STEM success academy

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STEM bootcamp 2022

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Overview

The **STEM success academy** is an initiative to inspire students and adolescents to opt for **STEM (Science, Technology, Engineering and Mathematics)** related vocations through free workshops where the students learn about STEM disciplines, electronics, computer engineering, and robotics. Introducing STEM at a young age instills in students curiosity and kindles a passion within them which they can carry along.

The **2022 STEM success academy** event comprises a **three (3) day STEM bootcamp** comprising activities designed to enable students to gain a general understanding of the science and engineering foundations of STEM fields. We adopt a project-based learning approach whereby students see the practical applications of the knowledge gained through hands-on activities and real-world projects.

Program

The 2022 STEM bootcamp will take place at the **National Advanced School of Engineering (Ecole Polytechnique Yaoundé)** from **December 21 to 23, 2022** and will aim to train 20 students (ideally 13-15 year olds) from diverse backgrounds. The bootcamp is free for all students; all related expenses will be handled by the organizers.

Day 1: Wednesday December 21, 2022

Day one's activities will focus on introducing STEM as a whole to the students, and discussing the benefits of a STEM education. We aim to have a couple of presentations from 2 guest

speakers (TBD). We will end the day with lessons on **prototyping, design** and **programming of microcontrollers** (more precisely, the **Arduino microcontroller**). The students will then be divided into groups and different practical projects assigned to them.

Day 2: Thursday December 22, 2022

Day two's main activities will involve group work on different practical programming projects. Each group will have access to electronic kits as well as a laptop computer to work with. Working on these projects will give the students the opportunity to engage with their peers in building and programming useful computer systems. This will permit the participants to think creatively and propose solutions to practical engineering-design problems. These hands-on activities will help the students discover their interests, and illustrate how engineering technology can solve real life problems. Each student group will be supervised by a senior engineering student from the National Advanced School of Engineering Yaoundé. All the groups will receive additional mentoring from computer engineering professionals.

Day 3: Friday December 23, 2022

On day three, the student participants will present their work to their peers.
We will wrap-up the bootcamp with some pictures and souvenirs. Every participant will have a take-away package comprising useful resources to further their knowledge on STEM, as well as a certificate of participation signed by the organizers (Engr. Peterson Yuhala and Engr. Rahimatou Daouda)

Project specifications

The 2022 STEM bootcamp projects will focus on designing and programming useful electronic systems based on the **Arduino microcontroller.** The selected projects are as follows:

1. **Project 1: Gas leak and smoke detection system.**

   Accidental gas leaks or fires pose very large threats to property, the environment and human life. Many industrial facilities as well as homes, comprise technological setups to detect gas leaks and fires, and transmit useful notifications like alarms, automatic SMS/calls, etc.

   This project aims to build a simple prototype gas leak/smoke detection system based on the Arduino MC. Gas, smoke, and temperature sensors are used to detect any accidental gas leaks or fire, and trigger necessary alarms e.g SMS calls, LED flashes, or buzzers.

   Main components: Arduino Uno, GSM shield, smoke/gas sensor, temperature sensor, buzzer, LEDs

2. **Project 2: Home automation (IR remote + Bluetooth)**

   Home automation or domotics involves automatic control of home appliances by electronic systems. These automations are the basis of smart homes. Popular home automation systems comprise Amazon Alexa, Google Home, etc

   In this project, we leverage an Arduino MC to build a home automation system that can switch on and off lights, fans, etc via infra-red remote control and bluetooth, e.g using a mobile phone.

   Main components: Arduino Uno, IR sensors, IR remote, Bluetooth module, LEDs and light bulbs, DC motors

3. **Project 3: Weather station**

A weather station consists of instruments and equipment (e.g temperature and humidity sensors) for monitoring atmospheric conditions. Weather stations provide information used for weather forecasts as well as scientific research.

In this project we design and build a prototype weather station capable of monitoring atmospheric temperature, humidity, etc. Sensors are used to obtain data which is sent to an Arduino microcontroller for processing. The results from the Arduino are then displayed on an LCD display. Additional functionality like a buzzer alarm system could be added to provide notifications when the temperature rises above a certain level.

Main components: Arduino Uno, temperature and humidity sensor (DHT22), LCD display, buzzer

4. **Project 4: Proximity sensor**

Proximity sensors are used to detect nearby objects without coming into physical contact. Detection of target objects is usually based on sound, IR, electromagnetic fields, etc. Proximity sensors are used in surveillance, automatic doors, radar systems, object detection (e.g in car parking), speed detection, etc

In this project we design and build a prototype system to mimic object detection in car parking systems. An ultrasonic sensor is used to detect how close an object (e.g someone's hand) is to the sensor. As the object comes closer, a buzzer sound + lights indicates how close the object is: e.g yellow + buzzer sound = close , and red + more frequent buzzer sound = object very close.

Main components: Arduino Uno, ultrasonic sensor, LEDs (green, yellow, red), buzzer

5. **Project 5: Safety Box with NFC reader**

   NFC (Near Field Communication) technology enables wireless communication between two NFC-compliant devices, typically called the reader and the tag.The NFC reader generates an electromagnetic field which activates a circuit in the NFC tag. This allows the tag to send information, i.e the unique identifier of the tag, to the reader. NFC technology is widely used in wireless/contactless payment systems, identification badges, theft control for expensive products, etc.

   In this project, we build a safety box which can only be opened with a specific authorized badge/card. The box is equipped with an NFC reader + Arduino MC system which tests the tags of the cards used. Any unauthorized card trying to open our safety box triggers an alarm.

   Main components: Arduino Uno, NFC module (RFID-RC522), NFC tags/cards, LEDs (green, red), buzzer, servo motor

The necessary code and READMEs for these projects can be found in our github repository: https://github.com/Yuhala/stem-bootcamp