

WAZIhub

Unlocking IoT Startups in Africa



The rise of tech startups in the African economy

The WaziHub Tech Hubs

Our startups

The Smart Village

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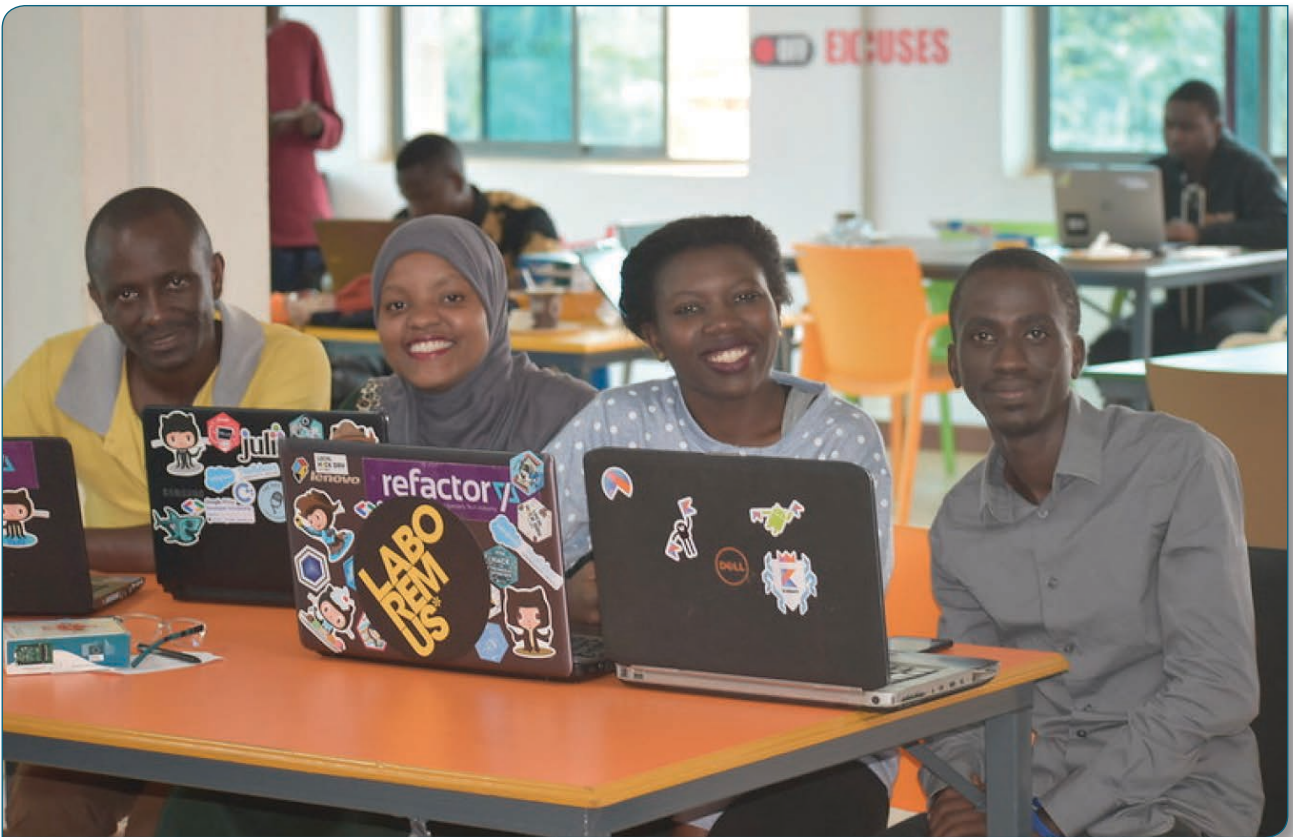


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Foreword



Abdur Rahim

The World Economic Forum published in 2018 the report “Internet of Things: Guidelines for Sustainability”, analysing the deployment of 640 Internet of Things (IoT) projects world-wide. This report claims that the full potential of IoT for sustainable development can only be achieved when sustainability is incorporated at the design phase. **Sustainability is at the core of WaziHub:** the key goal of the project is to create a strong business ecosystem and to foster partnerships between Africa and Europe.

Both continents are facing the same key challenges: promote sustainable growth, jobs, mobility, security, and good governance. Regarding the African startups (see our dossier page 23), there is a need to improve their innovation capacities with regards to emerging technologies. They also need better access to investment and business opportunities. On the other hand, European startups need better access to emerging markets, possible soft-landing, and a better understanding of the African local innovations ecosystem.

A recent phenomenon in Africa is the booming development of “Tech Hubs”, offering facilities and support for tech and digital entrepreneurs (see our dossier page 9). However, the Tech Hubs often need more technical expertise such as hardware, software, networking, and cloud-based data management. The WaziHub project aims to **improve the IoT capacity of the Tech Hubs** by offering technology and training. We are creating a network of connected IoT Tech Hubs throughout Africa, in which each hub can collaborate with each other. They can share best practices, experience, knowledge and services.

The objective of each WaziHub Tech Hub is the local adoption and adaptation of IoT technologies. The Tech Hubs together with local entrepreneurs and stakeholders are spinning off IoT and Big Data products and services in order to address the needs of local users. Local hubs play an important role in the self-sustainability of the project with the following three core components: technology capacity building for rapid prototyping and real-life testing, acceleration for service creation, and sustainable business transformation.

The majority of African Tech Hubs are concentrated in capitals (E.g. Nairobi, Accra, Cairo, and Lagos). However, African talents are distributed throughout the countries. As the public transportation infrastructure is still under development, it can be very expensive, if not impossible, to travel to the capital to join the training provided by Tech Hubs. That’s why we want to deploy and support hubs in smaller cities, as a key factor for offering access to technologies and innovation to local communities in Africa. These hubs also need further development as they provide services to the greater communities, including women, as well as vulnerable and marginalized youth.

This new volume follows the WaziHub Magazine no. 1¹, which was presenting the Waziup IoT technologies deployed on the African continent. In this edition, we will give the floor to our Tech Hubs and startups. I wish you a nice reading of WaziHub Magazine no. 2!

¹ <http://doi.org/10.5281/zenodo.4835730>

Keynote: The rise of tech startups in the African economy

More and more, the Internet of Things (IoT) is being championed by smart startups in Africa. Those startups are able to disrupt the economy and create a seamless way of life. They create semi-autonomous systems and processes that improve the operations of various businesses and segments of the industry. Recently, IoT technologies have been enhanced with a fusion of Artificial Intelligence (AI) and advanced wireless technologies, such as LoRaWAN. However, Africa is still behind in term of adoption.

What are the factors that are driving the adoption of IoT on the African continent? Which economic sectors are most in need of digital transformation? In the following, we'll give some keys for understanding how IoT can transform lives on the continent.

Encouraging economic growth and structural transformation

According to Manyika et al., some of the foundations encouraging economic growth and structural transformations include digitisation and development of innovations through communications technology by creating networks between machines and the wider internet. This is also known as the 'Internet of Things'. Estimation of economic growth and impact from IoT will be high, driven by lower prices for hardware; advanced computing; cloud storage; higher speed; and lower costs of connectivity; leading to an increasing

number of machines and devices connected to the Internet thus contributing greatly to the total world's GDP by 2025.

Digitisation of businesses is one of the key components contributing to this growth.¹

The WaziHub project has created a platform to help startups in Africa to grow with IoT, Big Data, and Artificial Intelligence.

Fighting poverty and inequality

The spread of digital knowledge and skills can empower the poor to access technologies for good. Local entrepreneurs can rely on simple, widespread technologies such as SMS, USSD, and mobile phone applications. Those technologies can contribute to making their products more accessible, even in remote places. Cheap sensors and boards such as Arduino also contribute to making IoT more accessible. Better education in ICT has also been recognized as a key factor for lessening inequalities in emerging countries. These technologies can be enablers for job creation and services that improve the way of life.

Authors:



Irene Mutesi Musoke, Hub and Innovations Manager, Women In Technology Uganda, Uganda.

¹ <https://doi.org/10.1080/10438599.2019.1695941>

Africa-wise reinvention of production, skills and labour

In the near future, Africa's workforce will be among the world's largest. Africa is modernising and reinventing the chains of production to accommodate this larger population. IoT technologies in particular are envisioned as key technologies to enable growth. With IoT, African entrepreneurs have the opportunity to co-create reliable services and products that are suitable for a changing world. IoT, Big Data, and Artificial Intelligence allow startups and businesses to transition from "analogue" to "smart".

Agricultural and agro-industry modernisation

Agriculture is what constitutes Africa's largest economic capacity. Africa is currently transitioning from subsistence farming to large scale production, in order to fill the global demand for food. There is no way this can be achieved without the use of smart solutions to monitor large farms and animals. Through the adoption of IoT technologies, Africa can harness the full potential of the agricultural sector. IoT communication and monitoring in particular can support large-scale production and increase production quality. This in turn provides jobs and increases income revenue streams.

Africa's way to improve healthcare and human capital

Numerous African countries are faced with challenges in the healthcare system, especially in remote places. These are further escalated by climate change and poor transport network systems. The lack of qualified professionals also has a negative impact on these constrained communities. Mobile technologies, IoT, and Big Data technologies can contribute to solving these challenges. For instance, some startups propose medicine deliveries and doctor reviews. The incorporation of drones into the disaster recovery and evacuation processes is another way African countries like Rwanda² are providing smart health care services to their people in remote areas.

Increment of financial services and investments

Recent technologies such as mobile payment have enabled people who do not normally have access to formal banking to make remote payments. The "unbanked" are slowly gaining access to electronic payment platforms, virtual savings, and credit supply. Mobile banking has been a great enabler for small-scale entrepreneurship. It also means immense opportunities for job creation for the youth, as new kinds of skills are needed for these services. In order to support this agile governance within the African context, new programs and support mechanisms are needed to boost knowledge, skills, and entrepreneurship.

² <https://reliefweb.int/report/rwanda/covid-19-response-rwanda-use-drones-community-awareness>

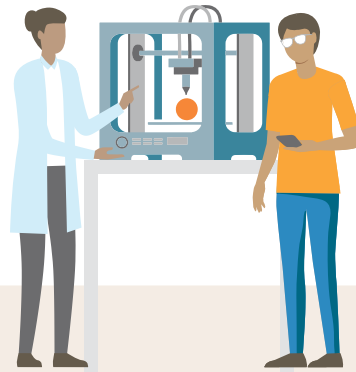
TECH HUB



COMMUNICATION



STARTUPS



PROTOTYPING



CAPACITY BUILDING



COMMUNITY

The WaziHub Tech Hubs

“Do-it-Yourself” Tech Hubs in Africa are challenging the dominance of traditional universities as sites of knowledge production. While traditional universities are struggling with resource constraints, inadequate industry engagement, and institutional bureaucracy, Tech Hubs are leading the way in generating new knowledge and innovative solutions particularly for those at the bottom of the pyramid. They are also more effective in economic and social value creation by generating new jobs, stimulating the entrepreneurial ecosystem, and improving the quality of life through technology. Africa has more than 600 Tech Hubs and that number

is still rising¹, ranging from incubators and accelerators to co-working sites. The latest collaborative effort by Briter Bridges and AfriLabs **identifies 643 active Tech Hubs**². This study found that 41% of these facilities are incubators, 24% are innovation hubs, 14% are accelerators, and 39% offer coworking space. In part thanks to the tech hub movement, technology ecosystems across Africa have witnessed incredible growth over the past few years, mainly boosted by a torrent of venture funds, development finance, corporate involvement, as well as an ever-growing innovative community.

While the startup game is about the survival of the fittest, it is also one where **community means power**. Hubs promote new ideas in a non-hierarchical way. For instance, bootcamps and hackathons are a great way to bring together tech-enthusiasts around a common problem and let them use their collective brainpower to solve it. New ideas emerge during these kind of events that sometimes lead to successful startups. Those startups are then “incubated”: the tech hub supports them with capacity building and training on technical and non-technical topics. The acceleration part comprises additional exposure, where startups participate in networking and promotion events. They get the chance to demonstrate their product to potential investors.

In this dossier, we will explore how these hubs’ unorthodox approach enables them to generate innovative solutions more efficiently, in direct response to specific industry needs and critical societal challenges. We will first present our Tech Hubs, spanning 6 countries on the continent. We will then show you the business side of things: how you can grow a simple idea, to a MVP prototype, to a full startup! We’ll finish with our tech community, and how events such as bootcamps and hackathons can kick-start your idea.

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¹ <https://www.gsma.com/mobilefordevelopment/blog/618-active-tech-hubs-the-backbone-of-africas-tech-ecosystem/>

² <https://www.theafricareport.com/23434/tech-hubs-across-africa-to-incubate-the-next-generation/>

Our TechHubs

WaziHub supports 6 Tech Hubs in Africa: Sonatel in Senegal, Kumasi Hive in Ghana, @iLabsAfrica in Kenya, The MakerSpace in South Africa, Dar Teknohama Business Incubator in Tanzania, Hive Colab in Uganda. All with different styles, all with a common goal: supporting startups!

1

**Sonatel,
Dakar, Senegal**



Sonatel (Société Nationale des Télécommunications du Senegal) is the principal telecommunications provider of Senegal. The company is active in fixed-line telephony, mobile telephony, internet services, television, and corporate telecommunications. Being the principal telecommunications provider in Senegal, Sonatel helps in providing facilities in the technological and innovative ecosystem in Senegal.

Sonatel is involved in several innovation activities with the aim of accelerating solution replication: an acceleration program for early-stage startups, hackathons and bootcamps for students and developers, training on new technology (IoT, Big data, AI, ...), and the Orange Digital Center (ODC). ODC's aim is to develop several strategic programs: coding school, FabLab Solidaire, Orange Fab and Orange Digital Ventures Africa, and the Group's investment fund.

Sonatel operates in partnership with Orange France, Senegal's public administration, the ARTP, and with a huge network of private partners all around Africa. In terms of communication, Sonatel provides a daily newscast (Flash Kaddu Sonatel, which provides information about the company's life as well as the different projects launched to serve the populations), a monthly newsletter dedicated to startups (more than 2000 e-mail addresses), and is strongly active on social media (Facebook, Twitter, Google - Youtube channel).

Finally, Sonatel hosts and maintains the FiWare Senegal Node and provides Technical support level 1.

www.sonatel.sn

2

**Kumasi Hive,
Kumasi, Ghana**



Kumasi Hive is an innovation hub for rapid prototyping of ideas, budding local innovations, impact startup support and promoting youth entrepreneurship as a way of addressing critical social economic and developmental challenges. The Hive as a multi-space hub provides affordable space rental services for co-working, makerspace, events, training, and meetings.

The Hardware Incubator is a service for selected promising hardware startups, helping them move from the idea stage through prototyping to the product-for-market stage with both technical and business development support. The Business Accelerator program focuses on non-hardware startups: it provides complete startup support services for early-stage startups to help them grow and contribute to the sustainable socio-economic growth of Africa.

Kumasi Hive is also connected to the grassroots and actively training, making resources available for the student community. The Creativity Group is an undergraduate students' community of makers, innovators, entrepreneurs, and social thought leaders, eager to use innovation and technology as a tool to solve critical challenges for social intervention and development of their communities. The Group currently has a membership of 300 students organized in five chapters in the five major public universities in Ghana, and it has channelled out a number of innovations including uServe, Smart Trash Bin, Hack Science Lab, RFID Door lock and a locally-built drone, Dr. Quad, etc. Kumasi Hive has played a huge role in contributing to the guidance and development of prototypes for start-ups, and contributing to the sustainability model to create products that are ready for the real market.

www.kumasihive.com



**@iLabAfrica,
Nairobi, Kenya**



@iLabAfrica is a Centre of Excellence in ICT innovation and Development based at Strathmore University in Nairobi, Kenya.. It was established to address the Millennium Development Goals (MDGs) and to contribute toward Kenya's Vision 2030. The research center is involved in interdisciplinary research, students' engagement, and collaboration with government, industry and other funding agencies.

@iLabAfrica also boasts a state of art coworking Tech Hub for startups, innovators, social entrepreneurs, creators, developers, technologists, designers, and change-makers. It provides a mean for young people to be able to begin their own startups which would otherwise have been difficult in the current Kenyan market. Members get an opportunity to be mentored, advised, and challenged to grow their startups.

@iLabAfrica has been the lead representative of the WaziHub project in Kenya, and it is active through a support platform where innovators showcase innovation and entrepreneurship interests, and they are supported with capacity building, technical training, and rapid prototyping programs.

www.ilabafrica.ac.ke



**The MakerSpace Foundation,
Durban, South Africa**



The MakerSpace Foundation is a co-working Tech Hub for startups, innovators, social entrepreneurs, creators, developers, technologists, designers, and change-makers in Accra, Ghana. Founded in 2013, MakerSpace fills an incredible gap in the ecosystem by providing an open environment where community, talent, management, entrepreneurship, business mentorship, and research meet to join forces and innovate while facilitating the connection of great minds, ideas, and talent. The Foundation leverages on four sites linked through the makerspace network, in the Eastern Cape and Gauteng. We are also part of two greater networks: the South African Maker Collective, and the Maker Library Network established by the British Council. We have laser cutters, 3D printers, various electronic / IoT development kits, CNC routers, mould making, and technical facilitators. Throughout the WaziHub project, MarkerSpace as a technical partner is engaged in leading the testing, validation, and piloting of services and products. Empowering the communities with knowledge and skills through the WaziHub project.

www.themakerspace.co.za



**Dar Teknohama
Business Incubator,
Dar es Salaam, Tanzania**

DTBi



The DTBi hub focuses on promoting innovation and technology entrepreneurship in Tanzania. Our main focus is more on capacity building and skill development of Tanzanian youths, therefore the DTBi hub nurtures individuals with or without ideas at the earliest stage of the journey towards becoming entrepreneurs and companies owners. DTBi activities and programmes are the maker-space, the internship programme, the mentoring programme, and the community outreach to achieve this. DTBi sustains the right kind of people with good ideas to be incubated, accelerated, funded, and employed. Through the WaziHub project and the core competencies of the hub towards the community, the DTBi hub introduced community members to IoT programmes, conducted acceleration programmes, and supported virtual accelerator programmes in Tanzania. The Tech Hub has previous working partnerships with the World Bank, Hivos-MAVC, Hivos-IIED, Financial Sector Deepening Trust.

www.teknohama.or.tz



**Hive Colab,
Kampala, Uganda**



The Hive Colab is a non-profit, community-owned, collaborative workspace for technology entrepreneurs in Uganda. Founded in 2010 as part of the Appfrica Labs' incubation initiative, and The Hive is currently home to over 2000 members, over 50 social tech and businesses enterprises have been created and supported by Hive Colab through economic empowerment.

The tech community in Kampala acknowledges that to date, Hive Colab has been a major contributor to local capacity building, creating local jobs, improving access to capital, and has encouraged innovation by fostering a culture of collaboration to build a vibrant tech community in Uganda.

Hive Colab is devoted to solving Uganda's social and economic challenges using technology in partnership with the private sector, government, and civil society. Some of our partners include Microsoft, Intel, Demo Africa, Uganda Communications Commission, the Anti-Corruption Coalition Uganda, Spring Accelerator, and Seacom among others.

Hive Colab is a founding member of Afrilabs, a network of African technology incubators. Our partner hubs include iHub, Mlab, and Nailab in Kenya, Bongo Hive in Zambia, 1776 in the US and Dubai, and OpenGov hub in Washington, DC.

Hive Colab also hosts "Women In Tech Uganda"³, which supports local capacity building and skill development for technology and entrepreneurship in Uganda for women by offering a collaborative environment for training, mentorship, and knowledge sharing in order to drive economic development in the region.

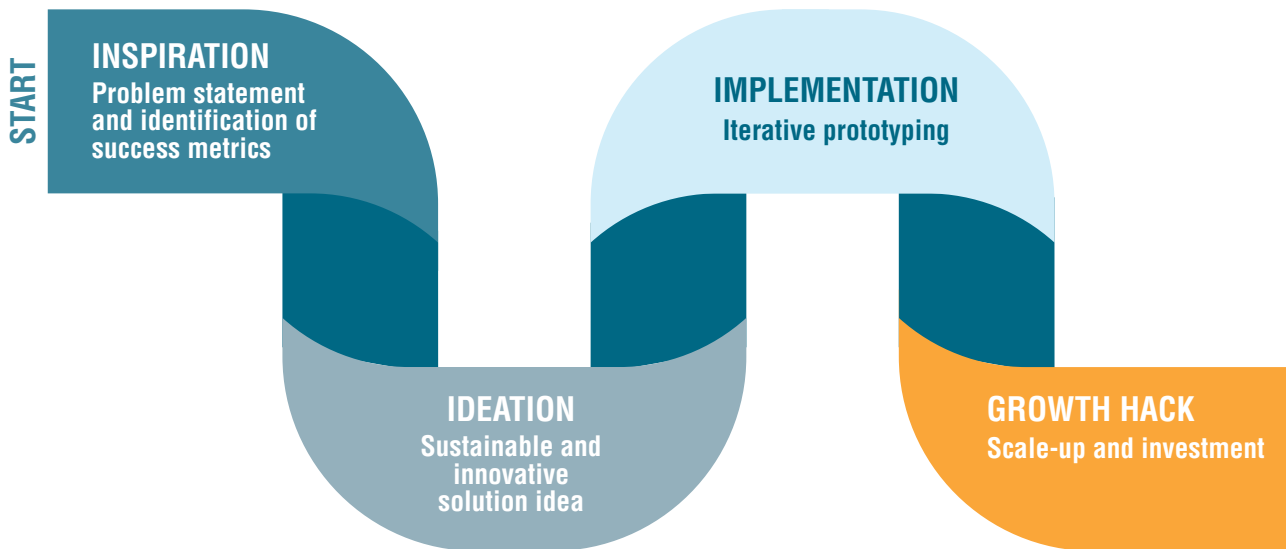
<https://hivecolab.org>

³ www.witug.org



From an idea to a product

By Servane Crave



Process from idea to product.

Triggering a successful Go To Market is always a complex operation for startups and entrepreneurs and we have noticed that a lot of startups fail to access the market. For this reason, the WaziHub project has initiated several actions to support them from the very beginning of their IoT project. During the two innovation competitions, we proposed sessions on Design Thinking and business models webinars along with one on one sessions with startups who expressed their interest.

It is of course important to have a great idea and to start developing an IoT prototype using Waziup technologies. However, in numerous cases we have observed that the end-user perspective is often forgotten. This may lead to spending much energy on developing a prototype which at the end might have little chance to meet customer needs.

Dedicating efforts to develop a Minimum Viable Product (MVP) is thus of paramount importance. A MVP is a product with enough features to attract early-adopter customers and validate a product idea early in the

product development cycle⁴. During the two innovation competitions held by WaziHub, this preliminary activity has been duly emphasized to support competitors to pay attention to their potential customers' needs.

Along with the MVP, we encouraged participants to develop their Value Proposition, which in one sentence should highlight how they differ from competitors.

When it comes to Business Models, we recommend Osterwalder's business model canvas to simply explain the components and relationships among the solution's stakeholders. This is certainly the most difficult part for a startup and elaborating the revenue model presents great challenges. This exercise was clearly easier for registered startups, and teams that spontaneously grouped for the purpose of the competition faced more difficulties when it came to defining their business models. This is also explained by the fact that these latter were composed of IT-enthusiastic engineers and that no business or marketing people were part of the teams.

⁴ <https://www.productplan.com/glossary/minimum-viable-product/>

Hacking in real-time: hackathons and bootcamps

Bootcamps and hackathons are multi-day events, which usually include several aspects from the WaziHub program: ideation, prototyping, capacity building... Prior to the bootcamp, the partners called out for applications and registration from interested stakeholders, which include developers, entrepreneurs, startups, IT professionals, and enthusiasts.

WaziHub Partners engaged innovators who have their own ideas or would love to build an IoT/Big Data Startup. To add value to the program, the partner hubs select the top ideas that can be supported to build viable businesses. Partner hubs can then select 5-15 ideas that will be turned into viable businesses. Online material from the WaziHub website also aided the participants in further understanding the Waziup platform and hardware kits. In pictures, let's discover some successful hackathons!

Kumasi, Ghana, July 2018

History is history: the first WaziHub bootcamp was organized in Ghana in July 2018. The five-day bootcamp started with a period allocated for sharing of resources (code, libraries, and software). Participants were then given an overview of the WaziHub toolkit and invited to form practical workgroups, the total number of participants was broken down into three domains, that is health, agriculture and business.

The WaziDev programming boards were introduced together with other available IoT related hardware. Participants were walked through the various parts of the Waziup dashboard and taught how to develop simple HTML and JavaScript applications. Participants also looked at the API's available, how to use them, and the basics of IoT cloud architecture. Teams were taken through prototyping of sensor nodes to communicate with the gateway and submit data to the cloud platform. Finally, all ten groups pitched their ideas and were awarded a certificate of completion.



First WaziHub bootcamp in Kumasi.

30
participants

Kumasi, Ghana, March 2019

This bootcamp took place in March 2019 right after a WaziHack training workshop. The bootcamp was divided into two distinct stages. The design thinking phase and the prototyping phase. Participants were taught to use the design thinking process to evaluate and refine their problems and respective proposed solutions. The prototyping stage allowed participants to build MVP's for their proposed solutions. A pitching session followed right after.

25
participants



Second WaziHub bootcamp in Kumasi.

Dar es Salaam, Tanzania, October 2018

WaziHub IoT bootcamp in Dar es Salaam with our partner Dar Teknohama Business Incubator (DTBi) was a four days bootcamp aimed at building the capacity of participants in IoT applying design thinking to solve crucial societal challenges. Participants selected with a good technical background were introduced to the Waziup Cloud platform.

A presentation on IoT and cloud computing for the digital transformation of the developing countries session kicked off the event, followed by an introduction of IoT and its use cases, sharing different resources needed for the entire four days period. Participants were then given an overview of the WaziHub toolkit so as to form practical workgroups, the total number of participants were broken down into four domains: health, transport, agriculture, and energy.

35
participants



First bootcamp in Tanzania.



WaziHub bootcamp in Nairobi.

Dar es Salaam, Tanzania, October 2019



This four-day boot camp was held in November 2019 at DTBi in Tanzania. This bootcamp focused on individuals or startups with ideas that can use IoT and Big data to solve different local community problems. The main agenda was an introduction to the Internet of Things, aiming at creating a general understanding of the topic by identifying challenges that could potentially be solved by using IoT and analysing the strength of IoT solutions to the innovation ecosystem.

five days of introduction and practical application of the Waziup platform. This was based on the development of IoT solutions using two themes: agriculture and environmental monitoring. Participants were expected to come up with concrete ideas for challenges they identified among these themes in groups. Participants were then judged based on predetermined metrics at the end of the five day bootcamp in order to test whether they had understood how to apply the Waziup technology.



2nd bootcamp at DTBi.

Nairobi, Kenya, October 2019



The second @iLabAfrica WaziHub bootcamp – on developing IoT solutions around Smart Cities – was held in October 2019 at the @iLabAfrica, Strathmore University premises. The four-day bootcamp was a practical and classroom-led training that engaged the participants to develop their ideas in the field of IoT using the Waziup technology. This workshop was rich in diversity as it engaged different players in the industry including; Liquid Telecom, Strathmore University Business School, and the UN-Habitat.

The main objective of the @iLabAfrica WaziHub bootcamp was to introduce the Waziup platform to the

Nairobi, Kenya, November 2018



The @iLabAfrica WaziHub Bootcamp took place in November 2018 at the @iLabAfrica Research Centre, located in Strathmore University in Nairobi, Kenya. The bootcamp consisted of



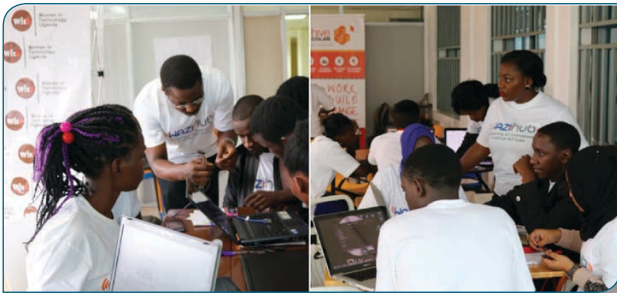
2nd Bootcamp at @ilabAfrica.

participants to enable them to develop solutions for local problems. The specific objectives of the bootcamp were: to introduce the Waziup IoT ecosystem, to enable participants to jumpstart their IoT ideas, to discuss emerging trends in cloud computing aligned with IoT, and to introduce interested participants to the WaziHub accelerator program.

Kampala, Uganda, December 2018

62
participants

Hive Colab and WITU held a three-day joint WaziHub bootcamp to ensure that the carefully selected applicants quickly onboard onto the Waziup IoT technologies as they come up with IoT ideas and start the journey of creating sustainable businesses out of them. After teams were formed, a basic introduction on IoT was given followed by a workshop on business modelling. Teams were asked to generate ideas by defining project ideas by brainstorming and identifying problems and proposing a solution. Participants were taken through training on Waziup APIs tutorial and Waziup cloud platform. After the distribution of the hardware kit, the teams started testing them with respect to their project ideas. The bootcamp allowed participants to start the prototyping of their solutions using the provided hardware kits and to pitch their solutions to be awarded certificates.

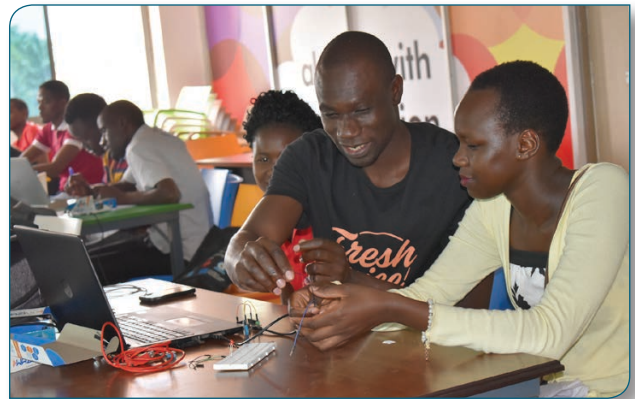


WaziHub bootcamp in Kampala.

Kampala, Uganda, October 2019

26
participants

Hive Colab organized an IoT bootcamp in October 2019 that focused on capacity building. The sole goal of this bootcamp was to train more people on how to utilize the low-cost Waziup technology while addressing the needs of African technical professionals/enthusiasts who might want to venture into IoT as a business. The bootcamp was titled "IoT Party".



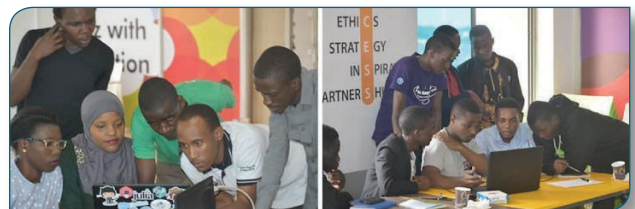
2nd Ugandan bootcamp in Uganda.

All participants worked on the same project which utilizes the Waziup IoT kits accordingly. We divided the project into sub-tasks to ensure that we are all on the same track. For each topic, the participants were requested to get their hands on the IoT equipment and implement code to operate a different number of sensors.

Kampala, Uganda, December 2019

30
participants

Hive Colab organized an IoT hackathon that was focused on the creation of startup teams. It was a business-oriented one-day hackathon where seven teams battled it out for the top three prizes. This hackathon was a follow-up to the previous bootcamp event named the "IoT party" where we trained more people on how to use the low-cost Waziup technology. The objective was to address the needs of African tech professionals/enthusiasts who might want to venture into IoT as a business.



Group working on their projects.

Durban, South Africa, March 2019

7
participants

The MakerSpace Foundation held an IoT introductory session that catered to students, professionals,



**Kigali, Rwanda,
September 2019**



@iLabAfrica organized a five-day WaziHub bootcamp in Kigali, Rwanda. The main objective of this bootcamp was to introduce participants to embedded systems with regards to prototyping and development of sustainable and efficient solutions using Waziup technologies. This bootcamp was also to pave the way for the second and third phases of training which involve IoT product creation, incubation and acceleration.

and enthusiasts. The day was divided into four stages as follows:

- Stage 1 was an instructor-led introduction to Arduino basics and setting up software and hardware;
- Stage 2 was a self-instructed discovery stage that allowed participants to explore and develop projects on their own with the available sensors;
- Stage 3 focused on uploading sensor data to the internet and explored different ways to place sensor data online;
- Stage 4 was a brainstorming and Ideation session to explore the potential of IoT in different verticals.



Picture of the 5 days bootcamp in Rwanda.

**Durban South Africa,
August 2019**



The MakerSpace IoT bootcamp – which was held in the last week of August took participants from concept to prototype in four days. The focus was on solutions to Smart City, AgriTech and Partner Solutions. WaziHub co-sponsored the event and donated the IoT technology hardware and cloud platform.

The participants were invited students from Durban University of Technology (DUT), UKZN, and the Google-funded Kwenza project (a MakerSpace Foundation initiative working with undergraduate mechatronics students from Mangosuthu University of Technology).



Group picture with participants on the 2nd WaziHub bootcamp in Durban.

**Saint-Louis, Senegal,
November 2019**



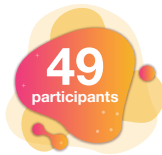
The WaziHub Smart Village kickoff took place between November 13 and 14, 2019. It was an opportunity to bring together the different stakeholders in the Smart Village initiative, and identify the needs of end-users. During the three years of the Waziup project, the Uni-



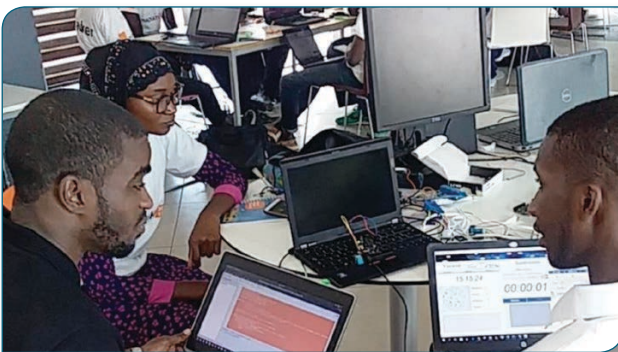
Capacity building during the Smart Village launch.

iversity Gaston Berger was a leader in the implementation of use cases, first with the establishment of a test-bed infrastructure, as a test base for MVP applications. The number of participants was high and well balanced in terms of end-users and Startups/entrepreneurs. A total of 58 persons joined the inauguration session. Three workshops were organized: developers & engineers workshop, end-user workshop, and developers, engineers & end-users workshop. The design thinking methodology was highly appreciated and four use cases were designed.

**Dakar, Senegal,
October 2018**



For the 2018 hackathon in Dakar, 264 projects applied, and 15 of these were selected for 48 hours of coaching. Teams received support to build and make progress in their IoT solutions. The hackathon winners were awarded for the originality and the relevance of their projects which they defended in front of a jury of experts from Orange and its partners.



Participants at Dakar Bootcamp.

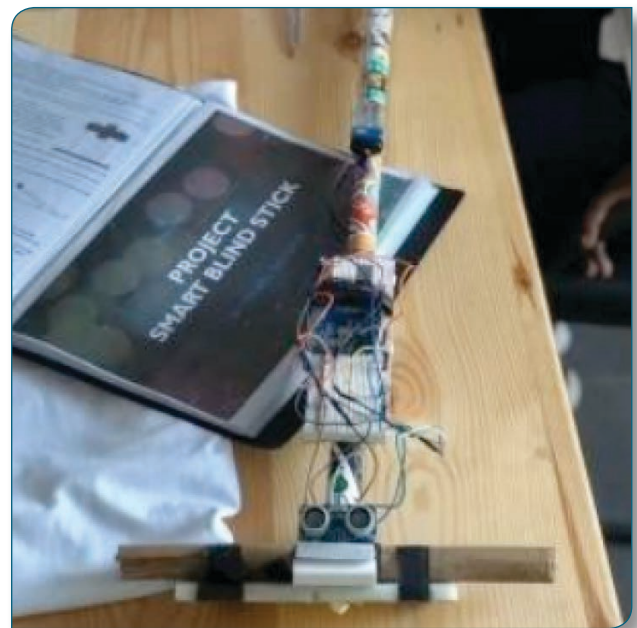


Winners of the Dakar bootcamp.

**Dakar, Senegal,
November 2019**



Sonatel organized the 2nd hackathon in November 2019, held at the Orange Digital Center. The three-day event received high attention with 325 project applications. Five selected project participants were given free hardware parts and training support to help them build a prototype before the end of the hackathon.



Smart blind stick prototype.

Meet WaziHub: Events around the world

Microphone in hand: Project partners, as part of their outreach and dissemination activities, participated in events held in their country or in international events. Here is a portfolio.

AFRICACOM, CAPE TOWN, 2018



THE DAKAR DIGITAL SHOW, DAKAR, 2018



FIWARE GLOBAL SUMMIT, GENOVA, 2019



IST AFRICA, NAIROBI, 2019



TRANSFORM AFRICA SUMMIT, KIGALI, 2019



WSIS, GENEVA, 2019



ITU WORLD, BUDAPEST, 2019



NATIONAL SOCIETY OF BLACK ENGINEERS (NSBE) WORKSHOP ON EMERGING TECHNOLOGIES AND THEIR ROLE IN THE FUTURE OF AFRICA, ACCRA, 2019



STRATHMORE UNIVERSITY RESEARCH SYMPOSIUM, NAIROBI, 2019



"OPEN SOURCE BEYOND 2020 - POWERING A DIGITAL EUROPE" WORKSHOP, AT THE EU DG CONNECT, BRUSSELS



AGRITECH INNOVATION CHALLENGE LAUNCH IN ACCRA BY KOSMOS INNOVATION CENTER, 2020



Our startups



1

ASC - Smart Collar
LOCATOR PREVENTING THEFT



2

Person Emergency Locator
LOCATOR FOR
ENDANGERED PEOPLE



3

Smart Sanitation
EDUCATIONAL
SMART BIN



6

TrackTile
MONITORING THE CURING
OF CEMENT



4

AgriStick
REMOVABLE
CROP SENSORS

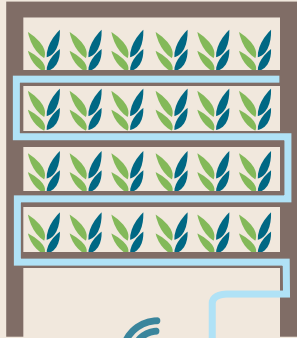
5

Farmsens
FIXED CROP
SENSORS



7

PregCare
PREGNANCY MONITORING



8

AgriTech
HYDROPONIC
MONITORING

Our startups

WaziHub launched two Innovation Competitions in 2020, in order to detect talents and good ideas. The innovation competition involved participants in Kenya, Uganda, Tanzania, Senegal, Ghana and South Africa. This challenge boosted ideas from the best innovators, requiring both technical and business skills. **The competitors were able to go from an idea to a scalable solution in three months!**

The competitors were required to have basic knowledge in IoT technology with a team composed of a maximum of five persons. Each competitor was paired with a technical team to support them during the competition. All the competition was performed online, due

to COVID-19 of course. We performed numerous webinars to give them the skills and knowledge required for realizing their Minimum Viable Product.

In each country, our network of Tech Hubs provided day-to-day support to the competitors. For each competition edition, more than 100 applications were received, out of them, around 30 competitors were selected. Competitors could apply in different topics: Agriculture, Smart City, Transportation and Health.

Without further ado, please meet our champion startups!

Authors:



*Wilma Sokeng
is Operation Manager for
Innotech21 GmbH.*



*Corentin Dupont, PhD,
is Technical Director of Waziup e.V*

Our Champions

They are the best of the best! Our “Champion” startups have been selected carefully in Kenya, Senegal, Ghana and Uganda.

Tracktile



The construction industry is growing at a very fast rate in Africa, which raises a lot of safety concerns that need to be addressed. Building collapses are catastrophic events, often due to unscrupulous developers bypassing safety regulations. This has led to numerous deaths and loss of valuables over the past years. Collapses are often due to weak and premature structures. **Lack of accurate concrete maturity and strength data can be costly to contractors in multiple ways.** Contractors usually have to wait a long time for concrete analysis results, losing precious time and elongating the project timeline. They also tend to skip formwork and move on to the next step of the project before optimal results have been achieved.

To address this problem, we selected Tracktile, a young Kenyan startup developing a device to ensure faster, safer, and cheaper constructions. WaziHub engaged in a conversation with Clinton Oduor, leader of Tracktile.

Hi Clinton, how does your solution work?

Tracktile is an IoT device that monitors in real-time the concrete temperature, relative humidity, maturity, and strength based on the ASTM C803 Standards. All data



The Tracktile concrete measurement device.

are automatically saved for quality assurance purposes. The device is easy to use: register the device on the App, install and attach on concrete or pour, then monitor.

Unlike the traditional break and test method, we provide an IoT solution that monitors the strength and maturity of on-site concrete in real-time, in order to detect anomalies during the concrete curing process. It is a non-destructive method that directly monitors the inside of concrete, taking into account weather variations. By gaining full visibility into concrete maturity and strength, contractors can optimize their construction schedule.

What have you learned so far from this experience?

For the solution to work, we had to undergo many iterations to ensure that the device could withstand different weather conditions and transmit flawlessly without losing any data in the air. We have also learned how to work together as a team, and how to pitch our solution to investors.



Tracktile measuring concrete on-site.

We were looking for a cheap solution to transmit data that could cover a large area and consume less power, and Waziup technology was the answer. The WaziHub team at @iLabAfrica also came in handy by providing us with technical assistance and business mentorship. We came to learn about the power of open innovation platforms such as the Waziup technology in solv-

ing the world's most serious, and urgent challenges such as the frequent building collapse that have been witnessed in Africa. Previous technologies struggled when it came to deploying sensors in the field due to constraints such as range, connectivity, and power consumption. Waziup technology provides a viable and efficient solution to all these challenges.

What strategy are you adopting for the market phase?

The real estate and the concrete industry are fast-growing with new structures coming up every day. The industry is currently valued to be above 1.9 Billion USD. Our potential customers are construction companies, commercial & residential structures, energy & utility construction companies.

Our revenue will majorly be from the sale of our devices and an annual subscription fee. We are operating on a B2B business model hence we reach our customers directly, mostly those who run big construction companies. As part of our growth strategy, we plan to partner with different stakeholders in the construction industry, including policymakers.

What about the next steps and funding opportunities?

Our next steps are to improve our application's UI, carry out beta tests, and then roll out our first finalized

product. We are seeking funding opportunities to facilitate the manufacturing of our product and grow the business. In the future, we would like to explore more opportunities in the construction industry to make construction safer, faster, and cheaper.

About the team

Our team consists of four co-founders, one from the civil engineering sector, and the others with an electrical engineering and software engineering background:

- Lilian Patience: Project Manager
- Clinton Oduor: Hardware Engineer
- Humphry Shikunzi: Software Engineer
- Gilbert Wamichwe: Research Scientist

We are all students at the Dedan Kimathi University of Technology in Kenya, pursuing our undergraduate degrees. The four of us are enrolled in Engineering Programs: one Civil Engineering and the rest in Electrical and Electronics engineering. What brought us together? We were actually volunteering at a local primary school to teach kids basic computer skills, hoping that will help them in the future. And that's how we met!

Website: <https://tracktile.azurewebsites.net/services>

Email: tracktile20@gmail.com

Video pitch: <https://youtu.be/9IS3V9GYxU>



Clinton Oduor at an on-site test visit in Nairobi, Kenya.

Person Emergency Locator

The dam burst in Brazil in January 2019 killed at least seven people and left 150 missing. Such disaster comes with the additional challenge for rescuers to try to locate the survivors and the victims. To find them, it is sometimes possible to triangulate the location of their cell phones. However for this a court order is required, and this causes a delay when every minute counts. Alternatively, there are many applications available that will track mobile phones using the inbuilt GPS, but not every phone has this installed. Furthermore, smartphones and cell towers are fragile and may be destroyed. How can we improve the situation? WaziHub selected the startup “Person Emergency Locator” from Kenya. We interview its creator, Paul Imison.

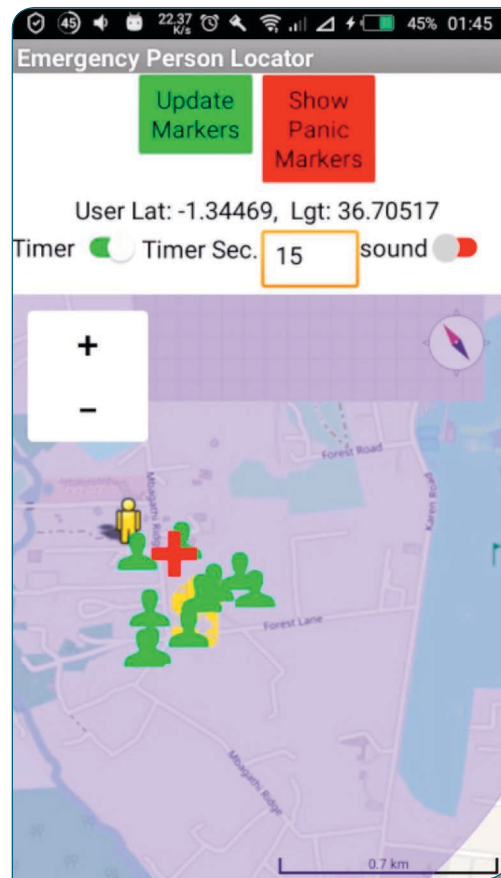


Post-tsunami emergency (Image by [Wikimedia](#) from [Pixabay](#)).

Hi Paul, how does your solution work?

The solution we came up with is a small, independent device worn by workers in dangerous areas, such as mines. It has a button to select panic mode in order to request assistance. This will enable the rescue teams to locate those who have the transmitters. It can be fitted into vehicles to act as a tracker and assistance request. Rescue units are able to see the location of the person requesting assistance and are guided to their location.

We use an independent system based on the LoRa technology, which has long battery life and long-range: around 10km in line of sight. We use an independent network of receivers which are portable and can be installed into rescue vehicles. The transmitters are able to withstand harsh environments. The solution is a GPS with a LoRa transmitter in a weatherproof case with a long-life battery.



Emergency Person Locator mobile application.

What have you learned so far from this experience?

Technology has moved many steps forward from my initial experiences, being far more complex today and with many different ways to achieve the same result.

The use of GPS to determine one's almost exact position, speed, and altitude is a far cry from looking out the window for landmarks to compare to the physical map, and then calculating your ground speed and drift from the high altitude winds.

I attended the first bootcamp by WaziHub at Strathmore University in November 2018, which is where I came across the LoRa technology. Thereafter I was assisted with the hardware and was able to implement the idea with a minimum viable product and show that the technology was viable.

The platform provided has taken out all the high technical programming, leaving the developers with the task of concentrating on their ideas and bringing them to life. I learned about the LoRa and LoRaWAN technologies, how the Gateway is put together, and used the Waziup.io cloud REST and MQTT APIs to drive my application.



The prototype's electronics.

What strategy are you adopting for the market phase?

There are two main options for making money:

1. The rescue devices will be sold to individuals together with a subscription package;
2. A complete system will be purchased by the rescue service or wilderness area management.

To grow I will need to approach rescue services and wilderness area management and to market the device as a product available to private citizens.

What about the next steps and funding opportunities?

On the technical level, the transmitters will be moved from the WaziHub development board to a more specifically designed board. They will be housed in a water-resistant and tough casing to protect the electronics from a harsh environment. We would also like to add a heart rate monitor and temperature sensors to monitor the wearer's health. This would allow it to automatically trigger emergency calls if the user has a major health issue.

To take the current MVP to a commercial level, investments into the hardware transmitters design and production will be required. Since the system is based on locating the transmitters, in the future the system could be used for unlimited uses, e.g. tracking stolen property, children and pet monitoring, etc.

About the founder

At the age of 17, I obtained my Private Pilots Licence. My father was a commercial airline pilot, and from this I learnt about the technology used to locate a downed aircraft. There was a unit called an ELT (Emergency Location Transmitter) that would be activated by a large impact. This would transmit a radio signal, which would be used to triangulate the exact location of the signal. Learning to fly, I had to learn navigation and as it was before the era of GPS, it was all done by using maps and circular slide rules.

I am a caucasian by two generations in Kenya and I have been married to an indigenous from Central Kenya for the last 23 years. After school, I went into the IT industry, by getting a job in a computer bureau in Nairobi, where I learnt COBOL and became the main programmer for the Cooper Motors Corporation (CMC) stores system. I was even the interim System Manager whilst he took his annual leave. Thereafter I worked with another company in Nairobi before going on my own as a consultant (Diners Club, hotels, and the African Safari Club in Mombasa). I then changed careers and moved into maintaining Land Rovers, which has also led me into the newer vehicles with computerisation and diagnostics combining mechanics, electrical, electronics and software combined.

I was fortunate enough to participate in the WaziHub bootcamp which led to me being in the first cohort. Then I was selected to participate in the first WaziHub competition, and having successfully completed that, I was selected as one of the WaziHub champions.



Paul Imison, founder of Personal Emergency Locator.

What are your passions outside of work?

I love nature and living here in Kenya, I can enjoy the outdoors. The national parks are great to go with my Land Rover. When I was living on the coast whilst working at the hotels, I was also able to go scuba diving.

ing. My “Super Power” is technology and I follow up on many things scientifically. I am particularly interested in space exploration: I have been fortunate enough to see the first moon landing, all the way to the first powered flight on Mars.

Email address: paulimison@gmail.com

Video pitch: <https://youtu.be/vjvNXgtZ8oA>

Africa Smart Citizens



Ensemble, éradiquons le vol de bétail !

Theft of cattle is a very common problem across Africa. It is a form of organised crime committed by international criminal networks. It is facilitated by an increasing proliferation of weapons, according to a study¹ by ENACT transnational organised crime researchers at the Institute for Security Studies. Cattle raiding has left dozens killed or maimed in the last years, and negatively affected human security and development in the region. For instance, only in Kenya’s West Pokot and Elgeyo-Marakwet counties, 30 people were killed during the first five months of 2019.

WaziHub selected “Africa Smart Citizens”, a startup from Senegal building a device to prevent cattle theft. We met Elimane Kane, the leader of Africa Smart Citizens.

Hi Elimane, how does your solution work?

We developed two solutions. The first one is a Smart Cattle enclosure: it will detect intrusion in the breeding field. This system triggers two loud audible alarms and sends alerts by phone and SMS. The second solution is a Smart Collar: it allows early detection of livestock theft by geolocation. The collar sends an alert if the animal leaves its safety perimeter (a radius of 100m to 10Km). It also sends alerts if the animal movements are suspicious (moving too fast, moving at night, or not moving at all); or if the collar is vandalized. Our solution is already patented².

¹ <https://enactafrica.org/research/research-papers/vanishing-herds-cattle-rustling-in-east-africa-and-the-horn>

² OAPI Patent Number 18162



The Smart Collar

What have you learned so far from this experience?

Our pilot experiments showed us a surprising fact: the aesthetics of the product are a major factor for the breeders. Most breeders are very proud of their animals and would not feel comfortable with the visual impact of the product on their animals. This revealed to us the complexity of the relationship between breeders and their animals.



The ASC Smart Collar

With WaziHub, we had the opportunity to have WaziDevs prototyping boards. The WaziHub competition allowed us to go faster and achieve results in a short time. The key learning from a technology perspective has been the LoRa Technology, with very low power consumption.

What strategy are you adopting for the market phase?

In Senegal, 60% of the population practices breeding, i.e 9 million persons. In Africa, we estimated more than 1 billion heads of animals, and more than 200 million families living from it. So the market share is about \$10 billion. We will make money by selling 2 products:

1. the Smart Enclosures for intensive breeding (indoor). The buying price is \$700 or as a subscription \$199 and monthly fees \$39.99;
2. the Smart GPS Collar for extensive breeding (outdoor). Subscription is \$39.99 and monthly fees \$3.99.

We plan to partner with veterinarians, cattle feed sellers, flour mills, and Orange/Sonatel (Telecom company). For the installation, we plan to train 200 young people with an electrical or electronic background in our local center in Thies (70Km from Dakar). Then, for any order, we will connect them to buyers.

Regarding the promotion, we have made a three-minute video describing our solutions in four languages (Wolof, Pulaar, French, English) and we use YouTube, Facebook and WhatsApp. The best channel is WhatsApp because there are hundreds of breeder groups, and they share the video advertisement among themselves. We are receiving many calls: on average 17 calls per day.



The Smart Collar on demonstration on a sheep.

To scale up, we will open a satellite office in Mali (July 2021), Burkina Faso (December 2021) and Tchad, Niger (2022). As funding opportunities, we are seeking seed funds.

About the founder

Our background is IoT, artificial intelligence, and security. I am a young pan-African entrepreneur, whose dream is to lift Africa out of poverty by bringing adapted technologies to our farmers and breeders. I am passionate about technology, and I like to go beyond the limits through innovation. I believe in the "Made in Africa" concept!

Email address: elimane.job@gmail.com

Website: <https://africasmartcitizens.com>

Video pitch: <https://youtu.be/J9qubAhids0>



Mamoudou Elimane Kane presenting his project.

FarmSens – Precision Agriculture



According to the World Bank, 56% of the African population are predominantly farmers. The lives of these farmers depend heavily on arid soil. Furthermore, 75% of Africa's soil is degraded, costing countries up to 10% of their GDP. Farmers resort to fertilizer application and irrigation to maintain a good soil makeup. Excessive use of nitrogen-based fertilizers in agriculture contributes immensely to nitrous oxide emissions, which is an important cause of global warming. Data suggests that agriculture alone accounts for 80% of human-caused nitrous oxide emissions globally and 8-14% of all greenhouse gasses.

The dominant traditional soil testing method employs wet chemistry, which involves farmers fetching soil samples from their farms and sending them to soil laboratories near them. Challenges associated with the current approach include exorbitant prices per test, limited access or coverage areas, time constraints, and – sometimes – the inability to comprehend soil test results and recommendations. Thus, soil fertility depletion coupled with limited access to extension services³, access to farm input and high market gaps are the fundamental root causes of declining per capita food production in Africa.

WaziHub selected FarmSens, a startup building a product for soil testing and monitoring. We met John Kwame Dunyo, the leader of FarmSens.

Hi John, what is the idea and which problem are you solving?

Growing up in a farming community in the Volta Region of Ghana, I was constantly reminded of the challenges many farmers face. They inherited their farm-lands from their parents, thus most of the soil had degraded in nutrients rendering them infertile. Besides, their farming is subsistent and mostly rain-fed. So just imagine the number of households that will go hungry if the rain fails! There are no extension officers to advise them on the types of fertilizers, or when and how to apply them.

³ Agricultural Extension: Assistance to farmers to help them identify and analyze their production problems and become aware of the opportunities for improvement



In-field experiment.

This is why we built FarmSens, so these farmers can test their soil easily. They also receive farm-specific extension services to enable them to increase their productivity by 70% and minimize wastes of farm resources.

How does the solution work?

Our affordable technologies ensure farmers make better decisions about their agricultural practices, while minimizing waste and increasing productivity. Our farmer-friendly IoT farming platform uses real-time field data in order to provide tailored actionable insights coupled with extension advice. We also build farmer profiles to guarantee better access to credit, and connect farmers to markets and storage facilities.

What have you learned so far from this experience?

We joined WaziHub in 2020 through the first WaziHub Innovation Challenge. At that time, we had fully developed the FarmSens concept and were exploring ways by which we could bring our products to life. Yes, joining WaziHub has been very helpful. During the pilot phase, we were able to fully prototype and deploy our sensors on the Waziup IoT infrastructure. This was sig-

nificantly beneficial, because of the speed, accuracy, and system availability that Waziup offered us.

From a technology point of view, I think the main thing we learnt from WaziHub is tech interoperability. I am personally fascinated about how Waziup is able to combine edge and cloud computing in a seamless manner allowing easy and fast prototyping. We at FarmSens are exploring how we can leverage this to provide more innovative solutions to our farmers.

What strategy are you adopting for the market phase?

The global market for soil testing equipment stood at \$2.97 billion in 2019. It is projected to grow at an annual rate of 12.8%. Locally, data from Ghana's 2010 Population and Housing Census confirms that 39.2% of Ghana's total population are crop farmers. This corresponds to about 10 million farmers. We intend to leverage our competitive advantages to reach out to 70% of these farmers. So indeed, the market exists, and we will take it by storm.

Our primary source of revenue is through sales of our sensors at an estimated gross margin of 22%. Besides, Farmers interested in the FarmSens Sensor Kits will pay on a monthly subscription basis. Secondary

sources of income include the commissions on all recommended inputs, a commission on credits, and commissions on all buying and selling on our platform. We are currently developing a comprehensive go-to-market strategy to increase our ability to reach and convert more farmers. This involves targeted marketing and farmer community sales.

We need more funds to enable us to expand and reach more farmers. We need to optimize our production processes by incorporating local materials and more in-house production. All this boils down to money. We are therefore raising USD 50,000.00 to accelerate our efforts in promoting our innovative climate-smart agriculture.

What about the next steps?

In the near future, we are going to work on optimizing our technology and production process. We are looking at enhancing our sensing technology, deployments and recommendations frameworks. We will significantly reduce the cost of production by efficient sourcing and product streamlining to remove redundant components.

The next phase of our project will involve the full-scale deployment of our Farmers' Profile feature. This feature will use farmers' field data coupled with financial histories to feed our credit scoring algorithms to build farmer profiles. These profiles will be used by banks and credit providers as a guarantee to grant credits and loans to our farmers. We are excited about it, and we can't wait to see it work.

After succeeding in the current phase, we will look into other areas of how we can integrate **IoT and artificial intelligence post-harvest**. For instance, we want to leverage IoT and AI to build smart supply chain systems, so that farmers can access post-harvest solutions at the touch of a phone, without physical interaction. The future is exciting.

Can you tell us more about the team?

Our founding team's leadership comprises individuals with diverse backgrounds representing the situations of our farmers. **We have all experienced the difficulties most faced in farming.** It is the passion to impact our communities that brought us together. We are committed to teamwork, dedication, and innovation. We see our challenges as opportunities to exploit and improve. In preparing the team for challenges and uncertainties, we are committed to open innovation where we leverage our creativity, ideation, and experience to find solutions to our challenges. The team is composed of:

- John Kwame Dunyo: Team Lead – Computer Engineering Senior at the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana;



The FarmSens team.

- Abraham Kudiabor: Marketing and Business Developer –Supply Chain Management Senior at Arizona State University (ASU), Arizona, USA;
- Obu Raymond Buernor: Hardware Lead – Computer Engineering Senior at the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana;
- Francis Gyimah: Software Lead – Computer Engineering Senior at the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana.

About the founder

I am the team lead for FarmSens, with key interests in IoT, Embedded engineering, AI, and Data Analytics. I am very passionate about the role of innovation in enhancing food security and boosting African economies and have been researching innovative ways of making agriculture more sustainable, productive, and less labour-intensive without polluting the environment.

Outside work, I enjoy reading. I read memoirs, histories, classics, and recently business and innovation books or articles. I also love to volunteer especially in projects of great social impact. This enables me to keep in touch with my community and make more friends too.

Oh yes, I have social media accounts, but I do more reading than posting. You can find me via Jon Dexter.

Email address: johnkdunyo@gmail.com

Website: <http://farmsens.netlify.app/>



John Kwame Dunyo.

Our startups

More startups! During our numerous Hackathons, boot-camps, and competitions organized across the continent, we scouted talents and good ideas. Some are already full-

fledged startups, with a product and clients. Some are just an idea with potential. All of them caught our attention. Here is a portfolio of 46 startups that we coached.

Aspawa Project

With the increasing number of smartphones all over the world, the demand for power also rises proportionally. Aspawa is a project that enables phone users to access power anytime anywhere and prevent carrying heavy, lethal power banks that can explode any time. The user enters the amount corresponding to the length of charging minutes intended. It takes about 10 seconds to authorize the payment and the phone starts charging.

Team lead: Walter Ombiro - **Location:** Kenya



Smart Parking

Finding a vacant car parking spot and good management of public or private parking is a major problem in Kenya. Our Smart Parking system uses parking sensors connected to a consumer-facing app, that guides drivers to the closest open parking spot.

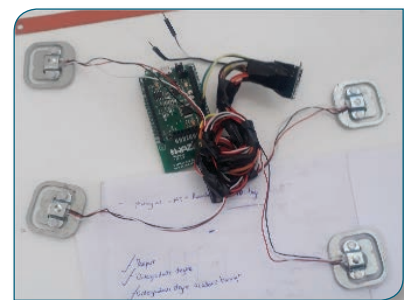
Team lead: Jean-Baptiste Kamabu - **Location:** Kenya



iCattle

Cattle health is a primary concern for farmers. The iCattle monitor device provides a farmer with real-time information. The device monitors the condition of the cows with great precision, in order to be able to give the animals the attention they need. iCattle will provide 24/7 monitoring, regardless of farm size, providing real-time information on a smartphone or other device.

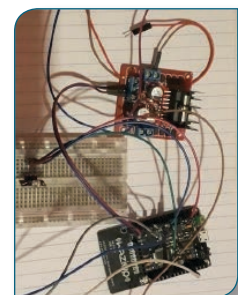
Team lead: Jack Mwirigi - **Location:** Kenya



Occupation Stimulator

For years, the norm for homeowners was to get someone to sit in their house for them if they were intending to travel and/or be away from their homes for extended periods of time. The main point of the project is to protect homes from thieves and vandals. Hence the simulation of occupancy, which would act as a deterrent for anyone who might consider your home a target for vandalism or theft.

Team lead: Shadrach Kobimbo - **Location:** Kenya



Automated Irrigation System

There is little intelligence when using traditional irrigation techniques. This leads to excessive waste of water. Our solution collects soil moisture readings, pH levels, temperature and other readings and sends this data to the Waziup cloud. Integrated into the system is an automatic irrigation system that responds to soil moisture readings to automatically sprinkle the farm with the required amount of water.

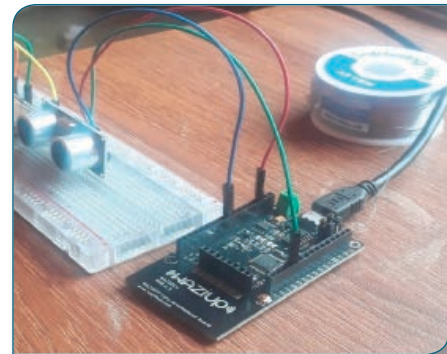
Team lead: Obed Mogaka - **Location:** Kenya



Smart Traffic System

Looking for a parking spot in Nairobi is like going through a maze. The solution is an IoT product that can sense free slots and send them to a web interface that is controlled by the admin and the free slots are sent to another interface that is accessible to the user where the user can book a free slot and save so much time.

Team lead: Brian Chege Mugo - **Location:** Kenya



Tech Nawa

With the current covid-19 pandemic there is much need for Smart hand washers to help people wash their hands without touching any surfaces. Tech Nawa (Smart hand-washer system) is an automated hand washing system that has been designed to replace the already existing handwashing taps to reduce contact with physical parts hence reducing the spread of Covid-19 (coronavirus) disease.

Team Lead: Linet Kiunga - **Location:** Kenya



Locust Early Detection System

The current locust swarms in East Africa are a serious threat to food security and livelihoods in the region. Inset, we propose a preventive early warning measure that utilizes emergent technologies in ICT. The end goal is to inform concerned authorities early, giving them the means to take effective measures before the eggs hatch and develop into adults.

Team Lead: Joseph Shitote - **Location:** Kenya



CiTe

The current digital health system for Covid-19 tracing is slow, difficult to use because many individuals do not have smartphones or internet access, and has security weaknesses. CiTe delivers Covid-19 contact tracing and accurate digital health feedback. This system provides clients with secure contact tracing, an accessible system that does not require devices or the internet, and real-time delivery tracking.

Team Lead: Solomon Muhunyo Githu - **Location:** Kenya

**Diodetech**

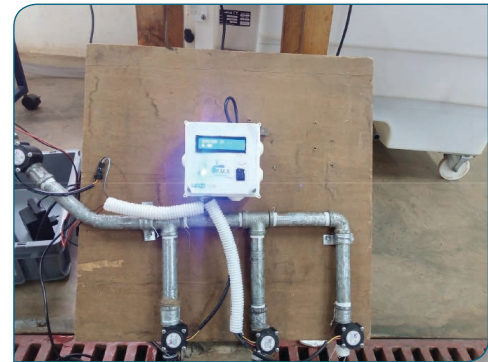
With lack of constant monitoring of the cost of energy, insufficient data on energy efficient upgrades, and no performance metrics available to compare the return on investment (R.O.I) of various energy efficiency and renewable choices, electricity prices are expensive. Diodetech provides data-driven, sustainable energy efficiency and renewable energy management, monitoring, and cloud simulations. We ensure that clients invest in solutions that provide the maximum return by leveraging the power of I.O.T. and technology. These tailored solutions have sensors that collect data on parameters that affect energy usage and provide real-time monitoring of energy consumption.

Team Lead: Douglas Rono - **Location:** Kenya

**Smart Water Meter**

Kenya faces a water crisis issue, which is exasperated by leaks in the existing distribution pipeline system. With unaccounted losses, slow leak detection and high operating expenses of the current system, this has become a big problem. The Smart Water Meter is affordable, customizable based on the customer's requirement and usage, and integrates features that enable remote monitoring and autonomous control of the system.

Team Lead: Joseph Maina - **Location:** Kenya

**Kalasave**

Manual meter reading collection is costly. Inaccurate data readings lead to common frustrations and conflicts between tenants and site owners. The smart meter IoT platform will solve power management issues in commercial buildings and sites and communities in general. Notifications are received on the MyPowerManager App client app and action can be taken by the client.

Team Lead: Sedrick Otolo - **Location:** Uganda



Incotech

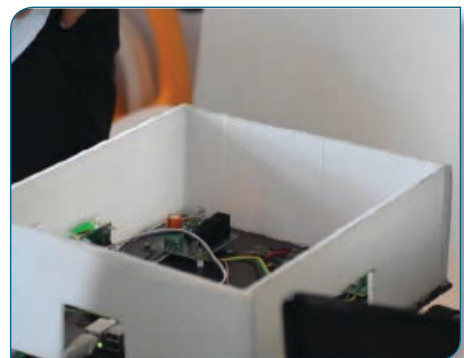
This system came into being in 2020 after research made on Ugandan poultry farms. The Incotech egg incubator is an IoT based system that monitors the humidity, temperature, and condition of the eggs.

Team Lead: Onyango George Adams - **Location:** Uganda

**Nbrains**

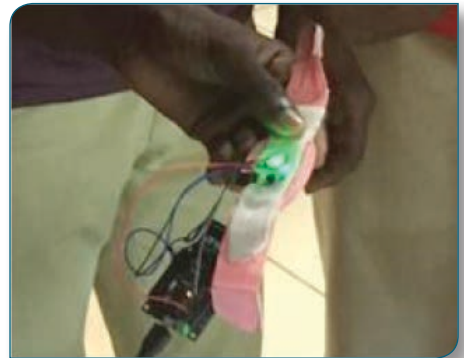
In many supermarkets, the payment method is a slow process which leads customers to wait in a long queue wasting their time. Hence, we are proposing to develop a smart shopping trolley that will keep track of purchased products with a Smart Trolley that has NFC technology installed and also online transactions for billing using RFID and ZigBee.

Team Lead: Noah Amani Kasambi - **Location:** Uganda

**PregCare**

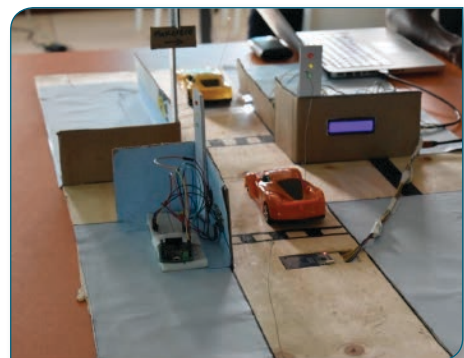
Worldwide, 800 pregnant mothers die every day and 99% of these deaths occur in developing countries. The pregnancy tracker, embedded with Waziup IoT technology, aids the doctor in receiving real-time data of his patients (expectant mother) and also in alerting the expectant mothers with a pregnancy complication if something is not fine with their body so that they are able to seek real-time help from the doctor.

Team Lead: Sedrick Otolo - **Location:** Uganda

**Wellus**

Traffic congestion monitoring and control has become a great challenge. Slow traffic flow due to traffic jams causes lots of delays and fuel wastage as short distances take lots of time. A traffic management system that uses motion sensors and cameras to monitor traffic flow and shares information on which areas are with no or slow traffic flow. This information may be used to alter the behaviour of traffic lights.

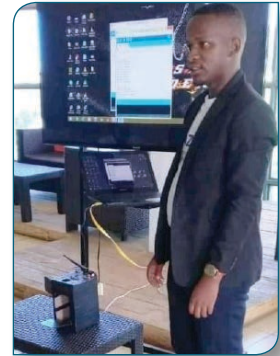
Team Lead: Kamazi Francesco - **Location:** Uganda



Smart Waste Management

Globally, poor sanitation is one of the main causes of illness and socio-economic problems. Smart Waste Management is a system that helps in tracking dustbins, toilets, septic and pit latrines when they are almost full. This system will send a notification to the center to notify the center/control system. The smart bin can tell in real-time when the bins are full and need to be emptied.

Team Lead: Jjunju Jackson - **Location:** Uganda



Home safety system

People can be exposed to hazardous gases, which might have a negative impact on their health. Carbon monoxide buildup in the home or workplace affects air quality and can lead to suffocation. Leakage of combustible gas, such as LPG, can start fires or cause explosions in homes or workplaces. Delays in fire detection in homes or workplaces can result in property loss. The Home Safety System is an IoT device that monitors and detects gas leaks in the home or office. It also measures the levels of carbon monoxide, smoke, and the temperature in real time. The technology functions as a smart fire detector.

Team Lead: Mujjona Eric - **Location:** Uganda

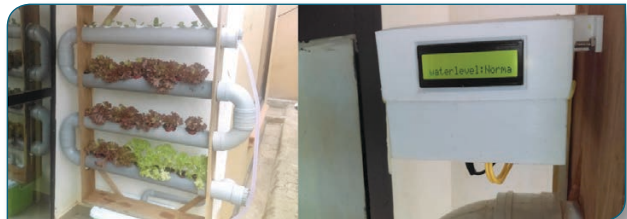


Hydroponic Farms

According to the International Soil Reference and Information Centre, 2019, climate variability and human induced soil health degradation greatly hinders food security in Uganda. Our smart farming innovation - Hydroponic Model HSFU2020 - has 32 planters, can grow fruits, vegetables, and herbs, has a submersible pump, and has a printed 3D cover for IoT automation systems. This enables farmers to cultivate directly on and off site. It can be controlled remotely for owners to gain access to healthy nutrition every day for the entire year.

Team Lead: Turyamureeba Amon

Location: Uganda



Tree-Bis

Poor monitoring of environmental variables such as light, salinity, soil pH, and temperature, as well as events such as a fire, flooding, or plowing are the primary causes of poor seedling development, which costs the producer a lot of money. The Tree-Bis is a web & mobile platform where nursery bed tree growers can monitor the varying weather conditions affecting the healthy growth of seedlings cheaply, remotely, and get predictions through a user-friendly IoT device - "Tree-bis Device".

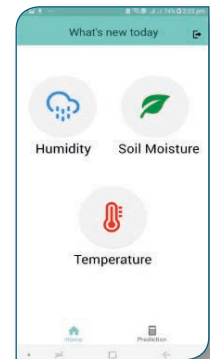
Team Lead: Jeremiah Joseph Okello - **Location:** Uganda



FarmAcy

Knowing precisely the health of their soils is a great challenge for farmers. FarmAcy Smart devices can help farmers monitor their farms in real-time. The device collects soil moisture, humidity, temperature, etc. via sensors and pushes the data to the Waziup cloud platform.

Team Lead: Juanita Sackey - **Location:** Ghana



HomA

The average Ghanaian spends 10% of his/her salary on electricity bills and most homes and offices do not have a smart security system. HomA system makes users aware of the internal conditions of the home. It displays air quality and occupancy states, and it allows remote control of appliances, alerting users in cases of theft, gas leakages, or fire outbreaks.

Team Lead: Nyarko Reginald - **Location:** Ghana



Edenlabs

Mushroom farmers rely on conditions such as temperature, moisture, and light intensity, in order to optimize their production. However currently most farmers do not have such a system. Our solution Edenlabs monitors the production of mushrooms by collecting data in the environment, allowing the automation of the production chain.

Team Lead: Godwin Mensah Atinyi - **Location:** Ghana



Visual Aid

Impaired by their lack of sight, blind people often get into accidents especially in the absence of caregivers. These accidents may be very catastrophic or worse, fatal. Visual aid is a device that will aid visually impaired individuals to navigate their environment; this will be coupled with an application that can notify caregivers of impending accidents with regards to obstacles or hot objects during movement of their ward so they can promptly respond.

Team Lead: Desmond Afisah Bempon - **Location:** Ghana



Airsene

this region of the globe are at risk of developing diseases as a result of air pollution. Those air monitoring devices that are accessible are expensive, making them difficult to obtain for the larger population. AirSene offers smart IoT based devices and a cloud based platform offering cheap solutions to air quality monitoring.

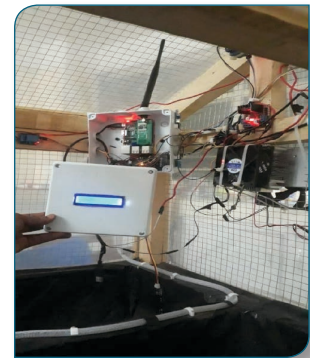
Team Lead: Dauda Mustapha - **Location:** Ghana



GreenGrow

According to the World Food Program, only about 25% of crops grown in Africa are actually consumed. This is due to global warming and lack of crop nutrients from the soil. GreenGrow offers an intuitive software application for users to gain control of their farm or greenhouse. Customers are able to view sensor data from the farm in real-time on the app and access 24/7 customer care service.

Team Lead: Joshua Nti - **Location:** Ghana



IrriGate

IrriGate solves under-watering and over-watering of crops by providing plants with the exact amount of water needed. IrriGate is a mobile app that connects to the internet and provides real time information on soil moisture levels. A moisture sensor detects soil moisture content and feeds it to a device, which then activates an actuator that will turn on the irrigation system. The data sent to WaziCloud for analysis purposes will be fetched using the WaziCloud API.

Team Lead: Samuel Adetsi - **Location:** Ghana



Smart Parking

Most parking lots have poor accessibility, resulting in congestion and confusion because drivers cannot find spaces or locate their vehicles. Drivers may also be concerned after parking their cars because they receive no security information. Smart Parking is an IoT device for parking lot clients that enables drivers to have easy access to and ensure security at parking lots. It is easily accessible, digital, and uses wireless internet connectivity. Users can use or access it at whatever position they find themselves once they are connected to the internet. It aims at improving accessibility and security in parking lots.

Team Lead: Atingedebonga David Awe

Location: Ghana



Soctech Systems

The average Ghanaian has difficulty determining how much energy he or she is paying for and how much energy his or her electrical equipment consumes. According to the Ghana Energy Information Agency and Ghanaweb.com statistics, electricity use has risen in recent years and is accompanied by higher bills. Soctech Systems provides smart devices such as smart switches, smart wall sockets, smart extension boards, and energy management applications. We enable users to control and automate the energy consumption of electrical appliances.

Team Lead: Dean Prince Agbodjan

Location: Ghana



Interactive Bin (InterBin)

Preventing littering and making sure all solid waste gets into the recycling pipeline is a major challenge for the eThekweni Municipality. The solution is a smart interactive and IoT enabled bin for the public which encourages throwing litter into the bin. The bin engages with the user, saying "thank you" in any of South Africa's official languages.

Team Lead: Mandisa Gono - **Location:** South Africa



Molemi IoT

Fresh food crops are not rapidly accessible in urban areas and yet urban agriculture is taking off, Molemi IoT sees an opportunity to provide urban farmers with relevant data to produce high-quality yield. The product is a portable greenhouse that can be used for both indoor and outdoor gardening/farming. It uses hydroponics as a method of growing food crops.

Team Lead: Tiisetso Mphuthi - **Location:** South Africa



Oringo

Triage is the process of sorting patients into different priorities based upon their degree of illness or injury. The South African Triage Scale (SATS) is a scientifically-derived triage tool initially developed by the South African Triage Group (SATG). The system will allow for 20 different biometric parameters such as pulse, breath rate, blood oxygen, electrocardiogram signals, blood pressure, muscle electromyography signals, glucose levels, galvanic skin response, lung capacity, snore waves, patient position, airflow etc.

Team Lead: Isaac Maisha Mongali - **Location:** South Africa



The Makers

In South Africa, there is a lack of models, simulations, and procedures to contain viral infections mainly because of inexperience with such threats. The solution entails an integrated system that utilizes computer vision and smart sensors to monitor work environments for PPE usage, sanitary human contact procedures, machine learning to analyze and develop procedures that reduce risks of infection.

Team Lead: Nokubonga - **Location:** South Africa



Intel Farming

Due to a lack of timely soil data information, farmers mistakenly over-fertilize their soils. Intel Farming delivers an easy-to-use soil monitoring system that can assist farmers in reducing fertilizer waste and increasing land production per square hectare by regularly extracting data from the farmer's soil and analyzing it in real-time using our wireless IoT soil probes and Web App augmented by Artificial Intelligence Technology. This would allow farmers to make better informed decisions.

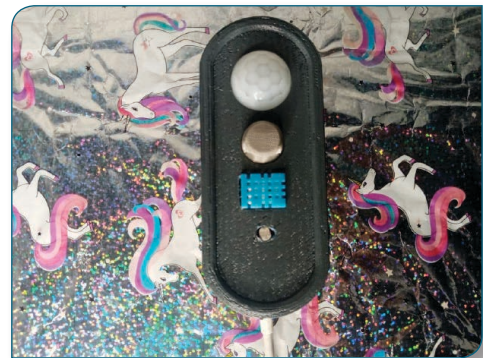
Team Lead: David Edwards - **Location:** South Africa



Smart Real Estate Ma-Mo

Property or residential owners can feel unsafe because their properties are not constantly monitored when they are unavailable. The Real Estate Ma-Mo device will help control the level of security and damage to property in an affordable way by providing property and residential owners with real-time data, letting them know their property is safe.

Team Lead: Xoliswa Shandu - **Location:** South Africa



Boki – Smart Box

Fires cause damage, injure, or kill people. Fires in commercial sites can spread rapidly, so early detection is key to maintaining the safety of tenants and reducing the amount of property damage.

The solution helps to fight and reduce fire damage, especially in local markets and uses LoRa to build affordable fire detection devices that can be purchased by business owners and installed in their shops and workplaces.

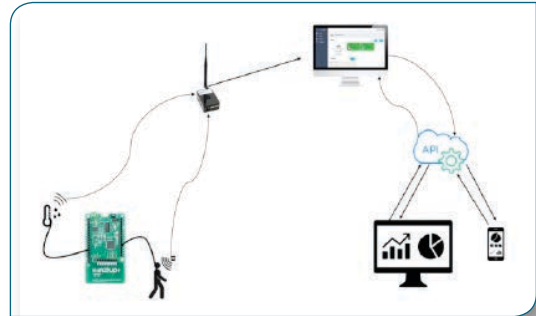
Team Lead: Djibril Sall - **Location:** Senegal



Conserv-tout

In a constantly changing world, production is more important than consumption. It is also difficult these days to keep certain products fresh. The solution is a connected barn based on IoT technology that offers an automated management system for the conservation of agricultural crops.

Team Lead: Madjiguene Sene - **Location:** Senegal

**O²Zone**

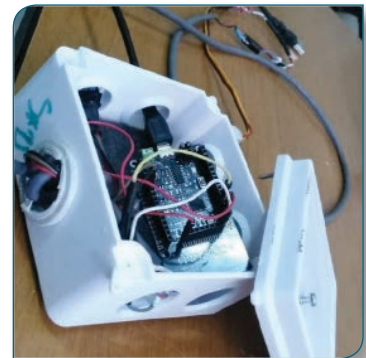
Degradation of cultivable areas leads to food shortage and the use of pesticides and chemical fertilizers results in food poisoning and disease. Our solution uses ancestral technology (aquaponics) combined with ICT. We ozonate the environment by creating forests on the facades of buildings. With an aquaponics system, coupled with IoT technology and gravitational irrigation equipment, we can transform the facade of a building into a garden.

Team Lead: Masserigne Diop - **Location:** Senegal

**Sanar IoT – Smart Gardening**

The problem faced is a lack of knowledge or means for micro gardening. The solution is to create affordable, easy to use “intelligent crop tables”. The goal is to maintain the well-being of a garden using the Internet of Things (IoT). With the versatility of the present software, embedded systems and tools, the planter (crop table) is integrated with sensors that monitor the real-time status of the crops. The smartphone app opens access to the data and helps taking necessary action when needed.

Team Lead: Sokhna Fatma Sakho - **Location:** Senegal

**Fossetic**

The use of septic tanks to hold household waste water is quite common throughout Africa and Asia. The users are unaware when the pits are full, causing sludge and waste water to overflow into the house and surroundings, emitting foul smells. Fossetic, a septic tank level warning system was developed for this reason. When the pit reaches a certain level, this warning system – Lora communication (WaziHub technology) delivers an alert via SMS or audio signal. The user is notified in good time, and our emptying service is able to intervene.

Team Lead: Mourtalla Mbeguere - **Location:** Senegal



Smart Weather

Air pollution causes a number of allergies and respiratory disorders. The air indoors is more contaminated than the air outdoors, and we spend 80% of our time indoors. Smart Weather measures key data in your home, such as temperature, CO2 levels, and pollution, and notifies you via a color code based on the results. You receive notifications on your phone's screen. You can view the history of your indoor data and the weather forecast in the app as well.

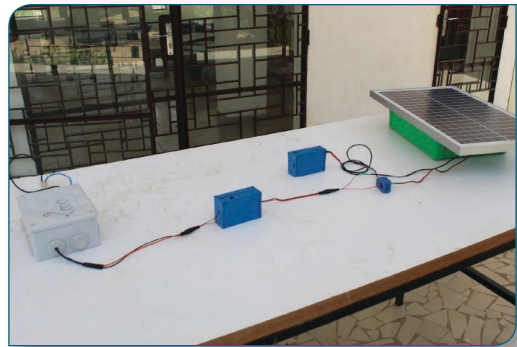
Team Lead: Penda Fall - **Location:** Senegal



Volta Safe

Using and maintaining solar panels has become problematic due to late failure detection, decreased system performance, or total system unavailability. Volta Safe provides real-time supervision and fault diagnosis to users. Remote monitoring of photovoltaic installation via sensors connected to a gateway also facilitates installation maintenance and upkeep.

Team Lead: Mame Faty Kane - **Location:** Senegal



Little BTS

In Tanzania we have a serious problem with telecommunication (weak signal reception), due to the shortage of towers and the relevant environment in some villages services do not function well. The solution amplifies the weak signal and rebroadcasts it as a strong one thus reducing dropped calls.

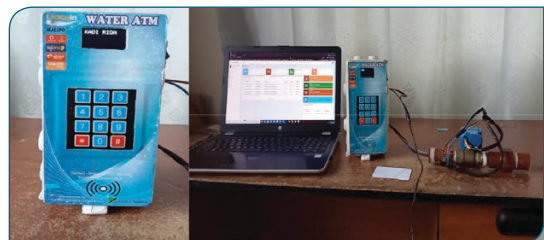
Team Lead: Said Hozza - **Location:** Tanzania



KFP water Meter Management System

Many people in Sub-Saharan Africa fail to manage and keep track of their water consumption data. As a result, there is a lack of accurate data on water consumption in the area. Also, because most nations utilize immersive data gathering methods, they are losing income from water services. The Water ATM Machine allows customers to use a credit card over mobile networks. The owner of this ATM gets reports at any time by defining a specified date-time, day, monthly, and yearly range. If the balance is inadequate to enable the machine to gather water, Huna Salio will be notified.

Team Lead: Festo Mwangungulu - **Location:** Tanzania



N-Switch

Too many farmers in Tanzania are unable to manage their farms due to the absence of real-time data and support. Farmers may lose up to 10% of their productivity if important activities are not completed on time. The shortage of agronomists is a serious issue for Tanzanian farmers. N-switch is an electronic device designed to help farmers manage their farms. Farmers will receive real-time updates making it unnecessary for an agronomist to travel long distances; instead, they will have access to all relevant information. They will receive reminders from N-switch on the current activities that have to be done immediately.

Team Lead: Shedrack Mkwepu - **Location:** Tanzania



MyCow IoT

Poor feed intake by cattle as a result of variations in environmental temperature and humidity affects milk productivity in the dairy sector. The proposed solution will be a decision support tool that generates the Relative Humidity and Temperature Index. The index will inform a farmer when he or she should respond to the animal to manage the stress caused by changes in environmental factors.

Team Lead: Wamola Mwangwa - **Location:** Tanzania



The Smart Village



The Smart Village

IoT services for citizens... Even in remote places!

The Smart Village objective is to develop and offer IoT services, even in remote places. The aim is to deploy a wide IoT infrastructure offered as a service to citizens and local entrepreneurs. Using this infrastructure, a large range of IoT applications can be developed and **new, smart services** can be offered.

Traditional networks such as 3G are often unavailable in rural areas. This seriously limits the accessibility to smart services for local citizens. However, new long range and low cost radio networks such as LoRa opens up interesting possibilities for data collection in rural areas. The Smart Village initiative takes advantage

of the Waziup technology, deploying the infrastructure and developing services that fit the needs of local citizens.

We launched the Smart Village initiative in Sanar, a village located near Saint-Louis, Senegal. It is led by the University Gaston Berger (UGB). Indeed, the UGB, with its pole of excellence in mathematics, computer science and ICT, has been committed to a number of projects targeting IoT applications for citizens. We developed several applications, based on a survey of routines and practices in areas such as agriculture, fish farming, livestock theft and transport.

Authors:



*Babacar Diop, PhD,
is an expert in the Internet of Things,
leading the Smart Village initiative
in Senegal.*



The Smart Village: more than a living lab

The living lab: our working space

In order to implement a Smart Village, a number of steps are necessary. The first step is to bring all parties together and collaboratively identify the challenges of the local citizens. Bringing together future users and creators of solutions made it possible to identify the objectives to be achieved in a gradual manner. All this while keeping a view on the final users, their aspirations, needs, and design requirements.

The Living Lab includes a number of activities such as physical meetings with farmers and breeders from the region, solution developers, and also project leaders. The presence of the incubator, the interaction with local authorities, and the support of the university facilitate progress in innovation and farmer involvement. Ongoing activities in the Living Lab include small meetings with startups and project leaders; calls and support for projects in collaboration with the incubator. The goal is to accelerate the

use of the Waziup technology in the management of village use cases; the collection and analysis of data collected from the users for the creation of future services.

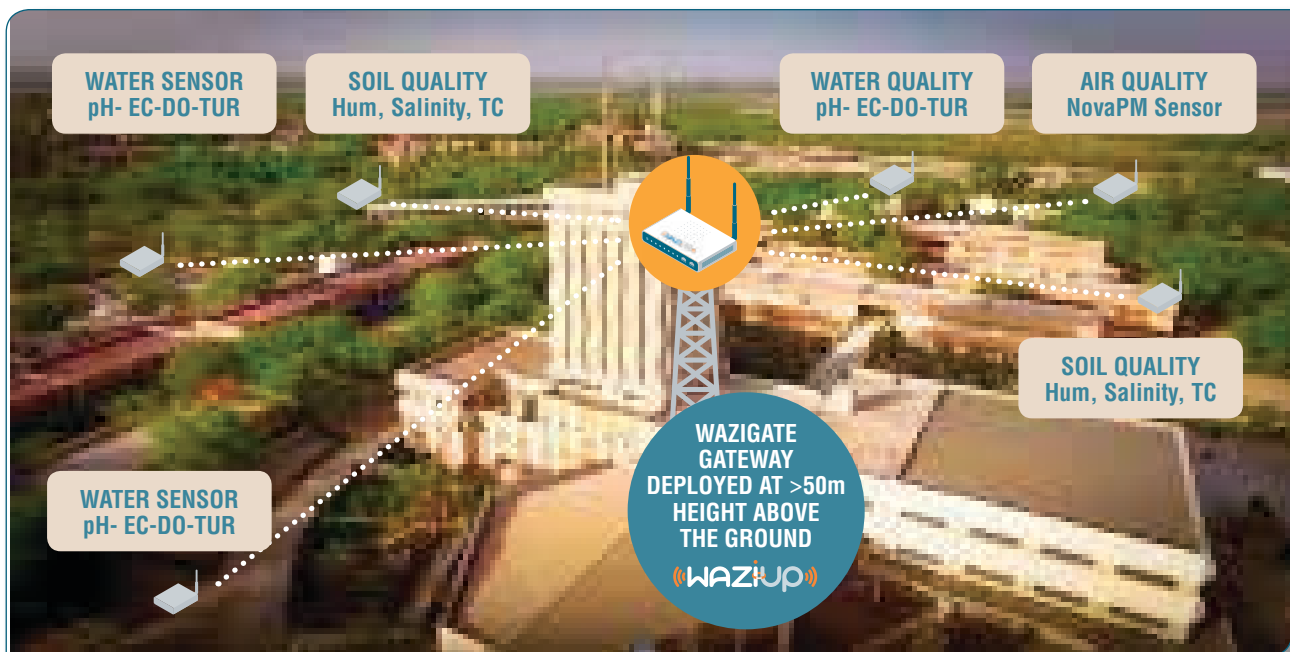
Today, the Smart Village Living Lab operates in support of many projects and startups in IoT, in order to cross these actions with the initiatives led by the University. Currently, a set of use cases has been developed, and sensors deployed in target environments. The applications, identified as relevant and applicable in the context of the Smart Village, present enormous opportunities for the surrounding population.

The infrastructure

In technical terms, the Smart Village infrastructure consists of 5 gateways deployed at different locations around the University to trigger data collection from sensors deployed all around.



Meeting with startups in the Living Lab.



Technical infrastructure with one antenna deployed at 50 meters height above the ground to maximize coverage.

With the WaziHub project, this infrastructure has been scaled up to provide value-added services to local populations. We deployed the low-cost and low-power WaziGate LoRa gateways capable of supporting large-scale deployment of sensors around the village. The deployment consists of five LoRa gateways deployed at different locations and collecting data on a daily basis.

This infrastructure has become vital when linked to the university's pedagogical component in the IoT field. This year alone, there has been a growing interest in the community of students, developers, and startups from here and elsewhere, developing their projects in the IoT field. With these open avenues, new reflections are triggered on the observation of parameters related to the problems in the rural world.

Where is our data stored?

The data generated as part of the Smart Village initiative is shared with the world wide community via a public repository on Github¹. Files are stored with nomenclature as well as a description reflecting the content of the data presented therein.

In order to achieve better data exploitation, it is important to pool data sources and operate on a diversified view of the problems downstream from the use cases. Dataset increases every week as sensors are sending data to gateways that route them to the platform. Data amounts range from +10,000 to +50,000 lines. This data is being used by students, researchers, and some startups as well to explore how new sets of services can be proposed.

¹ https://github.com/SmartVillageUGB/Open_Data

Our applications

The Smart Village in Senegal developed a number of pilot applications for citizens.

In order to develop the Smart Village concept, we developed several applications: Air quality monitoring, irrigation water control and Fish farming monitoring.

Air quality monitoring

Why do we monitor air quality? According to the W.H.O., in 2016 the 91% of the world's population lived in places where adequate air quality standards were not met. With up to 4.2 million premature deaths worldwide caused by outdoor air pollution, it is becoming crucial to monitor air quality in both rural and urban areas. With the air quality index getting worse every day worldwide, the number of air quality stations deployed in Africa is still very low. **In Senegal, there are less than 10 public air quality monitoring stations.** While the number of respiratory illnesses is alarming, a real public health risk factor is exposure to fine particles.

All these facts motivated us to deploy air quality sensors around the Smart Village, in order to collect daily parameters that can be harmful to the health of the population. **Four air quality monitoring stations have been deployed throughout the village.** While sensors can be deployed at fixed locations, mobile deployment of pollution capture devices is feasible for dynamic mapping scenarios of overall air quality. Sensors attached to the corner of a few moving cars can plot the daily level of air pollution on a map with stamped critical points.

These deployments have spurred the interest of several startups. The startups SAQAM and Smart Weather App are good examples. Both offer interesting software possibilities to allow subscribed users to be informed about environmental conditions, both indoors and outdoors. Target users are first of all people with diseases such as asthma and respiratory illness.

Generated data is made available to users in order to monitor the evolution of fine particles in this sub-Saharan area. The next stage challenge is to be able to predict pollution from this continuously collecting data process. The challenge of deploying large-scale stations to fill the gap is still pending. Another possibility is to exploit approximated prediction through



The Smart Village weather station.



Crop monitoring with Waziup.



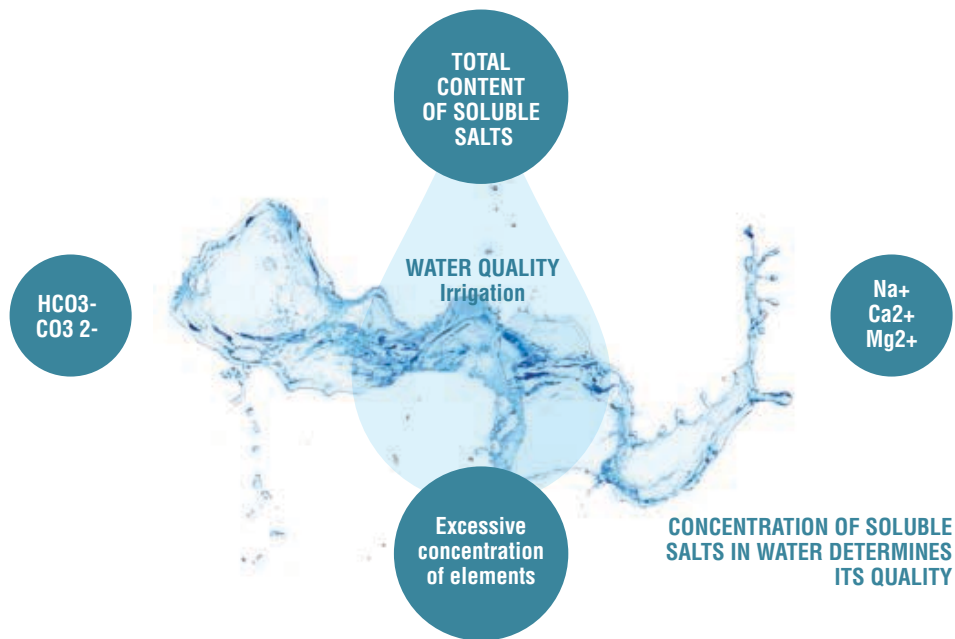
Amadou uses sensors and Waziup technology to grow strawberries in sub-Saharan climate.

complex research models. Specific machine Learning models embedded on battery-powered micro-controllers may help predict air pollution parameters, even without the use of sensors.

Irrigation water control

Water quality can be monitored through several parameters such as temperature, turbidity, dissolved oxygen, electrical conductivity, and pH. These parameters can be crucial depending on the application and the situation. For example, drinking water

requirements are different from water reuse for irrigation. Drained water from fish farms can be harmful when mixed with drinking water systems, despite the presence of filtration. On the other hand, it can greatly enrich crop fields when used for irrigation. Closely related to the problems associated with water irrigation is the **accumulation of salt in the ground**, which leads to slow crop growth due to difficult water penetration rates. Sub-Saharan countries are located in arid zones characterised by a severe lack of rainfall and moisture. As one of the important roles of rain is to clean the air and soil of stagnant components, an unclean soil situation is usually visible in these regions.



The 4 classes of parameters in water irrigation.

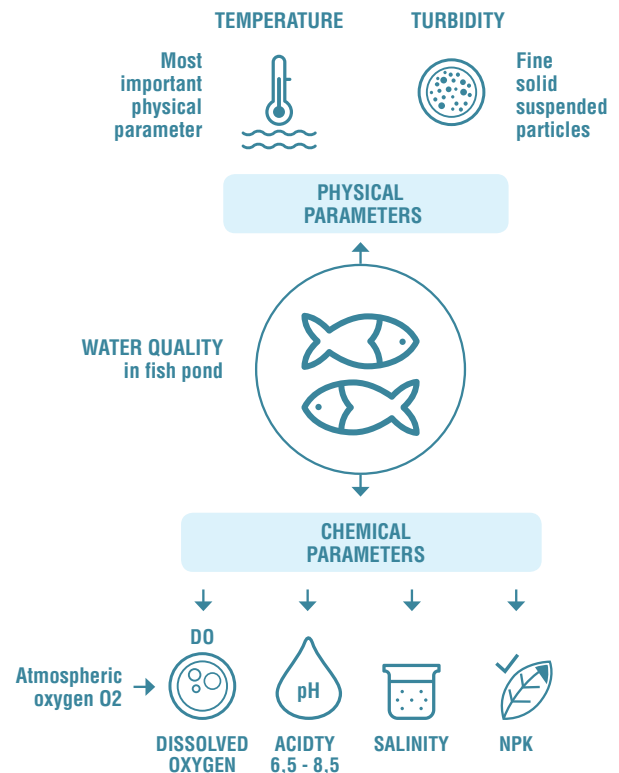
To overcome this problem, it is necessary to monitor certain parameters such as soil conductivity and other chemical factors whose extreme values can block roots and water penetration.

Water quality for irrigation is characterised by the four classes of parameters as shown in the figure above: salinity, anions and cations, and excessive concentration of elements. Although it is not possible to control the concentration level of each element, measuring soluble salts in water can help determine their quality for irrigation.

Fish farming activities control

For fishing activities, the range of parameters can be divided into two categories: physical parameters and chemical parameters. Physical parameters refer to the presence of fine solid particles measured as turbidity, and chemical parameters. The latter include parameters such as dissolved oxygen (DO), acidity measured by pH, salinity measured by electrical conductivity and NPK parameters.

The water quality measurement devices have been deployed for four years, and preliminary results have been obtained with regard to end-user fishing activities. Interesting results have been evaluated. In the Smart Village, devices capable of collecting these parameters on a daily basis have been used in recent



Physical and chemical parameters of water quality in a fish pond.



Malick uses Waziup to monitor pH, turbidity, dissolved oxygen level in fish ponds, as it is crucial to ensure a proper yield.

months to provide water quality recommendations for some fish ponds.

Since irrigation water is sourced from a single source, it is possible to anticipate water quality monitoring by deploying sensors upstream in the source areas. In this way, we hope to benefit from the efficiency of a unified monitoring system where the elements of relevant parameters for irrigation as well as water management in fish farming are improved.

Today, in the living lab, we have a set of sensors for water quality monitoring, which can be used for different aspects of the above-mentioned issues. These sensors, often deployed on-demand, allow us to monitor all the parameters that interfere with the optimal functioning of these use cases.



More on our websites:

www.waziup.io
www.wazihub.com

