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ENERGY HARVESTING FOR A BIKE SHARING SYSTEM

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PRESENTATION OUTLINE

- **Introduction to bike-sharing**
 - Why bike-sharing?
 - Differences between bike-sharing generations
 - Disadvantages
- **Bike-sharing New Concept**
 - Problems to solve
 - New characteristics and advantages.
- **Energy harvesting**
 - Technologies
 - State of the art
- **Conclusions and future work**

BIKE-SHARING: WHY?

- **Rapidly adopted by the most important cities**
- **Sustainable transportation**
- **Fast and easy access**
- **Link between public transportation and the destination**
- **Rent bicycle at one location, return at another**
- **Encourage not to use cars for short city-trips**

BIKE SHARING



New York

Source: greenforwardblog



Source: google maps



Aveiro

Source: noticiasdeaveiro

Differences between bike-sharing schemes:

- Type of bicycles
- The way we have access to bicycles
- Bicycle fleet management techniques



China

Source: wikipedia

BIKE SHARING

Disadvantages of actual bike sharing systems:

- **Need of automatic bike vending stations in the city**
- **Leave the bike at a docking station**
 - Docking stations can already be full.
 - Need of huge structures for docking stations.
- **Loss from theft**
- **Hard to reallocate or install docking stations during special events**
- **User acceptance when city's land topography varies**
- **Know the location of nearest bicycles**

BIKE-SHARING NEW CONCEPT

- **Use of electric bicycles (e-bikes)** ✓ Topography problems
- **Assisted pedal-power (pedelec)**
 - Use rechargeable batteries
- **Wheels blocking system in the bicycle** ✓ Less expensive docking stations and structures
- **GPS module** ✓ Theft reduce.
Allows geofencing – virtual docking stations
- **GSM module** ✓ Bicycles management,
locate near bicycles using a smartphone.

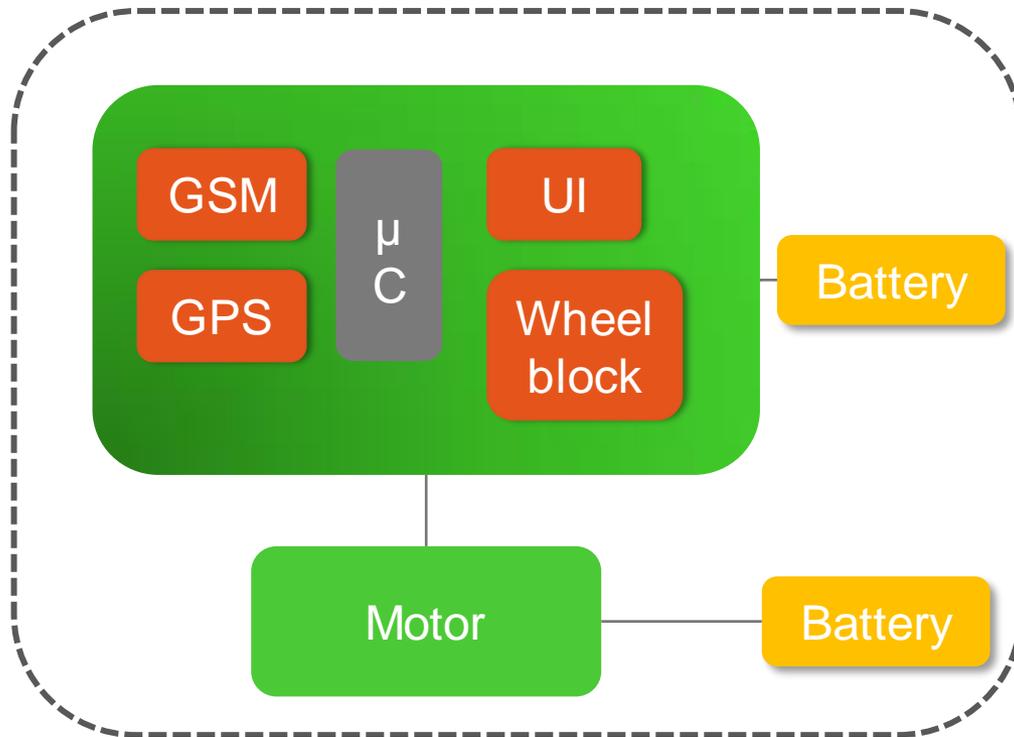
ASSISTED ELECTRIC BIKE



- **Maximum range: 100Km**
- **Charge time: 1 hour**
- **Assisted pedal motor**
- **Reduces the user physical effort**

ENERGY HARVESTING

Bicicleta



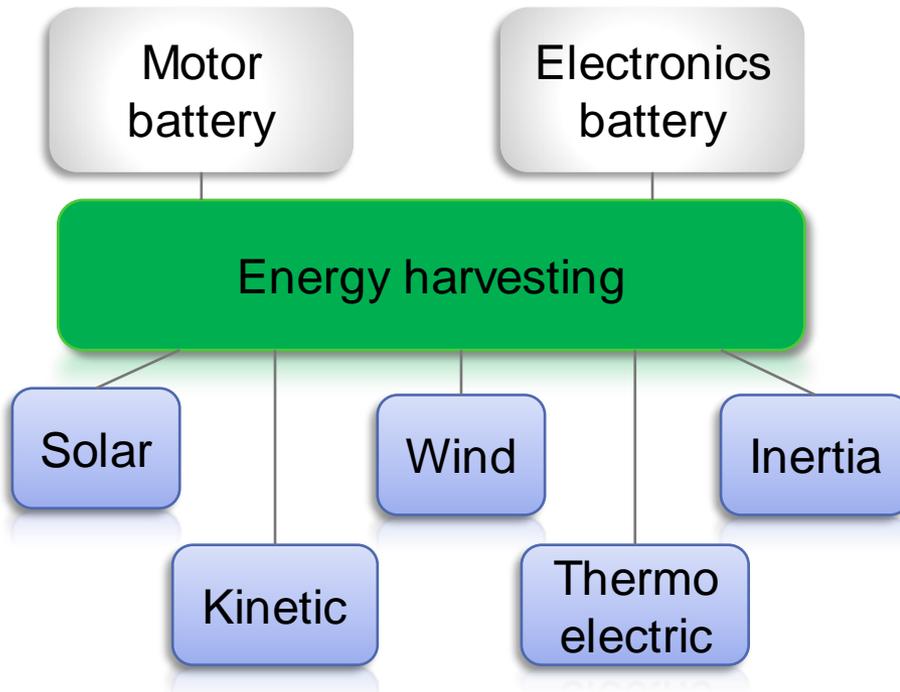
Objectives:

- Create energy from external sources
 - Free energy
- Store energy in batteries.
- Have continuous electric power available.

SOLUTION?

Energy Harvesting

EH SOLUTIONS



Case study research:

- **Ensure energy for electronics**
 - Continuous bicycle location, management and availability.
- **Motor battery recharge**
 - at bike or docking stations
 - Battery replacement?

STATE OF THE ART

“Bicycle management systems in anti-theft, certification, and race by using RFID” [1]

- **System for effective bike management**
 - Production management
 - Sales management
 - Theft management
- **Use of GSM and RFID**

STATE OF THE ART

"Solar energy powered bicycle for wireless supervisory control and remote power management applications," [2]

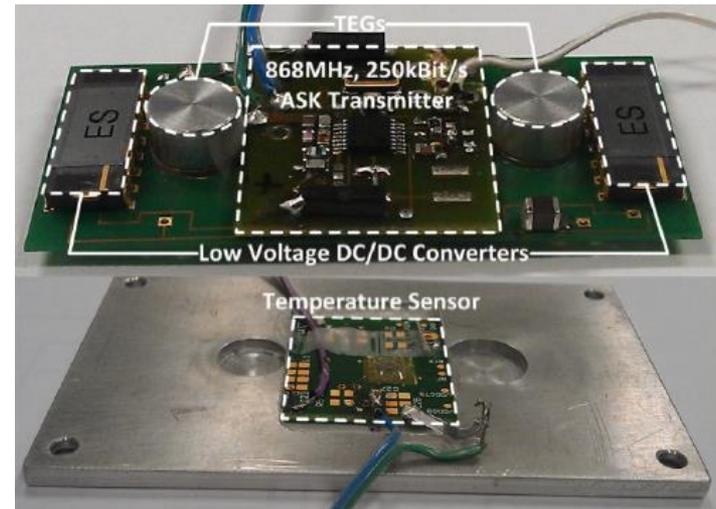
- Experimental application of a solar panel in electric bicycle.
 - 50W solar panel
- Charges two Lead-acid batteries pack.
 - 36Ah batteries
- Summer: 36km -> 54km
- Winter: 36km -> 46km



STATE OF THE ART

"Using thermoelectric energy harvesting to power a self-sustaining temperature sensor in body area networks," [3]

- Thermoelectric energy harvester (TEGs)
 - Extract energy from 1kelvin temperature variation
- Generates enough power for a temperature sensor and data transmission.

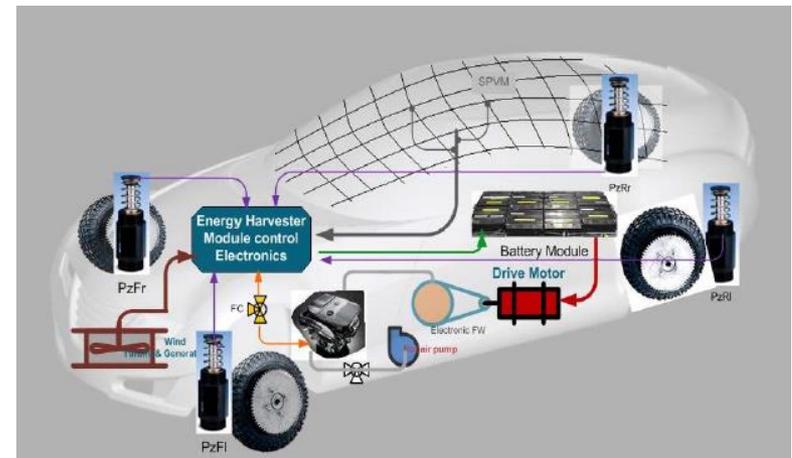


STATE OF THE ART

"Kinetic Energy Harvesting Using Piezoelectric and Electromagnetic Technologies — State of the Art," [4]

"Energy Harvesting & Intelligent load sharing for Electric Hybrid Vehicles," [5]

- Analysis of several piezoelectric energy harvesters
- Generates energy from vibration
- Piezoelectric technology for electric car



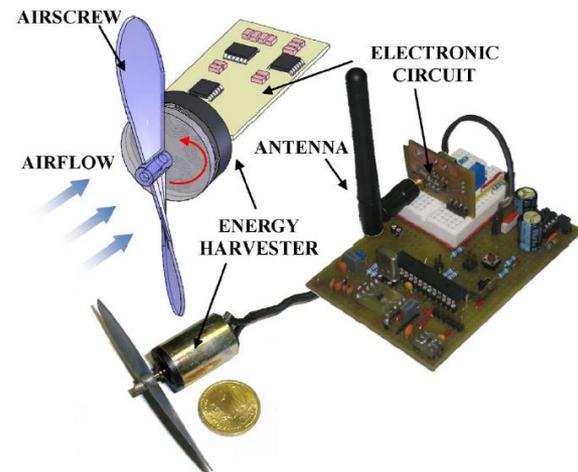
STATE OF THE ART

“Sun, wind and water flow as energy supply for small stationary data acquisition platforms” [6]

“Self-Powered Wireless Sensor for Air Temperature and Velocity measurements With Energy Harvesting Capability” [7]

"Development of micro air flow generator for electrical charging system," [8]

- Wind harvesting solutions applied in agriculture and in motorcycles.
- Generates power with winds at 15km/h
 - Perfect speed for a bike
- Great results to apply for low cost systems.



CONCLUSIONS

- **Bike-sharing will change with the introduction of e-bike.**
 - Easier to use... more users... less traffic... healthy people!
- **GPS and GSM will allow to:**
 - Apply geofencing
 - reduce docking station units
 - Simple to process when cultural events or seasons with more demand
 - Easily locate of the nearest bikes through smartphones
 - Ease bike management process
 - Reduce theft occurrences.
- **Energy harvesting applied in bikes will create possibilities for new applications.**

CONCLUSIONS

- **Several energy harvesting technologies**
 - Solar and wind have good research results.
 - Thermoelectric and kinetic not tested in bicycles yet
 - Good results in cars and human body.
- **Guarantees location and management system always on.**
- **May also allow to charge bicycles' motor batteries at the docking stations or during bicycle use.**
- **Next step**
 - Define all electronics consumptions to decide what harvesting technologies to adopt.
 - Research if harvesting for motor battery is a good solution and the best solution to charge them.

END

Next slides: references

Thank you for your attention

Questions?

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