SMART SOIL SENSING KIT

Modern Agriculture Technology

Muhammad Ibnu Fadhil

MVP

M. IBNU FADHIL

CODER.ENTREPRENEUR.TINKERER

Twitter : @mifmasterz / @gravicode

Founder of PT Gravicode Multinovative Plexindo

Initiator of Gadgeteer Indonesia & BMC

(facebook.com/netgadgeteerindonesia /

facebook.com/buitenzorgmakersclub)

Contributor in Makers.ID http://makers.id

Problems

Threat to Food Self-Sufficiency

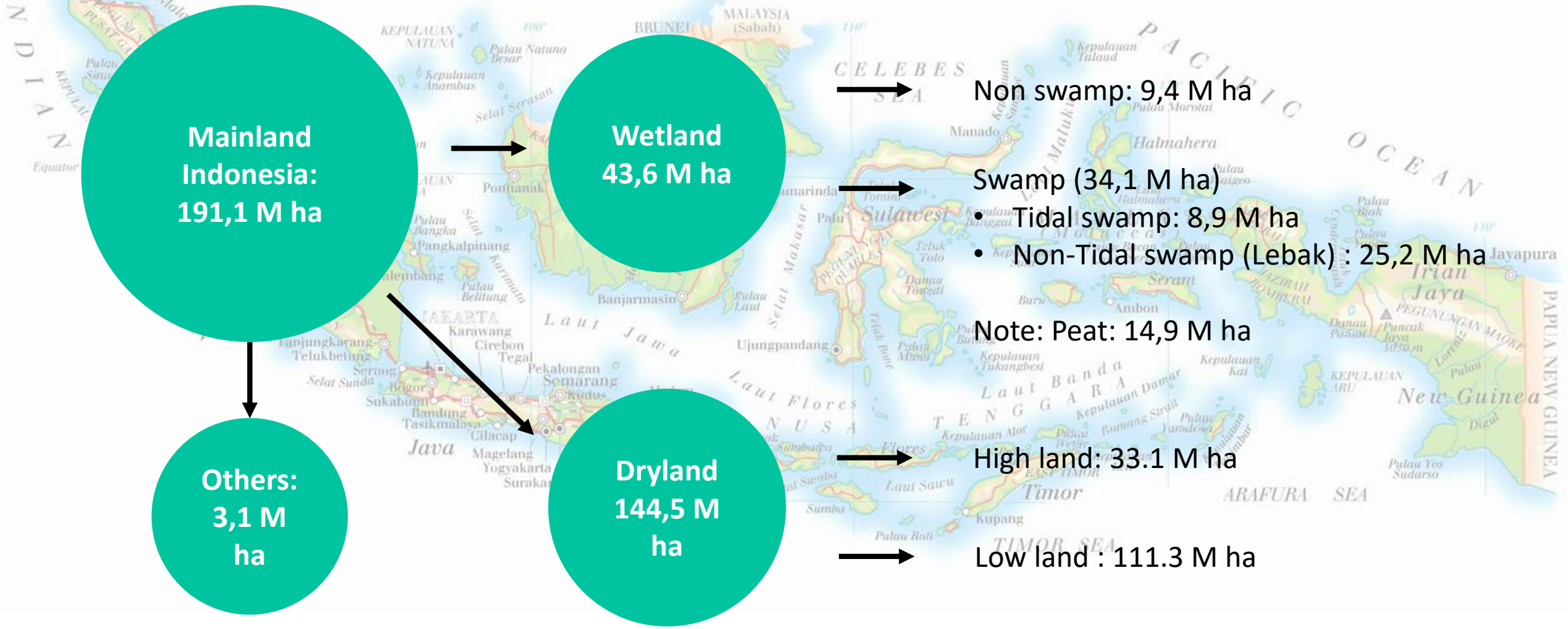
- Increase in human population of 1.45% / yr (an increase of 3.37 million people/yr)
- Agricultural land conversion, mainly rice field (50.000 ha/yr vs newly rice field construction 40.000 ha/yr)
- The height of yield gap (between potential and actual yields)
- Climate change

Challenges in Land Resource Problems

- Future Land resources problems : (a) Gap between Need & Availability; (b) Diversity of land characteristics, and (c) Policies/ regulations in land governance
- Land reserve dominated by sub-optimal (marginal) and degraded lands : “dry land (included highland) & swamp land”
- Land resource degradation (catchment area = DAS) & increasing degraded/abandoned lands due to deforestation, agricultural practices & land tenure

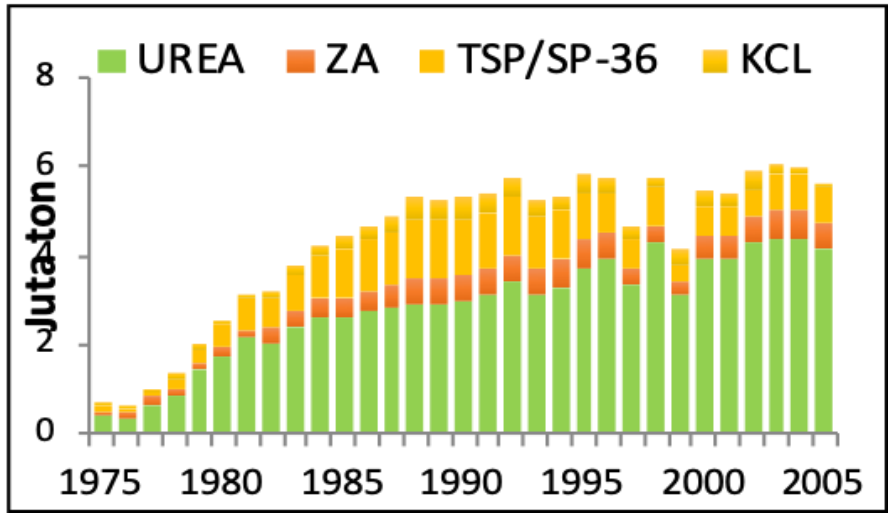
Source: BBSDLP, 2019

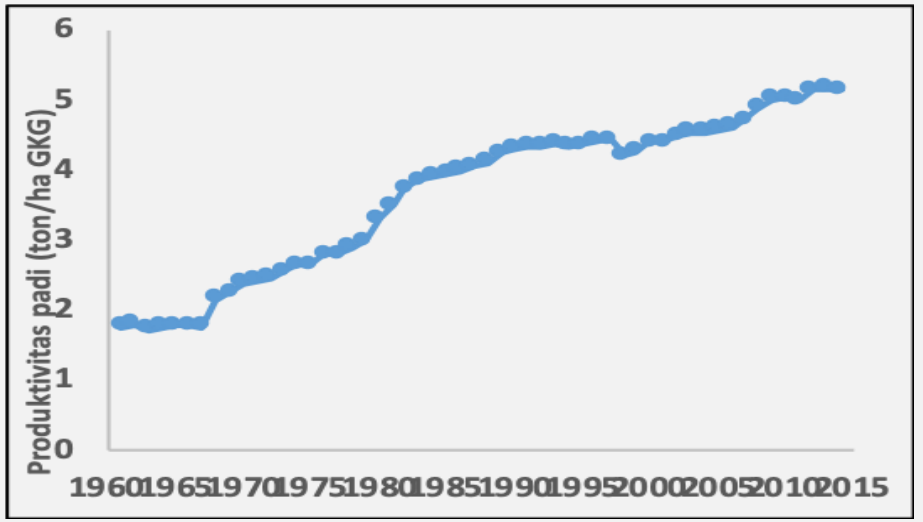
INDONESIAN LAND RESOURCES



Source: BBSDLP, 2019

Fertilizer Consumption in Indonesia 1975-2005





Source: BBSDLP, 2019

Fertilizers Contribute 20 to 40% to Production

Source: BBSDLP, 2019

Basic Development of Science and Technology in Fertilization

1. • Technology in determining fertilizer needs based on nutrient balance
2. • **Technology or test kit for determining fertilizer recommendations**
3. • Fertilizer production technology
4. • Technology for improving soil quality → effective and efficient fertilization

We are focus in here

Source: BBSDLP, 2019

SIX BASICS OF APPROPRIATE FERTILIZATION SHOULD BE APPLIED OPTIMALLY

Tepat Jenis	Tepat Dosis	Tepat Cara
Tepat Waktu	Tepat Tempat	Tepat Komoditas

Source: BBSDLP, 2019

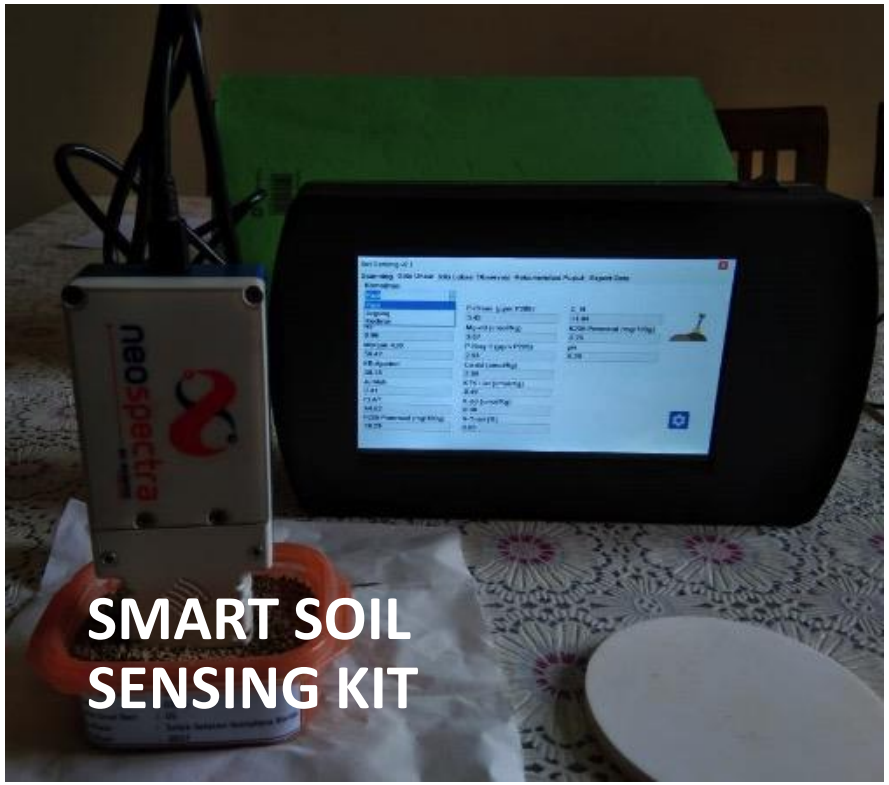
Existing Solution: Determination of Fertilizer Recommendations

- Soil Test Kit: a tool to determine fertilizer recommendations that are easy, fast and appropriate for various types of plants (PUTS, PUTK, PUTR).
- Fertilizer Test Kit: a tool to determine nutrient content of a fertilizer and to determine quality of a fertilizer (PUP and PUPO).

Source: BBSDLP, 2019

Solution

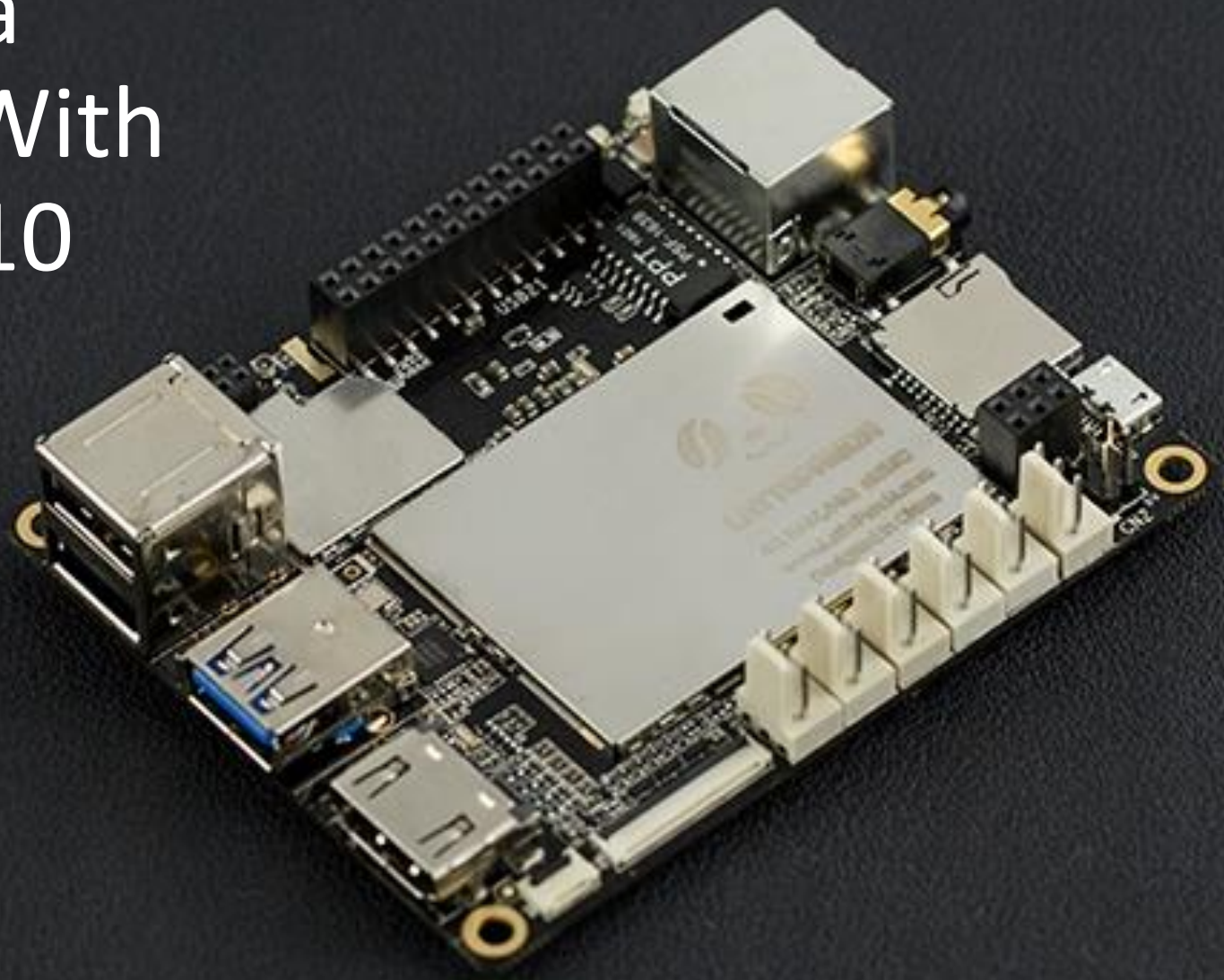
The Innovation Needs for Future Inorganic and Organic Fertilizers



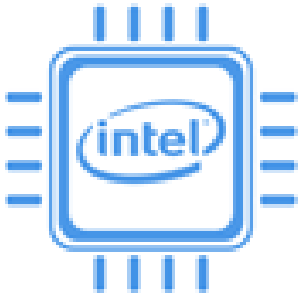
- Smart soil sensing kit is a tool used to measure soil properties directly in the field.
- The kit consists of a sensor (neospectra) and a display / mini computer device
- Measurement is more quantitative, practical and easy to use
- Parameters measured: pH, N-total, P2O5 and K2O extract 25% HCL, P-Bray, P-Olsen, P-Morgan, cation exchange capacity, exchangeable cation (Ca, Mg, K and Na) and soil texture.
- Provide recommendations for N, P and K fertilizers for rice, corn, soybeans and many more in the future


HARDWARE

LattePanda 2G/32GB With Windows 10 Activated



FAST & POWERFUL



QUAD-CORE
1.8GHZ

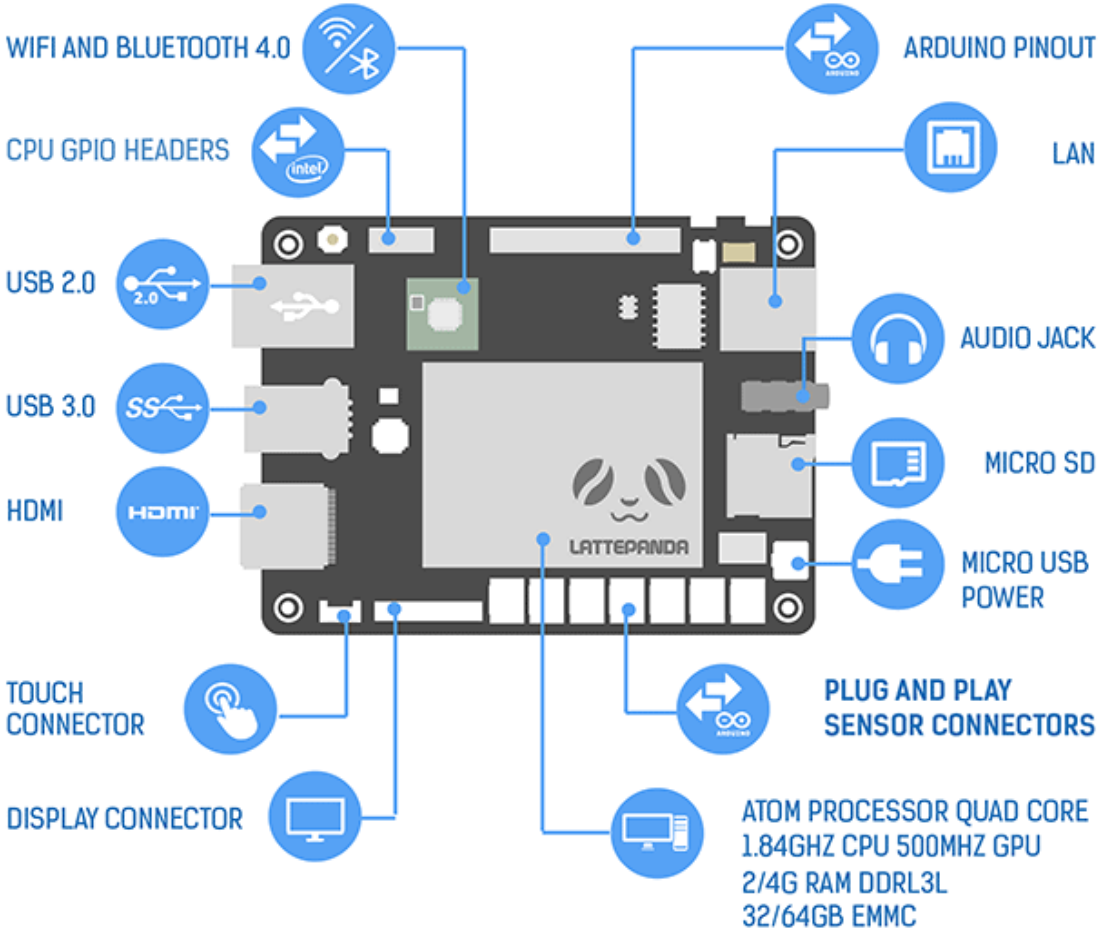
RAM
2-4GB

FLASH
32-64GB

Excellent Expandability

Powered by

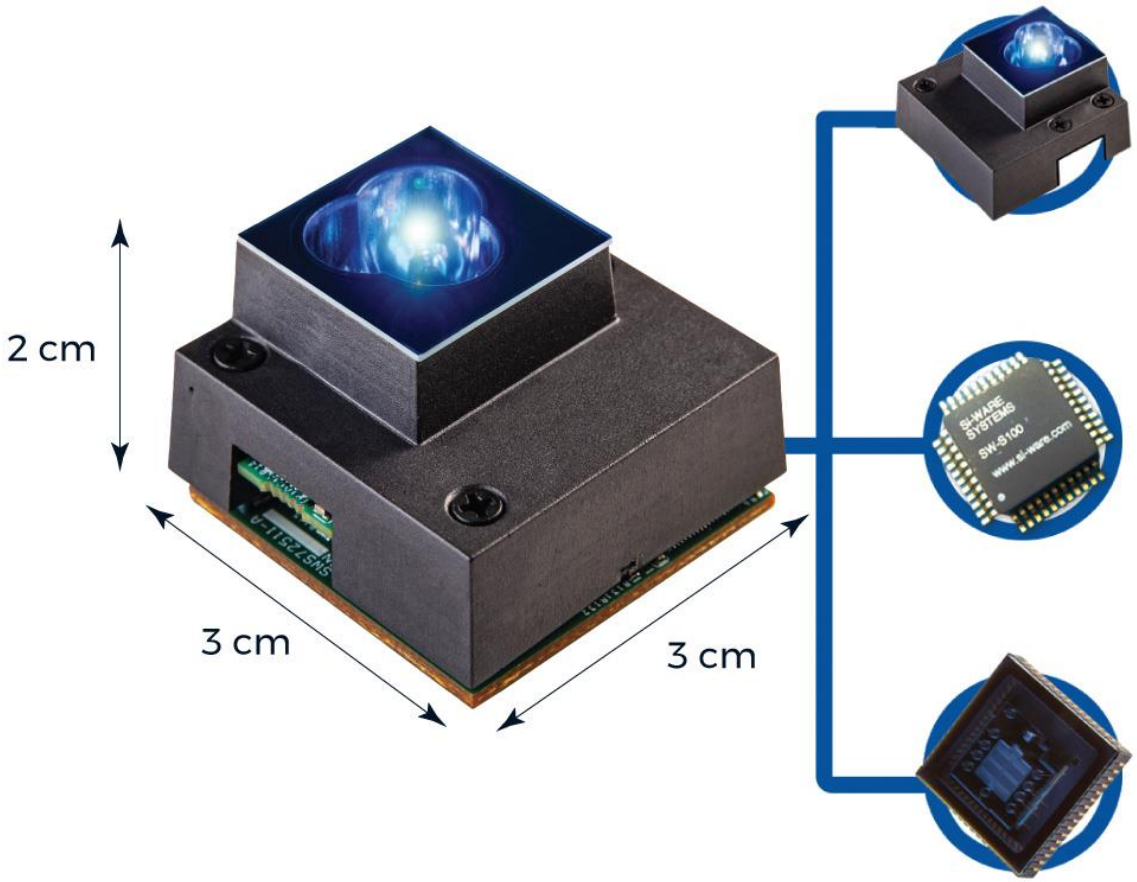
Windows 10



Spectral Sensing Device

The NeoSpectra-Module is a plug-and-play spectral sensing module that can be used in a wide variety of material sensing applications for qualification and quantification.

The sensors are based on Fourier Transform InfraRed (FT-IR) technology, which is a standard technique used in laboratory based spectrometers that offers a wide spectral range for the best qualification and quantification of materials. The sensors used patented Micro Electro Mechanical Systems (MEMS) technology, which allows for a Michelson interferometer to be created monolithically on a MEMS chip



Optical Head

- o Light sources for sample illumination
- o Collection of diffused reflected light

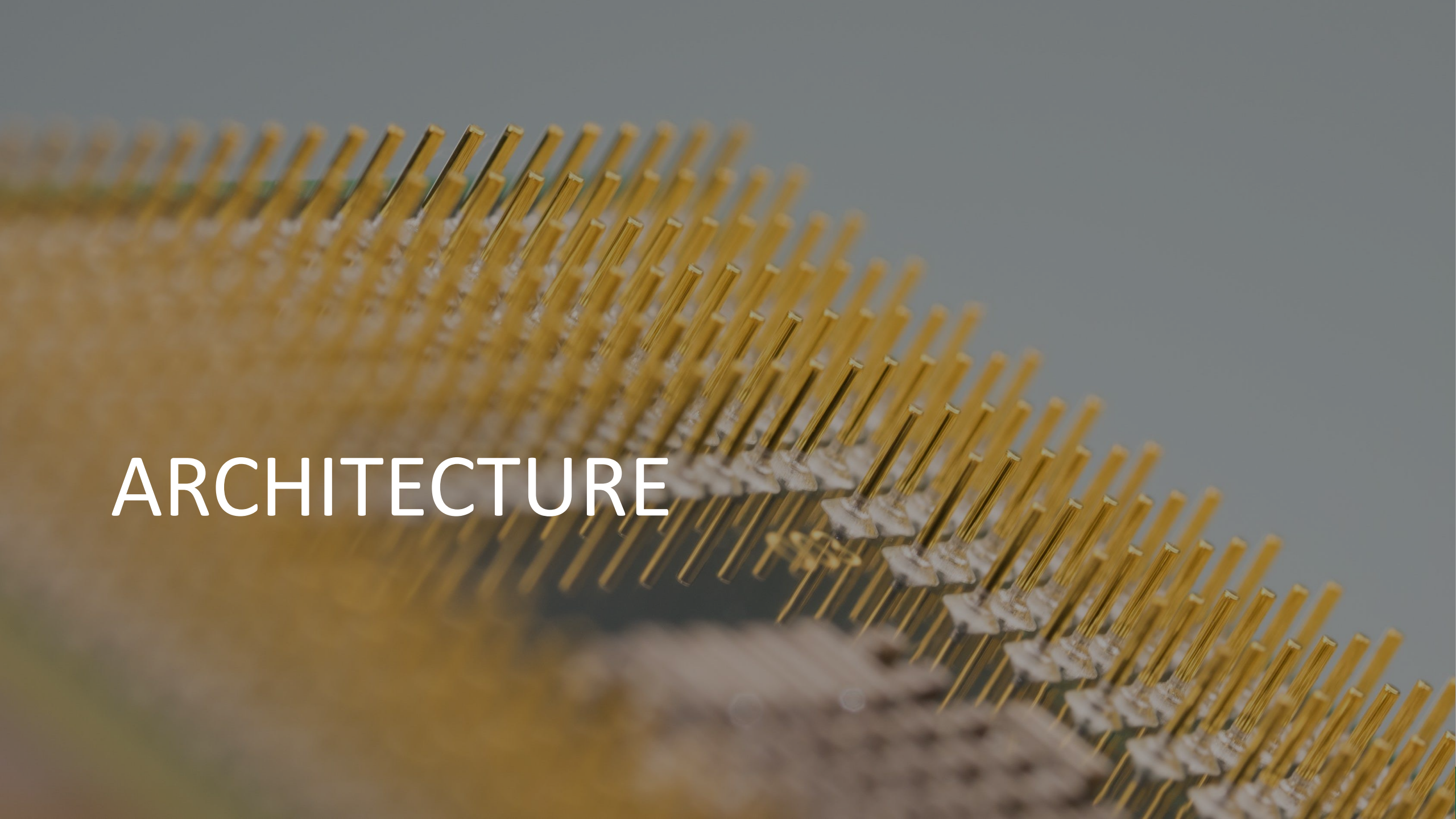
Electronics

- o Application Specific Integrated Circuits (ASICs) for system control and data processing
- o Proprietary design for performance optimization
- o Reduces the amount of external components

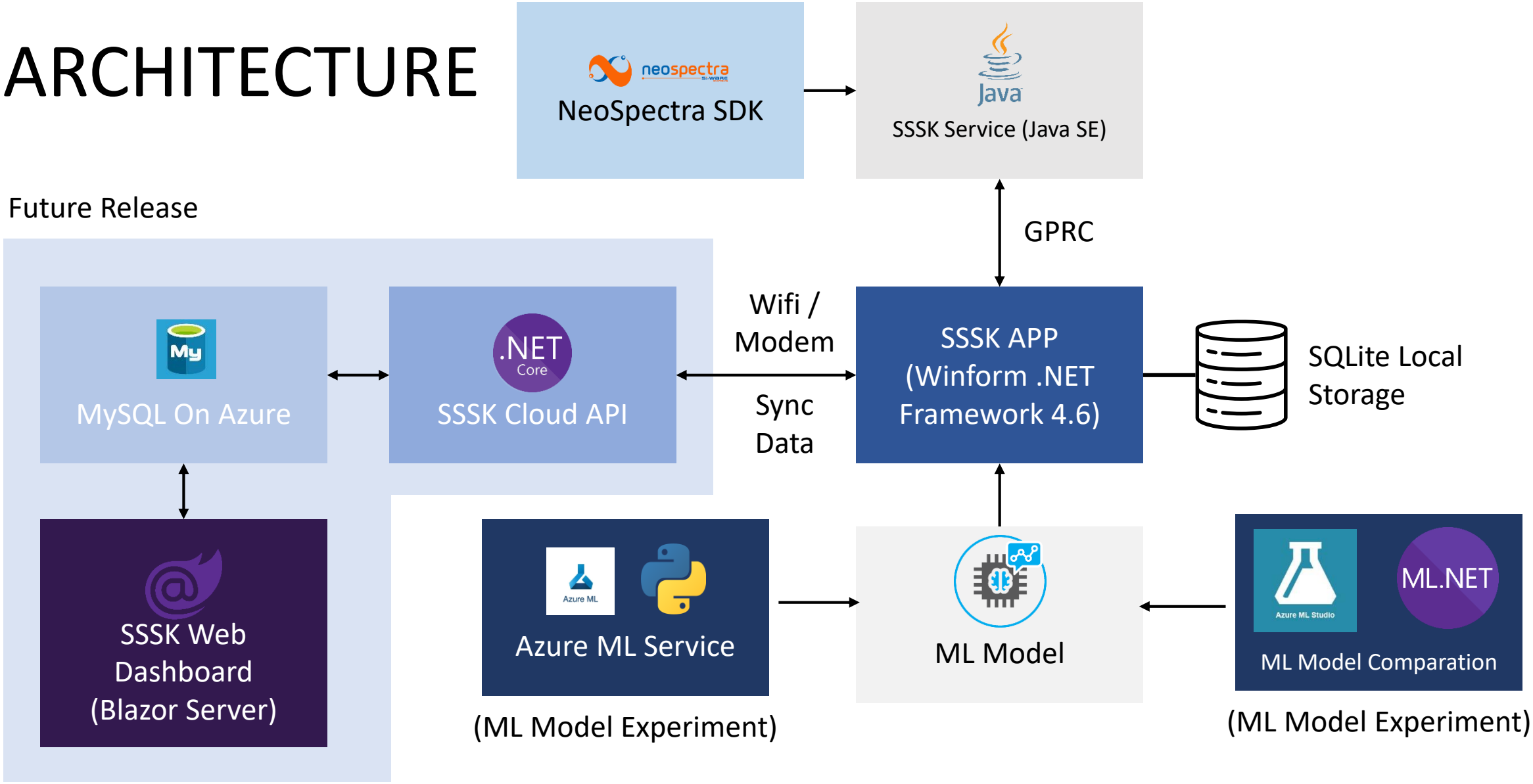
Optical Core Module

- o Monolithic MEMS Michelson interferometer
- o Single uncooled InGaAs photodector


Model Creation with VSCode + Azure ML Service
Windows App with .Net Framework 4.6
Export to Excel
Remote Update
SMART SOIL SENSING KIT
Local Storage
Portable
Touchsceen Display
Sync Data to Cloud
Windows 10 Pro
GPS Module
Battery Powered


ARCHITECTURE

ARCHITECTURE



Processing Flow

Data Acquisition

- Gather Soil Sample with VisNIR Sensor
- Get wave length spectrum from 1350nm – 2500nm

Proses Inferensi

- Data from sensor will be pre-processed : spectral trimming, convert to absorbance, savitzky-golay smoothing, SNV
- Process spectrum data with ML Model (SKLearn model)

Recommendation

- Process model output with fertilizer recommendation formula with additional parameter : commodity (rice, corn, soybean)
- The result are SP36, KCL, Urea, NPK 15 fertilizer recommendation (kg/ha)

Storage

- Data can be saved to SQLite database in flash
- Data can be exported to excel format for future analysis

Sync To Cloud (Future Dev.)

- Data can be pushed automatically when there is internet connection to MySQL Azure through web api
- Data will be visualized with map with Blazor server web

Demo

Soil Sensing Kit – Please visit MVP Booth

Lesson Learned

- Visual Studio as a DevTools can help to accelerate development significantly
- Hardware selection can be hard, choose the best partner with reliable and longtime support
- Collaborate with the experts to validate the result
- Data preparation, Formula Creation is the hardest part, time consuming and resources intensive
- AutoML can help you to find the most accurate ML model
- Focus on the solution, small team with great productivity is better than a large team with less productivity
- Automate everything
- Cloud can reduce time-to-market, auto-scale and can help team to focus on the solution rather than infrastructure

Where to get started ?

Learn more about

- Microsoft AI – https://aka.ms/aidevdocs
- Cognitive Services – https://aka.ms/cogsvcs
- Azure ML – https://aka.ms/azuremldocs
- Deep Learning VMs – https://aka.ms/dlvmdocs
- Visual Studio for AI https://aka.ms/vstoolsforai
- Batch AI https://aka.ms/batchaibuild
- ML.Net https://docs.microsoft.com/en-us/dotnet/machine-learning/


Learn to be AI Developer
Azure.com/ai

Learn to be IoT Developer

https://iotschool.microsoft.com/en-us

Please visit MVP Booth

Get awesome goodies, ask me anything, and get connected with your community

Teams

Team Lead: Dr. Husnain, M.Sc

Domain Experts

- Dr. Ir. Wiwik Hartatik, M.Si
- Dr. Linca Anggria, S.Si., M.Sc
- Dr. Adha F Siregar, MSc
- Dr. Ir. Diah Setyorini, Msi
- Dr. Ir. IG. M. Subiksa
- Ir. Kasno, Msi
- Heri Wibowo, ST, MSc
- Tia Rostaman, Ssi.

Data Scientist Team

- Prof. Budiman Minasny
- Dr. Wartini
- Dr. Edward

Engineering Team

- M Ibnu Fadhil
- Hosni Rachmani
- Januartha Ramadhan
- Adrian Angka
- Iwan Muttaqien

Thank you

“The advance of technology is based on making it fit in so that you don't really even notice it, so it's part of everyday life”

Bill Gates, Co-founder of Microsoft