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## Development of sensor networks for parking using the Internet of Things

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### Abstract

This project aims to study and implements of a sensor network using the concept of Internet of Things (IoT). The main goal is automate car parking without any human intervention, using the Machine to Machine communication (M2M) technology. The use of IoT is precisely to promote an autonomous communication between the various smart objects via the Internet, providing greater system intercom. The basic idea of the application is to make the car becomes intelligent, informing users, busy or free parking spaces in real time, reducing greatly the search time that the user takes to find a place available to park the car. The intelligence of this car is built precisely in the connection between the sensors and the internet network, since each sensor will have its own identification, in order that other sensors recognize and immediately obtain information about themselves, such as their position located at parking. The connection between the sensors, the server and the database will be all provided by a microcontroller system. The smart parking user will get the data in real time via a website or also through an application for smartphones.

### Key words:

*Internet of Things; Sensor Network; Microcontrollers.*

### Introduction

The Internet of Things (IoT) concept emerged in MIT's Auto-ID lab in the late 1990s to explain how sensors would communicate with each other without human interference in a vision of pervasive computing. Disruptive innovation of this concept is that various objects or things (including the most common of our day-to-day, such as refrigerators, cars and air conditioners) can connect to each other and to a remote central control system via the Internet, exchanging information [1].

The main objective of the project is to study the implementation of an intelligent car parking system using the internet of things concepts, implementing a network of low cost and high energy efficiency sensors.

### Results and Discussion

For the use of the IoT parking system, the following interfaces have been created for the user:

Webpage created with the intention that the intelligent parking user has a greater facility to register in to use the system, check the vacancies that are free in the parking lot and also request one of the vacancies that are free to park your car.

The Mobile Application was designed with the same characteristics used in the site (Registration and reservation of vacancies). The application was created in Java language to be used in the Android operating system.

A Marminino microcontroller board was built, which is based on the Arduino board structure. The board was all

manually built in the telecommunications laboratory of School of Technology at UNICAMP. Basically the board has resistors, capacitors, jumpers, an oscillator for the microcontroller clock and an ATMEGA 328P-PU microcontroller. All the algorithm and code made in C++ was compiled and executed in Marminino.

### Conclusions

In this work we combine IoT concepts, sensors, microcontrollers, smartphones and computational programming to construct a IoT system that analyzes real-time parking spots and informs the user in a dynamic way what spots are occupied and which are available to park, making the place a smart parking lot. This system can be extended to include others applications, for example, related to smart cities, to help solving problems in an efficient and sustainable way, increasing the interoperability between the actuators [2].

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<sup>1</sup> Q. Wu, "Cognitive Internet of Things: A New Paradigm beyond Connection", 2014, disponível em: <http://arxiv.org/pdf/1403.2498.pdf>, acessado em 12/11/2015.

<sup>2</sup> Felipe Muhamed-Avila, Thallyson Silva, Tania Tronco and Luis Fernando de Avila, Temperature Humidity Monitoring and Control Application Using Concepts of Internet of Things, 2015 XXXIII SIMPÓSIO BRASILEIRO DE TELECOMUNICAÇÕES, 1-4 DE SETEMBRO DE 2015, JUIZ DE FORA, MG.