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Advance in a meteorological station, developed in educational environment, for agricultural and urban purposes

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Internet of Things (IoT) has revolutionized many fields in every-day life. It addresses many aspects related to data management, storage and connectivity.

The main objective of this project focuses on the application of IoT to a low-cost system to be used on land for monitoring plant life parameters (humidity, temperature, rain, solar radiation, etc.) in crop growing control, viticulture, pest prevention for olive groves, greenhouse automation and other applications in agriculture.

Additional applications are in urban environment (where major problems of extreme weather phenomena occur) and in the integration with existing trust networks for better characterization of weather phenomena on very limited space and time scales. Adaptation strategies must start from the knowledge and the availability of additional information.

In a previous project (EGU2018), an ArduinoUno-based control system board was utilized. The fully automatic equipment allowed transmission of real-time data using external esp8266 Wi-Fi.

In the new version, a LoLiN board, an Arduino board-compatible with integrated ESP8266 and RTC with a few Lua script lines, is used. The board allows a simplification of the design-and-development phase, and an overall reduction of costs.

The proposed system uses wireless sensors placed in open space and collects information stored on cloud server. The diffusion of a large number of sensors is possible through the use of low-cost sensors and technologies. The new target for this project is to develop a microcontroller system on Wi-Fi protocol based on ESP8266 connected in station mode for data collection, and on LoRa protocol for interconnection among multiple systems that cannot be connected with Wi-Fi.

The system has been fully developed in the University of Florence, and a high school under the supervision of teachers, involving potential stakeholders interested in the use of low-cost sensors in agriculture. Some traditional sensors, tipping bucket raingauges, magnetic reed devices anemometers, capacitive/resistive thermos-hygrometers, and an innovative impact piezo-element raingauge have been adapted in order to develop the meteorological station.

During the current year 2020, the LoRa protocol will be developed on the new system to interconnect multiple systems in the absence of Wi-Fi coverage.

Despite the low nominal cost of data collection, the current use for application in precision and smart agriculture, as well as in climate change monitoring and adaptation, could be possible only through a massive work of sensor calibration in order to reach the standards of the WMO. In any case, also in absence of absolute calibration the quantification of measurement uncertainties is mandatory to give value to the amateur network observations.

All these aspects are included in the presented project, an attempt to develop a low-cost weather monitoring system for educational purposes, but with lateral effects of awareness among students.