Supporting Material for:
Fixed photogrammetric systems for natural hazard monitoring with high spatio-temporal resolution

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Content:

1. General software installation

For the operation of the system, it is necessary to install an operation system (OS) and the software for the WittyPi shield on the Raspberry Pi memory card. Details in that regard are beyond the scope of this study. However, these requirements can easily be completed by following the respective manuals. Therefore, solely a simplified guide of the main steps are detailed below.

To install the OS for the Raspberry Pi an OS image can be downloaded from the official repositories and must be "burned" on a microSD card. Tools such as Raspberry Pi Imager can be used for the installation process. For maximum efficiency (reducing boot time and power consumption), the legacy version of the Raspberry Pi OS, that does not include a graphical user interface, should be used.

The WittyPi software is provided by UUGear, and it can be downloaded from its repository and installed according to the instructions provided by the hardware. The software enables the access to the features of the WittyPi hardware. It is highly automated and integrated with the Raspberry Pi. Amongst other it can be used to i) update the time and date when there is internet connection to avoid RTC drifts; ii) load customed schedules; iii) shut down the device, iv) schedule the next boot and v) boot the Raspberry Pi at the programmed date and time.

2. Figure S1 - List of components
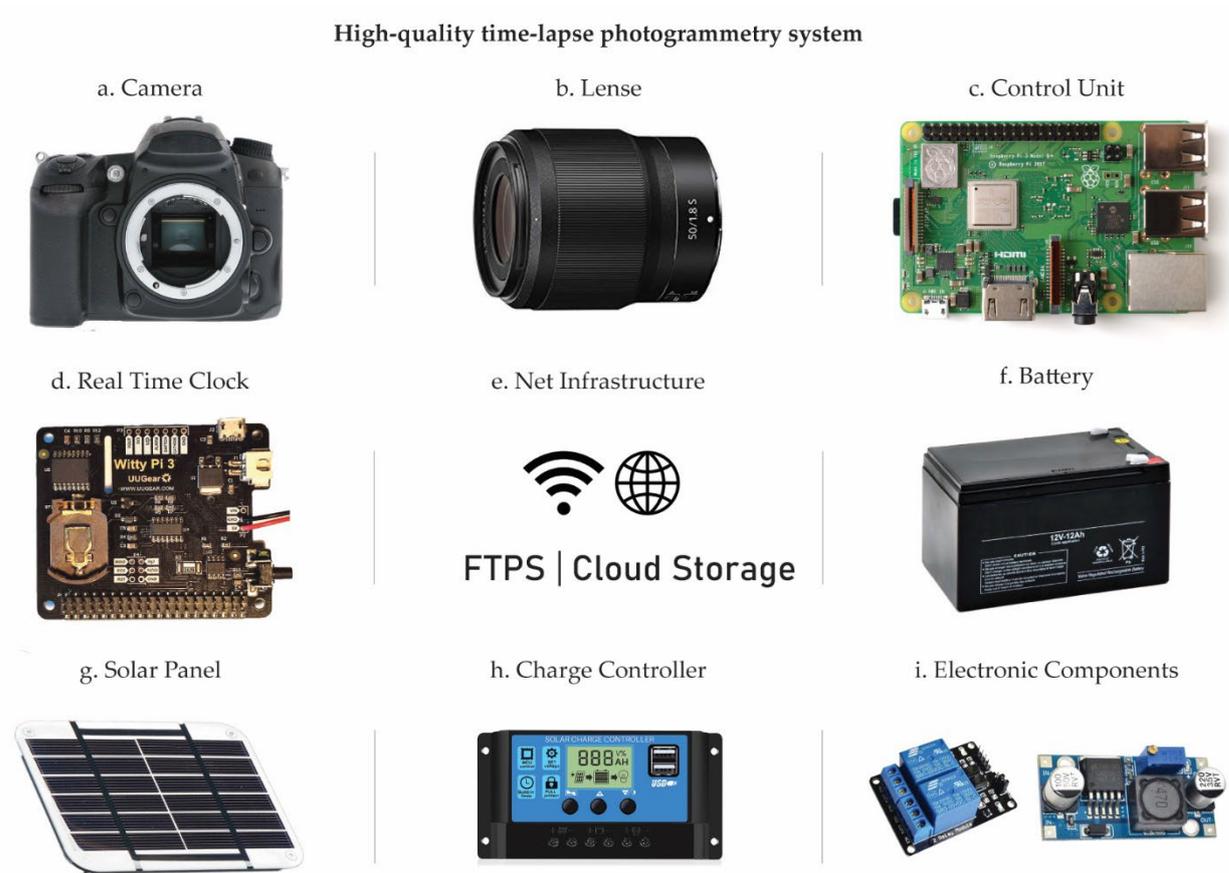
Figure S1. Specific elements that comprise the high resolution photographic modules: a) Camera (in this work DSLR and Mirrorless cameras have been tested); b) Lense; b) Raspberry Pi model 3B microcomputer board for the control unit; d) WittyPi 3 Real Time Clock (RTC) board; e) Network and servers infraestructure; f) AGM battery; g) Solar Panel; h) Solar charge controller i) Electronic components: DC-DC converter (Steep down) and generic mechanical relay.

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 3. **Figure S2. Connectivity Module (Assembly)**
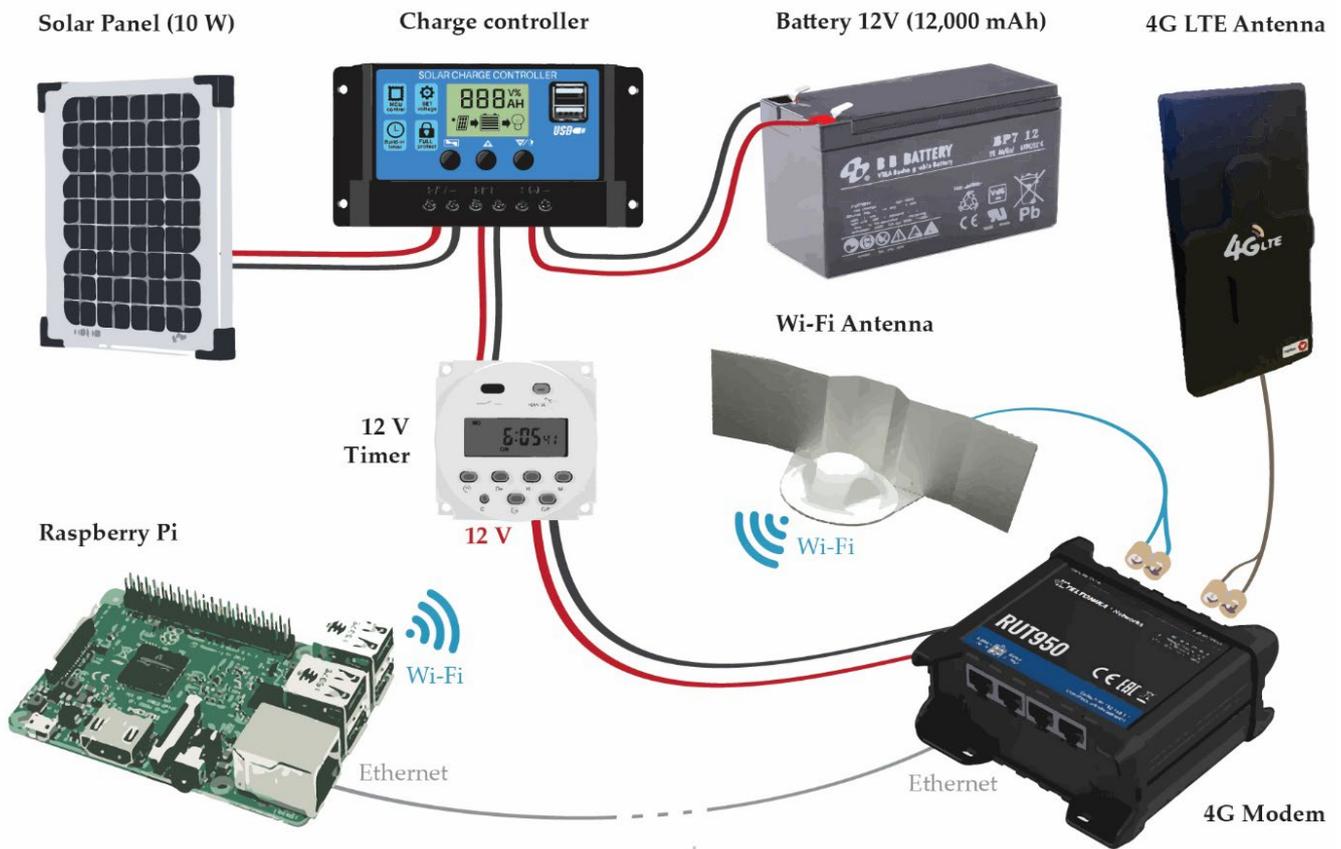
Figure S2. Installation sketch of the components for the connectivity system. The solar panel and battery are connected to the charge controller. A 12 V timer is connected to the output of the charge controller to be used as a system switch. External antennas can be installed on the modem using the RSM-A connections. Finally, the control units can be connected via Wi-Fi or Ethernet.

4. **Figure S3. Connectivity Module (Pictures)**
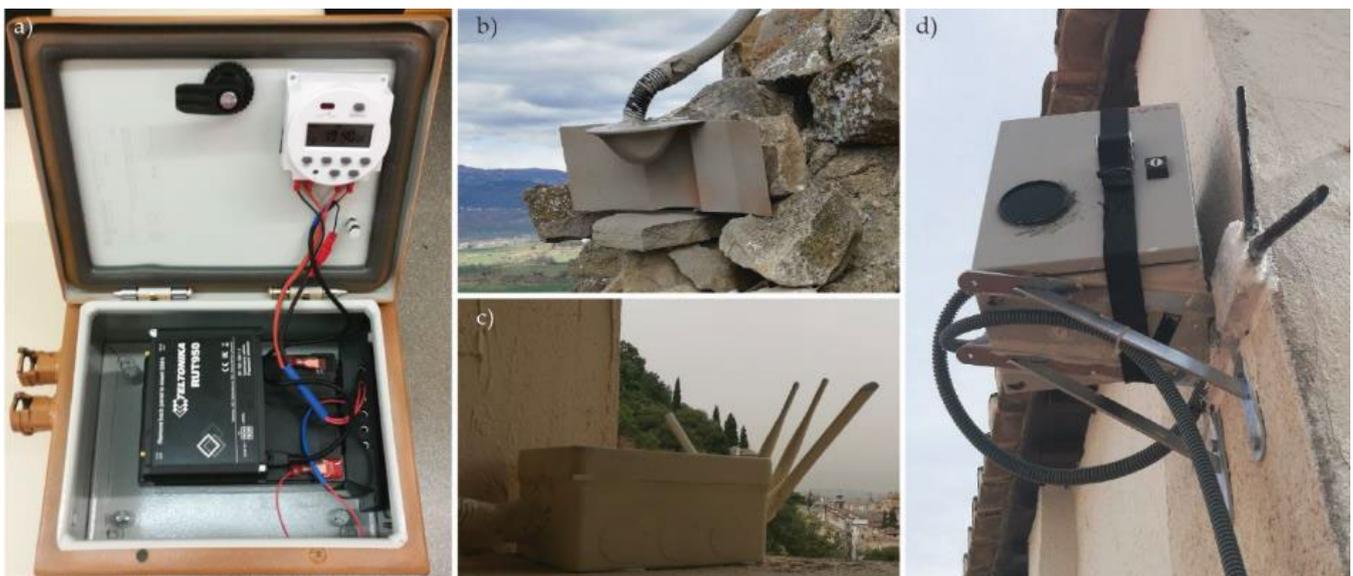
Figure S3. a) Connectivity module, the metal box contains the battery, the 4G modem, the solar charge controller and the 12V timer. b) Wi-Fi Antenna with a radiation pattern of 180º installed in Puigcercós. c) Plastic box with the omnidirectional antennas (360º radiation pattern) in a window in the Alhambra de Granada system. d) Photographic module with its own modem installed in the Alhambra de Granada site.

5. Figure S4. Images from Puigcercós high resolution system

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Figure S4. Images obtained with each high resolution photographic module installed in Puigcercós on 22 April 2019 at 17:47h. Three cameras use the Sony Alpha 7R III with a resolution of 42.4 MPx and are equipped with a 35mm f/2.8 lens. The other two modules use a Canon 77D DSLR camera with an APS-C sensor and a resolution of 24.2 MPx. The Canon cameras are equipped with a 24 mm f/2.8 pancake lens. a,b) imagees of the modules installed in the field.

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6. Figure S5. Images from Alhambra de Granada high resolution system

Figure S5. Images obtained with each high resolution photographic module installed in front of the Alhambra de Granada on 12 July 2019 at 09:17h. All cameras use the Nikon D610 DSLR full-frame with a resolution of 24.3 MPx. Each camera has a different lense due to the irregular distribution of the cameras. a,b) Images of the modules installed in the different building sites (e.g., a) roof, b) windows).

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7. Figure S6. Point Cloud from Alhambra de Granada high resolution system
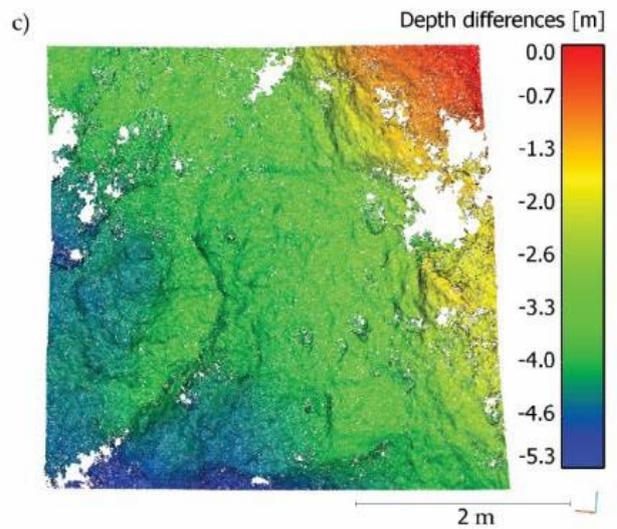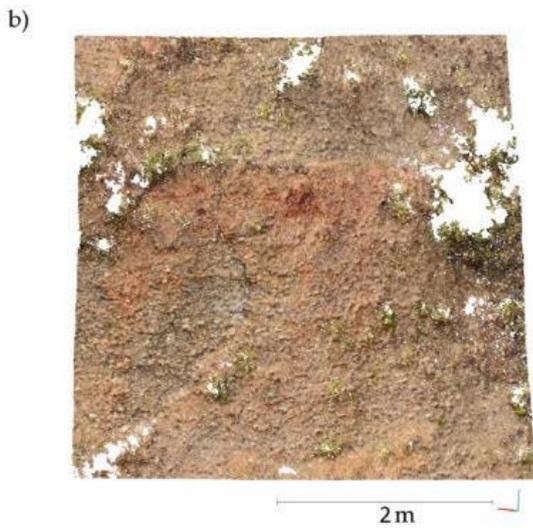
Figure S6. Point cloud of the photogrammetric model created with the images of the Alhambra de Granada. b) Detail of the central area of the escarpment (black inset). c) Depth differences map (black inset)