MOVING INNOVATION TO APPLICATION

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ABSTRACT *New iedas have promoted social, economic and technology growth and development throughout human history. While many ideas were novel, other innovations were the result of incremental improvements on existing technoloies. The adoption and diffusion of innovations require the availability of relevant knowledge, competent people, and the availablility of financial support. Organizations with formal R&D programs have been most successful in creating such innovations and subsequent adoption and application. An example of such an innovation is the development of a novel robotically controlled thermal maniking laboratry which combines a pneumotechnology with the Internet thus making the system accessible to researchers globally.*

1. INTRODUCTION

New ideas have spurred social, economic and technology growth throughout human history. Such innovations have come not only in the form of novel ideas and inventions but also in the form of incremental improvements to existing ideas, methods and technologies. However, there are important conditions that have to be met in order for an innovation to be adopted and implemented successfully. These include a well-defined need, the availability of information and knowledge specificically needed to move an innovation to an application stage, the availability of competent people to implement and manage the innovation, and financial support.

It has been shown that innovations are most often achieved by institutions that are engaged in systematic research and development activities. Structured R&D is known to foster patent development and promotes additional scientific breakthroughs that can lead to additional improvements in a broad range of different disciplines [1, 2]. However, new ideas and innovations are also created through less formal on-the-job modifications of practice. Such “incremental” innovations often emerge from actual practice through day-to-day experience.

An additional source of innovation that is becoming more widely recognized is the “end-use innovation” where an individual, or an institution, develops new ideas for their own use because existing products might not meet their current and future needs. Such innovations have been identified as the most important source of innovation in our society today [3] and are frequently employed by researchers who “piggy-back” new ideas onto on-going projects.

2. INNOVATION ADOPTION

We know that the adoption, distribution, and diffusion of new ideas can benefit society in many meaningful ways. The ultimate impact of an innovation, however, will depend on the nature of the innovation itself, the success in the disseminating the innovation, the technical and social visibility of the idea, exposure time to the user and professional community, and the social system into which the innovation is being introduced. Innovations are most often passed on from the inventor to other individuals within their working institutions. Such a process is illustrated by the "Diffusion-Curve" [4]. During the early stage of an innovation, application (adoption) growth is relatively slow while the new technology must first establish itself. At some point, users begin to demand the technology and the adoption growth increases more rapidly. Additional incremental innovations or modifications to the original idea will then allow the adoption to grow even more . Towards the end of its lifecycle, however, growth slows and may even begin to decline. In the later stages, no amount of new investment (improvements) to the innovation will maintain the demand. It is recognized that most innovations have a limited "product life" or "shelf-life. Therefore, organizations continue to develop new innovations in the hope that they eventually will replace the older ones. Successive S-curves will come along to replace older ones and continue to drive adoption and diffusion upwards. This process is illustrated in Figure 1 where an existing technology is depicted in the first curve and the second curve shows an emerging technology that eventually overtakes the first technology and leads to a greater levels of growth later.

It is clear that an innovation must be widely adopted in order to sustain itself. Within the process of adoption, there is a point at which an innovation reaches a "critical mass" and then continues to be adopted universally. This occurs during the growth phase. However, either positive or negative outcomes may result, the new outcomes could be desirable or undesirable, the long-term impact could be either direct or indirect, and the consequences of adopting the innovation may be unpredictable. These variables ultimately determine the impact an innovation will have on an organization or on a community.

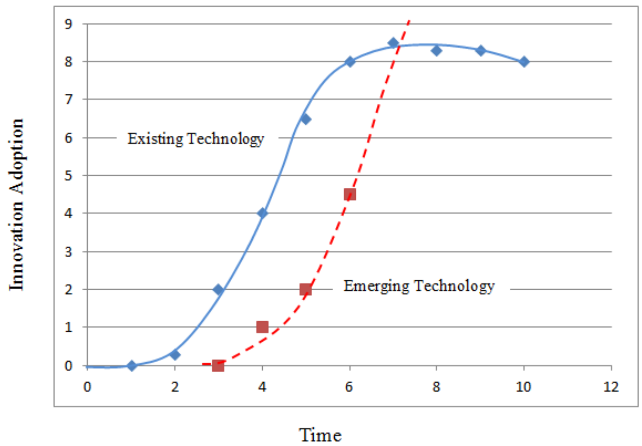

Figure 1: Illustration of the adoption "S-curve" where an existing technology (blue) is overtaken by an emerging technology (red).

3. UNIVERSITIES

Academic institutions have long fostered creative activities that promote the development of new ideas. Throughout history, the innovations created by such institutions have resulted in many useful products and services worldwide. However, the developments have often been end-user driven and have been incremental advances of existing technologies. Such innovations have been shown to require less time for adoption and fewer financial resources than emerging technologies. One such example is the development a remotely controlled ergonomics laboratory at Boise State University. The new development allows researchers and students worldwide to use ergonomic tools that are not available elsewhere. This technology represents an example of an incremental advance in the field of electronic communication utilizing an already existing platform which is readily available internationally.

4. LABORATORY DESCRIPTION

The remotely controlled Ergonomics Laboratory is equipped with a thermal manikin system capable of assessing the heat exchange characteristics of protective clothing worn under controlled environmental conditions. Equipment includes a manikin air pressure system, manikin air heating system, environmental ventilators, infrared radiators, and digital thermometers measuring manikin input and output temperatures needed to compute the manikin heat gain or heat loss. The system is illustrated in Figure 2.

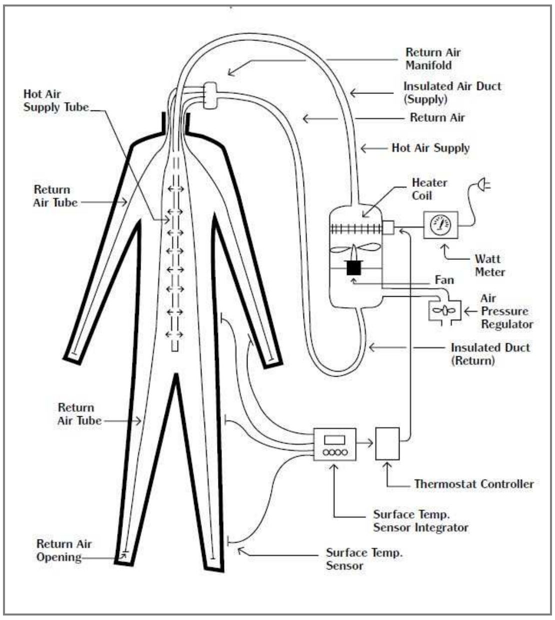

Figure 2: Illustration of the inflatable thermal manikin technology system.

4.1 Controls

The Internet platform serving the Remote Laboratory is provided by Apriori, LLC through its "Reach-In" browser technology. This system allows novice Internet users, i.e. users with no special computer skills, the ability to control mechanical devices through the internet using their computer and their home Internet connections. This functionality is possible in any geographic location in the world that has Internet access.

4.2 Technology Innovation

The platform provides new opportunities for remote laboratory use in the following ways:

- The software reduces latency to less than 1 second which makes it suitable for visual control of the instruments and equipment.
- The software works in all major browsers without the need for special downloads.
- The software can control any hardware component over the web.
- The technology allows many users to interact on one site without compromising the quality for the user in control.
- A queuing methodology allows for global users to join a queue from anywhere on the Internet.

Any researcher with access to a sufficient Internet band-width can now log onto the remote laboratory website and control all of the laboratory devices remotely. The user has the ability to control a camera, pan up and down, and zoom in and out on every instrument located in the laboratory. At a click of their mouse, a user can control multiple mechanical devices at any one time. The laboratory remote control schematic illustrating the relationship between the key components and the sub-systems are illustrated in Figure 3.

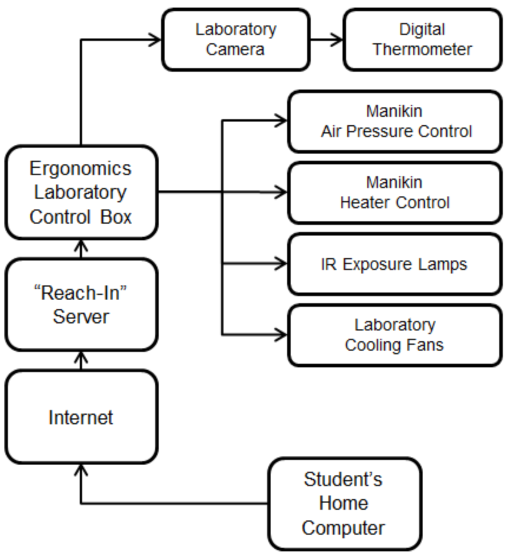

Figure 3: Schematic flowchart of the remotely controlled thermal manikin system.

5. CONDUCTING AND EXPERIMENT

To determine the heat transfer characteristics of a garment requires the researcher to perform two simple measurement procedures sequentially by using the following steps:

- The thermal manikin must first reach thermal equilibrium in a “semi-nude” configuration (wearing short pants only). This serves as the “control” configuration.
- The temperature difference between output air and input air is then observed and recorded and subsequently entered into a standard energy loss calculation (formula).
- Once thermal equilibrium is reached, heat radiation exposures or wind conditions can be added. Again, the manikin input and output temperature values are recorded at equilibrium.
- To measure the thermal characteristics of clothing systems, the procedures used for the “control” conditions are repeated with the exception that the manikin is now clothed. The energy loss values are then compared to the “control” conditions. This provides values for the thermal properties of the clothing system being tested under the selected environmental exposure conditions.
- The testing protocol is illustrated in Figure 4 and Figure 5.

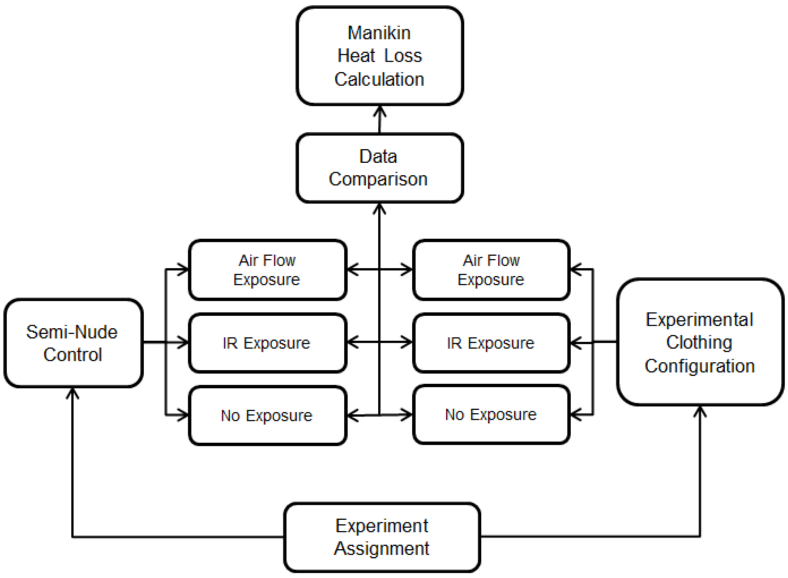

Figure 4: Schematic of research protocol used in evaluating the thermal characteristics of protective clothing.

A B

Figure 5. Illustration of thermal manikin in the “Control” configuration (A) and in the “Experimental” configuration (B).

5.1 Laboratory Use

A number of international research project have been conducted using the laboratory (5-7). Access to the thermal laboratory is open to the global Internet community. Visitors are permitted to operate the equipment “at-will” to observe the technical functions of the key manikin equipment. User tracking has shown that persons from all continents around the world have accessed the facility either as a viewer or as an active “user” operating the various manikin sub-systems. Although the current features appear to offer visitors a video-game “entertainment” opportunity, the goal of the open access policy is to promote interest in ergonomics research. When experiments are being conducted locally or “in-house”, the remote controls are disabled. This allows the researchers to eliminate outside interference or interruptions. However, the camera continues to remain “on” during experiments which allows visitors anywhere in the world to view these activities 24/7.

Institutional collaborations have expanded from Boise State University in the USA to the University of Zagreb in Croatia and the Hong Kong University of Science and Technology. Although the advantage of using the remote laboratory increases with distance, differences in the East-West time-zones can make real-time communications regarding technical problems inconvenient. Nevertheless, as academic resources become scarcer, collaborative use of laboratory resources locally, regionally, and internationally will be helpful. As additional innovations emerge, the use and practicality of remote laboratories for research and teaching will undoubtedly play an increasingly important role in the future.

7. REFERENCES

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