“Savings Lives With a Click”
An Emergency Medical Reasoning Engine

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ABSTRACT

This paper briefly presents medical software, which is referred to as EMRE (Emergency Medical Reasoning Engine), for Pocket PCs that will aid individuals in emergency situations. EMRE is designed to prompt users with a series of questions pertaining to their injury and based on their response, narrows the decisions for diagnosis and displays a diagnosis along with advice that can be considered until medical help arrives. The decision mechanism is based on a prototype that we developed.

1. INTRODUCTION

With today’s increasing usage of Pocket PCs for medical and personal reasons, the development of software that will aid individuals in emergency situations for PDAs and other Pocket PCs is relevant. For example, their is an individual at a pool and notice a child drowning, after removing the child the adult is unsure about the next steps to take. If the adult has EMRE available on her Pocket PC, she can easily enter the child’s status and a list of treatments will be displayed. On the other hand, if the adult does not have access to EMRE, she will have to find someone who is knowledgeable of the situation, now this is time that is not utilized and time is an important factor when dealing with emergencies. By the adult having to find someone the chances for the child surviving may decrease. However, having access to EMRE one’s chances for survival could be increased and future medical problems could be decreased because it utilizes every second by offering medical advice until help arrives. Overall, EMRE can be looked upon as an electronic first aid kit.

2. RELATED WORK

The concept of EMRE is closely related to WebMD, a medical website that allows one to research a wide variety of medical conditions, including the symptoms and diagnosis. These two applications share many of the same qualities such as user friendly; they are both designed for the average user which may have no previous medical training or knowledge. Also, they both display a diagnosis along with a list of appropriate treatments.

On the other hand, these applications also differ to some degree, for instance, EMRE is designed for emergencies whereas WebMD can be used for both emergencies and research. Also, EMRE’s architecture allows it to be easily converted to mobile devices, whereas WebMD is very difficult to manage on such devices.

3. EMRE

The concept of this software is to allow users to input data pertaining to their situation and based on their input displays a diagnosis and a list of treatments. Since this is an user
dependent application, the GUI is an important component. For the most part, the user interface is divided into three parts via a simple tab system located at the bottom of the screen. These tabs play a major role, because they allow the user to interact with the system. The following is a brief description of each tab:

**Vitals**
This is the first screen users are prompted to input data. The data recorded here is very simple Boolean questions such as heartbeat, consciousness, and breathing status.

**Diagram**
This screen simply shows a representation of the human body and is the second screen the user interacts with. This is where most data is inputted into the system. Thus, a simplified map of the human body was deemed the best mode of data input. By tapping the stylus on the injured body part, the user is presented with a series of questions as to the nature of the emergency.

**Diagnosis**
On this screen, the user receives the information pertaining to the nature of the emergency and a proper course of action. This includes a diagnosis and a detailed course of action.

4. **DECISION MECHANISM**

The decision mechanism is based on a prototype that we developed. The prototype focuses on heat-related illnesses such as Heat Stroke and Heat Exhaustion, it aims towards these illnesses because heat exposure is an issue that is taken lightly, but it is a serious topic. Also, heat exposure illnesses present similar symptoms and if one is not carefully can be incorrectly diagnosed. Also, the prototype was built on heat exposure for demo purposes but EMRE is not limited to this topic.

While testing EMRE with this mechanism it presented a diagnosis and advice in a reasonable manner but once additional emergency situations are added the prototype will not be suitable because the implementation of it will become tedious. In order for EMRE to present a diagnosis and advice for a wide variety of emergency situations another decision mechanism must be considered.

4.1 **Bayesian Networks**

The decision mechanism that is capable and suitable for EMRE when determining a wide variety of emergencies is influence diagrams, which combine Bayesian reasoning with multi-attribute utility theory. A Bayesian Network is a directed acyclic graph of interconnected nodes. The edges that connect the nodes together represent a cause and effect relationship. Overall, this mechanism is relevant for EMRE because this form of network is used to model a domain containing uncertainty in some manner. The uncertainty can be due to imperfect understanding of the domain, incomplete knowledge of the state of the domain at the time where a given task is to be performed, randomness in the mechanisms governing the behavior of the domain, or a combination of these. In EMRE’s case the uncertainty is due to a combination of the factors listed above because EMRE can only go by the data the user enters.
For example, the following network (Fig. 1) would run starting with Heat Exposure if Bayesian Networks were implemented as the decision mechanism. If there was indeed exposure to heat, the state of the node would be true and the flow of calculation would pass to either Heat Stroke or Heat Exhaustion. If false, it would pass to other areas of the network. The flow then continues until it reaches a Decision node and a diagnosis is made and displayed.

![Figure 1: Bayesian Network Ex.](image)

Within each node there is a probability table where the states of the previous nodes are cross referenced to produce a new state for the current node. For example, in Fig 2., if Heat Exposure is false and Heart Rate is rapid, there is only a 15% chance of Heat Stroke. However, nodes can pass more than one state at a time.

<table>
<thead>
<tr>
<th>Heart Exposure</th>
<th>Heat exposure = true</th>
<th>Heat exposure = false</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate = rapid</td>
<td>.75</td>
<td>.15</td>
</tr>
<tr>
<td>Heart rate = normal</td>
<td>.25</td>
<td>.85</td>
</tr>
</tbody>
</table>
5. FUTURE WORK

In order for EMRE to be beneficial software, additional work needs to be done, the following is just the top priority work that needs to be corrected: implementation of Bayesian Networks for the decision mechanism, addition of additional emergency situations so that it can benefit a wider variety of situations, and lastly real world testing of this software needs to take place. However, EMRE was demoed but it needs to be used by a wide variety of people who are actually in an emergency situation. Testing it among a wide population will determine if EMRE is capable of being relied on in emergency situations.

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7. REFERENCES


