

HeartToGo: A Smartphone-based Mobile Platform for Continuous and Real-Time Cardiovascular Disease Monitoring

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Motivation

I. CVD: The No.1 Cause of Global Deaths

Cardiovascular Diseases (CVD), e.g., heart attack and cardiac arrhythmia, caused by disorders of the heart and blood vessels, is by far the leading cause of death in the world. According to the World Health Organization (WHO), an estimated 17.5 million people died from CVD alone in 2005, representing 30% of global deaths (Fig. 1). To date, CVD is (and is projected to remain as) the No.1 leading cause of global

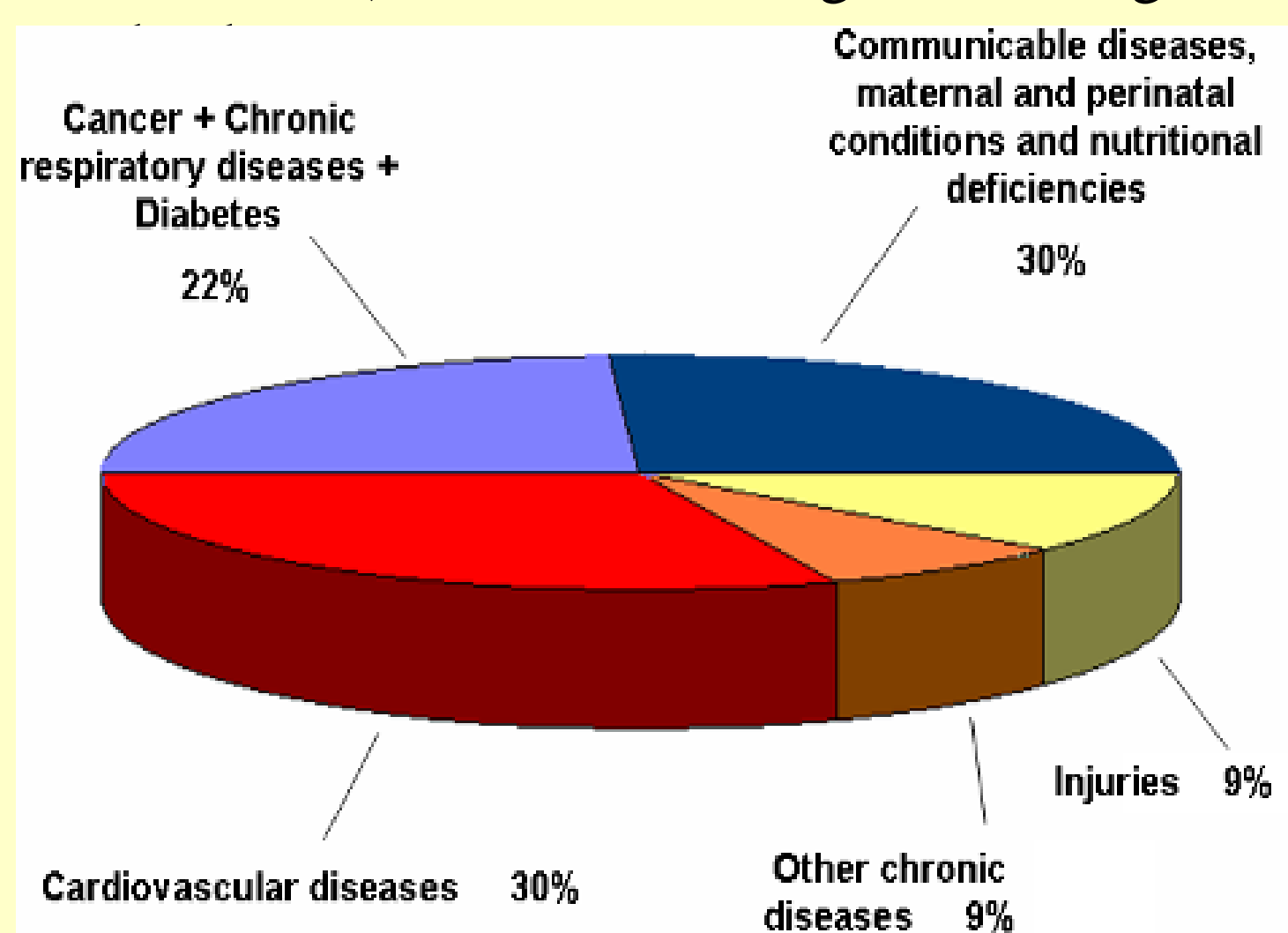


Fig. 1: CVD as No.1 cause of global death by World Health Organization (WHO).

II. Mobile ECG: an Effective Diagnostic Tool

The Electrocardiogram (ECG) is the most widely adopted clinical tool that measures and records the electrical activity of the heart from the body surface to assess the health condition of the heart, e.g., rate and rhythm. Today, commonly used ECG machines are stationary, bulky, and expensive; they also require experts' close supervision. A mobile, wearable, cost-effective, and layman-friendly ECG solution is necessary to achieve effective CVD



Existing ECG Machines

Fig. 2: Existing off-the-shelf stationary and ambulatory clinical ECG systems

Prototypes



Fig. 3: The HeartToGo Platform (left), including a Microsoft Windows Mobile Smartphone with a built-in GPS and Bluetooth, plus a wearable 2-lead Alive Heart Monitor with two possible lead configurations on the chest (right).



Fig. 4: The HeartToGo rule-based CVD detection user interface that includes: (top) a real-time ECG acquisition and display, plus an on-line CVD classifier; and (bottom) a 3-axis accelerometer measurement indicating the user's corresponding physical movement direction and degree of intensity.

- Heart rate (BPM) statistical summary: the average heart rate, the highest heart rate, and the lowest heart rate.
- Heart beat statistical summary: the total number of beats, the number of normal beats, and premature ventricular contraction (PVC) beats.

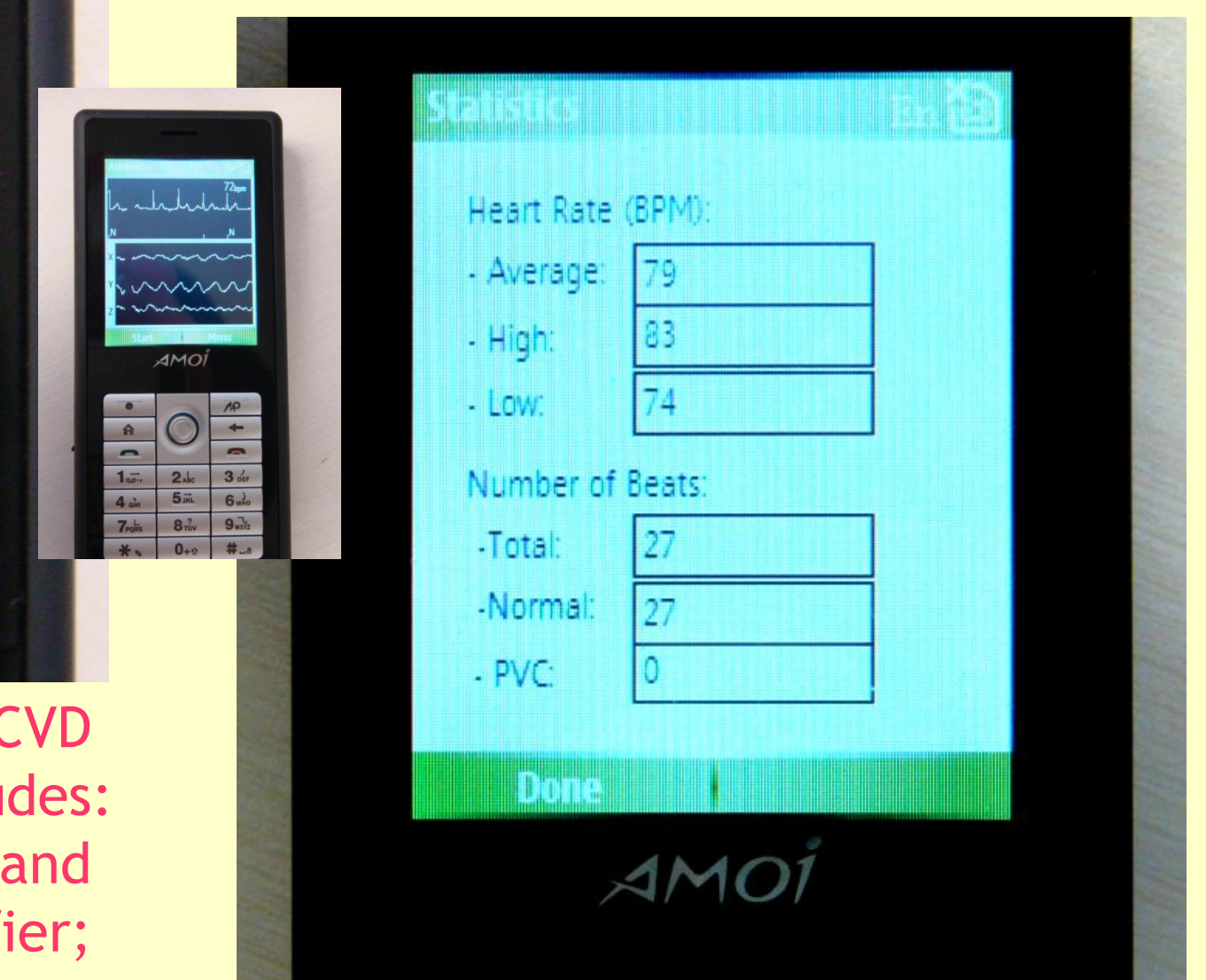


Fig. 5: The HeartToGo ECG Summary Report, providing a statistical summary of extracted ECG features.

Outcomes

- Constructing a portable physical test bed capable of acquiring, recording, transmitting, processing, and displaying ECG data in real time.
- Implementing an efficient ECG data processing module capable of dynamically extracting various features from acquired ECG signals.
- Designing an on-phone, online CVD diagnosis module capable of detecting cardiac abnormalities and matching them with possible CVD conditions.
- Developing a layman-friendly reporting module capable of generating an individualized clinical diagnosis report.



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