MO629 - Internet of Things

An overview of the IoT Smart Agriculture in Brazil

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Campinas, Nov 6th 2018

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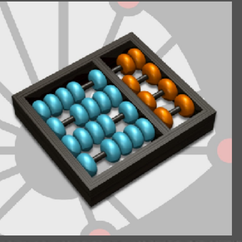
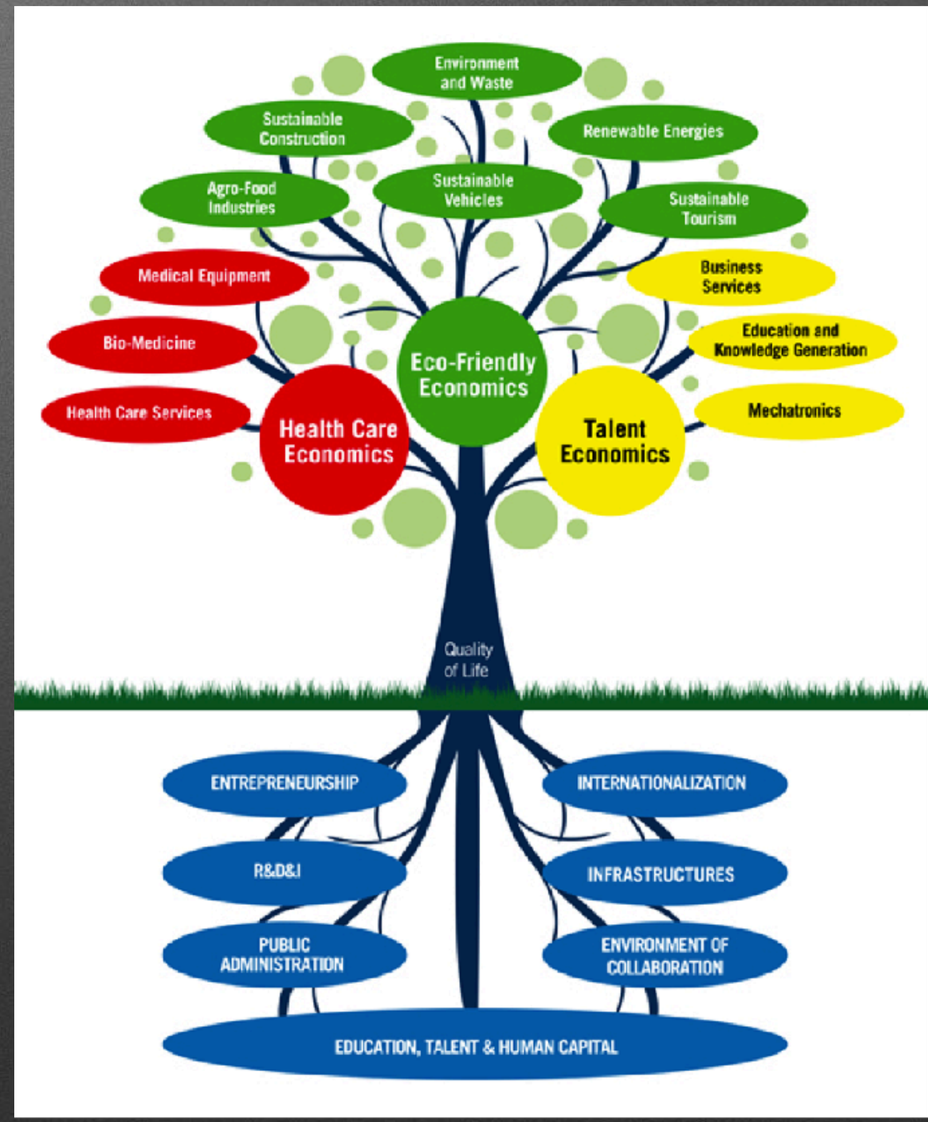


Agenda

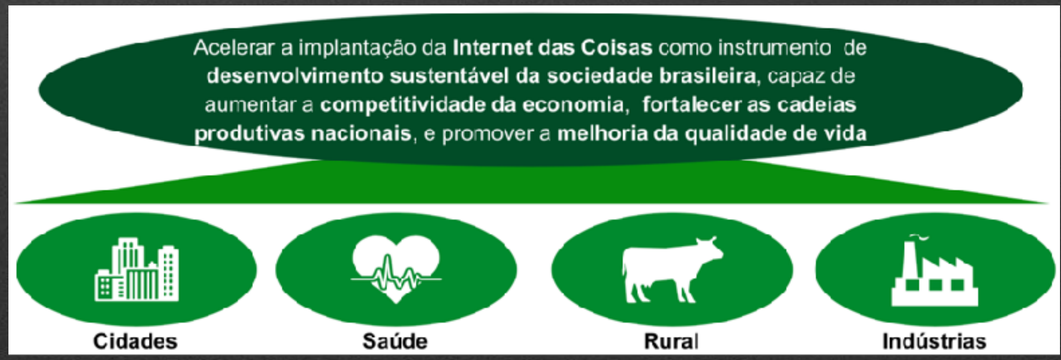
- Overview of the IoT Action Plan for Brazil
- Strategic Objective
- Challenges
- IoT Applications: Precision Agriculture
- IoT Cases: Precision Agriculture
- IoT Applications: Precision Cattle
- IoT Cases: Precision Cattle
- Next Steps



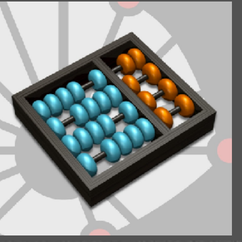
http://www.urbact.hu/node/152

Overview of the IoT Action Plan for Brazil

- Socioeconomic impact on the productivity of the economy and public services was estimated to be US $ 200 billion by 2025, ~ 10% of the GDP of 2016 (McKinsey)[1]
- Study “Internet of Things: an action plan for Brazil”[2]
- “Report of the action plan - Initiatives and Mobilizing Projects”[3]
- Priority environments: **Rural**, Health, Cities, and Industries



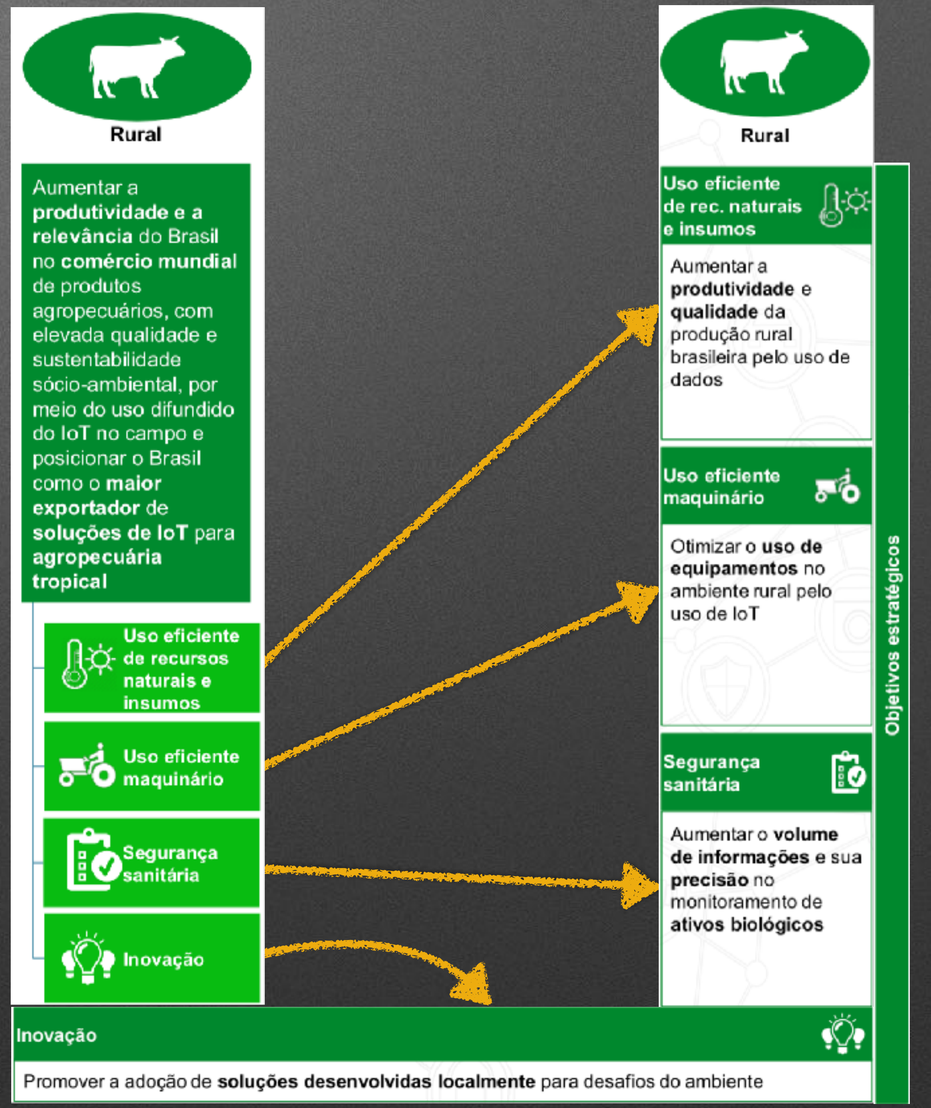
[1] O Brasil da Internet das Coisas, Pesquisa FAPESP
[2] Internet das Coisas: Um plano de ação para o Brasil, BNDES/MCTI
[3] Produto 8: Relatório do Plano de Ação Iniciativas e Projetos Mobilizadores



Strategic Objective

"In a country that owns farms of the size of Belgium, agribusiness is a mandatory and especially urgent discussion among all the involved actors. Agribusiness accounts for 33% of GDP and 42% of Brazil's total exports, generating around 37% of all jobs nationwide." [4]

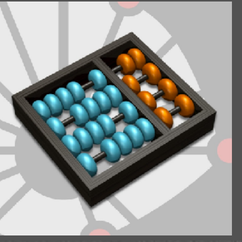
- To increase Brazil's <u>productivity</u> and relevance in the <u>world trade</u> in agricultural products: [3]
  - Efficient use of natural resources and supplies
  - Efficient use of machinery
  - Sanitation security
  - **Innovation**



[3] Produto 8: Relatório do Plano de Ação Iniciativas e Projetos Mobilizadores
[4] Fraunhofer, Agro 4.0: Experts discuss advances in digitizing the field

Challenges: Food, Fiber and Energy Production Figures [6]

[6] Massruhá, S. M. (2018, Junho). IoT na Embrapa. BNDES – Estudo Nacional de IoT



Challenges

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- Node level: [5]
  - ✓ Physical size
  - ✓ Power consumption
  - ✓ Cost
- Network level [5]
  - ✓ Size of the scale
  - ✓ Size of the networks
  - ✓ Amount of network nodes and data
  - ✓ Untrusted media
  - ✓ Addressing
  - ✓ Network management
- Interoperability issues between systems and standards [5]

https://twitter.com/SmartRuralAreas

[5] Vasseur, J.-P., & Dunkels, A. (2010). Interconnecting smart objects with ip: The next internet. Morgan Kaufmann.

Challenges: Embrapa Informática Agropecuária [6]

Foco de atuação: atuar nas áreas de agroinformática e bioinformática para prover soluções para a agricultura aplicando métodos, técnicas e ferramentas computacionais envolvendo equipes multidisciplinares

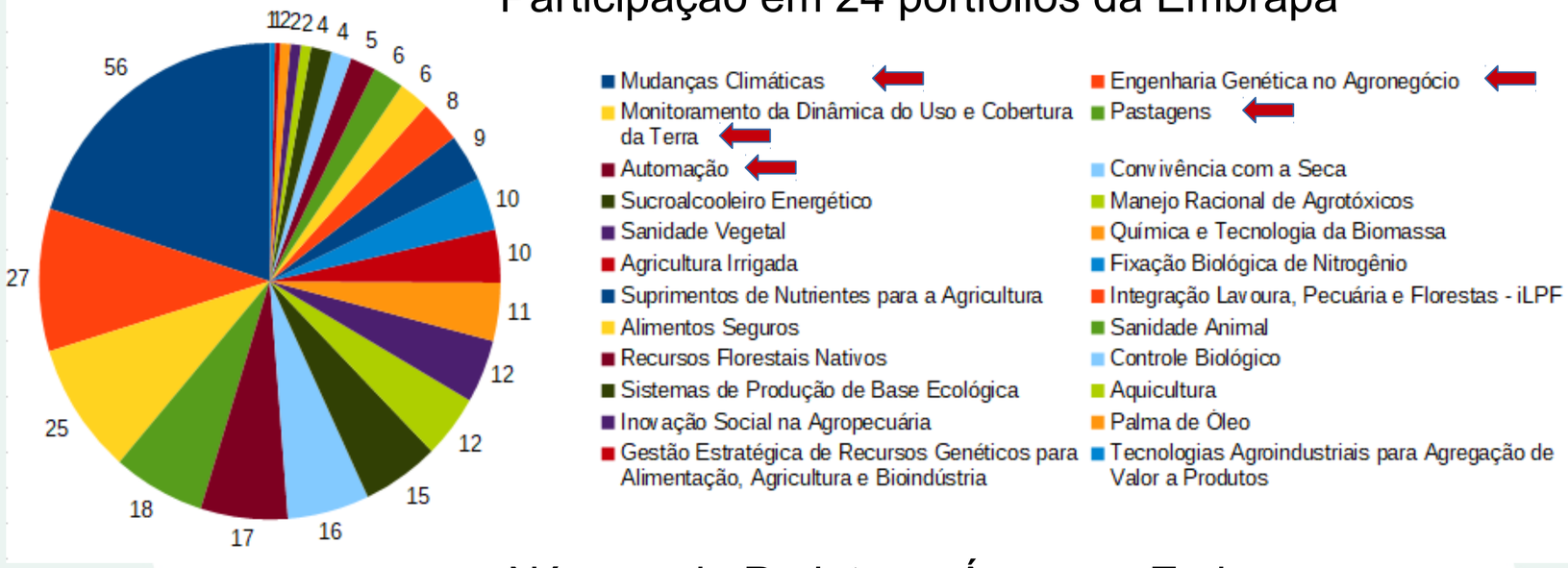
Localização:

UNICAMP Campinas – São Paulo - Brasil

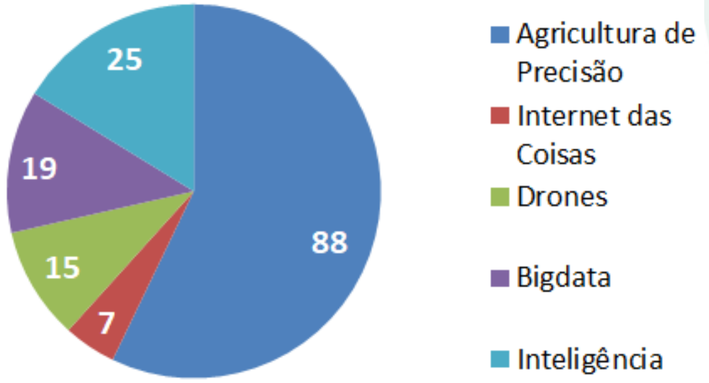
[6] Massruhá, S. M. (2018, Junho). IoT na Embrapa. BNDES – Estudo Nacional de IoT

Challenges: Portfólios e Projetos da Embrapa [6]

Participação em 24 portfólios da Embrapa



Número de Projetos x Áreas na Embrapa

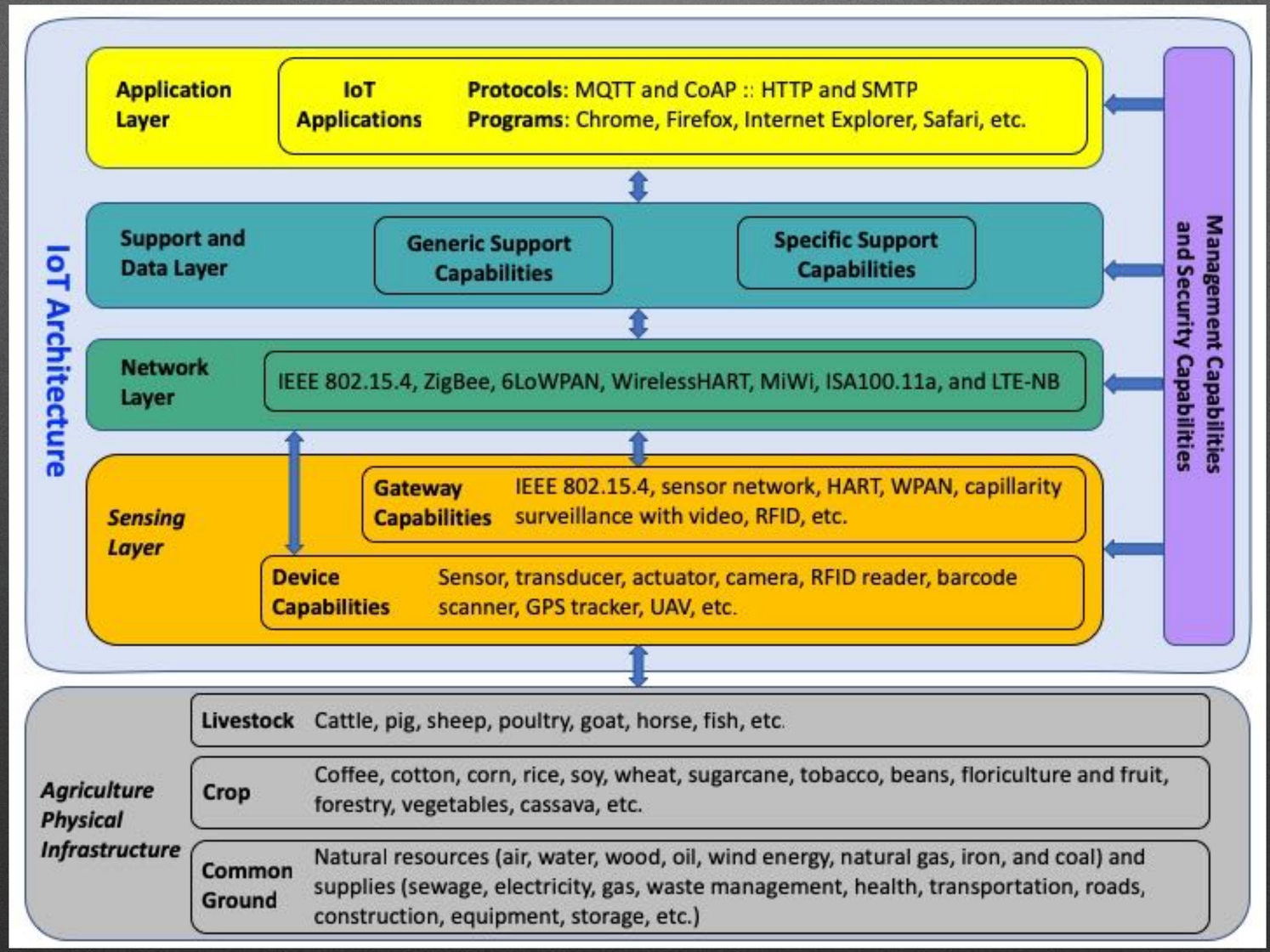


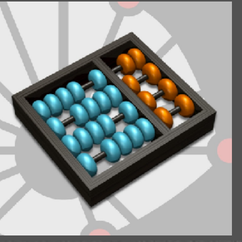
Fonte: SISGP e Quaesta – junho de 2018

154 projects which are agribusiness related

[6] Massruhá, S. M. (2018, Junho). IoT na Embrapa. BNDES – Estudo Nacional de IoT

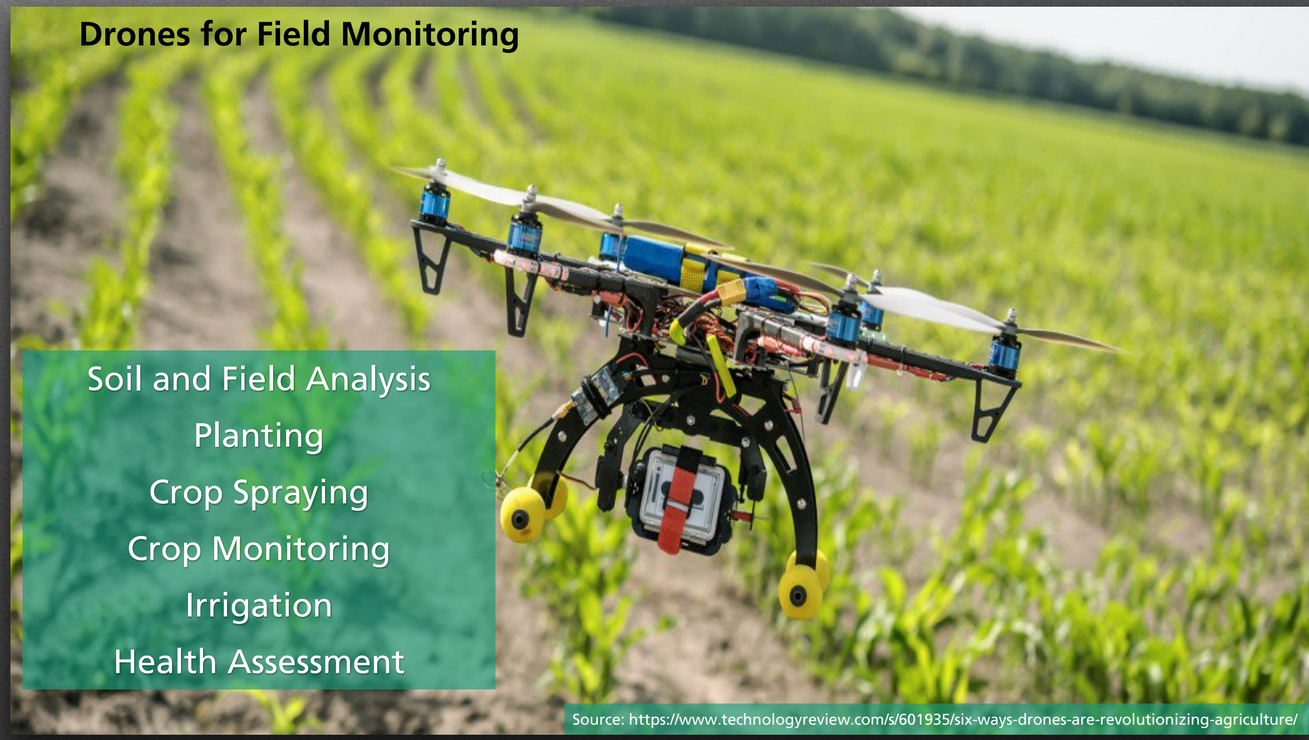
IoT Applications: Agriculture Architecture





IoT Applications: Precision Agriculture [6,7]

- Use of sensors
- Autonomous machines and GPS system
- Monitoring of plant needs
- Available water in soil and rainfall and subsequent performance (irrigation)
- Computer vision
  - ✓ Harvesting
  - ✓ Irrigation and water management
  - ✓ Weed removal and pest control



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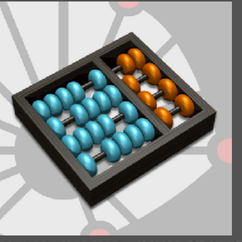
[7] Santos, T. (2017). Perspectivas de Internet das Coisas no ambiente rural

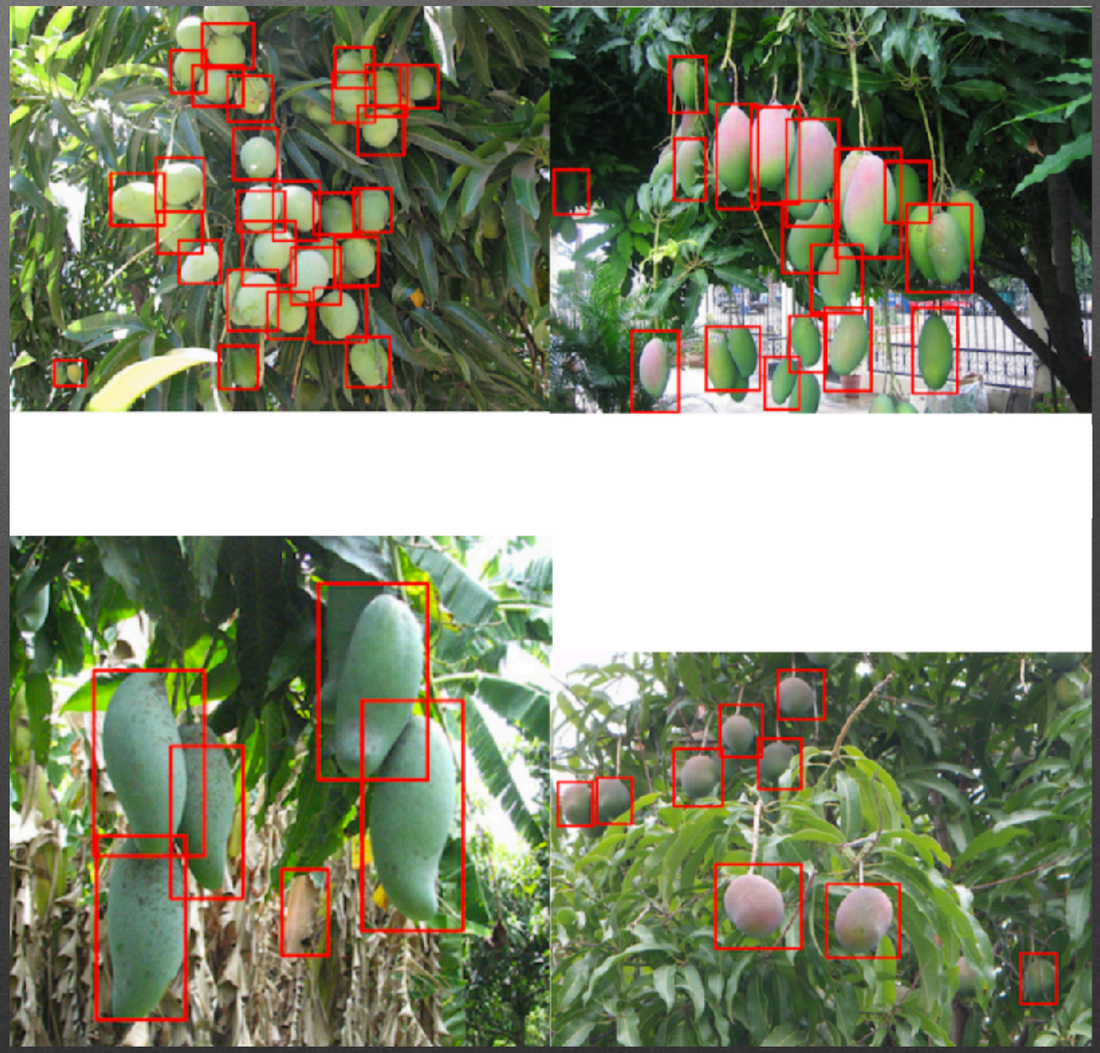


IoT Cases: Precision Agriculture I [8]

Analyze

IoT + Models + AI

- Agricultural models
  - ✓climate
  - ✓growth
  - ✓production
  - ✓irrigation
  - ✓fertilization, etc.
- Image processing
- Computer vision
- Machine Learning



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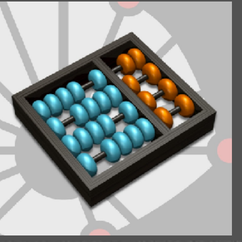

IoT Cases: Precision Agriculture II [8]

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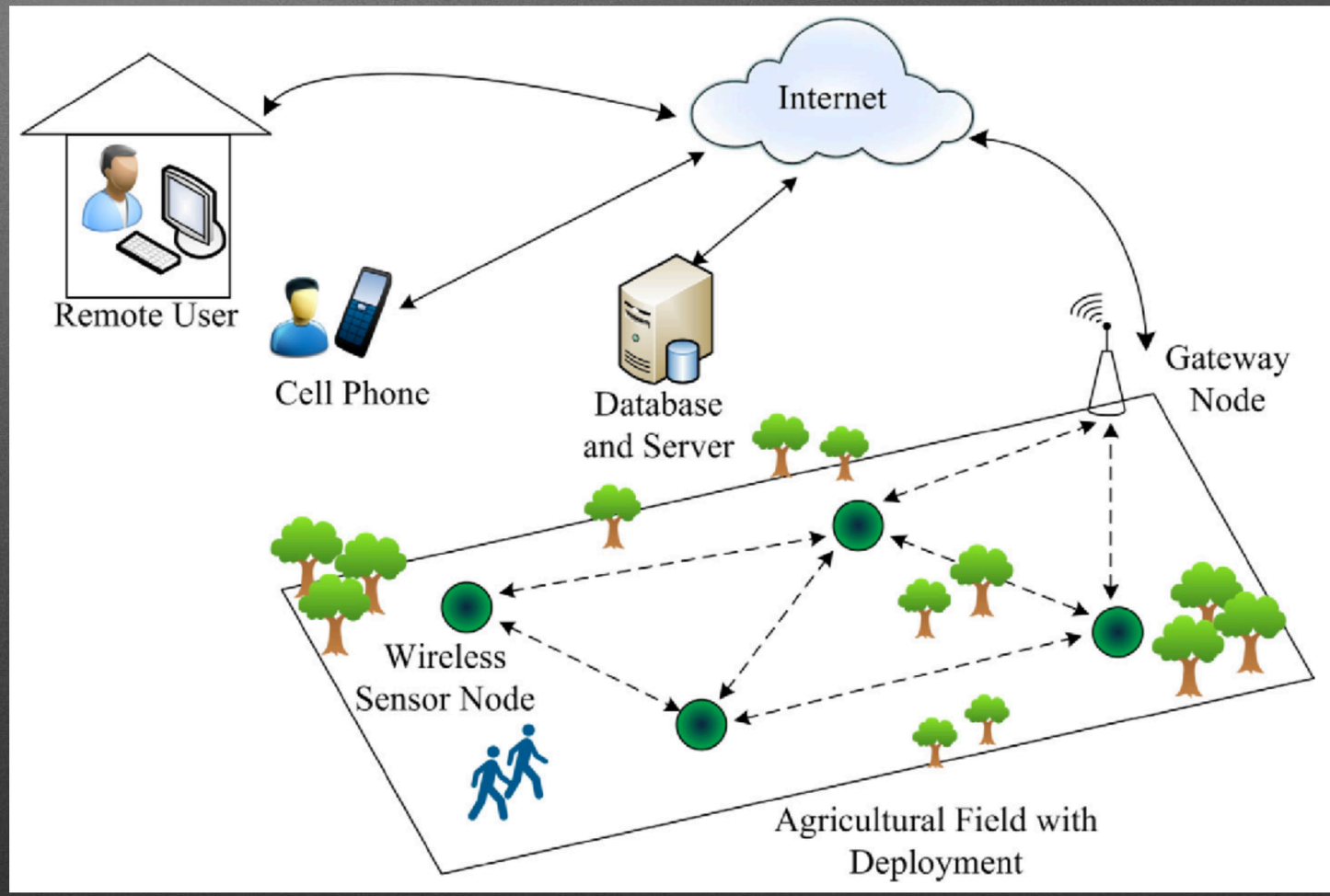
- Sensing:
  - A typical Wireless Sensor Networks (WSNs) deployed for agricultural applications [8]



[8] Ojha, T., et al. (2015). "Wireless sensor networks for agriculture: The state-of-the-art in practice and future challenges."

IoT Cases: Precision Agriculture III [8]

- A typical Wireless Sensor Networks (WSNs) deployed for agricultural applications [8] *(video)*[9, 13]

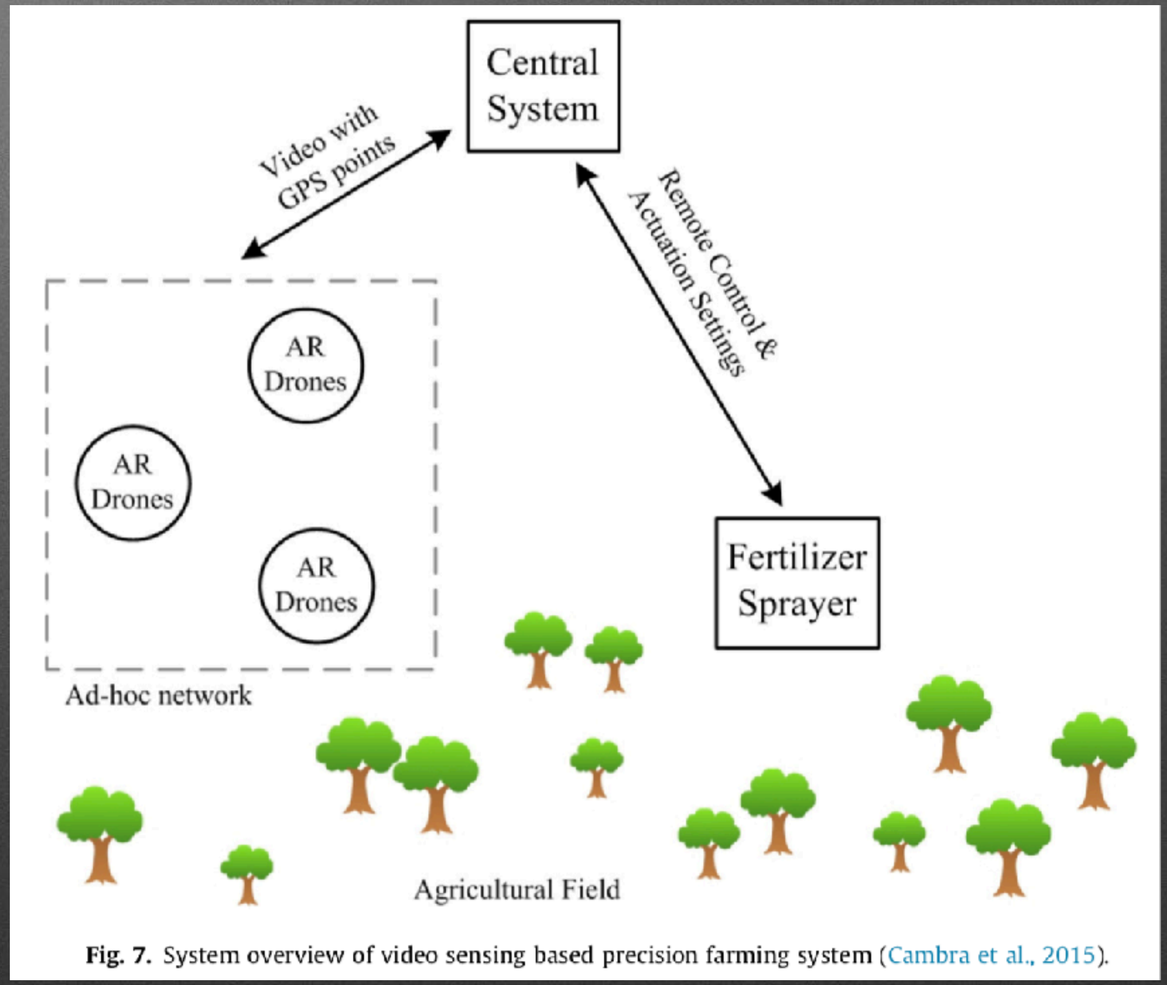
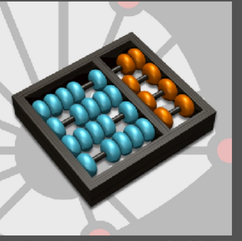


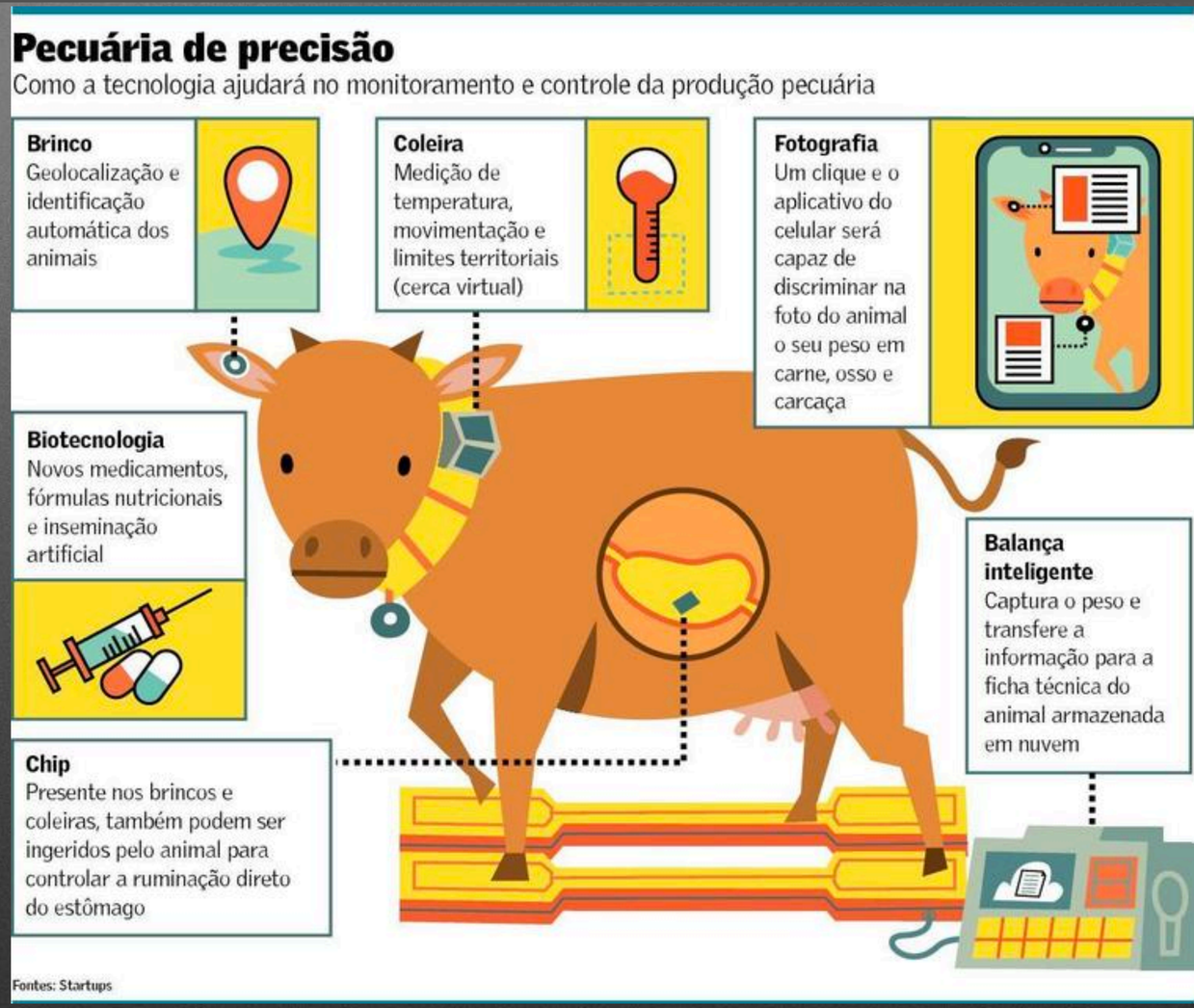
Fig. 7. System overview of video sensing based precision farming system (Cambra et al., 2015).

[8] Ojha, T., et al. (2015). "Wireless sensor networks for agriculture: The state-of-the-art in practice and future challenges."
[9] Andrade, R. d. O. (2016). Drones sobre o campo: Avanços tecnológicos ampliam as possibilidades do uso de aeronaves não tripuladas na agricultura.
[13] Jorge, L. A. d. C. and R. Y. Inamasu (2014). "Uso de veículos aéreos não tripulados (VANT) em agricultura de precisão."



IoT Applications: Precision Livestock [7, 10]

- Precision handling and nutrition traceability
- Monitoring the herd
- Collar: health monitoring (movement, leisure and rumination) and virtual fence
- Earrings: complete technical file of the ox (where born, age, vaccination portfolio, diseases and their georeferenced location)
- Intelligent scales: the animal can be heavy while walking on the equipment
- Chips: monitor the temperature and movement of the animal
- Carcass photography: algorithms that calculate the weight of the carcass from the photograph

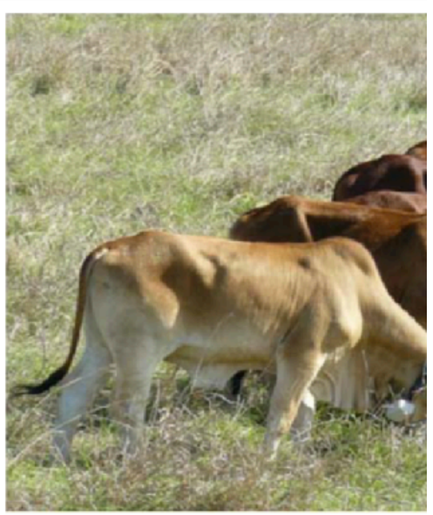


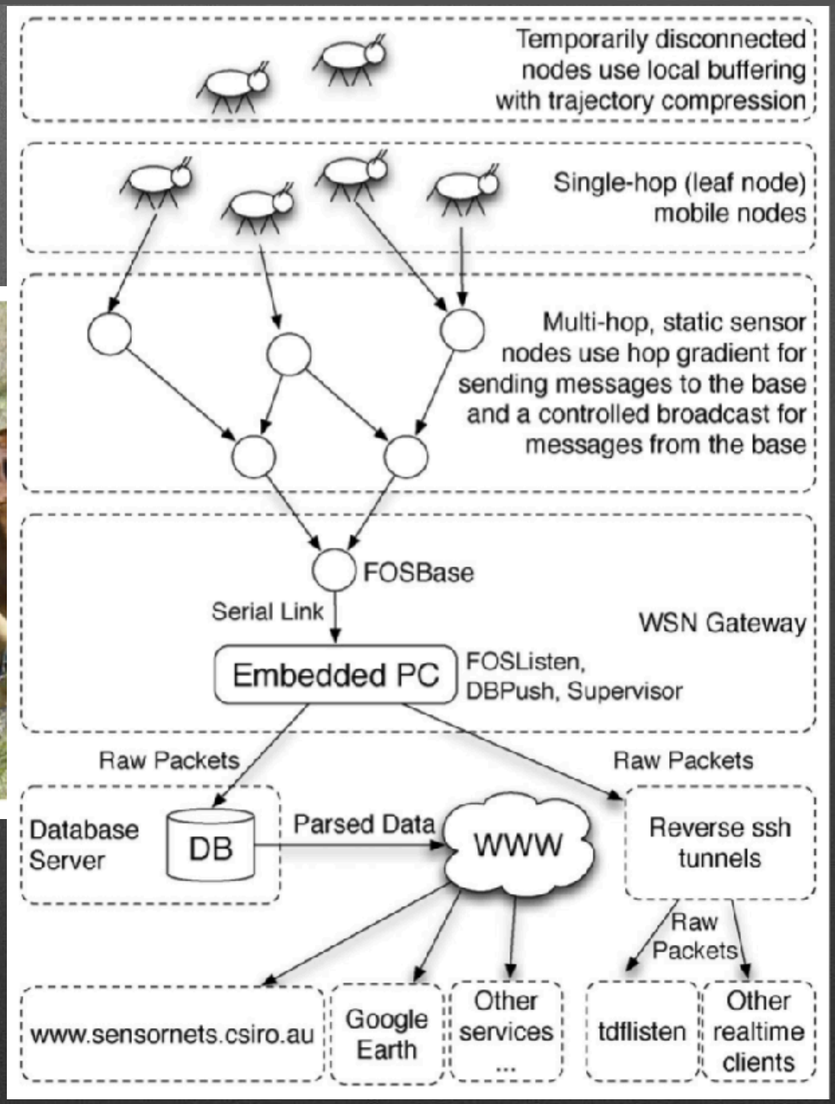
[7] Santos, T. (2017). Perspectivas de Internet das Coisas no ambiente rural

[10] Barros, B. (2018). O olho do dono, que engorda o boi, agora é digital. Valor Agronegócio.

IoT Cases: Cattle I

- Sensing:
  - Wireless Sensor Networks (WSNs) for cattle [7, 11]
  - Sensor nodes in the farm deployment [11]
    - ✓ (left) cow collars
    - ✓ (right) second generation environmental housing with solar cell on top
- End-to-End Software Solution
  - ✓ Data flow in and out of the WSN and interaction with the back-end Python tools





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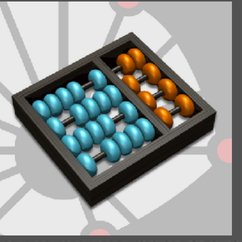
[11] Corke, P., & et al. (November 2010). Environmental Wireless Sensor Networks. Proceedings of the IEEE, Vol. 98, No. 11, 1903 - 1917



IoT Cases: Cattle II

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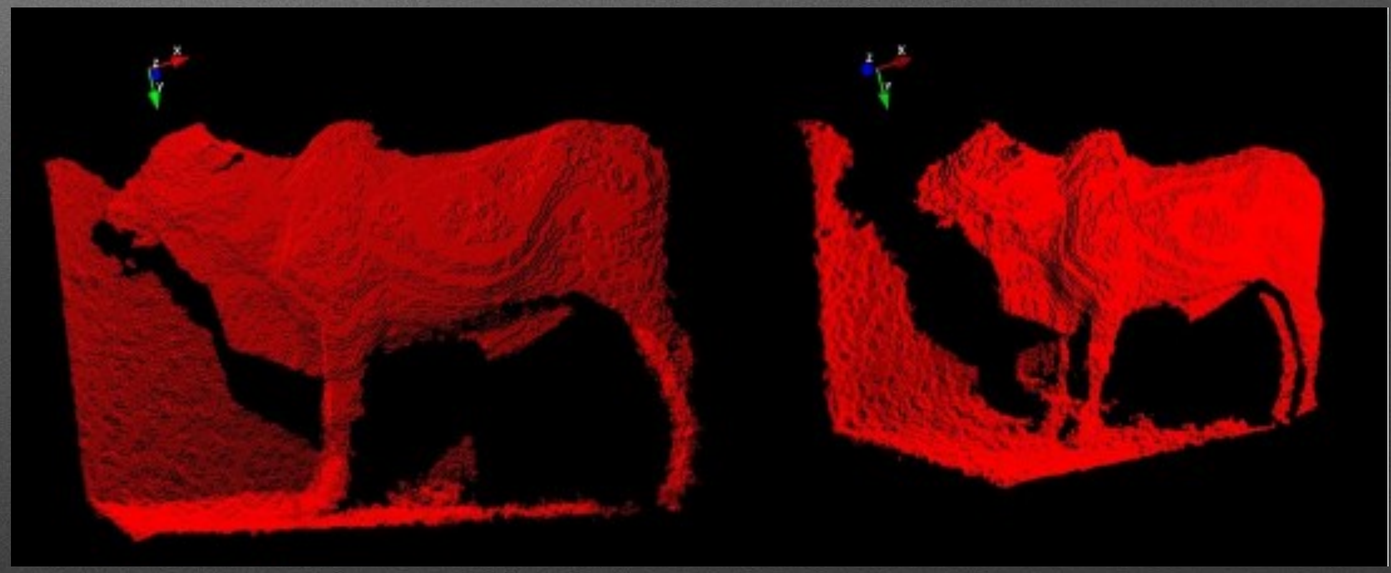
3-D imaging [6]

- 3-D point cloud obtained by an RGB-D camera (Red, Green, Blue-Depth) in a Nelore cattle
- Characteristics estimation
  - ✓composition of the carcass of the animals
  - ✓speed with which they will reach the point of slaughter



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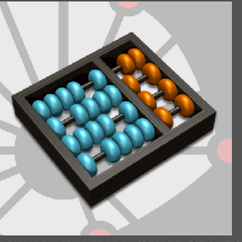


IoT Applications: Smart Farming [7]

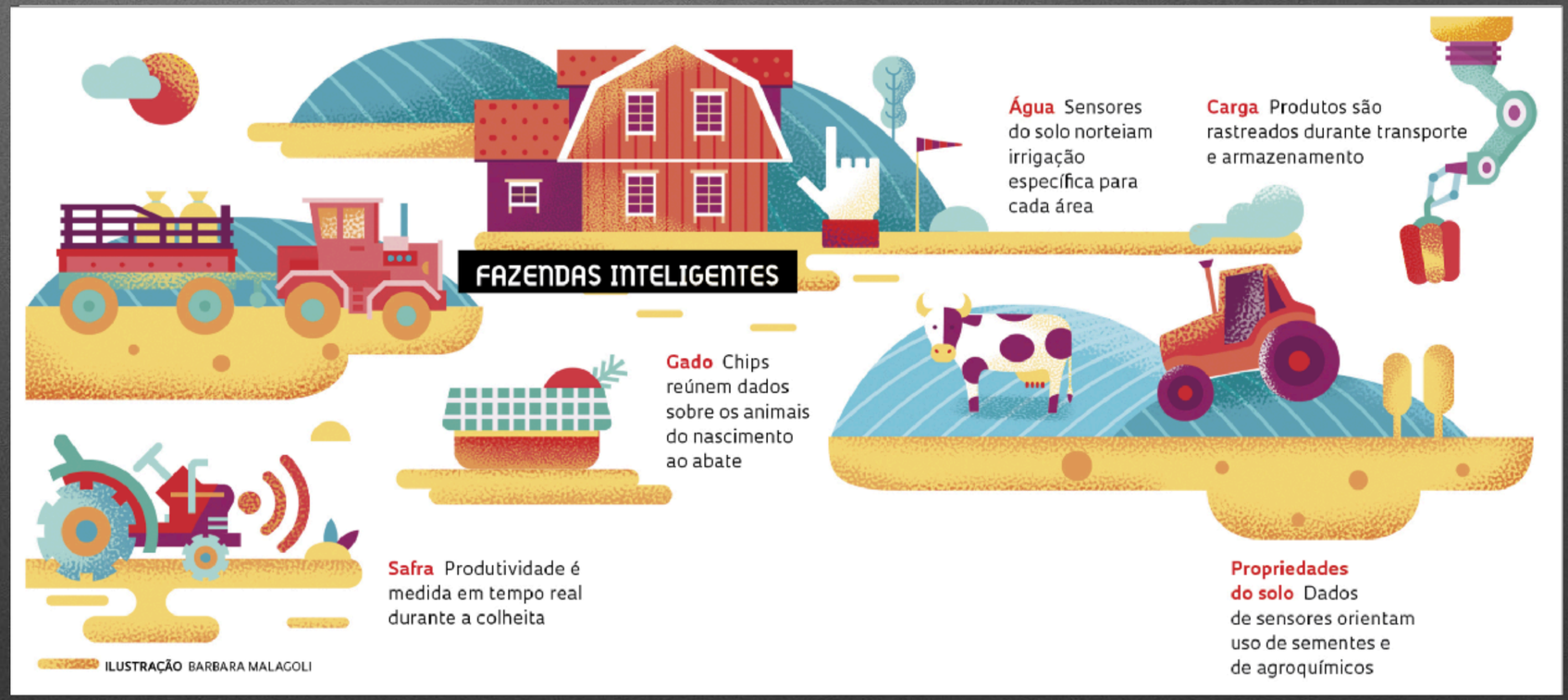
Precision Farming

+

Automated collection of the many variables of interest

+

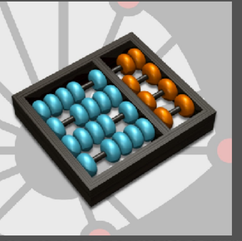
Integration and decision making (micro-decisions)



Smart Farming [12]

[7] Santos, T. (2017). Perspectivas de Internet das Coisas no ambiente rural

12 Marques, F. (2017). O Brasil da Internet das Coisas. Revista Pesquisa FAPESP



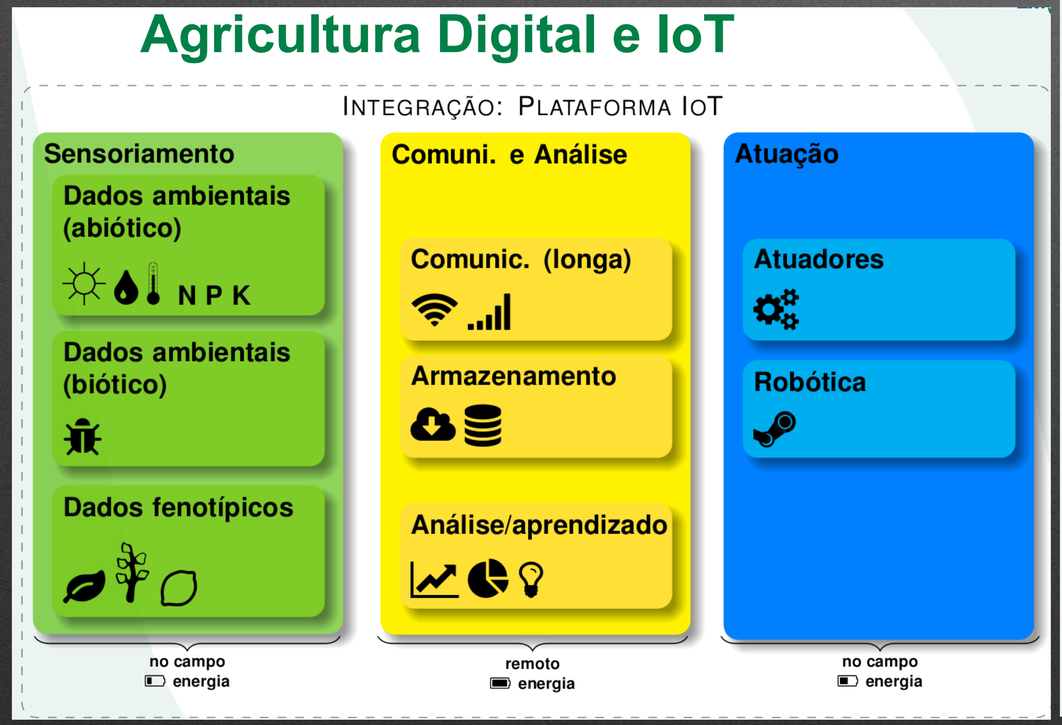
Next Steps: Startups

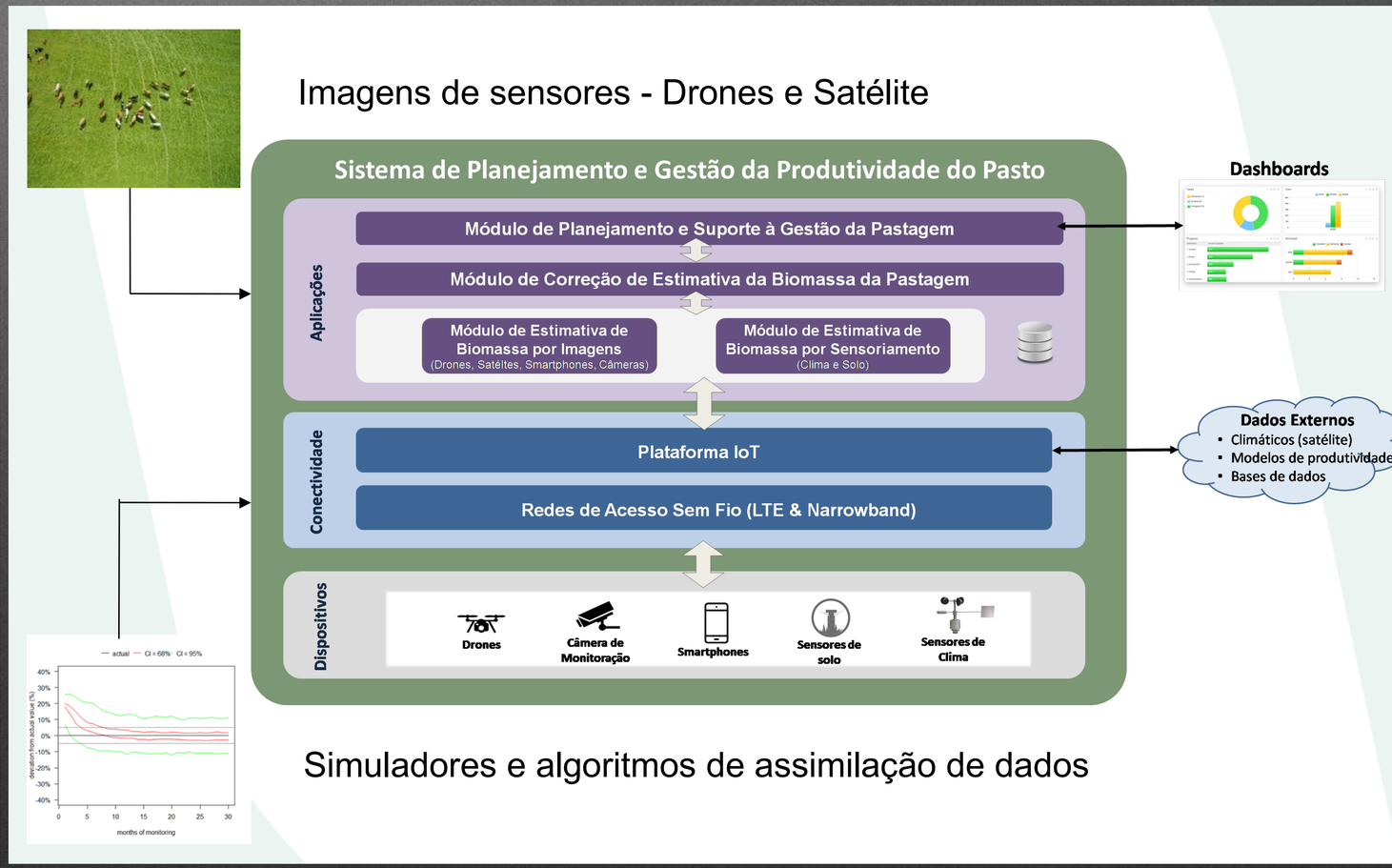
- "Between 2016 and 2018, Brazil has started 110 companies focused on the sector. They were 76, and now raised to 186. Of these, 30% work with solutions for beef cattle and 20% for dairy products (some work on both fronts)" [10]
- Startups, a.k.a. "agtechs"
  - ✓ Intergado
  - ✓ Cowmed
  - ✓ Imeve
  - ✓ 4milk
  - ✓ Arrobatech
  - ✓ Inprenha
  - ✓ BovControl
  - ✓ Pastar
  - ✓ Ecotrace
  - ✓ JetBov

[10] Barros, B. (2018). O olho do dono, que engorda o boi, agora é digital. Valor Agronegócio.

Next Steps: Livestock of the Future

- Pasture and Food Management Planning



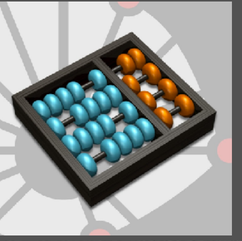


[6] Massruhá, S. M. (2018, Junho). IoT na Embrapa. BNDES – Estudo Nacional de IoT

Next Steps: The Future of Agriculture

- Brazilian: Megatrends and the Role of Science, Technology and Innovation

[6] Massruhá, S. M. (2018, Junho). IoT na Embrapa. BNDES – Estudo Nacional de IoT



Bibliografia

[1] O Brasil da Internet das Coisas, Pesquisa FAPESP – https://goo.gl/DtXDTU

[2] Internet das Coisas: Um plano de ação para o Brasil, BNDES/MCTI – https://goo.gl/y9A2vn

[3] Produto 8: Relatório do Plano de Ação Iniciativas e Projetos Mobilizadores - https://www.bndes.gov.br/wps/wcm/connect/site/269bc780-8cdb-4b9b-a297-53955103d4c5/relatorio-final-plano-de-acao-produto-8-alterado.pdf?MOD=AJPERES&CVID=m0jDUok

[4] Fraunhofer (2018). "Agro 4.0: Experts discuss advances in digitizing the field." Retrieved 13 Nov 2018, from https://www.brazil.fraunhofer.com/en/news_events/news/agro-4-0--experts-discuss-advances-in-digitalization-in-the-fiel.html.

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[7] Santos, T. (2017). Perspectivas de Internet das Coisas no ambiente rural. Retrieved from https://www.researchgate.net/publication/320064697_Perspectivas_de_Internet_das_Coisas_no_ambiente_rural

[8] Ojha, T., et al. (2015). "Wireless sensor networks for agriculture: The state-of-the-art in practice and future challenges." Computers and Electronics in Agriculture 118: 66-84.

[9] Andrade, R. d. O. (2016). Drones sobre o campo: Avanços tecnológicos ampliam as possibilidades do uso de aeronaves não tripuladas na agricultura. Revista Pesquisa FAPESP.

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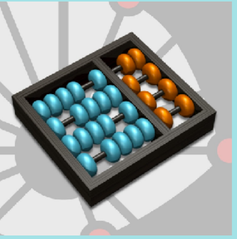
[13] Jorge, L. A. d. C. and R. Y. Inamasu (2014). "Uso de veículos aéreos não tripulados (VANT) em agricultura de precisão." Embrapa Instrumentação-Capítulo em livro científico (ALICE).



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Thank you!

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Q&A

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