Project WEAVER
Wi-Fi Enabled
Active Video
Experimental Rover

Senior Project by:
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Project Tasks

Hardware
- Obstacle Detection and Avoidance
- Wireless Interface
- Power Regulation
- Video Interface
- DSP Processor
- Motors and Interfaces
  - H-Bridge Motor Driver
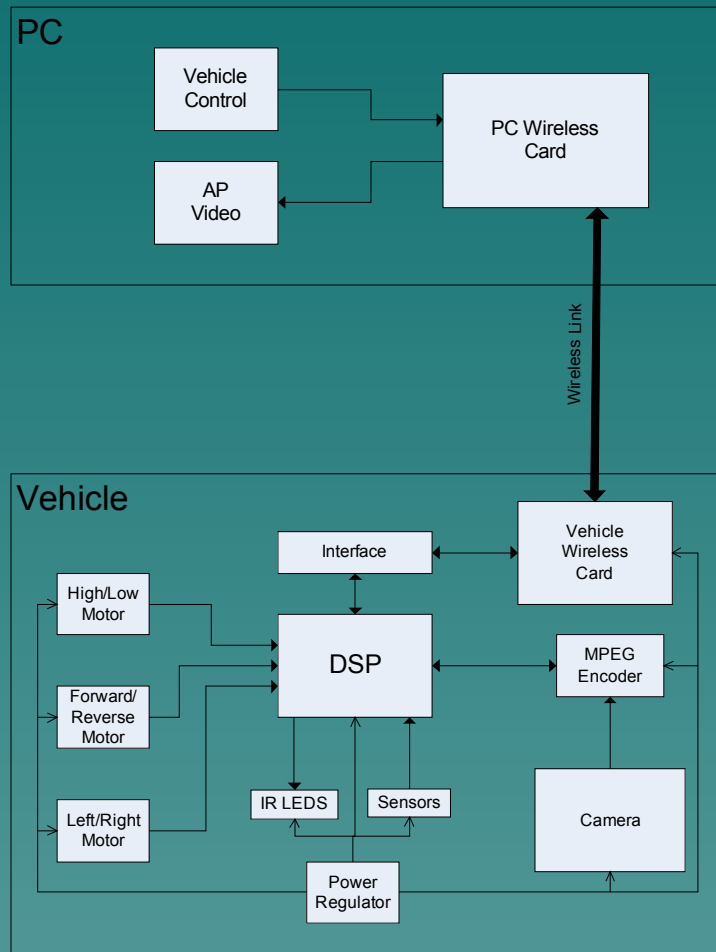- PCB Design and Verification
- Assembly

Software
- Obstacle Avoidance
- PC Wireless Implementation
- PC Video Stream Viewer
- DSP Video Pre-Processing
- PC Movement Control
- Rover Wireless Implementation
- DSP Movement Control
- GUI Wrapper

Schedule
- Hardware
- Software

Block Diagram

Obstacle Detection and Avoidance

Two Components – Hardware and Software

Hardware on Car
- IR LEDs, receivers, and resistors
  - IR receivers create a signal when the reflected IR signal is detected
- Input from HPWM on DSP
  - Duty cycle controls power level to LEDs which changes the sensitivity
- Output to a general purpose I/O pin
  - Receiver signal sent back to DSP

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Wireless Communication Link

On the Car

- Hardware

    The Plan: PC card, connectors, and bus to the DSP.

    Back-up: Wireless Flash or chip set Reference Design

- Software on the DSP

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Power Regulation

Sources
- 9.6V Ni-Cad rechargeable (Motors)
- 9V alkaline 6 AA cells in series (Digital)

Power sequencing
- Digital power is available first
- Motor driver power after H-Bridge is initialized

Single switch disables all voltage sources

Digital voltage regulation
- DSP
- Camera
- Wireless card
- Obstacle avoidance

Video Interface

CCD Camera
- – Toshiba TW10794V Digital Camera
- – Ribbon Cable Input/Output and Power

MPEG Codec
- – NEC µPD61051 MPEG2 Hardware Encoder
    - 208 pin TQFP (Thin Quad Flat Pack) package
    - 2.5 and 3.3 V requirements
    - Samples en route
- – Native Streaming Video Output

Mounting Hardware
- – Nuts and Bolts.

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Embedded Processor

Digital Signal Processor (DSP)
- Motorola DSP56F807
- On chip interfaces
    - SPI
    - UART
    - CAN
    - SCI
    - JTAG
    - External Memory interface port
        - 16bit data 16 bit address
- We have a development kit for the 801 version
- We have samples of the 805 and 807 versions

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Motors and Interfaces

One motor for forward and reverse

One motor for left and right

One motor for High and Low gear

Hardware Pulse Width Modulator (HPWM) to apply the signals to move

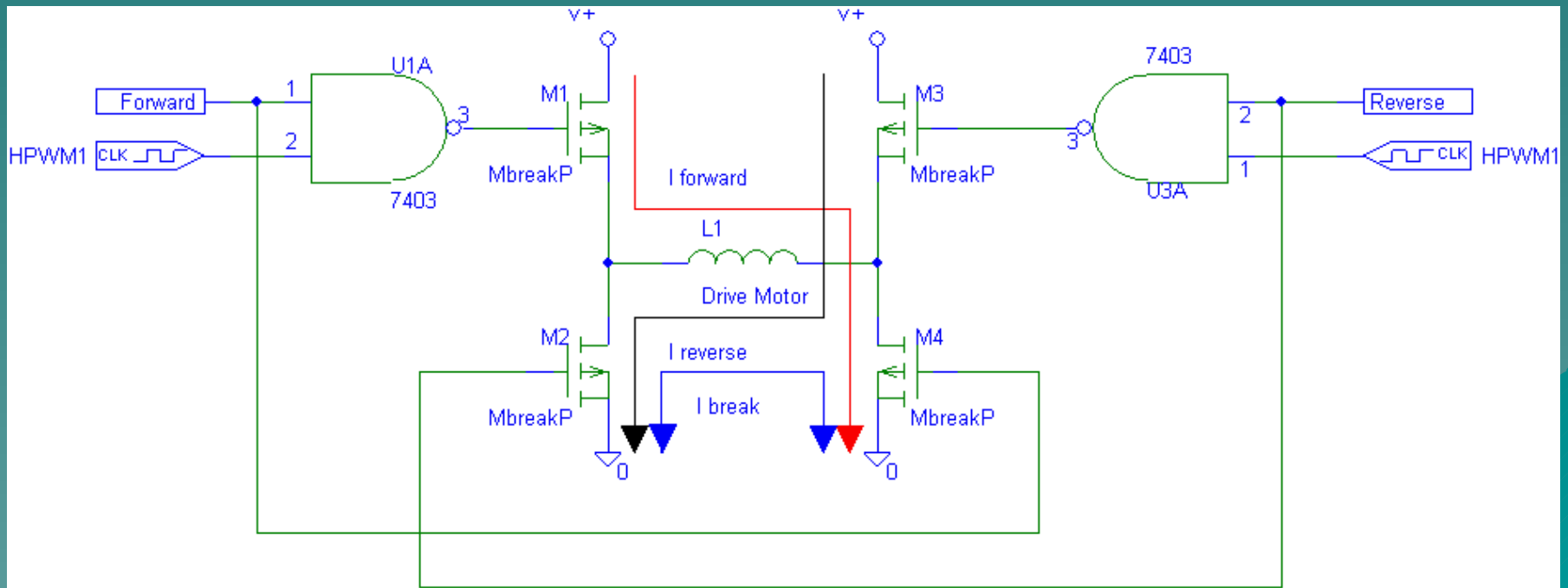HPWM duty cycle will determine speed.

- Duty Cycle range 0% - 100%
- Provides maximum motor speed

Rotation is proportional to the current passing through it

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H-Bridge Motor Driver

Allows bidirectional operation with minimal control signals

Provide a "break" to stop the rotation of the motor

requires one HPWM and either 2 or 4 IO pins

PCB Design and Verification

Protel 99se schematic and layout environment

- Output Gerber files

Verification, Review

- Schematic prior to PCB production
- Analyze current requirements to size traces
- Component footprints
- PCB trace paths

Circuit Graphics PCB fabrication

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Assembly

Populate the PCB in phases to check power regulation and control

Complete PCB

Mount modules to the Rover

- PCB
- Camera
- Wireless Card

Power all systems and verify power capacity

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Obstacle Detection and Avoidance

Software on DSP

– Sensor Control

Input – Approximate speed from Motor Control Software (duty-cycle of the HPWM)

Output – Duty cycle of the HPWM input to IR LEDs

– Evasive Action

Input – Output of the IR sensors

Output – Communication to Motor Control Software to avoid the object

Obstacles avoided by either turning the car, applying the motor breaks, or both

– Allow this feature to be disabled from the PC

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PC Wireless Implementation

802.11g wireless network (54 Mbps)

Hardware – PC card

Software – Write to and read from as a socket

- Wireless input - Video sent from the Rover
- Socket output – Relay Video to the PC
- Socket Input – Command Codes sent from the PC
- Wireless output – Relay Commands to the Rover
- UDP transfer protocol

There will also be a wireless access point that will act as a network switch

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PC Video Stream Viewer

Video stream viewer
- Input – MPEG video stream from the car received through Wireless Communication Software
- Output – Streaming video display on the monitor
- Decode using Windows Media Player or similar

Create a viewer in a reserved section of the GUI

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DSP Video Interface

Initialize CCD Camera
- Send configuration op-codes
  - Frame-rate, Resolution, Etc.

Initialize MPEG encoder
- Define input characteristics (Digital)
- Set compression type (MPEG2)
- Set output to real-time stream

Receive stream into DSP from encoder

Make stream available for wireless transmission

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PC Motion Control

Input
- Keyboard
- Explore joystick option
- Variable speeds
    - Forward/Reverse
    - Left/Right

Decode into hardware commands

Send to wireless link

Design a GUI for motion control

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Rover Wireless Implementation

Hardware – PC card in a connector mounted to the PCB

Software level1
- Interface
    IDE
    Card Bus

Software Level2
- Write to and read from as a socket
    Wireless input - Command Codes sent from the PC
    Socket output – Relay Commands to the Rover
    Socket Input – Video sent from the Rover
    Wireless output – Relay Video to the PC
- UDP transfer protocol

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DSP Movement Control

Receive Command message from the PC

Decode message

Respond to the message
- Change the duty cycle of one or more HPWMs
- Apply the break
- Change direction Forward/Reverse

Stop if wireless connection is lost

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Hardware Schedule

		May			June			July				August			
Tasks	point-person	14	21	28	11	18	25		16	23	30	6	13	20	27
Power regulation	Janos				■	■	■								
DSP circuitry	Tyler	■	■	■											
ireless transmission circuitry	mber				■	■	■								
Camera interface circuitry	Janos	■	■	■											
Collision avoidance circuitry	Amber	■	■	■											
Motor driver	Tyler				■	■	■								
PCB design	All							■	■	■					
PCB build	All										■				
Part acquisition	All	■	■	■	■	■	■	■	■	■	■				
Basic assembly	All											■	■	■	

Software Schedule

asks	point-person	September 10	17	24	October 1	8	15	22	29	November 5	12	19	26	ec 3
DSP Wireless communication	Tyler	🟥	🟥	🟥										
SP Motor control / DSP Video interface	Tyler				🟥	🟥	🟥							
	Janos						🟦	🟦	🟦					
DSP Sensor processing and collision avoidance	Amber									🟩	🟩	🟩		
SP MPEG encoding / PC laptop Wireless communication	Amber	🟩	🟩	🟩										
PC laptop Motor control	Janos				🟦	🟦	🟦							
C laptop Video interface software	Amber						🟩	🟩	🟩					
PC laptop GUI wrapper	All	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧		
Documentation		🟦	🟦	🟦	🟩	🟩	🟩	🟥	🟥	🟥	🟦🟥	🟦🟥	🟦🟥	