

# IoT'nin Enerji Sektörüne etkisi

Barış Sanlı

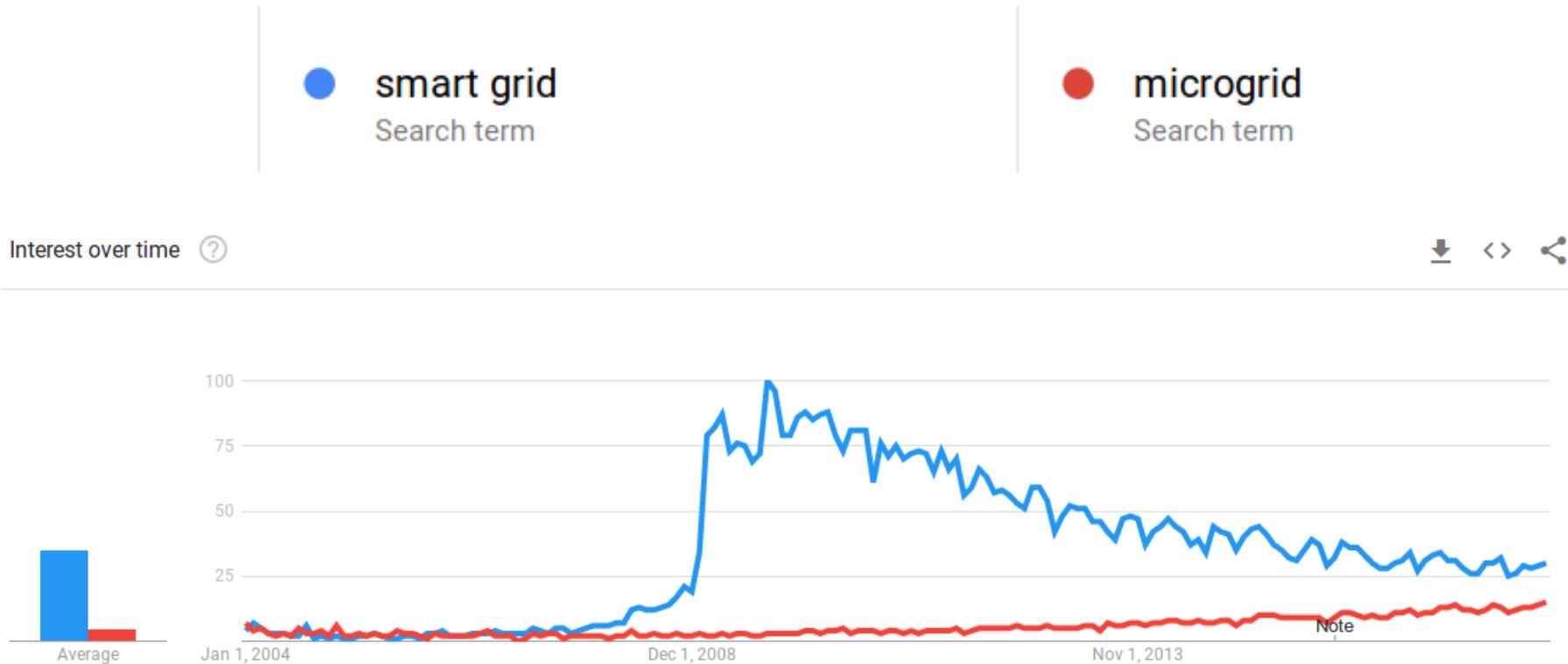
[www.barissanli.com](http://www.barissanli.com)

# İçindekiler

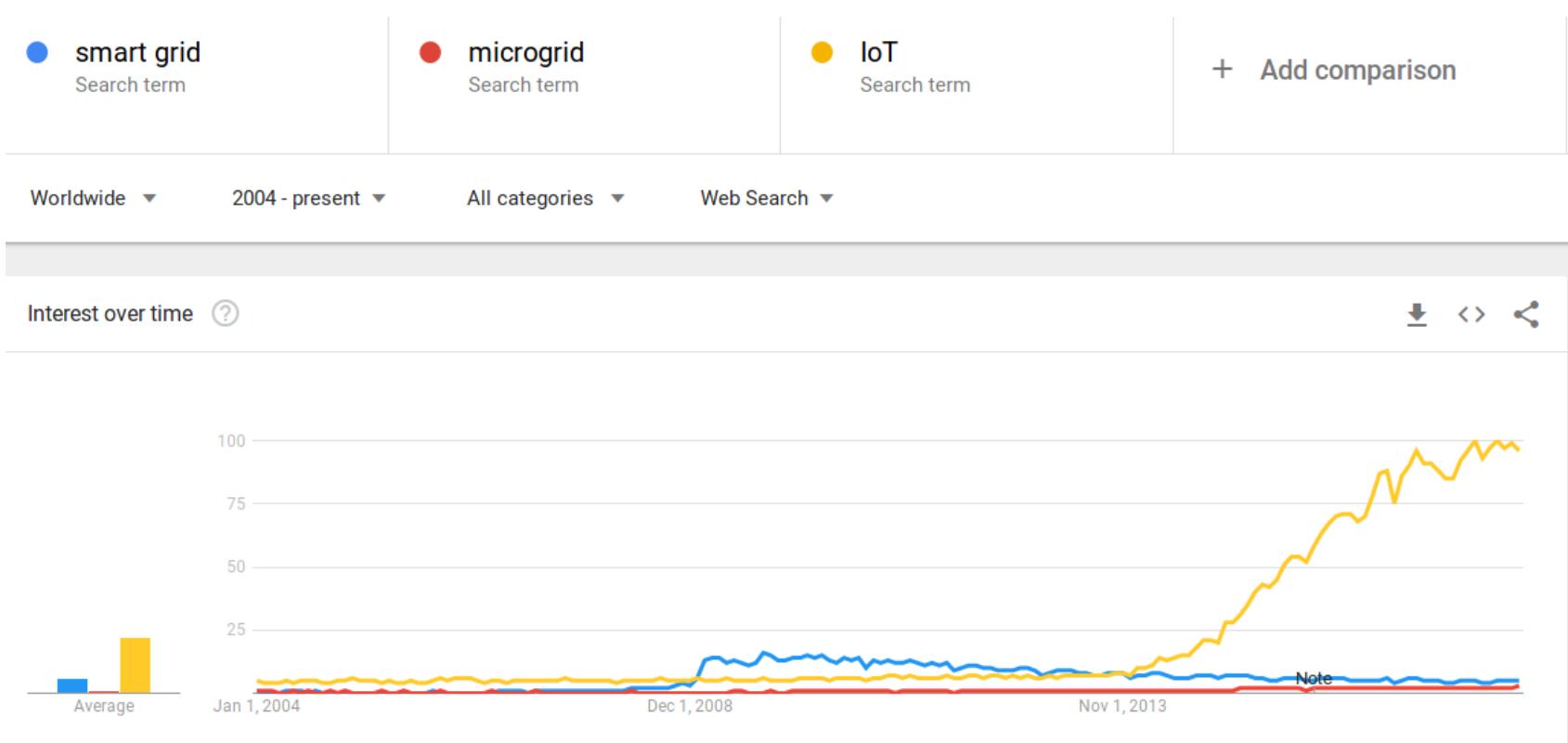
- Kavramların gelişimi
- Teknoloji – Düşünsel kritik
- Önceki bölümlerde (kişisel)
- Yeni çalışmalar (kişisel)
- IoT Ulaştırmada
- Akademik (IEEE daha çok)
- Tartışma

# Kavramların Gelişimi

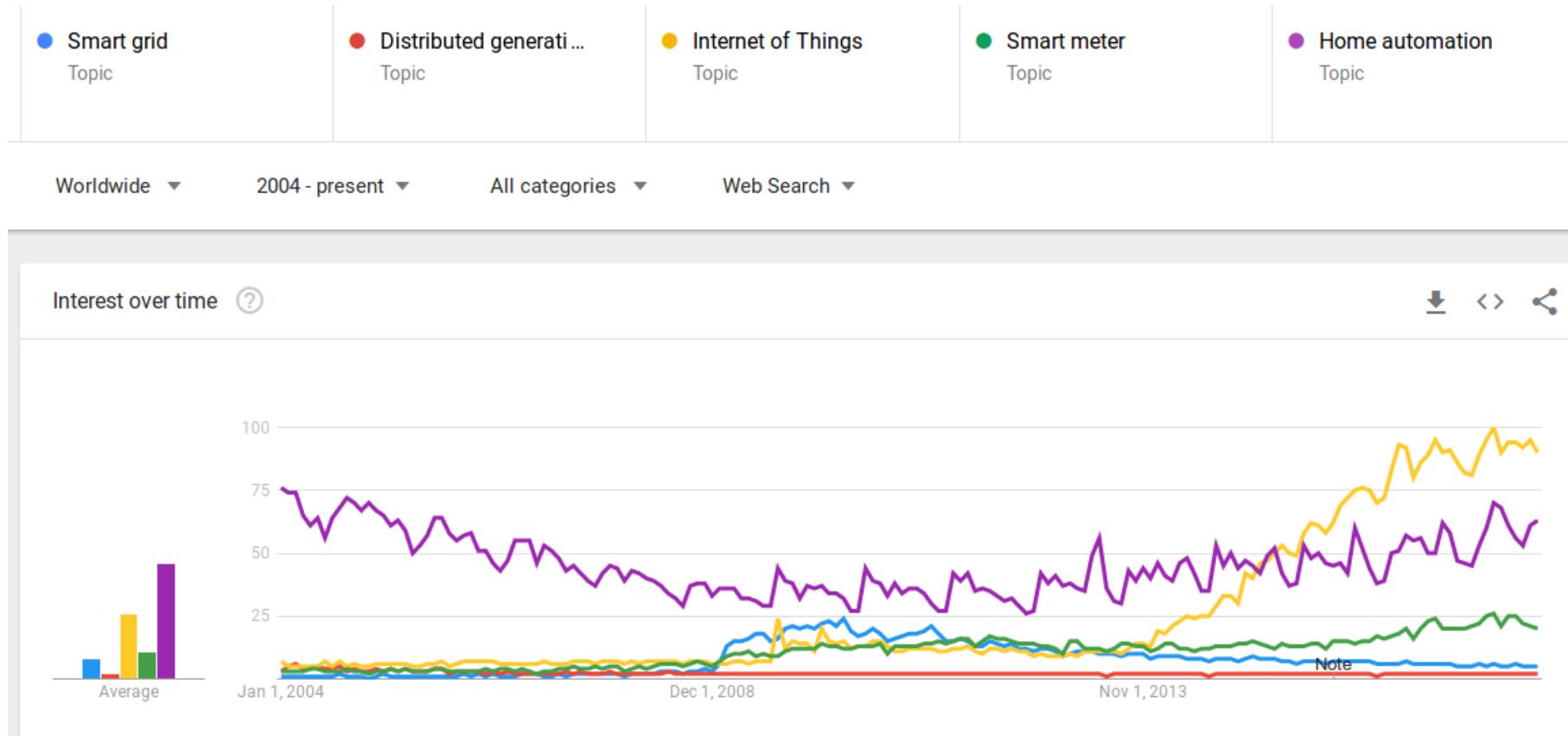
# Smartgrid ve Microgrid



# Ve IoT ile



# Ev Otomasyonu



# IoT, IIoT

- IoT (Internet of Things)
  - Genel, sivil
- IIoT (Industrial Internet of Things)
  - Sanayi, makineler
- İleride E-Lan, Fog computing

# Teknoloji

## Teori ve Pratik

# Gelecek teknolojilerinden bir tutam



# Teori



# Pratik



Algı



Hata/eksikliğin tanımı

<https://www.youtube.com/watch?v=guqpuNWQDhc>

www.kursusani.com

# Pılokşey ne demek la



# Önceki bölümlerde

## Daha önceki çalışmalar:

<http://www.barissanli.com/calismalar/2017/20170216-bsanli-iot.pdf>

<http://www.barissanli.com/electronics>

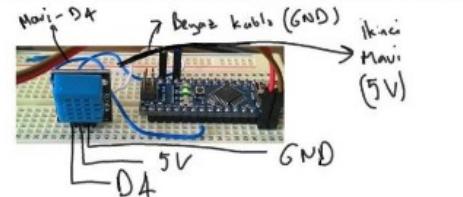
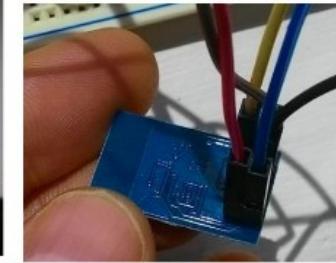
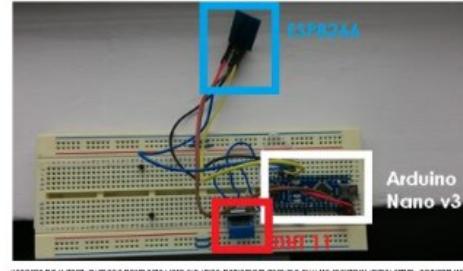
# İlk denemeler

Arduion + ESP8266 + DHT11?Röle



İlk çıktı

# Donanım



<http://www.barissanli.com/electronics/webserver.php>



# NodeMCU



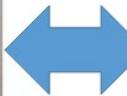
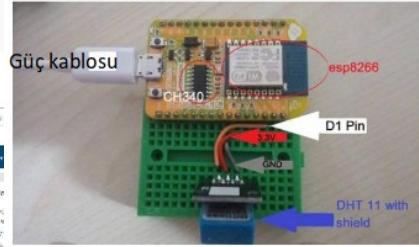
Wifi modül  
Lua ile yazılım  
1 analog giriş



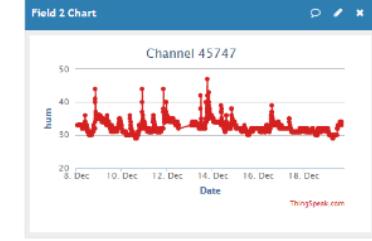
## Aynı Proje NodeMCU



- Minimal tasarım

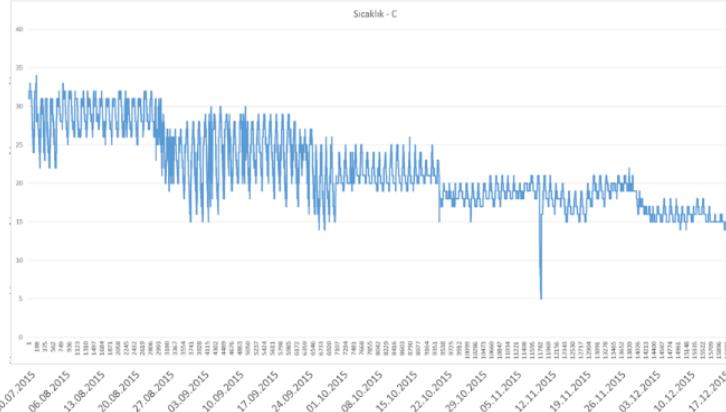


## ThingSpeak

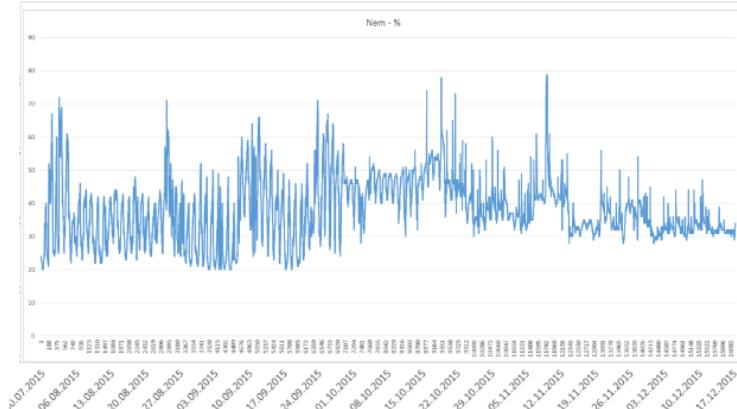


<https://thingspeak.com/channels/45747>

## Sıcaklık



## Nem %



aris

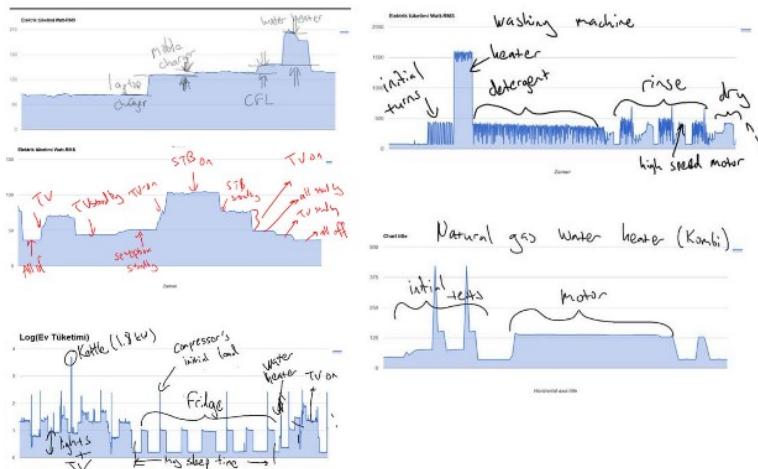
# (Spark)Particle Photon



Bulut destekli  
Web arayüzü ile geliştirme  
Arduino uyumlu  
Web: build.particle.io

İlla cloud'a bağlanacak

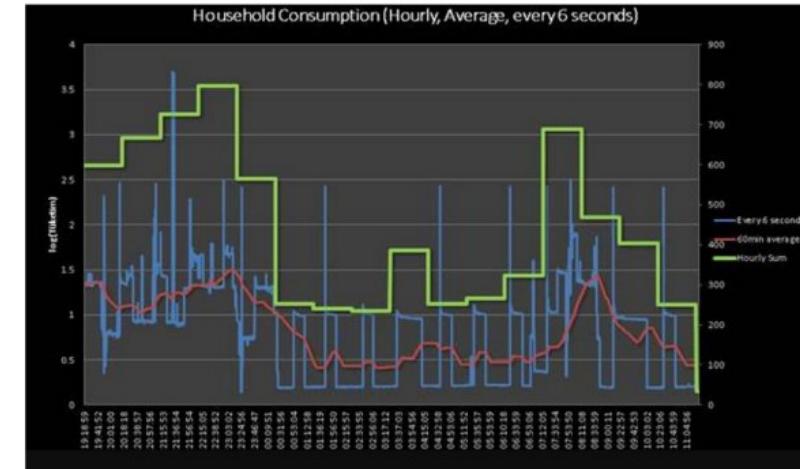
## İlk sonuçlar



# Donanım

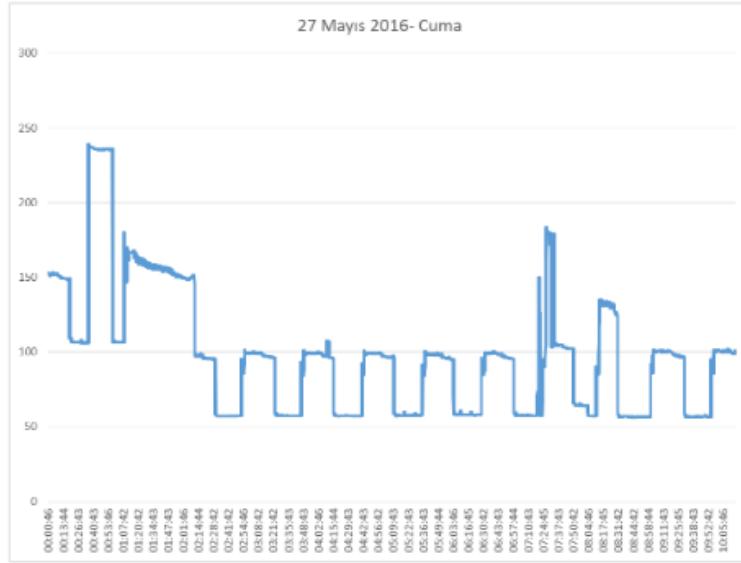


## En önemli Sonuç

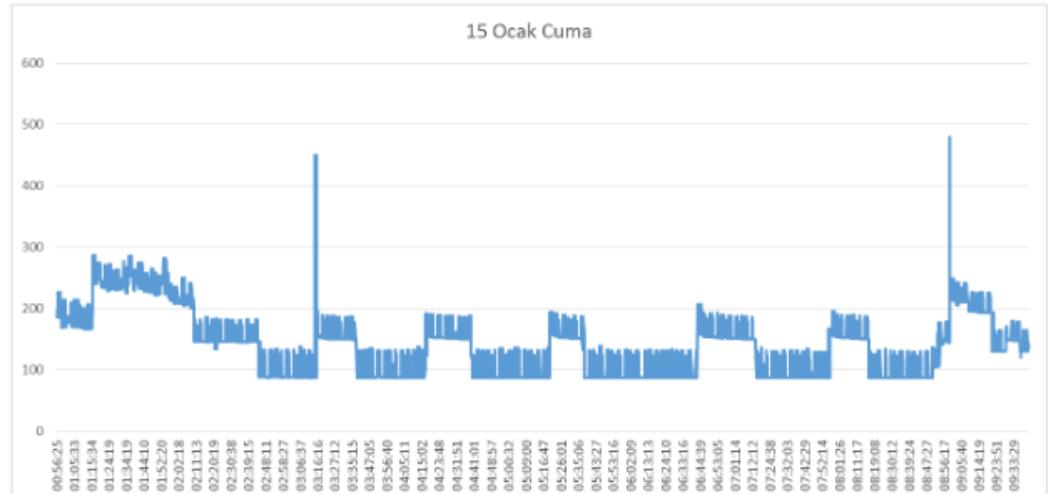


# Kışın elektrik faturaları neden yüksek gelir?

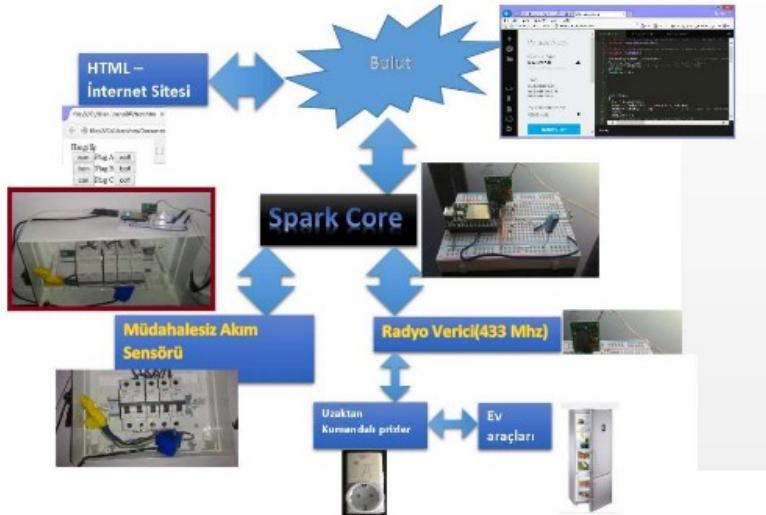
27 Mayıs Cuma



15 Ocak Cuma



## Proje sistemi



The screenshot shows the Particle IDE interface. On the left, the 'Particle Apps' sidebar lists the current app as 'NANODR' with an optional description 'Optional description'. Under 'File', the included files are listed: 'NANODR.ino', 'RCswitch.cpp', and 'RCswitch.h'. In the center, the 'My apps' section shows a list of available apps: 'BLINK AN LED', 'LEDS', 'RC-SWITCH', 'ENERGYMON', and 'NANODR'. A 'CREATE NEW APP' button is visible. On the right, the code editor displays the 'RCswitch.cpp' file:

```

// This structure statement was automatically added by the Spark IDE.
#include "semolib/semonlib.h"

// This structure statement was automatically added by the Particle IDE.
// This structure statement was automatically added by the Particle IDE.
// This structure statement was automatically added by the Particle IDE.
// This structure statement was automatically added by the Particle IDE.

#include "RCswitch.h"
#include "semolib/semonlib.h"

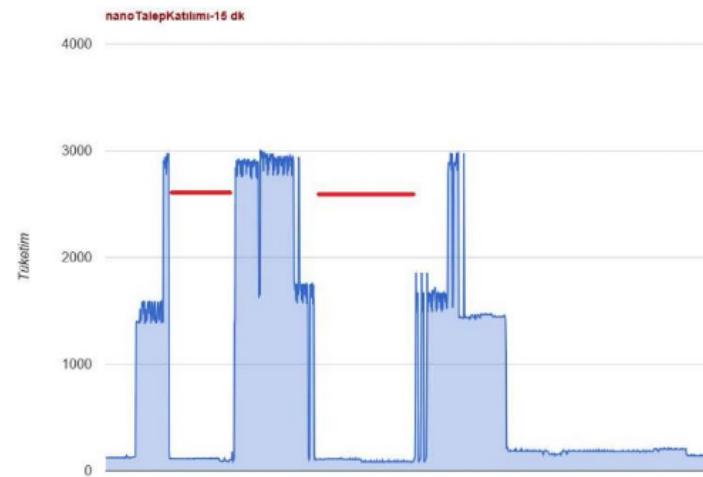
// Create an instance
RCswitch mySwitch = RCswitch();
// Create an instance
EnergyMonitor emon;
// String to store the sensor data
int sys;
double val[14];

void setup()
{
    Serial.begin(9600);
    EnergyMonitor.begin();
    Serial.println("Setup");
    Serial.println("RCswitch initialized");
    Serial.println("EnergyMonitor initialized");
    Serial.println("Time initialized");
    Serial.println("Systime initialized");
    Serial.println("val initialized");
    Serial.print("This is now: ");
    Serial.print(amon.read());
}

void loop()
{
    double raw = mySwitch.read();
    if (raw > 1000)
        Serial.println("Power");
    else
        Serial.println("No Power");
    emon.read();
    val[0] = emon.read();
    val[1] = amon.read();
    val[2] = time.read();
    val[3] = systime.read();
    val[4] = raw;
    Serial.print("val[0]: ");
    Serial.print(val[0]);
    Serial.print("val[1]: ");
    Serial.print(val[1]);
    Serial.print("val[2]: ");
    Serial.print(val[2]);
    Serial.print("val[3]: ");
    Serial.print(val[3]);
    Serial.print("val[4]: ");
    Serial.print(val[4]);
}

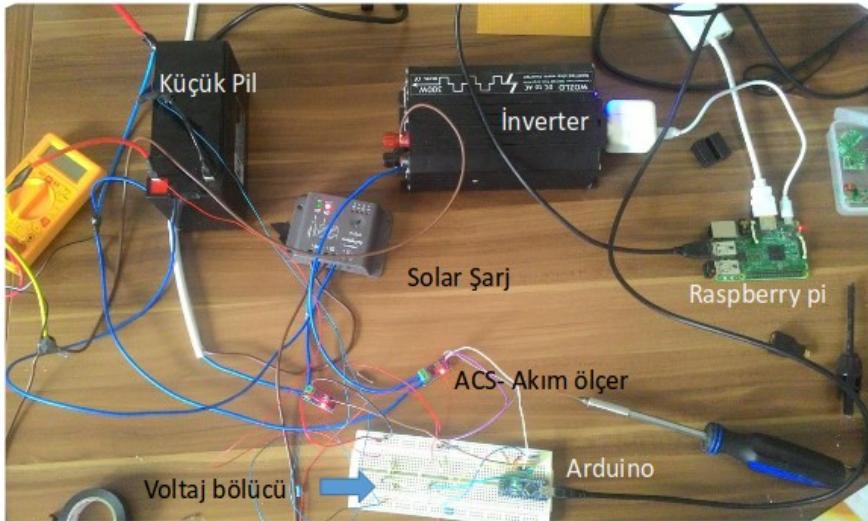
```

## Uygulama



# Güneş enerjisi sistemi ve Raspberry Pi

Ve veriler



<http://barissanli.com/ev>

# İkinci versiyon

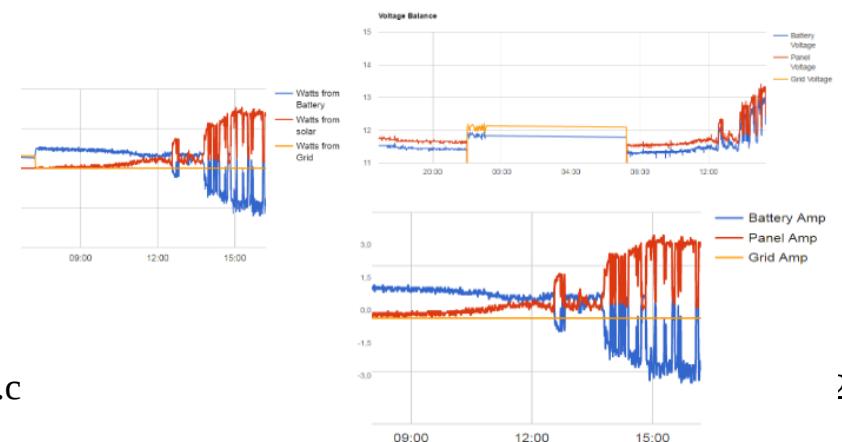
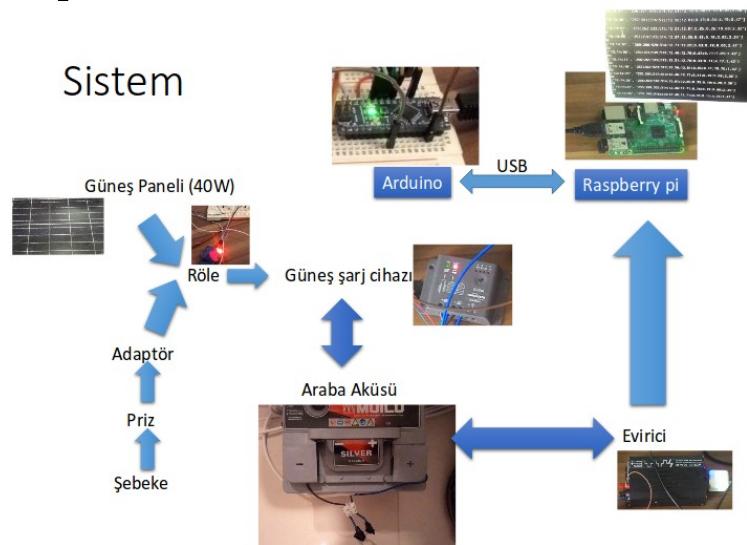
## Versiyon 2 – Aktif kontrol



Röle

433 Mhz Verici (Adaptörü kapatmak için)  
[www.barissanli.c](http://www.barissanli.c)

### Sistem



# Yeni Çalışmalar

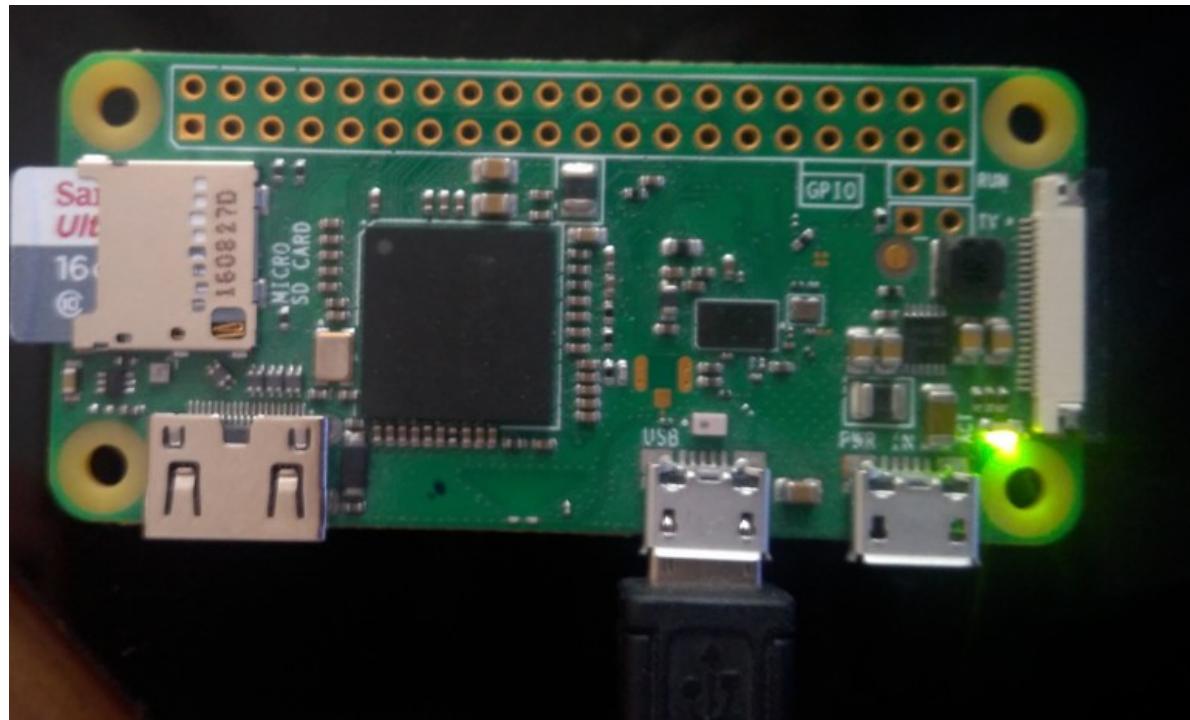
# UPS üzerine güneş paneli



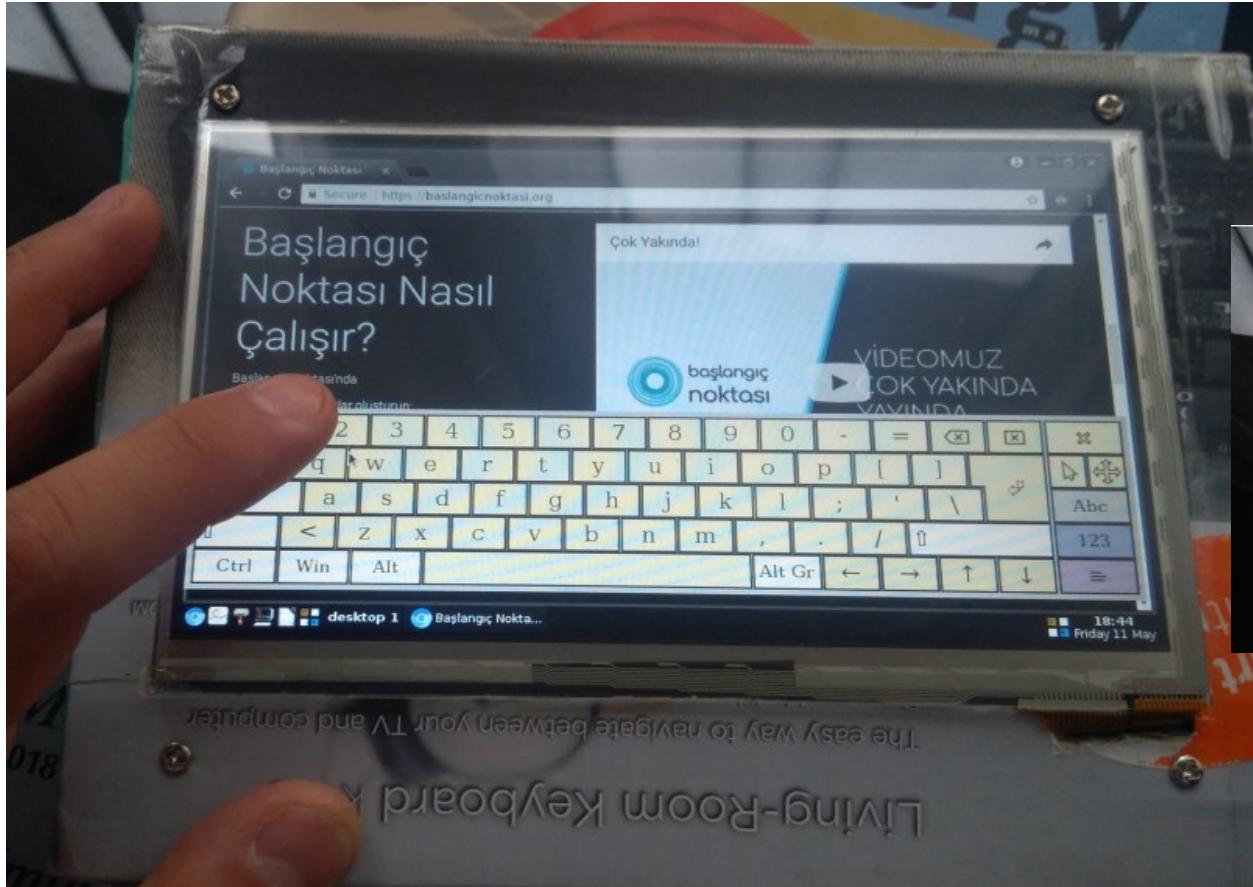
# Tek mıknatıslı motor ve Teflon bant



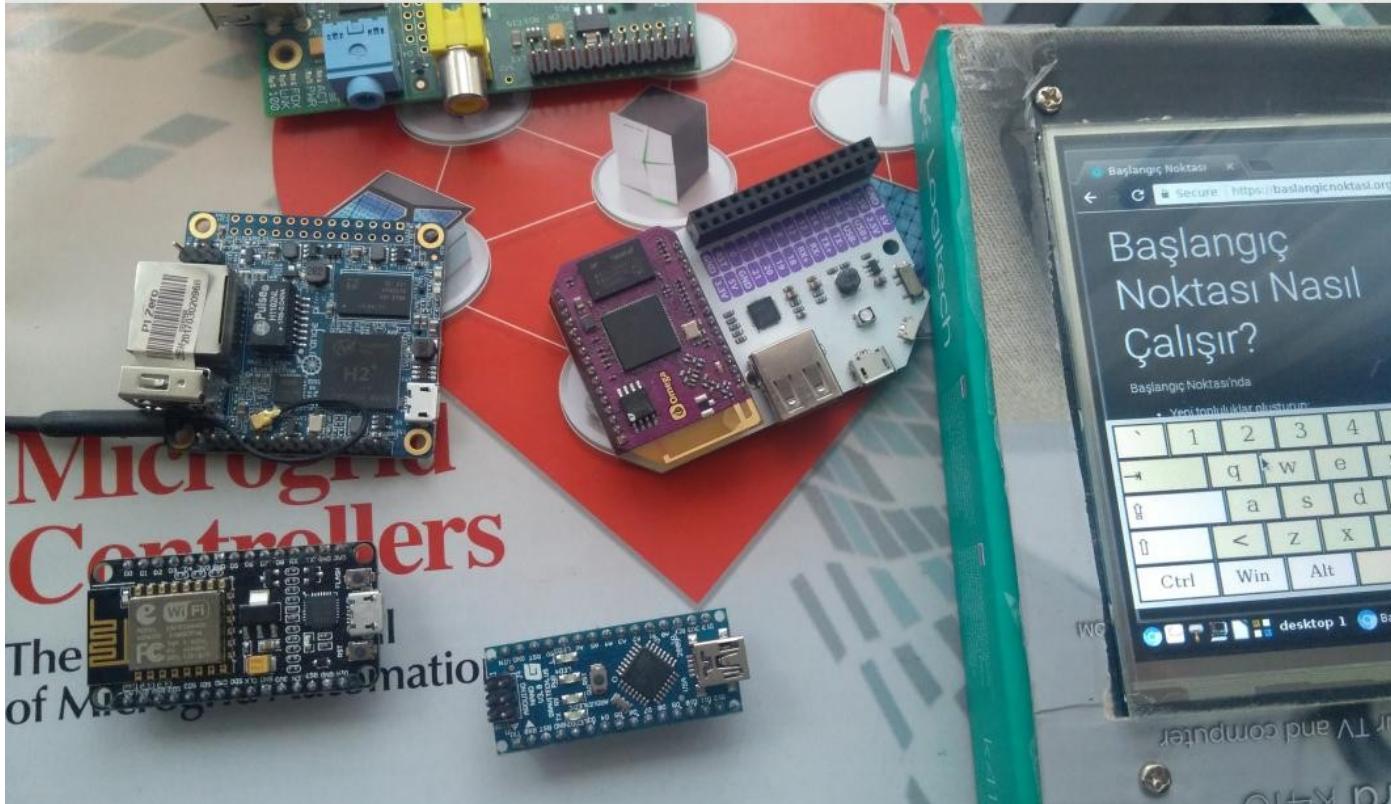
# Rpi Zero W



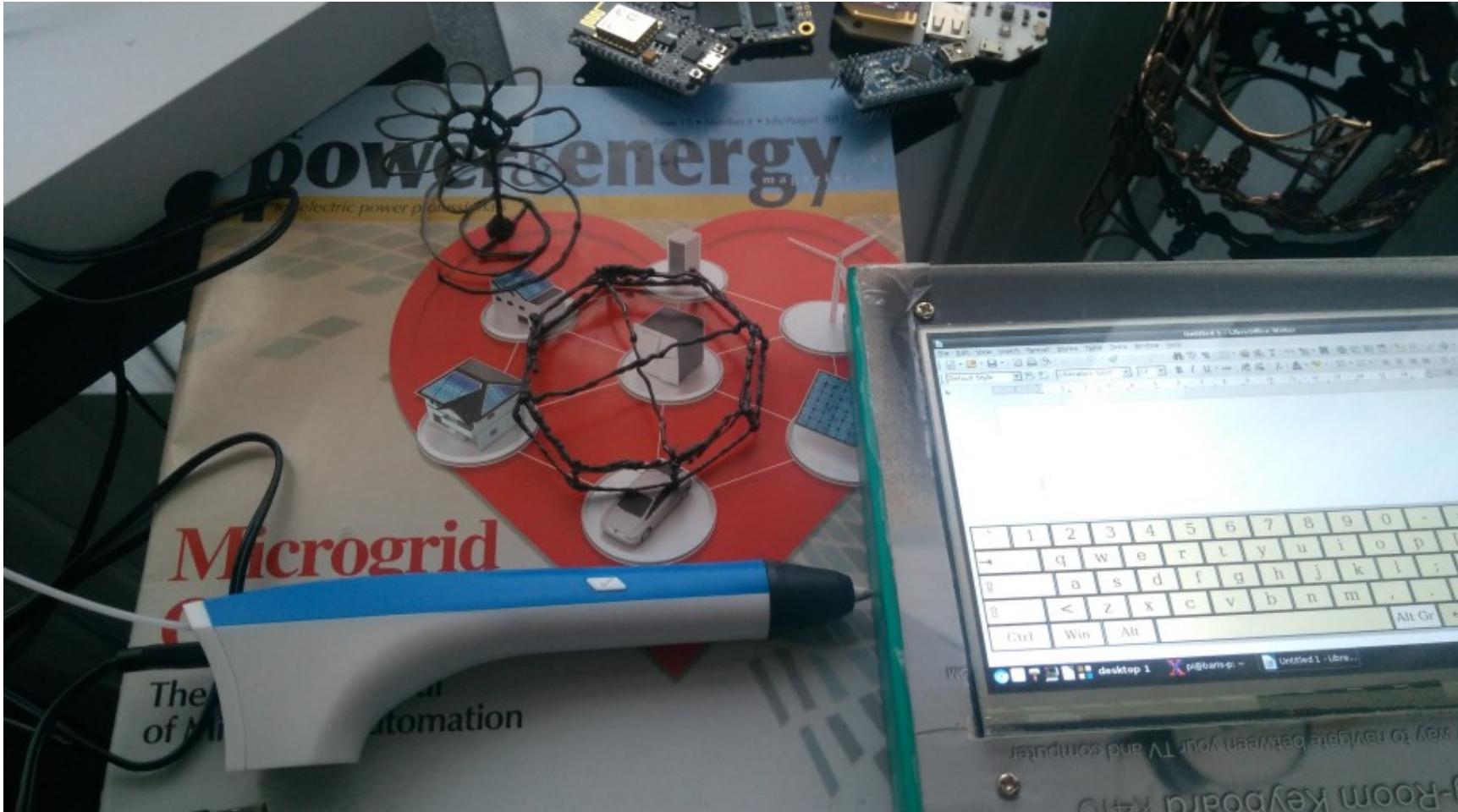
# Yerli Dokunmatik Tablet



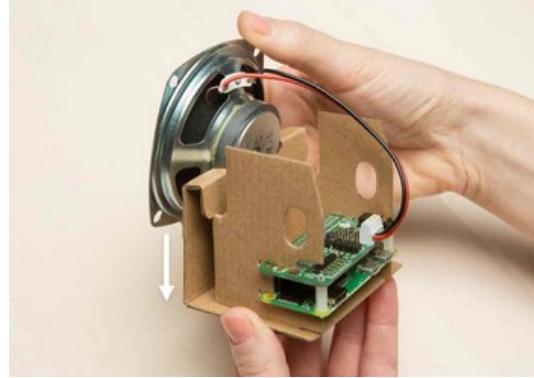
# Değişik elektronik kartlar



# 3D Kalem



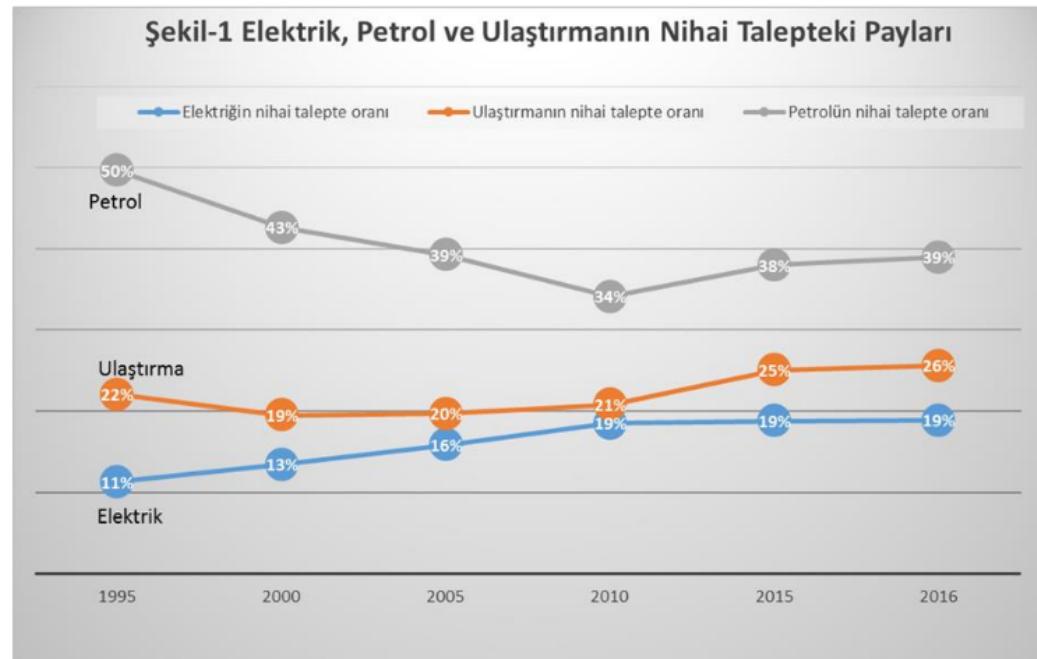
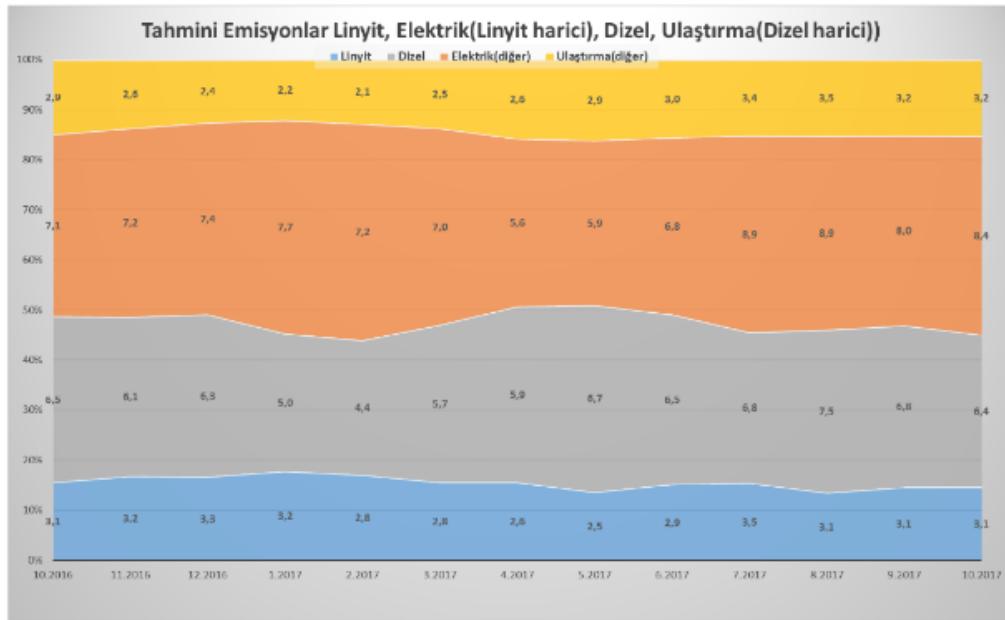
# Yeni proje çalışması – Avize 1.0



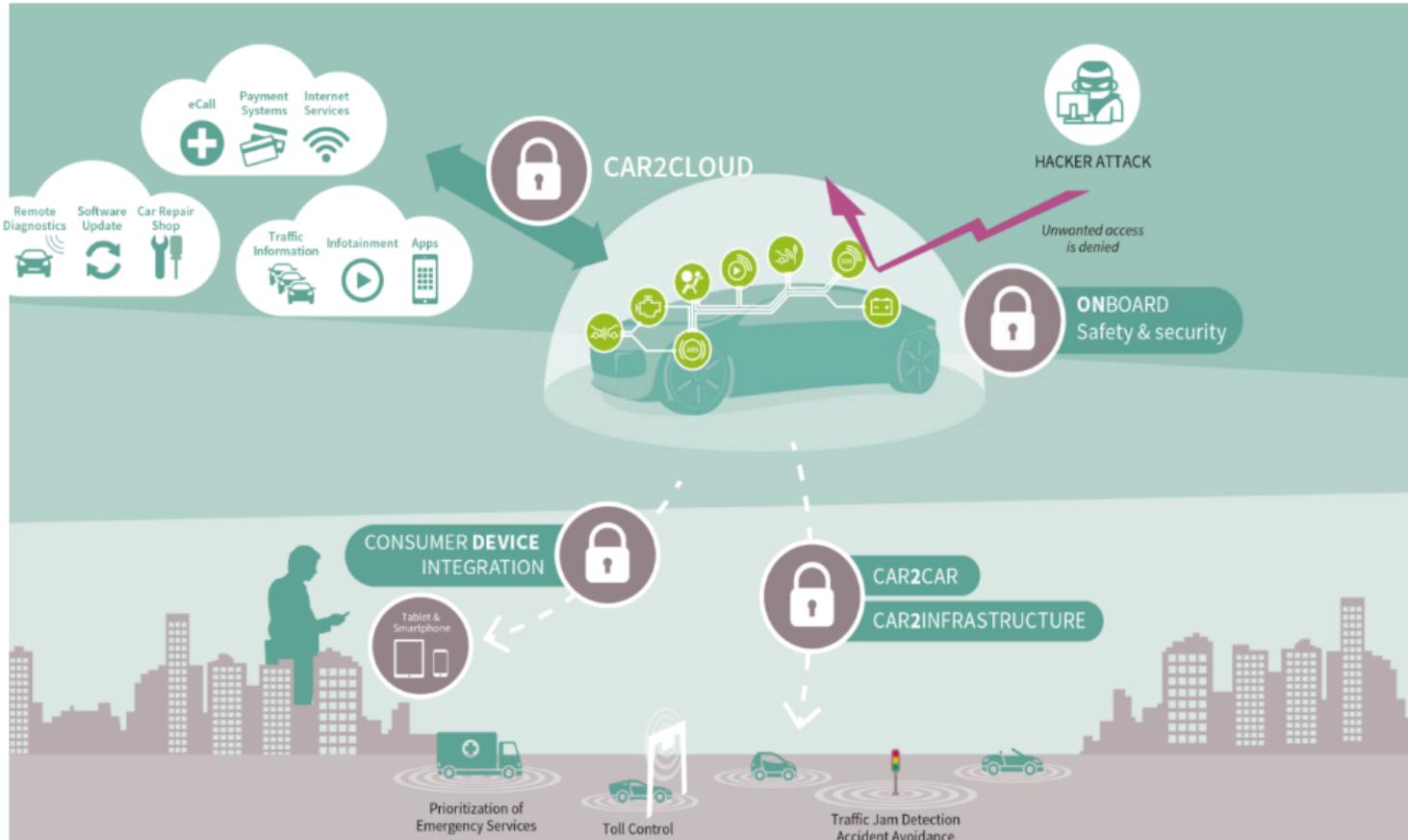
A screenshot of a product listing on a website. The product is a 'Led Mini Projeksiyon Cihazı Ev Sineması Hdmi+USB Projeksiyon Cihazı Ev Sineması'. It has a 4-star rating with 4 reviews. The price is listed as 199,90 TL. The product image shows a small white and yellow projector. On the right side of the listing, there is a shopping cart icon, a 'Sepete Ekle' (Add to Cart) button, and a heart icon for favoriting. There are also icons for 'ORIGINAL DRONE', 'ODEME KORUMA SISTEMI', and 'INTERNETTE GÖREVİ AL/İŞVERİŞ'. On the far right, there are navigation links for 'Mağaza' (Store) and 'Mağazalar' (Stores).

# IoT ulaştırmada

# Ulaştırma tarafından



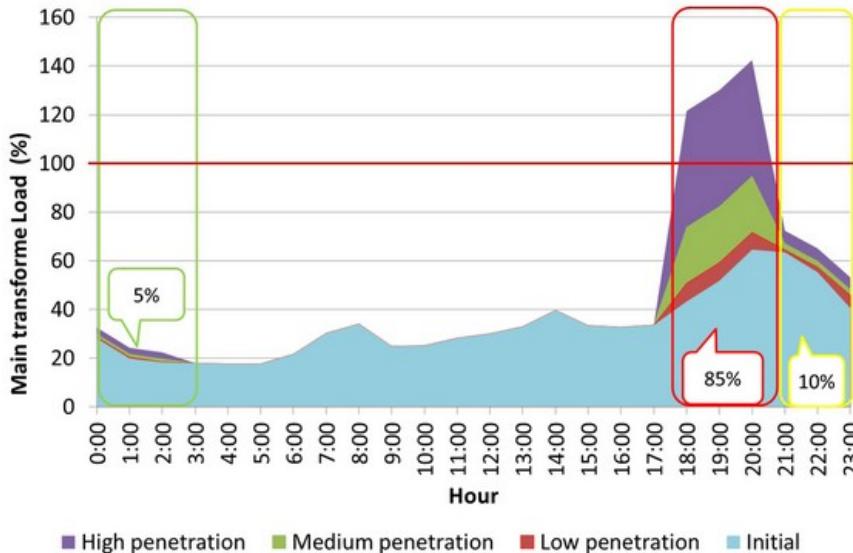
# Ulaştırma ve bağlantı



# Enerji sektöründe...

- Gelecek geleceği değiştiriyor.

Arabaları gece şarj edelim



Güneş çukuru



# Ulaştırma Talebi

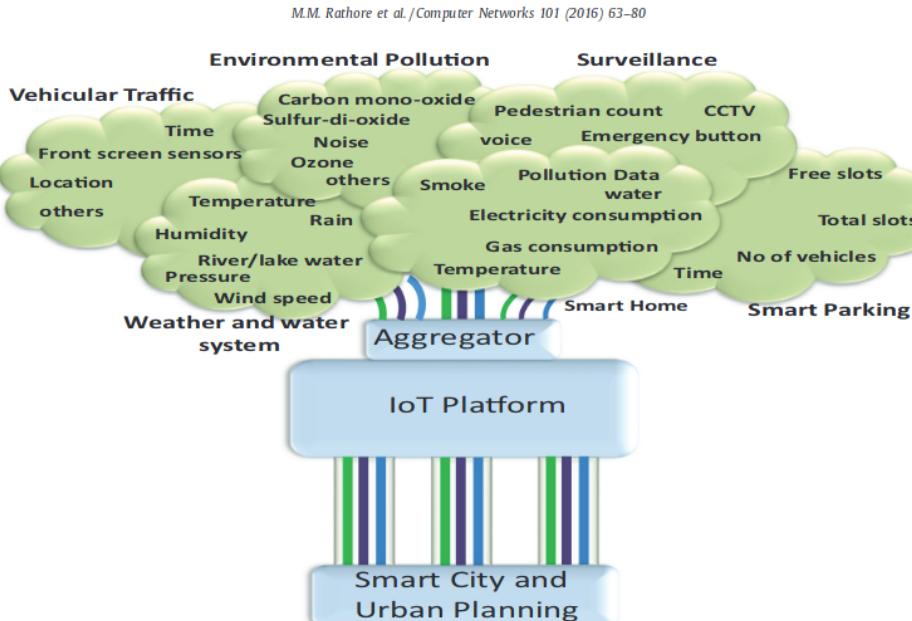


Fig. 1. Sensors deployment.

M.M. Rathore et al./Computer Networks 101 (2016) 63–80

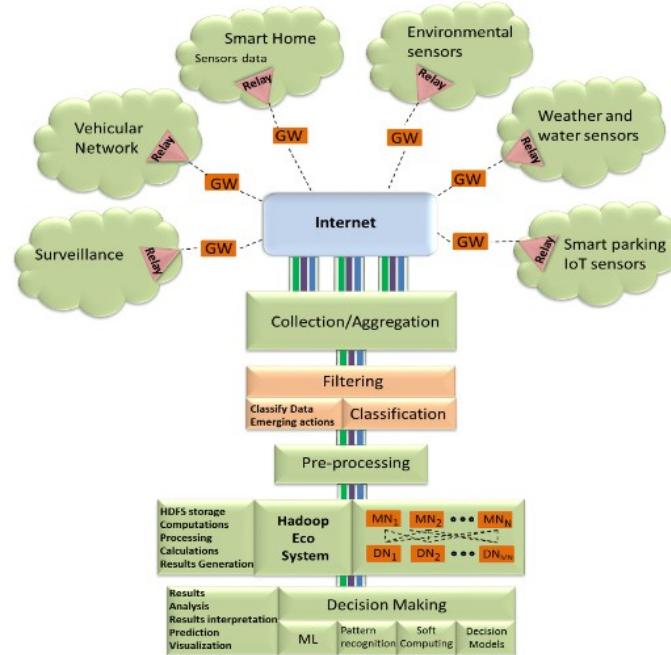


Fig. 3. Implementation model.

# Şehirlerde

- Trafik yönetimi
- Çevre sağlığı hava kalitesi
- Toplu taşıma kalitesi
- Altyapı verimliliği (su, elektrik)
- Güvenlik

# Akademik taraftan

# IEEE Internet of Things Journal

 Latest Published Articles

 Popular Articles

Article Title	Author(s)	Date Published
<b>IoT based Vibration Analytics of Electrical Machines</b>	D. Ganga ; V. Ramachandran	May-11 2018
<b>Building Data-Aware and Energy-Efficient Smart Spaces</b>	Neha Belapurkar ; Jacob Harbour ; Sagar Shelke ; Baris Aksanli	May-10 2018
<b>Enabling Relay-Assisted D2D Communication for Cellular Networks: Algorithm and Protocols</b>	Tingwei Liu ; John C. S. Lui ; Xiaoqiang Ma ; Hongbo Jiang	May-09 2018
<b>Hybrid-LRU Caching for Optimizing Data Storage and Retrieval in Edge Computing-Based Wearable Sensors</b>	Gangyong Jia ; Guangjie Han ; Hongtianchen Xie ; Jiaxin Du	May-09 2018
<b>Distributed Privacy-preserving Data Aggregation against Dishonest Nodes in Network Systems</b>	Jianping He ; Lin Cai ; Peng Cheng ; Jianping Pan ; Ling Shi	May-09 2018
<b>Internet of Things for Smart Cities</b>	Andrea Zanella ; Nicola Bui ; Angelo Castellani ; Lorenzo Vangelista ; Michele Zorzi	Feb-14 2014
<b>A Survey on Internet of Things: Architecture, Enabling Technologies, Security and Privacy, and Applications</b>	Jie Lin ; Wei Yu ; Nan Zhang ; Xinyu Yang ; Hanlin Zhang ; Wei Zhao	Mar-15 2017
<b>Fog and IoT: An Overview of Research Opportunities</b>	Mung Chiang ; Tao Zhang	Jun-23 2016
<b>Research Directions for the Internet of Things</b>	John A. Stankovic	Mar-18 2014
<b>A Survey on Security and Privacy Issues in Internet-of-Things</b>	Yuchen Yang ; Longfei Wu ; Guisheng Yin ; Lijie Li ; Hongbin Zhao	Apr-17 2017

# Elektrik sistem makinelerinde

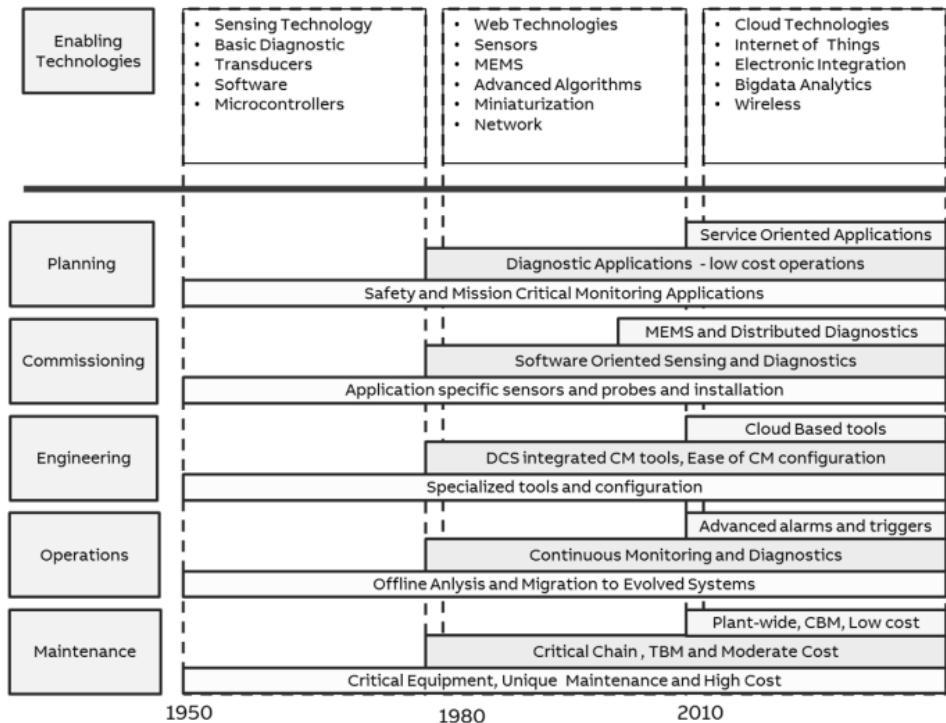


Figure 1. Technology trends, plant life cycle and monitoring system evolution.

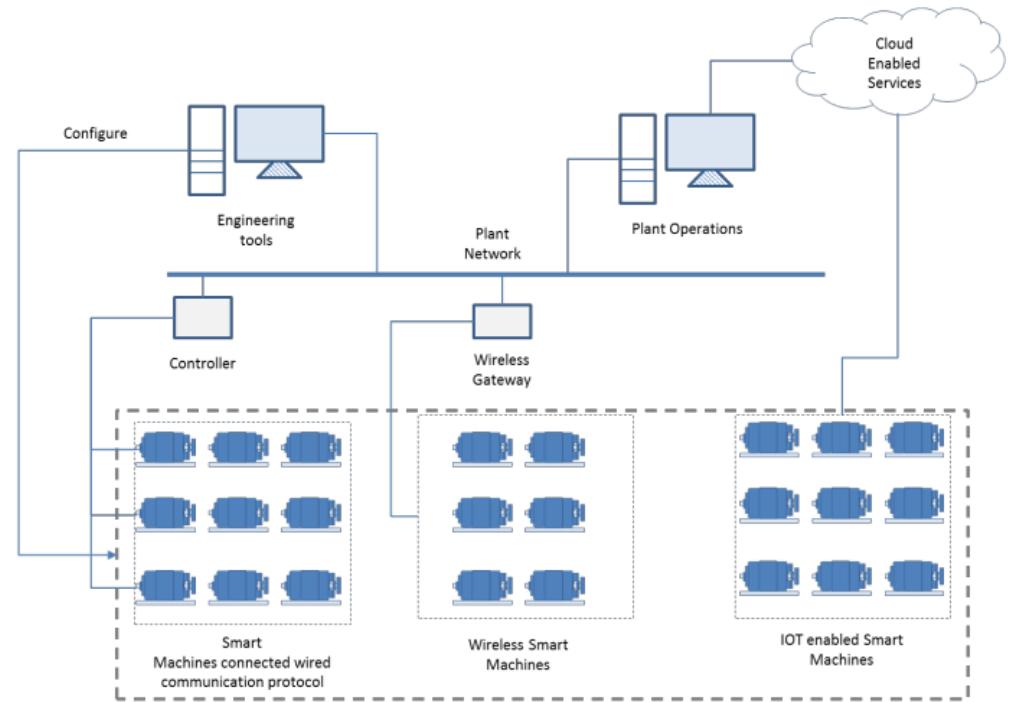


Figure 5. Plant-wide fleet condition monitoring.

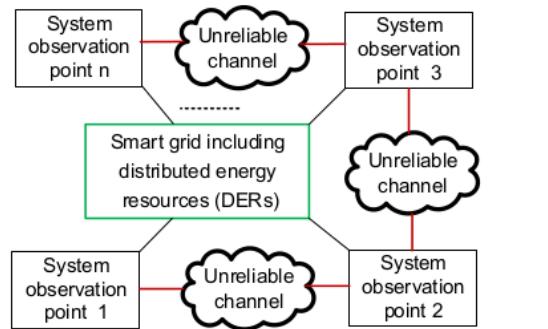
# Dağıtık sistemlerde durum tahmini

## IoT Based State Estimation for Microgrids

Md Masud Rana, Wei Xiang and Eric Wang

TABLE I: Simulation parameters [1].

Symbols	Values	Symbols	Values
$\lambda^{41}$	0.9	$\lambda^{12}$	0.95
$\lambda^{23}$	0.6	$\lambda^{34}$	0.1
$\mathbf{R}^1$	$0.0000002\mathbf{I}$	$\mathbf{R}^2$	$0.0000003\mathbf{I}$
$\mathbf{R}^3$	$0.0000004\mathbf{I}$	$\mathbf{R}^4$	$0.0000005\mathbf{I}$



Node  $j$  is called a neighbor of node  $i$  if they belong to edge  $E$ , i.e.,  $(i, j) \in E$ .

**Lemma 1:** The error is minimized if the following inequality

[www.barissanli.com](http://www.barissanli.com)

<https://ieeexplore.ieee.org/document/8255584/>

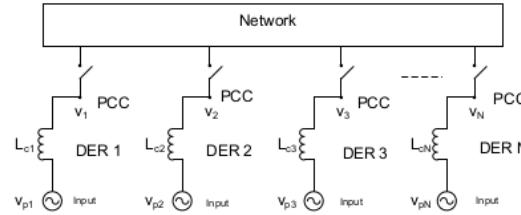


Fig. 2:  $N$  DERs connecting to the power network [7].

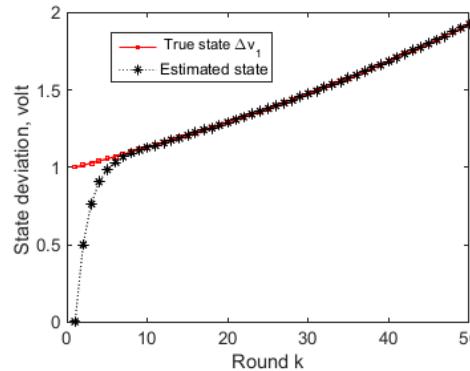


Fig. 3: Response of DER1 PCC voltage deviation  $\Delta v_1$ .

# Mikroşebekeler IoT

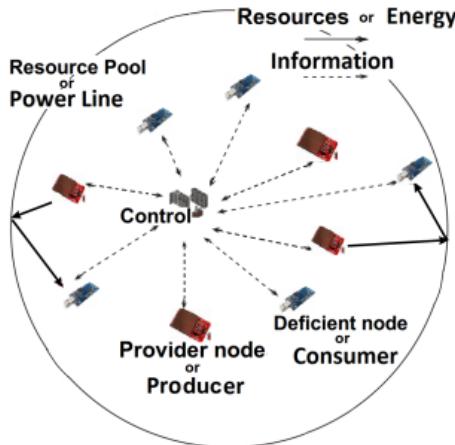


Fig. 1: Abstraction level: ecosystem of IoT devices sharing common resources. Study case: micro grid of consumers and producers sharing excess energy.

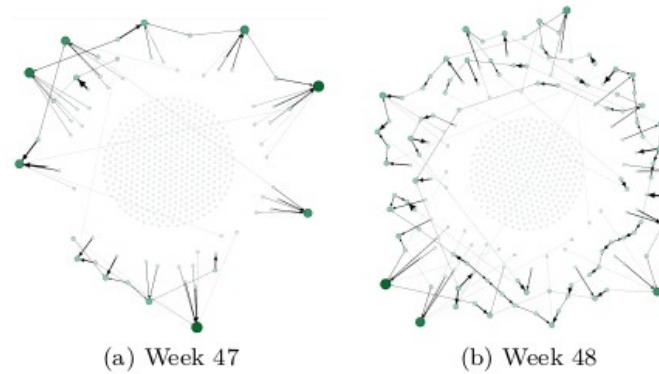


Fig. 2: Nodes changing roles in a time-varying graph representing a micro grid.

- (i) Dağıtık kaynakların organizasyonu
- (ii) Verinin sağlıklı dolaşımı
- (iii) En az aktif sensör ile sistem takibi
- (iv) Veri toplanmasını optimize etmek
- (v) Cihaz bozulmalarını tolere etmek

On Inferring how resources are shared in IoT ecosystems; a Graph Theoretic Approach, 39  
<https://ieeexplore.ieee.org/abstract/document/8355137/>

# Enerji İzleme Sistemleri ve IoT

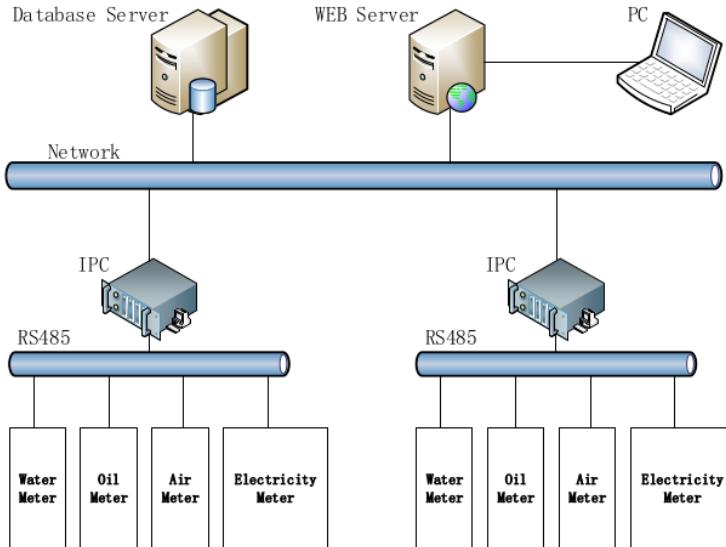


Fig 1. The system structure of energy monitoring system

IoT'nin temel karakteristikleri: ağ bağlantılı, ekipman, otomasyon, zeka

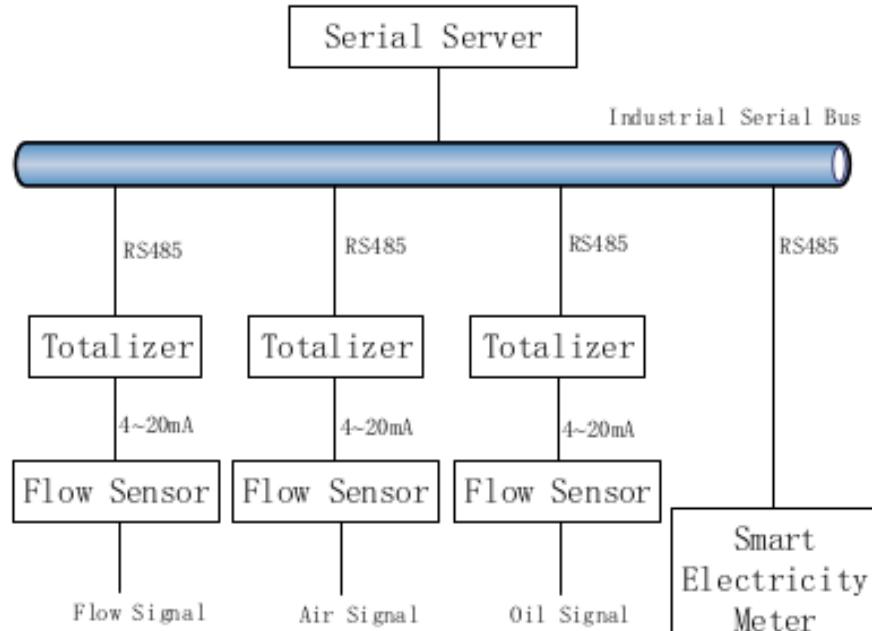


Fig 2. The system structure of sensing layer

# Enerji İzleme ve Yönetimi

## VII. RESULTS AND OUTPUT

- 802.11 b/g/n
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- 1MB Flash Memory
- Integrated low power 32-bit CPU can also be used as application processor
- SDIO 1.1 / 2.0, SPI, UART
- Standby power consumption of < 1.0mW



FIGURE 4: ESP8266-13 WIFI MODULE



FIGURE 9: OUTPUT VALUES AS DISPLAYED IN LCD

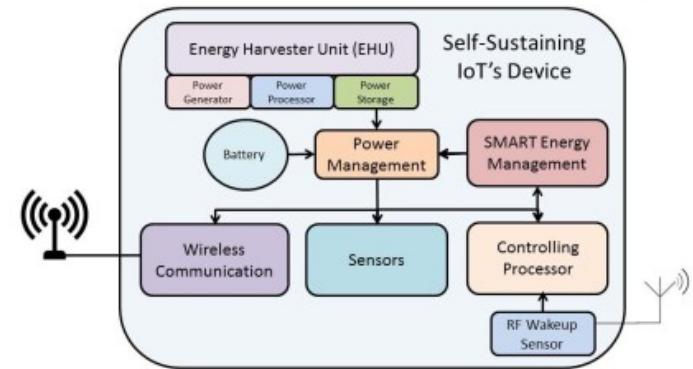
Energy Monitoring and Management using Internet of Things, <https://ieeexplore.ieee.org/document/8081088/>

# IoT enerji güvenliği - “Bırak ve Unut”

TABLE I: Available Energy Sources

Energy Sources	Power Density	Available Time
Solar Energy	100 mW/cm <sup>2</sup>	Day Time (4 ~ 8 Hrs)
Ambient RF Energy	0.0002~1 μW/cm <sup>2</sup>	Continuous
Piezoelectric Energy: Vibration	200 μW/cm <sup>3</sup>	Activity dependent
Piezoelectric Energy: Push Button	50 uJ/N	Activity dependent
Thermal Energy	60 uW/cm <sup>2</sup>	Continuous

- High conversion efficiency
- Low-power hardware
- Low-power controlling processor and duty-cycling
- RF Wake-up
- Stored harvested energy for the RF wake-up sensor and the CP in the sleep mode
- Low-power communication protocols
- Energy Storage and management



g. 1. Directions for self-sustaining IoT device

Bluetooth Low Energy (BLE), IEEE 802.15.4

# IoT ile Microgrid'e Enerji platformu

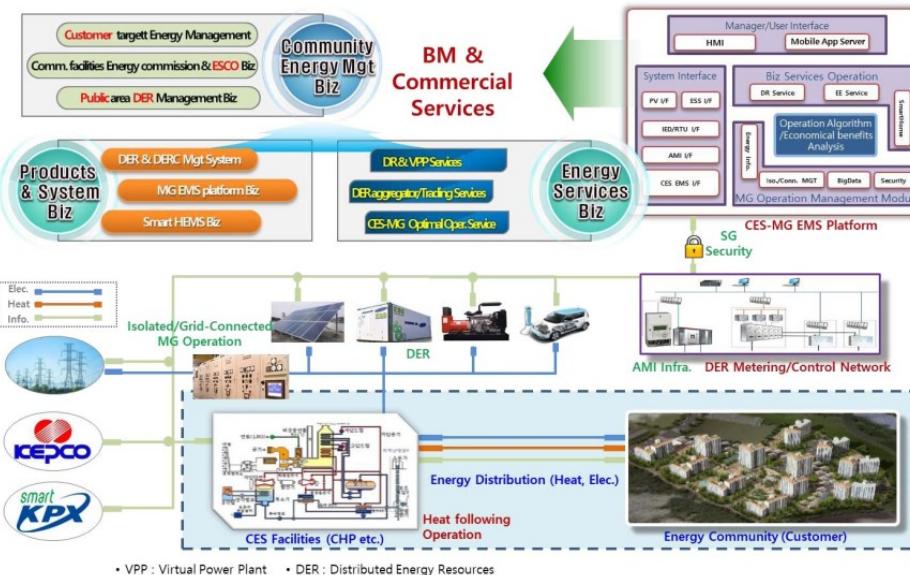


Figure 1. IoT energy management platform for CES MicroGrid.

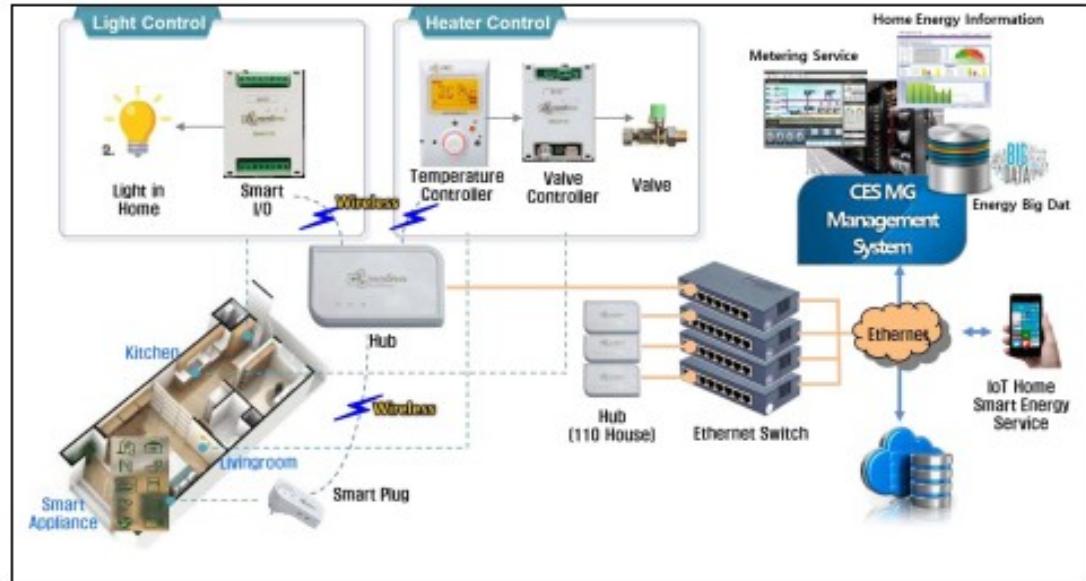


Figure 2. IoT energy information gateway architecture.

Internet of Things is defined as 'the word that comes together with work and things'. In other words, all kinds of things that we commonly see and use around us, such as people, cars, bridges, electronic devices, bicycles, glasses, watches, clothing, cultural properties, animals and plants, is a very broad concept that includes all imaginary objects, such as human behavior patterns.

# Güneş enerjisinin IoT ile yönetimi

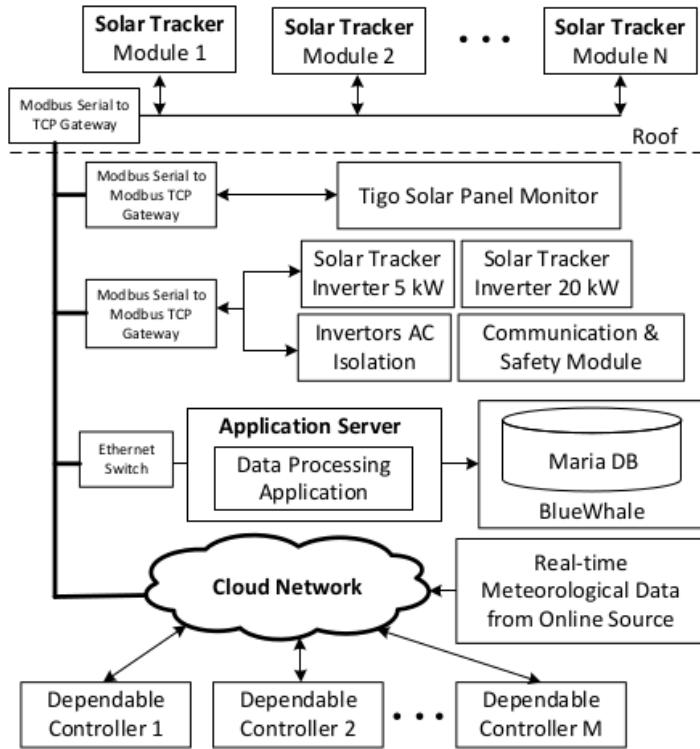


Fig. 1: Overview of the solar energy management in microgrids.

Management of Solar Energy in Microgrids Using IoT-Based Dependable Control,  
[www.harissanli.com](https://ieeexplore.ieee.org/document/8056441/)  
<https://ieeexplore.ieee.org/document/8056441/>

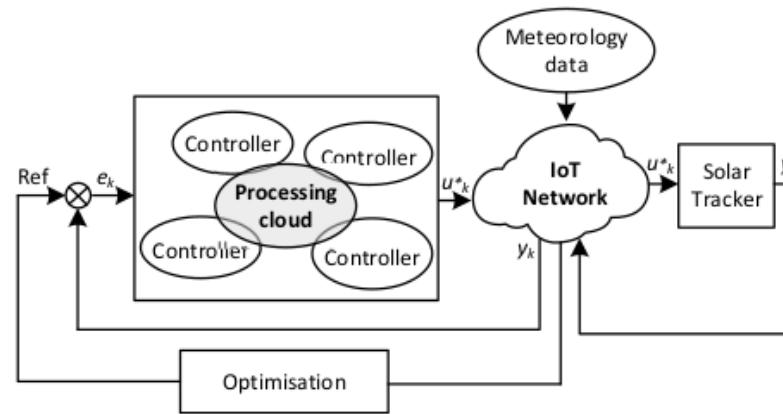
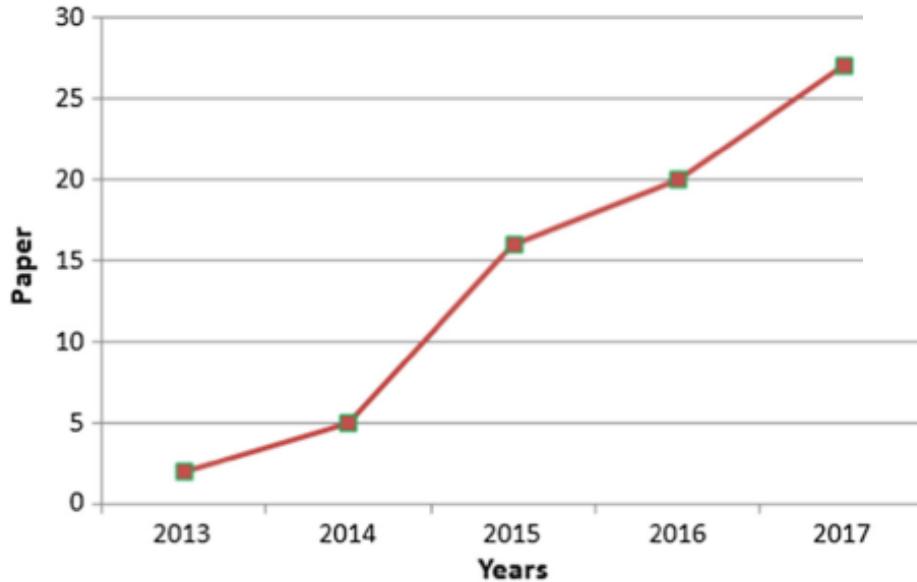


Fig. 2: Structure of a dependable control system.



Fig. 6: Embedded computer boards used as controllers.

# IoT için ortamdan enerji hasat etmek



setup. Harvested energy from the piezoelectric flag was applied to power a temperature sensor (Orrego et al. 2017)

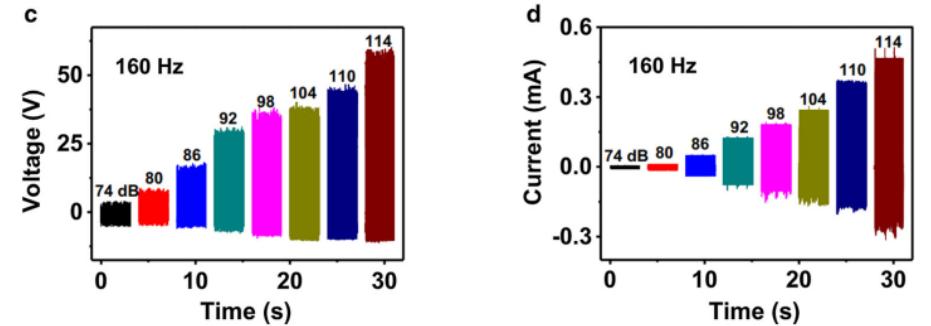
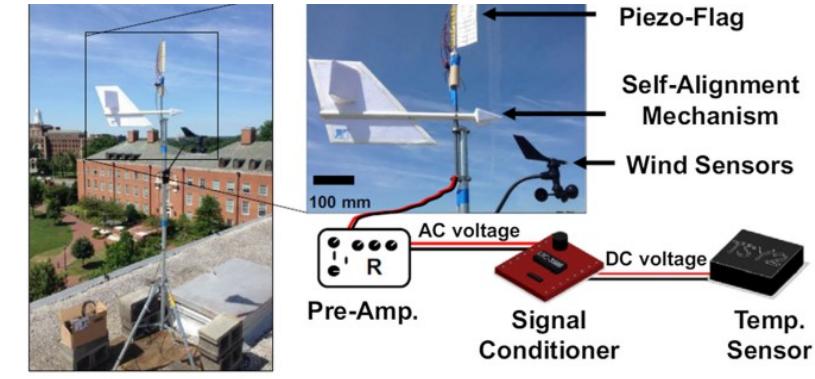


Fig. 1 Paper having both keywords “Energy harvesting” and “Internet of Things” increased rapidly during recent years

piezoelectric nanogenerator (PENG),  
tribo-electrification nanogenerator (TENG)

# IoT için güneş enerjisi

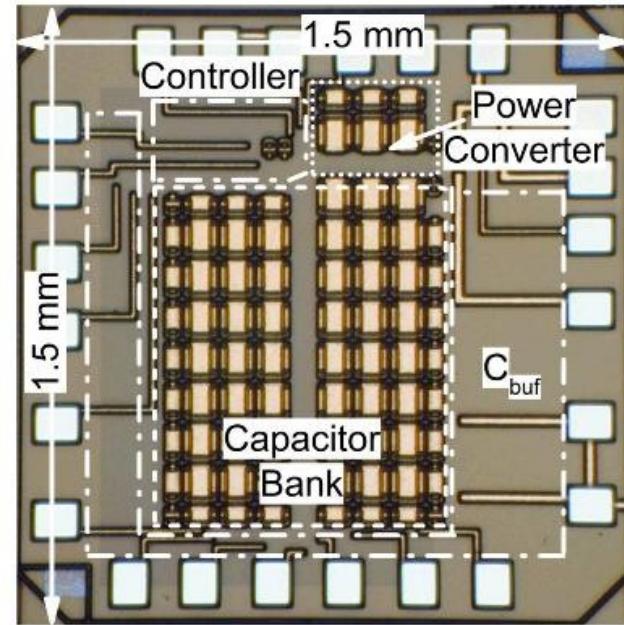
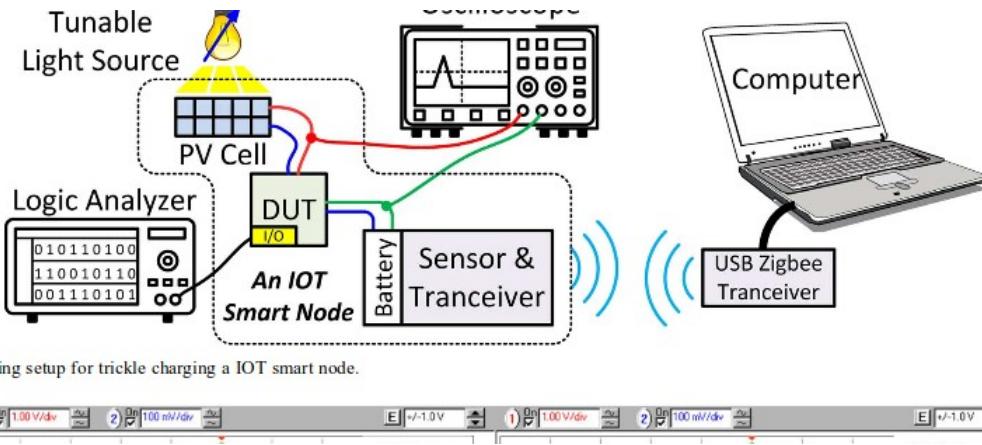


Fig. 16. Die photograph of the fabricated chip.

1.5 mm x 1.5 mm

An 86% Efficiency 12  $\mu$ W Self-Sustaining PV Energy Harvesting System With Hysteresis Regulation and Time-Domain MPPT for IOT Smart Node, [https://www.researchgate.net/profile/Xiaosen\\_Liu/publication/275409717\\_An\\_86\\_Efficiency\\_12\\_mu\\_W\\_Self-Sustaining\\_PV\\_Energy\\_Harvesting\\_System\\_With\\_Hysteresis\\_Regulation\\_and\\_Time-Domain\\_MPPT\\_for\\_IOT\\_Smart\\_Nodes/links/55c918ae08aec747d670e46/An-86-Efficiency-12-mu-W-Self-Sustaining-PV-Energy-Harvesting-System-With-Hysteresis-Regulation-and-Time-Domain-MPPT-for-IOT-Smart-Nodes.pdf](https://www.researchgate.net/profile/Xiaosen_Liu/publication/275409717_An_86_Efficiency_12_mu_W_Self-Sustaining_PV_Energy_Harvesting_System_With_Hysteresis_Regulation_and_Time-Domain_MPPT_for_IOT_Smart_Nodes/links/55c918ae08aec747d670e46/An-86-Efficiency-12-mu-W-Self-Sustaining-PV-Energy-Harvesting-System-With-Hysteresis-Regulation-and-Time-Domain-MPPT-for-IOT-Smart-Nodes.pdf)

# Internet of Energy - Sibergüvenlik

1 trilyon IoT sensörü 2022'de  
internete bağlı olacak

2022'de tüm internet trafiğinin %45'i

3 büyük uygulama:

- Sağlık (41%),
- İmalat (37%),
- Elektrik (7%)

TE (Transactive Energy)

E-LAN (Energy Local Area Network)

IoE (Internet of Energy)

Enernet

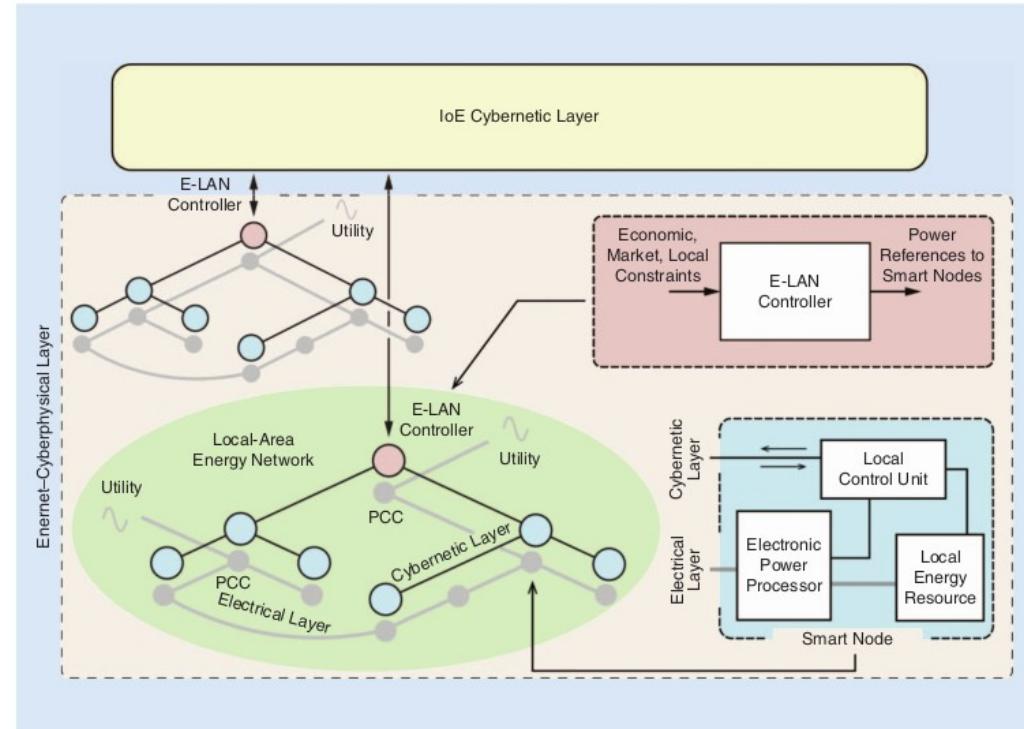


FIG 1 An example of the IoE architecture. PCC: point of common coupling.

# IoT ve Sis bilişim

Fog computing [3, 4] refers to distributing traditional Cloud Computing resources and services to the network edge thereby bringing cloud resources nearer to the endpoints (i.e. sensors and other IoT devices). Fog computing resources are located in the local network avoiding the need to send data to (geographically) remote Cloud data centers for processing and storage. However, Fog computing is not totally independent from the Cloud because the related components in the Fog and Cloud exchange important updates and other data in order to remain synchronized. Therefore, Fog computing is complementary to the Cloud computing and can serve applications which may not be well suited to (centralized)Cloud computing.

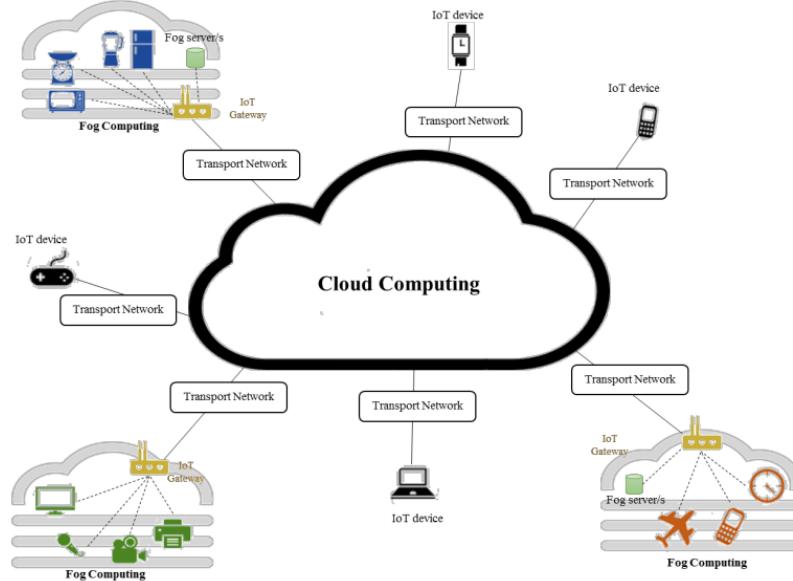


Figure 1. High level architecture of Fog and Cloud computing in IoT

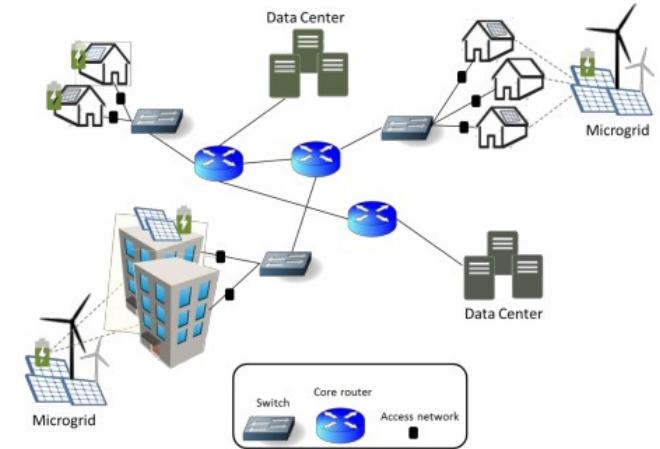


Figure 2. Network architecture of Cloud-Fog System attached to Microgrids

Greening IoT with Fog: A Survey,  
[www.hariissalih.com](http://www.hariissalih.com)  
<https://ieeexplore.ieee.org/document/8029253>

# Tartışma

# Ortalama tüketici

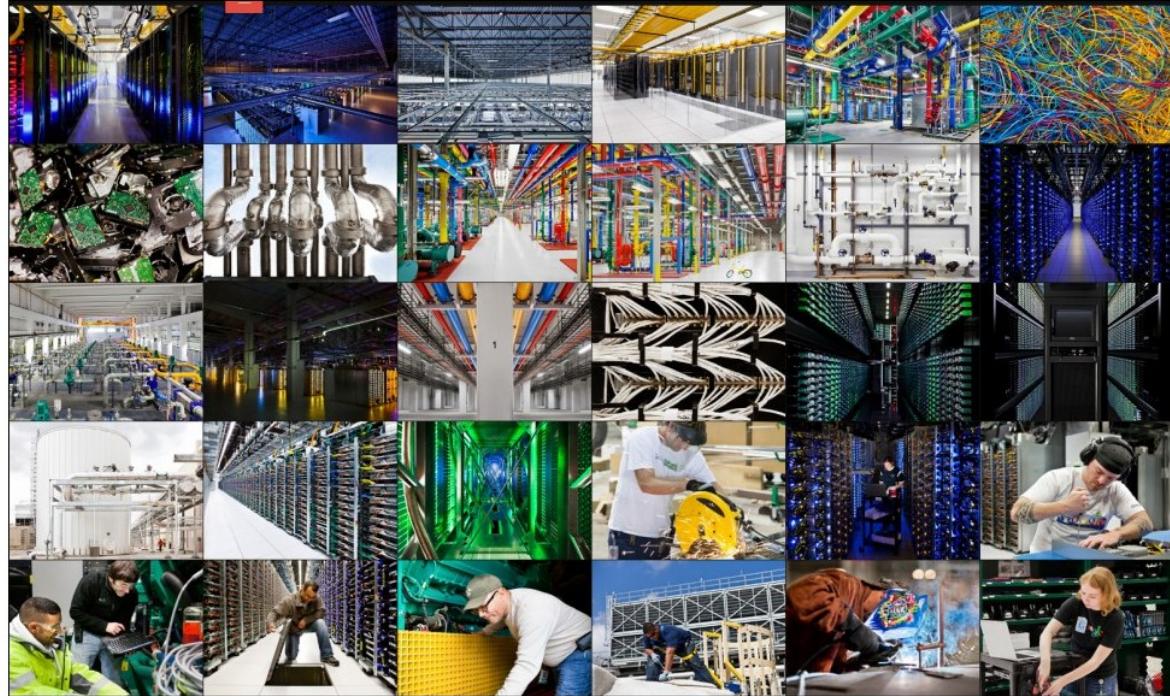
- Ortalama tüketici senede 8-9 dakika elektrik fatura – dağıtım şirketini aklına getiriyor
- Gelecekte daha çok mu düşünmeli, daha az mı düşünmeli
- Hangi katman daha karışık hangisi çok çok daha basit

# Google iş modeli



[Google'da Ara](#) [Kendimi Şanslı Hissediyorum](#)

Google'ı kullanabileceğiniz diğer diller: [English](#)



The online gallery reveal the interior of eight of Google's secretive server farms around the globe, from Finland to Iowa

# Siber tehlike

- 1 IoT sistemini kır, 1 milyon zombi kazan

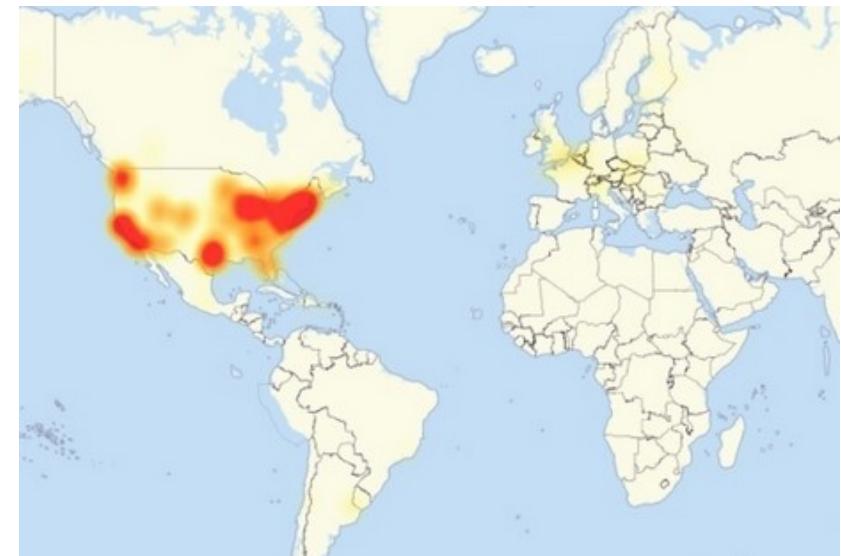
**How 1.5 Million Connected Cameras Were Hijacked to Make an Unprecedented Botnet**



Lorenzo Franceschi-Bicchieri

Sep 29 2016, 7:03pm

As many predicted, hackers are starting to use your Internet of Things to launch cyberattacks.



Dahua marka IP kameralarında, çok fazla rastgele karakterli kullanıcı adı girerek ele geçiriyorlar

# Hukuk

- Eskiden vana → Suçlu insan
- Şimdi vana+yazılım → Yasal suç kimde
- Makine sizin ama yazılıma müdahale yok
- Ön kontratta risklerin tanımlanması  
(yazılım+donanım)
- Sigortalama nasıl olacak

# Değer üretimi

- IoT bir değer üretiyor
- Bu değer
  - Düzenleme uyum maliyetleri (reaktif ceza vs)
  - Sibergüvenlik riskleri (operasyonel EA)
  - Bilinmeyen riskler (yazılım)

# Asıl ürün

- Asıl ürün insan
  - Hareketleri, davranışları, tercihleri
  - “Para ödemiyorsanız ürün sizsinizdir”
- Otonom arabalar
- Sosyal medya
- Bilgisayarınız sizi sizden iyi tanıyor olabilir

# Teşekkürler

Barış Sanlı

[www.barissanli.com](http://www.barissanli.com)

[twitter.com/barissanli](http://twitter.com/barissanli)