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Microcontroller's Applications in Driving of Industrial Robots

Microcontrollers and microprocessors are distinct in that, to be able to use a microprocessor, one has to integrate peripheral components like memory chip or data transmitters-receivers, while microcontrollers have integrated all the necessary components for an autonomous operation. There is no need for additional external part because all the required ones are already incorporated in microcontroller's capsule. Thus using microcontrollers on device construction it can be saved time and space, in terms of geometrical dimensions. The present paper describes an application regarding driving and controlling a automatic guided vehicle using microcontrollers. The kinematic curvature is performed using two guiding wheels that have immobile shafts and distinct velocities.

Keywords: *microprocessor, microcontroller, robots, programming, advantages*

1. Introduction

A microcontroller is a computer that includes a central processing unit (CPU), a program memory (ROM) and an operating memory (RAM), standard configurable interfaces (I/O), timer and interruptions controller.

PIC nomenclature origins from English language: "Peripheral Interface Controller„ and comes from initial purpose of the reason these circuits were, as a smart interface for 16 bit central processing units with great calculus capacity. Microcontrollers PIC are part of RISC class meaning Reduced Instruction Set Computer. Instruction set has around 35 instructions (usually 37). These are used on a large scale duet o the advantages they bring compared to microprocessors:

- They have a lower cost;
- They are easy to programme and re - programme, (all PC that have an internal flash memory can be reprogrammed);

- They are fast enough;
- The programming is made using simple or more complex programming languages.

The programmes designated for microcontrollers are written using assembly languages, where numeric codes are replaced by mnemonic codes. For the microcontroller to be able to run these programmes they must be translated into machine code. This is made using the assembler programme and the translated programme is called source, while the result is called the object programme. Further on the microcontroller used on the application and designed by Microchip Company, PIC 16F877 will be described.

2. PIC 16F877 Microcontroller

Microchip Company designs it and has the internal architecture shown in figure 1.

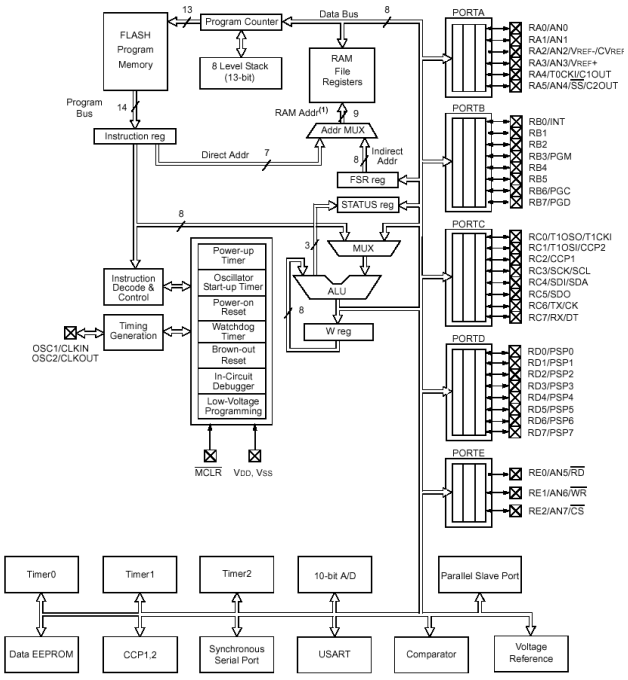

Figure 1. Internal architecture of PIC 16F877 microcontroller

The internal architecture is minimal and has some representative attributes:

- is build in Harvard structure, meaning that the programme memory and data memory are separate;
- has a small RAM space capacity, usually 256 KB ;
- has a single registry – WorkRegister ;
- has 5 I/O ports;
- Programme memory is on FLASH support;
- has a single CTC circuit and a Watchdog timer;
- has EEPROM data memory;
- memory for stack space is built hardware

In fig.2 is shown the block diagram of a PIC 16F877 microcontroller.

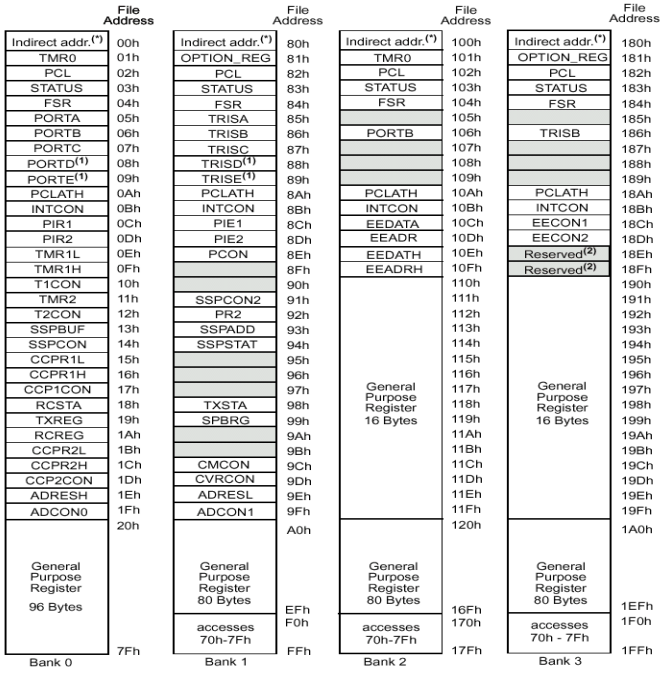

Figure 2. Organization of internal records PIC 16f877

Specific to PIC microcontrollers is the fact that all the instructions are performed in one cycle, except for the conditioned jump instructions. For this case two cycles are needed, the second one being performed as an NOP (No Operation). When a 4 MHz extern oscillator is used an instruction is ran in a 1 μs cycle and a jump instruction is ran in a 2 μs cycle.

3. Designing the guiding system of a automatic guided vehicle using PIC 16F877 microcontrollers

To illustrate the way a PIC 16 F 877 microcontroller can be used the guiding system of a automatic guided vehicle has been designed. The mobile robots, automatic guided vehicles, are automatic guided vehicles, being an advanced mode of transport and handling parts and subassemblies. Automatic guided vehicles follow a guidance path and are driven by a microprocessor or a microcontroller. Usually the automatic guided vehicles are able to move transversal or longitudinal, both ways.

3.1 The guidance system of an automatic guided vehicle made by the PIC 16F877

Automatic guided vehicle was performed on a platform-type chassis, equipped with two DC motors, wheels, battery (accumulator), two gear reducers, electric power for the motors and the electronic control management, equipped with PIC 16F877 microcontroller. The automatic guided vehicle is autonomous in terms of energy supply. The automatic guided vehicle self guided, by pursuing a white stripes made on the work surface. White stripe is tracked using infrared sensors (see figure 3, 4, 5,).

Figure 3. Platform-type chassis

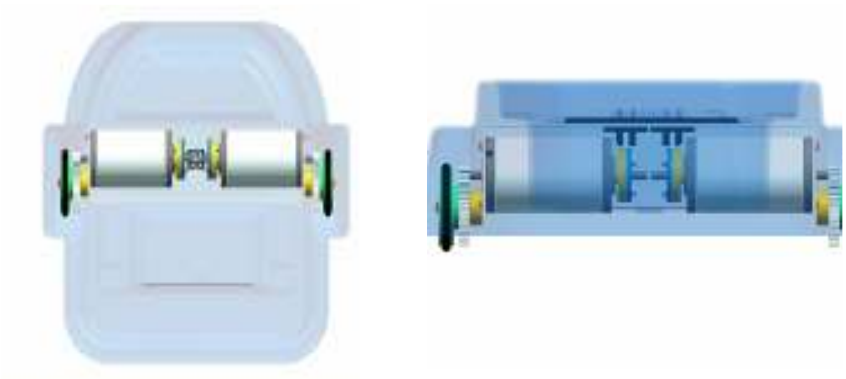

Figure 4. Platform with DC motors reducers

Figure 5. Platform with DC motors reducers and battery

3.2 The mechanical part of automatic guided vehicle

Chassis platform is equipped with a plastic housing emergency switch, the battery power socket, two independent DC motors, battery, and gear reducers. For greater stability, the platform is provided with three sets of slip, placed so that its wheels touch the ground. Steering control (the path) is achieved by difference of wheel angular velocity (each wheel respectively), and thus the automatic guided vehicle seeks white line drawn on the work surface.

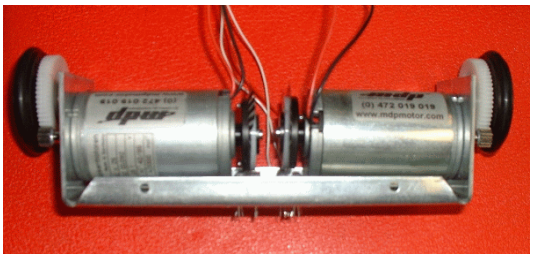

Figure 6. DC motors with gear

3.3 The electric and electronic part

DC motors operating through reduction gears with roller gear, each one is driven by a circuit equipped with PIC 16F877 (see Fig.4, and Fig.7 5.6) The infrared sensor detects the line of white color, 4 cm wide and transmits the information encoded on 5 bits to a control circuit realized with PIC 16F877 microcontroller, on the entry port TRIS A. This circuit examines each bit on Port TRIS A and according to the truth-value, 1 or 0 processes the information. It is used a control algorithm, which leads the two DC motors by PWM technique, see figure 7, 8, 9.

Figure 7. DC current regulators card

Figure 8. Current regulators and control

3.4. Control Program

Control program was written in assembler program and for testing and loading of microcontrollers, it is used software provided by the company Microchip MPLAB.

3.5. Operation guidance of automatic guided vehicle, led by the PIC 16F877

Current regulators and control card The operating principle is based on signals received from the infrared sensors at the bottom of the automatic guided vehicle platform. The five sensors are located on the middle shelf, top guide strip. If all five are on tape sensor guidance infrared radiation emitted by the diode is reflected by the white band to photo transistor sensor. They transmit signals 1 logic, on a port A TRIS to microcontroller. If all the bits of the entry port TRIS are on logic 1, then the command circuit does not change when the angular speed of DC motors and the automatic guided vehicle is running on a straight path. When one of the sensors is no longer above, the white band the phototransistor does not receive any longer, infrared radiation emitted by the diode will send to the microcontroller a 0 logic signal. Control algorithm continuously examines the five-bit value test and decides to change the angular speed of one engine. Thus, the difference in angular velocity of driving wheels is realized the automatic guided vehicle transfer, which will follow the white band. Control circuit realizes DC motor control by PWM method. The sending of control signals from command circuit to the motors circuits is realized on two wires through USART serial protocol.

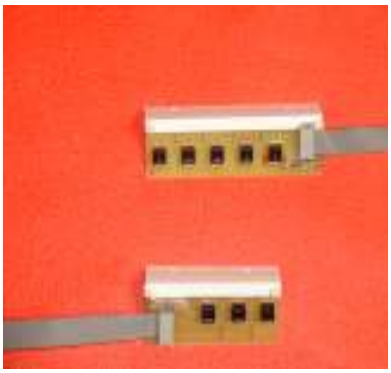

Figure 9. Infrared sensors

Figure 10. Development kit MPLAB

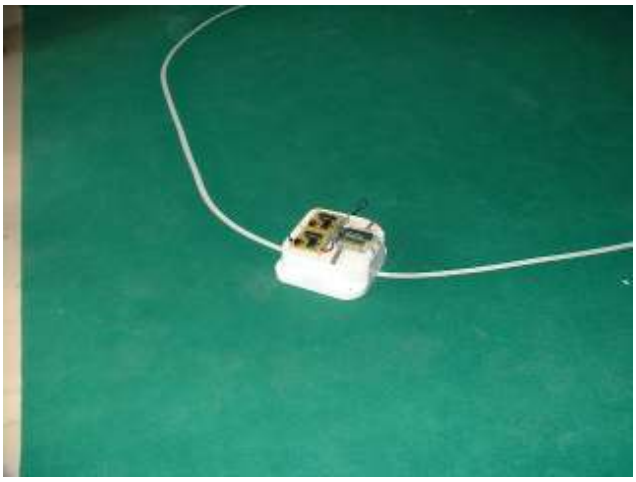

Figure 11. Automatic guided vehicles in movement

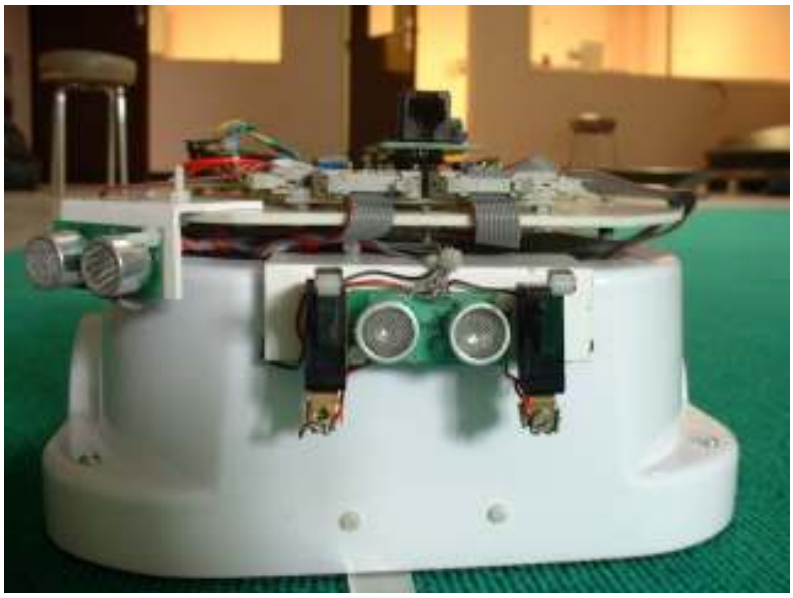

Figure 12. Automatic guided vehicles equipped with microcontroller PIC 16F877

Figure 13. Automatic guided vehicles equipped with microcontroller PIC 16F877

4. Conclusions

Using microcontrollers in leadership and automatic guided vehicles command has some advantages over the use of microprocessors:

- Lower prices compared to microprocessors microcontrollers;

- Microcontrollers do not require other peripherals;

- Simple programming language;

- Reduced number of instructions (RISC technology);

- Printed wiring simplicity to use microcontrollers;

- Quickly troubleshoot programming language programs because of its simplicity.

Disadvantages are:

- Microcontrollers can be used for small and medium-complexity algorithm for management of industrial robots

-The microcontroller clock frequencies are reduced compared with clock frequencies of microprocessors, processing speed is lower.

Using microcontrollers in automatic guided vehicle command and general of industrial robots is required where operations performed by robots are less complex or medium. Future studies of the authors will focus on simplifying control and management programs for industrial robots for greater use of processing capacity of microcontroller. This can achieve significant cost reductions in manufacturing industrial robots.References

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