G. GUTMAN, B. SYMES (Conveners). Falls prevention, exoskeletons and wearable sensors: Gerontechnology R & D in British Columbia. Gerontechnology 2010;9(2):100; doi:10.4017/gt.2010.09.02.301.00 **Participants**: *G. GUTMAN (CANADA), S.N. ROBINOVITCH (CANADA), M. MARZENCKI (CANADA), C. MENON (CANADA), N. LIVINGSTON (CANADA)*, and *B.L. BEATTIE (CANADA), DISCUSSANT*. **ISSUE** This symposium, sponsored by the British Columbia Network for Aging Research (BCNAR), is designed to illustrate some of the cutting-edge research and development in the gerontechnology field that is currently being conducted in British Columbia. The purpose is to raise awareness within the province, across Canada and outside its borders, of the featured researchers and their work and of the potential for new intra-provincial, regional, national and international cooperation and collaboration. A second purpose of the symposium is to draw attention to the value of organizations such as BCNAR. Research stimulation and research facilitation, assisting researchers with leverage of funding, student mentoring, knowledge translation and exchange, are all within BCNAR's mandate. These are vital support functions which individual researchers and even large research groups often lack the time, infrastucture and skills to undertake. BCNAR is also a user of technology – some of which will be described in the symposium. **CONTENT** The four research programs that will be showcased range from basic to applied. While three are focused on frail seniors, one addresses the technology needs of individuals ranging in age from 2 to 100. **STRUCTURE** Gloria Gutman, one of the six co-leaders of BCNAR, will open the symposium with a brief description of the structure and function of BCNAR and its use of ICT to faciliate networking and increase health and aging research in British Columbia. Steve Robinovitch, a BCNAR seed grant recipient will speak next, describing a research program focused on falls prevention in long-term care facilities. Technologies employed included networks of video cameras, wearable fall recorders, force-attenuating compliant flooring and 'smart' hip protectors. The third speaker, Marcine Marzencki, from the CIBER lab at Simon Fraser University, will describe a set of studies in which wireless sensors embedded in clothing are used to monitor heart rate and other vital signs and detect possible anomalies that could be harbingers of cardiac distress. He will also describe ways in which the sensor data are triagulated with data from the environment such as temperature, humidity and air pollution. Carlo Menon, the fourth speaker, will describe studies basic to the design of a wrist-exoskeleton that can serve as an assistive device for individuals with sarcopenia. He will be followed by Nigel Livingston who will describe the CanAssist program, headquartered at the University of Victoria, which has developed over 150 novel technologies to meet the needs of young and old clients with chronic and acute physical disabilities. BCNAR Chairperson Lynn Beattie will discuss the implications and applications of the gerontechnology R & D described in the symposium from her perspective as a geriatrician. **CONCLUSION** There is a rich array of gerontechnology research being conducted in the province of British Columbia. The BCNAR provides a model for increasing health and aging research capacity across disciplines and geographic boundaries and barriers.

Keywords: networking technologies, web collaboration, ICT, wearable sensors

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G. Gutman, B. Symes. Building research capacity through web collaboration: The BCNAR experience. Gerontechnology 2010;9(2):101; doi:10.4017/gt.2010.09.02.302.00 **Purpose** The BC Network for Aging Research (BCNAR) is one of eight population health networks funded by the Michael Smith Foundation for Health Research in British Columbia, Canada. Established in 2005, the mandate of BCNAR was to increase research capacity in the area of health and aging in the province through diverse networking activities; it was not mandated to conduct research itself. Several unique characteristics of BCNAR's organizational and management structure that have benefited gerontechnolgy and other health and aging researchers include its theoretical underpinnings; distributive/sub-network leadership model; research innovation model; regional networking structure; and use of networking technologies – the focus of this presentation. **Method** BCNAR began its research capacity building activities by establishing a comprehensive website that included a searchable database of publications on aging authored by BC residents. A second database, listing interests and contact information of its 1100+ members was subsequently added. Recently, a third database, called SMART- Senior Mentors Assisting Researchers and Trainees - became operational. SMART is a partnership between the Care for Elders Advisory Committee (University of BC Department of Medicine, Division of Geriatrics) and the BCNAR. It is a secure provincial database of older British Columbians (60+) interested in advising, participating and/or mentoring research and education on aging and age-related issues. Accessing the resources in the SMART database requires researchers to submit an on-line application indicating the role they are looking for seniors to fill: advisor, study participant, or mentor. Once the application has been reviewed and accepted notification is sent to the researcher that their opportunity will be distributed to SMART's list of senior volunteers. At this point it is up to individual seniors to contact the researcher[1]. Early on, BCNAR members were also offered access, cost free, to a web-based meeting platform (WebEx) that enables real time web collaboration and the development of virtual communities. **Results & discussion** While it is too early to ascertain the utility of the SMART database, the other two are well used and have been positively evaluated. The investment in WebEx succeeded far beyond our expectations. It has proved to be a popular, cost-effective tool used by researchers at the five geographically dispersed publicly funded research-intensive universities that are an integral part of BCNAR to communicate and collaborate with each other and with researchers in other provinces and countries. It has been used to connect university-based researchers with government agencies, community-based practitioners and agencies, seniors' organizations and business and industry, as mandated in our research innovation model. The synchronous environment provided has enabled these groups to share and manipulate research data, collectively edit reports, develop and edit poster and Power Point presentations, engage in knowledge translation and exhange activities, and to train and mentor new researchers. Organizations such as BCNAR provide a vital support function for R & D in gerontechnology.

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Keywords: research capacity buiding, networking technologies, web collaboration

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S.N. Robinovitch, E. Robinson, Y. Yang, T. Sarraf, O. Aziz, M. Jalili, M. Lueng, M. Loughlin, F. Feldman. Using wearable sensors and video networks for falls research in long-term care facilities. Gerontechnology 2010;9(2):101-102; doi:10.4017/gt.2010.09.02.303.00 **Purpose** Falls and their related injuries (most notably, hip fractures) are a major health problem for older adults. Two fundamental barriers to the prevention of fall-related injuries in older adults are: (i) the need to develop technologies (such as wearable sensors and video-based networks) for reliably detecting falls, and providing objective, real-time data on the cause and circumstances of these events; and (ii) the need to develop, implement, and evaluate improved technologies (such as compliant flooring and active wearable hip protectors) for reducing the risk for injury in the event of a fall. **Method** We have commenced a novel program of collaborative research between universities, government agencies, and end users, to develop innovative technologies to prevent hip fractures and other fall-related injuries in older adults. Our efforts involve an integrated set of research and demonstration projects in two long-term care (LTC) facilities in the Vancouver area. Our specific objectives are: (i) To utilize networks of video cameras to record the cause and characteristics of real-life falls; (ii) To develop wearable fall recorders to accurately detect and log the onset of a fall, and provide high-resolution data on body segment movements during the initiation, descent, and impact stages of falls; (iii) To test the effect of force-attenuating compliant flooring on mobility, falls, and fall-related injuries in high-risk environments; and (iv) To develop and evaluate 'smart' next-generation wearable hip protectors, which incorporate (a) integrated sensors to monitor user adherence and proper positioning in wearing the device, and (b) active, inflatable elements for improved force attenuation to protect against fracture. This talk will briefly highlight our results in each of these areas. **Results & discussion** To date, we have video-captured and analyzed over 200 real-life falls experienced by older adults in LTC. Our results are challenging current assumptions regarding the circumstances of falls in older adults. For example, the most common cause of falls was incorrect weight transfer (51%), followed by tripping (22%) and hit/bump (21%); slips accounted for only 4% of falls. Also, falls were equally likely to occur during standing quietly, sitting down, and initiating walking, as during forward walking. We have also conducted laboratory experiments to examine the utility of wearable sensors in distinguishing the cause of falls (as well as detecting fall occurrence), and have found that three sensors (mounted at the feet and sternum) provide at least 97% sensitivity in identifying slips, trips, and collapses. Our research to date on compliant flooring indicates that currently available (1" thick) floor coverings can attenuate peak force by 47%, without significantly affecting the balance of older women. Finally, preliminary results indlcate that inflatable hip protectors can attenuate the force applied to the proximal femur by over 95%, in comparison to the 10-30% provided on currently available passive devices.

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Keywords: falls, video capture, wearable sensors, compliant flooring, hip protectors
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M. Marzencki, B. Hung, P. Lin, Y. Huang, T. Cho, Y. Chuo, B. Kaminska. Wireless sensor network for context-aware health and activity monitoring. Gerontechnology 2010;9(2):102-103; doi: 10.4017/gt.2010.09.02.304.00 **Purpose** The increasing cost of healthcare and accelerated aging of society incite hospitals and other medical caregivers to look for solutions that are inexpensive, yet maintain proper quality of care. The prospects of efficient remote health and activity monitoring using wireless sensors have recently gained considerable interest. Wearable physiological monitors are usually capable of sensing one or more vital signs then communicating the data to a local or remote processing and interpretation centre[1,2]. The alluring promise of revolutionizing the health care system has stimulated research and creation of devices, but until now, very few of them have been introduced to the general public. Even though some wearable devices are equipped with multiple sensors, usually each parameter is analyzed separately. It often leads to false alarm generation and thus limits the acceptability of these systems. We propose not only to combine multi-sensor data available on the wearable device, but also to interface the wearable nodes with a mesh network of sensing devices deployed in the environment. Such solution enables context-sensitive analysis of the physiological data, leading to correct situation assessment and reliable alarm generation. **Method** The wireless sensor network provides a reliable and low power communication medium for wearable devices. Furthermore, a variety of environmental sensors can be connected to this system providing additional data and helping to better evaluate the situation: e.g. temperature, gas concentration, humidity. The wireless devices deployed in the environment also provide precise localization data based on radio signal triangulation. We base our system on a miniature, low power wearable node that acquires one lead ECG and acceleration data[3] An ECG signal is used to monitor heart rate and detect possible anomalies: e.g. arrhythmia, cardiac arrest. A tri-axial acceleration signal is used to detect falls and the level of activity of the subject. **Results & discussion** A test system has been built using the ZigBee mesh networking standard and Texas Instruments CC2530 transceivers. It includes a plurality of wearable sensors and a network of router devices with sensing capabilities. The routers can be as far as 100m apart (line-of-sight) and still provide reliable communication. Physiological signals acquired by the wearable sensors provide invaluable data about the subject. Combining the results from sensors with the data from the environment enables even better situation assessment. As the multi-source data is immediately available on the wearable device, it can be used to alter its operation. For example, when an elevated heart rate is detected, it triggers more precise ECG acquisition and processing to detect the actual reason of this change. When combined with body position, activity data and the location of the subject, a true context-awareness is created.

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Keywords: telehealth, wearable sensors, physiological monitoring

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Z. O. Khokhar, C. Menon. A Myo-electric Assistive Device. Gerontechnology 2010;9(2):103-104; doi:10.4017/gt.2010.09.02.305.00 **Purpose** With increasing age, people tend to lose their muscle mass which is referred to as Sarcopenia or more commonly known as frailty and is identified as one of the major issues with aging[1]. An assistive device is particularly useful to provide the extra force for activities of daily living and can also serve the purpose of training at the same time. Surface electromyography (sEMG) has been successfully applied to predict the intention of the user in terms of hand postures[2-4] and has been used in many prosthesis applications[5-7]. However for an assistive device it is necessary to not only predict the intention of the user in terms of posture but also in terms of the amount of force that needs to be applied. The purpose of this research is to study if the same techniques of posture recognition through sEMG signals can also be applied to control assistive devices in terms of force and direction. **Method** sEMG data were gathered from eight muscles of the forearm namely extensor carpi radialis (ECR), extensor digitorum (ED), extensor carpi ulnaris (ECU), abductor pollicis longus (APL), flexor carpi radialis (FCR), Palmaris longus (PL), flexor digitorum superficialis (FDS) and flexor carpi ulnaris (FCU). A commercial EMG measurement system (Noraxon Myosystem 1400L) was used with AgCl electrodes for sEMG measurement. The data were gathered from two subjects performing defined actions keeping their hands static at a neutral position. A custom rig was built using reaction torque sensors (Transducer Techniques TRT-100) to measure the direction and force applied by the wrist. All data were recorded using National Instruments data acquisition card (NI USB-6289) and LabVIEW. Features were extracted from the sEMG signals which included rms EMG amplitude, Autoregressive model coefficients and waveform length. A window size of 250 ms with an increment of 125 ms was used so that the intention of the user can be predicted without perceiving a delay[8]. The measurements from the forearm were divided into 13 classes given as percentage of maximum voluntary contraction (MVC) (*Table* 1). Support Vector Machines (SVM) was employed for classification purposes as they are very efficient and can perform in real time[9] (*Figure 1*). **Results & discussion** Results from this study show that the classification of user intention in terms of direction and force can be achieved with an accuracy of about 99.5% using the method described. It is also observed that SVM is efficient enough to perform the classification in less than 125 ms so that the exoskeleton can be derived in real time. As we continue our research, we will try to add more actions of the hand such as finger extension/flexion and elbow and develop a full forearm exoskeleton.

Table 1 Classes for different actions

Class #	Action
1	10% MVC extension
2	30% MVC extension
3	50% MVC extension
4	10% MVC flexion
5	30% MVC flexion
6	50% MVC flexion
7	10% MVC ulnar deviation
8	25% MVC ulnar deviation
9	40% MVC ulnar deviation
10	10% MVC radial deviation
11	25% MVC radial deviation
12	40% MVC radial deviation
13	Neutral

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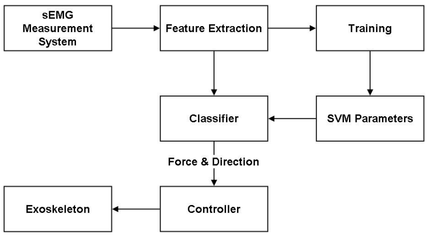

Figure 1. Block diagram of the assistive device

Keywords: assistive device, surface electromyography (sEMG), support vector machines (SVM)
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N.J. LIVINGSTON. CanAssist: a program that develops and provides technologies and services for people with special needs. Gerontechnology 2010;9(2):104;
doi:10.4017/gt.2010.09.02.306.00 **Purpose** This paper describes a university-based interdisciplinary program that in partnership with the community serves those with special needs. Specifically, the program is dedicated to developing customized technologies and services that improve the quality of life and increase the independence of those with disabilities. All of our activities are in response to requests from the community, whether from individuals or families or from professional care givers. We engage thousands of students and hundreds of faculty, staff and community volunteers (including retirees) in our program. Whilst CanAssist works with clients right across the disability and age spectrum (our youngest client is 2 years-old and our oldest is 100) a significant portion of our work is directed at seniors. With our aging population, this is likely to increase. Our assistive technologies can be categorized into three general areas: those that deal with mobility and motion, those related to communication and environmental control and those that involve human-computer interfaces. As an example of the final category, we developed, a very simple interface that allows people to make (video and audio) calls over the internet by simply touching a large photo or image of the person of interest displayed in a gallery on a computer screen. This project was started in response to a request from a daughter whose elderly mother has mild dementia and lives in a care facility. Now, not only are the mother and daughter (and other family members) in regular contact but the system is also being used by hundreds of other users across the country and around the world. **Method** Once a request is received, CanAssist assembles a team of engineers, scientists and relevant specialists to address the specific needs of the client. Clients are always considered to be an integral part of the design team and their input or that of their caregiver's is critical to the success of any project. In developing a solution, we refer to the Human Activity Assistive Technology (HAAT) model that conceptualizes the user, their activities, environment and assistive technology as an integrated system in which changing one element affects all other elements in the system[1]. It can be applied in the design, selection and evaluation of technology for use by an individual or as a conceptual model for exploring the influence of assistive technology on participation in daily activities. **Results & discussion** We have developed over 150 novel technologies that have been provided to thousands of users around the world. These range from sophisticated communication devices (for example for those with advanced amyotrophic lateral sclerosis, multiple sclerosis or Parkinson disease), to nurse call switches, to ball launchers that allow those with acute physical disabilities to 'throw' a ball for their dog.

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