OPEN SOURCE HARDWARE APPLICATION IN HORTICULTURE

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Abstract

Reducing costs is a primary goal, in all companies, especially in the current economic situation. One widely used method today is to replace proprietary hardware and software with free or open source hardware and software. In this paper I refer primarily to the open source hardware's because this market worth $1billion by 2015.

Key words: greenhouse, open source hardware, OSHW, open source software.

INTRODUCTION

Open source hardware is hardware whose design is made publicly available, so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design. The hardware's source, the design from which it is made, is available in the preferred format for making modifications to it. Open source hardware uses readily-available components and materials, standard processes, open infrastructure, unrestricted content, and open-source design tools to maximize the ability of individuals to make and use hardware. Open source hardware gives people the freedom to control their technology while sharing knowledge and encouraging commerce through the open exchange of designs (http://www.oshwa.org/definition).

MATERIAL AND METHOD

The first stage consisted of searching on the Internet for open source hardware platform and software for this. If the software had an online version published, that version was tested. Otherwise, the program for each hardware was installed on a PC with Intel i5 processor, 12GB RAM and Windows 7 - 64 bit operating system.

To study the applicability of these platforms in horticulture, we considered a greenhouse with size of 20*50m. In order to keep parameters within permissible values, one need not employ personnel twenty four hours a day for constant monitoring but merely invest in an automated system which allows for great accuracy with little user input.

The main features of open source hardware platforms are presented in

Table 1

Characteristics of open source hardware platforms

Platform	**Arduino**		**Raspberry Pi**	**Beagle board**	**ARM Mbed**
Model	Edison	Galileo 2	B+	BeagleBone Black	LPC1768-Xplorer
Price (Euro)	75	60	36	55	38
Size (mm)	60*29*8	123.8*72	85*56*19.5	86.4*53.4	101*27
Processor	500MHz dual core Atom + 100MHz Quark MCU	400 MHz Quark SoC X1000	700MHz ARM 1176JZF - S	1 GHz Sitara XAM3359 AZCZ100 Cortex A8 ARM	96 MHz ARM Cortex - M3 Core
RAM (MB)	1024	256 DDR3	512	512 DDR3L	256
External storage	micro SD socket	SD socket, external USB drive	SD socket, external USB drive	micro SD socket	micro SD socket
Input voltage (V)	3.3 – 4.5	7 - 15	5.0	5.0	4.9 – 9
GPIO (pins) (General - purpose input / output)	70	20	27	26	70
PWM (pulse-width modulation)	6	6	2	8	6
GPU	No	No	Broadcom VideoCore IV	PowerVR SGX530	No
Dev. IDE	Arduino IDE	Arduino IDE	C#, Java	Cloud9 IDE	Web-based C/C++
Ethernet	No	10/100 Mb	10/100 Mb	100 Mb	10 Mb
USB port	1 (OTG)	2	4	2	1
Video out	No	No	HDMI	HDMI	No
Audio output	No	No	Yes	Via HDMI stereo	No
Bluetooth	Yes (2.1/4.0)	No	No	No	No

For effective monitoring of the greenhouse, we need 8 soil moisture sensors, 4 air humidity sensor, two CO_2 saturation sensors, 4 sensors ground temperature, 4 air temperature sensors and 4 cameras. Cameras aimed both security and observation greenhouse plants.

Initially, in this project, to compare fair hardware platforms, we considered that all sensors and cameras are wireless. All information will be uploaded to a computer located near the greenhouse, where are the relays for control for irrigation, ventilation and heating. On this computer connected to open source hardware will be the greenhouse web page. From this web application, the responsible for greenhouse, from remote will be able to track values and perform some settings and commands. This system

automatically must prevent dew condensation, which can promote diseases caused by fungus and bacteria, in greenhouse.

Connection between wireless sensor and open source hardware platform is achieved through physical connection (wire) of a ZigBee wireless network coordinator.

RESULTS AND DISCUSSIONS

Each platform has its advantages and disadvantages. Most platforms can be connected directly or indirectly with Zigbee wireless system, so being able to not only get readings of sensors but also can execute commands by means of actuators.

A greenhouse automated system can be invaluable to greenhouse operations. It cuts down on the number of personnel the facility needs to operate and gives more control over the growth conditions needed for specific cultures.

A minimum SWOT analysis of open source hardware identifies:

- Strengths: small price of acquisition compared with commercial systems, versatility and adaptability, easy and cheap maintenance;
- Weaknesses: not an easy task to install the system, medium engineering and electronics knowledge is needed to set-up and debug;
- Opportunities: easy to find on the market, the Internet of Things trend will lower prices and increase interoperability, low shipping and handling price;
- Threats: improper configuration or hidden fault can lead to erroneous data output.

Open source hardware price is only a small part of the investment needed to achieve full automation of the greenhouse project. However, I think that may be a good platform to educate students and farmers.

Open source hardware use is not limited to the embodiment shown, can be used in automation of various fields.

CONCLUSIONS

Use of open source hardware will have a fast growing market estimate for 2015 is $ 1 billion. Open source hardware buyers are not only amateurs but also governments, NASA and Google. They will be incorporated in many consumer products and alongside with embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others, all have contributions to enable the Internet of Things (IoT).

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