satellite time).

Advances in technology and new demands on the existing system have now led to efforts to modernize the GPS system and implement the next generation of GPS Block IIIA satellites and Next Generation Operational Control System (OCX).

In addition to GPS, other systems are in use or under development. The Russian Global Navigation Satellite System (GLONASS) was developed contemporaneously with GPS, but suffered from incomplete coverage of the globe until the mid-2000s. There are also the planned European Union Galileo positioning system, India's Indian Regional Navigation Satellite System, and the Chinese BeiDou Navigation Satellite System.

Each GPS satellite continually broadcasts a signal (carrier frequency with modulation) that includes:

- A pseudorandom code (sequence of ones and zeros) that is known to the receiver. By time-aligning a receiver-generated version and the receiver-measured version of the code, the time of arrival (TOA) of a defined point in the code sequence, called an epoch, can be found in the receiver clock time scale
- A message that includes the time of transmission (TOT) of the code epoch (in GPS system time scale) and the satellite position at that time

Conceptually, the receiver measures the TOAs (according to its own clock) of four satellite signals. From the TOAs and the TOTs, the receiver forms four time of flight (TOF) values, which are (given the speed of light) approximately equivalent to receiver-satellite range differences. The receiver then computes its three-dimensional position and clock deviation from the four TOFs.

In practice the receiver position (in three dimensional Cartesian coordinates with origin at the earth's centre) and the offset of the receiver clock relative to GPS system time are computed simultaneously, using the navigation equations to process the TOFs.

The receiver's earth-centred solution location is usually converted to latitude, longitude and height relative to an ellipsoidal earth model. The height may then be further converted to height relative the geoids (e.g., EGM96) (essentially, mean sea level). These coordinates may be displayed, e.g. on a moving map display and/or recorded and/or used by some other system (e.g., a vehicle guidance system).

Most receivers have a track algorithm, sometimes called a *tracker*, which combines sets of satellite measurements collected at different times—in effect, taking advantage of the fact that successive receiver positions are usually close to each other. After a set of measurements are processed, the tracker predicts the receiver location corresponding to the next set of satellite measurements. When the new measurements are collected, the receiver uses a weighting scheme to combine the new measurements with the tracker prediction. In general, a tracker can (a) improve receiver position and time accuracy; (b) reject bad measurements, and (c) estimate receiver speed and direction.

The disadvantage of a tracker is that changes in speed or direction can only be computed with a delay, and that derived direction becomes inaccurate when the distance travelled between two position measurements drops below or near the random error of position measurement. GPS units can use measurements of the Doppler shift of the signals received to compute velocity accurately. More advanced navigation systems use additional sensors like a compass or an inertial navigation system to complement GPS.

D. Sensors

A sensor is a transducer whose purpose is to sense (that is, to detect) some characteristic of its environs. It detects events or changes in quantities and provides a corresponding output, generally as an electrical or optical signal; for example, a thermocouple converts temperature to an output voltage. But a mercury-in-glass thermometer is also a sensor; it converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube.

The sensor operating environment must be evaluated to ensure that the sensor's signal range not only covers the vibration amplitude of interest, but also the highest vibration levels present at the measurement point. Exceeding the sensor's amplitude range will cause signal distortion throughout the entire operating frequency range of the sensor. In other words, mechanical shock loading on the sensor or large degrees of machine movement can overload the sensor's response capability. Shaker screens used in materials processing are an example of such an application. The machine can generate high impacts compared to the "normal" working level, but an impact, a step, also causes excitation of the sensor resonance frequencies. The gain is then 10 to 20 dB higher.

Based on piezoelectric technology various physical quantities can be measured; the most common are pressure and acceleration.

For pressure sensors, a thin membrane and a massive base are used, ensuring that an applied pressure specifically loads the elements in one direction. For accelerometers, a seismic mass is attached to the crystal elements. When the accelerometer experiences a motion, the invariant seismic mass loads the elements according to Newton's second law of motion

The main difference in working principle between these two cases is the way they apply forces to the sensing elements. In a pressure sensor, a thin membrane transfers the force to the elements, while in accelerometers an attached seismic mass applies the forces.

Sensors often tend to be sensitive to more than one physical quantity. Pressure sensors show false signal when they are exposed to vibrations. Sophisticated pressure sensors therefore use acceleration compensation elements in addition to the pressure sensing elements. By carefully matching those elements, the acceleration signal (released from the compensation element) is subtracted from the combined signal of pressure and acceleration to derive the true pressure information.

Vibration sensors can also harvest otherwise wasted energy from mechanical vibrations. This is accomplished by using piezoelectric materials to convert mechanical strain into usable electrical energy.

III. Medical Record Retreival Of Victims From Cloud

The proposed project focuses on the reduction of time taken to gather the basic records of the accidental victims, by automatically providing it to the hospitals in case of accidents and reducing the time taken to begin the treatment to the victims thereby improving the survival rate. This is conceptually achieved by combining the Global Positioning System, sensor and cloud storage. Now the basic concern is on implementing the project and further improvements can be done after the basic implementation. In the proposed project, many implementation level challenges are to be faced such as security, synchronization, etc. The given project involves the use of Global Positioning System, vibration sensor, Radio Frequency transceiver, cloud storage.

On successful implementation of the project, the lives of many people could be saved by quicker identification of accidents and location it through Global Positioning System. The accident intimation may be given to the surrounding hospitals and nearby ambulances at a faster rate through Radio Frequency transceiver. The victim's data is uploaded in cloud storage by the use of smart card readers from the EHR. On successful completion of travel, the passenger details are erased from the cloud. In case of accident, the GPS location and encryption key for files are sent to the concerned authorized personnel.

Architecture

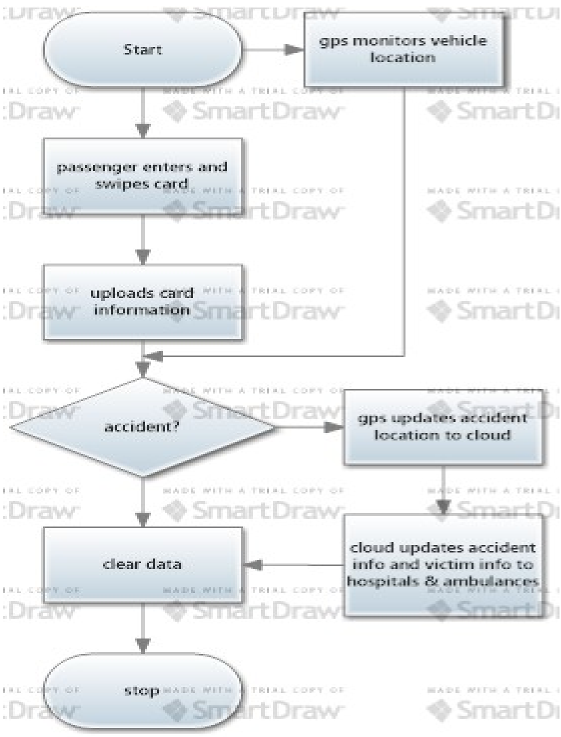

Fig.1. Architecture of the Proposed System

a) Data Uploading Section:

The basic medical record of the user is stored in the smart card. The smart card is provided a unique id and a pin. Once the passenger enters the vehicle, he/she swipes their card on the smart card reader fixed on every vehicle. This smart card reader would read the data and upload it to the dedicated cloud storage. Once the passenger leaves, he again swipes his card, and the particular record would be deleted from the cloud storage.

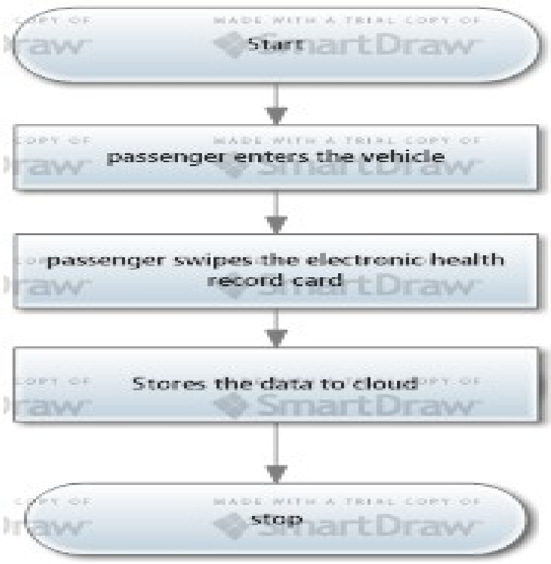

Fig.2. Operation of smartcard section

b) Cloud Storage Section:

Once the data are uploaded by the user, the cloud stores it temporarily. Once, the user swipes the card ensuring the end of his/her journey, the medical record of that particular user is deleted. Else, if an accident occurs, the cloud receives accident signals and the GPS location, the cloud sends the victim records to the hospitals and ambulances which are inside 5km radius. After successful transmission of data along with the encryption key, the cloud deletes the victim details after an acknowledgement.

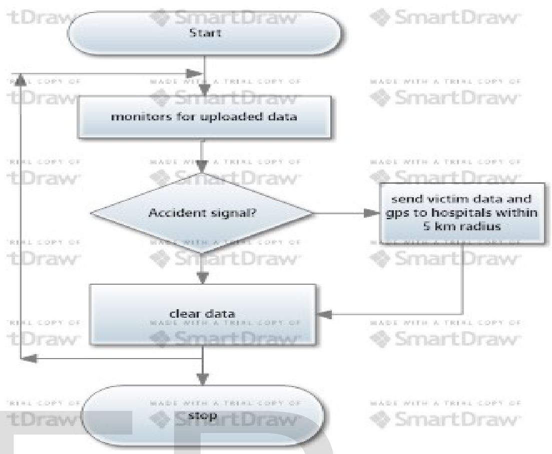

Fig.3. Operation of cloud storage section

c) Sensor Section:

A vibration sensor is attached to each of the vehicles. The sensor senses for abnormal signals. When the value exceeds the threshold value, the sensor senses it and sends the accident signals to the cloud and hospitals. The sensor continues to work constantly throughout the working of the vehicle.

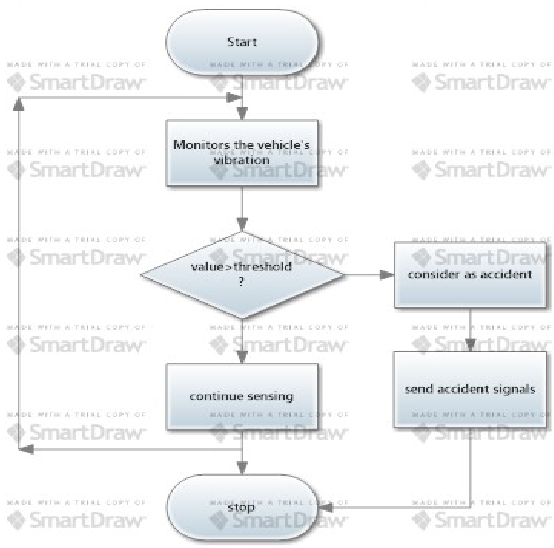

Fig.4. Operation of sensor section

d) GPS Section:

The GPS transmitter is placed in the vehicle for tracking purpose. The GPS will constantly track the vehicle throughout the working. Once, the GPS receives the accident signal, it retrieves the location of the vehicle which underwent an accident and uploads it to cloud. The vehicle can also be tracked by the GPS using signals from the smart phones used by passengers inside the vehicle.

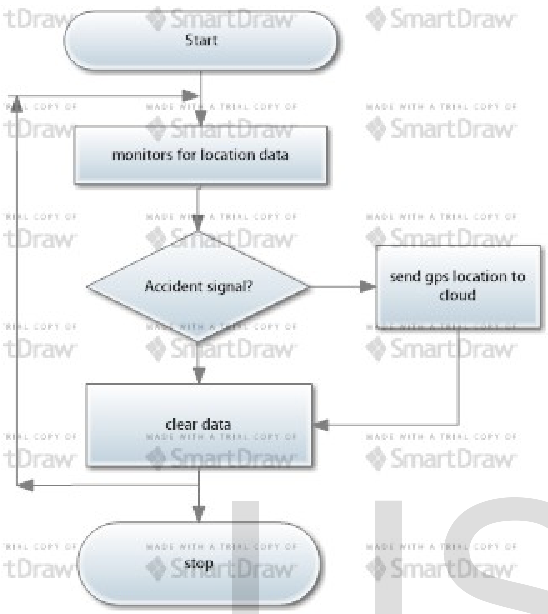

Fig.5. Operation of GPS section

Scope for Future Work

Providing a better interface to view shared files. Providing better authentication and allow authorized access to sensitive data. Extending our projected system, so that, it can also be used to send intimation about the accident to the emergency contacts of the accidental victims. Working on avoiding incorrect data transmission and delivery will help a broader range of EHR storage. With this project, the passengers of mass transportation vehicles may get better safety and quicker rescue in case of accidents.

Related Work

Data Value provides user's with service to share their data securely over cloud. But it is currently only for computers. Data Guard is another work going on which shares and protects user's data. It preserves data confidentiality and integrity using a middleware technology. It also provides disaster recovery and high availability.

Challenges

The main objective of the proposed project is to provide a convenient and rapid method for retrieval of victim data from the cloud. The major challenge which is to be taken care of is the cost issues, incorrect retrieval and security of victim data in cloud which is at the stake of getting into wrong hands.

CONCLUSION

In this day to day accident prone environment, the possibility of an accidental victim to lose his/her life is higher. By implementing the project, EHR and GPS location can be retrieved by authorized personnel in no time. In turn, the treatment could be started earlier, increasing the chances of survival of the victims. In this paper, in addition to the conceptual idea and the implementation perspective of the project, the authors have also discussed various issues including security and authentication of the information. With proper implementation and overcoming the various issues, the project could become one of the most important lives saving technological application in the near future.

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