

Steffen Block

Digital control methods for a line following robot

Bachelor Thesis

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ii ABSTRACT

The project aim was to build a robot, controlled by a PIC microcontroller to follow a line completely autonomously and as quickly as possible. The robot meets the requirements from the “RoboRama Contest” (www.dprg.com), followed a T-shape course, and obtained more (safety) features. Different kinds of design features and digital algorithms were developed and tested, in order to achieve the best results.

Applied project management techniques and used key skills, guaranteed the successful completion of the project, in the design and construction of hardware and software technologies.

The hardware was based on a block structure with infrared sensors at the front of the vehicle. Their analogue signals were transferred to digital logic with a comparator. This information used a PIC 16F84A microcontroller to control the movement and direction of the robot with pulse width modulation (PWM). All parts were mounted on a chassis, implemented with a mechanical construction set. Batteries of 9V provided the necessary power supply.

Adjustments were done through iterative steps, to come to the final result of the robot system. The main adapted design feature was the motor and steering system. First of all a separate servomotor for the steering and a single DC motor for the forward movement was fixed. Through implemented and first testing steps, this resolution lacked the required performance. Hence, the design changed to two DC motors, which offered a satisfactory solution.

The electronic circuit was designed with the computer aided design tool Proteus and executed as a strip line board.

The software algorithm development started with the truth table to reduce the possible events from thirty-two to the eleven applied conditions. The generated flowchart gave the program a structure and applied the truth table decision in different PWM generations. Finally, the software was written in assembler language and implemented on the PIC.

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Steffen Block

iv **LIST OF FIGURES**

<i>Figure number by chapter: Name of figure</i>	<i>Page</i>
Figure 1.1 Robot T- Course.....	4
Figure 3.1 General block structure	10
Figure 3.2 Sensor reflection principle	11
Figure 3.3 OPD 704 housing and connections	12
Figure 3.4 Comparator LM 339 schematic	14
Figure 3.5 Transistor TIP 31A connections in the TO-220 housing.....	14
Figure 3.6 PIC pins connection	15
Figure 3.7 PIC Oscillator / Resonator connection.....	17
Figure 3.8 Servomotor.....	21
Figure 3.9 DC motor with multi ratio gearbox.....	24
Figure 3.10 Used flow chart symbols.....	29
Figure 3.11 General flowchart	31
Figure 3.12 Flowchart Sensor input decisions	32
Figure 3.13 Flowchart PWM generation and time loop.....	34
Figure 3.14 Header of the program	35
Figure 3.15 Basic beginning of each assembler code	36
Figure 3.16 Bank switching to configure the I/O ports.....	37
Figure 3.17 Start of main program and obstacle stop	37
Figure 3.18 Sensor input decision	38
Figure 3.19 Added sensor input decision	38
Figure 3.20 PWM generation	40
Figure 3.21 Decision for fast or slow	40
Figure 3.22 Time loop	41
Figure 3.23 MPLAB surface	43
Figure 3.24 1 st toolbar	43
Figure 3.25 2 nd toolbar	44
Figure 3.26 3 rd toolbar.....	44
Figure 3.27 Special function register window	46
Figure 3.28 Stopwatch window.....	46
Figure 3.29 Edit project files window	47
Figure 3.30 MPLAP Project / Handling of the data files	48

Figure 3.31 PICSTART Plus device programmer / Device specifications configuration bits.	50
Figure 4.1 Block Structure with servo – motor and DC – motor	51
Figure 4.2 Implemented block structure with servo – motor and DC – motor	52
Figure 4.3 Block Structure with two DC – motors	53
Figure 4.4 Implemented block structure with two DC – motors.....	54
Figure 4.5 Circuit schematic / Sensor and comparator	56
Figure 4.6 Circuit schematic / Motor control	56
Figure 4.7 Complete circuit schematic.....	57
Figure 4.8 Implemented circuit board / Top view with components	59
Figure 5.1 Right Sensor Figure 5.2 Only Front Sensor without line	66
Figure 5.3 Only Front Sensor with line Figure 5.4 Left Sensor.....	67
Figure 5.5 Applied T-course dimensions	68

v **LIST OF TABLES**

<i>Table number by chapter: Name of Table</i>	<i>Page</i>
Table 1.1 Conversion course dimensions.....	4
Table 3.1 Register file map of the PIC.....	18
Table 3.2 Reduction table R.P.M. for DC motor	23
Table 3.3 Sensor abbreviations	27
Table 3.4 Truth table	27
Table 4.1 Bill of material	58
Table 4.2 Implemented circuit board / Terminal connections	60
Table 4.3 Implemented circuit board / LM 339 connections	61
Table 4.4 Implemented circuit board / PIC pin connections.....	61
Table 5.1 Servomotor tested pulse length for steering.....	63
Table 6.1 Pricelist of components	75

vi LIST OF ABBREVIATIONS

DC	<u>D</u>irect <u>C</u>urrent
DIP	<u>D</u>ual <u>I</u>nline <u>P</u>ackage
DPRG	<u>D</u>allas <u>P</u>ersonal <u>R</u>obotics <u>G</u>roup
CMOS	<u>C</u>omplementary <u>M</u>etal <u>O</u>xide <u>S</u>emiconductor
EEPROM	<u>E</u>lectrically <u>E</u>rasable <u>P</u>rogrammable <u>R</u>ead <u>O</u>nly <u>M</u>emory
FR	<u>F</u>ront Sensor
ICD	MPLAP <u>I</u>n-<u>C</u>ircuit <u>D</u>ebugger from Microchip
ICE	MPLAP <u>I</u>n-<u>C</u>ircuit <u>E</u>mulator from Microchip
IDE	MPLAP <u>I</u>ndependent-<u>D</u>evelopment Tool from Microchip
IEE	<u>I</u>nstitution of <u>E</u>lectrical <u>E</u>ngineers
I/O	<u>I</u>ntput / <u>O</u>utput
IT	<u>I</u>nformation <u>T</u>echnology
LI	<u>L</u>eft-<u>I</u>nside Sensor
LO	<u>L</u>eft-<u>O</u>utside Sensor
PCB	<u>P</u>rinted <u>C</u>ircuit <u>B</u>oard
PIC	<u>P</u>eripheral <u>I</u>nterface <u>C</u>ontroller
PWM	<u>P</u>ulse <u>W</u>idth <u>M</u>odulation
QTY	<u>Q</u>uant<u>I</u>ty
RAM	<u>R</u>andom <u>A</u>ccess <u>M</u>emory
RI	<u>R</u>ight-<u>I</u>nside Sensor
RISC	<u>R</u>educed <u>I</u>nstruction Set
RO	<u>R</u>ight-<u>O</u>utside Sensor
ROM	<u>R</u>ead <u>O</u>nly <u>M</u>emory
R.P.M.	<u>R</u>evolution per <u>M</u>inute

T.T. **Truth Table**

VAT **Value Added Tax**

vii LIST OF SYMBOLS

f	Frequency [Hertz = Hz = s⁻¹]
I	Current [Ampere = A]
l	Metre [m]; Millimetre 1/1000 of a meter [mm]
t	Time [seconds = s]; Millisecond 1/100 of a second [ms]; Microsecond 1/1000 of a second [μs]
T	Period time [seconds = s]
v	velocity [meter per second = m/s]
V	Voltage [Volt = V]
'	Foot [30.48 cm]
"	Inch [2.54 cm]