REMOTELY-OPERATED FIELD ROBOT TO DETECT OLIVE TREES INFECTED WITH *XYLELLA FASTIDIOSA* USING PROXIMAL SENSING

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A simple and flexible robotic solution has been developed that equips proximal sensing technology to inspect olive fields in search of early infection by *Xylella fastidiosa*. The robot is operated remotely. Two batteries allow continuous use for six hours, which allows the inspection of a field of approximately 4 ha. Due to the height of the trees, a system of elevation of the cameras has been designed so that they can be raised up to 200 cm. An encoder connected to the axis of one of the motors measures the distance travelled by the vehicle allowing the computer to trigger the cameras at programmable intervals. The system has been tested in a field of olive trees potentially infected by *X. fastidiosa* located in an area of Italy declared under containment in the province of Lecce (Apulia Region). A series of tests have been carried out in an olive testing orchard which showed mild symptoms of *Xf* infection. The sensing equipment consisted of a digital SLR camera, another digital SLR camera modified to capture BNDVI images and a multispectral camera capable of acquiring eight wavelengths in the region of 550 to 850 nm. The system was programmed to capture an image for each meter of the robot's advance. In addition, a 2D LiDAR scanner was used to obtain three-dimensional (3D) structural characteristics of the trees. Preliminary tests were carried out in which the robot captured images and data with all the sensors in different weather conditions (from intense sun to intense rain). The vehicle advanced in each row acquiring the images of the trees on one side and returning in the same row acquiring the images of the trees on the other side, thus obtaining information of the whole tree. These tests served to adjust all the developed software, electronics, and sensors, as well as to improve some key aspects of the robot in terms of battery life and ease of operation.

The robot worked properly during the tests in a field of relatively tall olive trees, being capable of continuously inspecting the whole field without interruptions while capturing valid data. The batteries lasted for more than six hours. During each survey, the robot captured around 35000 images (one every meter) with all cameras. The LiDAR information allowed the 3D reconstruction of the trees in an ulterior off-line process with a total execution time of 850 s for the entire field.