

**COMENIUS UNIVERSITY IN BRATISLAVA  
FACULTY OF MATHEMATICS, PHYSICS AND  
INFORMATICS**

**INTERNET OF THINGS IN  
AUTOMOTIVE INDUSTRY**

**Bachelor's thesis**

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Department: Department of Applied Informatics  
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.....  
študent

.....  
vedúci práce

## **Declaration of Authorship**

I confirm that this Bachelor's thesis is my own work and I have documented all sources and material used.

Bratislava May 26, 2015

.....

## **Acknowledgements**

I would like to thank my supervisor...

## **Abstrakt**

Tu je text slovenskej verzie abstraktu

**Kľúčové slová:** *slovo1, slovo2, slovo3, slovo4*

## **Abstract**

In this bachelor thesis we will show you the possibilities of connected cars, options in what advanced services a connected vehicle can provide and how you can do it in the first place. After a thoughtful study of our work anybody with computer science background will be able to build a device which will be capable of advanced services based on his/her needs.

**Keywords:** *Automotive industry, IoT, Big Data, Embedded device*

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# Introduction

Most of us who watched Knight Rider as a kid expected that by 2015 we would be driving self-aware cars like KITT - cars that would drive us without problems from point A to point B while entertaining us. However we can resort to that this is only partially true, we have successful tries at completely autonomous cars(e.g Google's car) but for ordinary costumer they are not available. What is available is connected cars. Connected cars provide the possibility of internet-based transfer of information. This can be obtained either with embedded devices in car or smartphone. Multiple car manufacturers sell connected cars where different OEM(Original Equipment Manufacturer) devices or applications. These OEMs offer various services which are provided to you when you purchase their car, but there is a small problem. If you are not satisfied with services provided by your manufacturer, the only option you have is to buy someone else product which comes with predefined services. You can not configue them to the extent as smartphones have apps. It is either you will get used to your OEM solution or go and buy whole solution from somebody else, nothing else. It is like we are stuck in the 90, where software offered to you had come on this particular hardware and you could not choose otherwise. It is 2015 where you can obtain music,movies,applications from various sources that does not limit you to specific hardware, so why on earth we should accept solutions offered by car manufacturers? Imagine you would buy smartphone with predifined set of applications and you could not change them or add new. Today in connected cars what is missing is operating system which would allow costumers to configure their Info-attainment system.So in my thesis I would like to solve problem where when you have car which has no connection or has connection with software you do not like, you could follow my thesis to gain insight into how to connect car and what possible services you can obtain for yourself. In first chapter I will establish some common ground on which we can build foundations of this thesis. Next we can describe the specification of problem which we need to solve and after that show implementation methods and solution to this given task.

# 1. Overview

## 1.1 Internet of Things

### 1.1.1 General Information

The Internet of Things (IoT) is a global infrastructure for further informatization of society, enabling advanced services by interconnecting things based on available technologies. Through identification, data capture, communication and processing capabilities, the IoT makes full use of things to offer services to all kinds of applications. Whilst IoT is a hot topic in the industry it is not a new concept. It was initially put forward by Mark Weiser in the early 1990s. This concept is opening up huge opportunities for both the society and individuals. However, it also involves risks and undoubtedly represents an immense technical and social challenge.[2]

“Things”, in the Internet of Things refer to a various devices. From hardware level they are all designed to do different things, collect data from various environments and sources. However, in software aspect they behave more generally, in simplistic form it's a thing which can report data and act upon them. Objectification is important, because then you can combine many things to work together and communicate between them. Current market example could be the smart thermostat systems combining washer/dryers that use Wi-Fi for remote access.

### 1.1.2 Benefits

IoT is generating a lot of interest in a wide range of industries. Here are a few examples of some significant early adopters:

- In the healthcare field, medical device manufacturer Varian Medical Systems is seeing a 50 percent reduction in mean time to repair their connected devices.[5] With IoT, Varian reduced customer service costs by \$2,000 for each problem resolved remotely, with 20 percent fewer technician dispatches worldwide.
- Tire maker Pirelli is using IoT to gain valuable insights about the performance of its products in nearreal time. The company is using an analytics platform to manage the huge amounts of data gathered directly from sensors embedded in the tires in its Cyber Tyre range. The system allows the pressure, temperature, and mileage of each tire to be monitored remotely. By keeping these factors in range, fleet managers can have a significant impact on

fuel economy and safety. In a trial covering nearly 10 million miles, Cyber Tyres saved the equivalent of \$1,500 per truck per year.

- Ford Motor Company's Connected Car Dashboards program collects and analyzes data from vehicles in order to gain insights about driving patterns and vehicle performance. The data is analyzed and then visualized graphically using a big data platform. Among the goals are better vehicle design and improved safety for occupants.
- In the public service sector, the Boston police department operates a "real-time crime center" that receives dozens of feeds from street cameras and other sensors around the city. The resulting data gives researchers the ability to analyze and match videos from incidents to help identify suspects, mobilize resources, and even map evacuation routes during emergencies

IoT has the potential to transform the way companies make products, track goods and assets in the supply chain, monitor the performance of systems in the field, provide security for employees and facilities, and provide services to customers. Clearly, it's enabling transformation in both the private and public sectors. "I firmly believe that there is not a single industry that won't benefit from IoT," Turner said. IoT is also changing the way businesses impact society and the environment. "Overall, the world needs better and more sustainable ways to live," said Stephen Miles, research affiliate at the Center for Biomedical Innovation at the Massachusetts Institute of Technology. "To accomplish this, companies need better, more holistic models that capture a complete picture of what is happening so that they can better access and optimize these systems."

### **1.1.3 Why is it important?**

In my thesis I will connect a thing(car) to the internet so following principles which was set by IoT field will allow me to build better and more secure solution[7].

## **1.2 Big Data**

### **1.2.1 General Information**

The rise of digital and mobile communication has made the world become more connected, networked, and traceable and has typically lead to the availability of such large scale data sets that the traditional data processing applications are insufficient. As the result new field trying to deal with this problem, have been created which scientists and computer engineers have coined 'Big Data'.

### **1.2.2 Concept**

### **1.2.3 Benefits**

### **1.2.4 Why is it important?**

When we will have connected car, we will need to collect information, e.g. data. With Big Data approach our solution will be scaleable without need for adaptation if a very big number of devices would be connected.

## **1.3 Single-board computer**

### **1.3.1 General Information**

A single-board computer(SBC) is complete functional computer built on single circuit board. It has microprocessor, memory, input/output and other features depending on the model and manufacturer. Single-board computers are used for educational purposes, embedded solutions and development research/systems.

### **1.3.2 Why is it important?**

Since we will be building embedded device which will allow us to gather data and send them to the Internet, it is necessary to choose a single-board computer which will fit fulfill our needs.

## **1.4 OBD-II port**

### **1.4.1 General Information**

OBD II is an acronym for On-Board Diagnostics II, the second generation of on-board self-diagnostic equipment. On-board diagnostic capabilities are incorporated into the hardware and software of a vehicle's on-board computer to monitor virtually every component in the car. Each component is checked by a diagnostic routine to verify that it is functioning properly. If a problem or malfunction is detected, the OBD II system will alert the driver that something is wrong. The system will also store important information about any detected malfunction so that a repair technician can accurately find and fix the problem.

### **1.4.2 Concept**

The OBD-II standard specifies the type of the connector and its pinout, the messaging format and electrical signalling protocols available. OBD-II also provides a list of vehicle accessible parameters for monitoring together with how to encode the data for each. One of the pin in the connector provides power to the connected unit, so it could run from the vehicle battery, which simplify use of scantools, because you do not need auxiliary power. On the other hand, sometimes auxiliary power is needed, because of car malfunction which could shutdown the scan tool and lead to loss of diagnostic data. Finally, the OBD-II standard provides an extensible list of DTCs(Diagnostic trouble codes). As a result of this standardization, a single device can query the on-board computer(s) in any vehicle. OBD-II standardization was prompted by emissions requirements, and though only emission-related codes and data are required to be transmitted through it, most manufacturers have made the OBD-II Data Link Connector the only one in the vehicle through which all systems are diagnosed and programmed. OBD-II Diagnostic Trouble Codes are 4-digit, preceded by a letter: P for engine and transmission (powertrain), B for body, C for chassis, and U for network. [6]

### **1.4.3 Why is it important?**

One of the main sources of information in my thesis will be data from OBD-II diagnostic port. This data will be accessible later in the database and we can preform logical deduction on them.

## **1.5 Accelerometer**

### **1.5.1 General Information**

An accelerometer measures proper acceleration which is the acceleration it experiences relative to freefall, and is the acceleration that is felt by people and objects. Put another way, at any point in spacetime the equivalence principle guarantees the existence of a local inertial frame, and an accelerometer measures the acceleration relative to that frame.[3]As a consequence an accelerometer at rest relative to the Earth's surface will indicate approximately 1 g upwards, because any point on the earth's surface is accelerating upwards relative to a local inertial frame. To obtain the acceleration due to motion with respect to the earth, this "gravity offset"should be subtracted.

The reason for the appearance of a gravitational offset is Einstein's equivalence principle[4], which states that the effects of gravity on an object are indistinguishable from acceleration of the reference frame. When held fixed in a gravitational field by, for example, applying

a ground reaction force or an equivalent upward thrust, the reference frame for an accelerometer (its own casing) accelerates upwards with respect to a free-falling reference frame. The effect of this reference frame acceleration is indistinguishable from any other acceleration experienced by the instrument. An accelerometer will read zero during free fall. This includes use in a spaceship orbiting earth, but not a (non-free) fall with air resistance where drag forces reduce the acceleration until terminal velocity is reached, at which point the device would once again indicate 1 g acceleration upwards.

### **1.5.2 Why is it important?**

For accident detection we will use accelerometer to determine if accident occurred[1]. Application will proactively monitor the occurrence of accident using accelerometer sensor. When the accelerometer sensor values exceeds the threshold value, system can act upon it.

## **2. Specification**

### **2.1 Requirements**

#### **2.1.1 Hardware**

Create a device which will be able to communicate over the Internet. Figure out how to connect this device to the OBD-II service port in vehicle. Your device will need to know position of the vehicle, create a solution which will utilize GPS connection when available. Prepare atleast one more source of information which will be relevant for you application solution.

#### **2.1.2 Server**

Develop a software server which will be able to log and store data collected from various inputs. These inputs will be modular, your solution have to be configurable for new input sources. One of these sources will be an OBD-II port in vehicle. Figure out how to connect your device to the OBD-II service port and how to collect information from this port. Parse collected data and create database of available information. To access this database create API/REST architecture which will be accessible securely from the Internet. Use any technology available to you.

#### **2.1.3 Application**

Create an application which will utilize information collected from connected vehicle. The application needs to perform logic deduction from accessed data and act upon it. First application will be accident detection/prevention. This application will access statistical database of accidents, look up how many of accidents happened in the location where vehicle is, if this number is higher than average inform driver of hazardous area. Design a system which will detect if accident happens, if so send an SMS/email to recipient depending on the settings, with contact information of driver and car's location. Second application will create statistical map of cars running on low fuel, so after you detect low fuel in the vehicle, log its position in your application, interpolate your collected data to the map also display real time position of cars which has low fuel.



### **2.1.4 Output**

### 3. Návrh - ako vložiť ukážku kódu

farby a ďalšie kľúčové slova na zvýraznenie sa dajú určiť v definícii `lstset` ktorá je v `main.tex` nasleduje niečo ako JQuery....

```
(new MojObj());          //vytvorenie
MojObj = function() {
  var preml = [];
  var bool = 0;
  var construct = function() {
    var preml = $('#id').find('div');
    preml.each(function() {
      preml.push(new obj(this));
    });
    $(document).click(nejakaFunkcia);
  }
  var funkcia = function() {
    for (var i in preml) {
      if ( bool ) { //tak nieco sprav
      }
    }
    bool = !bool;
  }
  $(document).ready(construct);
};
```

Momentálne je `lstset` nastavený na jazyk PHP, tak automaticky zvýrazní syntax aj bez pridávania kľúčových slov

ukážka php kódu

```
<?php
function randomcode() {    //komentarik
  $var = "abcdefghijklmnopqrstuvwxyz0123456789";
  $rand = (double)microtime()*1000000;
  $i = 0;
  while ($i <= 7) {
    $num = rand() % 33;
    $tmp = substr($var, $num, 1);
    if (isset($code)) {
      $code = $code . $tmp;
    }
  }
}
```

```
    $i++;  
}  
return $code;  
}  
?>
```

## **4. Záver**

Cieľom diplomovej práce bolo...

V práci som.....

Ďalší možný rozvoj....

# Zdroje

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# Prílohy

CD obsahujúce:

- Elektronickú verziu
- Zdrojáky
- atď