INTERFACING ARTIFICIAL AUTONOMICS, TOUCH TRANSDUCERS AND INSTINCT INTO REHABILITATION ROBOTICS.

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Abstract

The examples included are on going experiments in rehabilitation robotics, that relate to the integration of artificial external nervous systems, simple electronic brains, robotics and human interface. Each experiment is founded on the following basis: Each person regardless of the severity of paralysis or amputation has certain reactionary points such as eyebrow movement. They also have applicable sensory points which can be acted upon. Through adaptation, the reactionary points can be given a code which can control many functions or modes (a series of automatic functions) or provide accurate sensory feedback. Robotics can thereby return voluntary actions. It can also add the equivalent of artificial instinct which can provide automatic safety attributes. Modes can combine with the voluntary and instinctive attributes, to provide automatic features such as balancing a glass of water while constantly monitoring and obeying new commands, and surveying the surroundings. I have successfully tested the above methods.

Introduction

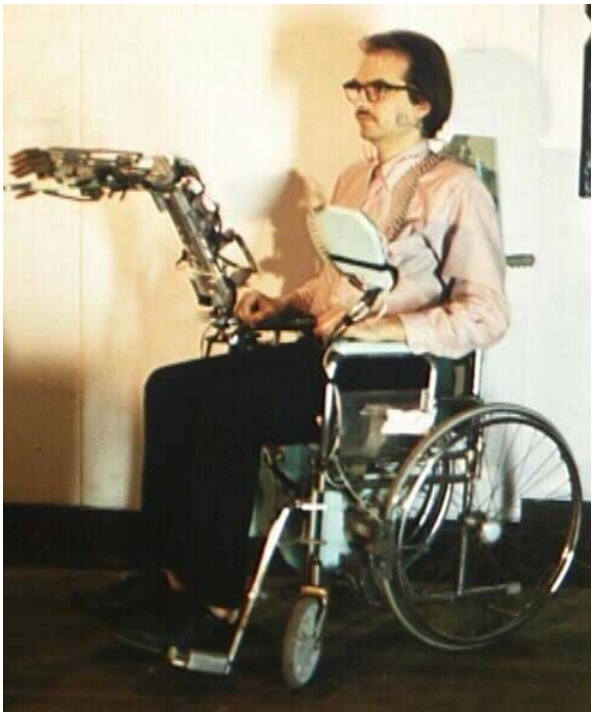
Approximately sixteen years ago I designed and diagrammed a rehabilitation device which would use a robot arm, equipped with servos, to allow a quadriplegic person to tend to some of their needs. The device had a major short coming as it was designed to react to neck movements which in many cases are not possible. I had also considered voice control, but the limitations of errors in recognition remain disconcerting. In a crowded room such errors increase to a unacceptable proportion. As years passed I developed an interest in artificial instinct. I was fascinated by the process of artificial autonomic systems and tested primitive circuits and robots which mimicked life forms. I coined the Name “Electronic Pets” to describe a variety of small and often hand held creations. Some of these were designed after common single cell animals and insects which focused mainly on reactions to touch, light and sound. Although far from sentient, each of these simple artificial creatures would relate to their environment by creating light patterns, moving or creating sounds. During these experiments I considered the possibility that many reactionary effects we consider as signs of life are actually pre-programmed instinctive responses which can be defined as the

preliminary programming data for life.

I believe that higher brain development is directly dependent on these simple built in command patterns. Although the higher functional reality of a human is paramount, the basic instinct for self preservation is ever ready to assist us. Instinct relates through many modes, most of which are linked to survival. Other levels of built in fundamentals relate to the nervous system and motor control functions. I have been designing a basic equivalent of instinct to function with artificial autonomics, which in turn interacts with the disabled. This strategy will allow people who are paralyzed to regain an additional degree of independence.

Feature Controlled Wheelchair

This experiment uses only three facial movements to utilizes fourteen functions that control a five range of motion robotic arm and a mobile wheelchair base, while relating it's status through a visual indicator console. This design is easy to control and allows multitasking. It maneuvers around a room in any direction, can pick up and move objects, and allow the user to print or draw on a vertical surface with primitive strokes. The robotic chair was created on a budget of $275.(two hundred and seventy five dollars). My limited budget forced me to try to condense it's circuits and power distribution by designing an unusual circuit which takes simple signals from sensors on a patient's face and integrates them through a matrix of wires, relays and electronics which relate Boolean logic and power distribution in both directions and on one set of common paths.



Next Phase Wheelchair

The exoskeleton design redefines the concept of earlier experiments by reconfiguring the unit to appear to fit like armor without the drive components being directly visible. As illustrated this design would reduce the bulky look associated with such concepts by housing the main servo mechanisms under the seat. Each range of motion would have both mechanical

and electronic limits to insure that hazardous over travel in a given range of motion does not occur. The design would embody the concept of an artificial motor control and instinctive reactionary system, that links to a patient's features. The non contact link will be self calibrating and designed to be as inconspicuous as possible. The sensors will work by comparing light and color absorption in relation to trajectory to track small marks on the patients features. The signal for this measurement will be oscillated at an exact frequency which will be recognized by the detector circuitry. The design also incorporates pulsed signal artificial touch.

Artificial Touch

Pulsed signal pressure can yield a sense of touch, both in location perception and intensity. My pulsed signal transducer consists of a basic 555 timer IC as an oscillator which is tuned to approx. 70 Hz. This in turn is connected to a small switching transistor which powers an electromagnetic coil and movable steel plate measuring approx. 3/8" square. Ideally the electromagnetic coil (Transducer) would be built out of electroactive polymers. Future touch transducers will be designed as arrays of tactile units placed along areas of sensitive tissue.

The simple version of the experiment cost only $10.(ten dollars) to build.

Pulsed signals are easily identified, because they generate a perceivable phase pattern, which readily converts into electrical variances in the nerve pathways. Naturally this form of pulsed artificial touch is far from normal but it is an effective and an extremely low cost method to create tactile feedback. This simple experiment was linked to my forehead and connected across a pair of eyeglasses.

Peltier junctions can also be added to this concept to allow a sense of hot and cold.

Modes

In each design the challenge in configuration is the inability of a patient to easily convey enough motion request data to the artificial system for fluid movement and quick action. To accommodate this problem, modes of operation can be designed to take care of known factors of movement relating to the surrounding environment. A mode can for example be balancing a glass of water, performing an emergency action to avoid tipping, calling for help if the patient's vital signs are questionable, calculating climbing angles for rough terrain, navigating towards an object, shaking hands, etc.

Safety

I distribute functional limitations across a robotic device to increase the chances of safe operation. For instance limits and simple logic circuits relate positions of arms and will not let them travel beyond a safe point regardless of what the main circuit board tells it to

do. I believe that robots would ideally have their “Electronic Brain” spread out across the entire robots body, freeing the main boards to imply actions rather than being the total governing discipline.

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