



GYRO SENSORS FOR AIR BAGS



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Gyro sensor

- Detects the angular rotation along the single or multi axis.
- Converts the angular rotation in to the analog DC voltage.

CRS03-02

CRS03-02(Silicon Sensing Systems Japan)



Output : Analog DC voltage centered at about 2.5VDC

Rate Range : +/-100 deg/sec

Scale Factor : 20mV/(deg/sec)

Bias (neutral) : 50% of Vdd

Number of Axis : 1

Bandwidth(-3dB, -90deg) : 10 Hz

Dimensions : 29 x 18 x 29 mm

Power supply (Vdd) : 5VDC +/-250mV

Current dissipation : less than 50mA(150mA for initialization)


Transfer function of CRS03-02

$$\omega = (V_o - 2.5) / 0.02$$

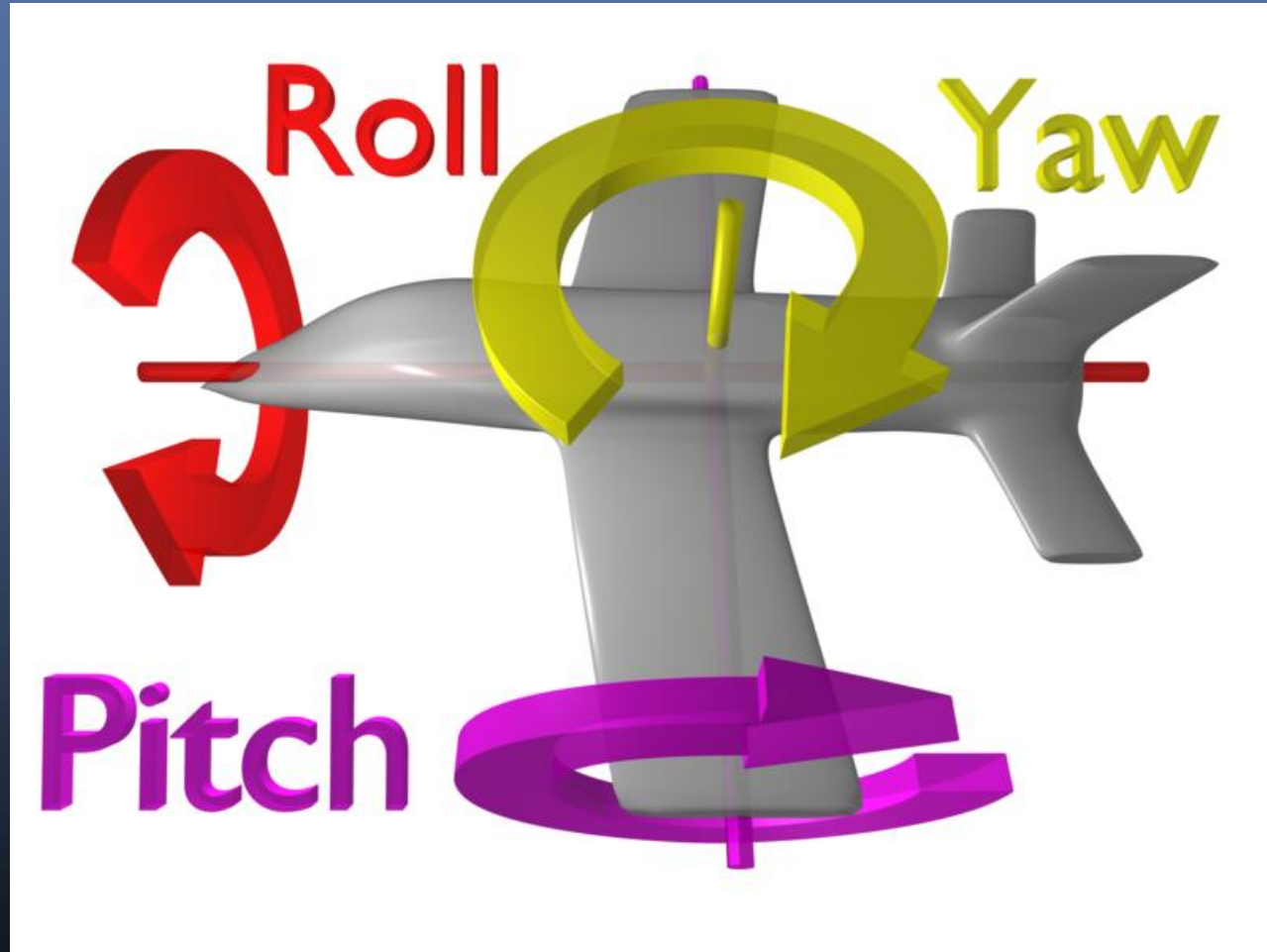
- ω = angular velocity
- V_o = output voltage
- $V_o = 0.5$ to 4.5 for $\omega = -100$ deg/sec to 100 /sec.



Applications

- Industrial
 - Agriculture
 - Aero space
 - Military
 - Subsea
 - Rescue
 - Maritime
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3-d motion of air-craft



Automotive electronic stability control (ESC)


- Uses low cost gyro sensors.
- Detects the vehicle trajectory using the steering wheel angle.
- Automatically brings the vehicle back in control by braking the wheels.



A WEARABLE AIRBAG TO PREVENT FALL INJURIES




Falls

- Falls are leading cause of injury and accidental death for elderly people.
 - Falls may also occur during construction in large sites.
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Falls (continued)

- People who work on tall electric poles are prone to falls which may lead to severe injury or accidental death.
- Fall detection and prevention are important issues!!

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- Falls are determined by
 - quality of sensory input
 - Central processing
 - Motor responses
 - Gyro sensor and accelerometer can be used to detect falls.

Air Bag system

- Used to protect elderly people from fall injuries
- Consists of
 - An inflatable airbag
 - Battery
 - A gas cartridge and
 - Sensors to determine acceleration and angular velocity
 - Trigger mechanism to release the gas
 - Inflator to inflate the gas

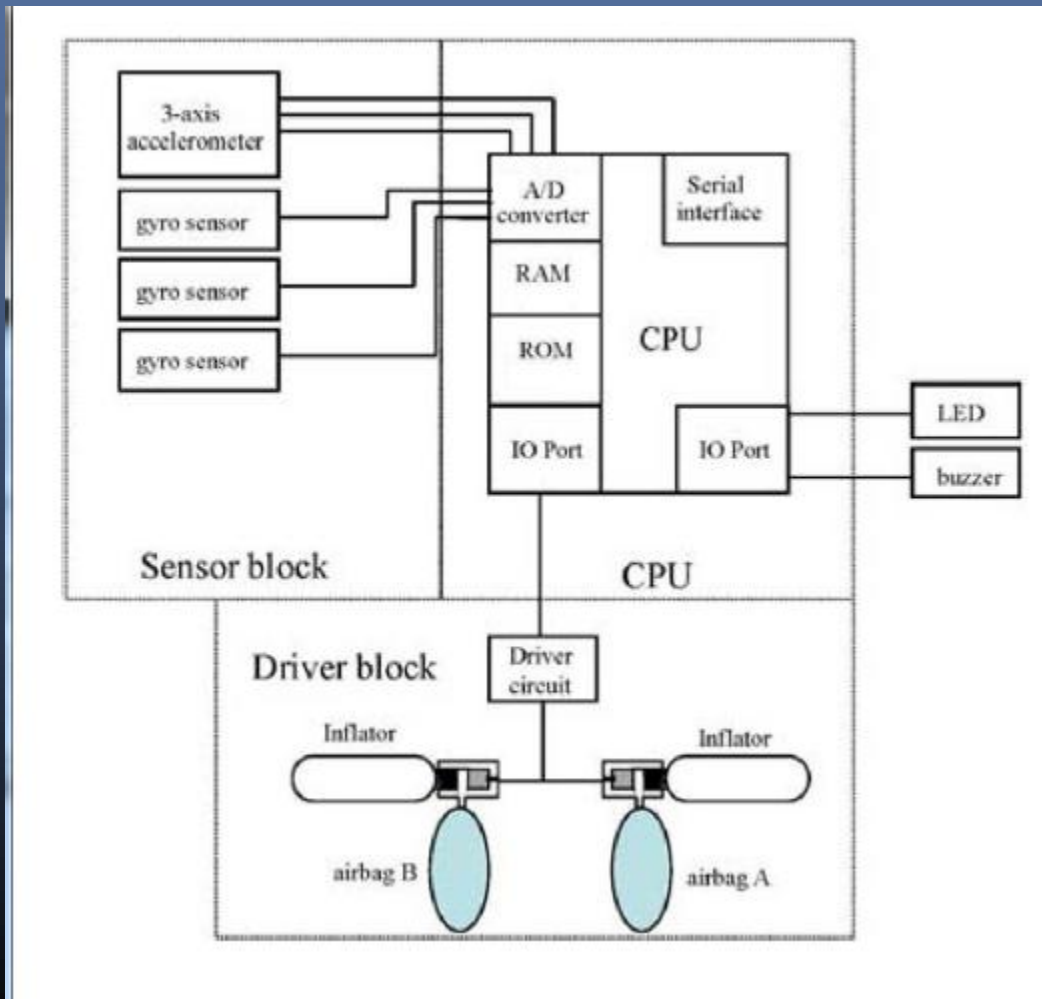
Air Bag system

- Heart of this system is sensor that detects falls
- It must be able to detect falls while the wearer is standing or walking.
- It must be small, lightweight, and simple to wear.
- It must be activated only during falls and not during daily activities.

Fall detection

- Tri-axial acceleration sensor and gyro sensors are used to measure subject moment
- Acceleration and angular velocity wave forms are converted into digital data
- Received data is transferred to the CPU and analyzed with the fall detection algorithm

Airbag system – Block Diagram



Fall detection algorithm


- Used by CPU to process the input sensor data and actuate airbag system
- Fall detection algorithm assumes a pre-determined acceleration and angular velocity values
- Hence fall is detected depending upon these values which are specific to a particular algorithm

Triggering Airbag system

- When user falls, sensor detects and sends the trigger signal to automatically release the gas from the cartridge to inflate the airbag.
- Gunpowder is used to release the gas



Good airbag qualities

- Compact size
 - Light weight
 - Ease of use
 - Reusability
 - Low power consumption
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Air Bag System



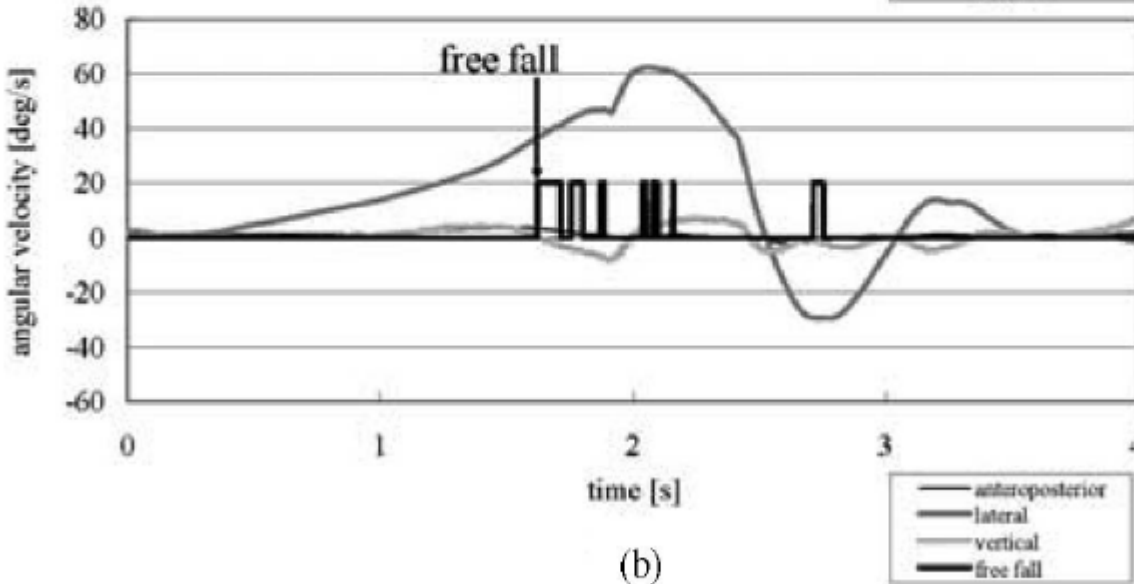
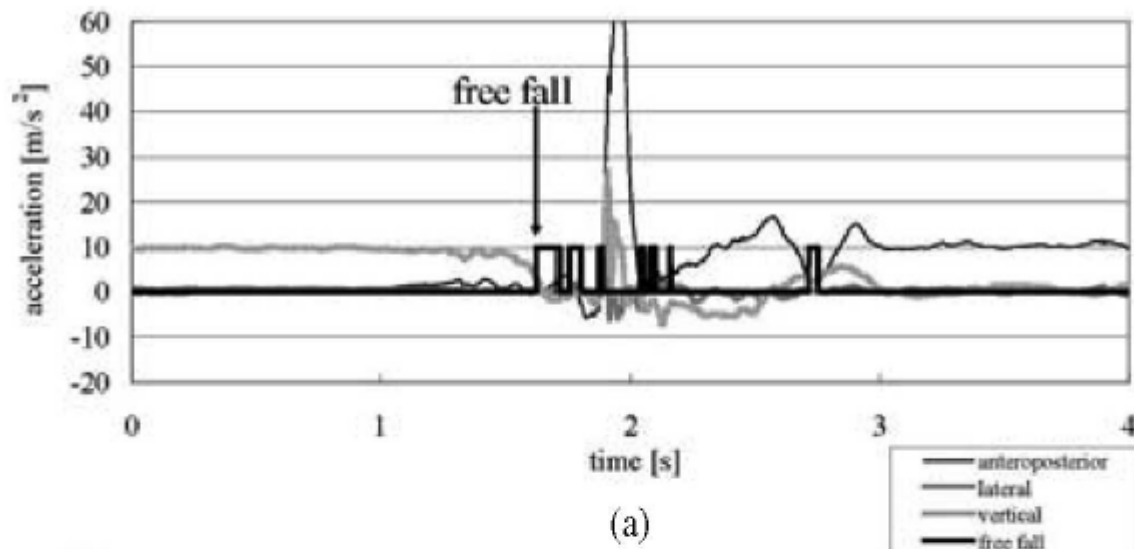



Fig. 3. Typical example of (a) acceleration and (b) angular velocity waveforms while mimicking a forward fall.

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- The inflation time of airbag must be very less than the fall time of a person.

Operation of the airbag system



Start to fall



Detect fall



Inflate airbag



Completely inflate



Fall



References

- Toshiyo Tamura, *Senior Member, IEEE*, Takumi Yoshimura, *Masaki Sekine, Member, IEEE*, Mitsuo Uchida, and Osamu Tanaka
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Thank you