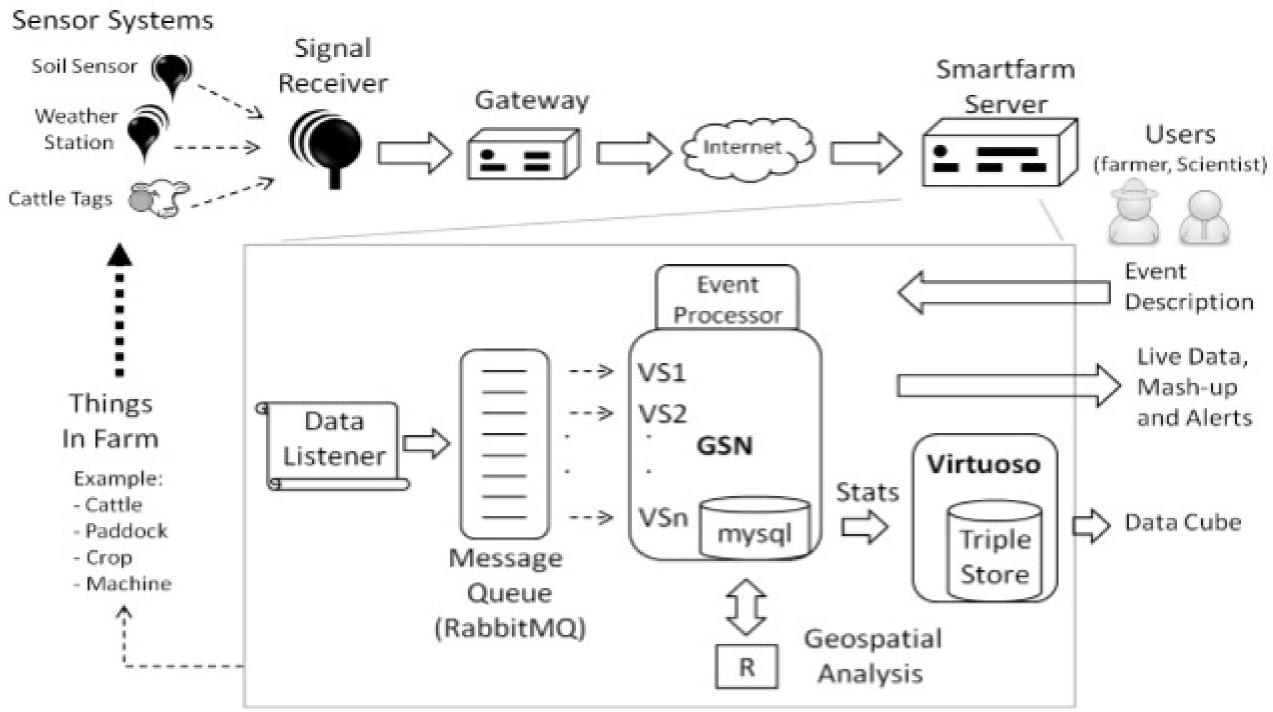
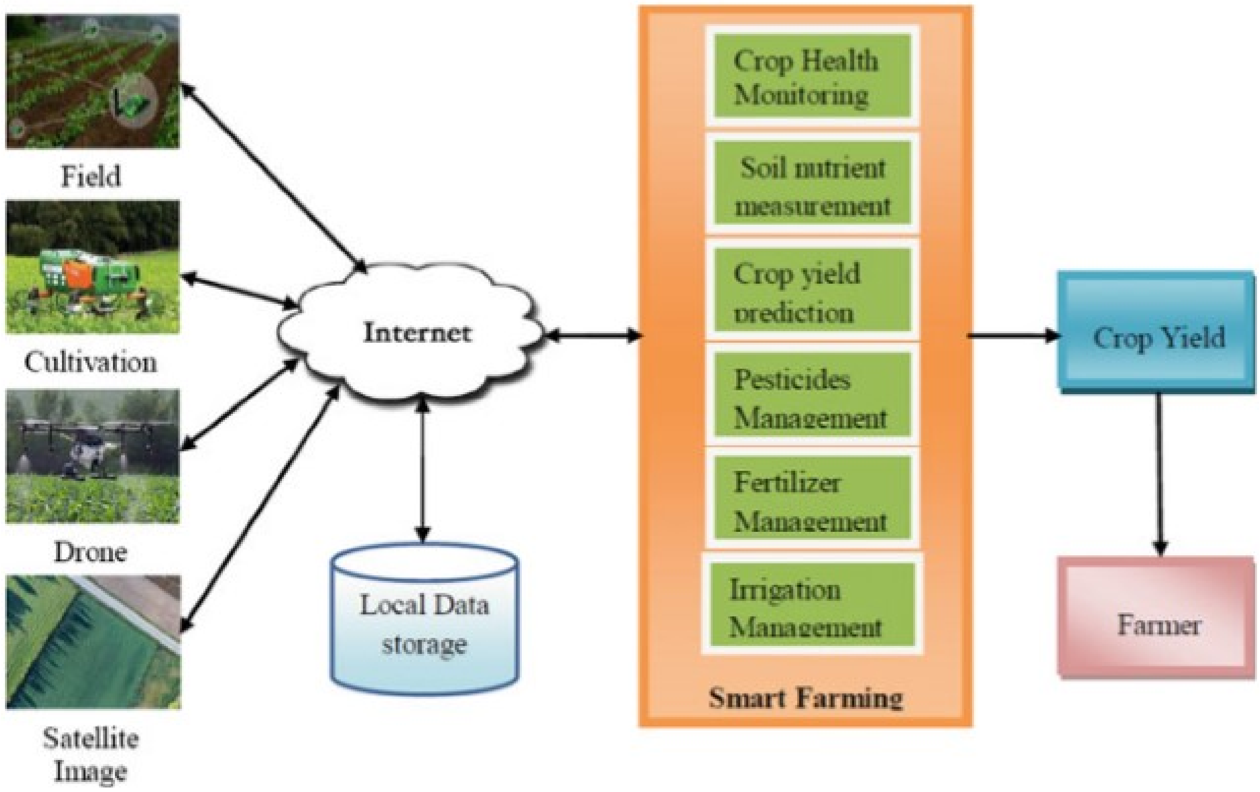
Module-7- Applications of Embedded Systems

7.1 Role in Agriculture sector – Embedded Systems



The Smart Farm System Architecture



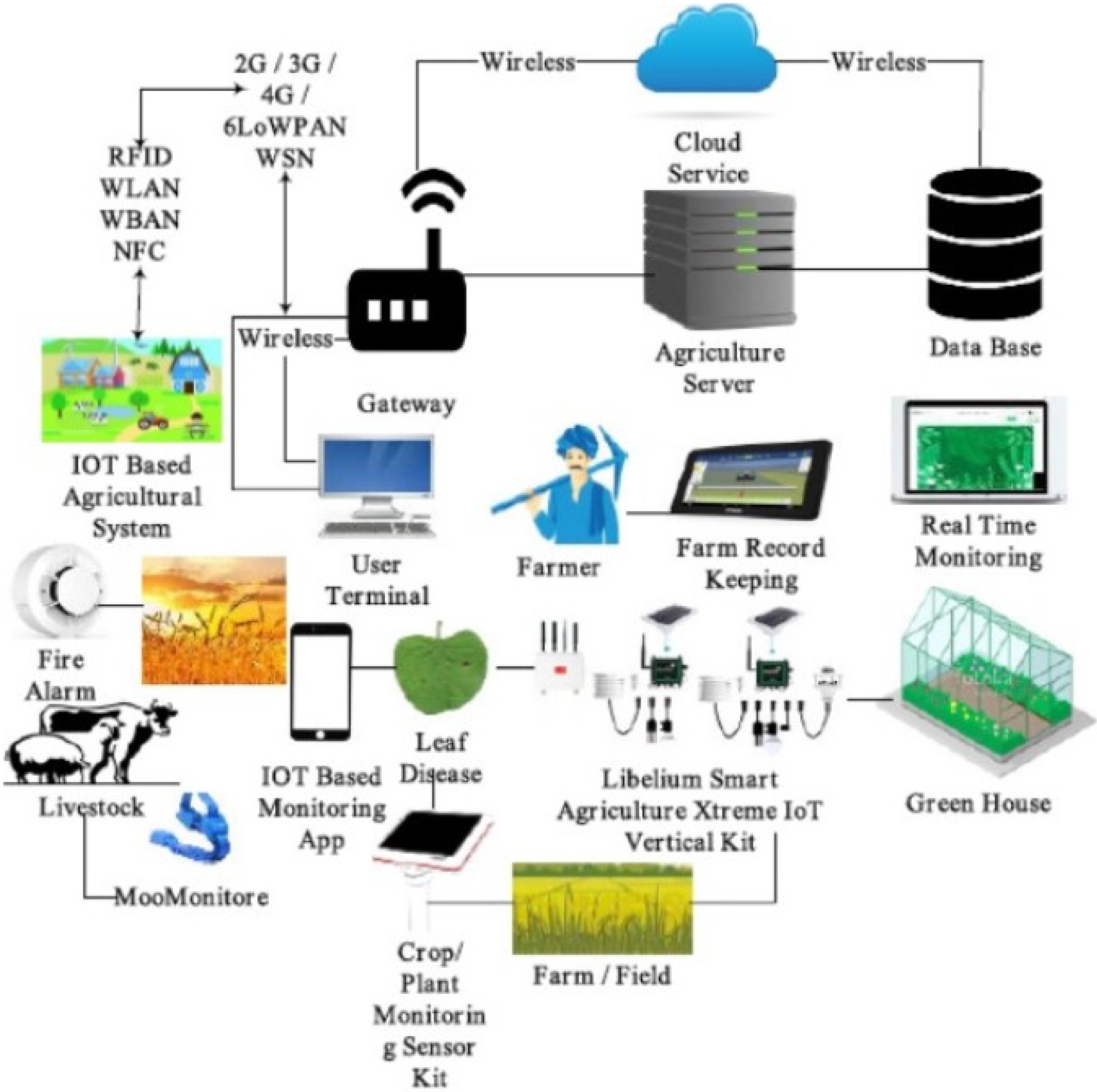
Smart farming architecture

SF technologies

Technologies	Utility
Wireless sensor networks	Irrigation automation Environmental monitoring
Remote sensing	Evaluates the various levels of soil moisture and nutrients, crop health and disease through collected images
Variable rate technology	Apply seed or fertilizer based on soil nutrient
Artificial intelligence	Monitoring condition of crop Pest detection Crop disease identification Plant species classification
Mobile technology	Remote farm monitoring Farm equipment monitoring
Drone	Crop data generation and surveillance of cultivation lands Capturing site images Observes failure in crop plantation Autonomous pest identification Autonomous pesticides spraying

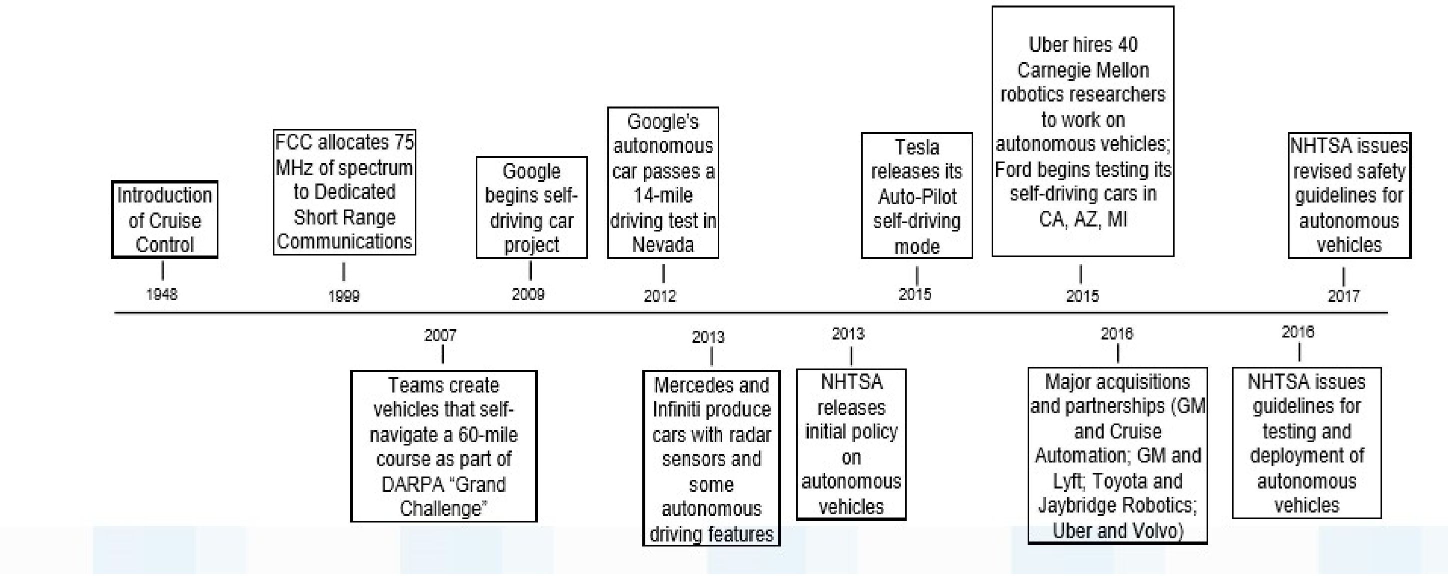
Issues	Causes	Proposed measures
Energy consumption	Sensing Data processing Data transmission	Renewable energy Solar power Kinetic energy
Data collection	Sensing of data	Aggregation Compression
Transmission range	Ecological effect	Multi-tire Ad hoc network Mesh network
Data security	Spoofing Sinkhole Sybil Denial of service Jamming	Access control methods Anomaly detection techniques
Fault tolerance	Physical damage Power depletion Blockage Radio Inference Collision	Redundancy mechanism Clustering techniques
Sensor node placement	Size of sensor node	Deterministic deployment Random deployment

Another example for Smart farming

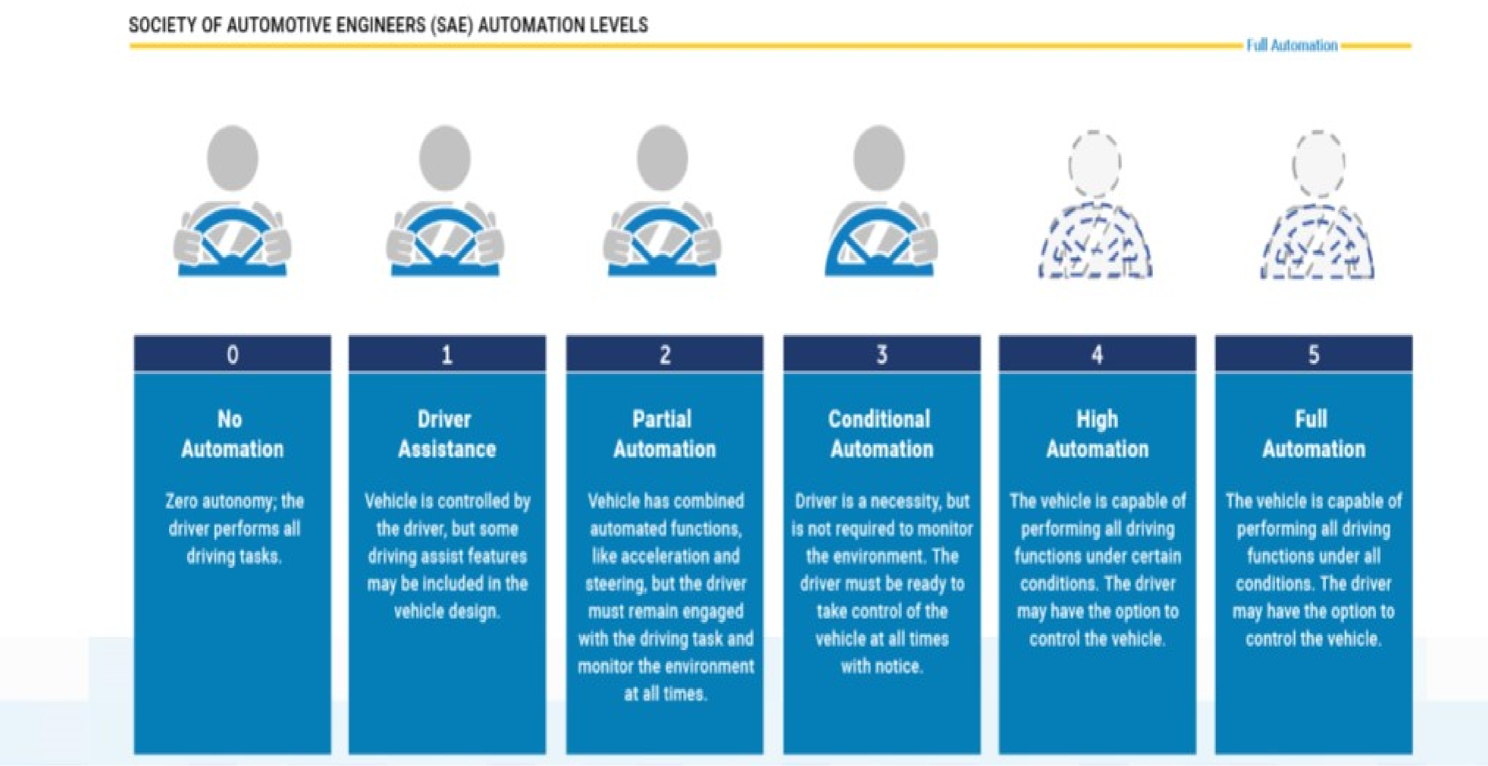


7.2 Example - Automotive electronics - Case Study

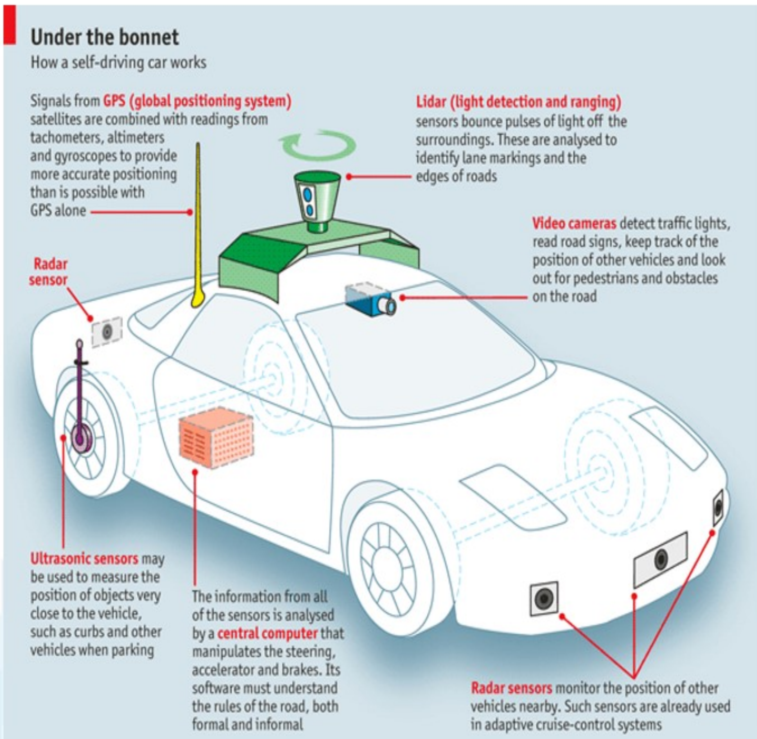
History of Autonomous Vehicles



SAE Levels of Automation



Basic Physical Ecosystem of an Autonomous Vehicle



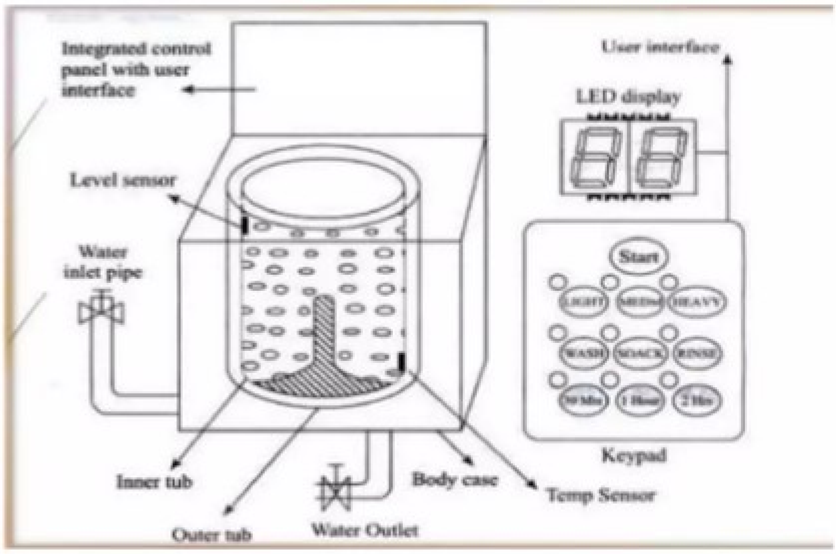
- Global Positioning System (GPS)
- Light Detection and Ranging (LIDAR)
- Cameras (Video)
- Ultrasonic Sensors
- Central Computer
- Radar Sensors
- Dedicated Short-Range Communications-Based Receiver (not pictured)

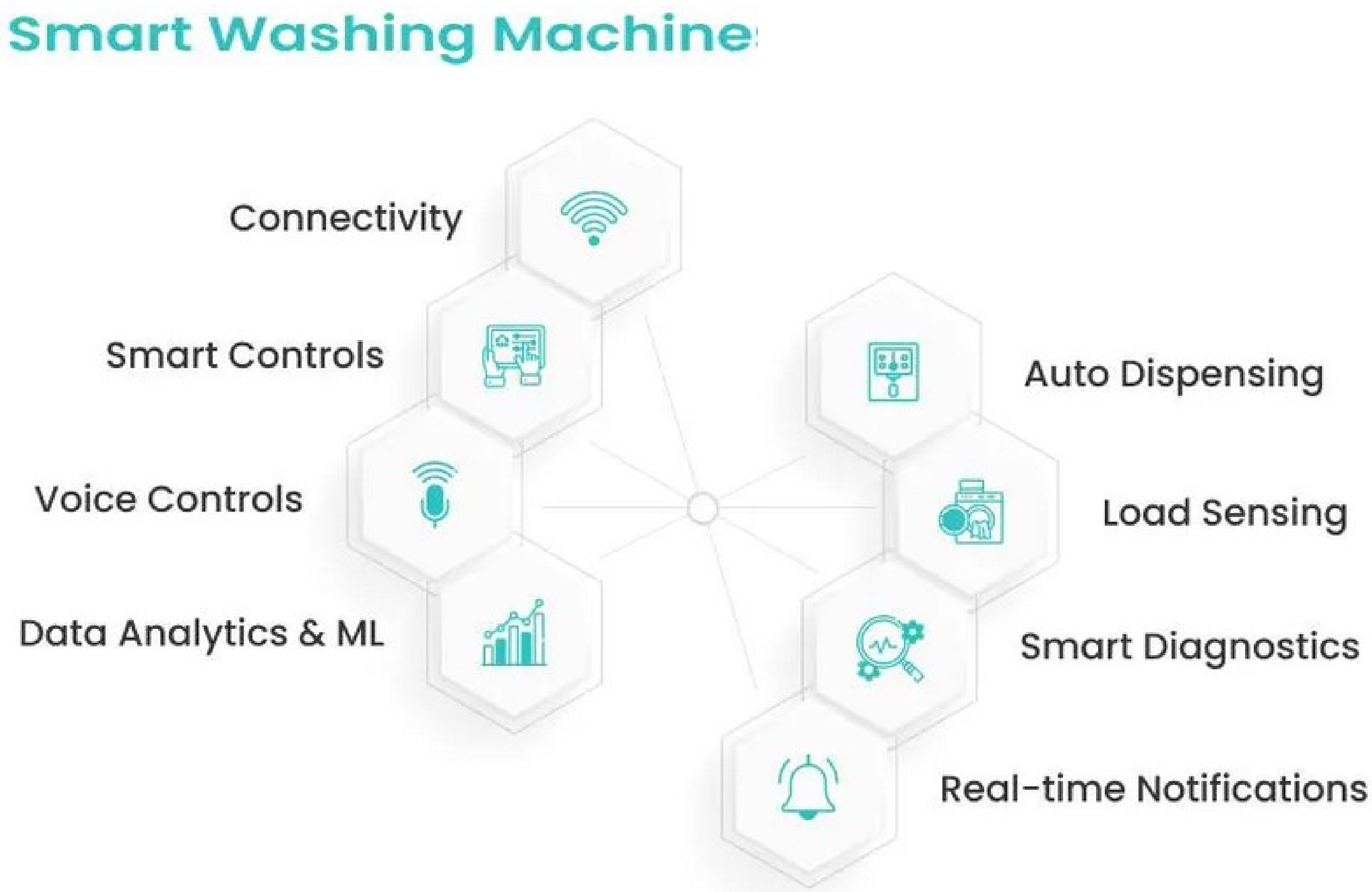
Key Physical Components of Autonomous Vehicles

- **Cameras –** Provide real-time obstacle detection to facilitate lane departure and track roadway information (like road signs).
- **Radar –** Radio waves detect short & long-range depth.
- **LIDAR –** Measures distance by illuminating target with pulsed laser light and measuring reflected pulses with sensors to create 3-D map of area.
- **GPS –** Triangulates position of car using satellites. Current GPS technology is limited to a certain distance. Advanced GPS is in development.
- **Ultrasonic Sensors –** Uses high-frequency sound waves and bounce-back to calculate distance. Best in close range.
- **Central Computer –** "Brain" of the vehicle. Receives information from various components and helps direct vehicle overall.
- **DRSC - Based Receiver –** Communications device permitting vehicle to communicate with other vehicles (V2V) using DSRC, a wireless communication standard that enables reliable data transmission in active safety applications. NHTSA has promoted the use of DSRC.

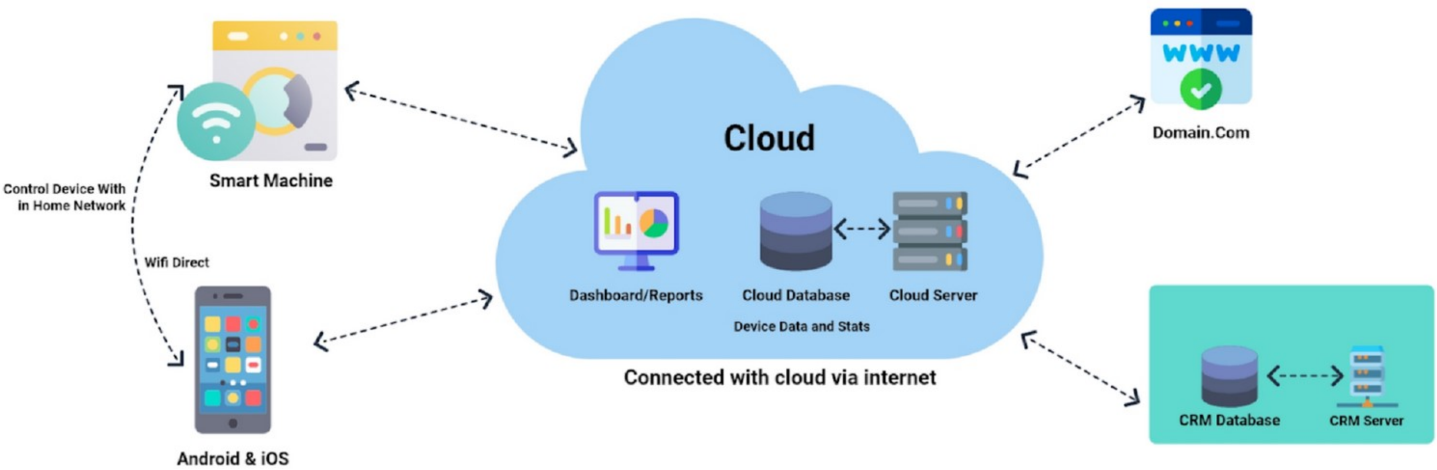
7.3 Example - Consumer Electronics – Case Study

BLOCK DIAGRAM





Smart Washing Machine - System Architecture



7.4 Example – Industrial controls – Case Study

WHAT IS AN INSTRUMENTATION

Instrumentation is the science of applying devices and techniques to measure, display, and control plant process operation.

OBJECTIVES

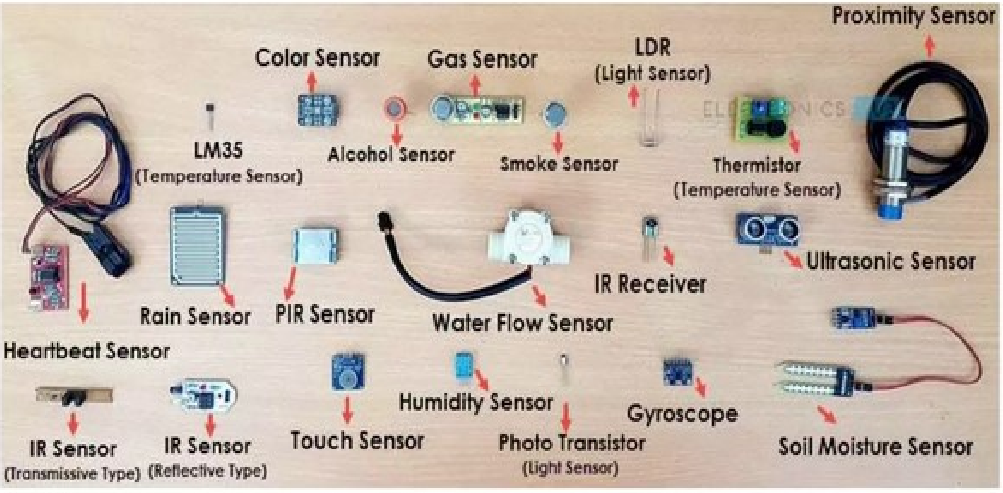
- Optimize process efficiency
- Produce a better product at lower cost in less time
- Provide safety systems for personnel, plant and processes
- Increase and control product quality
- Provide reliable data on raw material, product quantities and
- service related to process economics
- Provide timely and efficient control to avoid mishaps and to equipment and production loss

Few Industrial control Parameters

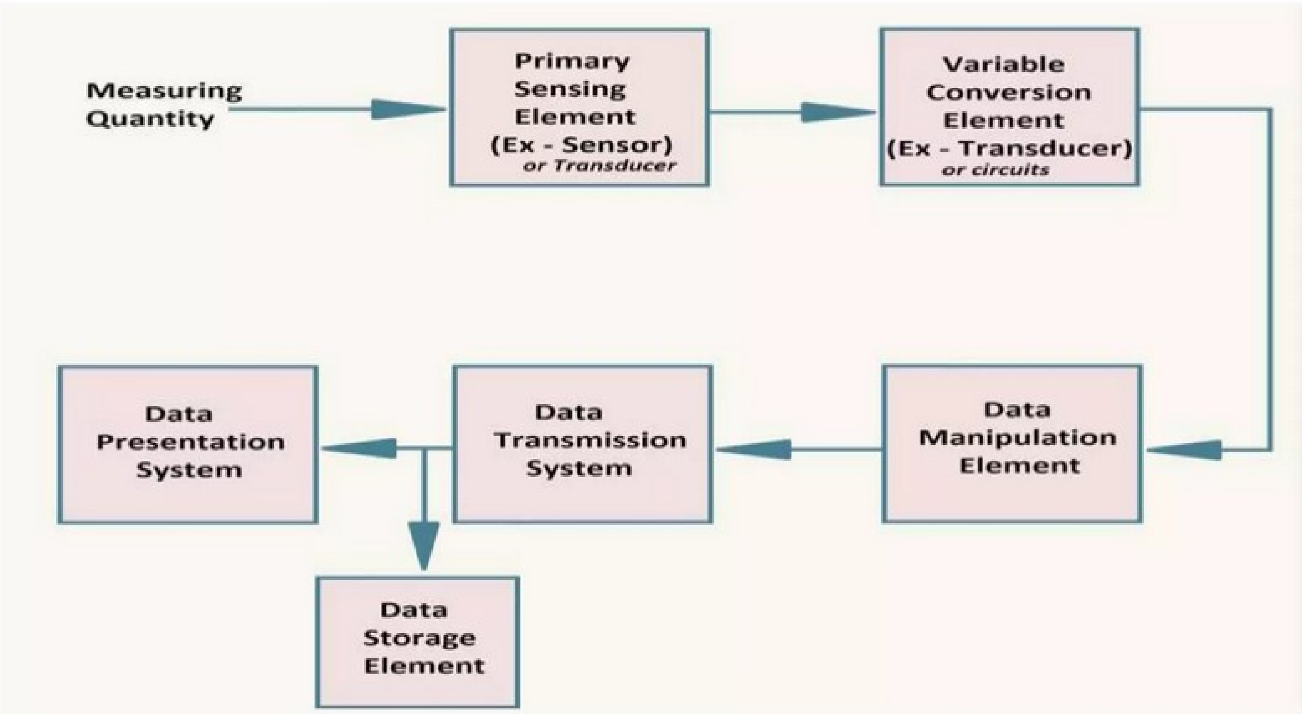
- 1: Temperature measurement
- 2: Pressure measurement
- 3: Flow measurement
- 4: Level measurement
- 5: Analytical measurement
- 6: Vibration and speed monitoring system
- 7: Process Controller
- 8: Final control Elements
- 9: Trend recorders and indicators
- 10: Alarm Annunciation
- 11: Instrument control loops
- 12: Smart instrumentation
- 13: PLC (programmable Logic Controller)
- 14: DCS (Distributed Control System)

SENSORS

Sensors fell the condition and originate the signal followed by the modification and amplification for effective display/transmission or control objective.



FUNCTIONAL ELEMENT OF INSTRUMENTATION



7.5 Example – Industrial controls – Case Study

Medical embedded systems

- Pocket calculators
- Hearing aids
- Implantable pacemakers and cardiac defibrillators
- Portable equipment for physically challenged
- Wristwatches
- Wireless computing

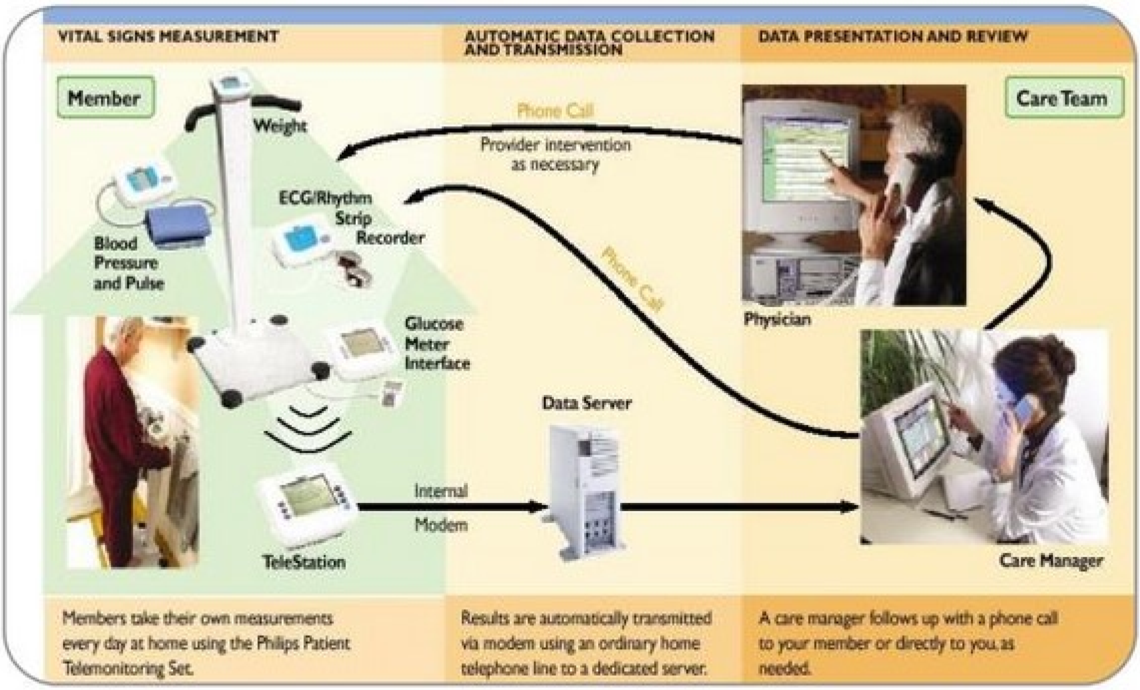
Pacemaker from
Medtronic inc.

Portable defibrillator
From Philips

Power needs are very different – one of the challenge

	Power range	portability	Re charge	Life of device
	10 micro watts	Light weight and wearable	Possible but preferred not	3-10 yrs
	10's of watts	Light weight and portable	Yes once in 24 hrs	10 yrs
	100's of watts	yes	Yes once in 24 hrs	10 yrs
	50 nano – 50 watts	Yes during use	Once after usage	25 yrs
	50 nano to 10 mili watts	no	no	Min 10 years

Remote Patient Management



Standards in Healthcare - Enabler