

 TEAM BÉNIN

Engineering Notebook

FIRST GLOBAL CHALLENGE 2026

Igniting Innovation



What's inside

01	The team and how we work	03
02	The game and what scores	06
03	What our robot needs	07
04	First ideas and sketches	08
05	Decision matrix	10
06	Prototypes and tests	12
07	Building the robot	14
08	Electrical system	16
09	Programming and controls	17
10	Help from mentor teams	18
11	How the robot changed	19
12	Final robot and match plan	20
13	FireWise Bénin, our innovation project	22
14	What we learned and what's next	23

Our team & our goal

We are Team Bénin, ten young people from 7 to 18 years old, trained and mentored by femCoders in Cotonou. This season we built a robot for the FIRST Global Challenge 2026 in Incheon, South Korea. We also created FireWise Bénin, an app that helps people in our country stop bush fires before they start.



Team Bénin with our mentors.

OUR GOAL

We decided early that we would rather do a few things well than everything badly. So we wanted a robot that grabs balls fast, shoots them into our Suppression Unit, and climbs at the end of the match. In this notebook we show how we got there, including the ideas that did not work.

10

team members, aged 7 to 18

4

small teams inside the team

2

projects: a robot and an app

Meet the team



Richmond

Team Captain, Software Lead & Strategist

Hey, I'm Richmond! I keep ten people moving in the same direction, I write the code that makes our robot move, and I plan our match strategy. If the robot does something weird, it's my code... or the mechanics. Usually the mechanics.



Ariel

Deputy Team Lead, Human Player & Strategist

I'm 18 and I'm the deputy lead. In matches I'm our human player at the Fire Shield, so a lot of balls go through my hands. I help with the code too, and wearing Bénin's colours at FIRST Global makes me really proud. I love basket ball.



Arao

Software & Mechanical

I code AND I build, so when something breaks, both sides come to me. I love the problems that make everyone go quiet. That's when it gets fun.



Arsène

Mechanical & Electrical Lead

Wires, battery, motors: if it carries power, it's mine. I also design parts with the mechanics. My rule number one? No loose cables on my robot.



Amos

Mechanical & Co-Driver

I build the robot with my hands, then I help drive it. Staying calm when the match goes crazy is kind of my superpower.



Melvit

Driver

I'm 15 and I've always loved robots and video games. Now I drive a real robot with a controller, so basically my dream game. Proud to represent Bénin, and I want to be back next year!



Paul

Build Team

I like taking things apart to see how they work. Putting them back together is the hard part, but I'm getting really good at it.



Joshua

Build Team

Give me a screwdriver and a problem and I'm happy. Best moment of the season? When a test finally works after ten that didn't. I'm the team's favorite member 🤖



Lucrèce

Build Team

I'm the one who asks "but why?" about everything. Turns out that's super useful when the robot won't do what we want.



Ayman

Youngest Member

I'm Ayman, I'm 7 and I'm the youngest! I love watching the robot shoot balls, and I help pick them up. One day I'll build my own robot.

Our mentors & how we work



Olanikè

Co-Mentor & Technical Mentor

She is our tech mentor , good at coding, she guides us during the construction of our robot, the 3D model of our robot, our tests and this notebook. She is calm, creative and super smart. With femCoders since 2017, she was already with Team Benin at FGC 2019.



Adeyoola

Mentor, Season Coordination

She is a ball of energy and happiness which is contagious, she organises our season: activities, communication, preparing for the competition, and making sure each of us is doing okay. Always helping us navigate blurry and stressful situations.



Simon

Mentor

Our saviour for the robot's architecture and programming. When something isn't working, he can tell us why in a few seconds. He is a genius, we want to be like mr. Simon ha ha. He was a team member and team 2025 mentor.



Claudel

Mentor

He knows almost everything. With his magic hands, he can craft or build anything we can imagine. Expert in cutting extrusions and making systems we struggle with work flawlessly.



Luz-Clarita

Assistant Mentor

She follows our work and helps us write down our methods and decisions in this notebook.

OUR SMALL TEAMS

Mechanical

Amos, Arao, Arsène

Electrical

Arsène

Software

Richmond, Arao, Ariel

Strategy

Richmond, Ariel

HOW WE WORK: WE REPEAT THESE 5 STEPS



Draw

Sketch the idea and name every part

Build

Make it with parts from the kit

Test

Try it with real balls and film it

Talk

Watch the video together and ask our mentors

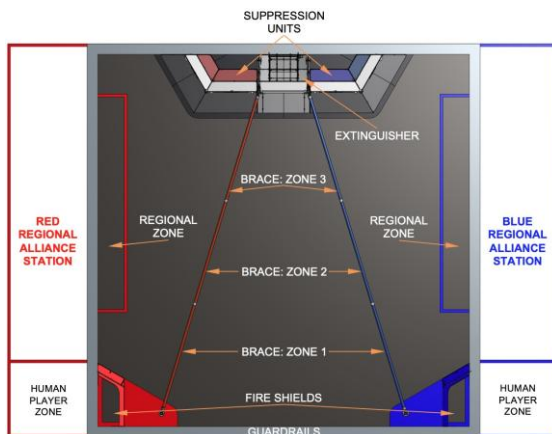
Fix

Change one thing, test again

What we always try to do: we film every test, we change only one thing at a time, we decide together by looking at what the test showed, and we write it down the same day.

The game in one page

This year the theme is wildfires. Two alliances of three robots play on a 7 × 7 m field for 2 min 30. At the start, 500 orange balls called WILDFIRE roll out onto the field, and every robot tries to collect them.



Field layout. Source: FGC 2026 Game Manual.

Suppression Unit

Where we score. The opening is much higher than our robot.

Extinguisher

Shared by all six teams. Only human players fill it.

Fire Shield

We push balls into its Port, and Ariel, our human player, takes them.

Brace

A long steel pipe with 3 zones. Robots climb it at the end.

HOW POINTS ARE SCORED

1 ball in our Suppression Unit	1 pt
1 ball in the Extinguisher (for all 6 teams)	1 pt
Each robot climbing: Zone 1 / Zone 2 / Zone 3	+0.10 / +0.20 / +0.30
Carrying a partner robot while climbing	25 pts
4, 5 or 6 robots in Zone 3 (bonus for all)	10 / 25 / 40

Our score = balls in our Suppression Unit × climb multiplier, plus the other points.

WHAT WE UNDERSTOOD

We have to score before we climb. The climb multiplies the balls in our unit, so if we have no balls, the climb gives us almost nothing.

Moving many balls matters more than one perfect shot. There are 500 balls, so we built for speed.

Drive

base

Collect

P1

Store

base

Score

P2

Climb

P3

Rules & requirements

50 cm

wide

50 cm

long

50 cm

tall

+50 cm

one side, after start

NUMBERS THAT SHAPED OUR ROBOT

100 mm ball. Every gap in the robot is sized for the ball, not the other way round.

Wide intake. Our robot is 50 cm wide, so 2 to 3 balls fit across the front at the same time.

Opening up high. Our robot can't reach the Suppression Unit opening, so we have to shoot the balls. That is why we have a flywheel.

RULES WE HAD TO FOLLOW

Kit parts only. Everything comes from the FIRST Global REV kit and there are no spare parts, so we had to be careful with every cut.

No power needed to free us. Balls and the robot must come off the Brace with the robot switched off.

One control system. One Control Hub, one Expansion Hub and one 12 V battery.

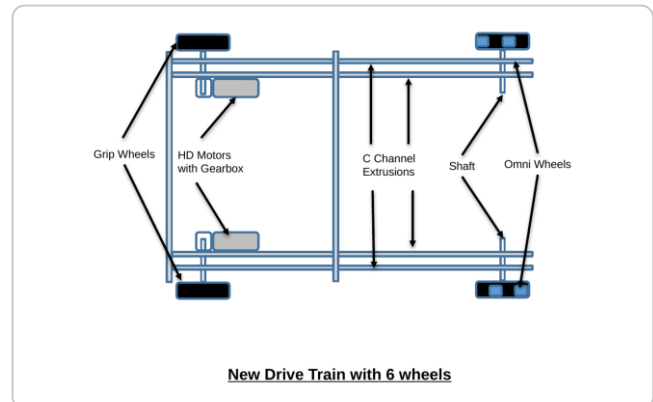
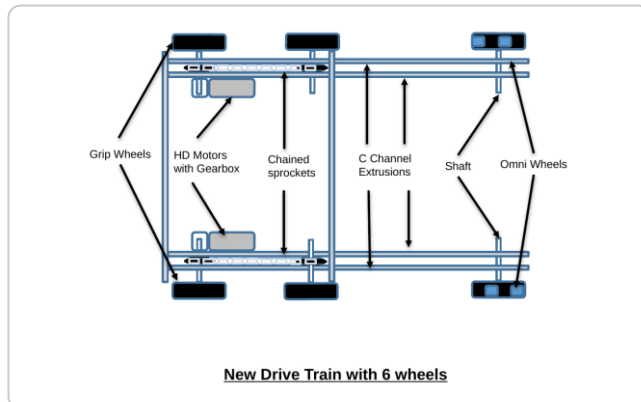
WHAT OUR ROBOT MUST DO, AND HOW WE CHECK IT

Job	What it must do	How we check
Drive	Cross the field fast and turn on the spot, even full of balls	Timed runs, empty and full
Collect	Grab 2 to 3 balls at a time without careful aiming	Drive through balls, count caught and missed
Store	Hold up to 25 balls without jamming	Fill it up, drive around, check nothing gets stuck
Score	Shoot 2 to 3 balls at once into the opening	Shoot many times from the same spot
Climb	Hang on the Brace, Zone 1 or higher	Climb test, then free it with power off
Size	Fit in the 50 cm cube at the start	Measure in a 50 cm box

Drawing before building

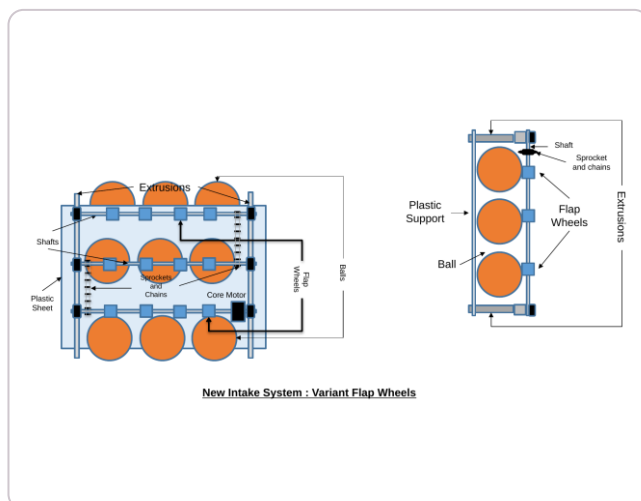
Before cutting anything, we drew every part of the robot and wrote the name of each kit part on the drawing. It helped us check that we had enough parts.

DRIVETRAIN: SIX WHEELS

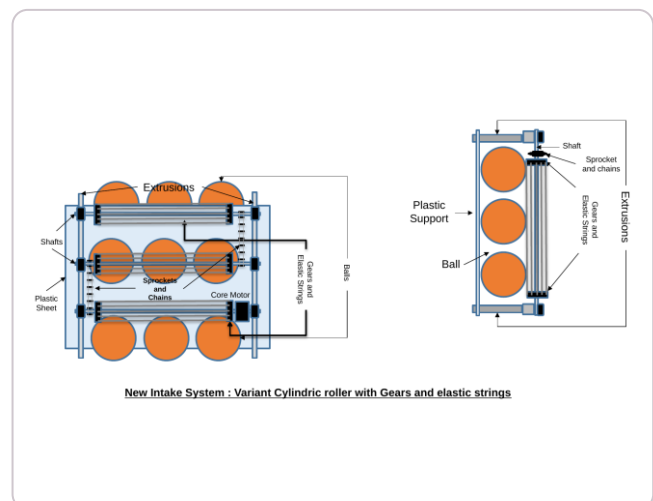


We put grip wheels to push through the balls and other robots, and omni wheels to turn easily on the spot. We drew one version with a chain and one without, to compare the number of parts.

INTAKE: TWO WAYS TO GRAB A BALL



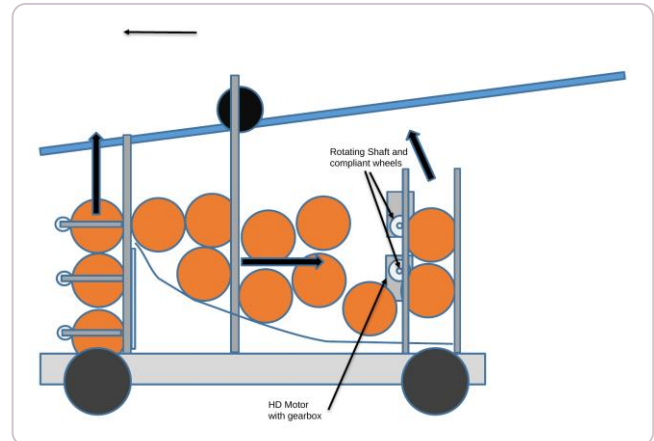
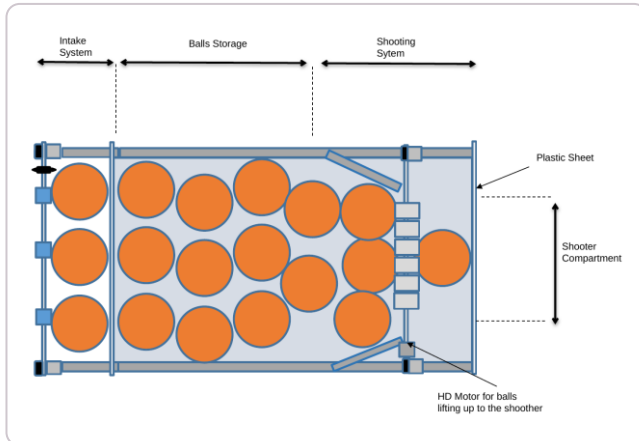
Idea 1: flap wheels. Rubber flaps on three shafts hit the ball and pull it in. They bend around the ball instead of squashing it.



Idea 2: elastic strings. Elastic strings between rollers wrap around the ball. It is soft on the ball, but there are a lot of parts that can slip.

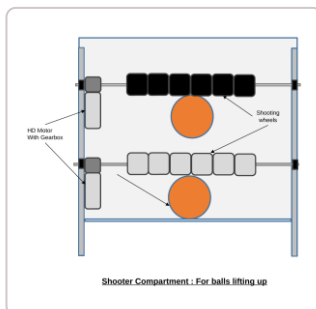
Ball path & shooter ideas

Then we drew the whole path of a ball, from the floor to the goal. This helped us see every place where a ball could get stuck.

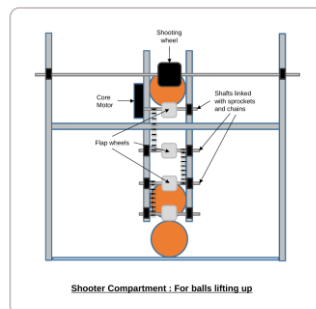


Left: top view, intake → storage → shooter. Right: side view, balls go up a ramp and get lifted to the shooter.

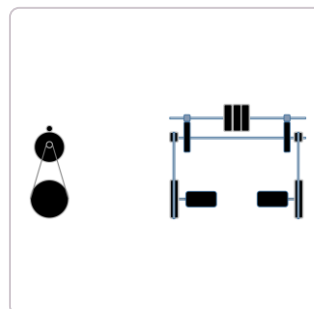
OUR FOUR SHOOTER IDEAS



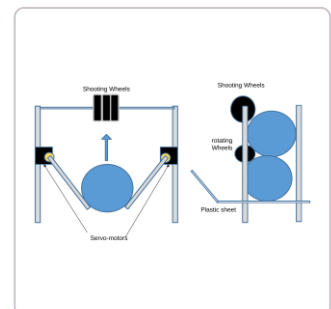
A. Two rows of wheels



B. Flaps feed one wheel



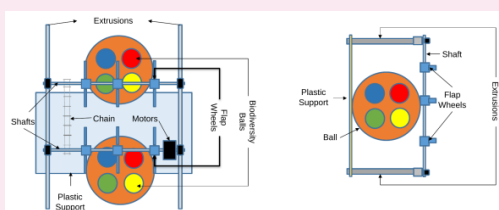
C. Speed-up gears



D. Servo gate

All four ideas use a fast spinning wheel that squeezes the soft ball and throws it. They are different in how the ball reaches the wheel, and in how many motors they need.

IDEAS WE KEPT FROM LAST SEASON



We did not start from zero. Our drawings from last season already had flap wheels to grab balls, servo arms to hold them, and a mast to climb. We changed them for this year's 100 mm ball and used them again.

How we picked

We gave each idea a score from 1 (bad) to 5 (very good) for each criterion. Then we multiplied each score by how important the criterion is for us and added everything up. Criteria about moving more balls count $\times 3$.

INTAKE

Option	Grip on the ball $\times 3$	Balls per second $\times 3$	Kit parts $\times 2$	Strong $\times 2$	Easy fix $\times 1$	Total /55
Flap wheels, 3 shafts	5	5	4	4	4	50
Rollers + elastic strings	4	4	3	2	2	36
One soft roller	4	3	5	4	4	43

SHOOTER

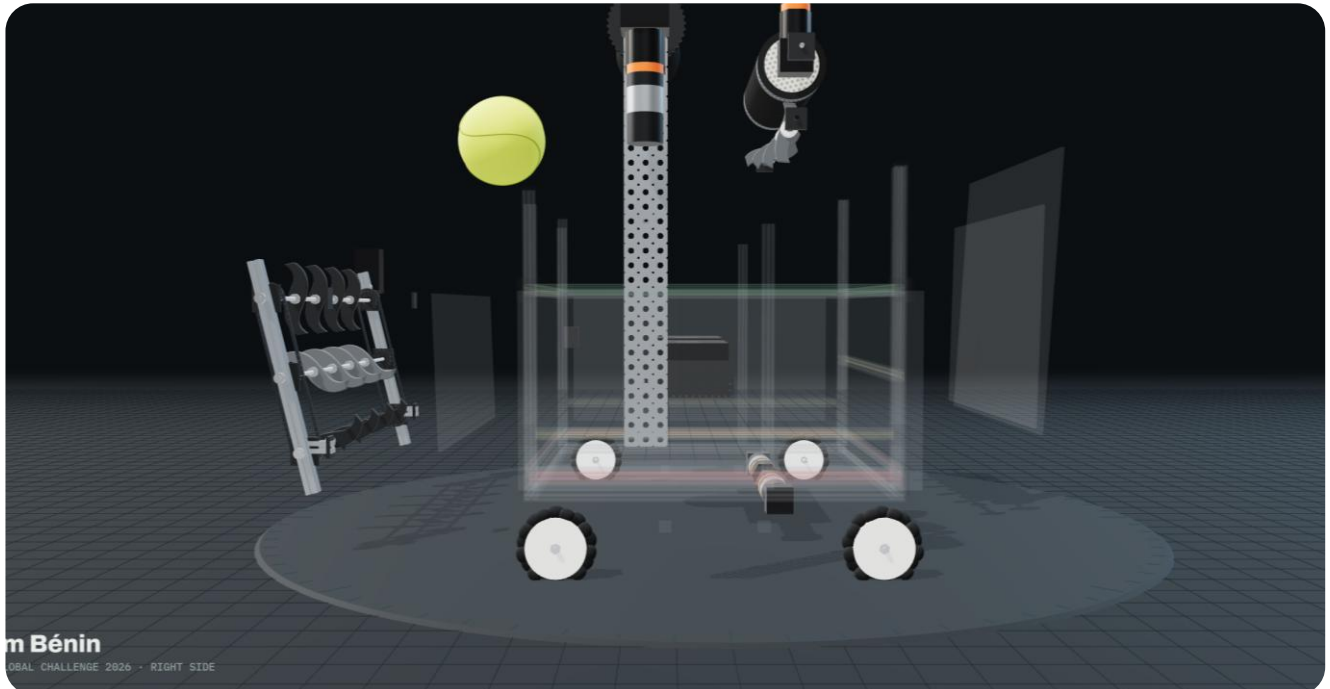
Option	Same shot every time $\times 3$	Several balls at once $\times 2$	Few motors $\times 2$	Simple $\times 2$	Easy to tune $\times 1$	Total /50
One wide flywheel	4	5	5	4	4	44
Two rows of wheels	5	3	2	2	3	32
Servo gate	2	2	4	3	2	26

Elastic strings lost because they stretch and slip off during a match, and we did not want to repair them between two matches.

One wide flywheel won because one roller across the whole width can shoot 2 to 3 balls at once with only one motor. The two-row idea was a bit more precise, but it needed two motors that we wanted for the intake and the climber.

Our chosen design

When we put the winning ideas together, we got one simple path for the balls and a separate climber. The whole robot uses six motors.



3D view of our final robot from the side, with the intake pulled out.

1

Intake

3 shafts of flaps, 2 to 3 balls at a time

collector

2

Hopper

Stores up to 25 balls

—

3

Feeder

Flaps under the flywheel push balls up

shooterDown

4

Flywheel

Wide roller, shoots 2 to 3 balls at once

shooterUp

5

Climber

Mast + V-shaped roller that rides the Brace

climbing

Version 1: the tower

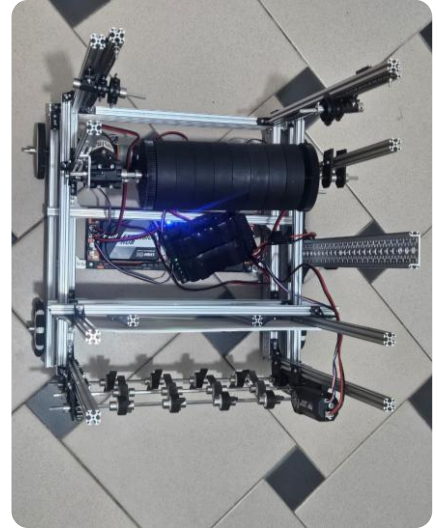
In our first full robot, the intake was standing up straight. The flaps pulled the balls up a vertical white panel to soft grey wheels, and these wheels sent them to the flywheel at the very top.



Front: the flap wall



Side: soft feeder wheels



Top: flywheel and hubs

WHAT WE LEARNED

The idea worked. The flaps grabbed the balls and the flywheel threw them.

The path was too long. Each ball had to climb the whole robot and pass through three mechanisms, so it had three chances to get stuck.

It was heavy at the top and had no storage. We could not collect many balls first and shoot them after.



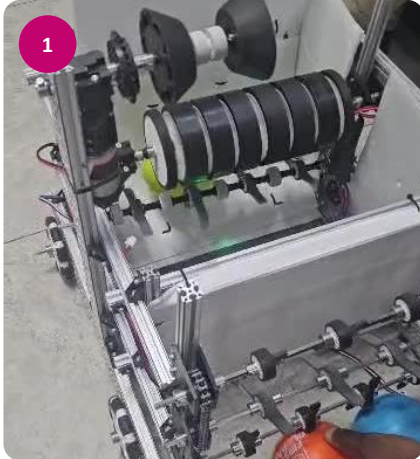
WE ALSO TESTED THE FEEDER ALONE

Can soft wheels push a ball up from below? Yes, if the floor under the ball is stiff. We kept this idea.

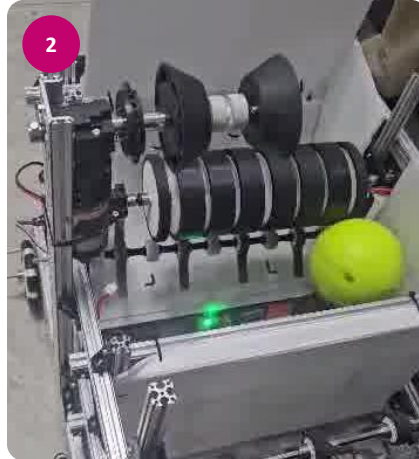
Can one wide roller take balls from anywhere across the robot? Yes. With wheels all along the shaft, the ball touches the roller wherever it arrives. We kept this idea too.

Version 2 on the test floor

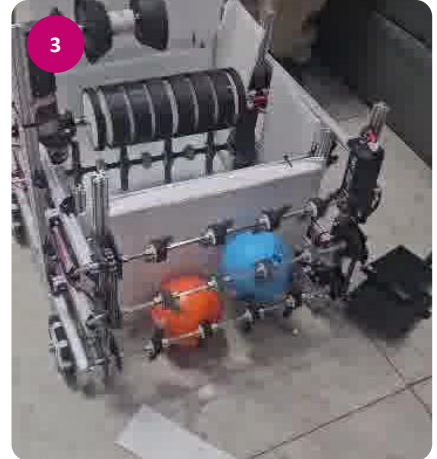
For version 2, we put the intake down along the floor, added a sloped panel that leads into a hopper, and placed a feeder under the flywheel. Then we filmed a short test with practice balls.



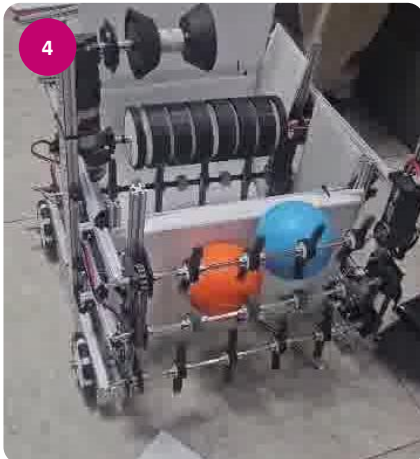
Ball placed at the flaps



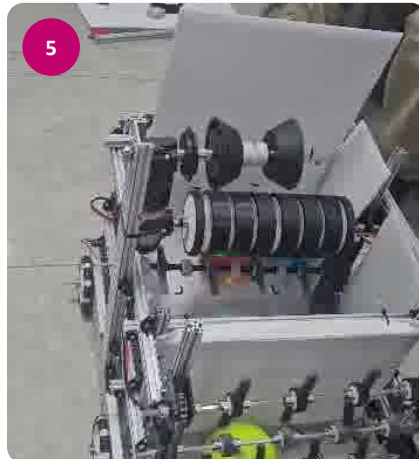
A ball comes out over the flywheel



Two balls pulled in together



Both climb into the hopper



A ball stays stuck at the flaps



A ball is shot out

WORKS

The intake takes several balls. Two balls went in side by side at the same time.

WORKS

The full path works. For the first time, a ball went from the floor to the shooter without stopping.

PROBLEM

Some balls get stuck at the entry. The gap is not the same everywhere, so some balls stop for a moment.

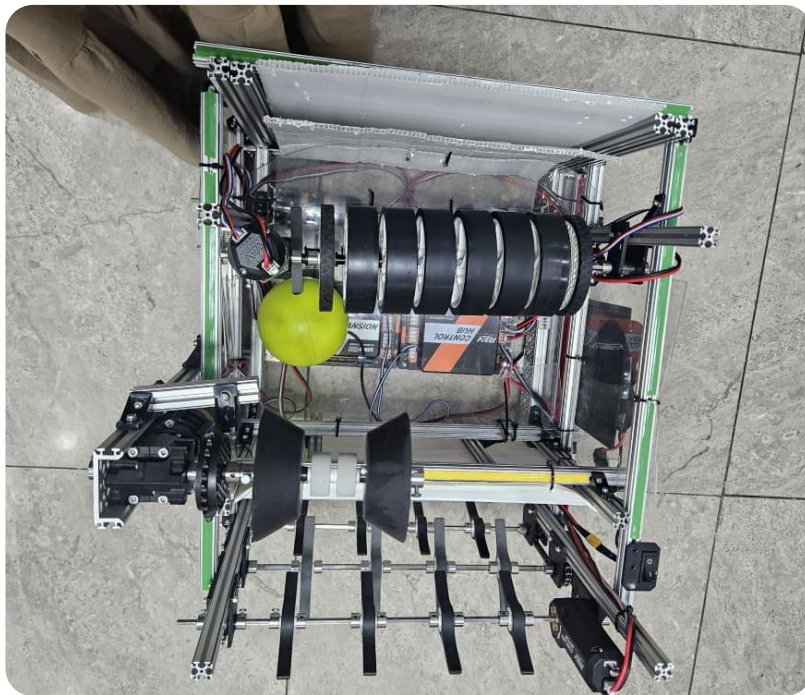
PROBLEM

The side panel bends. Where the wall bends, the path gets narrower and the balls slow down.

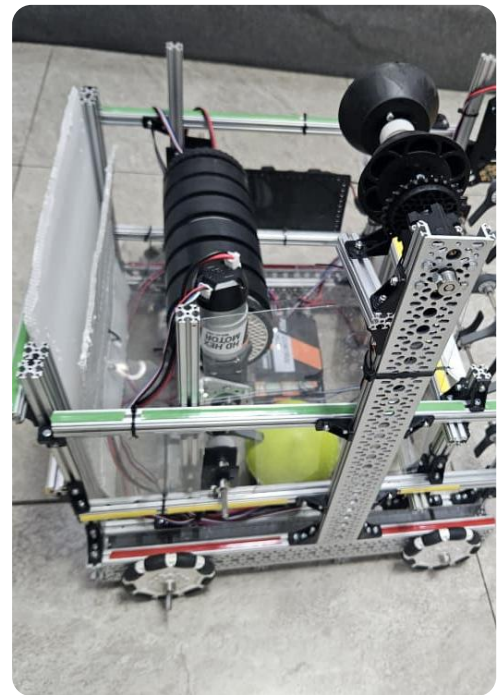
PROBLEM

The shots are weak. The flywheel presses the ball too hard, so it loses speed.

Frame, wheels & intake



Seen from above: intake at the bottom, flywheel over the hopper, hubs under the clear floor.



Omni wheels at the corners.

FRAME & WHEELS

Our frame is made of aluminium rails and fills the 50 cm cube. Because there are rails on every side, we can attach parts and move them easily.

We use tank drive, with one motor per side. Both sticks forward to go straight, one stick at a time to turn.

We put the heavy parts low. The battery, hubs and drive motors are near the floor so the robot does not tip over.

INTAKE & HOPPER

Three shafts of black rubber flaps cover the front of the robot. One motor turns them all with a chain.

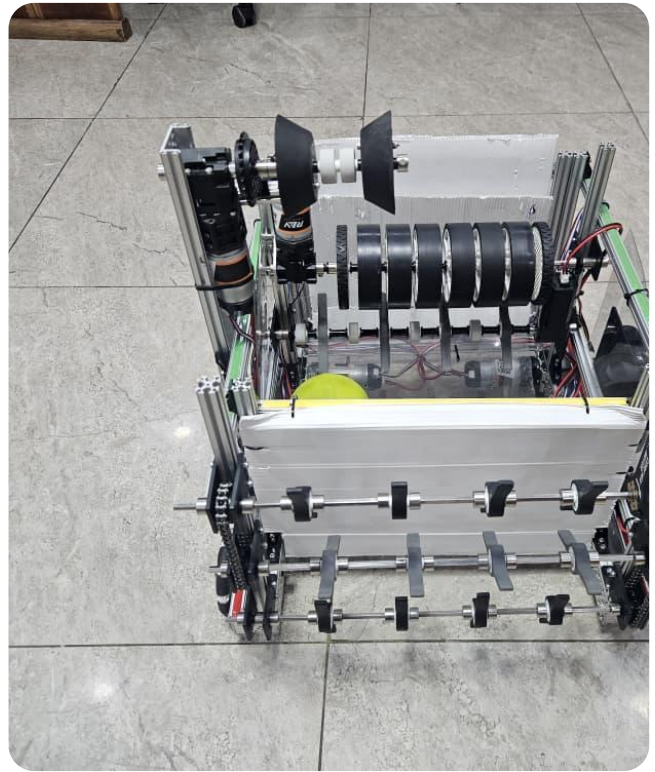
It catches 2 to 3 balls at a time, because the flaps cover the whole width.

The hopper holds up to 25 balls. Balls go up a sloped panel, then roll on a clear floor to the feeder. Extra rails keep the plastic walls flat.

Flywheel, feeder & climber



The flywheel stack and the mast.



The V-shaped climbing roller up top.

FLYWHEEL & FEEDER

Our flywheel is a row of soft black wheels on one shaft, as wide as the robot, turned by one motor. Under it, a shaft of flaps called the feeder pushes the balls up. The flywheel can shoot 2 to 3 balls at once. The feeder has its own motor, so the flywheel keeps its speed and the driver decides when to shoot.

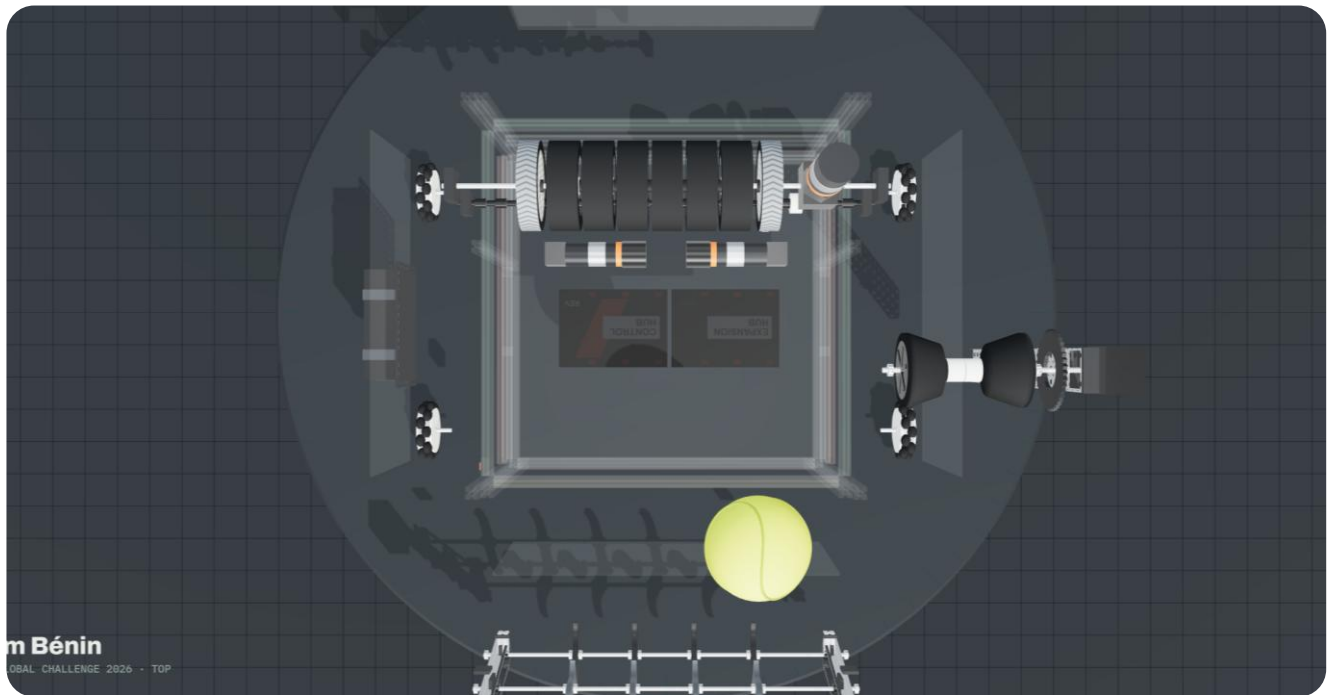
CLIMBER

A mast holds a roller made of two cone-shaped wheels facing each other. Together they form a V that sits on the round Brace pipe. We drive under the Brace, put the roller on the pipe, and its motor pulls the robot up.

Rule check: the robot must come off the Brace with the power off. We check this on our climber before every inspection.

Battery, hubs & motors

The rules allow one battery, one Control Hub and one Expansion Hub. Our six motors are plugged into the two hubs. We don't use servos or sensors, so our wiring stays short and simple.



3D view from the top: the Control Hub and the Expansion Hub are side by side, low in the middle of the frame.

Motor name in our code → what it turns

leftDrive Left wheels

rightDrive Right wheels

collector The 3 intake shafts

shooterDown The feeder

shooterUp The flywheel

climbing The climbing roller

HOW WE WIRED IT

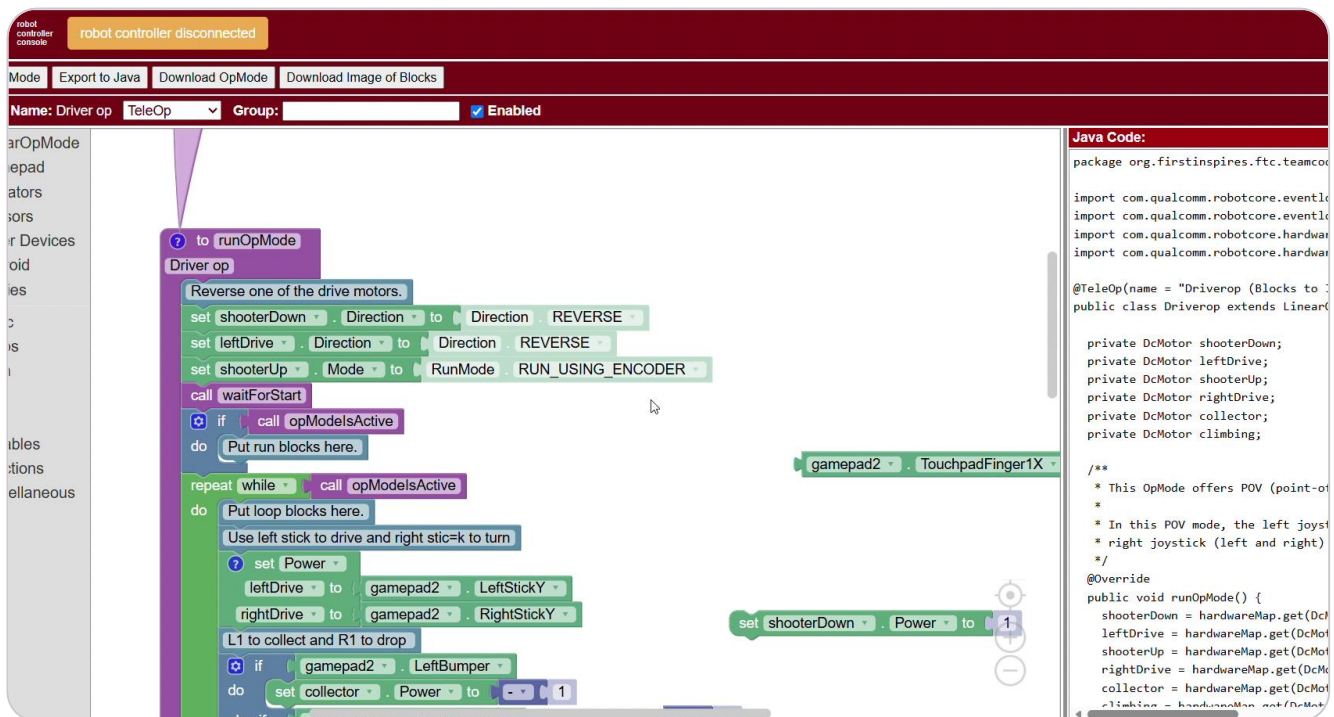
The hubs are under the clear floor, where balls can't hit them and we can still see their lights.

The power switch is on the outside of the frame, so anyone can turn the robot off without putting a hand inside.

The cables are tied along the rails, away from the chains, the flaps and the flywheel.

Our code & controls

We wrote our driver program, called “Driver op”, in REV Blocks, then exported it to Java. Blocks are easy for everyone in the team to read, and the Java version shows exactly what runs on the robot.



HOW OUR PROGRAM WORKS

1. It finds the six motors and reverses two of them so they turn the right way.
2. It waits for the match to start.
3. Then it repeats very fast: read the controller, move the motors, show the motor values on the driver screen.

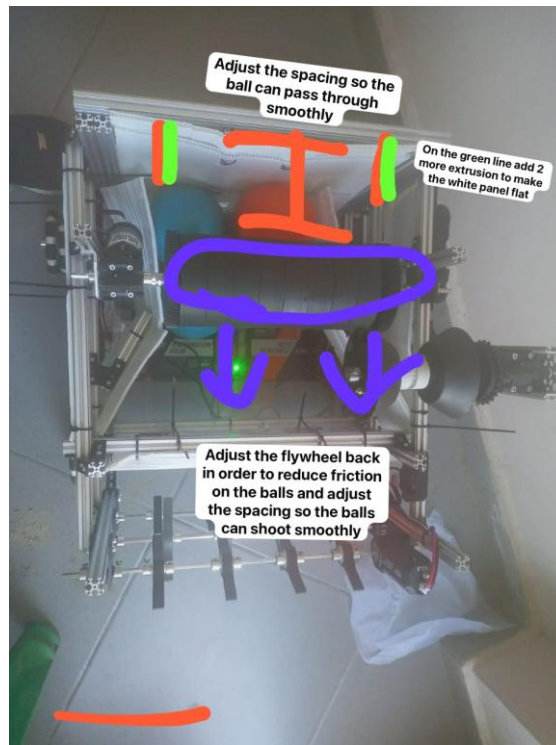
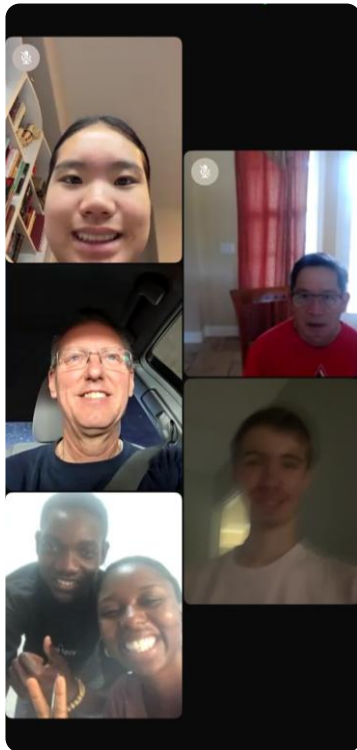
Why we set a speed for the flywheel: if we only set the power, the flywheel slows down when the battery gets low or after each shot. We set a target speed of 2600, and the hub adds power to keep it. This way our shots stay the same during the whole match.

CONTROLLER MAP

Left stick ↕	Left wheels
Right stick ↕	Right wheels
L1 (hold)	Intake in
R1 (hold)	Intake out (unjam)
Right trigger	Feeder (press more = faster)
Triangle / Circle	Flywheel on / off
D-pad	Climbing roller

What our mentor teams told us

After our test, we had video calls with two experienced teams, Team Inspiration and Team Spyders. They watched our video and photos, then sent us a photo of our robot with notes drawn on it. They noticed things that we did not see anymore because we were used to them.



1 Fix the entry

Make the gap the same everywhere so the balls pass smoothly.

2 Flatten the panel

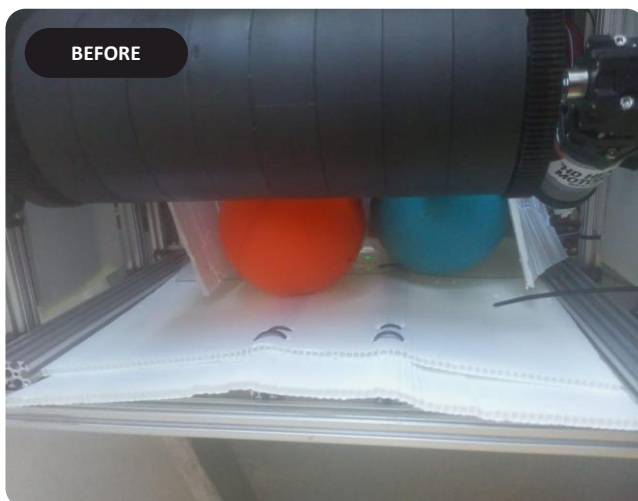
Add 2 rails along the white panel, on the green lines.

3 Move the flywheel back

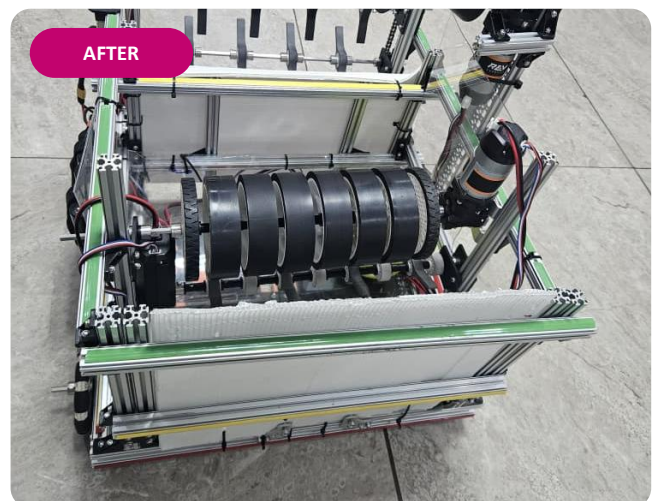
So it squeezes the balls less and shoots better.

Left: our video call. Right: the photo they marked up for us.

ADVICE 2: BEFORE AND AFTER



Before: the plastic wall bends between the supports.



After: the new rails (green tape) keep the walls straight.

From sketch to final robot

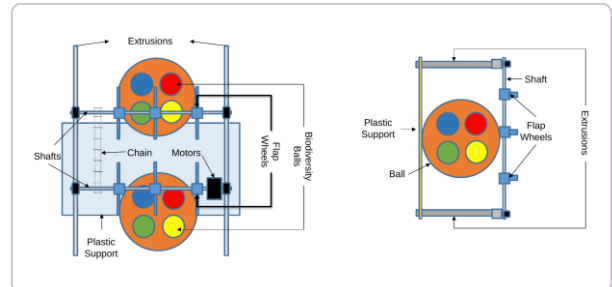
Our robot went through five stages. At each stage we drew, built, tested, talked and fixed, and each time the balls travelled from the floor to the goal a bit better.

1

LAST SEASON

Old ideas

Flap wheels, servo arms and a climbing mast from our old drawings.

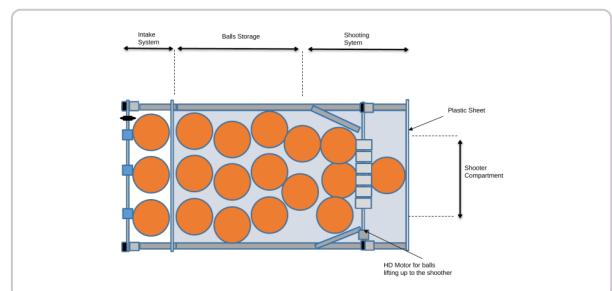


2

ON PAPER

Paper robot

Six wheels, two intake ideas, four shooter ideas and the full path of the ball.

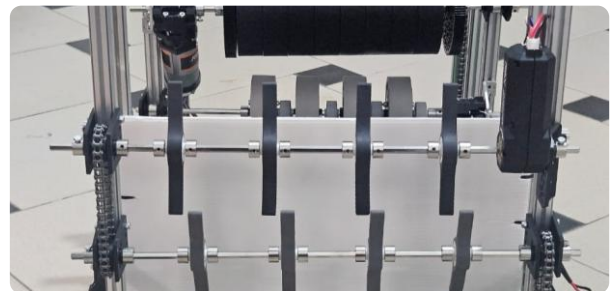


3

VERSION 1

The tower

Intake standing up, flywheel on top. It worked, but it was too tall and had no storage.



4

VERSION 2

Low intake

Intake on the floor, ramp, hopper and feeder. Our first full shot on video.



5

FINAL

Competition robot

Mentor advice applied, flat walls, climber added.



Our final robot



The real robot.



The same robot in our 3D model.

Size	Fits the 50 cm cube at the start	Wheels	Tank drive with 2 motors, omni wheels
Intake	3 flap shafts, 1 motor	Hopper	Clear floor, flat plastic walls
Feeder	Flap shaft, controlled with the trigger	Flywheel	Wide roller of soft wheels, fixed speed
Climber	Mast + V-shaped roller on the Brace	Control	Control Hub, Expansion Hub, 12 V, 6 motors

2-3

balls collected at a time

25

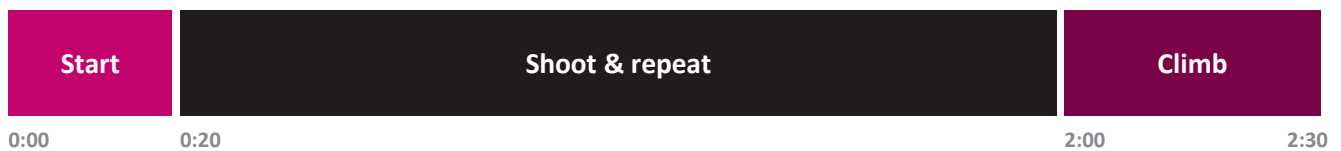
balls in storage, max

2-3

balls per shot

Our match plan

Our plan is to collect, fill the hopper, shoot, do it again, and climb at the end. Before each match, Richmond changes the plan depending on what our two partner robots can do.



Start (first 20 seconds)

All 500 balls come out at once. We drive into the biggest pile with the intake on while the flywheel speeds up. These are the easiest balls of the match.

Shoot & repeat

With up to 25 balls in the hopper, we go to the same spot in front of our Suppression Unit and shoot 2 to 3 balls at a time, because the flywheel speed we practised works from there. When the hopper is empty, we go to the next pile. If the way is blocked, we push balls into our Fire Shield so Ariel can use them.

Climb (last 30 seconds)

We stop collecting, go under the Brace in Zone 1, put the roller on the pipe and climb toward Zone 3. Each robot in Zone 3 adds +0.30, so we decide with our partners before the match where each robot will climb.

DRIVE TEAM

DRIVER	CO-DRIVER	STRATEGIST	HUMAN PLAYER
Melvit	Amos	Richmond	Ariel

Stop fire before it starts

In the game, robots stop fires that have already started. With FireWise Bénin, we wanted to act before that. In Bénin, most bush fires are started by people who want to clear a field, burn what is left after the harvest, get rid of trash, or renew pasture. Our app helps them right at that moment.



Choose better

You choose why you want to use fire, and the app shows you safer ways to do it, step by step.

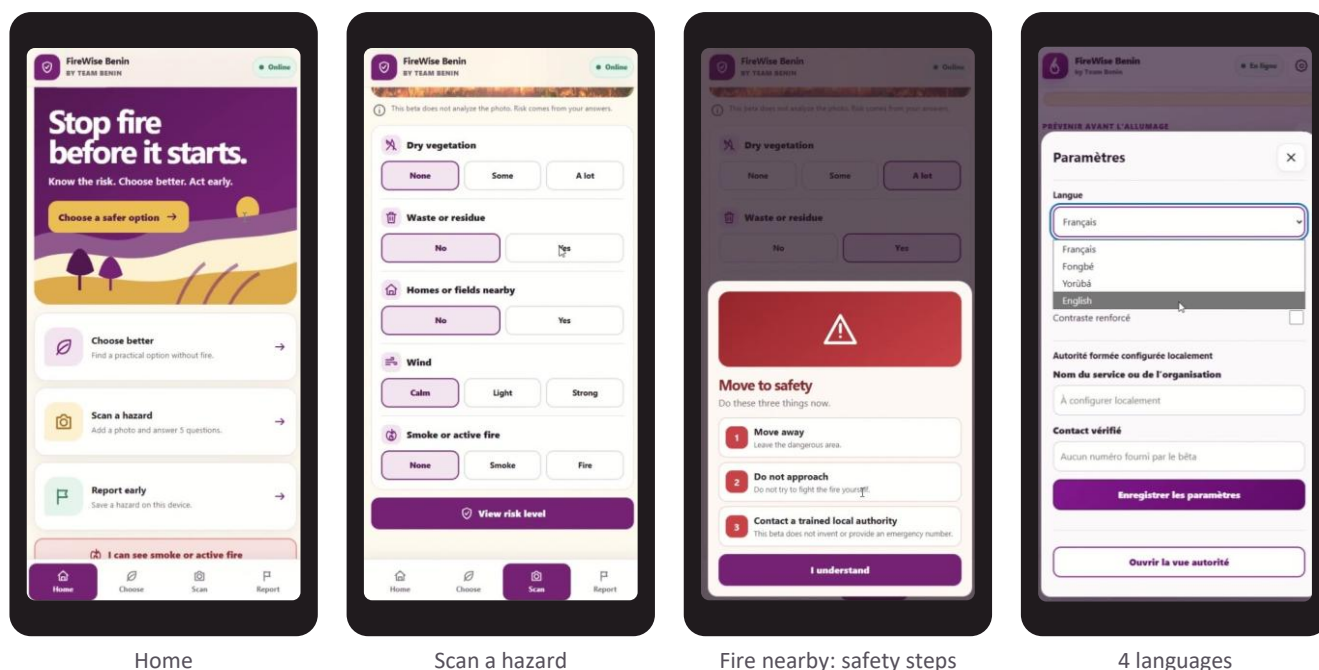
Scan a hazard

5 quick questions (dry grass, trash, homes nearby, wind, smoke) give a risk level. If a fire is already burning, the app tells you to move away, not to go near, and to call a trained local contact.

Report early

You add the type of danger, a photo, the place (GPS or typed) and the time. The report is saved on the phone, so it works without internet.

From our FireWise campaign video.



Home

Scan a hazard

Fire nearby: safety steps

4 languages

For everyone: the app works in French, Fongbé, Yorùbá and English, has a high-contrast mode for bright sunlight, and uses big buttons and pictures.

What we learned

1

Start with the ball.

The 100 mm foam ball decides the size of every gap and every roller. If we had measured everything around the ball from the start, we would have saved one rebuild.

2

A short path jams less.

In version 1 the balls had to climb the whole robot. When we put the intake on the floor, the path became shorter and we got space for storage.

3

Small details matter.

A plastic wall that bends a few millimetres is enough to slow a ball down. Two extra rails fixed it.

4

Pressing harder doesn't shoot faster.

When the flywheel presses the ball too hard, it just creates friction. The gap is as important as the motor.

5

Filming helps us get help.

Thanks to a short phone video, two other teams understood our robot and helped us in one call.

6

Our old ideas were useful.

The flap wheels and the climbing mast came from last season's drawings, so we will keep this notebook for next year.

NEXT STEPS

- Time our full cycles on carpet, so our match plan is based on real numbers.
- Practise the climb from every side, and check that the robot comes off the Brace with the power off.
- Fix the D-pad in our code: right now up and down both turn the climber the same way. Down should turn it backwards.
- Use two controllers: Melvit drives, and Amos controls the intake, the feeder and the flywheel.



femCoders

Team Bénin

FIRST GLOBAL CHALLENGE 2026 · INCHEON, SOUTH KOREA

Trained and mentored by **femCoders**, Cotonou, Bénin