WiMAX against unexpected Health problems: Automatic prevention and Assistance

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Abstract: Unexpected and sudden health complications like heart attacks, brain strokes, accidents and others are difficult to be dealt with at the proper time because the patient is unable to call for medical help. This kind of incidents often cause the patient’s life. In this paper, we suggest an automatic mechanism, which can call for medical help or give warning signs that a health complication may occur. The solution is based on a new telecommunication technology called WiMAX which provides broadband wireless connection.

Key-Words: WiMAX, wireless, health problems, heart attack, brain stroke, accident

1 Introduction
People often lose their life because of delayed medical help after unexpected health complications such as heart attacks, brain strokes or accidents. In such cases the first few minutes after the accident are really crucial for the patient’s life. Usually the patient can not react normally after such an unexpected health complication and he may not be in position to call for medical help. The problem is even more serious when the patient is alone or he is in a remote location not easily accessible. Therefore a permanent (on-line) tracking system for patients with a known record of serious health problems is necessary. However, such a tracking system can be quite expensive.

So far we discussed the situation after a health complication. However, sometimes it would be very helpful if the system could warn the patient that a health problem is about to occur. Such prediction can be based on measurements of the current body conditions, environmental conditions, the patient’s health record and other parameters. Moreover, apart from the on-line tracking system it is necessary for the patient to have an observer who has the appropriate expert knowledge and is able to justify the real occurrence of a health complication. Of course this will lead to an additional cost. This is a really complex problem if as well it is to be done automatically without the presence of a health expert, but if solved, it can really save the patient’s life. Furthermore, if we could develop such an automate system, this may lead gradually to building not only a self-preservative patient system but a self-preservative patient as well.

To obtain a solution to the above situations first there must be an on-line communication system between the patient’s device and the remote medical center. Such communication must combine at least mobility, high bandwidth and wide coverage. Usually this kind of communication is quite expensive and not available in remote non-urban places.

To address such communication difficulties we suggest using WiMAX (Worldwide Interoperability for Microwave Access), a new telecommunications technology which provides wireless connection with the above needed features. The WiMAX standard combines delivering high-speed, broadband and wireless connection.

2 WiMAX Technology
WiMAX (worldwide interoperability for microwave access) is based on the IEEE 802.16 BWA (Broadband wireless access) technology family. Demand for BWA technical solutions is growing quickly. However, most of these solutions can not be established on the market due to the lack of poor interoperability with other BWA products and high cost [1]. For example, high prices and limited throughput have kept adoption of Three Generation (3G) limited to business users [2]. WiMAX technology not only overcomes such problems but also is a long range system covering kilometers with a high bandwidth (Fig. 1). WiMAX exceeds by far the popular Wi-Fi because of the wide area of coverage (Fig. 1).
Specifically the power of WiMAX technology stems from the combination of the following features [2, 4, 5, 6, 7, 8, 9, 10, 11]:

- **Cost effective**: it is an open and international standard based platform for WiMAX technology drives costs down for the mass market.
- **Wider coverage**: it is a long-range system covering many kilometers.
- **Higher capacity**: it can deliver higher bandwidth efficiency and therefore higher data throughput.
- **WiMAX QoS (Quality of Service)**: it can be dynamically optimized for the mix of traffic that is being carried.
- **Mobility**: it enables subscribers to maintain their connection as they move across areas covered by different base stations.
- **Interoperability**: it is based on international standards which make it easier for end-users to transport and use their device at different locations or with different service providers.

These features show that WiMAX standard can address a wide range of applications.

### 3 How to prevent health complication

To overcome the aforementioned problem we suggest an application which consists of three phases:

**3.1 Phase I – Data collection (body device)**

At this phase the necessary data must be collected using an appropriate body device while additional data should describe the environmental conditions. Body conditions data are important because it can activate automatically the medical center to bring help in the case of an unexpected health complication or accident. On the other hand the mixed data from body and environmental conditions are necessary for the medical center to extract information from which the appearance of any health complication can be predicted.

These data can be sent automatically to the medical center’s device for further investigation to extract the necessary information or this procedure can be done first partly or locally with the appropriate algorithms at body device. However, when a patient faces a sudden health complication the data must be checked locally and an urgent signal together with the data must be sent to the medical center.

Except voice or data messages, to the medical center, it is sometimes necessary to send extra data such as images, videos, an on-line view of the patient or the environment and any other useful piece of information.

**3.1 Phase II – Data transfer (WiMAX)**

This phase is responsible for transferring the data from body device to medical center device. The patient and medical center can remain always online after negative health symptoms, known heavy health record or an accident. Here several problems are faced which show that the WiMAX standard as described above is the right solution:

- **Mobility**: the patient for example can be driving, climbing or running and the device can be always in touch with the medical center.
- **Bandwidth**: it is sometimes necessary that a large amount of data must be transferred to extract the appropriate conclusions.
- **Wide coverage**: for the application to be feasible it is better to establish a medical center per a wide region. Also the communication must cover difficult to be approached places or places with scarce population.
- **Low cost**: one of the most important criteria in order, for this application, to be available for everyone.

**3.3 Phase III – Info Extraction (medical center)**

At this phase the data received from patient are processed in order to extract the appropriate conclusions. This procedure can be done from an automated algorithm or a medical team. If the conclusion indicate the appearance of a serious health incident then the appropriate medical help
will be provided to the patient. Usually this is applied for a patient with a heavy medical record who remains most of the time on-line connected with the medical center. When the patient has a clean medical record, an on-line observation from the center is not necessary, but if the patient faces an accident or an unexpected health complication, then automatically an urgent signal is sent to the medical center.

4 Conclusion

Low cost and high performance of WiMAX technology make it a powerful tool for many applications available to mass market [12, 13, 14]. As we can see WiMAX can provide a fixed and broadband mobile access which can be helpful to save human lives. In that way a low cost medical help can be always close to the patient. Further this kind of application is maybe useful to collect statistical data which can be used to extract additional information about human diseases. Using real system data is important, because it is unknown how well simulated data approximate the relevant features of real syndrome.

References: