Bongani Ricky Masuku

workshop script HDSA2021

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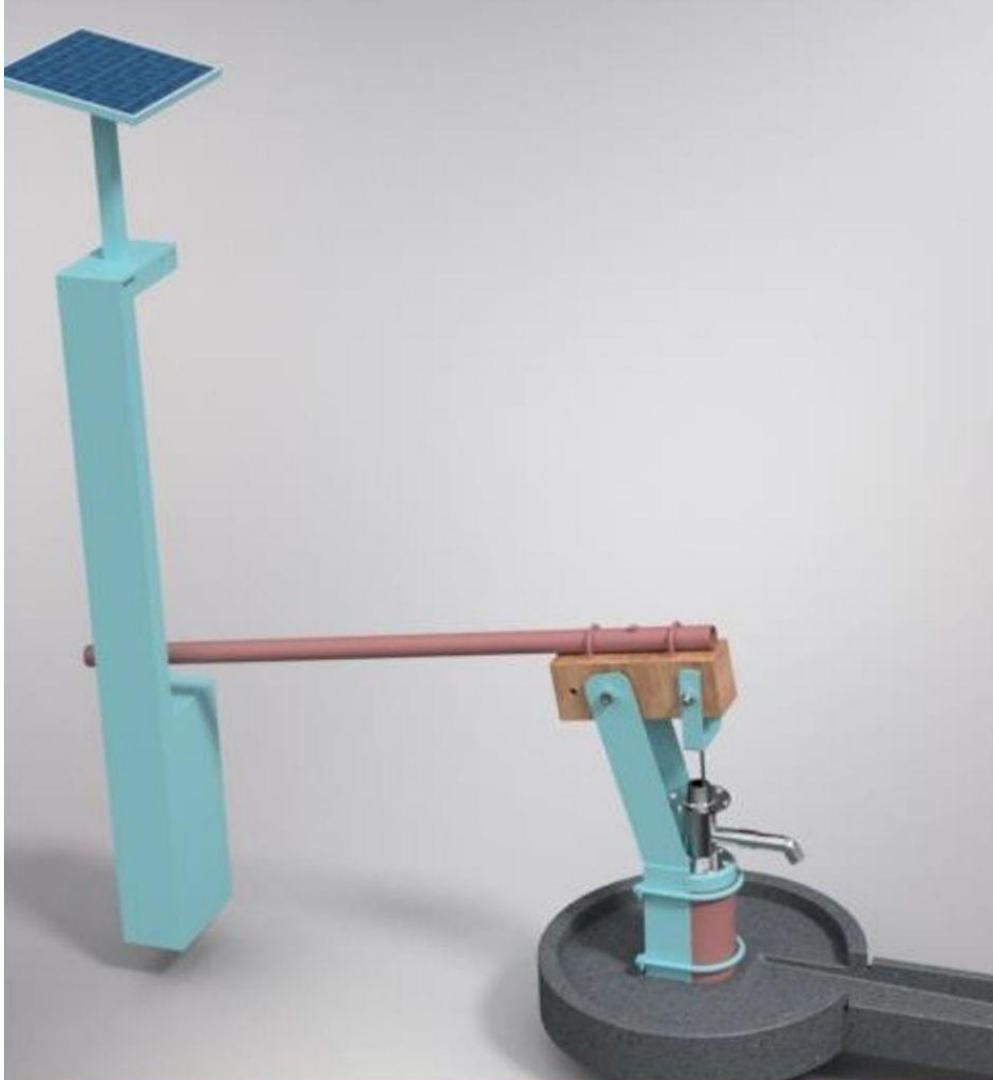
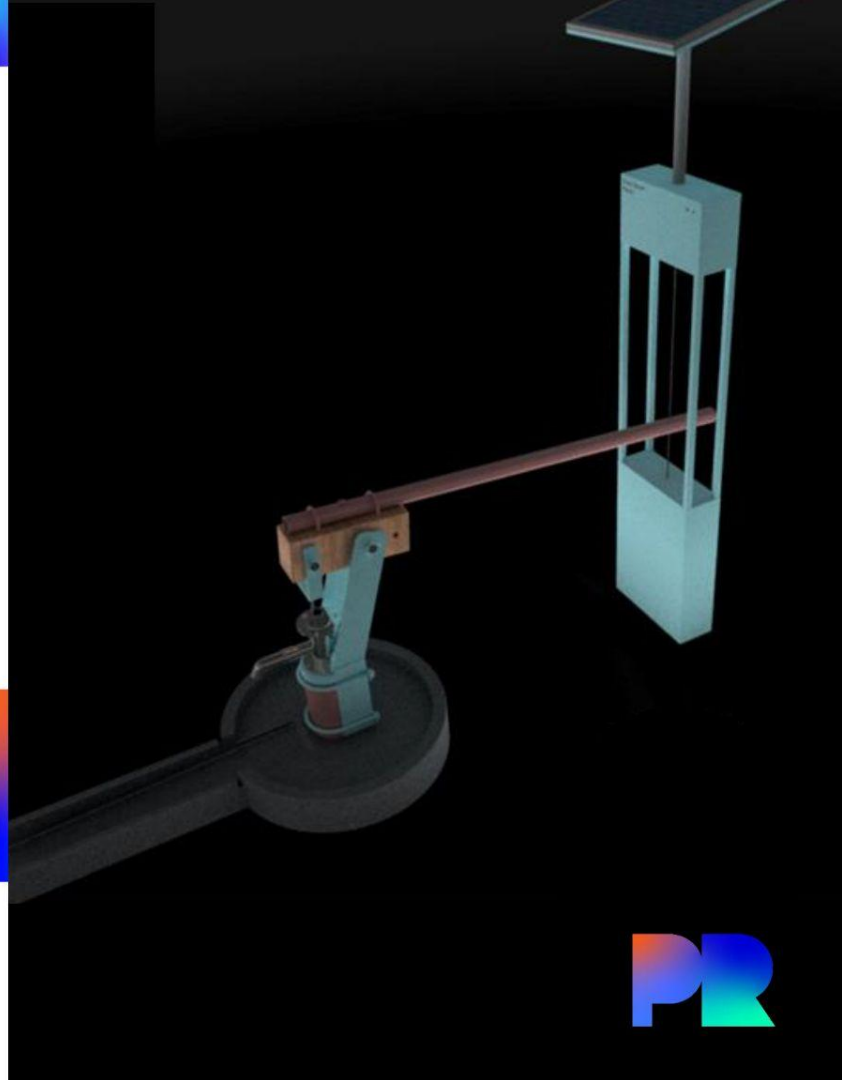


Project **Roko** is a startup that is geared towards alleviating the **global water crisis** through developing **water technologies** while leveraging **deep learning** in water data.

ProjectRoko

#SDGg6



About Author

Bongani Ricky Masuku is an industrial designer , passionate about disrupting the agriculture industry for the better. One of the challenges he noticed was the water crisis in both rural and urban areas. To help solve the problem he developed Roko, a solar powered mechanism that automates the required hand powered action for the conventional water pumps in Zimbabwe. As part of this year's H&D Summer Academy edition, he's compiled this workshop proposal in order to foster collaborative efforts in solving the water crisis through working with H&D chapters in other countries. During the workshop event the Roko demo unit will serve as the base technology for participants to explore different ways on how we can solve the water challenge through both virtual & practical sessions.

Our Journey

Every human being deserves access to clean , safe water. However due to the effects of climate change, fresh water sources across the globe are running dry at a very alarming rate. Project Roko is an open source initiative that seeks to address the global water crisis, through collaborative and hands-on activities, building sustainable water solutions.

– RICK BONGANI MASUKU, LEAD DESIGNER

Our Challenges

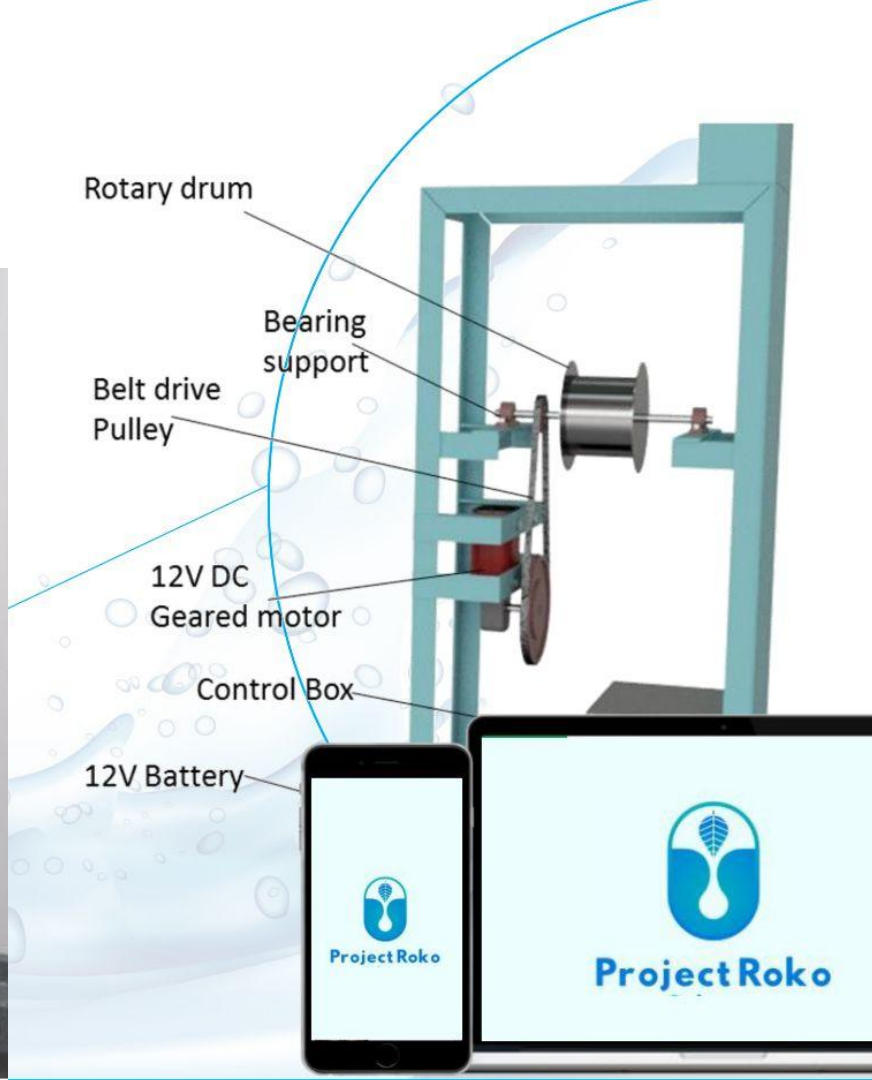
- 50% of the total residents in Harare,Zimbabwe go for months without access to water.
- Harare Municipality has no capacity to meet water requirements of the ever-growing population
- Lack of access of water is causing water sanitation challenges for urban communities with no access to water

No Aquifer Data

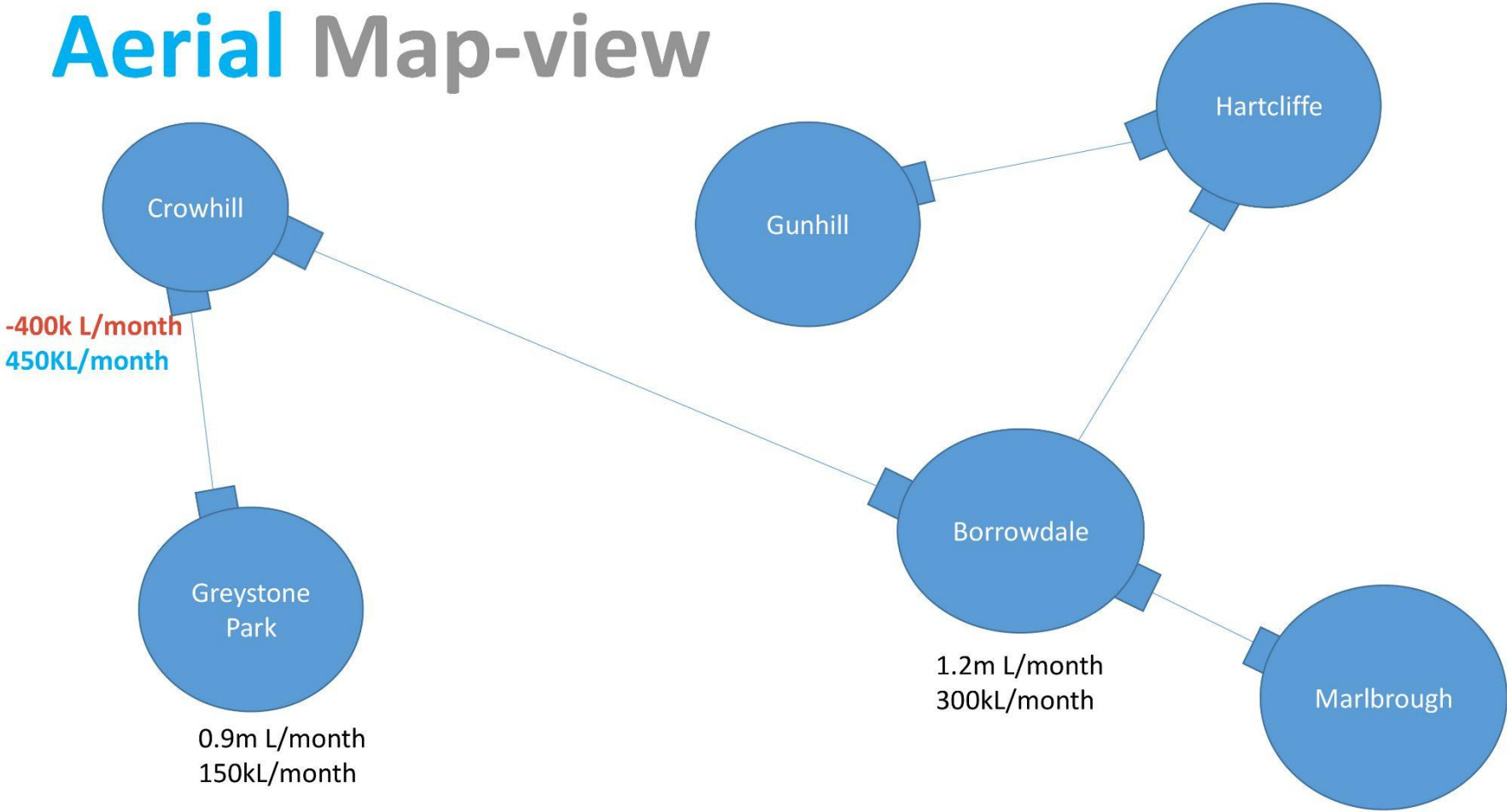
Undetected leakage

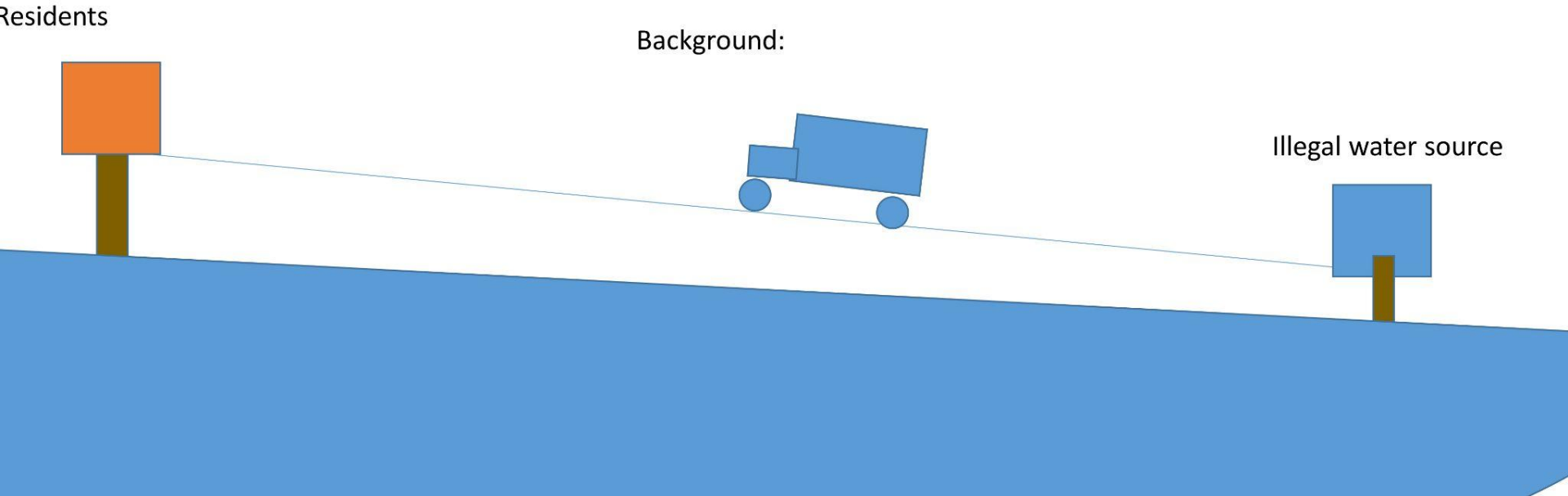
Lack of end-user awareness

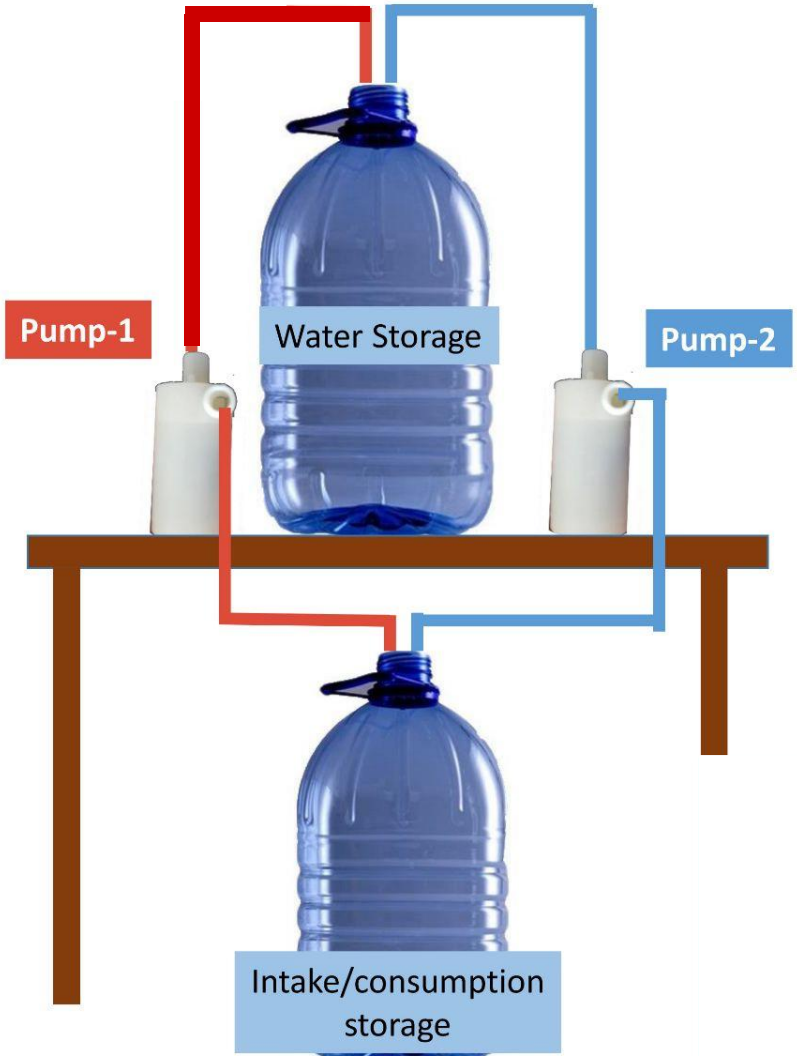
ProjectRoko



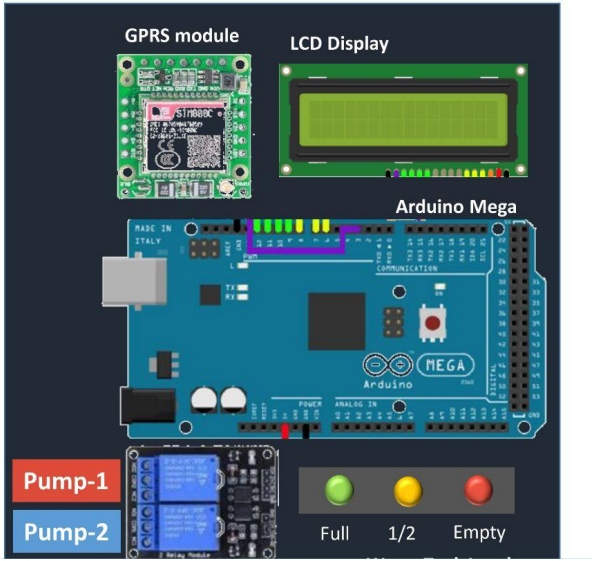
Aerial Map-view




Residents
Background:
Illegal water source



How Roko Works ?

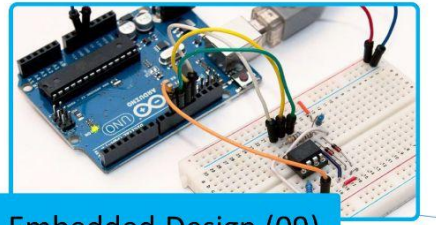


A smart water system keeps track of the water supply and usage in different locations and can distribute water accordingly to make sure water is available on-demand to the different communities.

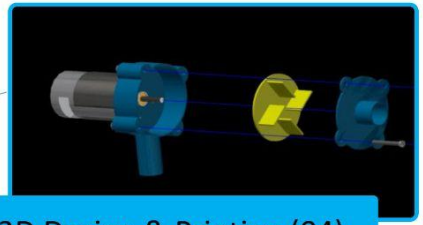
Activity Categories

Metal Art Work(03)

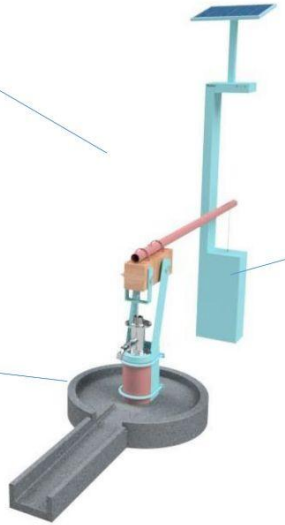
Mobile & Web Dev (02)



Embedded Design (09)



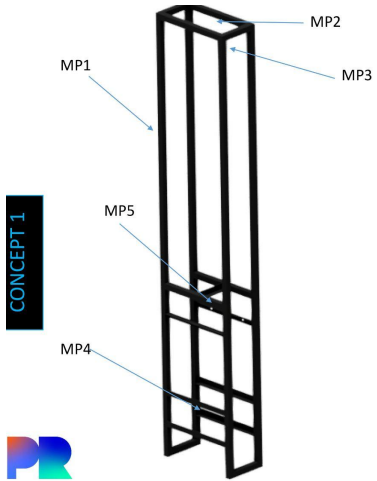
3D Design & Printing (04)



The ambition for project Roko

To build an open-source modular system for water management, based on use cases developed with local farmers and communities.

Desired sub-project include:



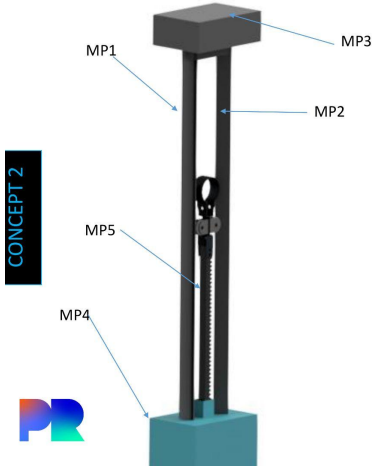
Framework fabrication

Required Tooling

	Tooling	Min Qnty
1	Metal Arc Welding Machine	1
2	Hand-held cutting machine	1
3	Hand-held drilling machine	1
4	Drill-bit 8 mm	1

Bill Of Materials

Items Required	Qnty
Angle iron 25 x 25 x 3mm	18 meters
Flat bar 25mm x 2 mm	6 meters
Square tube 25 x 25 mm	6 meters
Bearing support 20 mm	4 units
Round solid bar 20 mm	3 meters
Cutting disc	1
Welding rods	0.5 kg



Framework fabrication

Required Tooling

	Tooling	Min Qnty
1	Metal Arc Welding Machine	1
2	Hand-held cutting machine	1
3	Hand-held drilling machine	1
4	Drill-bit 8 mm	1

Guidelines

Smart Water Meter

Required Tooling

	Tooling	Min Qnty
1	3D printer	1

Bill Of Materials

	Items Required	Qnty
	20 mm solenoid valve	1
	20 mmm water flow rate sensor	1
	LCD 16 x 2	1
	Wireless Antenna GPRS	1
	Sim800 module	1
	Arduino Uno	1
	ABS 3d printing material	1 kg

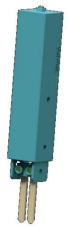
DC Water Pump

Required Tooling

	Tooling	Min Qnty
1	3D printer	1

Bill Of Materials

	Items Required	Qnty
	5V DC motor	1
	Veranda bolts 15 mm x 3mm + nuts	4
	ABS plastic material for 3d printing	0.3 kg



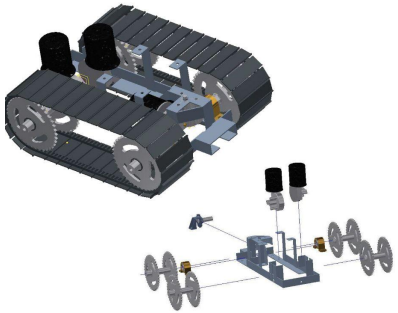
Portable Soil moisture Detector

Required Tooling

	Tooling	Min Qnty
1	3D printer	1

Bill Of Materials

	Items Required	Qnty
	Soil moisture sensor probes	1
	Arduino uno	1
	LED lights	3



Water Mobility: AGV Water Tanker

Required Tooling

	Tooling	Min Qnty
1	Metal Arc Welding Machine	1
2	Hand-held cutting machine	1
3	Hand-held drilling machine	1
4	Drill-bit 8 mm	1

Bill Of Materials

	Items Required	Qnty
	12V Geared motor	2
	Bearing supports (8 mm)	4
	Sprockets 170 mm	8
	Chain drive	4 meters
	For metal we use off-cuts from the demo unit	

Robotic Soil Moisture Detector

Required Tooling

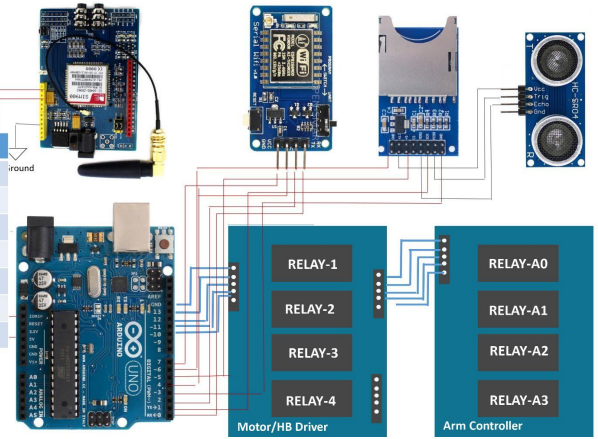
	Tooling	Min Qnty
1	3D printer	1

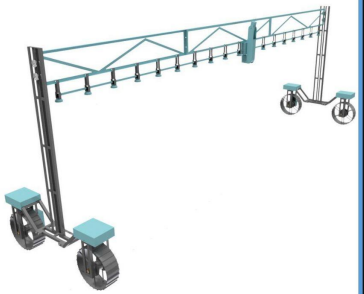
Bill Of Materials

	Items Required	Qnty
	5V DC geared motor	4
	5V linear actuator (30 mm stroke)	1
	Veranda bolts 40 mm x 3mm + nuts	4
	ABS plastic material for 3d printing	0.3 kg
	Soil moisture sensor	1
	Mini solar panel 10 cm x 10 cm min	1

Robotic Soil Moisture Sensor PCB Layout

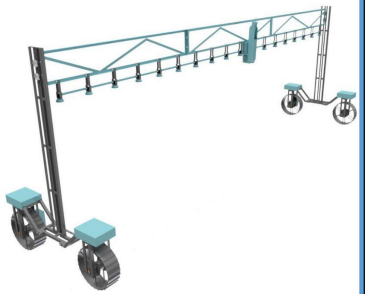
Items to Buy	Qnty
4 channel relay module	2
Sim900 module	1
Wifi module	1
Sd card module	1
Ultra-sonic sensor module	1
Arduino uno	1





Precision Irrigation

	Items to Buy	Qnty
	4 channel relay module	2
	Sim900 module	1
	Wifi module	1
	Sd card module	1
	Ultra-sonic sensor module	1
	Arduino uno	1
	12V Geared motor	4



Precision Irrigation

Required Tooling

	Tooling	Min Qnty
1	Metal Arc Welding Machine	1
2	Hand-held cutting machine	1
3	Hand-held drilling machine	1
4	Drill-bit 8 mm	1

Bill Of Materials

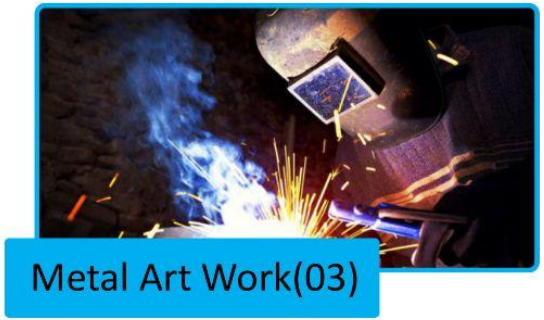
	Items to buy	Qnty
1	Angle iron 25 x 25 x 2 mm	36m
2	Square tube 25 x 25 x 3mm	18 m
3	Flat bar 25 x 3mm	6 m
4	Galvanized sheets 0.6 mm	1 sheet
5	Gate wheels (Grooved) 60 mm	4
6	Bearing supports 20mm	8
7	Round solid tube 20 mm	2m

Universal Workshop

HDSA activity program and workshop script

Universal Workshop - Harare Chapter

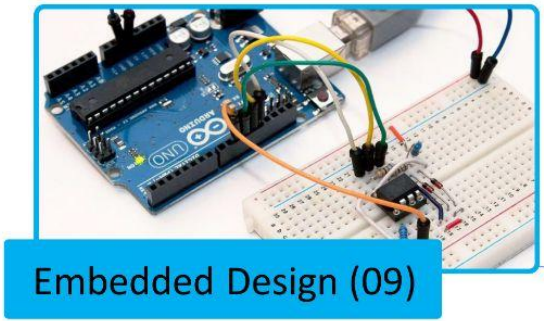
The Harare chapter will work on the hardware building (metal welding etc)



Universal Workshop - Harare Chapter

The Harare chapter will work on the hardware building (metal welding etc)

Universal Workshop - Remote Chapters



Contribute to project by developing one or more of the subsystems needed to realize the Roko product chain.

Make groups on your location, and **choose** one or more subsystems to develop based on skills level, interest, and materials available to you. You can replace parts with other parts where necessary.

Document your prototypes (hardware set-up, code, resources used) and share them for future development. Please **share on the Zulip channel**

Universal Workshop

List of activities for remote chapters

Activity 0: Build a water storage simulator

Activity 1: Fetching underground water using a simple button

Activity 2: Mitigating water usage using soil moisture sensor

Activity 3: Monitoring water usage using an LCD monitor

Activity 4: Securing the community borehole using an alarm system

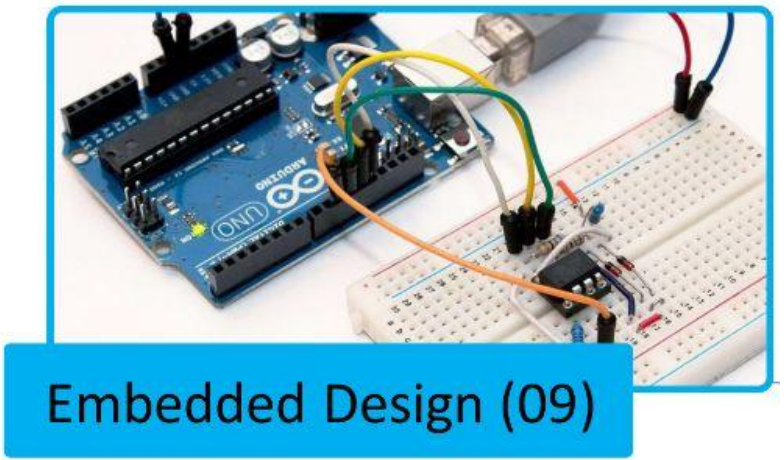
Activity 5: Fetching water using a real-time clock module

Activity 6: Building a smart water tap using an ultrasonic sensor

Activity 7: Combine all the systems and connect to reservoir

Activity 8: Build IoT app for controlling devices

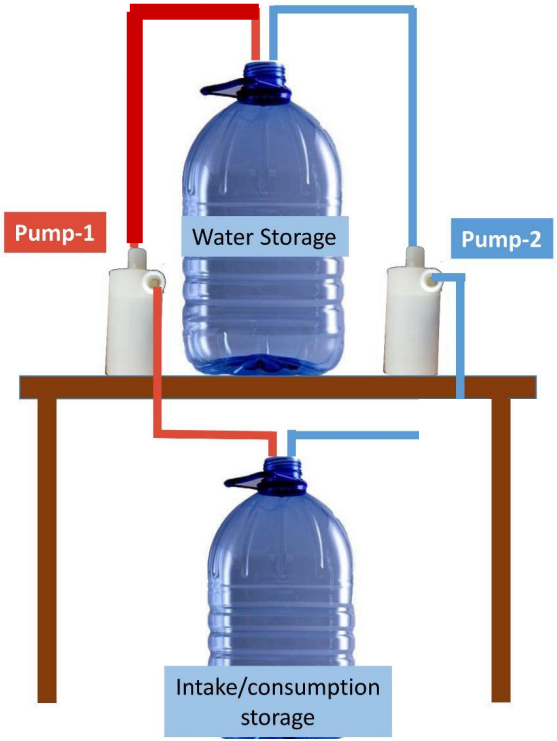
Activity 9: Build a robotic soil moisture detector

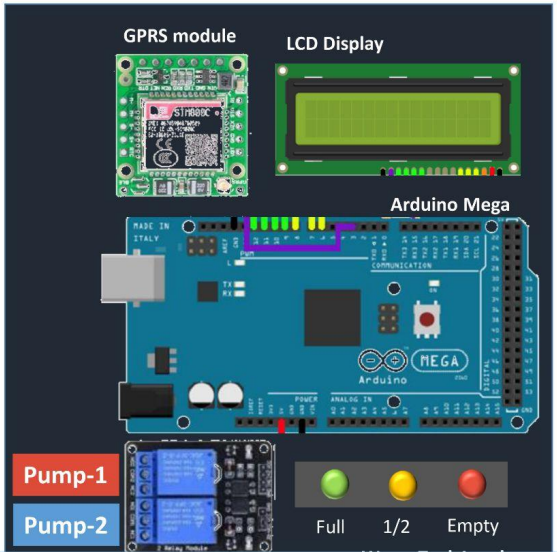


Activity 0: Build a water storage simulator

Level: intermediate

Resources: https://ethercalc.hackersanddesigners.nl/i9dygn59a5xq

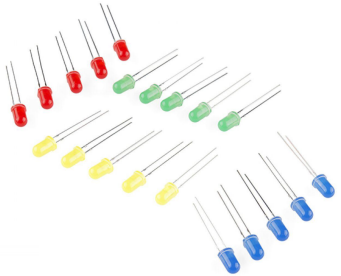




Activity 1: Fetching underground water using a simple button

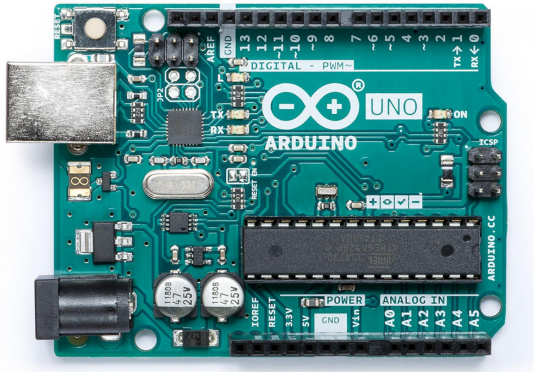
Level: beginner

Resources: https://ethercalc.hackersanddesigners.nl/i9dygn59a5xq



Workshop Materials

	Components	Quantity
1	Arduino Uno	1
2	Arduino Male to Male Connectors	10
3	10cm x 10 cm PCB breadboard	1
4	LED 6mm (9 mm optional)	2



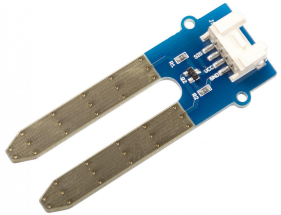
Pre-requisite Softwares

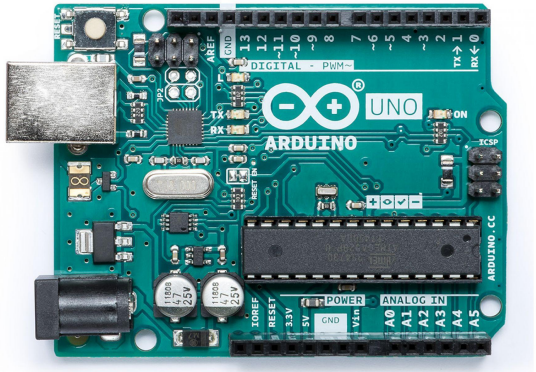
	Software Tools	License type
	Arduino IDE	Open
	Fritzing Vrtual Prototyping Bench (Optional)	Open

Activity 2: Mitigating water usage using soil moisture sensor

Level: beginner

Resources: https://ethercalc.hackersanddesigners.nl/i9dygn59a5xq





Workshop Materials

	Components	Quantity
1	Arduino Uno	1
	Soil Moisture Sensor	1
2	Arduino Male to Male Connectors	10
3	10cm x 10 cm PCB breadboard	1
4	LED 6mm (9 mm optional) 1x red ; 1 x Green	2

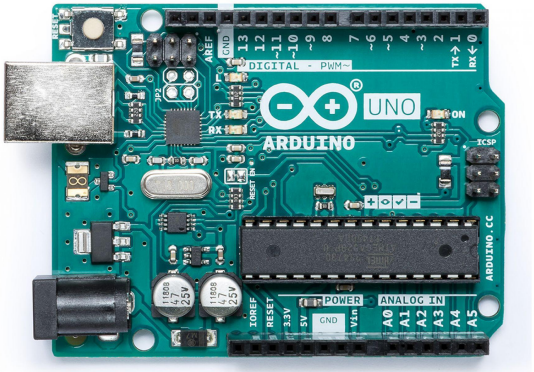
Pre-requisite Softwares

	Software Tools	License type
	Arduino IDE	Open
	Fritzing Vrtual Prototyping Bench (Optional)	Open

Activity 3: Monitoring water usage using an LCD monitor

Level: intermediate

Resources: https://ethercalc.hackersanddesigners.nl/i9dygn59a5xq



Workshop Materials

	Components	Quantity
1	Arduino Uno	1
	Arduino flow rate sensor	1
2	Arduino Male to Male Connectors	10
3	10cm x 10 cm PCB breadboard	1
4	Arduino LCD Output module	2

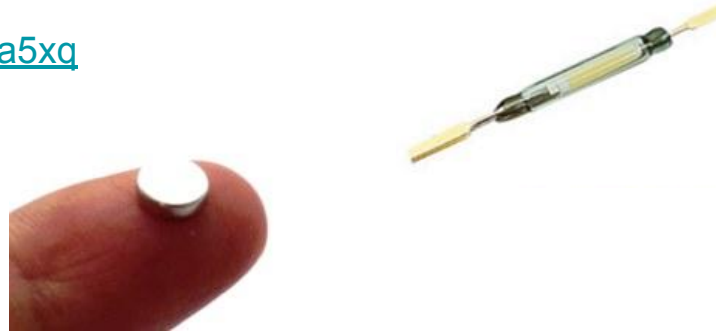
Pre-requisite Softwares

	Software Tools	License type
	Arduino IDE	Open
	Fritzing Vrtual Prototyping Bench (Optional)	Open

Activity 4: Securing the community borehole using an alarm system

Level: intermediate

Resources: https://ethercalc.hackersanddesigners.nl/i9dygn59a5xq

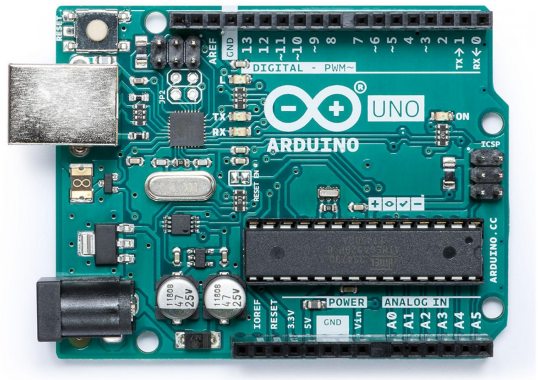


Workshop Materials

	Components	Quantity
1	Arduino Uno	1
	Magnetic + Reed Switch Sensor	1
2	Arduino Male to Male Connectors	10
3	10cm x 10 cm PCB breadboard	1
4	Arduino Buzzer Module	2

Pre-requisite Softwares

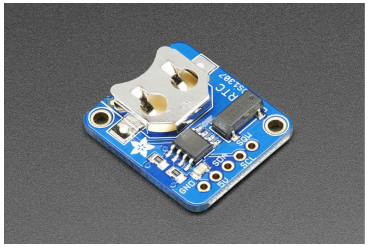
	Software Tools	License type
	Arduino IDE	Open
	Fritzing Vrtual Prototyping Bench (Optional)	Open

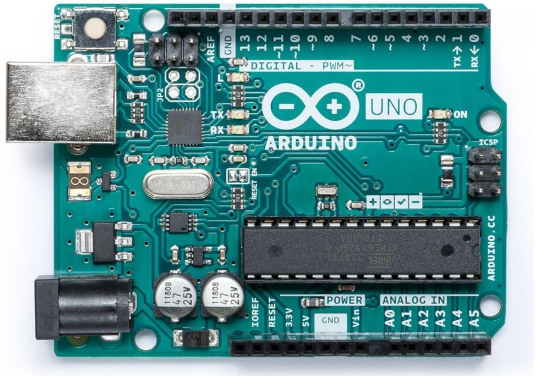


Activity 5: Fetching water using a real-time clock module

Level: intermediate

Resources: https://ethercalc.hackersanddesigners.nl/i9dygn59a5xq





Workshop Materials

	Components	Quantity
1	Arduino Uno	1
	Arduino Real-Time Clock Module	1
2	Arduino Male to Male Connectors	10
3	10cm x 10 cm PCB breadboard	1
4	LED 6mm (9 mm optional)	2

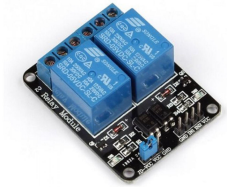
Pre-requisite Softwares

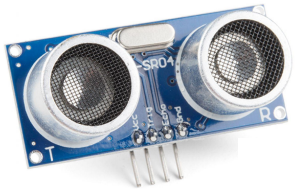
	Software Tools	License type
	Arduino IDE	Open
	Fritzing Vrtual Prototyping Bench (Optional)	Open

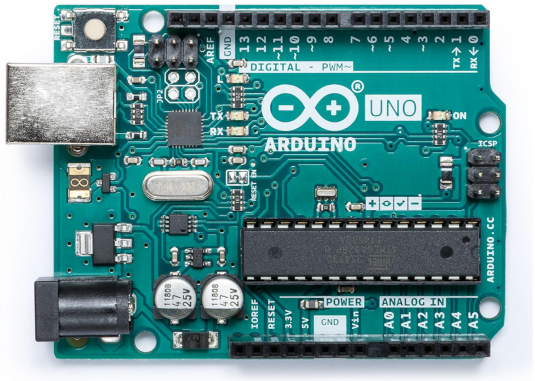
Activity 6: Building a smart water tap using an ultrasonic sensor

Level: intermediate

Resources: https://ethercalc.hackersanddesi







Workshop Materials

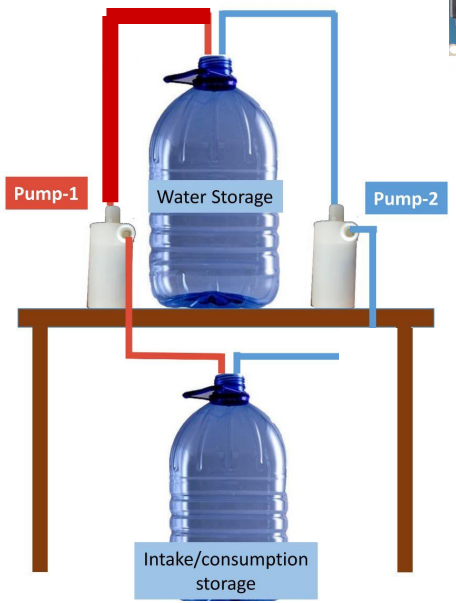
	Components	Quantity
1	Arduino Uno	1
2	Ultrasonic Sensor Module	1
3	5V DC Solenoid Valve	1
4	Flow-rate sensor (water)	1
5	Arduino Male to Male Connectors	10
6	10cm x 10 cm PCB breadboard	1
7	LED 6mm (9 mm optional)	2

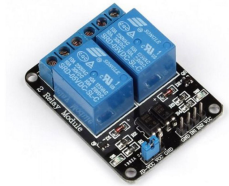
Pre-requisite Softwares

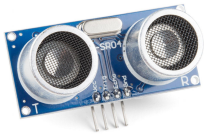
	Software Tools	License type
	Arduino IDE	Open
	Fritzing Vrtual Prototyping Bench (Optional)	Open

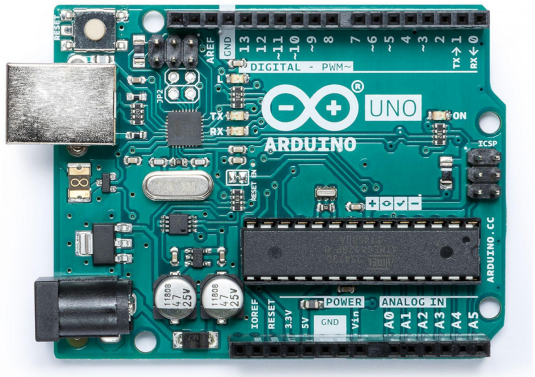
Activity 7: Combine all the systems and connect to reservoir

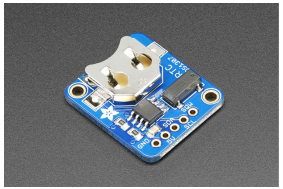
Level: advanced









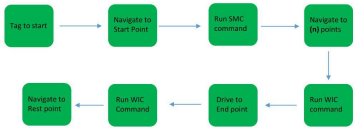


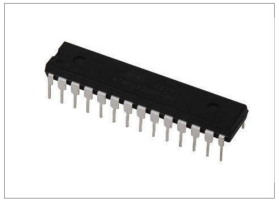
Activity 8: Build IoT app for controlling devices

Level: advanced

Develop an IoT application for web or mobile to control the hardware remotely.

Robotic Soil Moisture Sensor
CONTROL LOGIC





The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Activity 9: Build a robotic soil moisture detector

Level: advanced

Robotic Soil Moisture Detector

Required Tooling

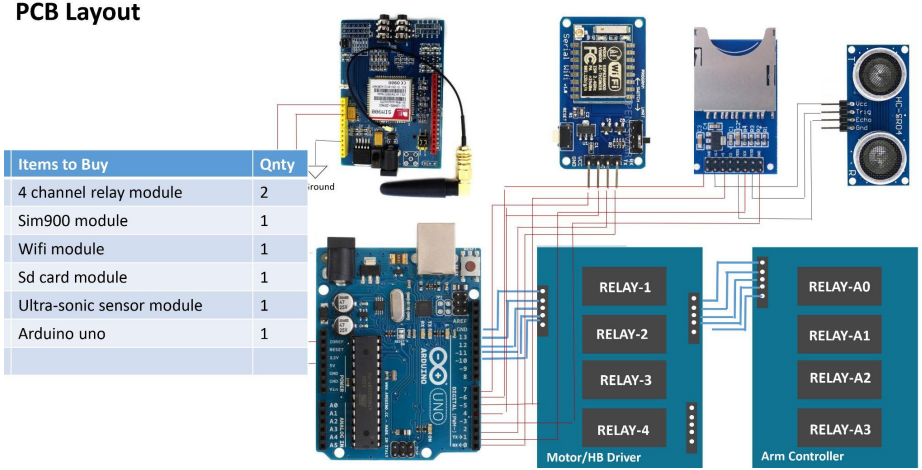
	Tooling	Min Qnty
1	3D printer	1

Bill Of Materials

Items Required	Qnty
5V DC geared motor	4
5V linear actuator (30 mm stroke)	1
Veranda bolts 40 mm x 3mm + nuts	4
ABS plastic material for 3d printing	0.3 kg
Soil moisture sensor	1
Mini solar panel 10 cm x 10 cm min	1

Robotic Soil Moisture Sensor PCB Layout

Items to Buy	Qnty
4 channel relay module	2
Sim900 module	1
Wifi module	1
Sd card module	1
Ultra-sonic sensor module	1
Arduino uno	1



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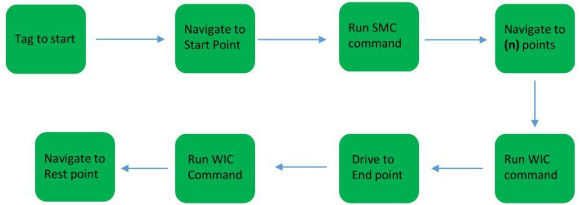

Universal Workshop Timeline

Activity per location	Day 1: Wed 21 July	Day 2: Thu 22 July	Day 3: Fri 23 July
Harare	Kick-off talk & distribution of resources (collective, online)	Metal work and development of subsystems (locally)	Wrap-up by Bongani after collective presentations (collective, online)
Remote nodes	Each team makes groups based on skills level, interest and available materials and chooses one or more sub-systems to develop this week (locally)	Develop and document one or more of the subsystems (locally) Optional: build a DIY water pump and connect your subsystems together (locally)	Develop and document one or more of the subsystems (locally) Finish with collective presentation of prototypes and documentation (collective, online)

Links and resources

Parts list: https://ethercalc.hackersanddesigners.nl/i9dygn59a5xq

General arduino resources for beginners:

- Search for “arduino + part name + tutorial” in a search engine
- https://www.arduino.cc/en/Tutorial/HomePage
- https://learn.adafruit.com/guides/beginner
- Instructables, e.g. https://www.instructables.com/Simple-Arduino-and-HC-SR04-Example/

Future steps & invitation to collaborate

The project is open-source and ongoing!
Want to collaborate? I’m interested in connecting with:

- labs with access to precision tooling (CNC machining, metal workshops)
- active open-source communities
- people who want to help attract funding for materials, access to tools & expertise
- etc

Contact:

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