



ONS

(Optical Navigation System)

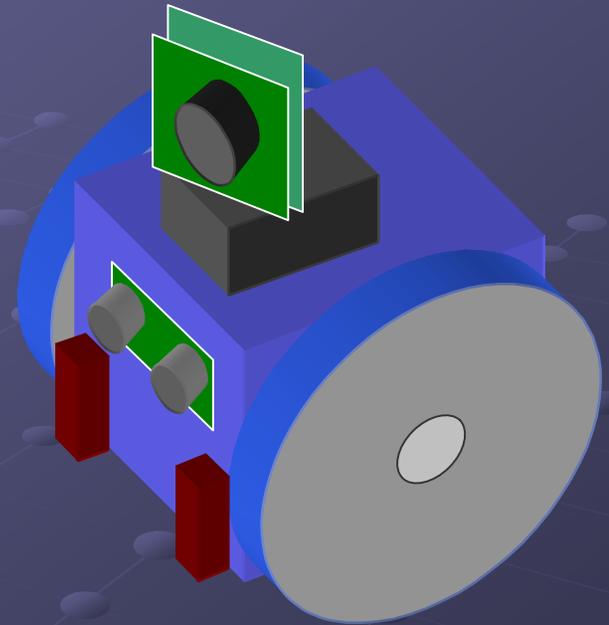
Jessica Chen
Dennis Yue
Chitoku Yato

Team Members and Areas of Expertise

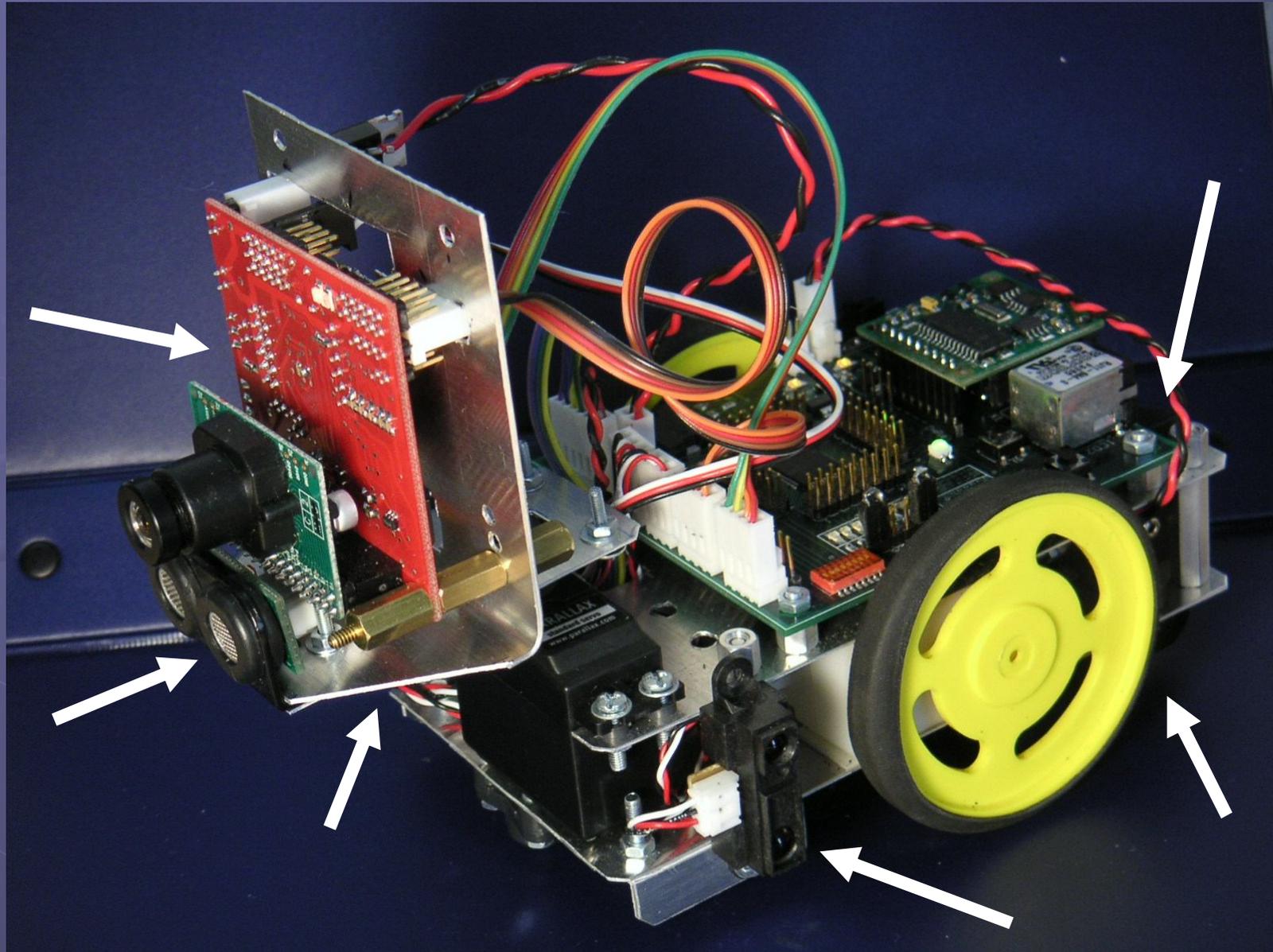
- Chitoku Yato
 - leader, system and mechanical design
- Jessica Chen
 - mechanical design, power
- Dennis
 - software (firmware) design

Product Definition

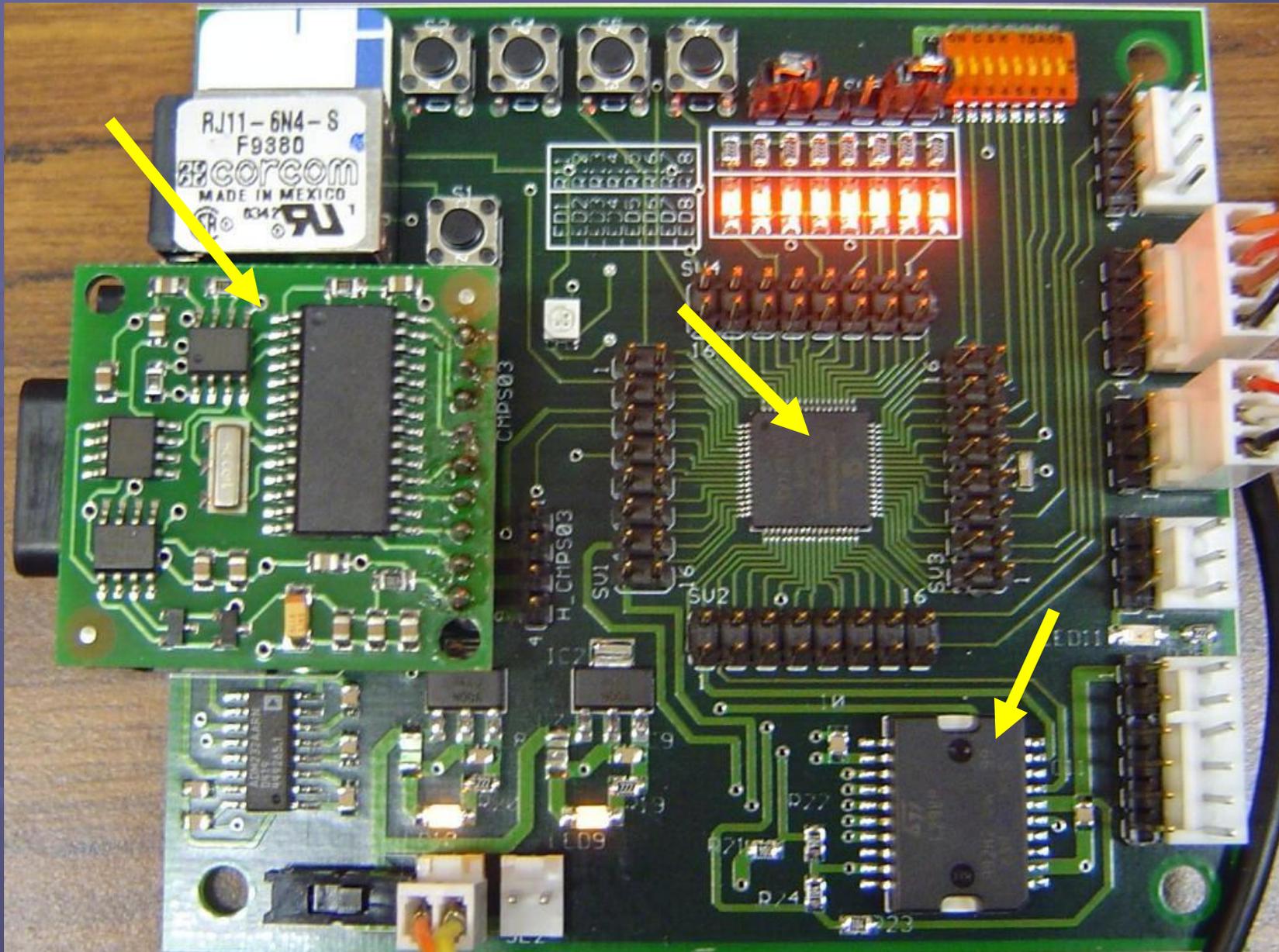
- We build a two-wheel robot that chases after a target utilizing the visual information obtained by an onboard camera.



Final Product



Fabricated Final Board



Product Application

● Automated Transportation

- Multiple vehicles forming a fleet and just follow the one ahead

● Driving Assistance

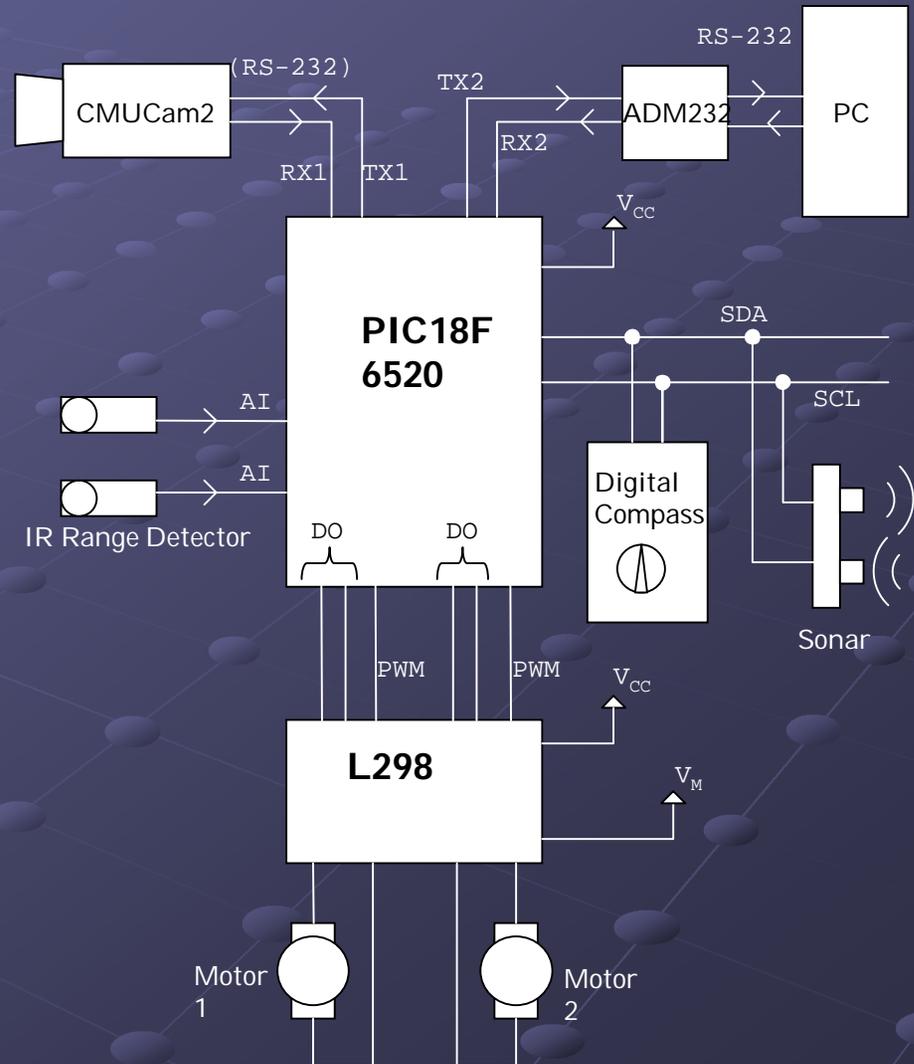
- This navigation model can be used for driving assistance

Data Sheet

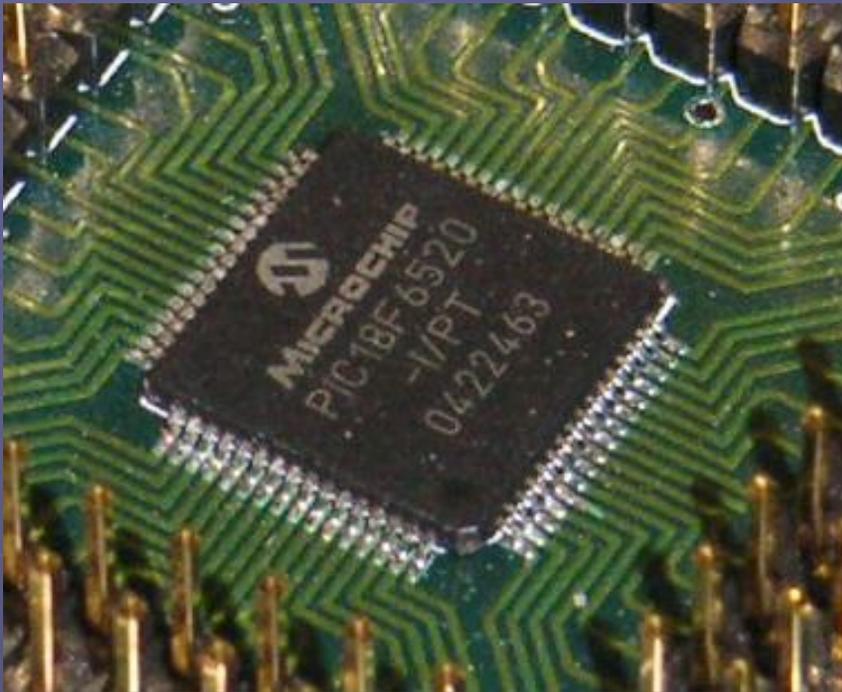
	ONS
Camera	CMUCam2
Sensors	1 x Ultrasonic range detector, 2 x IR range detector, 1 x Digital compass
MCU	PIC18F6520
Gear	GM2
Motors	RM2
Speed	24 m / min (MAX)
Power Source	6 x AA batteries for motor driving, 1 x 9V for control.
Dimension	W: 10cm, L: 14cm, H: 13cm

High Level Block Diagram

- CMUCam2 (RS-232)
- PIC18F6520
- SRF10 (I²C)
- GP2D12 (analog)
- CMPS03 (I²C)
- L298 (digital + PWM)



Processor - PIC18F6520



- Central Processing Unit (CPU)
- Interfaces with all the sensors and motors.
- Calculate the movement from sensor inputs and movement memory.
- Send signal to drive motors.

Processor Definition

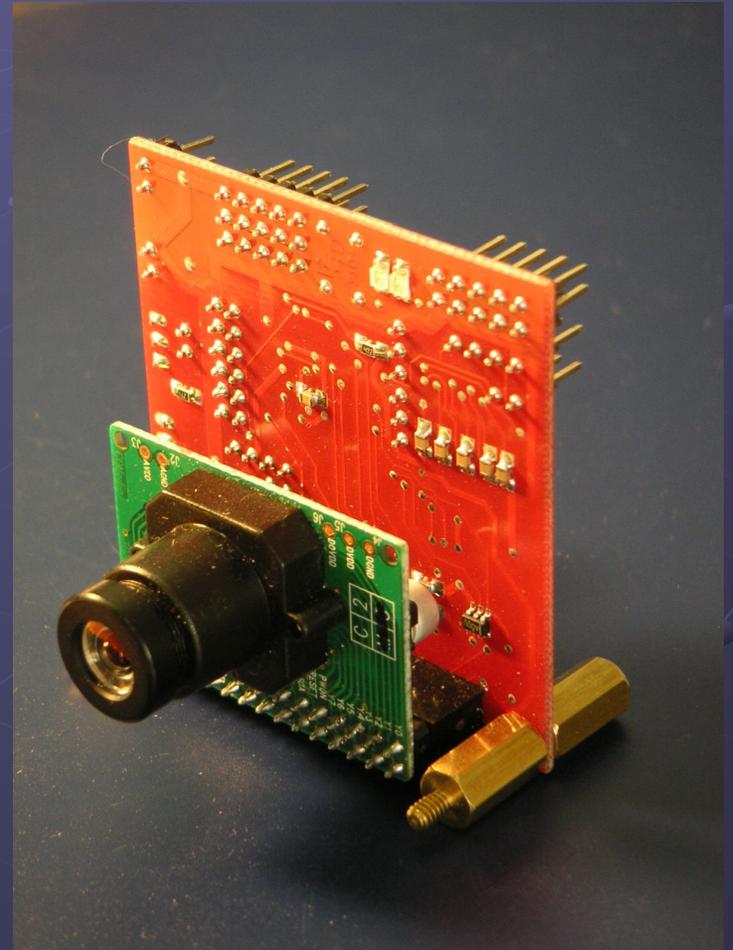
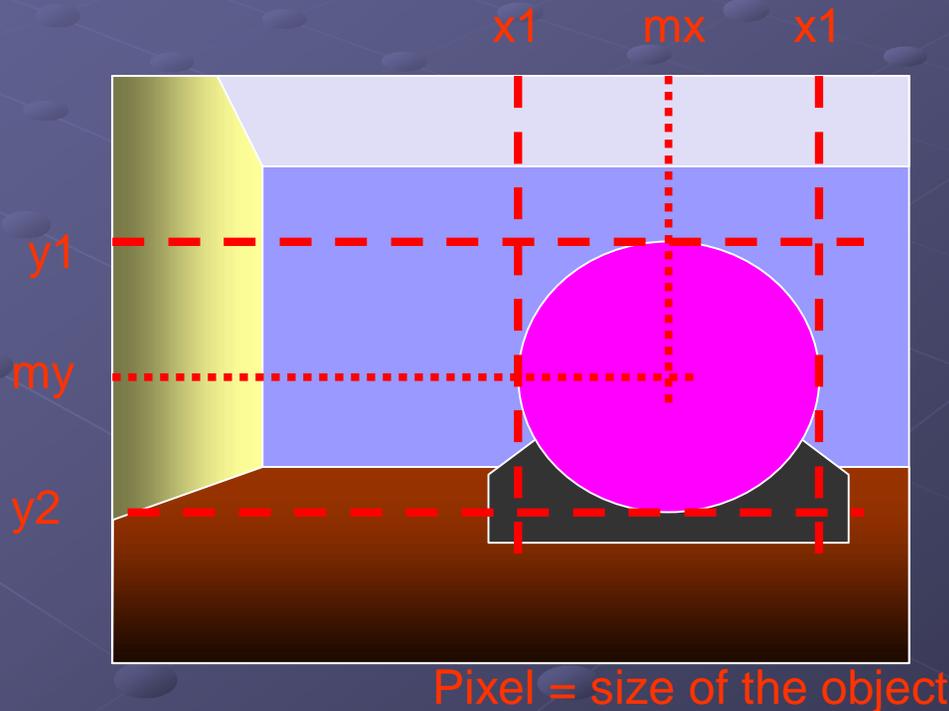
Manufacture	Microchip Inc.
Part number	PIC 18F6520-I/PT
Ordering information	\$10.73 at Digikey.com
Speed	DC – 40MHz
Operating speed	40MHz
Clock source	External, 10MHz Crystal
Power dissipation	300mA (1.0W)
Operating Voltage	2.0V – 5.0V
Busses	UART, I2C

Processor Definition (cont)

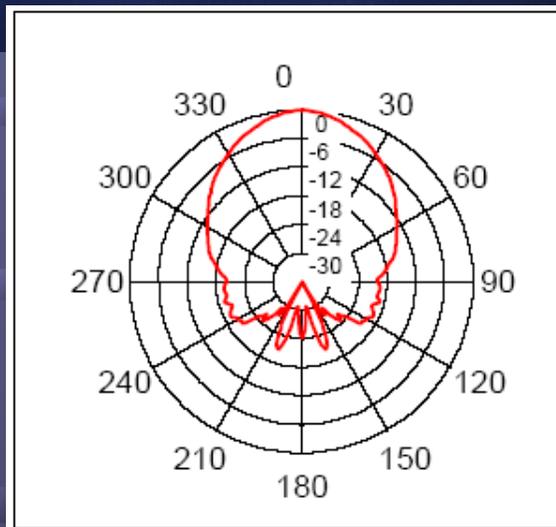
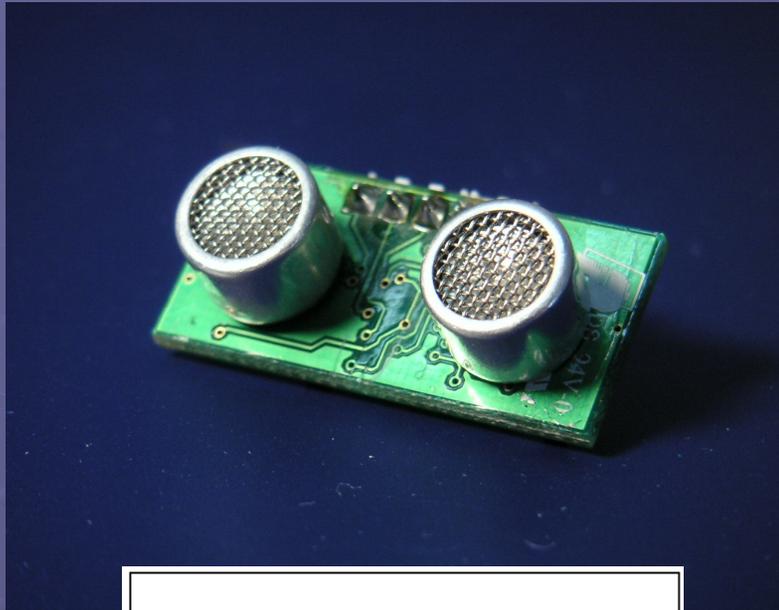
Internal memory	EEPROM(1024bytes)
Firmware changeability	Firmware stored in flash program memory that can be programmed by ICSP method via 2 pins.
System software availability	All provided by Microchip Inc.
Boot process	Program starts from location 0h of program memory.
Reset	MCLR pin is usually pulled up. To reset the PIC, pull down the MCLR pin to the ground.

CMUCam2

- Captures a scene and gives a tracking information at up to 50 fps



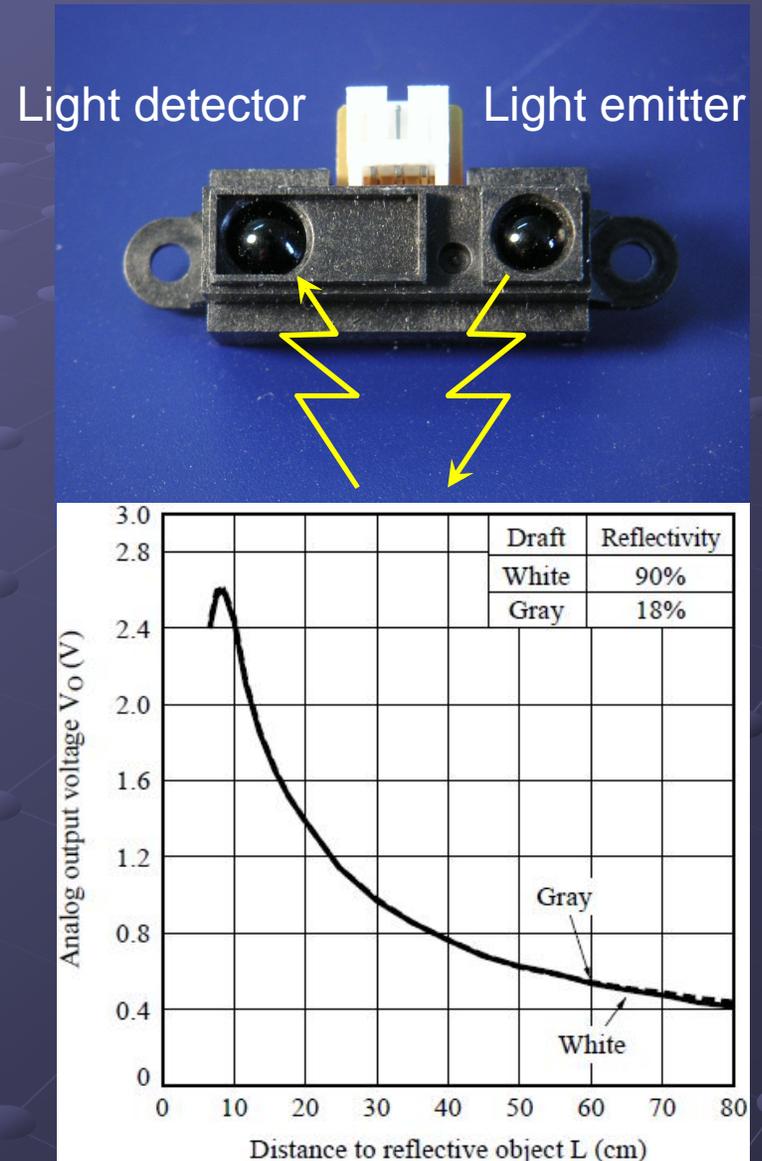
Ultrasonic range detector



- Measure the amount of time it takes to detect the ultrasonic reflected on the object
- Have wide range
- Used to detect obstacles in front and avoid collisions

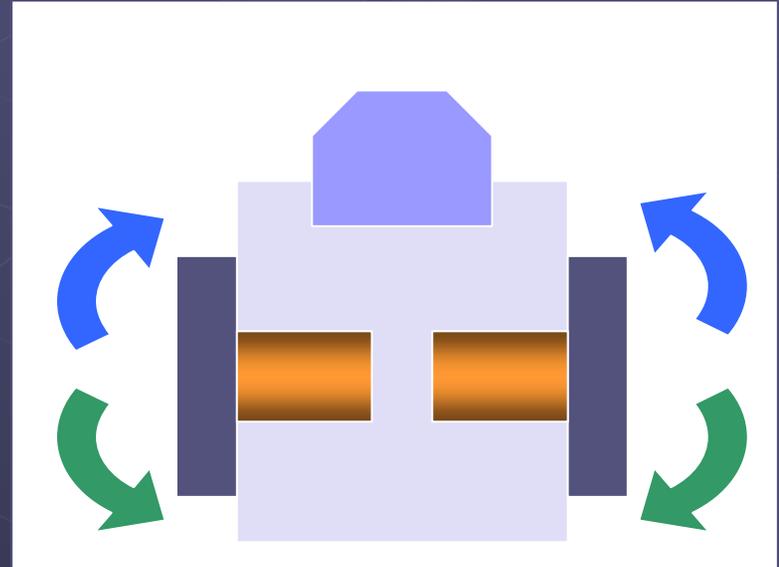
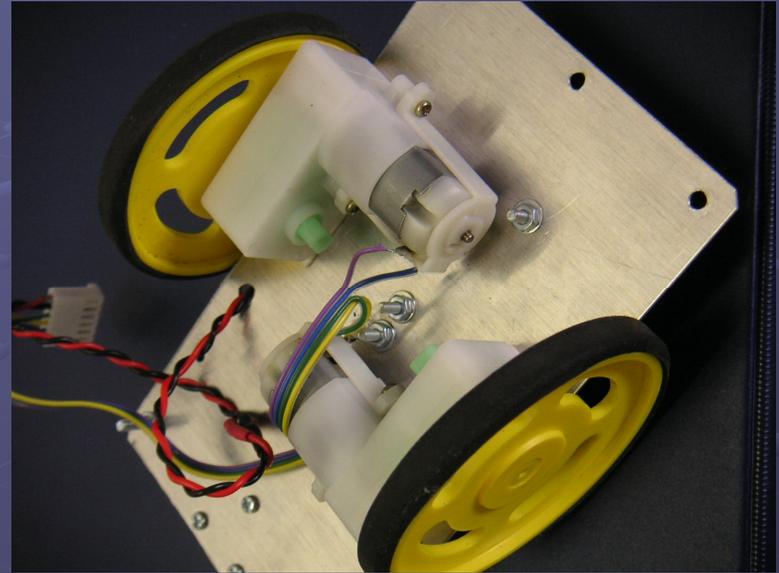
IR Range Detector

- Measure the amount of time it takes to detect the IR reflected on the object
- CPU reads off the voltage level and know the distance
- Used to check the obstacles on both side of the robot when turning.

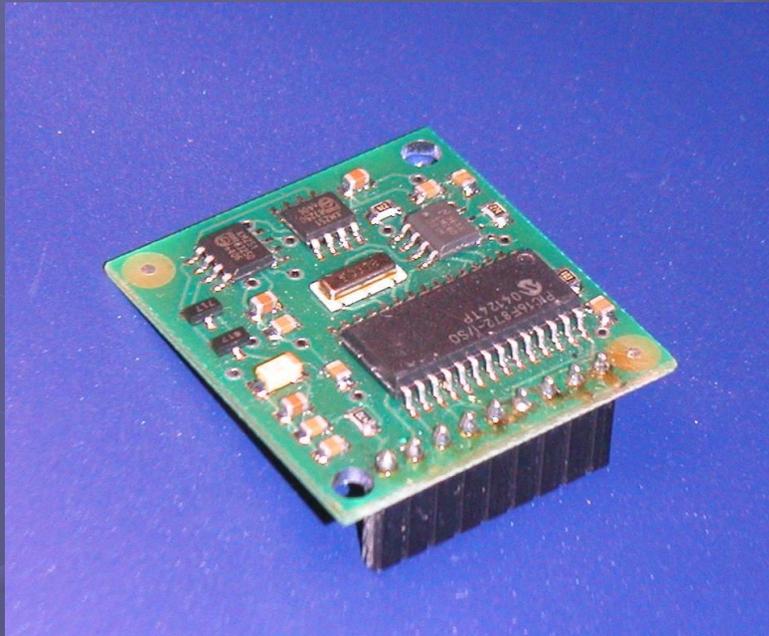


Motors

- Tank configuration
- motor on each right and left wheels
- Each motor runs in 4 modes (Forward, Backward, Brake, Stop), thus the robot can also “spin on a dime”



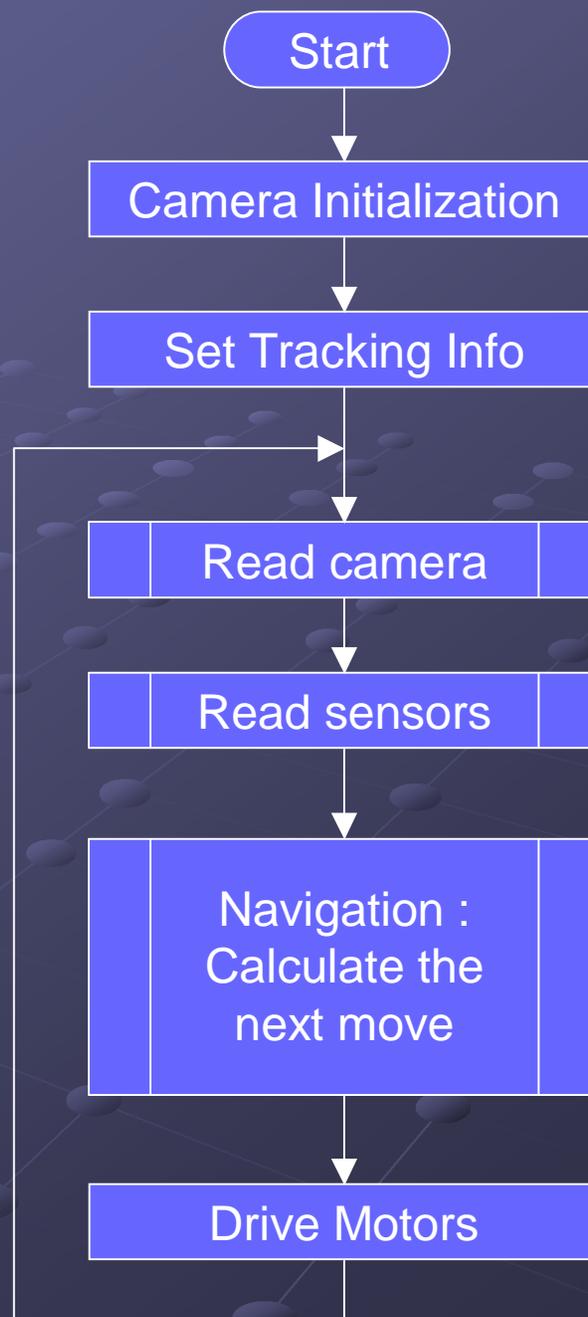
Digital Compass



- gives directional information at 0.1° accuracy
- Used to achieve inertial navigation

Software Structure

- Initialize camera and set tracking information
- Loop: simple round-robin
- Acquire data from camera and sensors
- Calculate the next movement based on the acquired data
 - Track mode
 - Search mode
- Send signals to drive motors

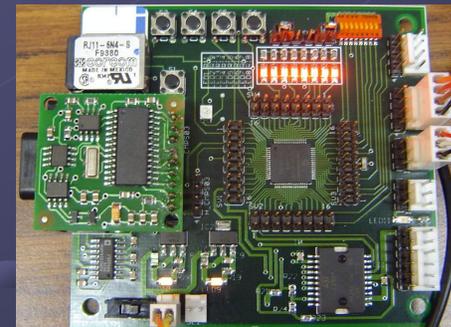


Power supplies

- Two independent power supplies to avoid possible CPU power drop

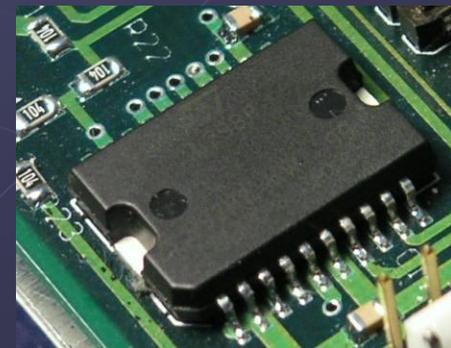
1. Control Board, camera and sensors

- One 9V NiMH battery

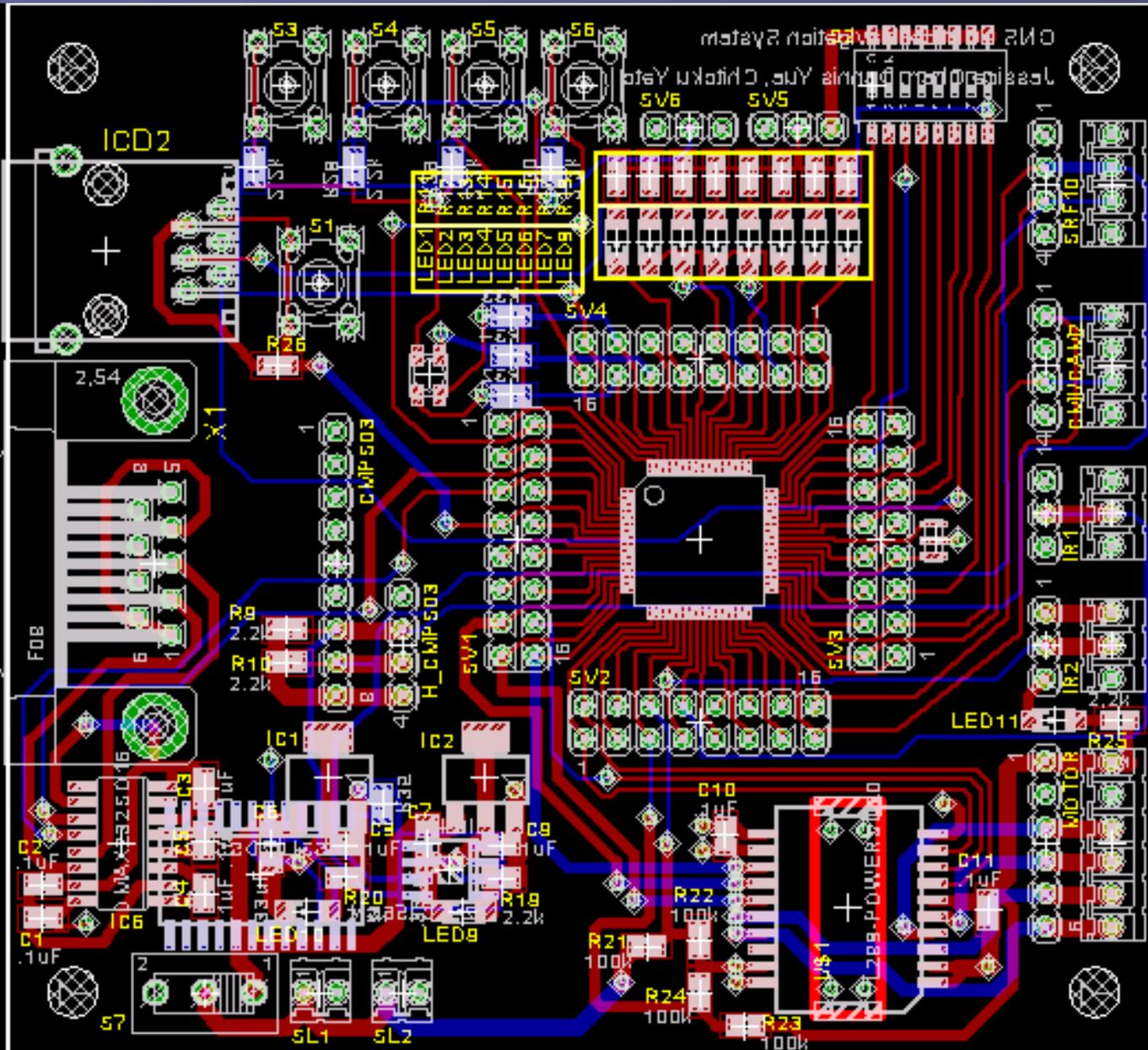


2. Motor & Servo

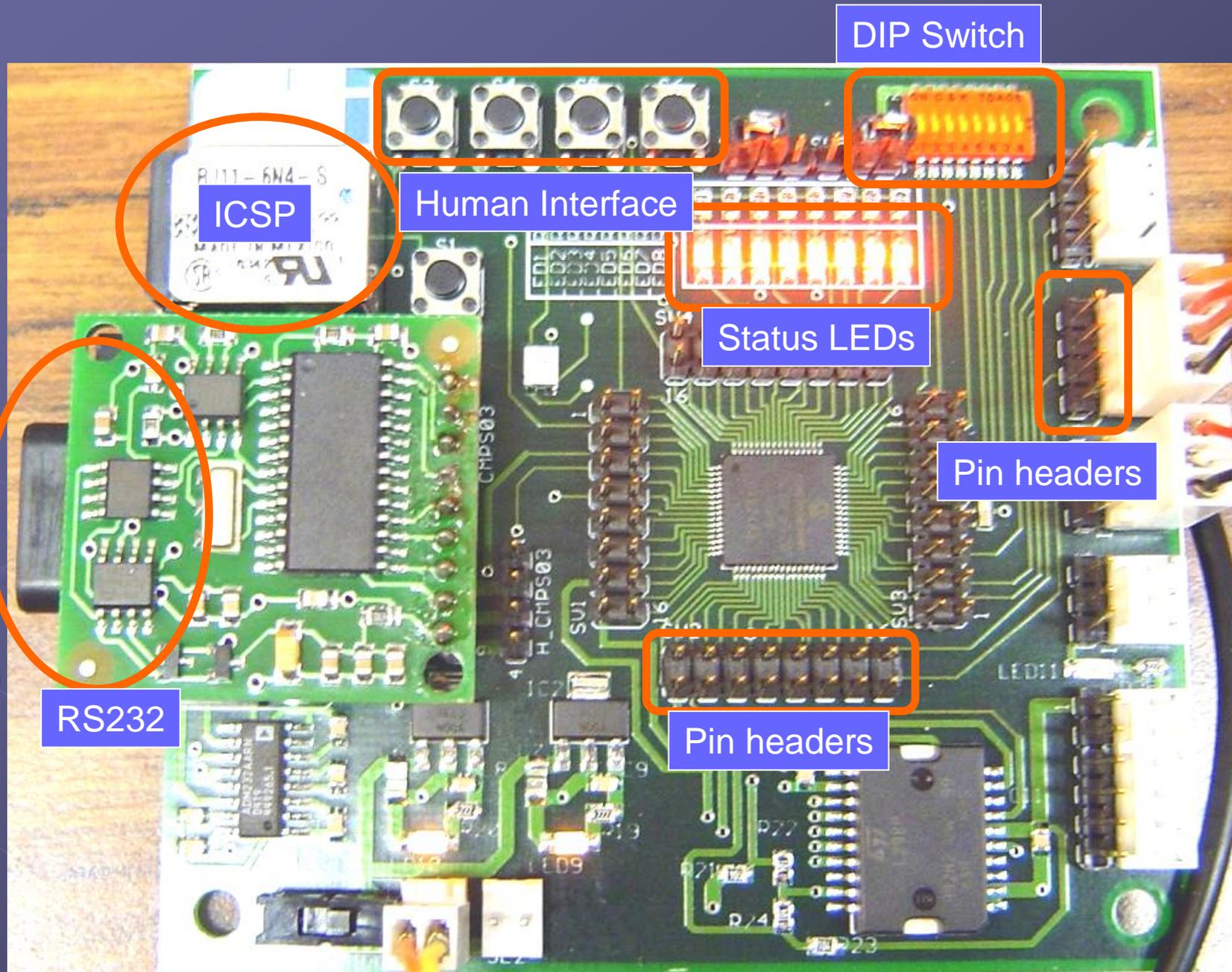
- Six 1.5V AA Alkaline batteries



Annotated Board Layout



Other capabilities



Demo Video

Enjoy!





End of Presentation
Thank You!