MOOC drones for agriculture : The making-of

MOOC Drones for Agriculture: The making-of

João Valente
Information Technology Group
Wagenigen University & Research
Wagennigen, The Netherlands
joao.valente@wur.nl

Lammert Kooistra
Laboratory of Geo-Information and Remote Sensing
Wagenigen University & Research
Wageningen, The Netherlands
lammert.kooistra@wur.nl

Abstract—**Imagine that there is an online course where you could learn how Drones/UAVs could be used to solve agricultural problems and contribute to the global food problem. What if you could make it yourself? We present the steps given in the design and development of the MOOC Drones for Agriculture: Prepare and Design your Drone (UAV) Mission. This MOOC is the first attempt to teach people about aerial remote sensing in agriculture. From the early stage idea to the making-of, this paper will drive you behind the scenes that made this MOOC.**

Keywords—UAVs, Drones, Agriculture, Online learning, MOOCs

I. INTRODUCTION

The food scarcity and growing population is demanding a rapid optimization of the current agricultural practices. UAVs are a rapid and efficient data gathering system when combined with Geographical information Systems (GIS) and Artificial Intelligence (AI). In agriculture this is very beneficial for farmers because it enables them to survey and assess large crop fields in a few dozen of minutes. Nevertheless, this technology is not yet fully available for non-experts and it is typically delivered by advanced users. Moreover, until recently there was not much discussion about the need to create new education programs and courses focusing on UAVs. But the high demand of applications and users have made that UAVs education is now a requirement [1].

This paper presents the setup of an online learning environment driven by a Massive Open Online Course (MOOC) that is an effort to contribute to further UAV education. The MOOC is named Drones for Agriculture: Prepare and Design your Drone (UAV) Mission. The MOOC will be represented by the mascot that is shown in Fig. 1.

II. PREVIOUS UAV MOOCS

The first MOOC was introduced in 2008 and succeeded several online learning courses. One of the first MOOCs given, was about Artificial Intelligence (AI). This MOOC attracted about 130.000 participants [2] showing the impact of this new learning approach. Moreover, for more than a decade edX have been hosting many MOOCs covering different subjects. For what UAV concerns, a limited number of MOOCs can be found. Some examples are the MOOCs offered by the University of Munich in Germany [3], and the University of Maryland, in USA [4]. The first is not active anymore and covers autonomous navigation and visual odometry applied to quadrotors. While the last MOOC is currently active and will give a general insight in drone technology fundamental and applications focusing in disaster response. The starting will be announced later, and the MOOC takes 6 weeks to complete. The MOOC presented in this paper cover an audience that is interested in agriculture, rural development and environment, but also other life domains where data science plays an important role.

III. THE IDEA

What is behind an idea? A MOOC aims to reinforce education in a determinate subject through a channel that is accessible to a wider audience around the world. An accessible and open learning scheme that will bring a message to the learner. This was the primitive that we start up with.

A. What is the purpose of this MOOC?

The MOOC as described in this paper is addressing UAV applied to Agriculture aiming to bridge the gap between people and UAV technology. This MOOC envisions an online course that provide the learner the fundamentals on aerial remote sensing focusing on agricultural applications. The MOOC informs learners about the current agricultural practices using this technology and the vantages that will bring to crop producers and farmers. It aims to teach how to use in a safe and efficient way an off-the-shelf UAV that can be acquired today right on the corner. Finally, with this MOOC we want encourage learners to think how to further customize aerial missions to solve specific problems.

Fig. 1. The Drone01x mascott named Johnnie is quadrotor that will accompanied the students through the MOOC.

B. Who is this MOOC for?

People. This MOOC is not just intended for students or drone professionals. This MOOC also intends to fill newbies learners with the enthusiasm to learn about this emerging technology and encourage them for gaining broader understanding on this subject. This MOOC is addressed for any person that wish to understand the functioning of the UAV technology, how UAV are used for agricultural management, and finally, but not least, how this platform can aid to solve

one of the most challenging problems in the world: Food scarcity and waist.

IV. CONTENTS

The Drone01x is composed of three modules that range from a basic understanding about UAVs and their role in remote sensing to the advanced usage of UAV data [5].

1) Remote Sensing, UAV's and Applications: In this module you will learn about what Remote Sensing is and how we can use UAVs as tool for our applications. We will explore the possibilities that airborne technology, e.g., types, sensors, offers. Finally, the UAVs legislation and regulations will be reviewed because flying safely it is our main priority.

Fig. 2. "Legislisation and Safety" knowledge clip taught by Dr. Lammert Kooistra.

2) Planning a mission and acquiring the data: In this module will cover the steps that need to be followed when planning a mission and the best practices to execute it in the field. It will explain how the data is acquired and how to customize an aerial survey with respect to flying parameters and mission requisites. Finally, it will introduce the learner to some of the handiest tools to manage program a mission in a drone.

Fig. 3. "Before you start flying" knowledge clip taught by Dr. Peter Roosjen and Dr. João Valente.

3) From acquisition to visualisation: This module focuses on evaluating and processing the data that we have obtained during the mission using open-source image processing software. Finally, this module will help you to understand how

to process Drone/UAVs data using accessible software and deliver a professional product instead of just a photo gallery!

Fig. 4. "Ground control stations" knowledge clip taught by MSc. Omar Velasco.

V. THE MAKING-OF

There are some rules of thumb for developing successful MOOC that can be learned from other authors experiences [6].

A. The MOOC in numbers

After the development of this MOOC several interesting numbers have pop up. Some of the numbers presented next are approximated: +10 filming days, +28 meetings, +12 hours of workshops and +150 emails. The time spent developing this MOOC from the kick-off meeting until the launching day was 10 months.
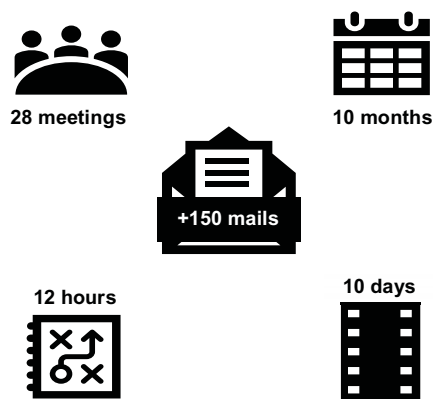

Fig. 5. Some intersting MOOCmetrics showing the overall team effort in numbers.

B. Important milestones

The most important milestones during the development of this MOOC were the kick-off meeting and the reality test meeting. The first addresses the 'must haves', while the second focus in the 'should haves. The kick-off meeting is where we can check if the idea of this MOOC makes sense and if all team member shares the same vision. It where's also the MOOC storyboarding is built, actually where the MOOC design starts with some side supervision (Fig. 6). Finally, there marketing, roles and other managing issues are also defined.

In the reality check meeting the main goal is to determine together if everything you designed and envisage to be

27–30 April, 2020, Porto, Portugal
2020 IEEE Global Engineering Education Conference (EDUCON)

included in the MOOC can in fact be developed in time for the course to open on the planned start date.

Fig. 6. Three lectures from the MOOC Drones for Agriculture working in team to build the storyboard during the kick-off meeting.

C. Creativity in action and planning

The MOOC team is made up five lectures and six members of an external support team. This team has based in five pillars from building this MOOC: Planning, resources, target groups, novelty, and commitment. The planning plays an important role as in another project. It's crucial for the synchronization of the team and resources, for ensuring contents delivery on time, and to estimate the MOOC launch. This MOOC was created to cover an heterogenous target group from the UAV enthusiast to the agricultural technician, to bachelor's students to entrepreneurs. The MOOC will employ novel didactical methods, such as the possibility to carry out outdoors learning activities. This new strategy is fundamental to this MOOC domain but is also essential to engage the students though a new learning dynamic. Finally, the key of a successful MOOC is the commitment. Most of the times MOOCs are side activities from lectures with other teaching responsibilities. An important amount of time should be reserved for MOOC contents development. This could be critical to the MOOC development. The amount of time need for contents development should be estimated beforehand.

D. Learning before teaching

Before starting the developing contents several courses and workshops where taken by the lectures: Introduction to knowledge clips, script writing training, studio training (Fig. 7), closed question writing training, etc. This workshop aims to provide the developers the personal tools to develop a MOOC that inform, inspire, enthusiast and encourage learners. Some of the most important lessons learned from these workshops are:

- During the studio training workshop: Try to use as many words you can say naturally without taking a breath. For most people this is about 12 words.

- During the knowledge scrip workshop: Use the word imagine. Be creative! Ask questions. Encourage students to do it itself.

- During the closed question writing training, workshop: Think about the learning goals before writing the exercises.

Fig. 7. A photo taken during the camera training workshop where we where learning about recording effects.

E. Knowledge clips

The most notable characteristic from online learning are the possibility to make knowledge clips that immortalize a lecture. Knowledge clips tell a story in short. Each clip should take 3-7 minutes and address a single topic. Before starting to write the script is mandatory to define the aim of the script and the take-home message. This MOOC offers several knowledge clips that were both recording on agricultural fields and in studio. In Fig. 3 show the preparation for recording a scene. The goal of this knowledge clip was to show what you have to have taken into account before flying, e.g., mission setup, materials list, transportation logistics, weather check. The take-home message was: Before flying there are several things that I have to have in consideration in order to fly in an effective and safe fashion.

Fig. 8. A day in the field while recording Module 2 – "Before you start flying".

F. Hosting

The MOOC provider is EdX that is where the Wageningen University & Research MOOCs are hosted (Fig. 9). The MOOC can will be launched in December 17th in edX under the flagship WageningenX [5]. Once completed is possible that you are illegible for a Verified Certificate, where the minimum grade of 60% is required. The exams in modules 1 and 2 each contribute 35% to your overall grade; the exam in module 3 contributes the remaining 30%. The graded exams are only available to learners in the verified track.

Fig. 9. Header of the Drones for Agriculture: Prepare and Desing Your Drone (UAV) Mission.

VI. SUMMARY AND ADVICES

This paper shows how the Drone01x MOOC was envisioned and the steps given over ten months of development. The MOOC will run from December 17th 2019 on. We are confident that the MOOC is going to contribute to disseminate knowledge about UAVs and how they can be used by non-experts for simple agricultural management tasks. Moreover, this is a very important step to bridge the gap between UAV technology and people. The outcomes from the first run will be used to improve successive MOOCs, but also to analyse UAV usability among learners.

Building a MOOC from the scratch it's a didactic and personal constructive experience, but it is also very time consuming. It advisable to plan ahead the time spent working in the MOOC, e.g., management, contents development, production. Ideally, schedule time slots in the agenda to dedicate to your MOOC project. Moreover, it also helps if everything is ready at least three weeks before the launching date because will give time to go through the details that sometimes are important for you. In general, enjoy this experience the best you can without putting boundaries to your imagination.

REFERENCES

[1] A. Fombuena, "Unmanned Aerial Vehicles and Spatial Thinking: Boarding Education With Geotechnology And Drones," in IEEE Geoscience and Remote Sensing Magazine, vol. 5, no. 3, pp. 8-18, Sept. 2017.

[2] Bertrand, S., Marzat, J., Maniu, C. S., Makarov, M., Filliat, D., & Manzanera, A. (2018). DroMOOC: A Massive Open Online Course on Drones and Aerial Multi Robot Systems. 2018 UKACC 12th International Conference on Control (CONTROL).

[3] edX course "Autonomous Navigation for Flying Robots", https://www.edx.org/course/autonomous-navigation-flying-robots-tumx-autonavx-0, last visited Oct. 2019.

[4] edX course "Drones and Autonomous Systems", https://www.edx.org/professional-certificate/umgc-usmx-drones-and-autonomous-systems, last visited Oct. 2019.

[5] edX course "Drones for Agriculture: Prepare and Design Your Drone (UAV) Mission", https://www.edx.org/course/drones-for-agriculture-prepare-and-design-your-drone-uav-mission, last visited Oct. 2019

[6] Manallack DT, Yuriev E (2016) Ten Simple Rules for Developing a MOOC. PLoS Comput Biol 12(10): e1005061.