

# Crowdsourcing the Monitoring of Global Environmental Change with Citizen-oriented Science

## FINAL REPORT

**Title:** Digital Earth Watch

Development of the Virtual Picturepost: the DEW smartphone app

Co-Principal Investigator: Fabio Carrera

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Worcester Polytechnic Institute,

100 Institute Road, WOrcester, MA 10609

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This research project has its origins in a NASA-funded program called *Measuring Vegetation Health* (<http://mvh.sr.unh.edu/>), spearheaded by the Earth Systems Research Center at the University of New Hampshire. The MVH project developed the concept of the *Picturepost* to monitor long term vegetation health (and climate change) using repeat-pictures of vegetated areas, over time. The concept revolved around the installation of octagonal posts at parks and nature reserves, from which the visitors could take a panoramic set of 8+1 photos with consistent orientations to the North, NorthEast, East, SouthEast, South, SouthWest, West, NorthWest and even looking Up at the sky or tree canopy. Once home, these volunteer citizen-scientists would upload the photos to the picturepost web site (<http://picturepost.unh.edu/>).

Our research group participated in the second phase of the Picturepost project (also funded by NASA), called Digital Earth Watch (DEW). Our role in this three-year project was to facilitate public participation using innovative techniques and technologies, above and beyond the physical posts that would continue to be installed around the country.

To satisfy the objective of the sub-award, our WPI-led team developed a prototype Android app for smartphones, which allows aspiring citizen scientists to create virtual pictureposts anywhere on earth, and still be able to take aligned photos in consistent orientations, using the phone's sensors as guides for the alignment. The smartphone app has the major advantage of being able to upload the images directly to the UNH server, which makes it a desirable tool even in the presence of a physical picture post.

Although we explored all 7 of our original objectives, we chose to focus primarily on the mobile application development because it promised to fulfill most of our current aims, while opening up interesting possibilities for the future.

## APP DESIGN AND DEVELOPMENT

The app was designed by the co-PI and developed by sub-contractor Redfish Group LLC of Santa Fe, NM, thanks to lead architect Stephen Guerin and two principal programmers: Joshua Thorp and Scott Wittenburg. Final interface designs were mocked-up by WPI intern Neil Pomerleau and implemented by Scott Wittenburg. Other interns played a variety of roles in the course of the three year project, primarily: Kyle Miller and Benjamin Lichtner.

The principal challenges encountered in programming the app on the Android platform were related to the lack of a real standard for programmatic access to the phone camera, which differed from one phone make/model to the next.

The development of the app forced a parallel amount of work on the development server <http://picturepost-dev.sr.unh.edu/>, which had to allow the app to access several of the functions already available in the PicturePost web site, through an Application Programming Interface (API). The server-side API's were programmed by UNH researcher William Armstrong.

## **DISSEMINATION of RESEARCH**

The work on the DEW app has been presented at a number of meetings, conferences and workshops, most notably:

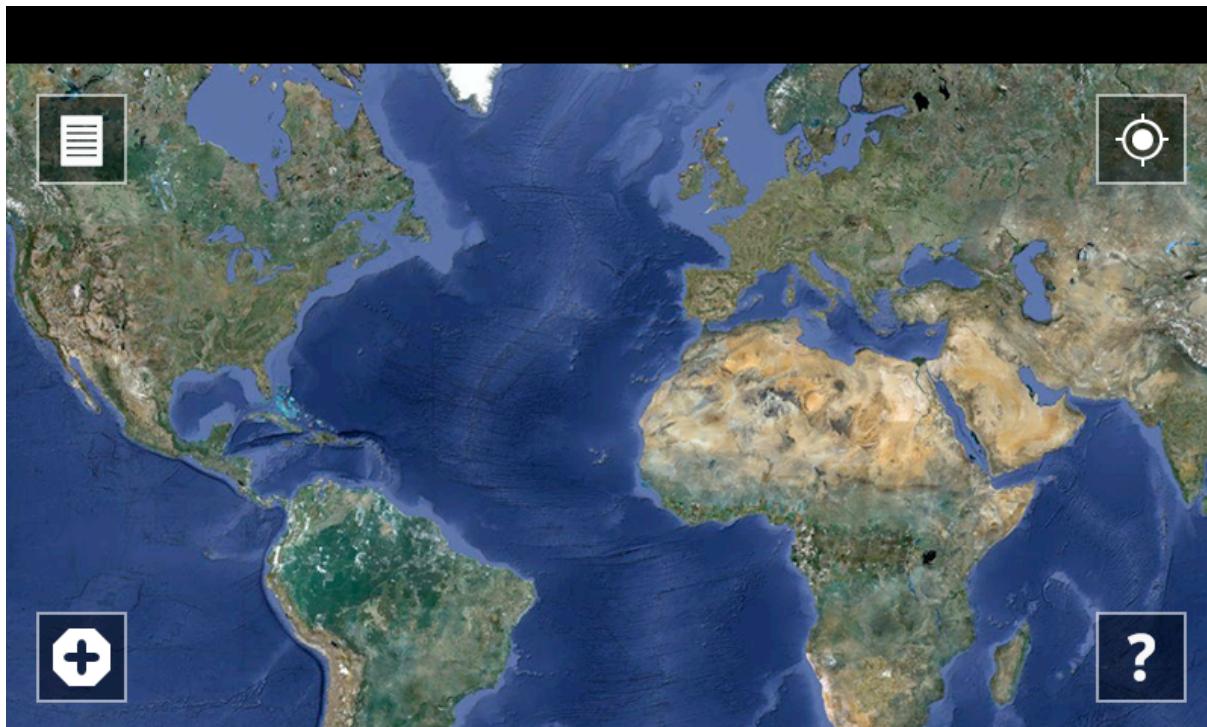
- AGU, S.Francisco, 2011 , poster  
([https://docs.google.com/file/d/0B7ELN\\_M21x\\_kbE1YcW1kZ2NMclU/edit](https://docs.google.com/file/d/0B7ELN_M21x_kbE1YcW1kZ2NMclU/edit))
- ESA, Austin, 2011, Powerpoint (<http://www.slideshare.net/carreraf/ecological-society-of-america-austin-2011>)
- Oxford University, 2011
- MIT, UIS Research Seminar, Powerpoint\* (<http://www.slideshare.net/carreraf/urban-agents-and-citizen-apps>)
- National Geographic Society, Washington DC, 2010, Powerpoint\*  
(<http://www.slideshare.net/carreraf/citizen-apps>)
- UNH, 2009, Powerpoint\* (<http://www.slideshare.net/carreraf/cs-1338347>)

\*Click on the FULL SCREEN button at the bottom right of the presentation window on slideshare to view the Powerpoint presentation on a full screen.

## **DESCRIPTION of the DEW app**

The DEW app is available for the Android platform and it can be downloaded from the market (now Google Play) by searching for “Digital Earth Watch”.

The home screen of the app is shown below (to be updated). The app only works in Landscape mode, irrelevant of the screen orientation.



In essence the application allows a smartphone user to:

1. CREATE a new “virtual” picturepost anywhere on earth
2. SELECT an existing picturepost (real or virtual) from a MAP or from a LIST
3. VIEW the information and photos associated with a post
4. ADD PHOTOS to a picturepost of choice as a set of aligned and oriented images
5. UPLOAD the smartphone pictures to the picturepost server directly

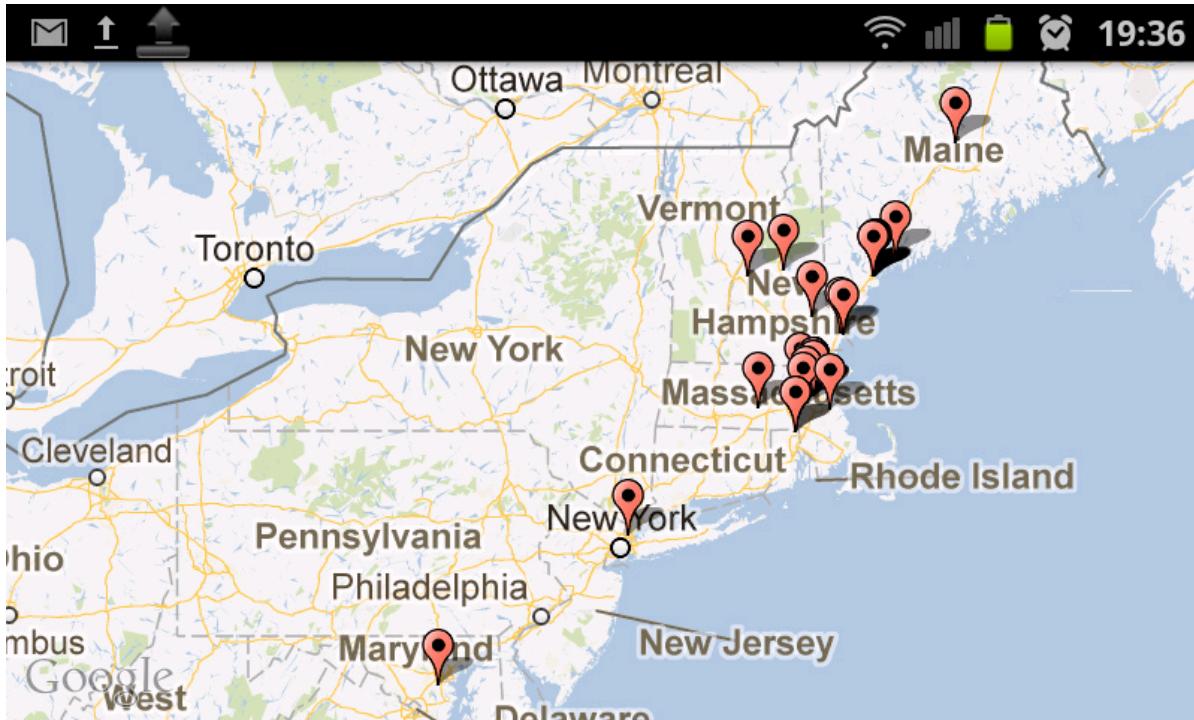
### **Creating a Virtual Picturepost**



By clicking on the + sign  on the main screen of the DEW app, a registered Picturepost user will be able to create a new “virtual” post at that location. The GPS coordinates of the phone are gathered automatically and all the user needs to do is to give the virtual post a name and optional description. After the post is created, the app goes straight into the photo-taking mode to allow the user to add the first set of pictures to the newly created post. Selecting a Post



Users of the DEW app can select a specific picturepost from the Map view



Alternatively, one can also select a post from or the List view

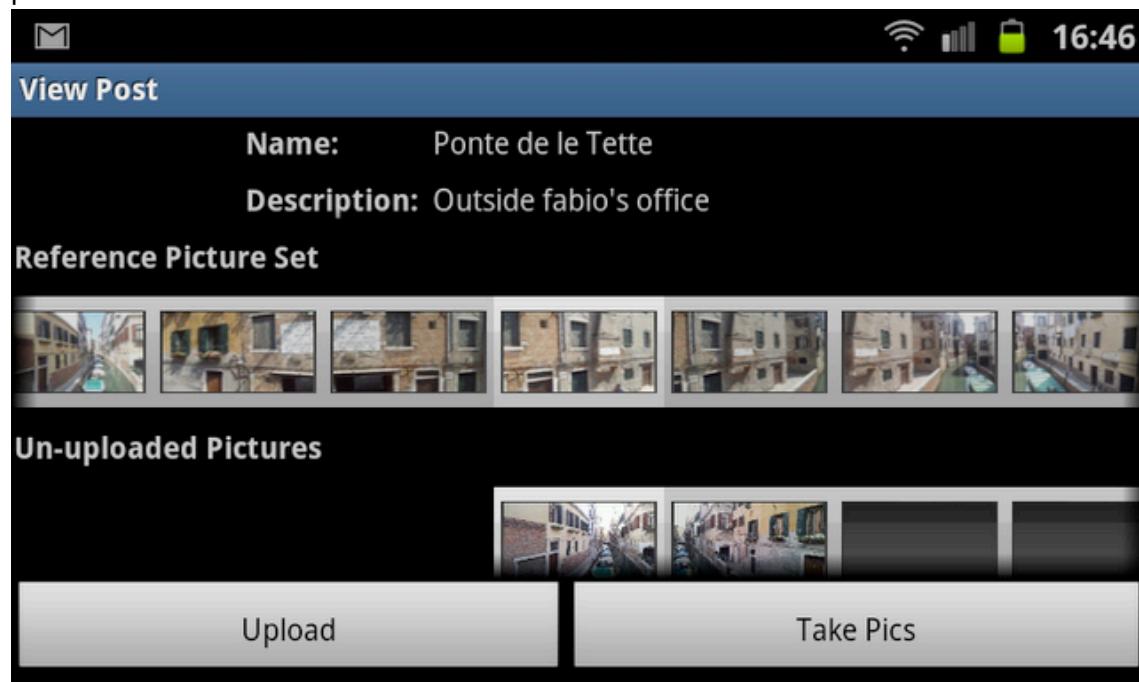


Until it is combined with the [official picturepost site](#), the list of posts in the App comes from the partial database on the [Development server](#), which contains a set of “real” posts (frozen in time) and a whole lot of “virtual” posts created around the world while the DEW app was in alpha version.

The DEW app does not affect the official Picturepost yet, though it is expected that it will interact with the actual picturepost database at some point in the future.  
Selecting a post, will bring up the post VIEW screen.

### **Viewing a Post**

Once a post is selected either from the list or from the map, the user can view the Post data and photos.



By clicking on Take Pics, the DEW app gets into photo-taking mode.

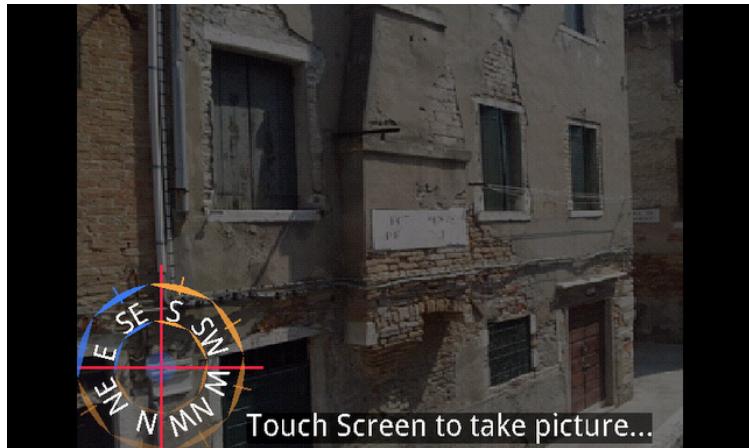
### **Adding Photos to a Post**

The photo-taking component of the DEW app is intended to eliminate the need for a physical post, though it can still be used even in the presence of a real post, with the major advantage of being able to immediately upload the picture set to the picturepost web site.

When used to update a virtual post, the user is expected to navigate to the GPS location of the post and then enter the photo-taking mode after selecting the post from the list or the map.

#### **Taking Panoramic Pictures**

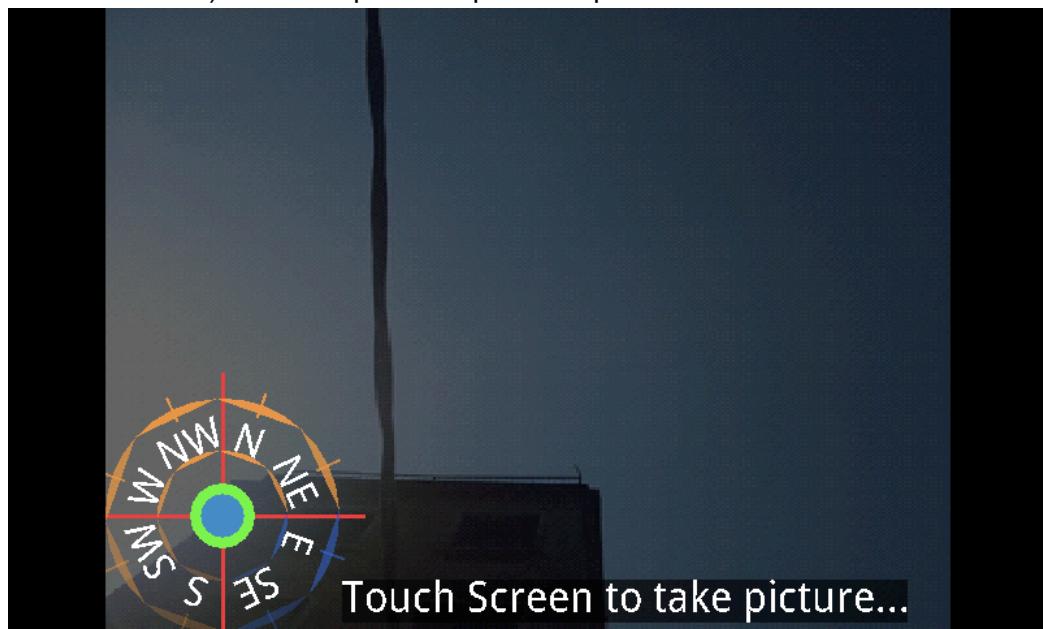
The photo-taking mode presents an orientation wheel at the lower left of the horizontal (landscape) screen. Initially, all 8 directional arcs of the wheel will be Blue to indicate that no picture has been taken in that direction yet. Once pictures are taken, the corresponding quadrant of the wheel turns Orange.



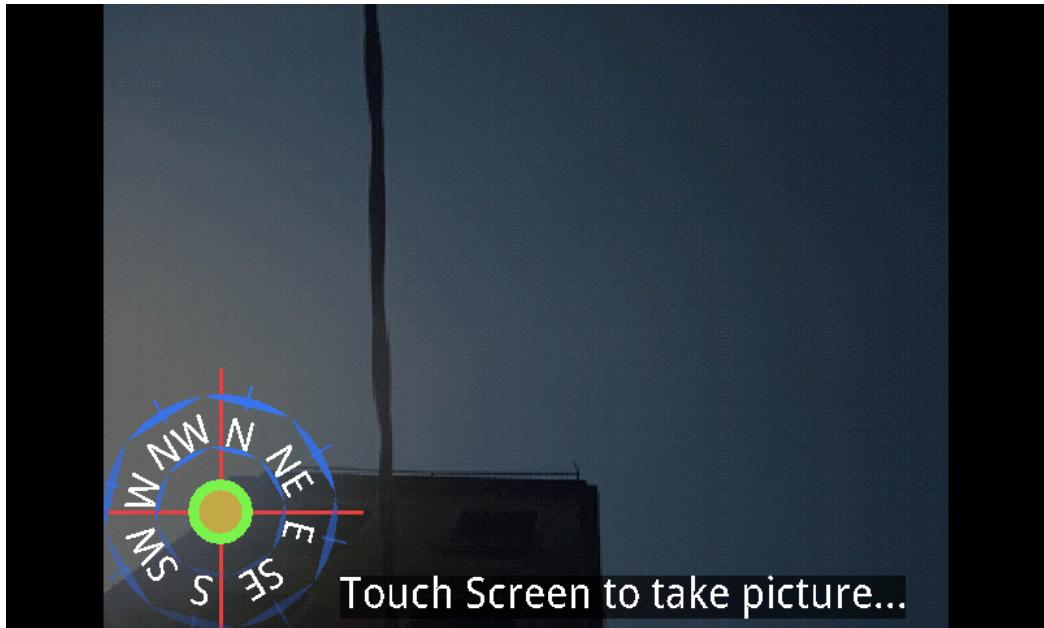
When the phone is aligned with one of the 8 positions, the corresponding segment of the outer wheel will turn bright green. To take a picture, the user has just to touch the screen.

#### Taking the UP picture

The system also gives a similar indicator for taking the “UP” picture, by first showing a BLUE circle with a GREEN border in the middle of the wheel, which activates (using the phone accelerometers) when the phone is pointed upwards.



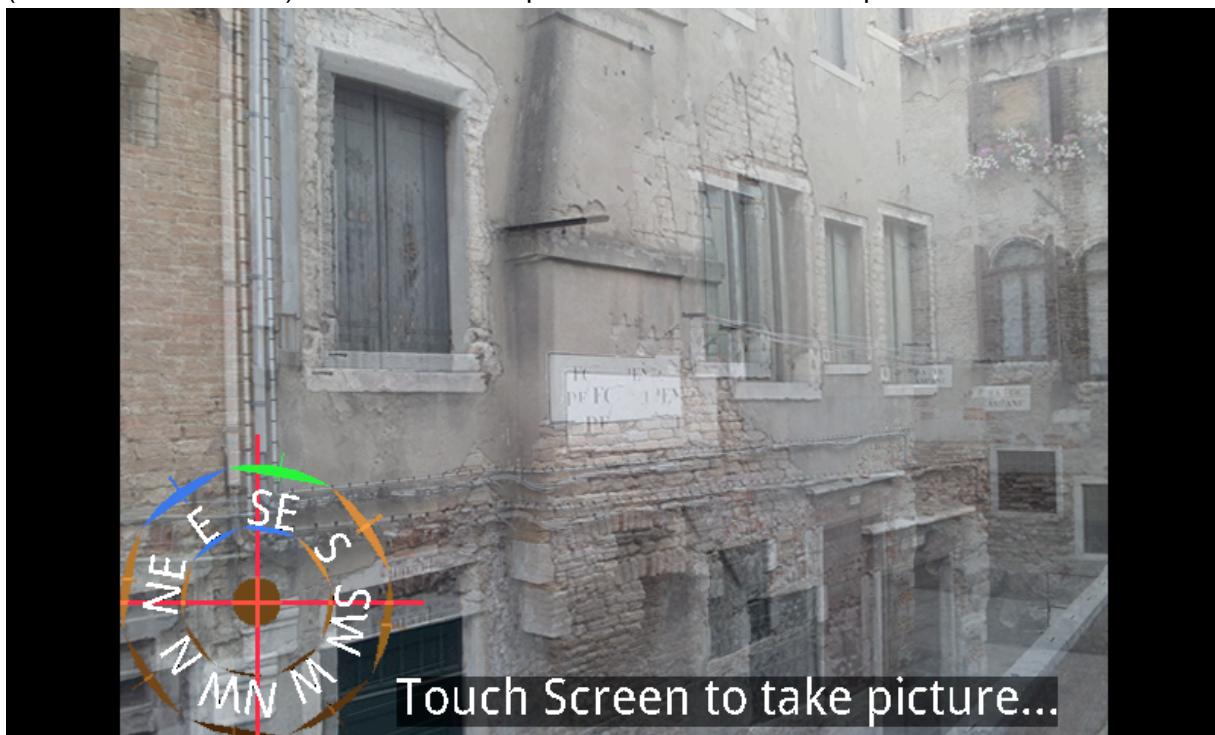
Once the UP picture has been taken, the circle turns ORANGE.



#### Aligning the Photos (Alignment Wheel and “Onionskin”)

Ideally, the user should try to take the picture when the center line of the compass wedge is aligned with the red crosshair, especially when creating a new virtual post.

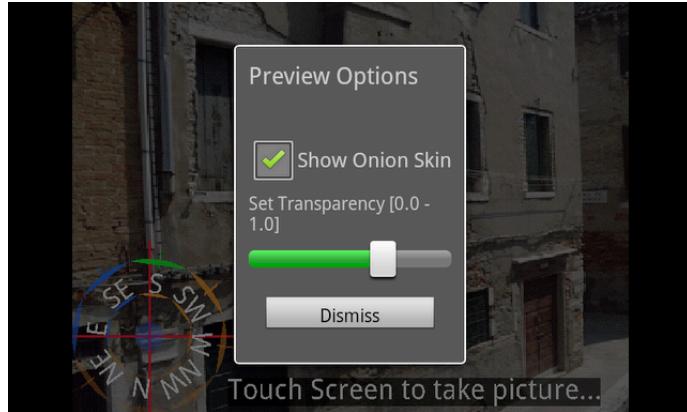
To assist the user with subsequent photos, the system will superimpose a transparent image (called an “onionskin”) of the “reference photo” for the current compass direction.



### Onionskin Transparency Adjustment

To facilitate the use of the onionskin to align the new photo with a prior reference one, the user

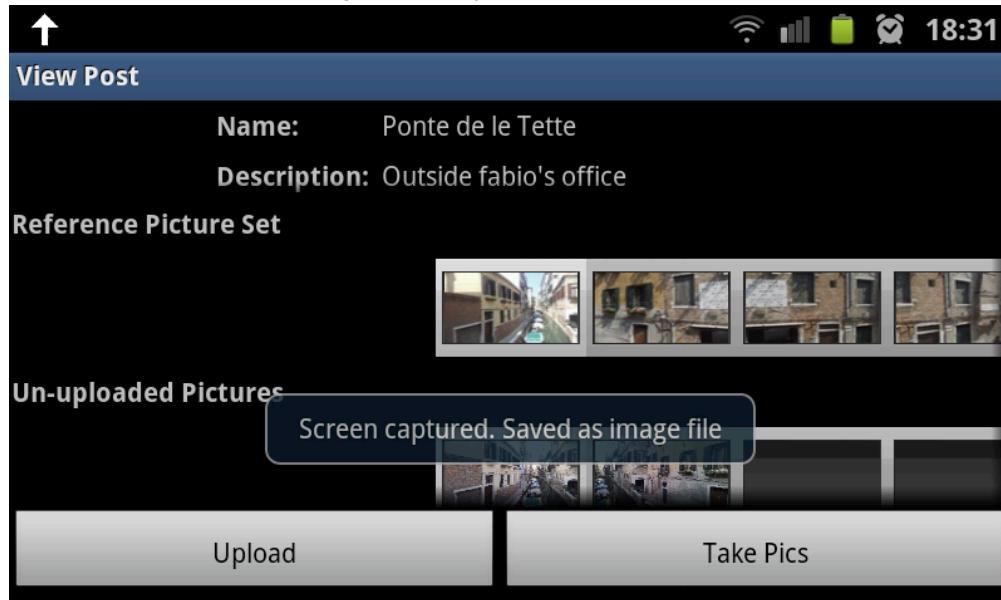
can hit the Android hardware menu button  (bottom left of phone) and select “Camera Preview Options”.



By sliding the Onion Skin slider to the right, the “older” reference picture (onionskin) will be more visible (i.e. less transparent, or more opaque). Viceversa, by sliding it to the left, the onionskin gets more transparent. Depending on light conditions, the user will want to adapt the transparency to facilitate the alignment of the new picture with salient elements of the onionskin (like windows, doors, corners, etc).

### Uploading Photos to the Server

Once a full set of 9 pictures has been captured at a (virtual) post location, the user can hit UPLOAD to send the images directly to the PicturePost server.



Currently these pictures go to the development server, not the official one.

picture post

Home | Stuff You Can Do | Educators | Buy | Build | Gallery | Help | My Page | Logout (Fabio Carrera)

**Post:** Ponte de le Tette  
**Upload:** Click [here](#) to upload pictures for this post.

Click [here](#) to add this post to your favorites list.

comments  metadata  satellite (TC)

Click [here](#) to comment on this picture.

← E →  
 Scroll around the panorama.

↑  
 2012-06-28 19:52  
 ↓  
 Scroll through time.

1 - 3 of 3      50 per page

N	NE	E	SE	S	SW	W	NW	UP	Info
									2012-06-28 19:52 <a href="#">manage</a> <a href="#">flag</a>
									2012-06-28 19:42 <a href="#">manage</a> <a href="#">flag</a>
									2012-06-11 15:17 <a href="#">manage</a> <a href="#">flag</a>

The user can continue to use the phone or the DEW app while the uploads are happening in the background. An upload indicator (white arrow pointing up) is shown on the phone status bar while the upload is in progress.

