Name of Competition: **CUHK Vice-Chancellor's Cup of Student Innovation**

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Project Title: **A Novel Wearable Wireless Device for the Monitoring of Multiple Physiological Signals**

Brief Description of Project

The prevalence of cardiovascular disease (CVD) is on the rise. By 2020, CVD is expected to be world's leading cause of death, accounting for one-third of the total deaths. Unfortunately, CVD usually does not carry any significant sustained symptoms that would induce a patient to go and consult a doctor; it is often left unnoticed and unattended at its early stage. Besides, the abrupt but infrequent irregularities associated with CVD may not be picked up by doctors with present-day medical devices such as the stethoscope and cuff-based sphygmomanometers during their brief meeting with the patients. On the other hand, routine checking of risk factors associated with CVD, for example, hypertension, will help to identify and, thereupon, treat the disease at the early stage of its development.

Therefore, it is our proposal to invent a user-oriented healthcare device that is able to measure and record the user's heart sound, lung sound, blood pressure (BP), heart rate and their variability continuously. The device will provide medical practitioners with sufficient data to better assess the health condition of the user.

At present, physicians use stethoscope to hear a patient's heart and lung sounds, particularly in screening CVD and other acute respiratory diseases. The major drawbacks of the conventional stethoscopes are that the various sounds heard cannot be distinguished very clearly, and that the sounds cannot be stored up for future reference and consultation. Our device provides a function to playback the sounds at different speed and to visually display their waveform on screen. More importantly, whilst it records heart and lung sounds simultaneously, it automatically separates the two sounds into two channels at user's selection.

As mentioned above, our device measures BP continuously. A cuffless arterial BP measurement design enables the device to carry out this function. Conventionally, BP is measured by sphygmomanometers that are designed with a cuff. Although the measurement period is lengthy, it provides only a snapshot of the BP at a particular point of time. The cuff-based design causes circulatory interference at the measurement site,

and therefore, cannot be used repeatedly unchecked. In contrast, by using the proposed cuffless technique, an accurate BP reading is readily available in seconds and a continuous stream of BP reading are recorded so that even short-term BP variability can be obtained. This will provide a medical practitioner with historical data of the patient which are unavailable in our present-day medical environment.

In addition, the device will be developed on a PDA platform, which has a wireless communication feature to transmit data to a medical practitioner for remote professional consultation. Remote professional consultation is particular important in emergency cases where patients can be attended to at the earliest possible moment. It is also important and helpful to medical personnel in dealing with infectious diseases such as a flu that can be spread by human-to-human transmission. The platform allows medical practitioners to gather first-hand information from the patient without physical contact. And even if the practitioner decided that the patient has to be referred to a hospital for further investigation, he can adequately brief the hospital concerned of the patient's condition in advance and make proper preparation to avoid a possible outbreak of the disease.

Consequently, a model-based study is carried out to investigate multiple physiological factors such as respiratory rate, cardiac rhythm and events, and propagation time delay for an in-depth interpretation of blood pressure. The model will provide insight for accurate measurement of blood pressure and how it varies from beat-to-beat. The model forms the basis of the development of the proposed device.