EMBEDDED HUMAN CONTROL OF ROBOTS USING MYOELECTRIC INTERFACES

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Abstract: *Myoelectric controlled interfaces have become a research interest for use in advanced prostheses, exoskeletons, and robot teleoperation. Current* **research** *focuses on improving a user's initial performance, either by training a decoding function for a specific user or implementing "intuitive" mapping functions as decoders. However, both approaches are limiting, with the former being subject specific, and the latter task specific. This paper proposes a paradigm shift on myoelectric interfaces by embedding the human as controller of the system to be operated. Using abstract mapping functions between myoelectric activity and control actions for a task, this study shows that human subjects are able to control an artificial system with increasing efficiency by just learning how to control it. The method efficacy is tested by using two different control tasks and four different abstract mappings relating upper limb muscle activity to control actions for those tasks. The results show that all subjects were able to learn the mappings and improve their performance over time. More interestingly, a chronological evaluation across strialsreveals that the learning curves transfer across subsequent trials having the same mapping, independent of the tasks to be executed. This implies that new muscle synergies are developed and refined relative to the mapping used by the control task, suggesting that maximal performance may be achieved by learning a constant, arbitrary mapping function rather than dynamic subject- or task-specific functions.*

Key words: *Mems, Zigbee, Rfid, Motors,Ethernet ,,pc.*

INTRODUCTION

Myoelectric controlled interfaces, through mediating connections between electromechanical systems and humans, are a vital component for advancing applications in prostheses, orthoses, and robot teleoperation. This technology offers promise to help amputees regain independence, humans perform tasks beyond their physical capabilities and robotic devices be teleoperated with precision. Breakthroughs in reliable detection of neural signals using electromyography (EMG) have given researchers noninvasive access to muscle activity, bringing myoelectric interfaces to the forefront for further advancement of these applications. A. Neural Decoding Current research has focused on improving performance of myoelectric controlled interfaces through optimal decoding of neural signals. Various algorithms use machine learning techniques, but wide inter-user variability in EMG signals requires intense training phases to create a decoder specifically for a given user. Even with Mark Ison, Chris Wilson Antuvan and Panagiotis Artemiadis are with the School for Engineering of Matter, Transport and

Energy, Arizona State University, Other methods use intuitive decoders to control an interface with a small set of simple commands, translating to predefined actions by a robot [12], [13]. However, the rigid set of actions limit users' ability to learn better control of the system, and the performance cannot generalize to new tasks. Both methods intend to maximize the initial performance of the user. This does not capitalize on a human's natural ability to learn and optimize control strategies while performing tasks. Thus, these approaches may not provide a foundation for efficient performance over time. Alternatively, other works investigate the capacity to learn an inverse model of a predefined decoding function. Heliot etc. All form a model of the brain to convert firing neurons to two dimensional (2D) positions for center to reach out tasks. This model simulates how minimizing output error influences brain plasticity to learn the inverse model of the decoding function. Kim et. All confirm these results experimentally with closed loop training. Chase et. When comparing performance of two decoding algorithms, show significant performance differences between decoders in open loop tasks, but minimal difference in online closed loop control tasks.

Closed loop myoelectric controlled interfaces are further investigated by Radhakrishnan et. All to understand human motor learning. Two distinct decoders are used to decode EMG signal amplitude from six muscles to generate a 2D cursor position. The intuitive decoder maps muscles to a vector along the 2D plane most consistent with limb movement when the muscle contracts. The non-intuitive decoder maps muscles randomly along equally spaced vectors in the plane. Results indicate learning via performance trends best fit by exponential decay. While the intuitive decoder gives better initial performance, the non-intuitive decoder provides a steeper learning rate and achieves nearly equal performance after 192 trials. Pistol etc. Demonstrate the natural extension of this motor learning to practical robotic applications. Using EMG signals to control fingers on a robotic hand, subjects are able to learn a non-intuitive decoding function with comparable performance to a 2D cursor control task similar to. These studies establish that humans can learn to control myoelectric interfaces using various decoders when presented with closed-loop feedback. The study presented in this paper expands these findings by investigating the performance impact of previously learned mappings on new control tasks. In addition, population-wide muscle synergy development is evaluated to confirm learning of a more efficient control.

DESIGN OF PROPOSED SYSTEM

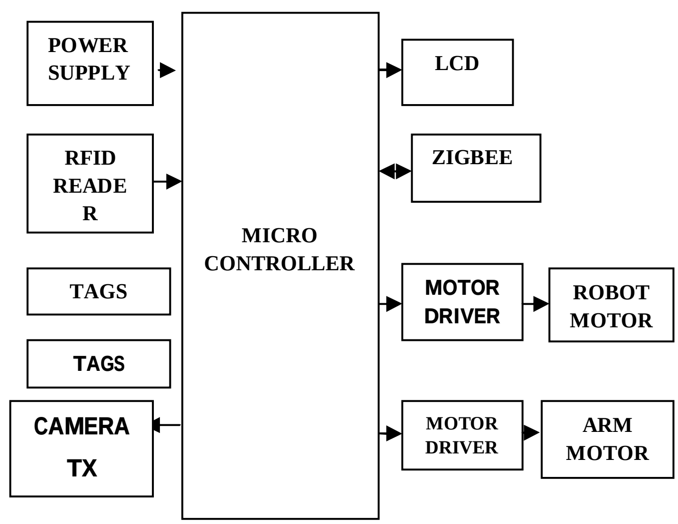

Fig.1.Robotic Section Block diagram

With the advancement of technology, we can overcome above drawbacks we are going this proposed method. In this method we are going to maintain a library using my controller based system. Here in this system we will be using touch panel to operate my robot section like move front, back, left, right and placing wireless camera on the robot section. It will capture the images of books in shelf and send data to receiver section. Then we can monitor the captured images using software and we will be using here MEMS technology to pick and place the objects like books and we are maintain the information in memory. They maintain records for giving books and taking books from the users. This leads time consuming, wastage paper books and also maintaining of more workers that means cost is increased. These are the drawbacks of above system.

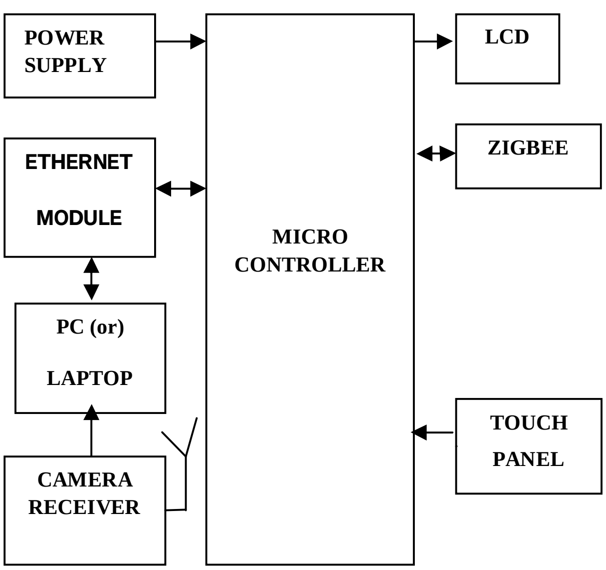

Fig.2. Monitoring Section Block Diagram

THE HARDWARE SYSTEM

Micro controller:

This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

Arm7tdmi:

ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

Ethernet:

Networking is playing vital role in current IT era where data distribution and access is critically important. As the use of communication between two or more entities increases the networking technologies need to be improved and refurbished over time.

Fig:3:LAN

Similarly the transmission media, the heart of a network, has been changed with the time improving on the previous one. If you know a little bit about networking you surely have heard the term Ethernet which is currently the dominant network technology. Wide spread of the Ethernet technology made most of the offices, universities and buildings use the technology for establishment of local area networks (LANs). To understand what actually Ethernet is, we need to know about IEEE first which is a short of Institute of Electrical and Electronics Engineers. IEEE is a part of International Organization for Standardization (ISO) whose standard IEEE 802.3 is defined for Local Area Network. The standard 802.3 commonly known as ETHERNT defines the communication standards for how data is transferred from one network device to another in a local area network. Since the limit for Ethernet cable is few hundred meters Ethernet is commonly deployed for networks lying in a single building to connect devices with close proximity. The same standard for Ethernet enables manufactures from around the earth to manufacture Ethernet products in accordance with the ISO standards that are feasible for all computing devices worldwide.

ZIGBEE:

Zigbee modules feature a UART interface, which allows any microcontroller or microprocessor to immediately use the services of the Zigbee protocol. All a Zigbee hardware designer has to do in this ase is ensure that the host's serial port logic levels are compatible with the XBee's 2.8- to 3.4-V logic levels. The logic level conversion can be performed using either a standard RS-232 IC or logic level translators such as the 74LVTH125 when the host is directly connected to the XBee UART. The below table gives the pin description of transceiver. The X-Bee RF Modules interface to a host device through a logic-level asynchronous Serial port. Through its serial port, the module can communicate with any logic and voltage Compatible UART; or through a level translator to any serial device. Data is presented to the X-Bee module through its DIN pin, and it must be in the asynchronous serial format, which consists of a start bit, 8 data bits, and a stop bit. Because the input data goes directly into the input of a UART within the X-Bee module, no bit inversions are necessary within the asynchronous serial data stream. All of the required timing and parity checking is automatically taken care of by the X-Bee's UART.

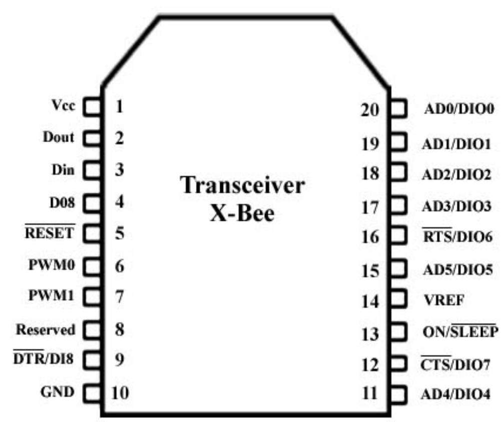

Fig.4: ZIGBEE pin diagram

PC SECTION:

Keyboards on an OEM basis to leading global PC manufacturers for use in desktop and notebook PCs and also supplies for retail keyboard OEMs.

Features:

Internal Sourcing of almost all of main Parts Almost all components - frame, key switches and membrane sheet - other than connecters and cord are manufactured in-house, giving Minebea an un-matched advantage in terms of quality, supply capabilities, cost-competitiveness and speed of delivery. Especially, these products capitalize on Minebea's ultra-precision machining technology of components. Efficient Production System Plant in China which supply's the global market employs the Minebea's vertically integrated manufacturing system, whereby all process, from machining components to final assembly are conducted in-house.

RFID:

Many types of RFID exist, but at the highest level, we can divide RFID devices into two classes: active and passive.

Active tags require a power source i.e., they are either connected to a powered infrastructure or use energy stored in an integrated battery. In the latter case, a tag's lifetime is limited by the stored energy, balanced against the number of read operations the device must undergo. However, batteries make the cost, size, and lifetime of active tags impractical for the retail trade.

Fig: 4: RFID tags

Passive RFID is of interest because the tags don't require batteries or maintenance. The tags also have an indefinite operational life and are small enough to fit into a practical adhesive label. A passive tag consists of three parts: an antenna, a semiconductor chip attached to the antenna and some form of encapsulation. The tag reader is responsible for powering and communicating with a tag. The tag antenna captures energy and transfers the tag's ID (the tag's chip coordinates this process). The encapsulation maintains the tag's integrity and protects the antenna and chip from environmental conditions or reagents.

CONCLUSION

This paper investigates the transfer of learning and population-wide synergy development for efficient performance in myoelectric controlled interfaces. The results reveal a significant learning transfer when a new control task is presented to a subject using the same mapping function as a previous control task. This gives evidence that subjects do not only learn those mappings between their actions and the control task, but they can retain this learning and generalize it to different control tasks resulting in better initial performance and control efficiency. Moreover, comparison of EMG signals for all subjects show that the signals become significantly more similar as subjects spend more time using a specific mapping function and control task. This suggests a development of population-wide synergies while learning the inverse model of a given decoder, confirming convergence towards efficient muscular control of the task-space. These two findings support the idea of the human embedded control of devices using myoelectric interfaces, which can result in a paradigm shift in the research field of neuroprosthetics. More specifically, results show that humans can be trained to control different tasks by learning new motor controls mapping directly to the control axes of the tasks (i.e. embedded control). The implications of this method are vast, since it means that myoelectric controlled interfaces can extend beyond anthropomorphic controls and user-specific decoders. Instead, humans can learn to efficiently control the interface through practice and synergy development, opening new avenues and capabilities for the intelligent control of myoelectric controlled robotic systems.

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