**PA RASPBERRY PI COMPETITION 2022**

**SCHOOLS, COLLEGES AND CLUBS SUBMISSION FORM**

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| SCHOOL/COLLEGE/CLUB NAME | Fulford School |
| TEAM NAME | RiverSafe |
| CATEGORY  *(**please circle)* | Category 1: Years 4-6  Category 2: Years 7-9  Category 3: Years 10-11  Category 4: Years 12-13 |

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| SUMMARY  500 word summary of your project | We are students at Fulford School who are passionate about the world and have the skills to help save it.  Sewage companies are supposed to treat wastewater but sadly they often dump it in rivers. This is legally allowed when there's extreme weather, but some rivers have worryingly high levels of pollution far frequently.  Clean water in rivers is especially important for people that swim as well as the fish and fauna that live in it. It should be a high priority to keep our rivers clean.    RiverSafe is designed to test the pollution levels of water, so that wild swimmers can swim with safety and confidence but more importantly we can all help hold big companies to account so they cannot get away with dumping raw sewage into rivers.  By doing this, we can help protect the environment and the animals from the harm of our sewage. We have developed a device using a Raspberry Pi Pico which records the Total Dissolvable Solids in the water and displays it on a screen. This then passes that information to a webpage hosted on a Raspberry Pi 4, so that anyone can monitor the pollution levels in the water.  RiverSafe can provide you with information that allows you to determine whether the water is safe (and warm enough!) to swim in as well as helping keep track of the actions of water companies.  Our idea is scalable because Raspberry Pi Picos are very affordable and can be used in different rivers and other aquatic environments all over the world. Our idea could be extended to create a map of how severe pollution is to provide a potentially life-saving resource for wild swimmers and environmentalists.  There’s huge commercial potential as the Raspberry Pi Pico is much cheaper than a raspberry pi so we could have multiple sensors all over the world. There are two ways that we could fund the project: we could campaign for water companies to donate a proportion of their profits to cover hosting and development costs so people can enjoy clean water. We could also ask enthusiasts to sponsor a RiverSafe device at popular swimming locations so that the wild swimming community can share the sense of ownership of the project.  This project is made by Jonathan, who worked on the prototype and webpage; Zak, who developed the original idea; Isaac, who made the media; and Sally, who made the logo and branding. Benjamin helped with the video production. |
| PROOF OF WORKING  This should be photos and a video to show your entry working. *(Attach photos here, and videos separately to your email. Please note that we encourage teams to use video footage as proof or working. Videos can be shared on private links for confidentiality and security).* | Here is our video explaining the project:  30s RiverSafe Ad giving an overview of our idea- <https://youtu.be/G7eM-UWJYfo>  2min RiverSafe Presentation showing what we’ve made- <https://youtu.be/6uCORoeYTvM> |
| SOFTWARE & HARDWARE  Materials you used to get your project working. Must be within £100 (see rules) | List of stuff you need Parts List  |  |  |  |  |  | | --- | --- | --- | --- | --- | | Part | Price | Available From | Used for | Picture | | Raspberry Pi Pico | £3.60 per pi | Pimoroni | Read values from the TDS sensor because it has analogue inputs | Inserting image... | | Pico Explorer base | £22.20 | <https://shop.pimoroni.com/?variant=32402092294227> | Has an LCD screen, can attach different wires to control physical objects |  | | TDS Sensor | £11 | <https://www.dfrobot.com/product-1662.html> | Inputs data about water quality |  | | Raspberry Pi 4 | £40.50 | Pimoroni | Hosting a web server so that people can see the water quality from home |  | |
| SOURCE CODE  For the new software you created | Link to GitHub:  <https://github.com/JJTB100/RiverSafe>  This contains all of the code that runs both on the raspberry pi webserver and the raspberry pi pico |
| INSTRUCTIONS  Provide written instructions explaining how your project could be recreated using this software, hardware, and code. | RiverSafe Set up guide 1) Take the raspberry pi Pico out and put it into the Pico board, making sure the delicate pins are not bent. Make sure the pins are pushed all the way in so you can see them poking through the other side. There might be a nasty crunch ;)  Inserting image...    Plug a USB cable into the Pico from your computer.  The first time you use the Pico you will need to install the pimoroni firmware. Download the UF2 file from: <https://github.com/pimoroni/pimoroni-pico/releases/download/v1.18.0/pimoroni-pico-v1.18.0-micropython-v1.18.uf2>  Hold down the bootsel button on the Pico when you plug in the USB cable so that the Pico opens as a device:    Copy the UF2 file into the folder. When it is finished copying the device will restart. If you need help, then this guide shows you exactly what to do: <https://learn.pimoroni.com/article/getting-started-with-pico>  This guide assumes that you are using Thonny, which you can download from <https://thonny.org/>  At school we are using version 3.1.2    Make sure your Pico is plugged in then open Thonny and go to Tools and then Options then choose the following settings in the Interpreter tab. The COM port number might be different for you.   Setting up the raspberry pi webserver First, download the Raspberry Pi Imager from <https://www.raspberrypi.com/software/> and choose the Raspberry Pi OS Lite      It is helpful to choose a hostname and set up access to Wi-Fi at this point so that it is easier to connect later. You can do this by clicking on the cog icon  For development, we set the hostname to riversafe, the username to riversafe and the password to r1ver  The raspberry pi that we used did not set the date automatically so we had to set it manually before we could install any other packages:  sudo date -s "2022-02-28 10:32:00"  Next, you need up update the raspberry pi:  sudo apt update  sudo apt upgrade  Next, we need to install a web server – we will use apache  sudo apt install apache2 git  You should now be able to access the web server in a browser by going to [http://riversafe.local](http://riversafe.local/) although we need to customize the web page. Let us get the code from GitHub.  git clone <https://github.com/JJTB100/RiverSafe.git>  We need to make it so that the web server shows the files from the RiverSafe repository that we have just got from GitHub. Edit the apache2 config file:  sudo nano /etc/apache2/sites-available/000-default.conf  We need to change the DocumentRoot from /var/www/html to /home/riversafe/RiverSafe/web    You can save and close by Pressing Ctrl X and then Y  We also need to add a section as follows:  <Directory /home/riversafe/RiverSafe/web>  Options Indexes FollowSymLinks  AllowOverride All  Require all granted  </Directory>  We need to reload the apache web server config by running:  sudo service apache2 reload  This will give an error message because the web server cannot access files, so we need to give the web server user permissions to the RiverSafe folder with the following command  sudo chmod –R 777 RiverSafe Python server The python server runs on the raspberry pi and gets sensor data from the Pico  First, we need to install the serial module for python:  sudo apt install python3-serial  We need to make the python script run when we switch on the Raspberry Pi  Add this to the file: /etc/rc.local above the last line (which says exit):  python /home/riversafe/RiverSafe/python/server.py & Connecting the TDS sensor The water quality sensor (Total Dissolvable Solids) sensor has three wires which need to be connected to the raspberry pi pico. All of the pins on the pico explorer board are helpfully labelled so it should be easy to plug them into the right place:   |  |  |  | | --- | --- | --- | | **TDS sensor wire colour** | **Description** | **Where to connect it on the pico explorer board** | | Black | 0v | GND | | Red | Power | 3v3 | | Blue | Signal | ADC0 |   The raspberry pi pico can then be powered by plugging it into the raspberry pi web server whilst also sending the pollution levels and temperature readings by USB. You should end up with something like this:    The reason we’re using the pico as well as the raspberry pi is because the pico has an analogue input so it’s much easier to read the pollution levels. We plan to extend it in the future to support multiple picos sensing pollution levels in different locations all hosted on a central control panel with a map showing pollution levels.  All being well you should now have a live display of pollution levels and temperature on the pico screen but you should also be able to access the webpage on the raspberry pi which will look something like this:  At the moment, this web page is accessible from any computer connected to the same network as the raspberry pi from <http://riversafe.local/> but we could extend the project to make it publically accessible from anywhere in the world so people can check pollution levels before they swim and use the data to hold big water companies to account so that together we can have a cleaner, healthier planet. |