Appendix A. DR10K Data Collection System Details

A system was developed to collect the patient's demographic data and the macula-centered fundus images for both the right and left eyes. The system allows also the ophthalmologists to annotate the collected images.

1. Data Collection

To collect the data, eight mobile collection units were used. Each of them is composed of a handheld portable non-mydriatic fundus camera of type Optomed Aurora and a laptop. The camera is of 50x40 field of view and produces images of a resolution of 2368x1776 pixels. Each unit is assigned to a team containing an image taker and an operator. The image taker captures the patient's fundus images using the camera then, the operator uses the data collection system on the laptop to enter the required data.

This system can be used online if the network connection is available and stable. Otherwise, an offline version is installed on the laptop with its local database to be used later to upload the collected data to the central system database whenever an internet connection is available.

We collect the patient's demographic data including his national ID, name, gender, date of birth, address, diabetes type, and diabetes disease starting date. Then, the exam data including the 4 fundus images of the two eyes, unless we are unable to capture one of them, and a signed consent letter that represents the patient's agreement to use his data for research purposes. Optional data are weight, height, blood pressure, HbA1c blood test, and blood sugar level measurements can also be collected.

In figure 1, we show a sample screen for adding the collected images using the data collection software that we developed.

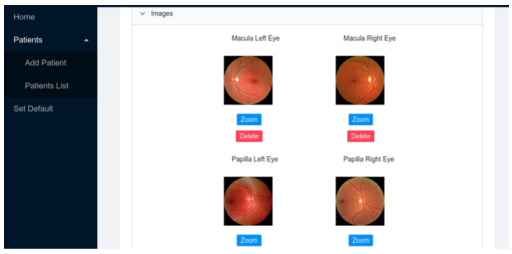

Figure 1. Sample Screen from the data collection software.

2. Image Grading

The fundus images are then annotated for their gradability, DR PIRC level, and referable DME. The annotation is done by a group of specialized ophthalmologists, each of them is UK certified grader[1]. Our grading system forces each image to be graded by three different graders. Firstly, the grader chooses whether the image is gradable, non-gradable, or non-applicable (not a fundus image for example). If the image is gradable, the grader must choose one of the 5 DR levels as the image grade and choose whether DME exists or not.

If the annotations of the 3 graders concerning the gradability and the DR level are not identical, the image is re-annotated by an adjudicator who is an ophthalmologist having more than 14 years of experience. The adjudicator can agree with one of the graders confirming his annotation or disagree with all of them and re-annotate the image. So, the final decision on the image gradability and the DR level, if it is gradable, is based on the agreement of three different graders or on the adjudicator grading in case of their disagreement. As for the grading of DME, the final decision is based on majority voting and not adjudication in case of disagreement.

In figure 2, we show a sample screen for grading an image using the image grading software that we developed. The ophthalmologist is allowed to grade the image and to enter a comment if needed as well.

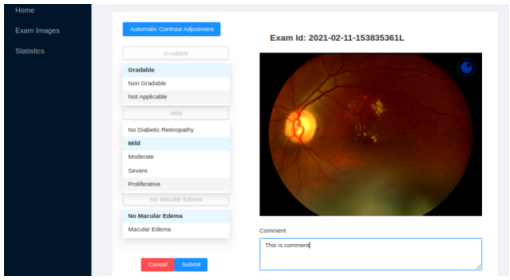

Figure 2. Sample screen from the grading software.

[1] All the graders and the adjudicators were certified after completing an online UK DR grading course (Diabetic retinopathy grading course awarded by Gloucestershire Retinal Education Group. Gloucestershire Hospital NHS Foundation Trust, UK) and successfully passing the final evaluation exam.