Low-cost electronics for railway safety applications

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Non-critical safety additions

We are developing low-cost non-critical safety additions, i.e. equipment that helps increasing the safety of rail operation, without being a replacement for previous approaches

Therefore requirements are much more relaxed than for critical equipment, such as signaling and interlock.

Thus this is not like, for example, replacing the human check of train integrity with axle-counting interlocking.
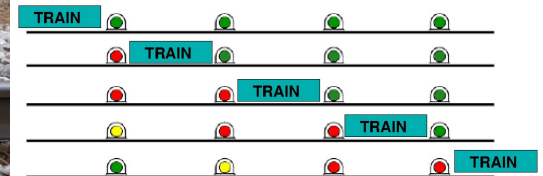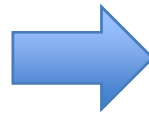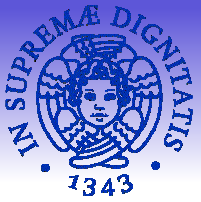
Derailment detection (I)

Derailment of a freight car may remain unnoticed for several kilometers, if it is far from the locomotive, and severe damage to the infrastructure can result

A minor event, if not promptly detected, can lead to a major accident, with extensive property damage and even loss of human life
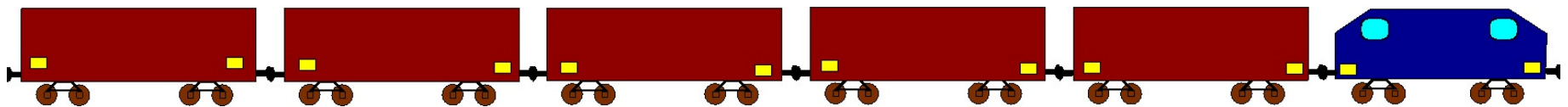
Derailment detection (II)

Existing commercial derailment detection systems for freight trains (manufactured by Knorr Bremse) are based on a mechanical principle and stop the train by acting upon the pneumatic brake line

We have proposed an electronic system exploiting energy scavenging for the power supply, which has the following main characteristics:
- Very low-cost (potentially less than 100 Euro per unit)
- Simple installation on existing freight cars by non-specialists
- Driver warning
- Very long maintenance intervals (several years)
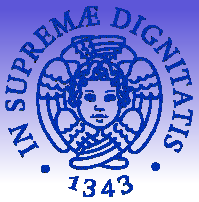- Wireless communication along the train

Derailment detection (III)

Antennas

Accelerometer	→	**Signal processor and logic**	**Comm. module**

Energy scavenger and power supply
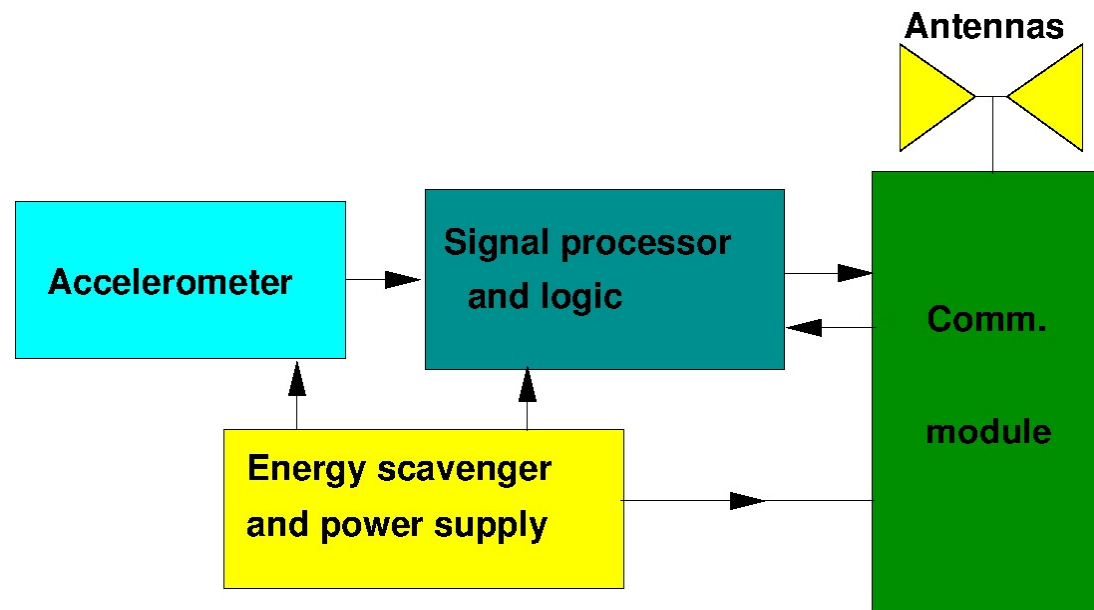
The operation of each node is based on energy scavenged from vibrations and the local processing of the information from an accelerometer
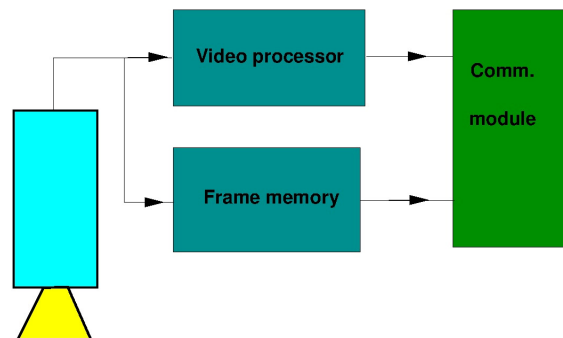
Door monitoring (I)

Several accidents, some even fatal, occur at train doors, in particular during train departure, as a result of improper passenger behavior and/or breach of safety regulations by railway personnel

Our concept consists in the retrofit of low-cost cameras on the top of door frames, with limited built-in image processing capabilities, to detect the presence of passengers in situations that cannot be handled securely even by sensitive edges

Door monitoring (II)

The proposed system is not (at least in the present formulation) a replacement for the visual control by the conductor, but rather an addition to it, providing an additional safety layer

Operation is based on the comparison of the acquired image with the regular background of a safely closed door without any passenger or unexpected object: any discrepancy is communicated to the driver, who can choose to display the acquired still image on a monitor

Communication can take place using a train data bus for new rolling stock or via a wireless link in the case of retrofit to older cars