Assignment 4

Section 1

	Justin WIlliams	Nishant Panchal	Kevin Barresi
Percentage of effort towards assignment	33.3%	33.3%	33.3%

Table 1: Group contribution distribution

Section 2

Smartphone Application

The connected medical device (eCMD) developed by the group will serve to secure personal health records along with making the records accessible through a smartphone or the medical device itself. There has been an implementation of a personal health record system through a smartphone by CORAnet Solutions Inc. CORAnet application was composed of two parts, the CORAVaultTM and the CORAnet Emergency Widget. CORAVaultTM simply integrated various EMR systems and other medical records from various hospitals, doctors offices and clinics, and placed them all in a single record that could be accessed through a cellphone in a secure manner. CORAnet Emergency Widget would activate if the application owner is unconscious and showing their name, date of birth, their blood group, and any other important medical information. The application also identifies the location of the emergency making it easier to locate the patient.

The group is attempting to create a focused EMR application that transmits information from a blood glucose meter to a smartphone device via an encrypted path. Our EMR application would have three parts to it. The first part would be simply updating the information of the blood glucose level of the patient every few hours. The second part of the application would be to figure out any discrepancies or any harmful conditions that might occur based on the reading. The third part of the application would be to notify the doctor/nurse and to notify the user of the eCMD. With the record database, the individuals record would always be available even if the hospital or a doctors clinic closes. It would also allow sharing medical records with parents who want to manage to keep an eye on their childrens health, and children who want to monitor their elderly parents records. CORAnet Solutions Inc. has made their applications available on Google Market for $1.99, but our application serves to create more effective medical devices. Our application would run within the medical device and create a record database that can be accessed through mobile devices.[1][2]

Connected Medical Devices

The concept of creating electronic medical records has been around for a while, but many people have focused on tying applications of hospital information systems with electronic

records. There is less attention in the area of linking electronic records to medical devices. There are three basic categories of medical device; episodic devices, continuous stand-alone devices, and continuous networked devices. The group would focus on implementing an EMR on the episodic devices as these devices would communicate with a server wirelessly as it moves the patients information from the medical device to the server. One question that arises when developing an eCMD is patient association. Patients associations could take place either with a patient ID number on the patient's wrist or by a unique code given to the user when buying the medical device. Dissociation of a patient could either be done automatically once the record is transferred to the EMR server or manually by selecting an option in the drop down menu.

There are a few hurdles that would need to be crossed in order to make this application successful. Making sure that the application runs without glitches is a must for any medical device. It would be helpful if the group was able to raise interest of other doctors and nurses in order to validate the application. Making sure that the application improves the quality, safety and efficiency of the user is critical for this eCMD.

An example of EMR integration is conducted by Cardiopulmonary Cop. Bernoulli Enterprise. This solution focuses on enhancing the effectiveness of episodic devices similarly to our group. The Bernoulli Enterprise is mainly a software solution and hardware configuration similarly to the one the group is attempting to create. The Bernoulli can be downloaded in any PC or mobile device. It is created based on a patient-centric association and dissociation which is conducted by an ID from the patient. System downtime can be taken into consideration by having a caching policy that can store 4 days of data, which would transfer over once the server is running again. The figure below shows the EMR storage policy that would be implemented. The first part is the user interface portion through which the data is taken and placed in a database. The storage module would contain information regarding each patient in a different area, which would be parsed when a doctor or the patient wants to view their record. [3][4]

Existing Intellectual Property A major aspect of any business venture is that of intellectual property. That is, what potential exists to protect ideas through patenting? As such, a critical component of the group progress was searching for relevant, state of the art methods relating to smartphone application to medical devices.

One such method, filed in 2003, depicts a method of coupling medical devices with personal data assistant (PDA) devices[5]. Interestingly, the claims listed within this patent appear to limit the scope to include *only* insulin based devices. With this in mind, our device would have to be broad enough to cover various types of measurement devices not listed within this patent. It should also be noted that the PDA in this patent is simply an embodiment of the patent, and the device can be any that contains a touch screen with microprocessor components that can wirelessly interface with the medical device itself. Naturally, these claims lay rather close to the concept of our system, so care must be taken not to infringe upon this patent.

Another related patent addresses the issue of wireless communication[6]. It was filed in

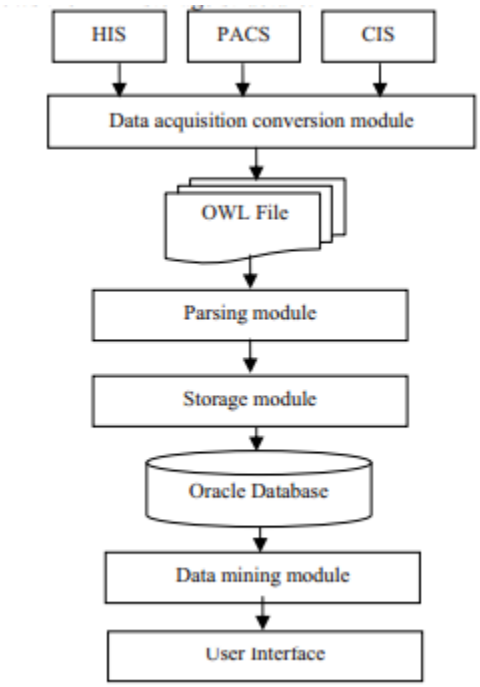

Figure 1: Example dataflow over medical data.

2006 by Edwards Lifesciences Corporation. Specifically, it outlines a wireless communication system for medical sensor data. As a more broad overview, it consists of a portable unit connected to a wireless sensor with a monitor, that connects to a sensor monitor. Once this module is activated, any number of these units organize themselves into a wireless system specified by the portable control unit, creating an "ad-hoc" network of self organizing sensors. This approach in itself is an interesting look at creating the communication back-end for our system, but it appears significantly more complex than required. Instead, we will most likely rely on passive Bluetooth connections tethering devices and sensors. This approach will not result in any intellectual property, but has the benefit of being simple to implement, and of being rigorously tested in previous devices.

Similarly, a patent filed by Abbott Diabetes Care Inc. in 2012 aims to outline a communication method between medical devices. Specifically, it targets "analyte" systems, which are glucose monitoring systems, generally including a small subcutaneous analyte sensor. This sensor continually transmits data via RF signals to a battery powered microprocessor controlled unit that collects data. Again, this patent limits its claims to include only glucose monitoring.

While we will ultimately move in different directions that the final two patents presented, it is important to consider their work. Specifically, it shows that these types of systems are being actively and currently researched. More importantly, it appears that most attempts at a wireless medical device communication system are focusing on novel network systems,

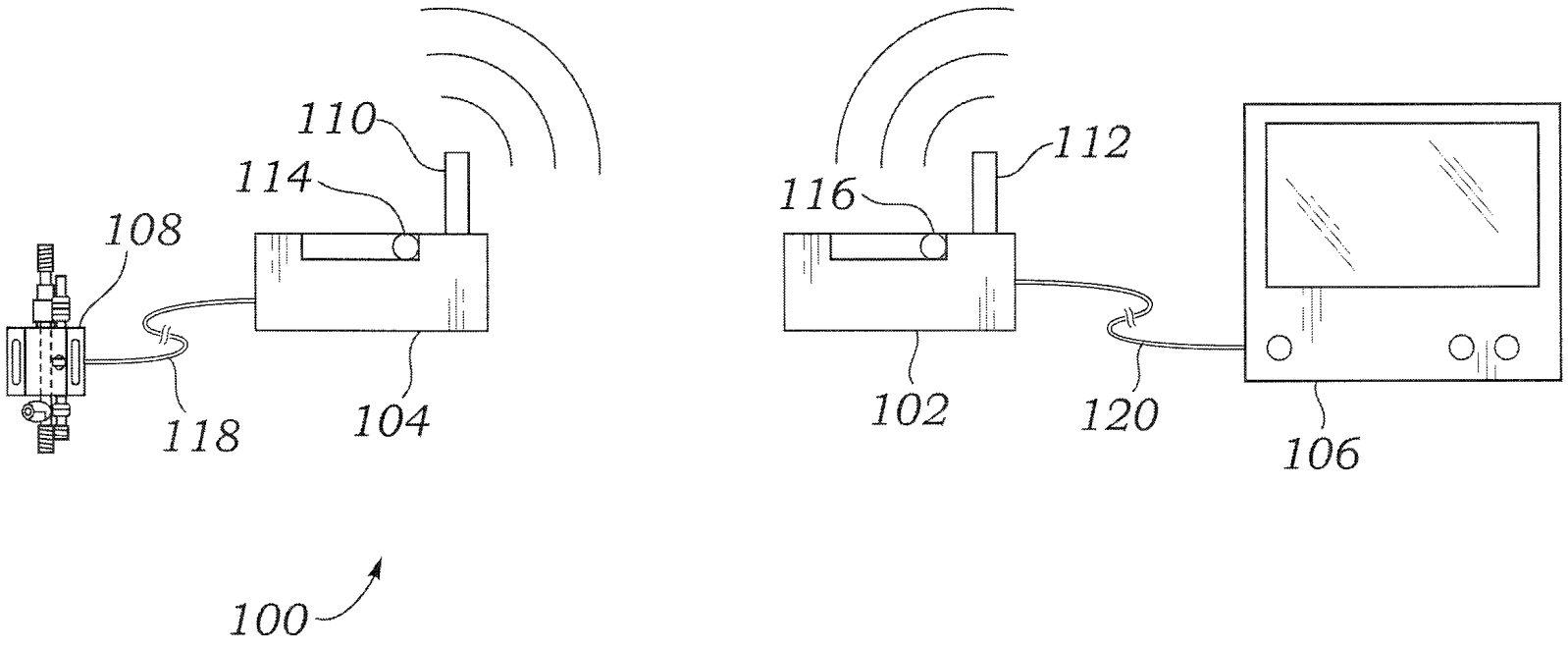

Figure 2: Existing method of wireless data communication for medical devices, presented in [5].

rather than focusing on the devices themselves. This seems a bit counter-intuitive, because reusing existing communication systems (i.e. 802.11x, Bluetooth, RFID, etc) would be significantly simpler to implement. Security also does not seem to be addressed in many of these patents. In conventional wireless systems, this is easily obtained using the same technology as virtual private networks (VPNs), where the tunnel would exist between the sensor and monitoring device itself.

References

[1] Making connections: Integrating medical devices with electronic medical records, 2012.

[2] Medical records; mobile, secure personal health record system puts electronic medical records at consumers' fingertips through smart phones and mobile devices, 2011.

[3] Chenguang Zhao and Luwei Zhang. Research of information presentation for electronic medical record based on ontology. In *Information Management, Innovation Management and Industrial Engineering (ICIII), 2013 6th International Conference on*, volume 3, pages 489–492, Nov 2013.

[4] Joseph Goedert. Medical devices meet electronic records, 2005.

[5] J.D. Causey, R.E. Purvis, and J. Henke. Handheld personal data assistant (pda) with a medical device and method of using the same, May 6 2003. US Patent 6,558,320.

[6] H.A. Heitzmann, J.A. Frazier, M.T. McKeown, W.A. Noda, G.F. Sutton, A.B. Yadlowsky, M.L.R. Gelvin, J.T. Armstrong, and J.D. Richert. Wireless communication protocol for a medical sensor system, September 29 2009. US Patent 7,595,723.