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Methodology

Development of an Android Based Interactive Guide for the Berliner Medizinhistorisches Museum of the Charité

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Abstract

Background

Pathology is defined as the science of disease-induced tissue alterations that range from macroscopic via microscopic to molecular levels of view. Herein we report the implementation of portable electronic devices that offer a holistic education and visualize disease related tissue information of formalin fixed organs (macroscopic appearance) together with microscopic images.

Aims

Continuous content updates, high performance, data-caching and the use apps in offline mode without network connection as well as the large amount of smartphone and tablet computers that run under Android operating system got us to create an appropriate system. The inclusion of virtual slides and virtual microscopy was assigned, however not yet possible at the date of system compilation.

Methods

We combined our virtual microscope „AndroScope“ with a new developed user-interface of the „Berliner Medizinhistorisches Museum“(Berlin Historic Medical Museum, BMM) for android based mobile devices such as smartphone and tablet computer. We used images of the exhibition samples, information of the corresponding organs and diseases, as well as epidemiology data and whole slide images for visualization of histological changes. Linkage of digital content and samples is realized using QR-codes to assure valid and user-friendly recognition. We have also evaluated other technologies such as NFC, Bluetooth, WiFi or GPS to ensure that the QR-Code solution is the best opinion. The application offers an online mode with full functionality and an offline mode with limited access to images as well as to the virtual microscope.

The application main database is stored localy at the android device. Online update capabilities are added.

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Results

The "BMM Guide" is available for all visitors of the museum for lendable devices or for students (professional audience) using their personal devices and installing the application manually via the web-access "eduroam". The guide is connected to the internet. It is designed to easily extend, update or transfer the content catalogue data. At the moment there is connection between the exhibit and text-, image-, video- or virtual microscope content via QR-Code. The offline mode is limited to the connection between text content and the exhibit. We also implemented a multi-language support for English and German. Information of room exhibitions, plans, opening times and latest news of the museum are available. The museum guide is an easy to understand, self-explaining blended learning tool, which can be embedded in a general educational system. The BMM exhibition guide opens a new door for self-studying of students. It can be integrated in curricular lectures in the future.

Keywords: e-Learning, Berlin Historic Medical Museum, Android, Podcast, Holistic Education.

Introduction

Surgical pathology or tissue – based diagnosis is defined as the science of disease associated tissue alterations [1]. It includes visual investigations at various levels of magnification, for example using the naked eye (macroscopy, gross appearance), magnifications within the range of light waves (microscopy), or macromolecules (DNA, genes, receptors, etc.) [2]. We want the students to study and explore all these changes using our educational approaches [3].

The education in pathology should be as detailed and informative as the science itself. That can be done by combining different teaching tools. These include classic lectures, where both students and teacher are present, classic e-Learning, or blended e-Learning to intensify and retrieve knowledge.

The classic methods include lectures that distribute detailed disease information and knowledge. They are usually supplemented by pictures of macroscopic and microscopic findings, and include three different kinds of practice.

The first kind is the classic macroscopic lecture. Corpses and organs, which are fixed by solutions with or without formalin, such as the Jores (I and II) or Kaiserling fixative are displayed and investigated by the students. The students should learn how to describe, differentiate, and to evaluate the visible disease induced tissue changes.

The second kind is the classic microscopic lecture. Students get informed of characteristic histological tissue changes. They should learn how to use a microscope, to search for areas of significant alterations, to describe and differentiate the microscopic visible abnormalities.

The third kind of lectures is called interdisciplinary education. Pathologists and physicians (specialists of different medical disciplines, for example oncologist, surgeon, etc.) discuss specific cases and include students in their discussion. Students should understand the significance of interdisciplinary diagnosis, treatment, and disease outcome, and the influence of treatment on prognosis and life quality.

E-Learning includes (power-point presented) slides of the classic lectures and whole slide images. It is designed for self-study. Slide presentations include commentaries, annotated

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pictures of glass slides or whole slide images. Some of them are converted into so – called podcasts of teaching slideshows.

E-learning courses provide healthy (physiological) and diseased (pathological) examples and derived algorithms of disease symptoms, causes, and classifications. It should be noted that any diagnosis finally results in a digital (yes or no) decision, and that all learning procedures should focus on its characteristics, independently of which teaching method and material is used [4].

Blended e-learning forces the students to execute a case (including all diagnostic findings and derived images) and finally proofs their knowledge by multiple choice questionnaires. These might include virtual slide images, macroscopic pictures, DNA fractions, etc. They can be arranged in two different manners, either by selecting the correct image to a certain disease, or be selecting the disease that is associated to a presented image [5].

Virtual slides can be integrated into the new lecture style (“blended learning”) too. It intermingles various issues that can be learned from case reports, such as clinical information, radiological images, or virtual slides, and recalls acquired knowledge memory - quizzes by matching pairs of macroscopic and microscopic pictures or diagnosis and microscopic pictures.

One portable viewer of digital slides for android-based devices is named “AndroScope” [6]. The AndroScope software tool allows the viewing and navigation of virtual slides on portable devices by touch gestures.

In addition to mandatory teaching sessions our students have the opportunity to visit the "Berliner Medizinhistorisches Museum (BMM)". BMM is included in the institutes of the Medical University Charité - Berlin. It is located nearby the institute of pathology (in the former museum building). It is composed of two sections, namely a temporary exhibition that focuses on different aspects of today’s medicine and medical history. The second part consists of a permanent exhibition that offers a path through medical history and - as the heart of the museum - the specimen hall with around 750 pathological-anatomical wet and dry preparations on display. Small tables present information (diagnosis, age of patient and specimen) about the specimens. [6]

All these offers are accessible from different places, from the library, from home, or on the way, and enable students to practice with the lecturer, study in the library and repeat the learning at home.

Basically, it is not possible to provide students with a microscope, books or mobile devices inside the museum. Extended supervision and control by trained personnel as well as time and information storage burden prohibit such a solution.

However, we want to combine the information that the BMM specimens present to the visitors with general knowledge and virtual slides of the specimen disease.

The visitor should need only one device to get informed. It should be multi- or at least bilingual (German and English) in order to offer understanding for most of the visitors, and to provide specific guides translation opportunities from English into their native language.

Therefore we choose the opportunity to inform the student/visitor right in front of a specimen in combination with the associated morphology images. We call this procedure the holistic education of diseases and their development.

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Currently 90.000 visitors enter the BMM each year. Most of them are interested, non-medical individuals. In addition, numerous students, pupils and employees of medical professions visit the BMM too. [6]

Material and Methods

We combined our virtual microscope „AndroScope“ with a new developed user-interface of the BMM and implemented an interactive guide. The guide is running on android-based mobile devices (smartphones, tablets, etc.). The commands are intuitive and given by touch gestures (drag, scroll, swipe, pinch). The application offers both an online mode with full functionality and an offline mode with limited access to images and the virtual microscope.

The home page(or cover?) of the guide includes different compartments, such as a Welcome-screen with the main menu, the table of content, a viewer for macroscopic pictures, the details of the disease or specimen, the scan of Quick-Response-Codes (QR-Codes), the viewer for microscopic (virtual) slides [5-7].

The Welcome screen includes a welcome message with current information, the main menu and the navigation bar (here only standard items, configuration and "about").

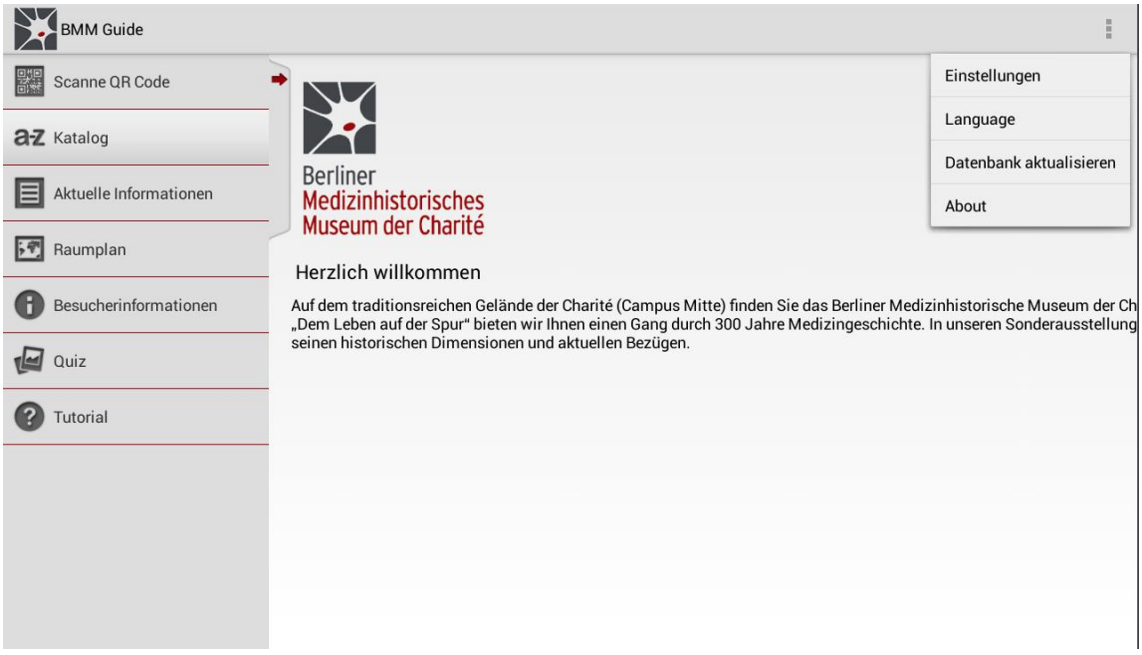

Figure 1: Welcome screen (left: main menu, middle: welcome message, top right: navigation bar)

The main menu appears as a scrollable list, a small icon, which explains the function of the item, and includes help functions. The main menu can be faded out to the left side if necessary.

The table of content is an organ-related list in alphabetical order. The organ-related order allows the user to find information about the organ, see all its diseases, and find an overview of all specimens of the organ. The table of content is usable in the offline mode.

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Figure 2 : Table of content.

The viewer for macroscopic pictures displays nearly full screen pictures. The user can zoom in and out and navigate the picture by touch gestures.

The details of the disease or specimen are presented in three parts: main navigation bar (title of the current specimen or disease), main area (information about the current disease and specimen), and additional information. The information content includes images of the exhibition samples, description of the corresponding organ and disease, as well as epidemiology data and whole slide images for visualization of histological alterations.

A QR-Code next to the specimen information-table is read by the QR-Scanner of the device and serves to connect the specimen with the guide. Each disease has its own QR-code. The whole structure is disease related. The same disease (of different specimens) possesses the same QR-Code and thus the same content. The disease related content offers the opportunity to unify all specimens (images) and information of the same disease.

The viewer for microscopic (virtual) slides is the AndroScope. The user can navigate by touch gestures. The user can zoom in and zoom out like a classical microscope, and move the slide (pinch and drag).

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Results

The “BMM Guide” connects the macroscopic images of the specimens with the microscopic alterations and main information about the specimen and its disease. The guide is bilingual, and designed for foreign students or professional audience.

The visitors can manually apply for installation of the guide via the web-access "eduroam", and easily install the guide on their personal devices and application.

All contents are available as long as the guide is connected to the internet (online mode). The offline mode is limited to the connection between text content and the exhibit.

It is designed to easily expand, update or transfer the content catalogue data.

The macroscopy viewer displays the specimen (or additional pictures of its disease either in the same or a different organ). It is equipped with a zoom, a navigator, and information descriptor of the specimen.

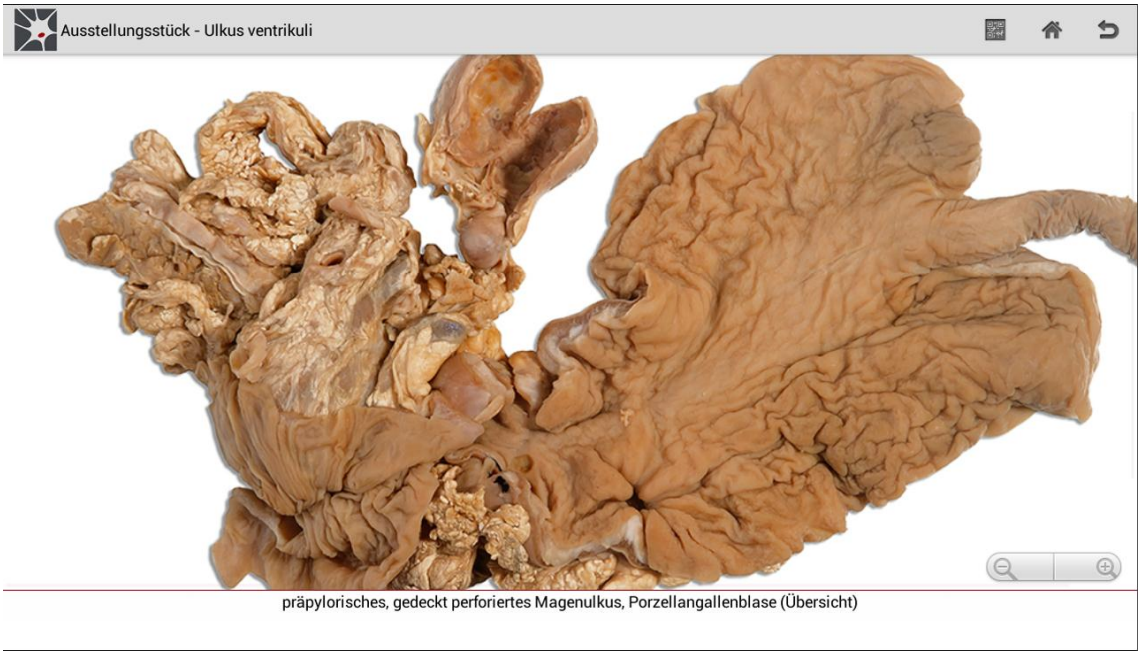

Figure 3: The macroscopic viewer.

At present, connections between the exhibit and text-, image-, video- or virtual microscope content via QR-Code are available.

The QR-Code permits a fast and accurate connection. It is not necessary to buy a new hardware or to install a specific hardware at the displayed specimens, in contrast to making a connection via Bluetooth, near field communication (NFC) or Holograms. Every mobile phone and tablet is equipped with a camera and possesses an App for QR-Code scanning or can download it for free.

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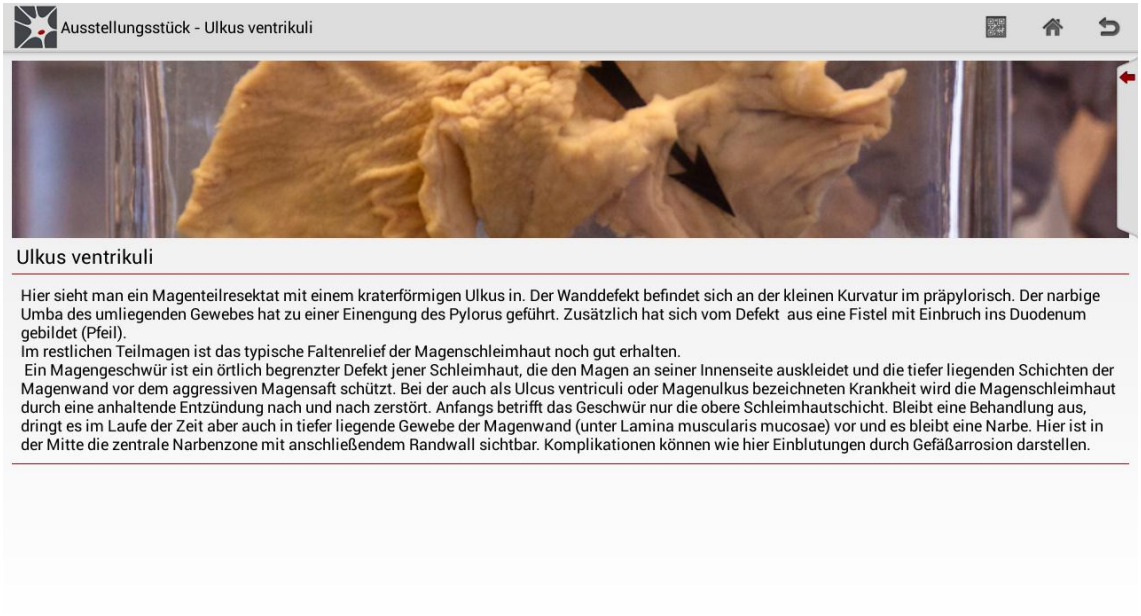
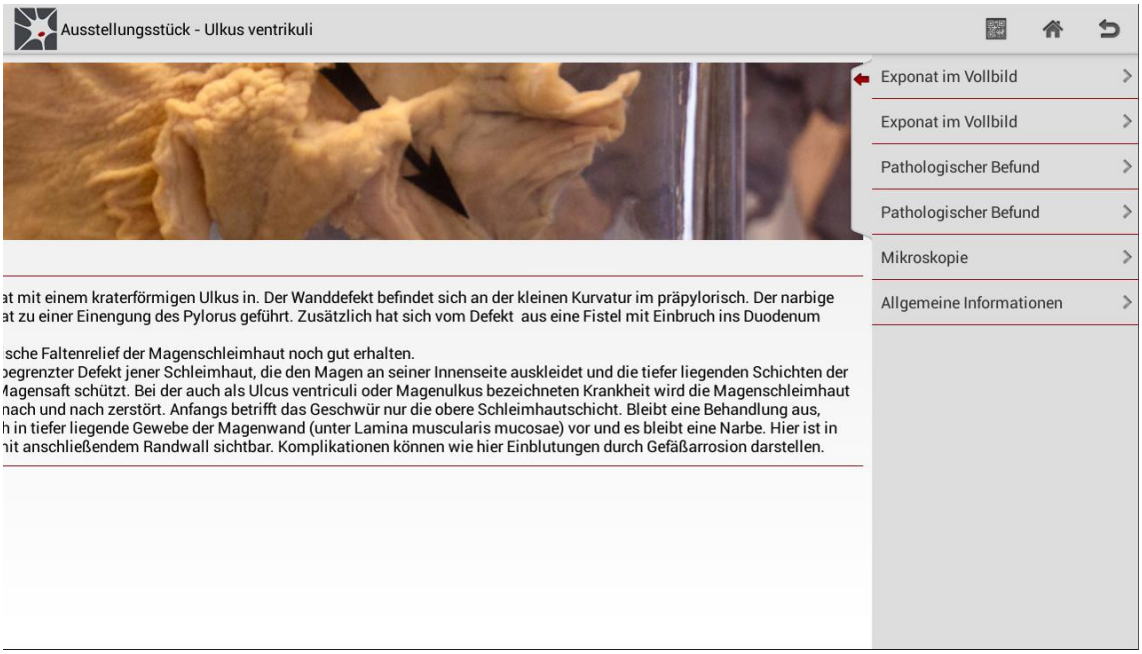


a



b

Figure 4(a+b): a - detail of disease; b - detail of disease with tool bar.

As demonstrated in Figures 4a and 4b the visitor immediately gets to know the details of the disease or specimen after scanning the QR-Code, and can decide if he would like to view the included microscopic images or different macroscopic pictures of this disease.

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The (virtual slides) microscopy viewer is included in the AndroScope. It starts with an overview, followed by interactive magnification and navigation.

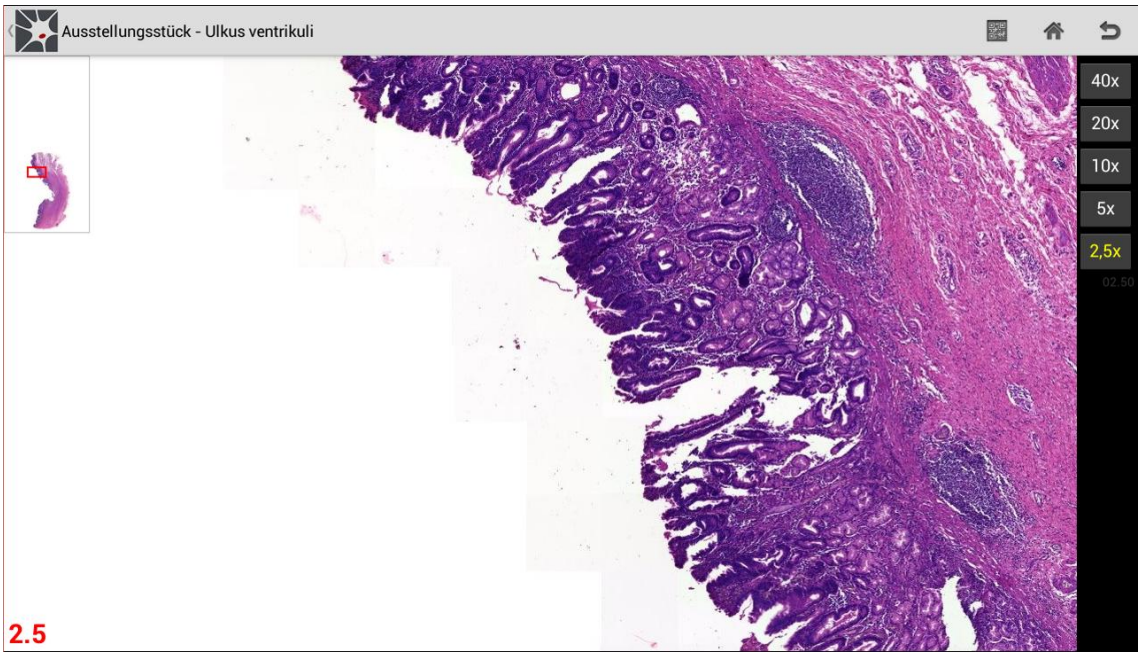

Figure 5: The microscopic scanner.

The "Welcome screen", the "main menu" and "the table of content" (including all exhibit specimens, <Figure 1>) are available in the offline mode too. A welcome message greets the visitor and informs briefly about the BMM. The main menu is clearly ordered and easy to understand. The navigation bar includes the configuration, the language settings, update of the database and the item “about”.

In addition, the visitor will find information about room plans, opening times and latest news of the museum.

The museum guide is an easy handable, self-explaining blended learning tool, which can be added or embedded in general education systems.

Conclusion

In aggregate, the developed BMM system has potential to be integrated in curricular lectures in the near future [7].

For medical students the “BMM Guide” offers a holistic education and opens a new door in self-learning. It is intuitive in its use and light weighted, is equipped with sufficient space to add more information that can be derived from additional specimens, diseases or macroscopic and microscopic images of healthy and diseased organs. Additional activities can be expected, like including an audio guide that obviously would increase the guide’s performance. Its implementation is foreseen in the near future.

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