Voice Monitored Wheel Chair Control

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Abstract— People suffering from Parkinson's disease or from paralysis (paraplegia or quadriplegia) have the inability to move their limbs and other voluntary organs, they are dependent on someone's help to move around all the time and this makes them feel incapable and brings down their morale to survive. A solution to this becomes inevitably necessary in order to provide them with the necessary mobility and independence as they are inferior to nobody. The existing large scale manufactured versions of the wheelchair are either manually driven i.e. by the help another individual or hand driven. Paralyzed patients however do not have the ability to move their limbs but do possess the ability of speech which is the whole concept behind this voice driven wheelchair. The aim of this wheelchair is to provide a whole new platform of independent existence to these patients in the form a voice guided wheelchair. An implementation of the manufacture of this wheelchair on a large scale, the reduction of cost by simplicity in setting up and working. This will enable the wheelchair to be provided at an affordable price to the common man, this acted as another big driving force.

Key words: Microcontroller 89s52, Voice recognition system, A command microphone and Intruder sensor

I. INTRODUCTION

Voice driven system is a new wireless assistive technology which is used for handicapped people or for those who are suffering from Parkinson's diseases. Voice monitored system enables the patients to record their voice and helps them to move around without anyone's help. Voice monitored system consists of a command microphone, intruder sensor, microcontroller, voice recognition system, lcd display, dc motor, power supply and H-bridge. Command microphone will accept the commands given by the patient and transmit it to the voice recognition chip. This chip will determine the various commands given by the user and instruct the microcontroller to perform the task based on the given commands. This controller is connected with the lcd display whose main function is to display the active command. When a rectangular coil carrying current is placed in a magnetic field, a torque acts on the coil which rotates it continuously. When the coil rotates, the shaft attached to it also rotates and thus brings about the mechanical movement. This is the main function of Dc motor. H-bridge avoids the effect of back emf and current surge when the polarity of the current to the motor is changed and thus provides efficient polarity switching. Power supply is used for motor and other relay units. An intruder sensor is present in the form of an IR sensor which recognizes any obstacles present in the form of other humans, tables, chairs etc and comes to a standstill. This technology provides faster advanced smoother and more convenient control. [1]

A. Speech Recognition Circuit:

HM2007 is a single chip CMOS voice recognition LSI circuit with the on-chip analog front end, voice analysis, recognition process and system control function.

1) Initialization & Recognition process:

When the power is on HM2007 will start its initialization process. If WAIT pin is "L", HM2007 will do the memory check to see whether the external SK byte SRAM is perfect or not. If WAIT pin is "H", HM2007" will skip the memory check process. After the initial process is done, HM2007 will then move into recognition mode. In this mode, the RDY is set to low and HM2007 is ready to accept the voice input to be recognized. It is recommended that user tram the particular word pattern before the beginning of the recognition operation, otherwise the result will be unpredictable. When HM2007 receives the command RECOG, the chip will begin its recognition process. The external device will poll the status flag to monitor the operation state of HM2007.

ST1	ST0	Operating State
0	1	Ready to get voice input.
1	0	Ready to get command.
1	1	– The first nibble of the output data is available on the output buffer during cycle. – HM2007 is ready to get second nibble of the input data during a write cycle.
0	0	– The second nibble of the output data is available on the output buffer during a read cycle. – HM2007 is ready to get second nibble of the input data during a write cycle.

When the operation state is changed to (01), and WAIT pin is "L" HM2007 will be back to the operation state (10) and then ready to receive another command. When the operation state is change to (01) and WAIT pin is ~ET it is ready to get voice input and then do the recognition process. When the operation state is changed back to (10) again, then the recognition process is completed and HM2007 is ready to get another command.

2) Voice Analysis:

After the recognition process is complete, the result will appear on the D-bus with the pin DEN active.

D7 D6 D5 D4	D3 D2 D1 D0	Description
0 0 0 0	0 0 0 0	Power on
A	B	WordAB
0 1 0 1	0 1 0 1	Voice too long
0 1 1 0	0 1 1 0	Voice too short
0 1 1 1	0 1 1 1	Not match

A it the binary code in the range 0 to 4. B is the binary code in range 0 to 9. If WLEN is high, maximum word length is 1.92sec.

3) Training or clearing pattern:-

If the number key 99 is entered and the functional key clr is pressed, the entire pattern in the memory will be cleared by HM2007. If the function key TRN is pressed, HM2007 will begin its training process. For example,

2 4 TRN→ training the 24th pattern.

1 3 2 6 TRN→ training the 26th pattern.

4) System Control Function:

The CPU mode provides several functions like RECOG, TRAIN, RESULT, UPLOAD, DOWNLOAD, RESET etc. In this mode, the K-bus is used as a bi-directional data bus between the external controller and HM2007 and S1 to S3 as the R/W control pins.

Command	Code	Word #(L)	Word#(H)
RECOG	0001		
TRAIN	0010	B3 B2 B1 B0	0 0 B5 B4
RESULT	0100		
UPLOAD	0101	B3 B2 B1 B0	0 0 B5 B4
DOWNLOAD	0110	B3 B2 B1 B0	0 0 B5 B4
RESET	0111		

There are three registers in HM2007, one input buffer register, one status register and one output register. The first is a write-only register and the last two are read-only registers. If S1 pin is high, the data read from the K-bus will come from the output buffer register If S1 pin is low. the data read from the K-bus will come from the status register S2 and S3 are R W control signals If S2 is high, it's in a read cycle and the external controller can read data from the K-bus. If S3 is high, it's in a write cycle and external controller can write data into the input buffer. Note that S2 and S3 cannot be high simultaneously and the state of SI will be ignored during a write cycle. The status register reflects the current status of HM2007 for the CPU control mode.

B. Command Microphone

The basic function is to which transmit the audio signal from the microphone by radio waves to a nearby receiver unit, which recovers the audio with the help of receiver unit connected by cable.

1) System Working:

A wireless system consists of three main components: an input device, a transmitter, and a receiver. The input device provides the audio signal that will be sent to the transmitter. The transmitter handles the conversion of the audio signal into a radio signal and broadcasts it through an antenna. The antenna may stick out from the bottom of the transmitter or it may be concealed inside. The strength of the radio signal is limited by travel ranges from 100 feet to over 1000 feet, depending on conditions. All wireless transmitters require a battery (usually AA or 9- volt) to operate and the one we are using requires the 9-volt battery. The job of the receiver is to pick up the radio signal broadcast by the transmitter and change it back into an audio signal. The output of the receiver is electrically identical to a standard microphone signal, and can be connected to a typical microphone input in a sound system.

2) Training words for recognition:-

The keypad and digital display are used to communicate with and program the HM2007 chip The keypad is made up of 12 normally open momentary contact switches. When the circuit is turned on, "OCT is on the digital display, the red LED (READY) is lit and the circuit waits for a command.

Press 'T' (display will show "01" and the LED will turn off) on the keypad, then press the TRAIN key (the LED will turn on) to place circuit in training mode, for word one. Say the target word into the microphone (near LED) clearly. The circuit signals acceptance of the voice input by blinking the LED off then on. The word (or utterance) is now identified as the "01" word. If the LED does not flash, start over by pressing "1" and then "TRAIN" key. You may continue training new words in the circuit. Press "2" then TRN to train the second word and so on. The circuit will accept and recognize up to 20 words (numbers 1 through 20). It is not necessary to tram all word spaces. If you only require 10 target words that's all you need to train.

C. Microcontoller AT89S52

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of m-system programmable Flash memory T. The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines. Watchdog timer, two data pointers, three 16-bit timer/counters, a six- vector two-level intermit architecture, a full duplex serial port, on-chip oscillator, and clock circuitry.

1) Program Memory:-

If the EA pin is connected to GND, all program fetches are directed to external memory. On the AT89S52, if EA is connected to VCC, program fetches to addresses 0000H through 1FFFH are directed to internal memory and fetches to addresses 2000H through FFFFH are to external memory.

2) Watch Dog Timer:

The WDT is intended as a recovery method in situations where the CPU may be subjected to software upsets The WDT consists of a 14-bit counter and the Watchdog Timer Reset (WDTRST) SFR The WDT is defaulted to disable from exiting reset. To enable the WDT. A user must have 01 EH and 0E1H in sequence to the WDTRST register (SFR location 0A6H). When the WDT is enabled, it will increment every machine cycle while the oscillator is running The WDT timeout period is dependent on the external clock frequency. There is no way to disable the WDT except through reset (either hardware reset or WDT overflow reset) When WDT over-flows, it will drive an output RESET HIGH pulse at the RST pin.

3) UART:

Universal asynchronous receiver transmitter is one of the microcontroller features making it so powerful is an integrated UART, better known as a serial port. It is a full-duplex port, thus being able to transmit and receive data simultaneously and at different baud rates. Without it, serial data send and receive would be an enormously complicated part of the program in which the pin state is constantly changed and checked at regular intervals. When using UART, all the programmer has to do is to simply select serial port mode and baud rate. When it's done, serial data transmit is nothing but writing to the SBUF register, while data receive represents reading the same register. The

microcontroller takes care of not making any error during data transmission.

4) Programmable Clock Out:-

A 50% duty cycle dock can be programmed to come out on P1.0, as shown in figure. This pin besides being a regular I/O pin, has two alternate functions It can be programmed to input the external clock for Timer/Counter 2 or to output a 50% duty cycle clock ranging from 61 Hz to 4 MHz (for a 16-MHz operating frequency).To configure the Timer/Counter 2 as a clock generator, bit C/T2 (T2CON.1) must be cleared and bit T20E (T2MOD.1) must be set. Bit TR2 (T2CON.2) starts and stops the timer.

$$\text{Clock-Out Frequency} = \frac{\text{Oscillator Frequency}}{4 \times [65536-(\text{RCAP2H,RCAP2L})]}$$

5) Interrupts:-

The AT89S52 has a total of six interrupt vectors two external interrupts (INT0 and INT1), three timer interrupts (Timers 0, 1, and 2), and the serial port interrupt. These interrupts are all shown in figure. Each of these interrupt sources can be individually enabled or disabled by setting or clearing a bit in Special Function Register IE. IE also contains a global disable bit, EA, which disables all interrupts at once. Note that Table shows that bit position IE.6 is unimplemented. User software should not write a 1 to this bit position, since it may be used in future AT89 products. Timer 2 interrupt is generated by the logical OR of bits TF2 and EXF2 in register T2CON. Neither of these flags is cleared by hardware when the service routine is vectored to. In fact, the service routine may have to determine whether it was TF2 or EXF2 that generated the interrupt, and that bit will have to be cleared in software. The Timer 0 and Timer 1 flags, TF0 and TF1, are set at S5P2 of the cycle in which the timers overflow. The values are then polled by the circuitry in the next cycle. However, the Timer 2 lag,TF2, is set at S2P2 and is polled in the same cycle in which the timer overflows.

(MSB) (LSB)

EA	–	ET2	ES	ET1	EX1	ET0	EX0

Enable Bit = 1 enables the interrupt.
Enable Bit = 0 disables the interrupt.

Symbol	Position	Function
EA	IE.7	Disables all interrupts. If EA = 0, no interrupt is acknowledged. If EA = 1, each interrupt source is individually enabled or disabled by setting or clearing its enable bit.
–	IE.6	Reserved.
ET2	IE.5	Timer 2 interrupt enable bit.
ES	IE.4	Serial Port interrupt enable bit.
ET1	IE.3	Timer 1 interrupt enable bit.
EX1	IE.2	External interrupt 1 enable bit.
ET0	IE.1	Timer 0 interrupt enable bit.
EX0	IE.0	External interrupt 0 enable bit.
User software should never write 1s to reserved bits, because they may be used in future AT89 products.		

Fig. 1: Interrupts

D. 1111

An LCD is a small, low cost display. It is easy to interface with a micro-controller because of an embedded controller(the black blob on the back of the board). This controller is standard across many displays (HD 44780) which means many micro-controllers (including the Arduino) have libraries that make displaying messages as easy as a single line of code. There is a two line display provided on the Microcontroller board which displays the command which is active at that moment.

1) System Interface:

This chip has both kinds of interface type with MPU: 4-bit bus and 8-bit bus.4-bit bus and 8-bit bus are selected by the DL bit in the instruction register. During read overwrite operation, two 8-bit registers are used. One is the data register (DR), and the other is the instruction register (IR).The data register (DR) is used as a temporary data storage place for being written into or read from DDRAM/CGRAM. The target RAM is selected by RAM address setting instruction. Each internal operation, reading from or writing into RAM, is done automatically. Thus, after MPU reads DR data, the data in the next DDRAM/CGRAM address is transferred into DR automatically. Also, after MPU writes data to DR, the data in DR is transferred into DDRAM/CGRAM automatically. The Instruction register (IR) is used only to store instruction codes transferred from MPU. MPU cannot use it to read instruction data. To select a register, you can use RS input pin in 4-bit/8-bit bus mode.

2) Operations to RS and RW:-

Various kinds of Operations according to RS and R/W bits.

RS	R/W	Operation
L	L	Instruction Write operation (MPU writes Instruction code into IR)
L	H	Read Busy flag(DB7) and address counter (DB0 to DB6)
H	L	Data Write operation (MPU writes data into DR)
H	H	Data Read operation (MPU reads data from DR)

3) LCD Driver Circuit:

LCD Driver circuit has 16 common and 40 segment signals for LCD driving. Data from CGRAM/CGROM is transferred to a 40-bit segment latch serially, and then is stored to 40-bit shift latch. When each common is selected by 16-bit common register, segment data is also output through segment driver from a 40-bit segment latch.In case of 1-line display mode, COM1 to COM8 have 1/8 duty or COM1 to COM11 have 1/11 duty, and in 2-line mode, COM1 to COM16 have a 1/16 duty ratio.

E. Power Supply:

1) Factors kept in mind while choosing:

- The amount of voltage and current it can supply to its load.
- How stable its output voltage or current is under varying line and load conditions.
- How long it can supply energy without refueling or recharging (applies to power supplies that employ portable energy sources).
- How economic the power supply unit thus chosen is.

2) Step Down Transformer:

In our circuit the transformer of 230V/15-O-15V is used to perform the step down operation where a 230V AC appears as 15V AC across the secondary winding. iteration of input causes the top of the transformer to be positive and the bottom negative. The next alteration will temporarily cause the reverse. The current rating of the transformer used in our project is 2A. Apart from stepping down AC voltages, it gives isolation between the power source and power supply circuitries.

3) Rectifier Unit:

A commonly used circuit for supplying large amounts of DC power is the bridge rectifier. A bridge rectifier of four

diodes (4*IN4007) are used to achieve full wave rectification. Two diodes will conduct during the negative cycle and the other two will conduct during the positive half cycle. The DC voltage appearing across the output terminals of the bridge rectifier will be somewhat less than 90% of the applied RMS value. Normally one alteration of the input voltage will reverse the polarities. Opposite ends of the transformer will therefore always be 180 deg out of phase with each other.

For a positive cycle, two diodes are connected to the positive voltage at the top winding and only one diode conducts. At the same time one of the other two diodes conducts for the negative voltage that is applied from the bottom winding due to the forward bias for that diode. In this circuit due to positive half cycle Dl& D2 will conduct to give 10.8v pulsating DC. The DC output has a ripple frequency of 100Hz. Since each altercation produces a resulting output pulse, frequency = 2*50 Hz. The output obtained is not a pure DC and therefore filtration has to be done.

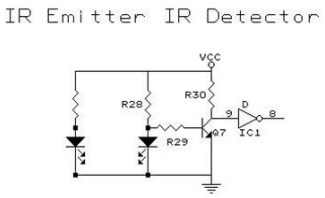
4) Voltage Regulators:-

The voltage regulators play an important role in any power supply unit. The primary purpose of a regulator is to aid the rectifier and filter circuit in providing a constant DC voltage to the device. Power supplies without regulators have an inherent problem of changing DC voltage values due to variations in the load or due to fluctuations in the AC liner voltage. With a regulator connected to the DC output, the voltage can be maintained within a close tolerant region of the desired output. IC7812 and 7912 is used in this project for providing +12V and -12V DC Supply.

F. Intruder Sensor:-

As we all know the partially or fully paralyzed patients are very slow and weak they cannot react to situations instantly therefore in this project we require sensors to sense obstacles like walls. doors, other human beings in the proximity of the wheelchair so that it can stop wheelchair stops automatically when there is an obstacle and accidents can be avoided. It also gives enough time for the patient to react. We use an IR EMITTER-DETECTOR as an intruder sensor.

1) Infrared Sensor:-



Typical materials used for emitters include GALLIUM ARSENIDE and GALLIUM ALUMINUM ARSENIDE, among others. When a forward bias current flows through the emitter's P-N junction, photons are emitted. The total output power ts a function of the forward current, and is measured in mW. Likewise, the axial radiant intensity of an emitting device, which is the portion of the total emitted power radiated within, a specified cone angle directly on axis, is also a function of this forward current and is measured in mW per steradian. Here we are using a current limiting resistor to safeguard I.R.EMITTER as well as to produce enough rays density, which is necessary to drive I.R. DETECTOR. We have used IK. resistor from 5V dc to the I.R. EMITTER to restrict current flow beyond 5mA. Even though I.R EMITTER can withstand up to 35mA, we have used 5mA due to shortest Stance. If the distance is more we have to increase the current flow to the emitter. Beyond the limitation of I.R. EMITTER can be achieved by using additional lenses (OPTICALSYSTEM) in front of the emitter.

2) Detectors:

This device stands as a classic circuitry, photo-optic technology; high voltage solid, physics and field effect transistor (FET) technology are all incorporated on a monolithic integrated circuit chip inside this device.

Future trends point to even higher performance characteristics and more circuit integration in photo detectors. Detectors, are like emitters, are available in plastic and in lenses metal packages. These holes w i l l align the IR-rays to pass through them to the detector. The other rays from the Emitters are not allowed to incident on the detector. Whenever the IR rays flow through the whole the corresponding output at that location is low, otherwise it is in the high state.

Flow of current = SV/IK =5mA.

G. Relays:

Relays are electromagnetic switches, which provide contact between two mechanical elements. Relays have a coil which works on 12V dc power supply and provides DPDT action as an output. In general relays provide potential free contacts which can be used for universal function like DC, AC voltage switching and to control bigger electrical switch gears.

1) Function:

It is a solid state relay where a small control signal (a binary output from the microcontroller) controls a larger load current or voltage. It consists of a sensor which responds to an appropriate input (control signal), a solid-state electronic switching device which switches power to the load circuitry, and some coupling mechanism to enable the control signal to activate this switch without mechanical parts. The relay may be designed to switch either AC or DC to the load. It serves the same function as an electromechanical relay, but has no moving parts. The control signal must be coupled to the controlled circuit in a way which isolates the two circuits electrically. Many SSRs use optical coupling. The control voltage energizes an LED which illuminates and switches on a photo-sensitive diode (photo-voltaic); the diode current turns on a back-to-back thyristor, silicon controlled rectifier, or MOSFET to switch the load. The optical coupling allows the control circuit to be electrically isolated from the load.

A SSR based on a single MOSFET, or multiple MOSFETs in a paralleled array, works well for DC loads. MOSFETs have an inherent substrate diode that conducts in the reverse direction, so a single MOSFET cannot block current in both directions. For AC (bidirectional) operation two MOSFETs are arranged back to back with their source pins tied together. Their drain pins are connected to either side of the output. The substrate diodes are alternately reverse biased to block current when the relay is off. When the relay is on, the common source is always riding on the instantaneous signal level and both gates are biased positive relative to the source by the photo-diode.

H. H-bridge:

An H bridge is an electronic circuit that enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards and backwards. H bridges are available as integrated circuits, or can be built from discrete components.

1) Operation of H-bridge:-

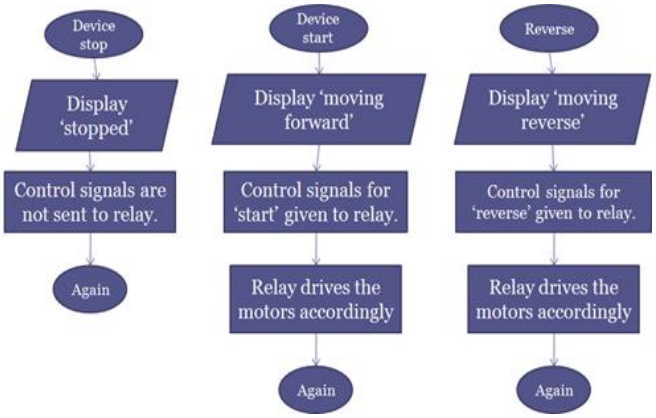
As we all know that the wheel chair has to move in different direction i.e. left, right, forward, reverse etc .These can be achieved by changing the direction of the current flowing to the motors. But sudden change in the polarity of the current causes back emf to flow through the circuit and as a result current surge takes place this can be effectively avoided with the help of H-Bridge.

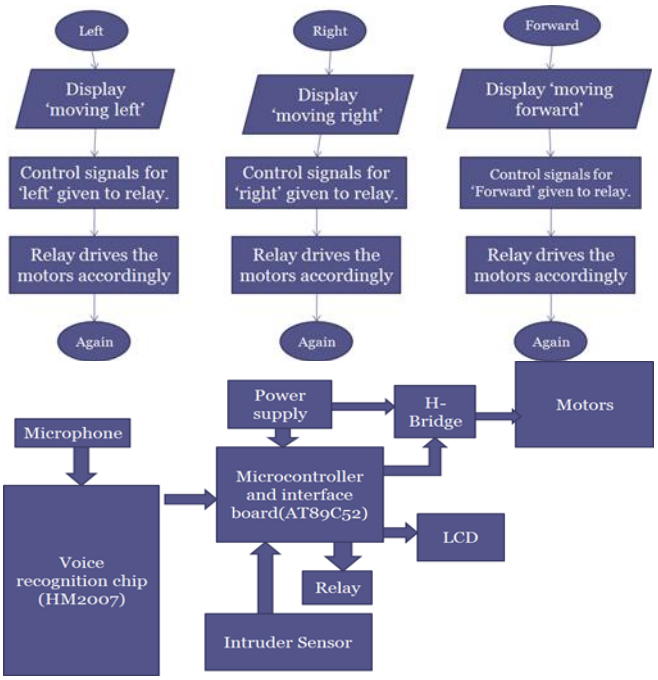
The H-bridge arrangement is generally used to reverse the polarity of the motor, but can also be used to 'brake' the motor, where the motor comes to a sudden stop, as the motor's terminals are shorted, or to let the motor 'free run' to a stop, as the motor is effectively disconnected from the circuit. The following table summarizes operation, with S1-S4 corresponding to the diagram above.

S1	S2	S3	34	Result
1	0	0	1	Motor moves right
0	1	1	0	Motor moves left
0	0	0	0	Motor free runs
0	1	0	1	Motor brakes
1	0	1	0	Motor brakes

II. CONCLUSION

This project enables physically challenged persons like paralytic patients or physically disabled patients or patients having acute diseases like Parkinson's disease. The particular project is useful for the patients where they can move their wheelchair at their own will or command, without any third party's help or support. The sufficient safety measures such as personalized voice recognition, intruder sensor to detect obstacles, and sufficient (slow) response time being the highlights. It can be practically implemented at an affordable price of 30,000(rough estimation). Thus it empowers the disabled and builds confidence in them.





REFERENCES

[1] D.A. Bell, S.P. Levine, Y. Koren, L.A. Jaros and J. Borenstein "Design Criteria For Obstacle Avoidance in a Shared-Control System", RESNA'94, Nashville, 1994.

[2] T. Gomi and K. Ide, "The Development of an Intelligent Wheelchair". In Proceedings IVS'96, Tokyo, Japan, September 1996.

[3] Rory A. Cooper, Intelligent Control of Power Wheelchairs, IEEE Engineering in medicine and Biology, 0739-51 75/95, July 1995.

[4] S.K. Pal, S. Mitra: Neuro-fuzzy ―Pattern Recognition: Methods in Soft Computing, John Wiley and Sons, NY, USA, 1999.

[5] J.Z. Yi, Y.K. Tan Z.R. Ang, "Microcontroller Based Voice-Activated Powered Wheelchair Control", ACM publishers, 2007.

[6] Rabiner L. R., "A Tutorial on Hidden Markov Models and Selected Applications in Speech Recognition"

[7] Munro, Jay. "Watch What You Say." PC Magazine Online. March 10, 1998. http://www.zdnet.com/pcmag/features/speech/intro1.html (23 October 1998).

[8] C. Chandramouli and Vivek Agarwal," Speech Recognition based Circuit for the Quadriplegics, Paraplegics, Paralytics and Amputees", ACM publishers.

