



Accelerating Open IoT and Big Data Innovation in Africa

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Report D3.6

Report on capacity building for entrepreneurs, developers, start-ups and partners (Gamma)

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TABLE OF CONTRIBUTORS

Section	Author(s)	Reviewer(s)
1. Capacity building materials	Corentin Dupont	Corentin Dupont, Wilma Sokeng
2. Capacity building events	Wilma Sokeng, Irene Mutesi	Corentin Dupont, Wilma Sokeng
3. WaziHub external hubs	Fiifi Baidoo	Corentin Dupont, Wilma Sokeng

TABLE OF CONTENTS

1	Introduction	5
2	Capacity building materials	6
2.1	Online Courses	6
2.2	WaziHub Platform User Manuals	10
2.3	IoT DIY tutorials	11
2.4	Hardware Kit	12
2.5	WaziHub forum	13
3	Capacity building events	15
3.1	Bootcamps and hackathons	15
3.1.1	Kumasi, Ghana, July 2018	15
3.1.2	Kumasi, Ghana, March 2019	16
3.1.3	Dar es Salaam, Tanzania, October 2018	17
3.1.4	Dar es Salaam, Tanzania, October 2019	18
3.1.5	Dar es Salaam, Tanzania, November 2019	19
3.1.6	Nairobi, Kenya, November 2018	19
3.1.7	Nairobi, Kenya, October 2019	21
3.1.8	Kampala, Uganda, December 2018	22
3.1.9	Kampala, Uganda, June 2019	23
3.1.10	Kampala, Uganda, October 2019	23
3.1.11	Kampala, Uganda, December 2019	24
3.1.12	Kampala, Uganda, March 2020	25
3.1.13	Durban, South Africa, March 2019	26
3.1.14	Durban, South Africa, August 2019	26
3.1.15	Kigali, Rwanda, September 2019	28
3.1.16	Saint-Louis, Senegal, November 2019	29
3.1.17	Dakar, Senegal, October 2018	30
3.1.18	Dakar, Senegal, November 2019	32
3.1.19	Summary	32
3.2	Training sessions	33
3.3	Info sessions	34
3.4	Webinars and Tutorials	35
3.5	Training for partners	39

4	WaziHub external Tech Hubs	40
4.1	Nodes community	40
4.2	Selection and evaluation of the nodes	41
4.3	Nodes website	42
4.4	Node Activities	46
4.4.1	CodeFactory	46
4.4.2	Sotehub	49
5	Conclusion	52

1 INTRODUCTION

This deliverable explains the capacity building activities achieved by WAZIHUB. Numerous workshops were conducted to ensure that the skills of the participants are improved and maintained. We promoting a continuous learning culture for the participants and those involved in the ecosystem. The deliverable contains the training methodologies that have been used throughout the program to ensure that the participants become conversant with IoT and its applications within their communities. It also describes the tech community program WAZIHUB is undertaking.

WAZIHUB innovation program includes ideation, bootcamps, training, coaching and development of the entrepreneur, growth hacking and finance unlocking for the entrepreneur. The accelerator program will be standard with each hub running the same program including those who are not part of the consortium. This deliverable D3.6 (Gamma) covers the full project period. It will share a broader picture of the status and also include new results for sections 2, 3 and 4.

2 CAPACITY BUILDING MATERIALS

This section gives an overview of the capacity building materials published by the project. We published several types of material:

- Online courses
- User manuals for the WAZIHUB platform
- Do-It-Yourself IoT tutorials
- Video tutorials

2.1 Online Courses

As part of its capacity building activities, WAZIHUB has built online courses. The courses are hosted on Google Classroom. This platform is free and available for every student to enrol. The first course covers the fundamentals of IoT, teaching students how to develop practical IoT solutions and using basic IoT devices. The course will follow a structure below:

- Fundamentals of IoT
- Available Resources
- Prototyping and Testing: Getting Started with WaziDev and NanoLoRa
- Prototyping and Testing: Getting Started with Waziup Gateway
- Prototyping and Testing: Introduction to Waziup IoT Cloud Platform and,
- Waziup Applications

Figure 1 to Figure 3 gives screenshots from the online courses.

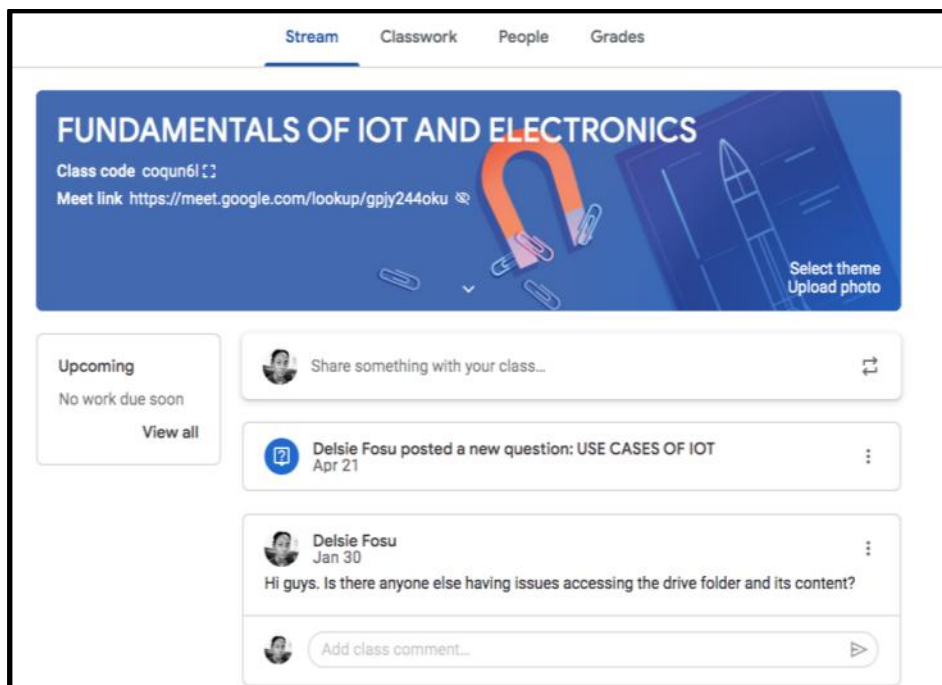


Figure 1: Classroom Homepage

The screenshot displays a course interface with a sidebar on the left and a main content area on the right. The sidebar lists categories: 'All topics', 'INTRODUCTI...', 'UNDERSTAN...', 'INTRODUCTI...', 'INTRODUCTI...', 'QUIZ', and 'RESOURCES'. The main content area features a '+ Create' button, 'Google Calendar', and 'Class Drive folder' links. It is organized into sections: 'INTRODUCTION TO IOT' (with two posts: 'WELCOME TO THE WAZIUP IOT SE...' and 'INTRODUCTION TO IOT'), 'UNDERSTANDING IOT DEVICES AND ARCHITE...' (with two posts: 'USE CASES OF IOT' and 'UNDERSTANDING IOT DEVICES A...'), 'INTRODUCTION TO BASIC ELECTRONICS AN...' (with five posts: 'INTRODUCTION TO BASIC ELECT...', 'HARDWARE RESOURCES: OVERVI...', 'HARDWARE RESOURCES: WAZIUP...', 'HARDWARE RESOURCES: OVERVI...', and 'HARDWARE RESOURCES: ACTUAT...'), 'INTRODUCTION TO BASIC ELECTRONICS: SO...' (with three posts: 'SOFTWARE RESOURCES: GITHUB ...', 'SOFTWARE RESOURCES : ARDUIN...', and 'SOFTWARE RESOURCES: WAZIDE...'), and 'QUIZ' (with one post: 'Graded Assignment'). Each post includes a document icon and a 'Posted' date.

Figure 2: Course Work

INTRODUCTION TO BASIC ELECTRONICS AN... ⋮

Delsie Fosu posted a new material: INTRODUCTION TO BASIC ELECTR...
⋮

Posted Jan 24
Introduction to basic electronics components, characteristics, electrical concepts and common terms used.

Lecture 4 introductio...
 YouTube video 2 min...

▶

Delsie Fosu posted a new material: HARDWARE RESOURCES: OVERVIE...
⋮

Posted Jan 24
Brief introduction to the Wazidev and Nanolora boards and their characteristics

Lecture 5 Overview o...
 YouTube video 1 min...

▶

Delsie Fosu posted a new material: HARDWARE RESOURCES: WAZIUP S...
⋮

Posted Jan 24
Introduction to the types of sensors that can be used with waziup

▶

Delsie Fosu posted a new material: HARDWARE RESOURCES: OVERVIE...
⋮

Posted Jan 24
Introduction to the waziup gateway, its parts and how it works

Lecture 7 Waziup Gat...
 YouTube video 1 min...

▶

Figure 15: Detailed Course work

Teachers 👤+

Delsie Fosu

Aqui: Babacar Diop ⋮

Corentin Dupont ⋮

[View all](#)

Students 10 students 👤+

Actions A-Z

Brian Adjei ⋮

Terence Chibire ⋮

Michael Damilare ⋮

sfiso dlamuka ⋮

Daouda Hamadou ⋮

Kossi Djidjogbe Koudi... ⋮

maleghemi@gmail.co (invited) ⋮

Godwin Mensah ⋮

Kioko Muthui ⋮

IoT Network Hub ⋮

Emmanuel Odunlade ⋮

Figure 3: Signed up participants

Guideline

An effective assessment enhances the students' learning, influencing how a student interprets what is important for the course. Assignments and quizzes are designed to assess the students.

- Quizzes and assignments must be spaced from lessons to allow students allocated sufficient time for study. Assessment tasks can be taken at the end of the course or after 2 or 3 lessons.
- Allow students to show their errors and explain their reasons for such in order to validate the learning process.
- Clearly explain the assessment task
- Give sufficient and detailed feedback on each task, ensuring that the feedback aligns with the learning goals of the course.

- Give clear grading criteria, to make the grading process efficient and help students perform better. It removes confusion and frustrations about their grades.

2.2 WaziHub Platform User Manuals

The WaziHub technology has three main components¹:

- **WaziDev**: an Arduino based development board, with LoRa integrated.
- **WaziGate**: a LoRaWAN gateway
- **WaziCloud**: a Cloud platform for managing your IoT data.

The following user manuals are available for WaziDev:

- **WaziDev user manual**: This user manual will guide you with your first step with the WaziDev².
- **Connect your Sensors**: This tutorial will help you connect any sensor to WaziDev³.
- **Connect your actuators**: This tutorial will help you connect any actuators to WaziDev.
- **Connect with other boards**: This tutorial shows you how to connect alternative boards to WaziCloud.

The following user manuals are available for WaziGate:

- **WaziGate quick start**: This short tutorial will get you started with WaziGate with only a few steps.
- **WaziGate installation manual**: This user manual will help you install your WaziGate⁴.
- **WaziGate LoRaWAN**: This tutorial will show you how to communicate with LoRaWAN devices.
- **WaziGate Apps**: This tutorial will show you the “Edge” feature of WaziGate, i.e. how to create and run your aown application of the gateway itself.
- **WaziGate video tutorials**: This serie of video tutorials will help you set up your gateway and develop WaziApps for the gateway⁵.

The following user manuals are available for WaziCloud:

- **WaziCloud Dashboard user manual**: You can build a full application with Waziup, without programming! In this tutorial, we'll learn how to build a soil monitoring application able to display the soil moisture and to send notifications on SMS, twitter and voice messages⁶.
- **Web app tutorial**: Waziup allows you to develop and host you own IoT applications. The WaziApp is an HTML5 application and will be hosted directly on Github. Only a few steps are necessary to get your application running with Waziup⁷!
- **API User manuals**: This is a collection of tutorials to guide you through the WaziCloud API. It includes Access control, Sensor management, Gateways management and Notifications⁸.

¹ <https://www.waziup.io/platform>

² <https://www.waziup.io/documentation/wazidev/user-manual>

³ <https://www.waziup.io/documentation/wazidev/sensors>

⁴ <https://www.waziup.io/documentation/wazigate/user-manual>

⁵ <https://www.waziup.io/documentation/wazigate>

⁶ <https://www.waziup.io/tutorials/software/dashboard/>

⁷ <https://www.waziup.io/tutorials/software/browserapp/>

⁸ <https://www.waziup.io/documentation/wazicloud/api>

- **MQTT Access:** This tutorial will show you how to access the platform using the MQTT protocol⁹.

The user manuals were published on the Website. The corresponding website section was restructured. As can be seen in Figure 4, the documentation is displayed in the centre. On the left side, a menu is showing the list of all available documentation, with the current document displayed in bolded letters. On the right, another menu is presenting the table of content of that specific document, for easier navigation. Additionally, a PDF version is available for download. All documentation has been formatted using this style.

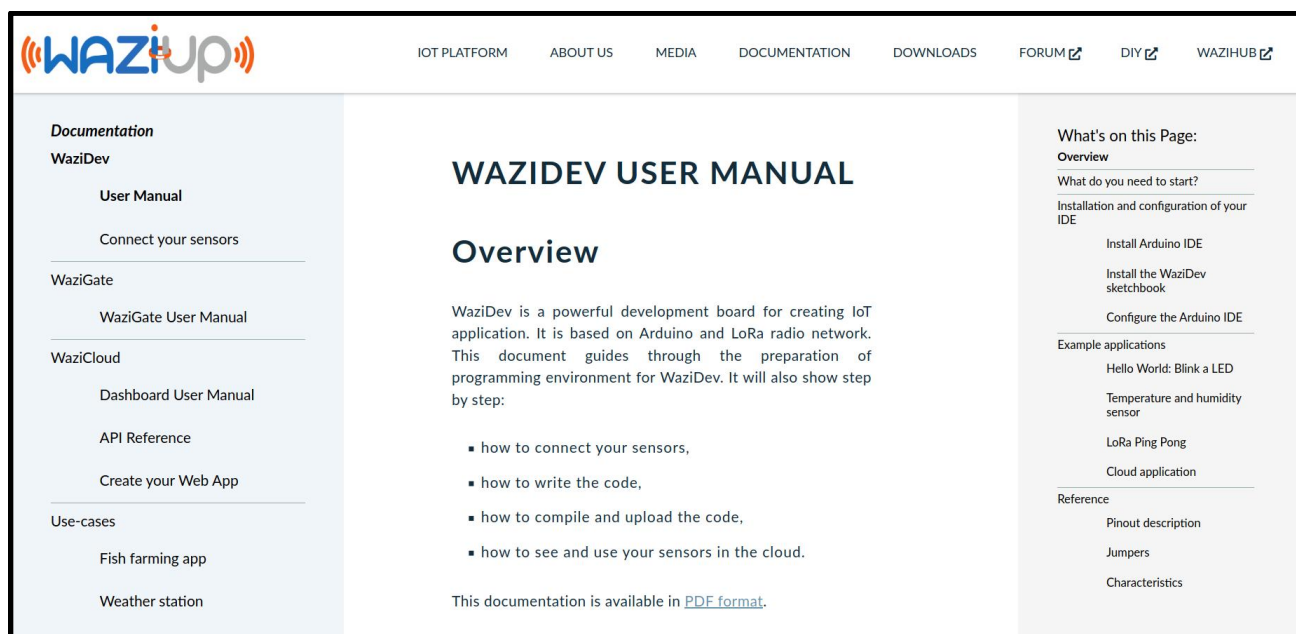


Figure 4: Example of user manual on the website

2.3 IoT DIY tutorials

Existing IoT tutorials are given below:

- FAQ is our low-cost LoRa framework Frequently Asked Questions. It is advised to read it first.¹⁰
- **Low cost LoRa IoT step-by-step** shows how to build a simple LoRa IoT sensing device with the simple temperature example and an Arduino Pro Mini, running on 2-AA battery for several years.¹¹
- **Low-cost-LoRa-IoT-outdoor-step-by-step** shows how you can improve the design for out-door usage.¹²
- **Low-cost-LoRa-IoT-supported-sensors** explains in a didactic manner how physical sensors can be connected and how they can be integrated into our generic framework.¹³
- **Low-cost-LoRa-device-leaflet** is a leaflet summarizing the IoT device side.¹⁴

⁹ <https://www.waziup.io/documentation/wazicloud/api/v2/#mqtt>

¹⁰ <https://github.com/CongducPham/tutorials/blob/master/FAQ.pdf>

¹¹ <https://github.com/CongducPham/tutorials/blob/master/Low-cost-LoRa-IoT-step-by-step.pdf>

¹² <https://github.com/CongducPham/tutorials/blob/master/Low-cost-LoRa-IoT-outdoor-step-by-step.pdf>

¹³ <https://github.com/CongducPham/tutorials/blob/master/Low-cost-LoRa-IoT-supported-sensors.pdf>

¹⁴ <https://github.com/CongducPham/tutorials/blob/master/Low-cost-LoRa-device-leaflet.pdf>

- **Low-cost-LoRa-GW-step-by-step** shows how you can build and configure the LoRa gateway with a Raspberry PI to start pushing data to the cloud.¹⁵
- **Low-cost-LoRa-GW-web-admin** explains the web admin interface extension to easily configure and update your gateway.¹⁶
- **Low-cost-LoRa-GW-leaflet** is a leaflet summarizing the gateway side.¹⁷
- **Low-cost-LoRa-IoT-antenna Cable** is a tutorial on how to assemble an antenna cable with SMA and/or N connectors to match your antenna and radio module connectors. This is mainly required when you want to use a higher gain antenna or when you want to place the antenna outdoors and have your gateway indoor to simplify deployment.¹⁸
- **WAZIUP-Deployment-guidelines** describes some deployment issues and best practices when deploying IoT and gateways.¹⁹
- **Low-cost-LoRa-IoT-using-demo-kit** explains how the WAZIUP long-range demo kit can be used for demonstration purposes. It will show how to use the out-of-the-box gateway distribution `raspberrypi-jessie-WAZIUP-demo.dmg.zip` and the `Arduino_LoRa_Simple_temp` sketch example.²⁰
- **low-cost-iot-hardware-parts** lists all the parts you need to build both the low-cost device and the gateway.²¹

2.4 Hardware Kit

The Purpose of the Development kit is to leverage the hardware availability issue and second, to provide an out-of-the-box software minimal configuration. The kit comes as a DIY that can be used to build a fully operational and efficient IoT LoRa device but all the basic components are off-the-shelf and can be obtained separately.

The community will place a request for the kit to the WAZIHUB. They will in turn assess the number of kits needed and send the kit to the community manager. The number of kits requested for by the tech community is dependent on the total number of requests from the Nodes. Requests to the foundation must be placed once the annual plans for each Node have been received.

Node leads can be placed in a request for hardware by completing a Google form. The completed form will be evaluated and responded to accordingly. A Google form will be completed for this request, as shown in Figure 5.

¹⁵ <https://github.com/CongducPham/tutorials/blob/master/Low-cost-LoRa-GW-step-by-step.pdf>

¹⁶ <https://github.com/CongducPham/tutorials/blob/master/Low-cost-LoRa-GW-web-admin.pdf>

¹⁷ <https://github.com/CongducPham/tutorials/blob/master/Low-cost-LoRa-GW-leaflet.pdf>

¹⁸ <https://github.com/CongducPham/tutorials/blob/master/Low-cost-LoRa-IoT-antennaCable.pdf>

¹⁹ <https://github.com/CongducPham/tutorials/blob/master/WAZIUP-Deployment-guidelines.pdf>

²⁰ <https://github.com/CongducPham/tutorials/blob/master/Low-cost-LoRa-IoT-using-demo-kit.pdf>

²¹ <https://github.com/CongducPham/tutorials/blob/master/low-cost-iot-hardware-parts.pdf>

WAZIHUB Hardware Request

Your request will be reviewed and promptly responded to.

*** Required**

Email address *

Your email

What is the item you would like to order? *

WAZIDEV PACKET

WAZIGATE PACKET

How many WAZIDEV packets would you like to order?

Your answer

How many WAZIGATE packets would you like to order?

Your answer

State VAT Percentage
Import VAT or Customs Duty

Your answer

Number of MVP prototypes planned *

Your answer

Please provide reasons for the request *

Your answer

Requesting Tech Community Chapter *

Choose ▾

NEXT

Never submit passwords through Google Forms.

Figure 5: Hardware Request Form

2.5 WaziHub forum

We launched during the period a new forum for technical exchanges. This forum is used to help users with the WaziHub technology. Several sections are opened, for exchanges on the WaziDev, WaziGate, WaziCloud or general discussion. A screenshot of the forum is given in Figure 6.

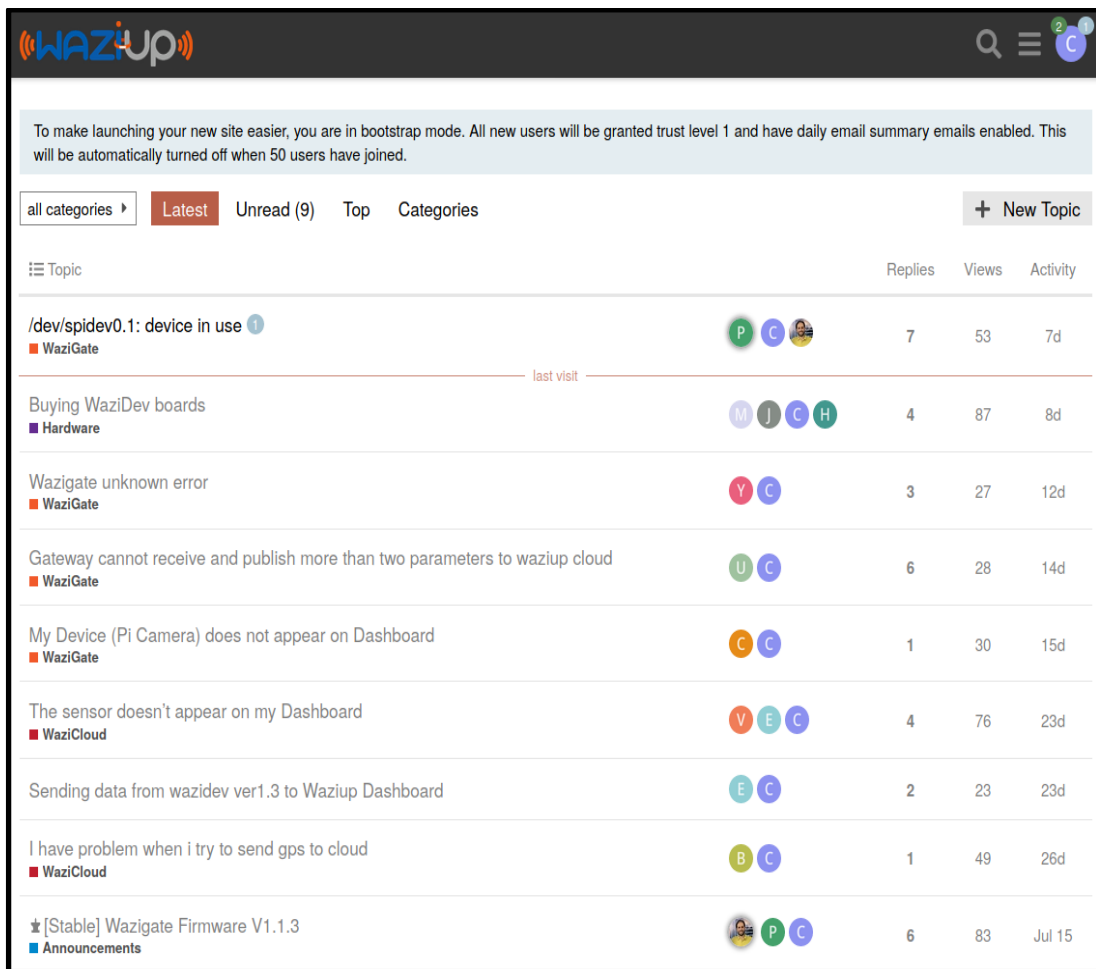


Figure 6: WaziHub forum screenshot

3 CAPACITY BUILDING EVENTS

Several types of capacity building events were held:

- **Bootcamps:** bootcamps are multi-days events (typically 5 days) that include several aspects from the WaziHub program: ideation, prototyping, business models... Qualified trainers from the project and from external universities are also present for the capacity building.
- **Training sessions:** short capacity building and knowledge sharing sessions organised by each partner hub, where they equip participants with skills that they need to efficiently utilize all the available Waziup technologies.
- **Info sessions:** Sessions where information is shared on the WAZIHUB program, held usually before bootcamps.
- **Webinars:** online courses using a conferencing tool (such as Zoom).

Starting from 2020, due to the COVID-19 crisis, our strategy changed. Instead of hackathons and bootcamps, we organized several online competitions as our main capacity building strategy. This section gives an overview of all the events that were organized.

3.1 Bootcamps and hackathons

Bootcamps and hackathons are multi-days events, which usually includes 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 partners selected the top ideas that can be supported to build viable businesses. Partner hubs can select 5-15 ideas that will be turned into viable businesses. Online Material from WaziHub website also aided the participant in further understanding of the Waziup platform, and hardware kits.

The following sections give details about the main bootcamps that were held by the partners.

3.1.1 Kumasi, Ghana, July 2018

Kumasi Hive organized the first WaziHub IoT bootcamp in July 2018. The five days bootcamp started with 30 selected participants that have a good technical background coupled with the right reasons for wanting to participate where chosen.



Figure 7: First WaziHub bootcamp in Kumasi

There was a period allocated for sharing of resources (code, libraries and software's) needed for the entire five days period. Participants were then given an overview of the WaziHub toolkit and invited to form practical work groups, the total number of participants were broken down into three domains, that is Health, Agric and Business.

The Nano-Lora boards have been introduced together with other available IoT related hardware. Participants have been taken 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 by WaziHub's trainers. Teams have been taken through prototyping of sensor nodes to communicate with gateway and submit data to the cloud platform.

On the last day all ten groups pitched their ideas to a panel of three judges and where awarded a certificate of completion. Participants who attended all five days of the bootcamp received a certificate of completion.

- Total number Applicants: 52
- Total number of participants: 30
- Total number of groups: 10
- Number of ladies who participated: 7
- Total number of participants who completed: 22

3.1.2 Kumasi, Ghana, March 2019

This bootcamp took place on the 2nd March 2019 following a Wazihack training workshop held on 23rd February 2019. The bootcamp was divided into two distinct stages. The design thinking phase and the prototyping phase.



Figure 8: Second WaziHub bootcamp in Kumasi

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.

- Total number of Applicants: 52
- Total number of participants: 25
- Number of ladies who participated: 8
- Total number of groups: 9

A total of 25 participants completed with 3 groups emerging as winners. A certificate of competence is to be awarded to all participants with regards to the 8 weeks IoT training prior to the WaziHub bootcamp.

3.1.3 Dar es Salaam, Tanzania, October 2018

WaziHub IoT Bootcamp was a four days bootcamp aimed at building capacity of participant in IoT. Applying design thinking to solve problems and creating innovations solving crucial societal challenges. Participants were also introduced to the Waziup Cloud platform.

Registrations for the four-days bootcamp was closed on Friday 1st October 2018 with 59 applicants. A criterion for selecting participants was then developed and 35 participants that have a good technical background coupled with the right reasons driving them to participate where chosen. The selected few had a chance to participate in the bootcamp which started on the 08 October 2018.

A presentation on IoT and Cloud computing for the digital transformation of the development countries session kicked off the event with Corentin Dupont leading the session. Also, Prince Bani from Kumasi Hive took another session on 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 by Prince so as to form practical work groups, the total number of participants were broken down into four domains, Health, Transport, Agriculture and Energy. These groups were further divided into 7 teams, each made up of five members.



Figure 9: First bootcamp in Tanzania



Figure 10: First bootcamp in Tanzania

On day 2, after some hand on trainings, all participants were in groups working on their ideas (projects) while interacting with the tool kits. Again, there was a session on WAZIUP Gateway Configuration done by Corentin and Prince, all participants in their teams configured their kits with the gateway as to have a working connections.

Day 3 began with a pitching session where seven groups presented their ideas for the first time to the team of trainers and mentors just to mention them; Fiifi Baidoo, Prince, Corentin and Congduc Pham. All teams got constructive feedback from the judges and the audience which would then assist them in improving their ideas and pitching skills. Each team worked on its take outs from the previous pitching session with a support from mentors and trainers to create better and viable solutions. Congduc Pham took another session on more understanding of IoT Ecosystem in Africa also he worked through WAZIUP Dashboard, smart web application development and mobile application development tools. Participants were left to work on their ideas and prototypes with their mentors. This session was more focused on hands on as all participants had enough time to work on their ideas and make use of different tools which were introduced to them for the sake of building their prototypes and come up with viable solutions.

The last day was the demo day where all seven groups presented their ideas to internal and external juries. With the pitching skills they acquired during the pitching session teams were confident enough to share what they had worked on for the past three days and showcase their prototypes and relevance of what they have worked on. All seven teams finalized their solution prototypes and prepared for pitching session. Each team pitched its ideas to a panel of three judges and were awarded certificate of completion.

3.1.4 Dar es Salaam, Tanzania, October 2019

These four days boot camp bootcamp were held from 22nd November 2019 to 25th November 2019 at DTBi. 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 being an introduction to the internet of Things and creating general understanding of the topic by identifying challenges which could potentially be solved by using IoT and analyse the strength of IoT solutions to the innovation ecosystem.

- Total number of participants: 45
- Number of ladies who participated: 17
- Number of applicants: 20



Figure 11: pictures of the 2nd bootcamp at DTBi

3.1.5 Dar es Salaam, Tanzania, November 2019

DTBi held a four days bootcamp in the quarter M13-M18, the info session was held on the 22nd-29th November 2019. The focus of the bootcamp was capacity building community beneficiaries on WaziHub open source IoT technology and to guide the start-ups in building in short period solutions to community ideas that can use this open-source technology to solve community challenges. The startups are equipped with an all-round understanding both knowledge and Technical of leveraging smart data into our societies to create smarter businesses and solutions.

3.1.6 Nairobi, Kenya, November 2018

The @iLabAfrica WaziHub Bootcamp took place from the 12th to 16th November 2018 at the @iLabAfrica Research Centre, located in Strathmore University in Nairobi, Kenya. The boot camp consisted of 5 days of introduction and practical application of the Waziup platform. This was based on the development of IoT solutions using 2 themes: Agriculture and Environmental Monitoring. Participants were expected to come up with concrete ideas for challenges they identified among these themes in groups. Participants would then be judged based on predetermined metrics at the end of the five days bootcamp in order to test whether they had understood how to apply the Waziup technology.



Figure 12: WaziHub bootcamp in Nairobi

- Total number of applicants: 98
- Number of invitations sent: 40
- Total number of attendees for the bootcamp: 29
- Number of female attendees for the bootcamp: 10
- Number of male attendees for the bootcamp: 19

After the distribution of resources for the boot camp including software and tools needed were distributed to the participants.

An ideation session took place in the afternoon and was meant to enable the participants think out of the box and design solutions fit for the challenges around them. The problems were to be solved in practical work groups. The @iLabAfrica training team covered the topic Electronics Fundamentals and Breadboarding, as well as the basics of IoT hardware. This was meant to help those who had not interacted with IoT hardware before and as well set a good base for learning and understanding the Waziup platform.

Joel Muigai-Head of IoT Strategy from Liquid Telecom was invited for the industry partner session. Ignatius Maranga from the Strathmore University Energy Research Centre (SERC), was also invited to talk about: “The energy Industry perspective and the need and usefulness of smart systems for this sector”. This also helped participants open up their minds in finding solutions for the energy and environment sector from an expert.

The final day was kick started by John Troon, Information Security Manager @iLabAfrica. He covered a special topic in IoT: IoT Security, Big Data, Machine Learning and AI. This opened the participants’ knowledge on the possibilities and scope of IoT and how it can be applied in various fields.

Andrew Kimutai, the assistant project coordinator covered Entrepreneurship and IoT. This also helped the participants see how they can benefit from IoT by beginning their own business ventures.

The participants continued on finalizing on their projects as they prepared for the pitching session. The final pitching session was meant to test whether the participants had applied what they had learnt throughout the five day bootcamp period. The best team was announced and each team

member was rewarded with a complete IoT development kit. This was meant to encourage them further advance their idea.

3.1.7 Nairobi, Kenya, October 2019

The second @iLabAfrica WaziHub bootcamp was held on the 15th to 18th October 2019 with the training venue being at the @iLabAfrica, Strathmore University premises. The 4 days bootcamp was a practical and classroom led training that engaged the participants to develop their ideas in the field of the Internet of Things (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 theme of the 4 days workshop was on developing IoT solutions around Smart Cities. A smart city uses the different types of IoT sensors to collect data and then use the insights gained from that data to manage assets, resources and services efficiently. Data collected is processed and analyzed to monitor and manage traffic, transportation systems, waste management, crime detection, power plants among other services.

The main objective of the @iLabAfrica WaziHub Bootcamp was to introduce the Waziup platform to the participants to enable them develop solutions for local problems. The specific objectives of the 5-day 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.
- To introduce interested participants to the WaziHub Accelerator program.

The participants were however not limited to develop their ideas around these themes. If any of them had a pressing idea, they were allowed to come up with an IoT solution around that.

The 2nd @iLabAfrica bootcamps had a total attendance of 17 participants. All of the 17 participants maintained attendance consistency for all the 4 days of the training. At the end of the bootcamp, all of the participants were awarded certificates of participation. The judges were also awarded with certificates of appreciation.

- Total number Applicants: 36
- Total number of participants: 17
- Total number of groups: 5
- Number of ladies who participated: 4
- Total number of participants who completed the program: 17



Figure 13: group picture of the 2nd Bootcamp at @ilabAfrica



Figure 14: 2nd Bootcamp at @ilabAfrica

3.1.8 Kampala, Uganda, December 2018

Hive Colab and WITU held a joint WaziHub bootcamp that ran from the 12th of December 2018 to the 14th of December 2018 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.

- Total number of applicants: 83
- Total number of attendees for the bootcamp: 62
- Number of teams: 9



Figure 15: WaziHub bootcamp in Kampala

After teams were formed a basic introduction on IoT was given followed by a workshop on business modelling. Team were asked to generate ideas by defining project ideas by brainstorming and identifying problem and proposing a solution. Participants were taken through training on Waziup API tutorial and Waziup cloud platform. After the distribution of the hardware kit teams start testing them out with respect to their project ideas.

The bootcamp allowed the participants to start the prototyping of their solutions using their provided hardware kits and pitch their solutions to be awarded certificates.

3.1.9 Kampala, Uganda, June 2019

On June 15th 2019, an IoT hackathon with partnership with Andela was performed on site. In the second year, there was a blend of both onsite and online collaborative team training where the teams display progress of their MVPs and also share knowledge on some of the bugs and how to debug or work around.

The hackathon goals was to leverage knowledge on the utilisation of various IoT technologies to help solve the challenges of traffic, environmental pollution, parking, buildings, public safety, economic development, public health, collaborative infrastructure maintenance or any other aspect that involves the interconnection of devices over wireless networks e.g. Commerce/Economic developments, Public Safety challenge, Intelligent Building, Environment challenge and Traffic/Transportation challenge. This was done in order to spread knowledge in the Dev communities on how important IoT technology is inevitable to building smart ideas.

3.1.10 Kampala, Uganda, October 2019

The Hive Colab organized in October 2019 an IoT bootcamp that was 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”.

All the participants worked on the same project which utilizes the Waziup IoT kits accordingly. We divided the project into sub-tasks accordingly 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.

- Total number Applicants: 50
- Total number of participants: 26
- Number of ladies who participated: 3
- Total number of participants who completed: 17

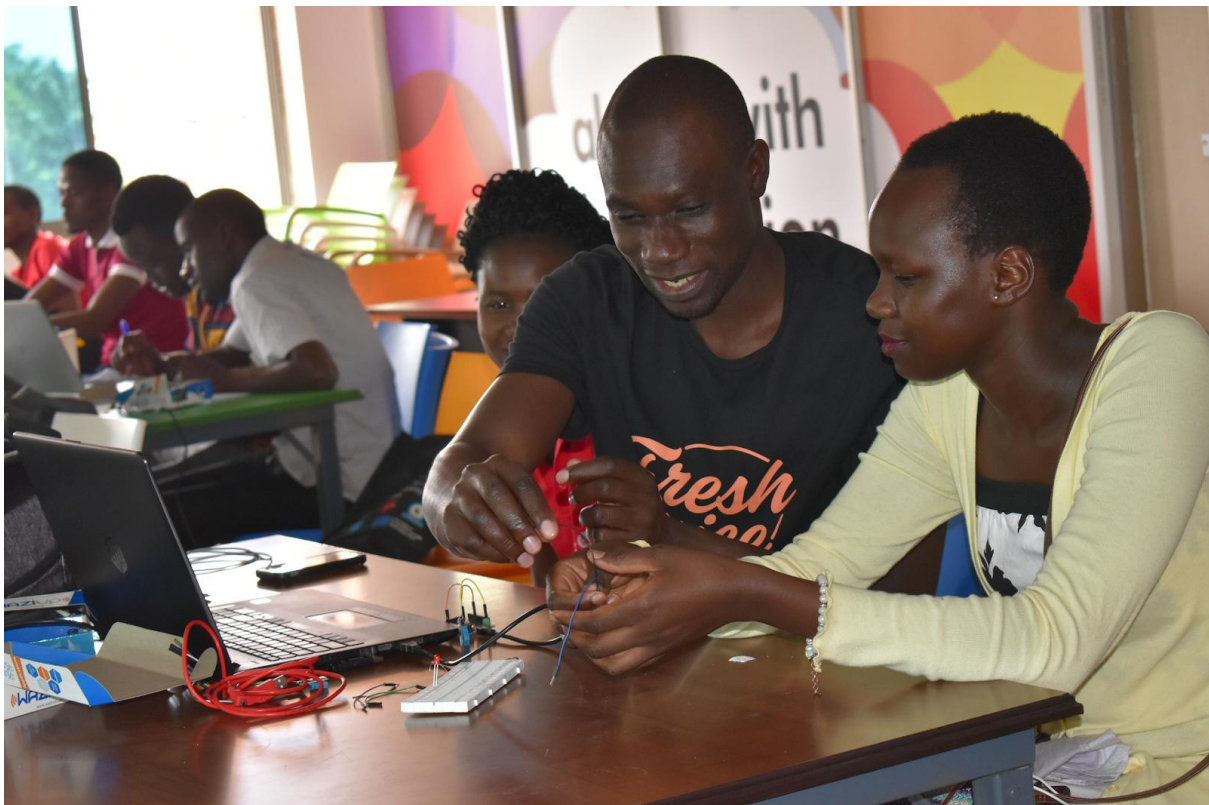


Figure 16: participants in the 2nd Ugandan bootcamp

3.1.11 Kampala, Uganda, December 2019

Hive Colab organized an IoT hackathon that was focused on the creation of startup teams. It was a business-oriented one-day hackathon where 7 teams battled it out for the top three prizes. This hackathon was a follow-up to the previous boot camp event which we termed as the IoT party where we trained 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.

It was recorded up to 54 participants where the majority of them were given priority over the rest. All the participants worked on their different ideas in groups of 3 or 4.

- Total number Applicants: 54
- Total number of participants: 30

- Total number of groups: 7
- Number of ladies who participated: 8
- Total number of participants who completed: 27



Figure 17: Group working on their projects



Figure 18: Group working on their projects

3.1.12 Kampala, Uganda, March 2020

In March 2020, Hive Colab held IoT accelerators²² from the applications received, the goal was to enable existing teams to iterate and develop their MVPs to focus more on market replication. The

²² <https://sites.google.com/view/wazihub-iot-prototyping-ug/home>

start-up teams have been able to streamline their business model, have recorded an improvement of the MVPs. Each team has an average number of 5 members.



Figure 19: Hive Colab capacity building session

3.1.13 Durban, South Africa, March 2019

The MakerSpace held an IoT introductory session on the 16 of March 2019 which catered for students, professionals and enthusiasts. The day was divided into 4 stages as follows:

- The stage 1 was an instructor led introduction and involved introducing the participants to Arduino basics and setting up the software and hardware. The participants were initiated to the Installation of Arduino IDE and how to connect and interface the board via Arduino IDE. Stage on ended with a hand on training on how to connect sensors an uploading and reading the sensor values.
- The stage 2 was a self-instructed discovery stage that allowed participants to explore and do projects on their own with the available sensors.
- The stage 3 focused on uploading sensor data to the internet and explored different ways to get sensor data online
- Stage 4 was a brainstorming and Ideation session to explore the potential of IoT in different verticals

3.1.14 Durban, South Africa, August 2019

The Makerspace Internet of Things (IoT) Bootcamp - that was held in the last week of August took participants from concept to prototype in 4 days (27th to 30th of August). The focus was on solutions to Smart City, AgriTech and Partner Solutions. WaziHub co-sponsored the event and the IoT technology hardware and cloud platform were powered by WaziHub, a European Commissioned project playing an influential role in the adoption of IoT in Africa.

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 mechatronic students from Mangosuthu University of Technology).

The MakerSpace is uniquely positioned to bring stakeholders together from all backgrounds and disciplines and can leverage our expertise alongside organizations to develop a new breed of social entrepreneurs that leads to positive disruption in Southern Africa, starting in Durban.

In the buildup to the Bootcamp time and effort were invested in identifying and exploring areas where IoT solutions could be deployed. This began with conversations and meetings with Durban Solid Waste (DSW) management around their green bins and other potential municipal areas of influence. We then spent time at LIV Village in Verulam exploring small agricultural applications and water treatment solutions.

We believe all these conversations are important in developing relationships with government and non-profit organizations and introducing areas for collaboration and we look forward to working together in the near future.

- Total number Applicants: 40
- Total number of participants: 32
- Total number of groups: 11
- Number of females who participated: 4
- Total number of participants who completed: 26



Figure 20: Group picture with participants on the 2nd WaziHub bootcamp in Durban

3.1.15 Kigali, Rwanda, September 2019

iLabs organized a WAZIHUB bootcamp in Kigali, Rwanda. The main objective for 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 involves IoT product creation, incubation and acceleration. The entire workshop took place in 5 days from Monday, 23rd to Friday, 27th September 2019.

The bootcamp itself was divided into three distinct stages. The first stage introduced participants to the basics of IoT, sensors, gateway and cloud architecture and use cases of IoT. There was an overview of the Waziup toolkit and materials. Participants proceeded to setup their laptops with the Waziup examples, libraries and all software materials ahead of the prototyping stage. This introductory stage spanned 1 day; Monday, 23rd September 2019.

The second stage was the design thinking stage that introduced participants to practical means of validating and refining their ideas by empathizing, defining, ideation, prototyping and testing. The design thinking stage spanned from Tuesday, 24th to Wednesday, 25th September 2019.

The prototyping stage was the last two days of the workshop. That is Thursday, 26th to Friday, 27th September 2019. During this period participants had a hand on practical session developing sensor nodes with the NanoLora board and a variety of sensors. They also learned about the Waziup GitHub repository and how to step by step setup a gateway for the first time and connect it to the internet by means of Wi-Fi, modem or RJ45 LAN. Using the Waziup cloud platform was the last activity as it was usually the central point of data in the IoT process.

- Total number of participants: 26
- Number of ladies who participated: 4
- Total number of groups: 6



Figure 21: picture of the 5 days bootcamp in Rwanda

3.1.16 Saint-Louis, Senegal, November 2019

The Smart Village (see D2.2) kickoff took place between 13 and 14 November 2019. It was an opportunity to bring together the different stakeholders in the initiative of the Smart Village, to identify around a table, the needs end users.

During the three years of the Waziup project, the UGB has been a leader in the implementation of use cases, first with the establishment of a testbed infrastructure, as a test base for MVP applications. The idea of the Smart Village is to put in place solutions adapted to the needs of the users of the area around the University Gaston Berger, by targeting the different activities of the area.

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:

- The developers & engineers' workshop - 11 participants.
- The end-user's workshop - 9 participants.
- The developers, engineers & end-users' workshop - 20 participants

All sessions went in a good spirit of interactions among participants. The design thinking methodology has been highly appreciated and 4 use cases have been designed.



Figure 22: Capacity building during the Smart Village launch

3.1.17 Dakar, Senegal, October 2018

For this 2018 hackathon there was 264 projects subscribed, and 15 projects was selected. Among these, there was 4 project IoT domain such as:

- Baay-Tech: A system to allows the farmer to optimize his production, by using sensors which allow to send information on the real time such as the temperature and the solar radiation.
- Smart Aquaponie: A combination of aquaculture and hydroponics, consisting of a plant food production that combines the classical system of freshwater aquaculture with the breeding of aquatic animals such as snails, fish, crayfish or shrimps in basins, with hydroponics (growing plants in water) in a symbiotic environment.
- Yaxanal: Impacting on the economic aspect with the reduction of electricity bills that allows heads of households to spend less, companies to have more income and the State of Senegal to achieve one of its objectives in the PES which is the reduction of the public invoice to the tune of 40% per year and the global bill to the height of 10 to 15%.
- Nay-baar: A solution of connected objects (IoT) to obtain a waiting layout ticket for a selected branch. It also makes it possible to make an appointment with a specific agent.

For these 48 hours coaching, IoT teams have received our contribution and support to build and make progress in their IoT solutions with: Cheikh Tidiane Diop, Babacar Diop and Medoune Sabaly as a coach and WaziHub member.

The 4th edition of the Hackathon Winners were known Sunday after 48 hours of competition. They were awarded for the originality and the relevance of their projects which they defended before a jury of experts of orange and its partners.

- 49 Participants
- 15 Selected Projects
- ?? Project Categories



Figure 23: Participants at Dakar Bootcamp



Figure 24: Winners at Dakar Bootcamp

3.1.18 Dakar, Senegal, November 2019

The Senegalese partner hub, SONATEL organized in November 2019 their 2nd 2 days Hackathon. The event was held at Orange Digital Center which is dedicated to digital training for young people, startup acceleration, and guidance for project owners. The 3 days event had received a lot of attention with 325 projects application received. Selected participants were given free hardware parts and training support to help them build a prototype before the end of the Hackathon.

- Total number Applicants: 325
- Total number of IoT projects: 5



Figure 25: Smart blind stick prototype

3.1.19 Summary

A total of 15 boot camps were organized during the period, with a total number of participants of 445 persons. The table below gives a summary of the bootcamps.

Table 1: Impact of WaziHub bootcamps in numbers

Bootcamp place	Date	Number of participants
Kumasi, Ghana	July 2018	30
Kumasi, Ghana	March 2019	25
Dar es Salaam, Tanzania	November 2018	35
Dar es Salaam, Tanzania	October 2019	20
Dar es Salaam, Tanzania	November 2019	25
Nairobi, Kenya	November 2018	29
Nairobi, Kenya	October 2019	17
Kampala, Uganda	December 2018	62
Kampala, Uganda	June 2019	25
Kampala, Uganda	October 2019	26
Kampala, Uganda	December 2019	30

Kampala, Uganda	March 2020	25
Durban, South Africa	March 2019	7
Durban, South Africa	August 2019	32
Kigali, Rwanda	September 2019	26
Saint Louis, Senegal	November 2019	20
Dakar, Senegal	October 2018	49
Dakar, Senegal	November 2019	57
Total number		540

3.2 Training sessions

Training sessions are short capacity building sessions, organised by the partner hubs themselves. The objective is to equip participants with skills that they need to efficiently utilize all the available Waziup technologies. The training sessions happened **frequently**, on average once a week. The skilled trainers come from the local communities.

Every partner hub was able to share their timelines and reports in which they would conduct their training sessions. These were coupled with trainer sessions from our various technical teams nominated below is a breakdown of sessions so far conducted by each partner hub. The training sessions are delivered on site in the different hubs and teams are supported to build their prototypes with the Waziup technology. When the need be, teams are taken individually by the trainers to give them the best support.

For the second annual and the last trimester of the first year, **@iLabAfrica** has been able to execute a number of training and prototyping sessions for the start-ups that are currently in the WaziHub program. The project lead shared a planner which includes from August to December 2019 they concentrated on having Business trainings, design thinking sessions and Bi weekly trainings that they will be holding for the teams, the design thinking and bi weekly meetings are still ongoing and this is no longer onsite but rather online due to the current global crisis caused by the COVID19. This crisis however has not deterred them with proceeding on executing the prototyping phase. This is also proceeding for this annual year 2020. The sessions also equip the start-ups with knowledge and expertise on how to read data from the sensors, clone the project repository that has the pre-written code on various sensors i.e., LED, Ultrasonic sensor, RFID, Push-button, Buzzer.

Kumasi Hive has so far had 15 prototyping sessions that have been conducted in the period of October 2019 to date. They are working with a number of start-ups that are trying to iterate and develop MVPs that they can scale into working market ready prototypes, in line with the plan, they have conducted according to the needs of the start-ups for as evaluated for M18-M24, product design incubation, mentoring and technical training, Business coaching as well as industrial visits. Kumasi Hive has also created Narratives for the online training material and social media training tools as well as 3D printing new parts for smart bins' open and closing mechanism.

Each of their start-up teams have about 4 developers working either onsite or through the online meeting training or coaching session. There are a total of 7 teams who are basically concentrating on the prototype development and iterations. We followed up with online demo presentations with the WaziHub core team.

DTBi has executed several prototyping sessions for the last trimester of the 1st year as well as into the project's second year term. They have managed to conduct a total of 10 mentorship and coaching sessions. The sessions have been conducted online and onsite and with the WaziHub core technical team. The start-ups have also been able to present online the MVPs and onsite during the plenary meeting that was done at DTBi in Dar Es Salaam recently between the 22nd February -25th February 2020. The WaziHub core technical team also assisted the start-ups to debug some of the errors they were facing with their code. The start-ups are continuing to come up with near market ready prototypes to scale to the growth hack phase.

Sonatel is training two main startups: "Africa Smart Citizen" (See Deliverable D3.14) and "Free Design Lab". They received 50 hours of mentoring with 15 mentors. In particular, they attended the WaziHub training sessions, and the Webinars led by the WaziHub speakers.

During the two innovation competitions, training sessions were also used for the local training of participants. In total, more than **200 training sessions** have been held in our 6 tech hubs during the last 16 months of the project.

3.3 Info sessions

Info sessions are usually held before bootcamps, in order to inform the participants about the bootcamps, the prerequisites and the expectations. They can also be general information sessions for increasing the public's knowledge about WAZIHUB.

For instance, **Hive Colab and WITU** held three joint WaziHub info sessions: on 01/02/2019, 06/04/2019 and 04/05/2019. This was done before each bootcamps. The goal was to ensure that the carefully selected teams/startups understand the rules of engagement for this phase and emphasize the need for all the teams to continue thinking through their journey of creating sustainable businesses out of their products.

@iLabAfrica performed Info sessions during the IST-Africa Conference 2019 and the Strathmore University Annual Conference 2019. Within the events, they conducted the WaziHub Information sessions to create awareness of the project and also onboard interested Participants in the project beneficiary catalogue. From the workshops on the conferences the following were achieved:

- Awareness on the WAZIHUB program, - training on the WAZIUP technology
- Brief training on the WAZIUP technology
- Exploration and brain storming of future possibilities for improvement of the program.

These enabled the partner hubs to select and come up with interested teams that have now been to the prototyping phase. The selection criteria are designed as per the guidelines.

The interested participants are then asked to submit their proposals. They can apply as individuals or as teams. Teams with a good mix of different professional abilities that are relevant to the project are encouraged. The @iLabAfrica team checks whether the project is qualified to join the prototyping phase at this stage through predefined metrics. The metrics used are:

- Problem statement. Does this solution solve a need?
- Proposed solution.
- Their applicability of IoT in the problem and solution proposed.
- Business model.

The ideas are filtered out and the most promising are selected to move to the next stage (Prototyping). Suggestions on the proposals are made by the @iLabAfrica team. The teams selected are expected to make the corrections before the project starts. Participants are then given devices to kick start their project. The iLab Africa team provided any technical assistance in regards to the startup projects.

At **Kumasi Hive**, participants were introduced to the Waziup IoT and Big Data Cloud Platform through a weekend Wazihack training workshop on the 23rd February 2019. The sole aim of this Wazihack workshop was to introduce participants to Waziup technologies, some use cases, available resources and its perks. Participants were taught to develop simple sensor nodes and deploy it on the Waziup platform. In short, this event was for participants to take the Waziup platform and its available resources for a test run to better understand how it works.

3.4 Webinars and Tutorials

Despite the COVID-19 situation, during the period M24-M40 the WaziHub project continued to perform trainings using alternatives methods. We organized many webinars, in particular for the two competitions (see D3.9 for details on the competitions). The webinars are a series of trainings ranging from Design Thinking up to technical aspects. For instance, the webinars showed the participants how to create their gateways for their innovation prototype, and how to integrate communication and messaging solutions. The Webinars had a registration system, and were free to attend.

The webinars were conducted by the WaziHub Technical Team. Most webinars were held in English, as most of the participants know the language quite well. Some webinars were also held in French. French were used to answer some questions from the participants, when necessary. They were all recorded and stored on YouTube for future references, if the beneficiaries would like to review any time and discover the content.

Below is a summary list showing the webinars that we performed, with a link and the date. A breakdown of the series of the webinars is done after a careful consideration of the relevant information and feedback from the participants and the partner hubs situated in the respective consortium African countries.

#StayHome&Learn: IoT Fundamentals (English Session) ²³

The series of webinars #StayHome&Learn were held in spring 2020 as a response to the COVID-19 outbreak. The webinar was animated by Prof. CongducPham. It covered all the principal fundamentals of IoT. The session was recorded live on the 13th April 2020 with English and French versions. YouTube recordings have a cumul of 141 views.

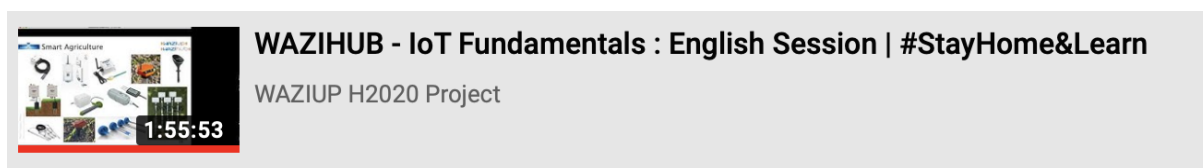


Figure 26: Webinar "#StayHome&Learn: IoT Fundamentals"

²³ <https://www.youtube.com/watch?v=k2thN9QzLs>

#StayHome&Learn: Principes de l'IoT (French session)²⁴

This is the French version of the previous webinar. It was held on the same day by Prof. Congduc Pham in French language.

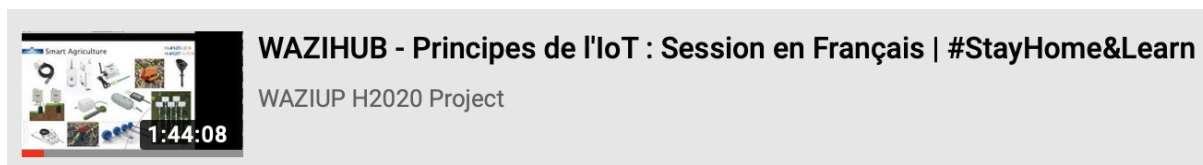


Figure 27: Webinar "#StayHome&Learn: Principes de l'IoT"

#StayHome&Learn: IoT Web Apps (English session)²⁵

This session from the #StayHome&Learn series showed how to create a full web application dedicated to IoT. It was held by Dr. Corentin Dupont on the 14th April 2020.

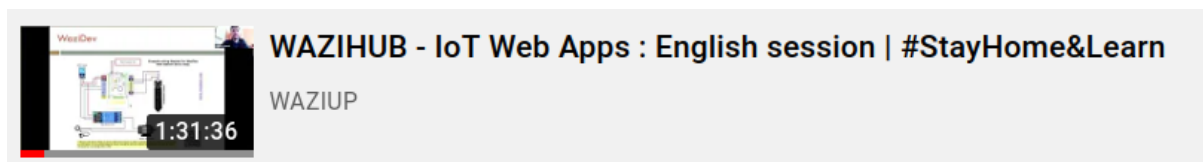


Figure 28: Webinar "#StayHome&Learn: IoT Web Apps"

#StayHome&Learn: IoT Web Apps (French session)²⁶

This is the French version of the previous webinar.

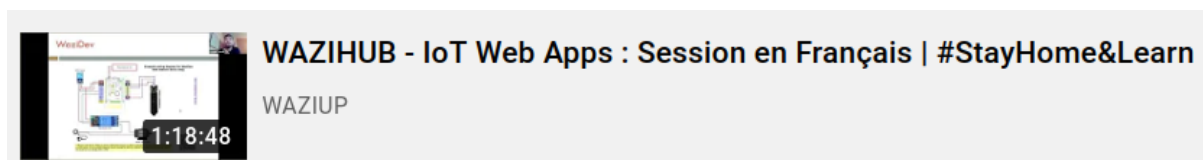


Figure 29: Webinar "#StayHome&Learn: IoT Web Apps"

Discover LoRaWAN with Waziup²⁷

Webinar hosted by Corentin Dupont, PhD on the topic "Discover LoRaWAN" with the enrolled teams on the second edition of the WaziHub Innovation Competition. It was recorded live on 9th March 2021. English version 167 views.

24 <https://www.youtube.com/watch?v=dYU2UBbkgw8>

25 <https://www.youtube.com/watch?v=6xyFPEnfCPI>

26 <https://www.youtube.com/watch?v=mcLqNlx dye8>

27 <https://youtu.be/oS2R7XHWvOk>

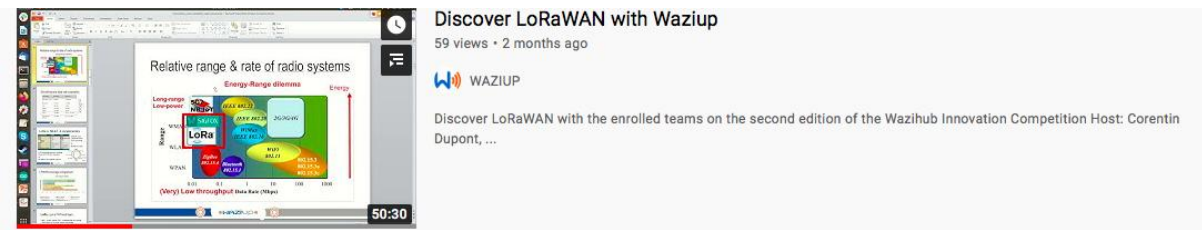


Figure 30: Webinar “Discover LoRaWAN with Waziup”

Web apps with Waziup²⁸

Webinar conducted on the 13th April, 2021 by Corentin Dupont, PhD entitled “Web apps with Waziup”. It showed the different technologies that the competitors can use to create their web app. The YouTube video had 68 Views.

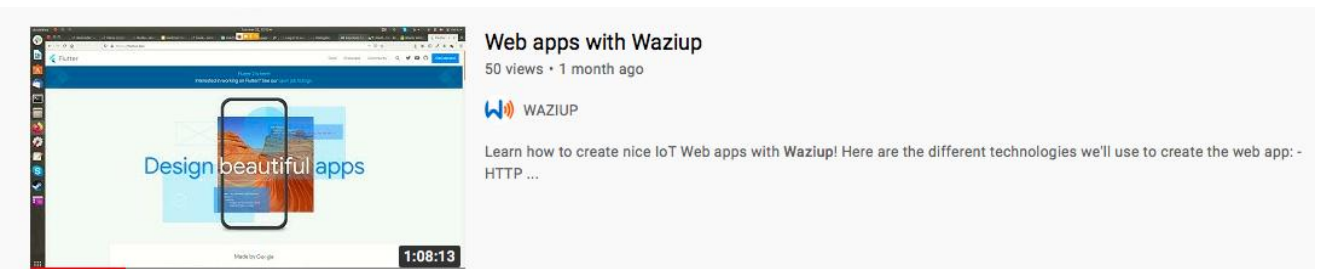


Figure 31: Webinar “Web apps with Waziup”

Waziup #1: How to setup WaziGate developer version on a raspberry PI²⁹

Webinar recorded live on the 23rd April 2021 by technical trainer Mojtaba Eskandari. WaziGate is an IoT LoRa Gateway, ideal for all your remote IoT applications. WaziGate is an affordable solution for developing countries' needs.



Figure 32: Webinar “How to setup WaziGate developer version on a raspberry PI”

Setting up a LoRa gateway in less than 5mins (live demo)³⁰

Webinar by Prof. Congduc Pham recorded live on the 25th July 2018 training on how build a low-cost LoRa gateway: 4,675 views

²⁸ <https://youtu.be/zcowuaNV7sM>

²⁹ <https://youtu.be/IWs4zOi89ms>

³⁰ <https://youtu.be/CJbUFxLpSok>



Figure 33: Webinar "Setting up a LoRa gateway in less than 5mins"

Webinar on How to develop a WaziApp with Python³¹

Live recording done by one of the technical trainers, Mojtaba Eskandari. This webinar is a hands-on development of an App for Wazigate edge platform. 81 views

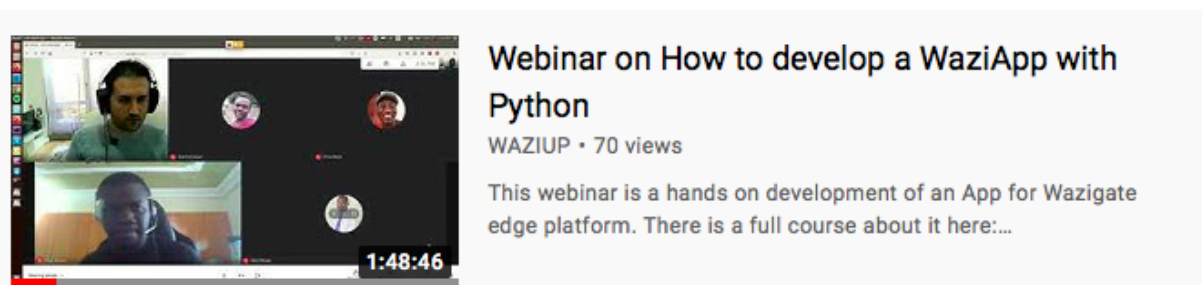


Figure 34: Webinar on how to develop a WaziApp with Python

AI and Machine Learning with Waziup³²

Webinar conducted by technical trainer; Prof Congduc Pham recorded on the 8th June 2021. The webinar will give an introduction about Artificial Intelligence and Machine Learning with Waziup. 81 views



Figure 35: Webinar on AI and Machine Learning with Waziup

Data visualization with Waziup³³

Webinar done by Corentin Dupont, recorded on 13th April 2021 train innovation competition participants on how to create nice data visualizations for your IoT App with Waziup. The video also will cover different technologies to create your visualizations. 46 views.

³¹ <https://youtu.be/9NPYI3BdKKE>

³² <https://youtu.be/z5TVLl2MWM>

³³ <https://youtu.be/9zEC-dU9trQ>



Figure 36: Webinar on Data visualization with Waziup

A Complete Guide to Setup WaziGate Edge Computing firmware/IoT Gateway on Raspberry pi³⁴

A Complete Guide to Setup WaziGate Edge Computing firmware/IoT Gateway on Raspberry PI. The tutorial explains a number of key sections to take note of when setting up the WaziGate. 399 views, Recorded on the 23rd June 2020.

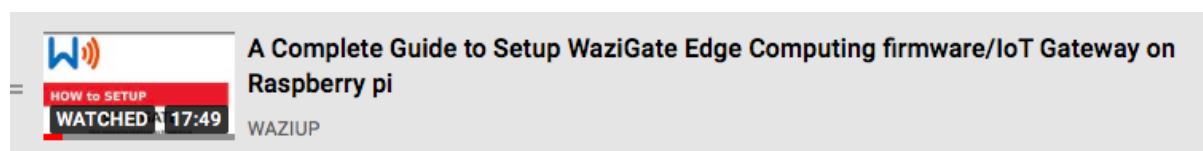


Figure 37: A Complete Guide to Setup WaziGate Edge Computing firmware/IoT Gateway on Raspberry pi

3.5 Training for partners

To ensure that the right training is done for each partner, surveys were carried out where we got to assess the needs of each participant and thereafter tailor training materials for each partner accordingly. Training is conducted both online and offline through materials and tutorials.

The trained individuals also are able to transfer their newly acquired knowledge to any new participants that will come onboard or individuals or other budding startups that would want to equip their communities with Waziup technology.

With the focus on experiential learning, all the partners trained ensure that they are able to apply any newly acquired knowledge into their existing projects. The partners trained should also be able to introduce action plans by the end of the training course or workshops.

³⁴ <https://youtu.be/DvGdmdsGZHA>

4 WAZIHUB EXTERNAL TECH HUBS

Tech Hubs are at the core of the WaziHub program. This is why, in addition to the project's six partner hubs, we also recruited external hubs to execute our program. We call those Hubs "WaziHub Nodes". A Node is a community of IoT enthusiasts who explore the applications of IoT and ultimately solve problems in the society with their solutions. The program will be an amalgamation of individuals and developers from the various hubs and/or individual developers across Africa. It is a group sharing ideas and networking with developers in local communities. The Nodes engages in various technical activities such as workshops, online classes and events. The Nodes provides start-ups and entrepreneurs with:

- **Accessibility of the technology:** Readily available materials on WAZIUP and other IoT technologies will be shared amongst members of a Node. The technology can be accessed via online courses, events, hackathons, training etc.
- **Capacity building:** Readily available resources and materials to support operations. End products from Nodes shall be showcased at events to existing IoT players. The ecosystem should be sustainable.
- **Professional growth:** Train individual on various technical and non-technical skill, with a view for new employment.
- **Support and training of Start-ups:** Provide technical and educational support to its members. Each member of a Node with a plausible idea or solution shall receive readily available technology (WAZIUP/FIWARE/IoTinaBox etc) kits for rapid prototyping.
- **Development of a sustainable Ecosystem:** Members engage in activities based on the technologies developed and learn to develop prototypes and solutions that are applicable and focused on the development of the African ecosystem.

There are no limitations to which countries outside the consortium qualify as external Nodes. The informative website³⁵ developed for the external nodes provides them with a 360-degree informative database and a contact form to the WAZIHUB technical team.

4.1 Nodes community

The WAZIHUB Nodes is an initiative that seeks to bring together IoT, Big Data and AI enthusiasts to create innovative and cutting-edge tech solutions to the issues that face the African continent and possibly beyond. The community establishes a safe space for members to meet up and share experiences and compare notes on ideas. The community is made up of Nodes groups and Trainers each working together to help develop the community. The Nodes are made up of various individual members who applied as an entity and have the capabilities of managing communities in their respective areas. Each Node is expected to:

- Have a technical background and knowledge on the technologies engaged in by the community.
- Have available space to run workshops, events or seminars.
- Organize events
- Legally registered as a startup/tech hub or other institutions.
- Must genuinely have an interest in leading a Node.

³⁵ <https://sites.google.com/cloudport.tech/tech-community/home>

The WAZIHUB tech community will support its Nodes with:

- Access to industry experts and researchers
- Free IoT dev kits for rapid prototyping
- Free training and IoT capacity building

With the limitations of physical meeting and access to holding workshops in the Annual year M24-36, we have enhanced the process to include online one on one training to the interested Members. The interested participants can request for the customisable training through the Web process after signing up as members. Membership forms are located online. The figure below shows the enhanced online membership process.

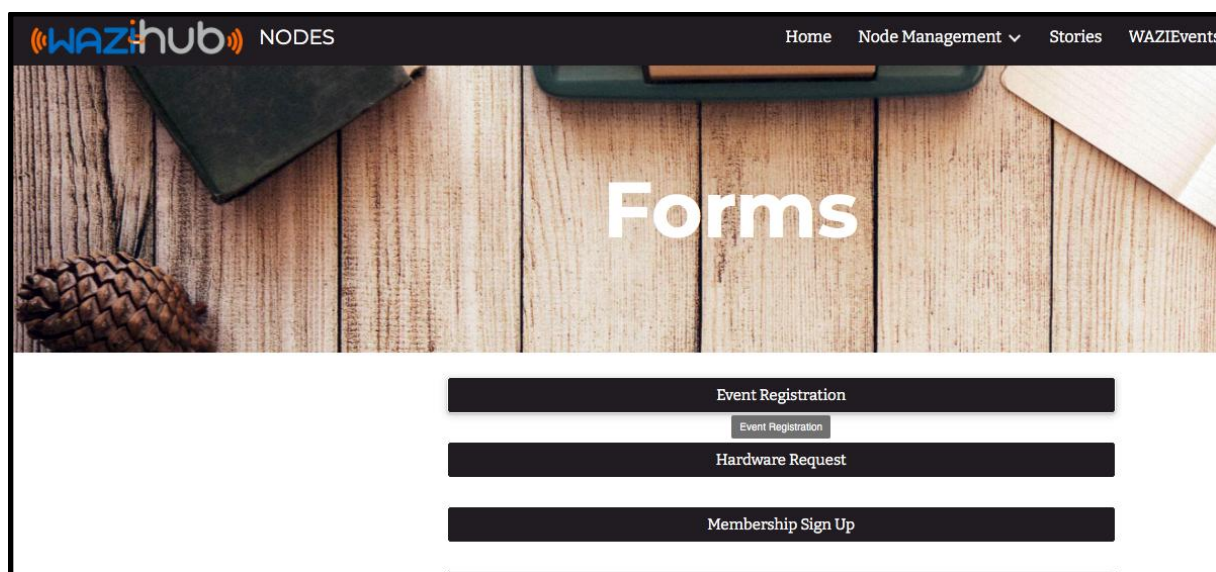


Figure 38: Enhanced online membership signup page

4.2 Selection and evaluation of the nodes

A rigorous process has been set up to select the applicant hubs. The call for application fell under two categories:

- **Call for Applications-Individuals:** This form will collect data on the applicant's personal profile such as name, email address, contact, country and gender. It also collects data on the applicant's expertise in the technologies of interest and their reasons for wanting to join the community.
- **Call for Applications- Entities:** This form collects data on the applicant's profile such as name, person of contact details, country, and legally registered number. It also collects data on the applicant's expertise in the technologies of interest, and issues of interest and their reasons for wanting to join the community.

Standardised selection and evaluation of the Nodes in the COVID19 situation: As much as there has been challenges with physical meetups, the standardised application template for the interested startups have been collected through the website. The WAZIHUB Tech community followed a number of criteria on which the applications have been be evaluated. Focus was on:

- The core business activities of the applicant.
- The management experience of the applicant.

- The key qualifications of the applicant to meet the objectives of the Tech community.
- The technological experience of the applicant to lead a Node.

A team of experts have been formed to assess the evaluation processes. The team used their technical and business expertise to help select which applicants can start and lead a Node. Once the call for application has been evaluated, notifications were sent out to the applicants on the status of their applications.

4.3 Nodes website

The Nodes website serves as a database for all resources and news relating to the WAZIHUB Tech Community. Members are free to use all the resources available here to help shape their respective Nodes. The type of information held here include how to access:

- Community Guidelines
- Forms Templates
- Media Pack etc.
- Events
- FAQs and
- Nodes stories

Figure 39 to Figure 44 gives screenshots of the current WAZIHUB Nodes website.

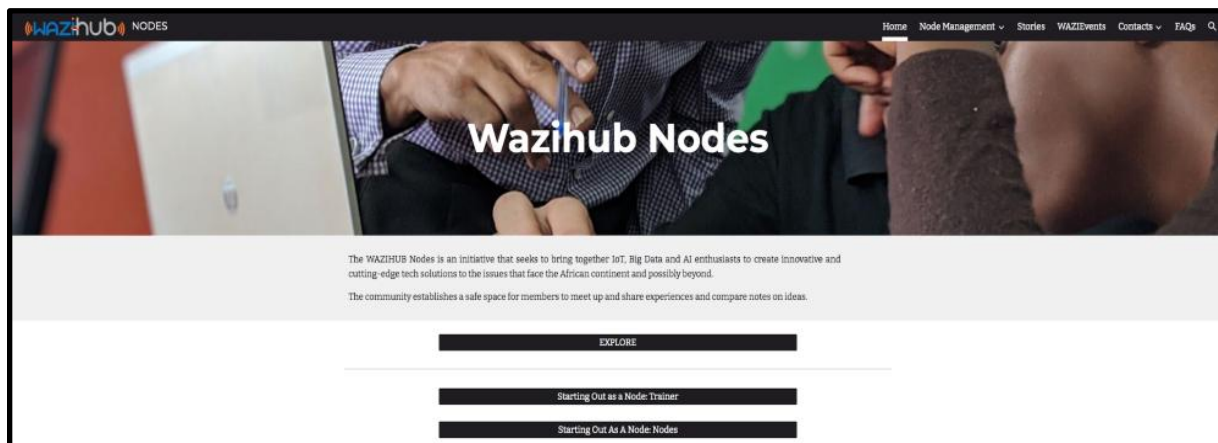


Figure 39: Tech community home page

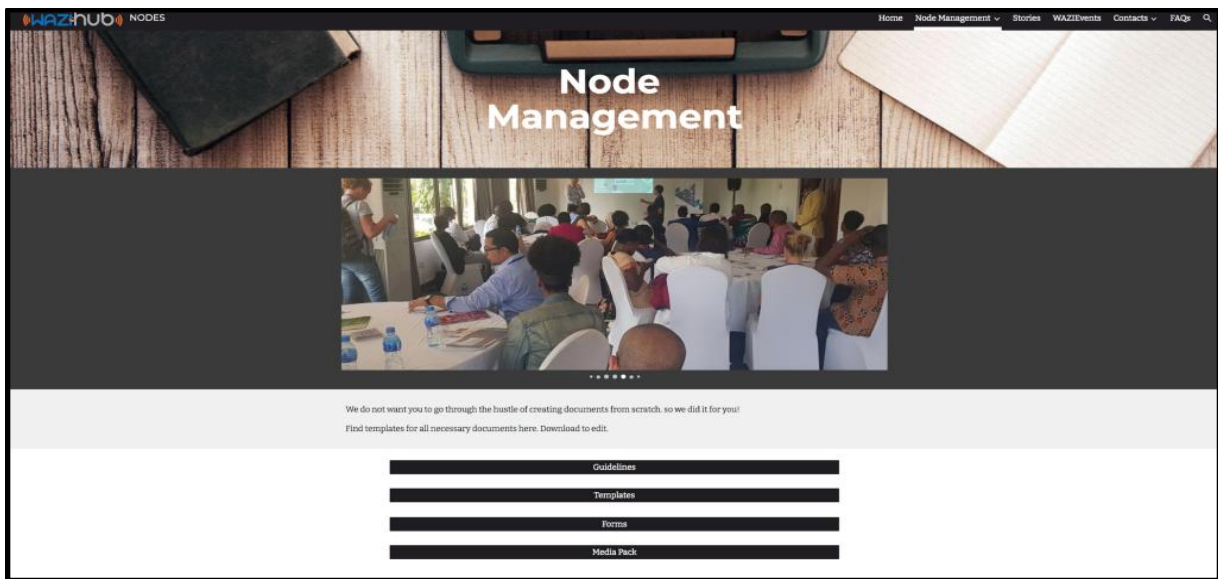


Figure 40: Nodes management page

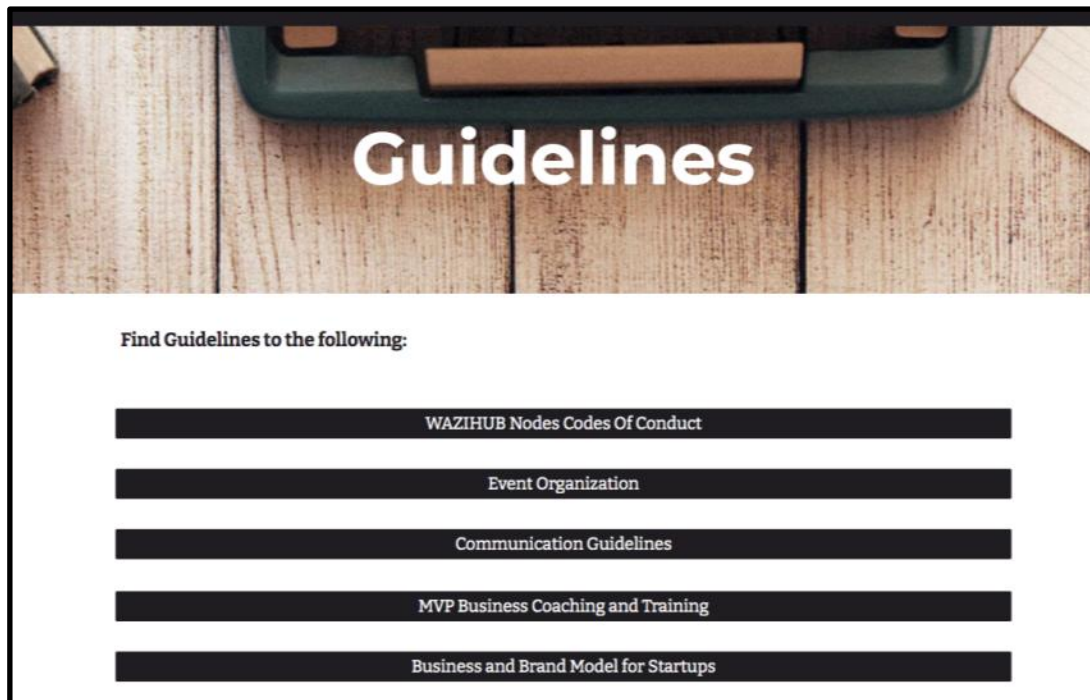


Figure 41: Guidelines Page

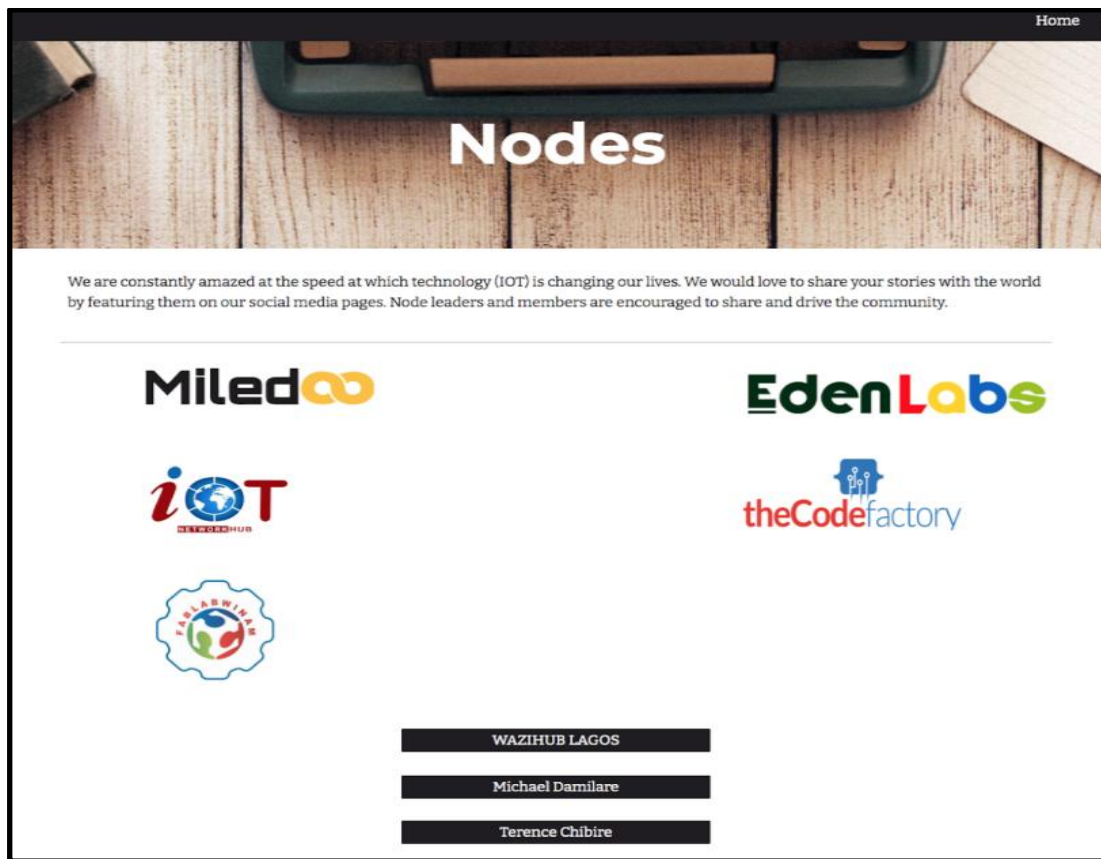


Figure 42: Nodes Page



Who we are:

Emmanuel Odunlade, Hardware design Engineer, IoT Architect and Entrepreneur. Emmanuel is an IoT Consultant at Hinge Systems; an engineering firm focused on the design of custom IoT Solutions around Energy/Utility management, remote sensing, and Industrial IoT. Before Hinge systems, Emmanuel Cofounded Dev's District Nigeria, and led the engineering team, overseeing the design and development of several solutions ranging from IoT based smart devices to military grade hardware. He was also at the heart of the engineering team at several organizations including VNTS and Frontdoors alongside consultancy roles at ABE Engineering (IIoT), Stackonly and Instatrolley.



Emmanuel Odunlade

As an entrepreneur, Emmanuel is interested in the development of solutions that leverage on IOT to solve problems that are peculiar to developing countries and has worked on several game changing projects, receiving diverse awards like the Access banks prize for innovation in 2016, and made it to the top 100 innovators in Africa List at IPA 2017.

Our available space :

The Space at Dev's District Nigeria which can sit between 60-80 people will be used for most of the programs.

What we expect to achieve:

During the program year, I hope to host 4 bootcamps in strategic locations across the country and facilitate the emergence of at least 10 Scalable, high impact IoT startups via the bootcamps. Through some of my existing relationship as the Chair of the Hardware Nigeria Community, and new ones that will be acquired during the course of my work as the Node, I hope to facilitate opportunities to help the startups test and run pilots for their solutions.

An avid speaker, Emmanuel has been oppurtuned to speak at conferences including the LiveWorx'17 in Boston where he spoke on "Brownfield IoT development", the African Space Generation Workshop 2017, where he spoke about "Solving Afrocentric Problems using space technologies and IoT", and IoTFA 2018 in South Africa where he spoke on "Selecting the Right Platform for your IoT Solution".

I will also be facilitating the establishment and growth of the WAZIHUB community in strategic universities across the country, providing trainings among others, such that, by the end of the program year, the community would have grown to atleast a 100 members.

Emmanuel is passionate about knowledge sharing and the growth of the Maker Culture in Africa and is spare time is spent around this, via writing and advocacy for the growth of the Maker/DIY Culture in Africa.

Figure 43: Node profile Page

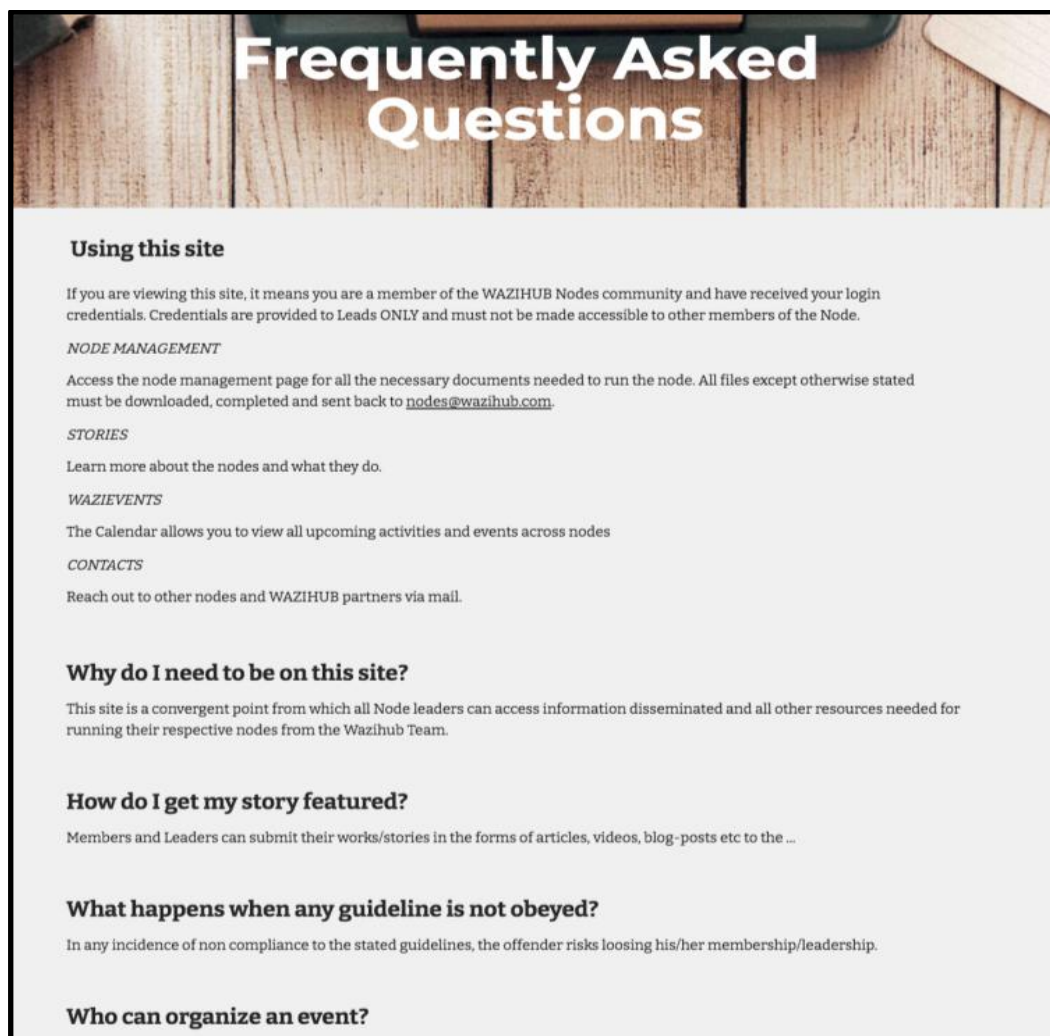


Figure 44: FAQs Page

4.4 Node Activities

Two Nodes were recruited during this activity: CodeFactory and SoteHub. This section gives some of the activities held by them.

4.4.1 CodeFactory

As part of the WaziHub Nodes community, CodeFactory organized a WaziHub workshop. It took place during 5 days from Monday, 23rd to Friday, 27th September 2019. The main objective for this workshop was to introduce participants to embedded systems with regards to prototyping and development of sustainable and efficient solutions using Waziup technologies. This workshop was also to pave way for the second and third phases of training which involves IoT product creation, incubation and acceleration. The workshop itself was divided into three distinct stages. The first stage introduced participants to the basics of IoT, sensors, gateway and cloud architecture and use cases of IoT. There was an overview of the Waziup toolkit and materials. Participants proceeded to set up their laptops with the Waziup examples, libraries and all software materials ahead of the prototyping stage. The introductory stage spanned 1 day, which is Monday, 23rd September 2019.

The second stage was the design thinking stage that introduced participants to practical means of validating and refining their ideas by empathizing, defining, ideation, prototyping and testing. The design thinking stage spanned from Tuesday, 24th to Wednesday, 25th September 2019. The prototyping stage was the last two days of the workshop. That is Thursday, 26th to Friday, 27th September 2019. During this period participants had a hand on practical session developing sensor nodes with the NanoLora board and a variety of sensors. They also learned about the Waziup GitHub repository and how to step by step setup a gateway for the first time and connect it to the internet by means of Wi-Fi, modem or RJ45 LAN. Using the Waziup cloud platform was the last activity as it was usually the central point of data in the IoT process.



Figure 45: Node Community workshop with CodeFactory, Rwanda

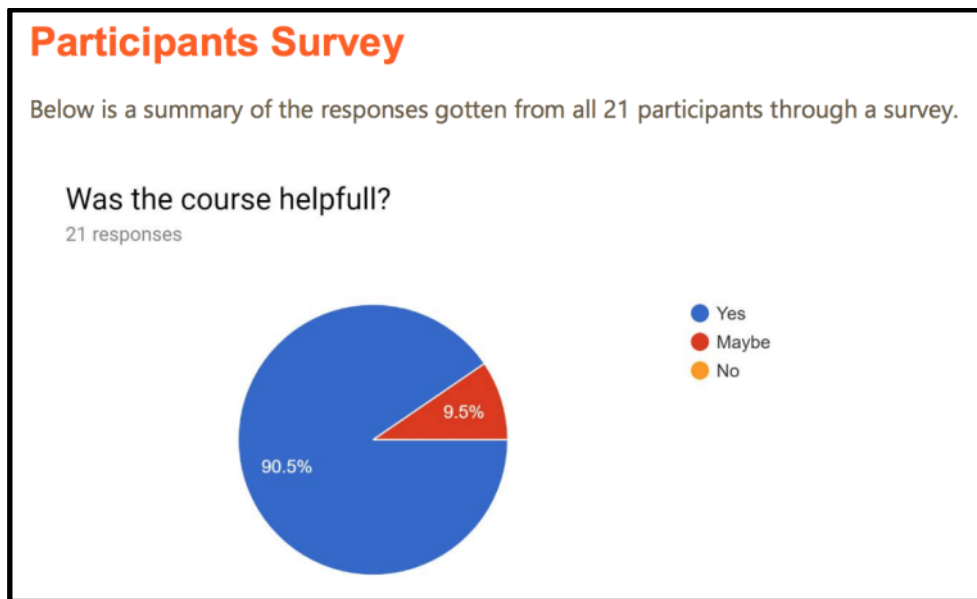


Figure 46: Participant feedback



Figure 47: Images from the workshop

4.4.2 Sotehub

As part of the Nodes community, SoteHub organized a WaziHub bootcamp. The primary intent of this boot camp was:

- To introduce the IoT ecosystem and discuss emerging trends in cloud computing aligned IoT.
- To enable participants to jumpstart their IoT ideas
- To introduce interested participants to the WaziHub Accelerator program.

The goal was to help interested participants build their prototypes using Waziup IoT infrastructure. Each Participating team was allowed to present their solutions which were judged and the top 4 teams moved forward.



Figure 48: Node Community session at Sotehub

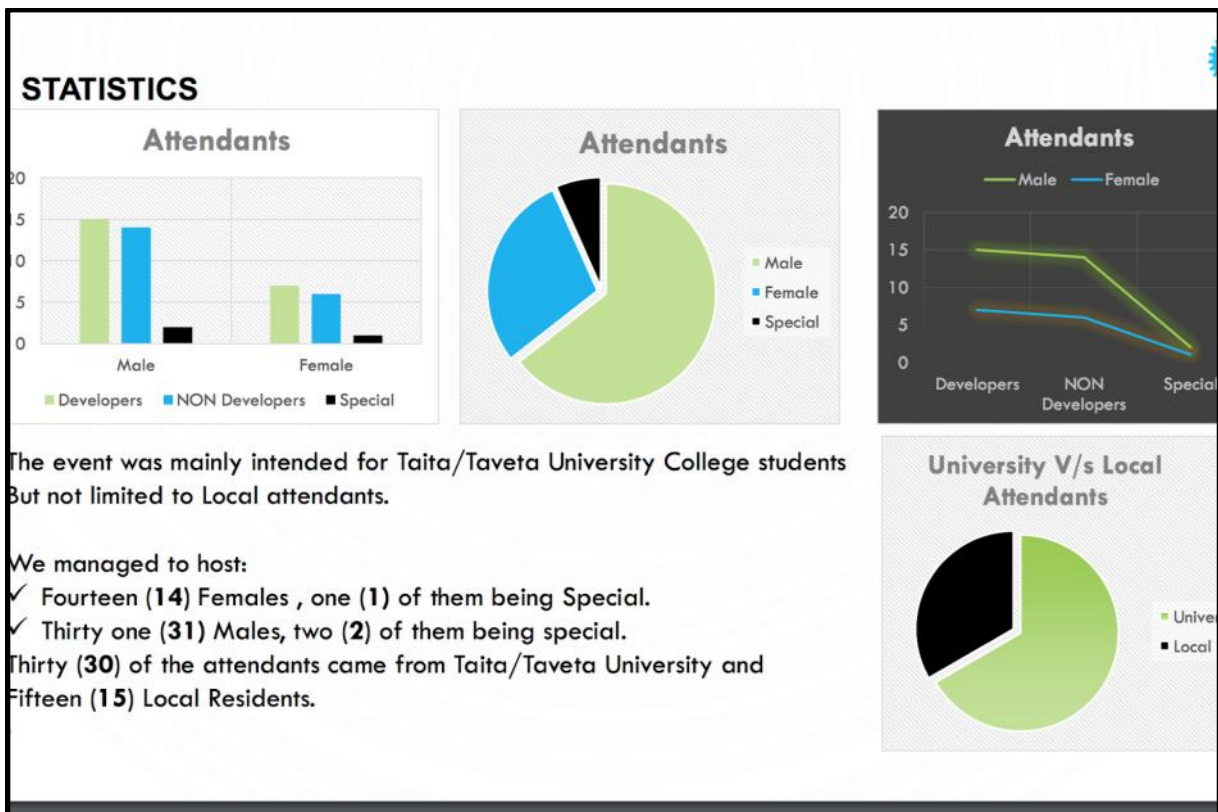


Figure 49: Statistics of participants



Figure 50: Images from event

5 CONCLUSION

As part of bridging the gap between Africa's problems and its solutions, the WAZIUP platform has been made available through WAZIHUB and as such it is left to the various components of the ecosystem to play their roles and bring to realization the objectives of the organization. Each actor is greatly encouraged to help sustain the system by offering all the resources needed to enable its smooth operation.

PROJECT COORDINATOR CONTACT

Dr. Abdur Rahim

FBK CREATE-NET

Via alla Cascata 56/D

Povo- 38123 Trento, Italy

Tel : (+39) 0461 408400

Fax : (+39) 0461421157

Email : arahim@fbk.eu

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