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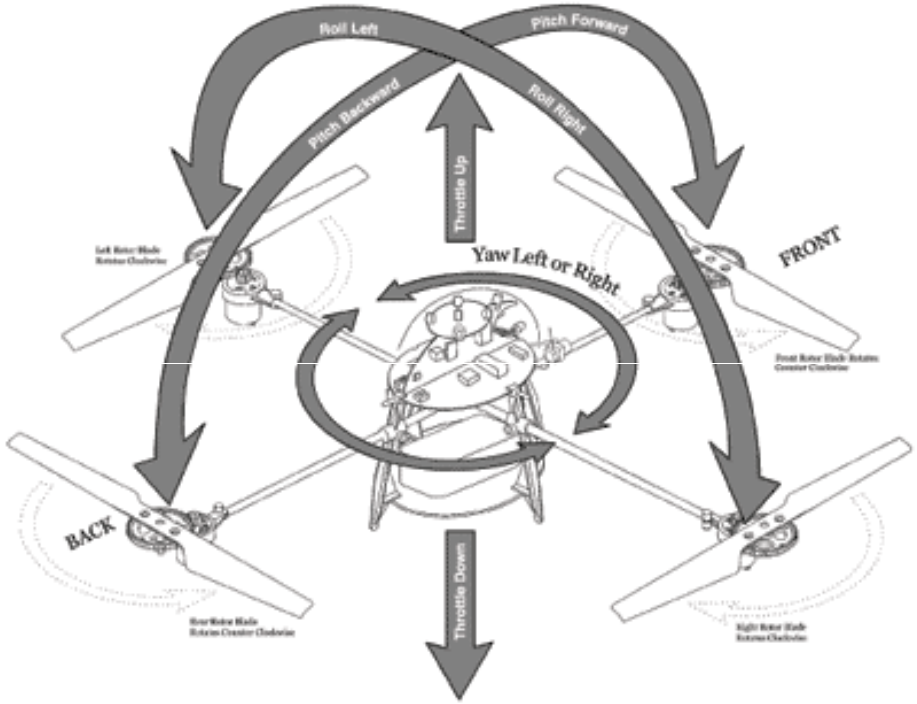
REAL TIME EMBEDDED CONTROL SYSTEM



Application: VTOL Aircrafts – Quad-Rotor Helicopter

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A few acronyms

- UAV

  Unmanned Aerial Vehicles

- VTOL

  Vertical Take-Off and Landing

Challenges:

Complex laws of Aerodynamics

No room for error!

Goal / Objective

To develop a platform to stabilize flying vehicles which are able to make Vertical Take-Offs and Landings

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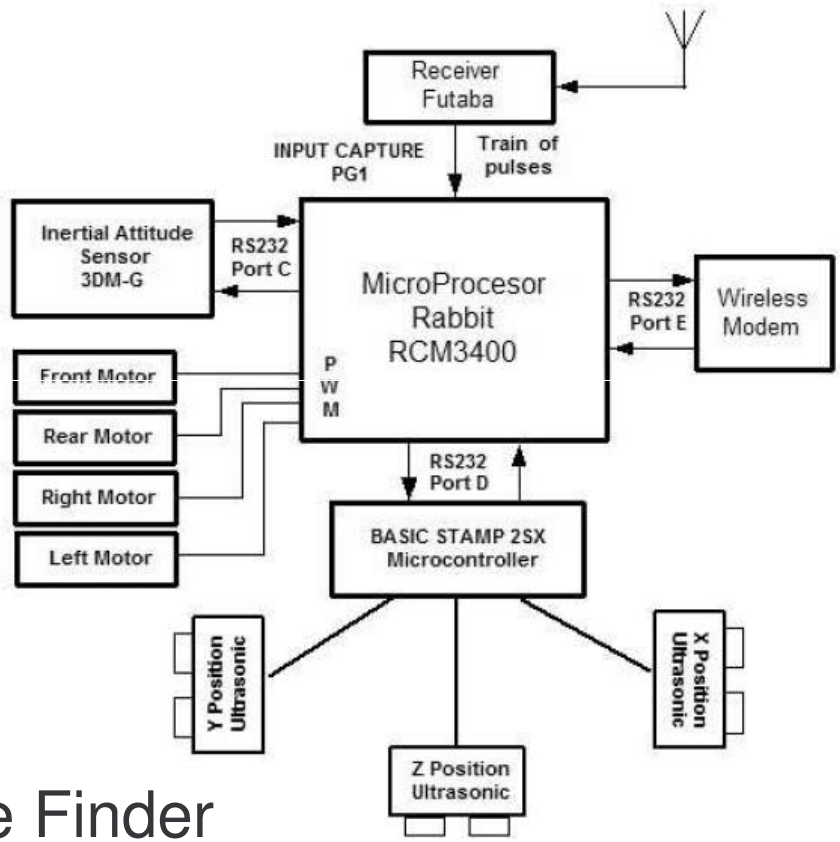
The Embedded System:-

RABBIT RCM3400 MCU

- 512Kb FLASH
- 512Kb SRAM
- 6 Serial Ports (A – E)
- 4 PWM outputs

SENSORS:

- IMU 3DM-G Attitude Sensor
- 3 x SRF04 Ultrasonic Range Finder
  (data gathered by a BS2X Basic Stamp MCU)



The Embedded System:-

ACTUATORS

DC Motors driven by PWM

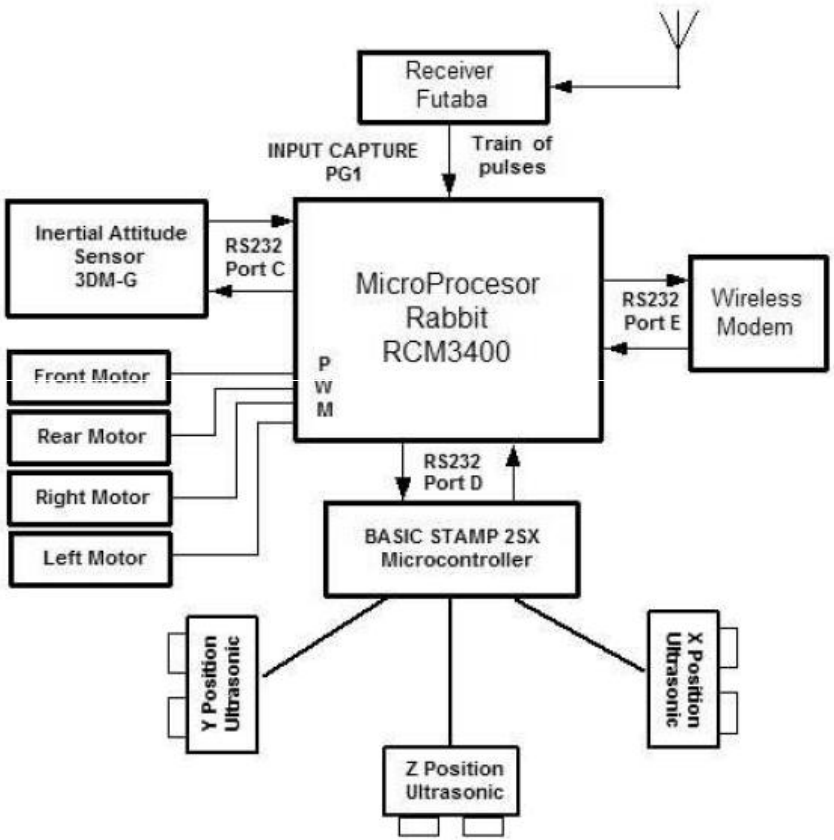
COMMUNICATIONS

RS-232

- Attitude Sensor
- Wireless Modem

FUTABA Receiver

Wireless Modem



Software Development Tools

IDE: "Dynamic C"

Multi tasking – Frequently referred to as *"virtual parallel processing"*

Takes advantage of natural delays in each task to increase overall system performance

Software Architecture

Begin – Initialization

Run Scheduler as follows:

- Get attitude data from IMU every 15ms
- The IMU gets position info from the ultrasonics every 50ms
- Send data to ground station every 200ms
- Refresh Servos every 15ms

Input Capture ISR

- Triggered by falling edge of incoming pulses
- Detect received pulses and check validity of data
- Calculate the control law

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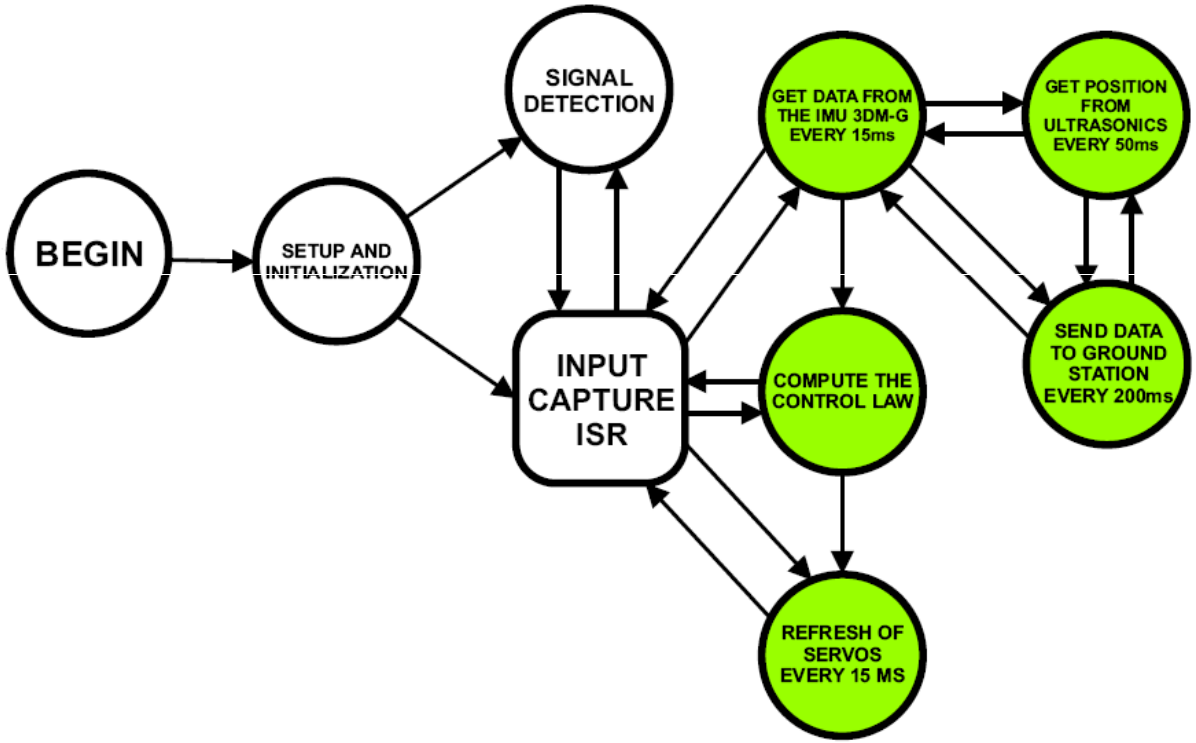
Software Architecture



The Input Capture ISR

If a falling edge is detected and the signal is valid, the periodical train of 7 data pulses must exist:-

Pulse	Name	Description
0	Flank	Used for ISR synchronization
1	Yaw	Yaw set point
2	Pitch	Offset adjustment for pitch
3	Power	Value of the thrust of the motors
4	Roll	Offset adjustment for roll
5	Auto-Manual	Switch for Auto-manual mode
6	Yaw-Trim	Yaw Fine adjustment

Conclusion and further work

Designed an embedded control system for VTOL aircrafts

System was tested on a quad control helicopter

System tests proved Non-Linear control was more robust than the conventional linear

Further work includes use of a GPS sensor to measure position of the aircraft

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