

Mobi-MOOCs

A Simple And Effective Way To Deliver Educational Content

Prabhakar Tadinada, Sharwan Shukla, Gaurav Shukla
Department of Computer Science and Engineering, IIT Kanpur
{tvp, gshukla, sharwan}@iitk.ac.in

Abstract

Mobile phones have become affordable and ubiquitous. However, in most parts of the developing world, the data connections on these are either not present, or are of very low bandwidth and erratic and expensive for a large segment of the population. We suggest that we use voice connections to deliver educational content in such scenarios – we call this a *Mobi-MOOC*. Essentially, in Mobi-MOOCs, when a user calls up a number (can be toll free), an Interactive Voice Response System takes over and guides the user through learning objects. The system uses *Speech Recognition* to help the user interact with the system. We developed courses on Basic Crop Production Practices for Farmers and Gardeners and found them to be very effective. In this paper, we present the concept of Mobi-MOOC, the technologies and processes involved, and also the results of our Mobi-MOOCs. Not every subject can be taught in this format. In this paper, we will discuss the pedagogical issues related to designing courses for a Mobi-MOOC, like the duration of a lecture, and navigational issues etc.

1. INTRODUCTION

Since their inception, MOOCs have been consistently gaining popularity. In the developing world, they are still not accessible to a large segment of the population with scarce resources of data connections, if at all data is available, it's bandwidth is very low and erratic. However, this segment has access to simple mobile phone or feature phone with voice connections. So, it becomes imperative to build a technology based platform using voice connections to deliver a course with maximum possible engagement.

1.1. What is Mobi-MOOC?

Mobi-MOOC^[1] is an online course delivered over *simple* mobile phones. The user does not need a smartphone or an active data connection. The user interacts with the Course Management System using the NumPad or a Speech Recognition Interface. The course content is in audio format and is delivered over the phone through a voice call. All the stages of the course like Registration, Content Delivery, Assessments and Announcements happen over the IVR interface.

Mobi-MOOCs aim at making learning easier by making the course content available to them through simple mobile phones. Access to the mobile phones for this segment of population is relatively easy which makes Mobi-MOOC a better learning alternative. Audio clips of the lessons can be accessed by the Farmers while they carry on with their daily tasks, thus (taking up less time) making them more productive.

For better understanding of Mobi-MOOCs, we divide this discussion into two parts:

- a) Mobi-mooKIT: Technology and System Workflow
- b) Mobi-mooKIT in Agriculture: A case study of the courses delivered using Mobi-mooKIT platform i.e. Mobile for Maalis (MFM), MOOC on Agriculture/Horticulture, Basic Crop Production Practices (BCPP).

2. Mobi-mooKIT

“Mobi-mooKIT” is a platform which comprises of various hardware and software resources and their interaction with each other.

2.1. Technology

The technology behind Mobi-mooKIT is based on Interactive Voice Response (IVR), Speech Recognition and Open Source Soft Switch PBX System.

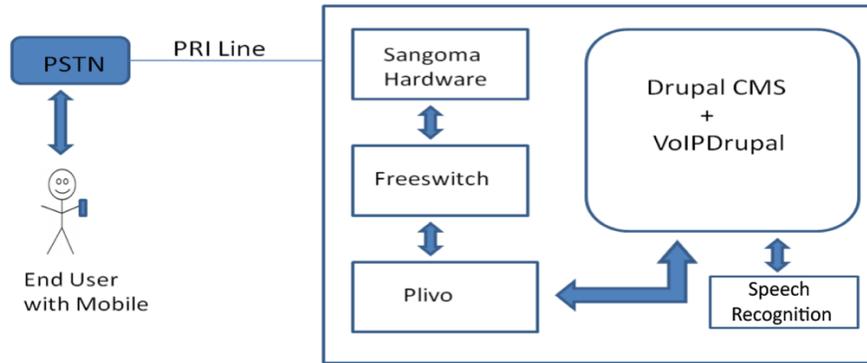


Fig 1: Mobi-mooKIT Architecture

Fig 1 shows various hardware and software components which constitutes Mobi-mooKIT platform. The system depicts an incoming call from the user's mobile phone through the PRI Line, which is attached to the Sangoma Card. Freeswitch Software acts as an intermediary between the Sangoma Card and Plivo. VOIP Drupal (a module residing in Drupal) interacts with Plivo APIs. This completes the end-to-end connectivity between the user and the system. Upon a successful connection, user interacts with the system using the IVR. User responds to the IVR either by speaking (which is deciphered by HTK Speech Recognition Toolkit) or with the help of NumPad to listen to the audio lessons.

The database of all participants and their activities is maintained by Drupal CMS. In this way, the experts can monitor the activities of the registered users, their progress in the course modules, their performance in the assessments and their feedback.

The various hardware/software components for building the platform are:

- **Drupal + VoIP Drupal:** Drupal^[5] CMS is used for managing the content. VOIP-Drupal^[6] is a module that provides interaction between Drupal and other telephony software like Plivo, Freeswitch etc.
- **Plivo:** Plivo^[7] provides Application Programming Interfaces (APIs) to make and receive calls, send SMS, make a conference call, and more. These APIs are used in conjunction with XML responses to control the flow of a call or a message.
- **Freeswitch:** Freeswitch^[8] is a scalable open source cross-platform telephony platform designed to route and interconnect popular communication protocols using audio, video, text or any other form of media.
- **Sangoma Card**^[9]: It is a hardware device where external PRI lines from PSTN (Public Switched Telephone Network) are connected to. It is the interface that allows Inbound and Outbound calls interact with underlying software.
- **PRI Line:** A PRI (Primary Rate Interface^[10]) line is an end to end digital circuit. It is a form of ISDN (Integrated Services Digital Network) line which is a telecommunication standard that enables traditional phone lines to carry voice, data and video traffic.
- **Speech Recognition:** For Speech Recognition, the Hidden Markov Model Toolkit (HTK^[11]) is used. It is portable, and one of the primarily used libraries for speech recognition.

2.2. System Workflow

A registered user can navigate through the course modules as well as the assessments with a basic knowledge of the working of a mobile phone, by following the steps displayed in Fig 2.

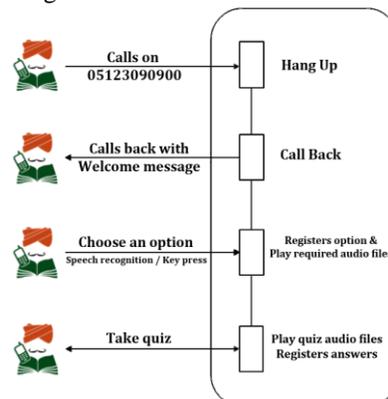


Fig 2: System Workflow

The process for delivering the course is as follows:

1. Users call up a number provided by the course administrators.
2. The system hangs up the call and initiates a callback with a welcome message.
3. Users have to Register themselves by providing their Name and Age. During registration the system stores their Mobile Number which is used for Identity Management.
4. When the course starts, the registered users can listen to the content in an audio format.
5. After completion of the course a quiz (having multiple choice or true/false based questions) is conducted as a part of student assessment/certification.

3. Mobi-mooKIT IN AGRICULTURE

3.1. Case Study of Agricultural Courses

In this section we will discuss the Pedagogical Issues, Navigational Issues, Exams, Feedback, Promotional Activities, etc. in the light of the Agricultural Courses (Mobile for Maalis^[2,3] {MFM}, MOOC on Agriculture/Horticulture^[4], Basic Crop Production Practices {BCPP}) conducted.

3.1.1. Pedagogy

First a structural outline for the course have to be formulated. This is the most important part as not all the content can be delivered over audio lessons and hence content selection is critical. It is essential to break the full course into sections and subsections. Let's see this in the perspective of MOOC on Horticulture^[4] course ran by IIT Kanpur.

1. The course was scheduled to run for 6 (4+2) weeks, where 4 weeks are for delivering the content and 2 weeks are for conducting the exams at the end of each week.
2. A total of 22 crops were selected for the course. First week covers 7 crops and rest three weeks cover 5 crops each. The details of each week along with their duration is listed in Table 1.
3. A single crop content is divided into nine subsections, typically the set of production practices (from Varieties to Harvesting) as shown in Table 2.

Week 1 (Vegetable Crops)	Duration (in min)	Week 2 (Flower Crops)	Duration (in min)	Week 3 (Fruit Crops)	Duration (in min)	Week 4 (Spice Crops)	Duration (in min)
Potato cultivation	6:21	Rose cultivation	7:01	Mango cultivation	6:38	Fenugreek cultivation	5:31
Tomato cultivation	5:56	Marigold cultivation	5:41	Guava cultivation	5:25	Coriander cultivation	4:48
Pea cultivation	5:38	Tuberose cultivation	5:15	Banana cultivation	6:30	Chilli cultivation	4:25
Brinjal cultivation	5:38	Chrysanthemum cultivation	5:53	Anola cultivation	6:38	Garlic cultivation	4:51
Cauliflower cultivation	5:23	Gladiolus cultivation	4:55	Papaya cultivation	5:15	Onion cultivation	4:11
Radish cultivation	4:04						
Carrot cultivation	4:11						
Total hrs.	2:00:13						

Table 1: Lectures Duration

Production Practices (Potato)	Duration (in min)
1. Varieties	0.27
2. Field preparation	0.21
3. Seed and sowing	1.08
4. Manure and fertilizer	0.30
5. Irrigation	0.30
6. Weed control	0.30
7. Disease control	0.57
8. Insect control	1.10
9. Harvesting	0.40

Table 2: Production Practices Duration

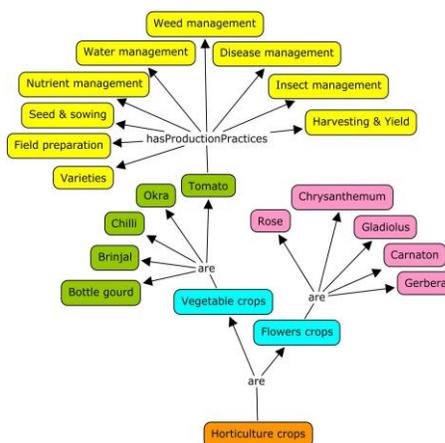


Fig 3: Production Practices

Pedagogical Issues

1. The lecture recorded has to be very clear.
2. The smallest logical unit of course must not exceed the duration of 7-8 minutes.
3. The smallest logical unit must also be complete in itself.
4. It is important to break this smallest unit to further sub-section of 1-2 minutes for better comprehension and also for the ease of navigation, as one can go back and forth to some specific part without listening to whole content.

3.1.2. Navigation

An IVRS (Interactive Voice Response System) is used to guide the candidates in a step-by-step manner and thus navigates through the program components without any hindrance. User can respond to the IVR by speaking the desired input (if speech recognition is enabled) or with the help of NumPad.

Upon selection of the desired crop, the lectures start with proper guidelines. User can listen to Production Practices from first part “Varieties” to ninth part “Harvesting”. Anytime the user go to other parts by verbal navigational aids which are provided for the purpose in the system (like “front”, “back”, “again” or by speaking the number from “one” to “nine” for the corresponding part). Alternatively, user can use the keys to navigate.

Speech Recognition: User can respond to the IVR by pronouncing the crops name in their local language. As the targeted audience were from the Hindi speaking belt, a Speech Recognition System is developed in Hindi. For this purpose, voice samples (of the words needed for navigation) from many users in Hindi were collected and the system was trained for this.

Navigational Issues

1. The hierarchy of the IVR system does not go more than 3 levels, i.e content is delivered to the user on or before 4th level.
2. At any point, user can interrupt and can go to other parts or to the previous menu.
3. For Speech Recognition the system has to be trained for the specific language.

3.1.3. Promotion, Quiz, Feedback, Announcements and Call Center

Promotion for all the courses, was done through a variety of channels. The courses were advertised in regional newspapers, through road shows and college visits. Users of the previous courses were informed over their mobile phones about the upcoming courses.

Quiz at the end of each week of the course is conducted. It consists of Multiple Choice or True/False Questions. 10-20 questions in each quiz are selected randomly from a set of questions for each user. User doesn't have to take the quiz in one stretch. User can attempt few questions, and can complete it later within the given time span for the quiz.

Feedback is collected from each user during the course. A survey was conducted later after the completion of the course by interacting with the user's individually (through feedback forms and interviews).

Announcements are sent to the registered users time-to-time to keep them informed about the content, assessments and certification etc..

Call Center facility was made available for the users with a dedicated number (different from the one used to listen the content) to resolve their issues/queries related to the course.

3.1.4. Participation and Evaluation

All the five courses conducted so far saw widespread participation. Table 3 lists a detailed statistics for the number of registered and successful users for each course.

Course Name	Duration	Course Content	Registered Users	Successful Users
Cultivation of Vegetable Crops in Kitchen Gardens (trial course)	1 week	5 vegetable crops	12	11
Cultivation of Flower and Vegetable Crops (trial course)	2+1 weeks	5 flower & 5 vegetable crops	111	58
MOOC On Horticulture	4+2 weeks	7 vegetable, 5 flower, 5 fruit and 5 spice crops	1055	296
Mobi-MOOC On Agriculture	4 weeks	4 cereal, 4 pulse, 4 oilseed and 4 vegetable crops	702	201
Basic Crop Production Practices	6 weeks	20 horticulture crops	1769	211

Table 3: Summary of all the courses

The qualifying criteria for the certificate was based on two factors – attendance and performance. Attendance was calculated from the number of complete audio lessons a user had listened to and Performance was based on the marks secured in the assessments/quizzes. Candidates needed a minimum of 50 per cent marks to qualify for the participation certificate and a minimum of 80 per cent for the competency certificate.

3.1.5. Key Findings

Some of the key findings inferred from the delivered courses are as follows:

- A technology built on Open Source Software (Drupal) with Open Educational Resources (OER) delivered over simple mobile phones makes learning easier and cost-effective.
- Learners exhibited positive sign in accepting ICT tools for learning.
- Teaching quality and content selection for the course is critical.
- High availability of online services is a critical factor to sustain learners' interest.
- The completion rate of the Mobi-MOOCs is higher than that of custom MOOCs.
- Incentives like certification or some prize for distinguished performance allure learners.
- Mobi-MOOCs cut across literacy barrier.

4. CONCLUSIONS AND FUTURE WORK

“Quidquid praecipies, esto brevis. (Whatever precepts you give, be brief.)”. Brevity in conducting these courses is of high importance. The course material designed for Mobi-MOOCs should be concise yet understandable and complete. Navigation is the browsing capabilities provided to the users through set of IVRs. So the IVRs should have clarity in voice and content.

For the technology part the PRI line connections have to be up all the time. This must be taken care of, as the dysfunctional line will have a bad impact on user convergence. However, the technology part can be replaced with some external service provider as setting up a server with PRI line connections and also its maintenance is resource intensive hence cost prohibitive. The “call-back” or missed-call” feature can also be replaced with a toll-free number.

Mobile users are ubiquitous. They are less constrained by time and place and hence are able to better manage self regulated learning. This may be the reason why the percentage of the user qualified in Mobi-MOOCs is reasonably more than the completion rates of MOOC courses. Mobi-MOOCs thus leverages the deep penetration of mobile phones and goes beyond literacy barriers.

Apart from agriculture, Mobi-MOOCs can effectively be used in sundry other domains such as Health Care, Taxi Drivers-Language Training Program. We would like to extend the Speech Recognition System to languages other than Hindi.

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