Voice Controlled Vehicle

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Abstract: The aim of this paper is to describe a speech recognition hardware. The implementation of this algorithm with an DSP allow to design and construct a vehicle that can be fully controlled from human generated sounds.

Keywords: Speech recognition, DSP, voice controlled vehicle.

1. INTRODUCTION

The results obtain in the speech recognition had leading to application in drive system. Because the speech recognition domain is very interesting we have decided to make a project with this theme. Our application consist in fully controlled by human sounds.

The most suitable for this application is DSP. The vehicle can receive commands to go forward, to left or right and to stop.

Limited by the memory size and the power of computing we decided to use the simple sound speech recognition algorithm (see block diagram in figure 1).

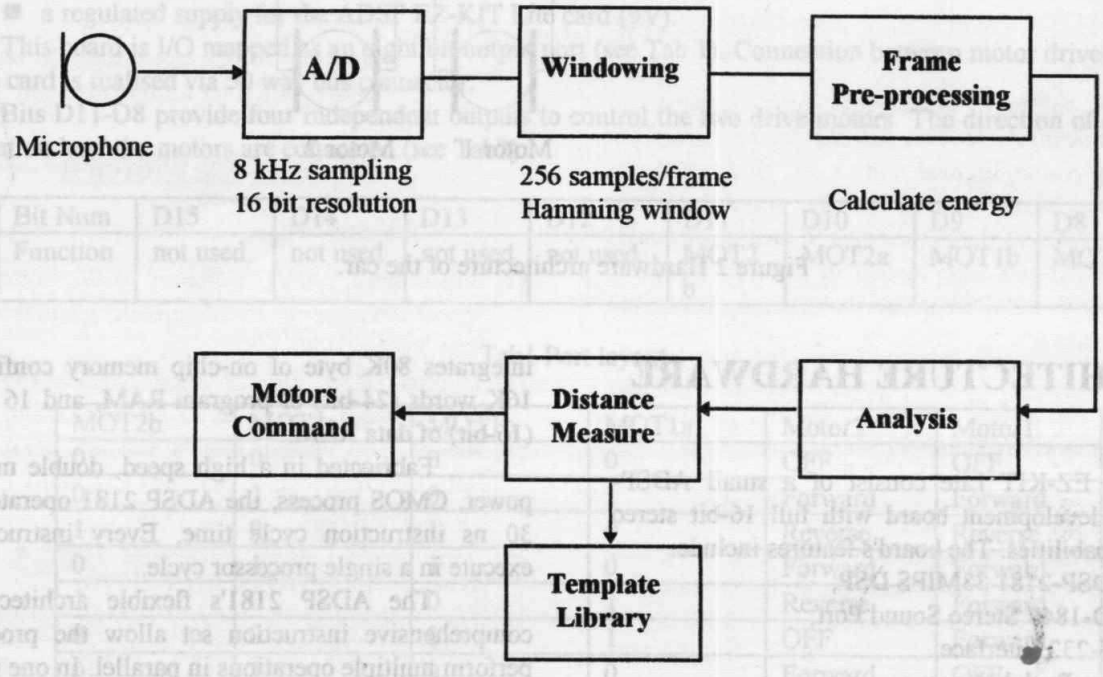

Figure 1 Block diagram of speech recognition algorithm.

2. VEHICLE HARDWARE

Overview: The vehicle will comprise of a pair geared dc motors to provide propulsion and steering, a microphone to monitor any sound, a EZ-KIT Lite board to process and analyse these sounds and a motor card to provide adequate power for the motors. Six 1.5 volt AA batteries will provide the power source. The hardware architecture is show in figure 3.

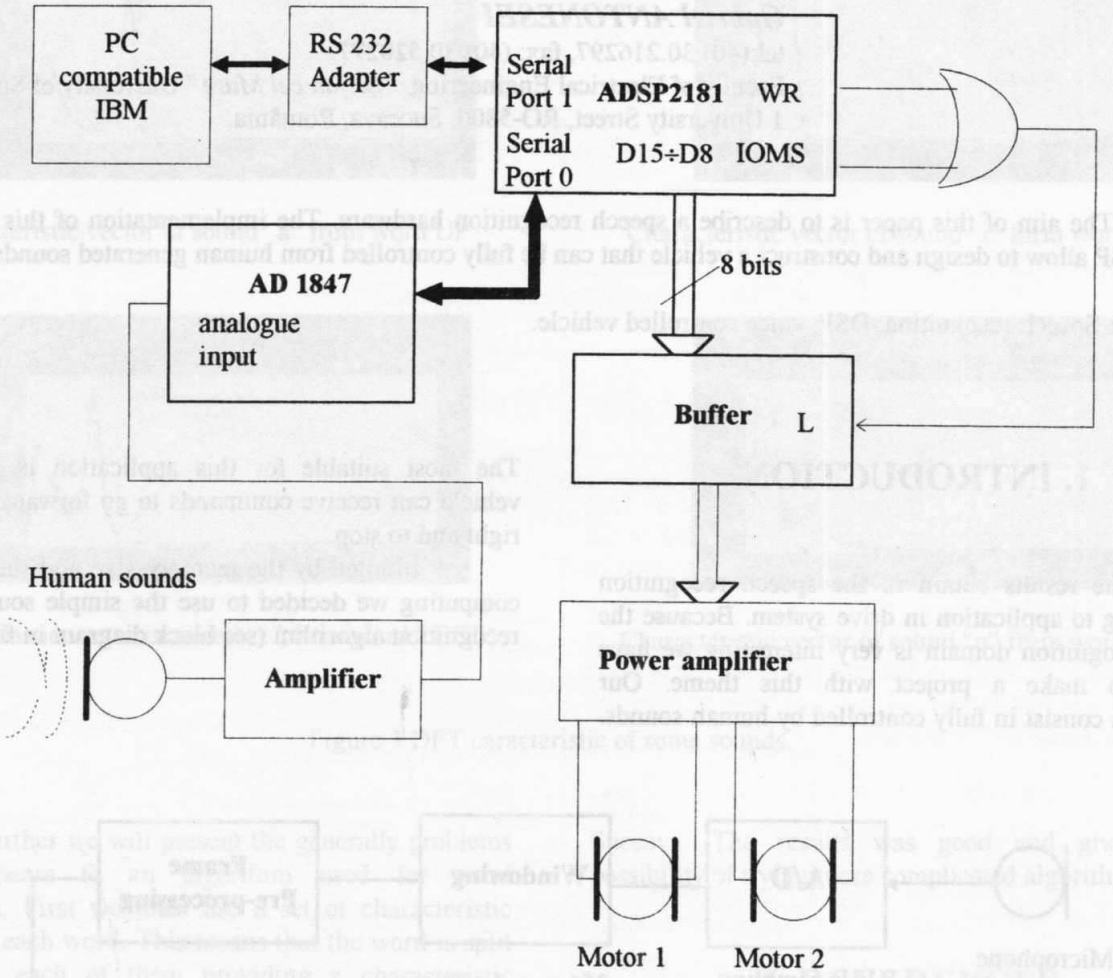

Figure 2 Hardware architecture of the car.

3. ARCHITECTURE HARDWARE

The EZ-KIT Lite consist of a small ADSP-2181 based development board with full 16-bit stereo audio I/O capabilities. The board's features include:

- ADSP-2181 33MIPS DSP;
- AD-1847 Stereo Sound Port;
- RS-232 Interface;
- User Push buttons;
- Expansion Connector.

The ADSP-2181 is a single-chip microcomputer optimised for digital signal processing and other high speed numeric processing applications. It integrates 80K byte of on-chip memory configured as 16K words (24-bit) of program RAM, and 16 K words (16-bit) of data RAM.

Fabricated in a high speed, double metal, low power, CMOS process, the ADSP 2181 operates with a 30 ns instruction cycle time. Every instruction can execute in a single processor cycle.

The ADSP 2181's flexible architecture and comprehensive instruction set allow the processor to perform multiple operations in parallel. In one processor cycle the ADSP 2181 can:

- generate the next program address;
- fetch the next instruction;
- perform one or two data moves;

- update one or two data address pointers;
- perform a computational operation.

The AD1847 integrates key audio data conversion and control function into a single integrated circuit. Dynamic range exceeds 70 dB over the 20 kHz audio band. Sample rates from 5.5 to 48 kHz are supported from external crystal. The sample rates in our program is 8 kHz. We need to build two others board: microphone adapter board and motor drive board. This two boards are used to interface the microphone and the motors with EZ-KIT Lite board.

Microphone board its a simply amplifies the input from the microphone to a suitable level for the codec input of the EZ-KIT Lite board. The schematic of this board is show in figure 4.

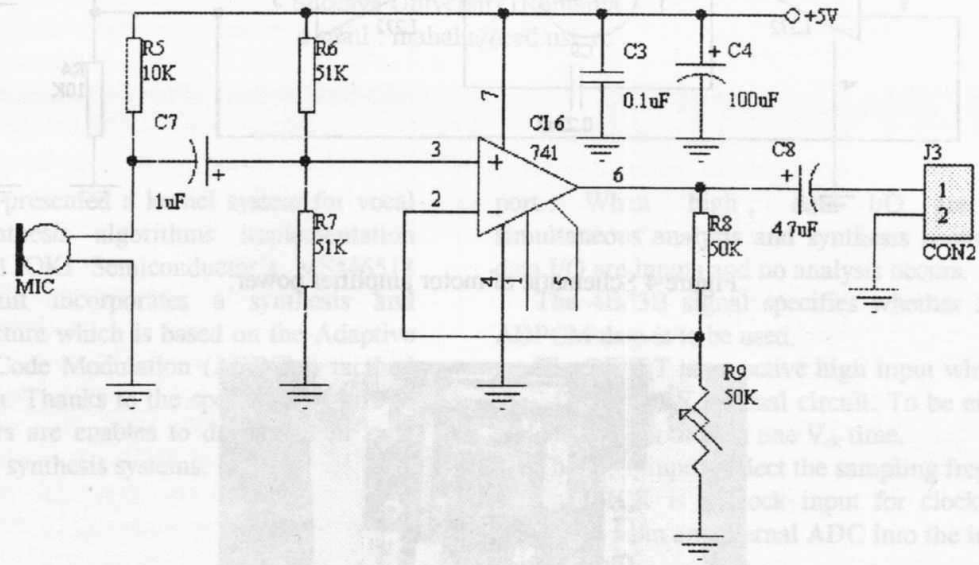

Figure 3 Schematic of microphone ampifier.

The motor drive card is a custom made board for the vehicle project and provides the following facilities:

- four high current outputs (6V @ 500mA) to control the two drive motors;
- a regulated supply for the microphone board (5V);
- a regulated supply for the ADSP EZ-KIT Lite card (9V).

This board is I/O mapped as an eight bit output port (see Tab 1). Connection between motor drive card and EZ-KIT Lite card is realised via 50 way bus connector.

Bits D11-D8 provide four independent outputs to control the two drive motors. The direction of each motor is dependent on how the motors are connected (see Tab2).

Bit Num	D15	D14	D13	D12	D11	D10	D9	D8
Function	not used	not used	not used	not used	MOT2b	MOT2a	MOT1b	MOT1a

Tab1 Port layout.

MOT2b	MOT2a	MOT1b	MOT1a	Motor2	Motor1
0	0	0	0	OFF	OFF
0	1	0	1	Forward	Forward
1	0	1	0	Reverse	Reverse
0	1	1	0	Forward	Forward
1	0	0	1	Reverse	Forward
0	0	0	1	OFF	Forward
0	1	0	0	Forward	OFF
1	1	1	1	Brake	Brake

Tab.2 Pins used for direction of motors.

The command of the motors was implemented with operational amplifier which able to support 1A on its output (L272, SGS Thomson), like in figure 5.

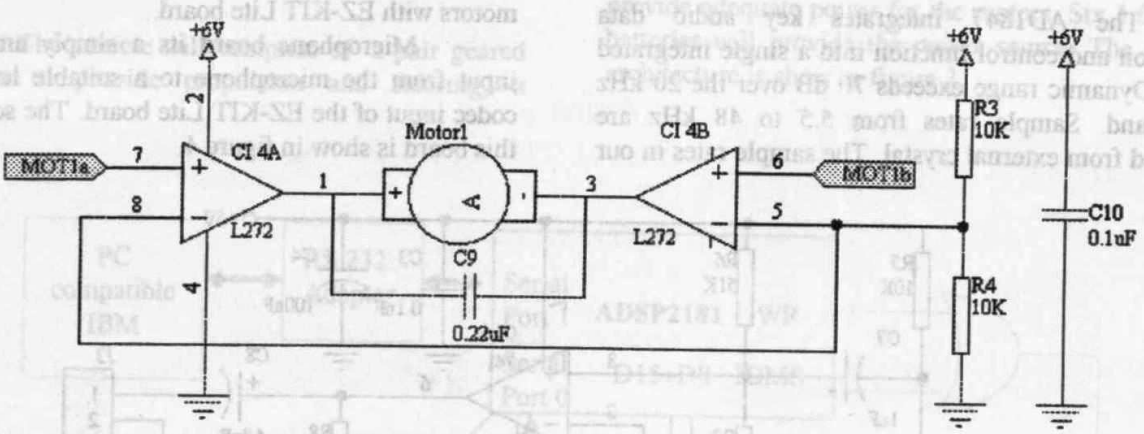

Figure 4 Schematic of motor amplifier power.

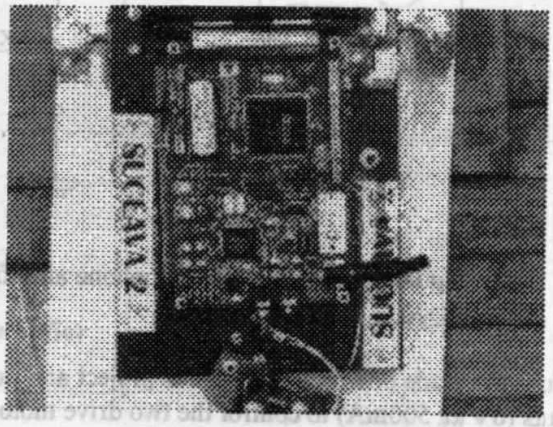

Figure 5 Photography of the car.

The software application was written in assembler language. A very useful feature was the possibility to communicated with a PC through serial port. Also we take advance of the simulator tools provided the EZ-KIT Lite. The object code program is realised with PC and then loaded in the DSP program memory through serial port. The photography of the car is show in figure 6.

4. CONCLUSIONS

The presented speech recognition algorithm and hardware a was implemented on an fully controlled by human sounds vehicle realised in the Digital Signal Processing Laboratory of Electrical Engineering Department from Suceava. The results was good and give us the possibility of trying more complicated algorithms.

5. REFERENCES

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