Development of a software interfacing unit to control an automatic machine for field applications using Raspberry pi OS

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Abstract

In this paper, we present a software interface for the robot that could be used for a host of field applications. The OS of Raspberry pi is being used for the work mentioned in the project undertaken and to implement it using the software. It is an Raspberry pi one & by implementing this method we can also reduce the man power required to look after the plants. The work done in this paper is the effect of the project work undertaken by the under-graduate students of the college under the guidance of the faculties, which is a part & parcel of the UG curriculum in the final year. Here, only a part of the work done (software part) is being presented in a nut-shell.

1. Introduction

Fruit picking robots, driverless tractor / sprayers, and sheep shearing robots are designed to replace human labor. In most cases, a lot of factors have to be considered (e.g., the size and color of the fruit to be picked) before the commencement of a task. Robots can be used for other horticultural tasks such as pruning, weeding, spraying and monitoring. Robots can also be used in livestock applications (livestock robotics) such as automatic milking, washing and castrating. Robots like these have many benefits for the agricultural industry, including a higher quality of fresh produce, lower production costs, and a decreased need for manual labor. They can also be used to automate manual tasks, such as weed or bracken spraying, where the use of tractors and other manned vehicles is too dangerous for the operators [1].

2. Software Development

In this section, the software interface & the software development for controlling the mobile robot that is used for the agricultural purpose is being presented in a nut-shell, whereas the hardware design is being the concept of another paper developed by the same group [2].

RASPBERRY PI OS - you've probably seen our compilation of awesome things you can build and use powered by a Raspberry Pi. Even if you may not be a fan (in which case here are alternatives), you can't ignore the possibilities that this small yet resourceful single-circuit board can do. But if you aren't interested in making your Pi power up a custom-build gadget for your home, you can just turn it into a lightweight yet still powerful general purpose computer. Here are 11 operating systems that you can load up onto your Raspberry Pi to get it started on a road to general purpose computing. These OS come with essential apps (and some pretty cool special features) that get things going upon boot up [3].

RASPBIAN - A free Debian-based OS optimized for Raspberry Pi's hardware, Raspbian comes with all the basic programs and utilities you expect from a general-purpose operating system. Supported officially by the Raspberry foundation, this OS is popular for its fast performance and its more than 35,000 packages. It uses the lightweight **LXDE**

desktop for its user-friendly graphical session. Its helpful community supports and develops free software for Raspbian, and you'll need a 8 GB SD card to load its latest version, Jessie [4].
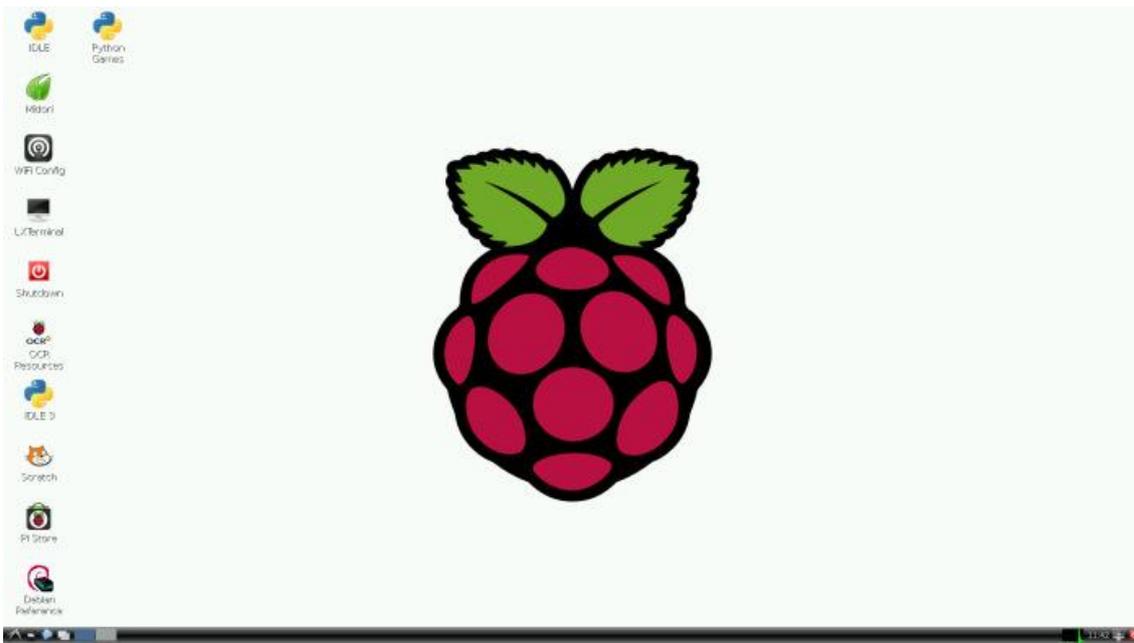

Fig. 2.1 : Raspberry pi window

3. ARDUINO IDE

The Arduino/Genuino Uno can be programmed with the (Arduino Software (IDE)).

Select Arduino/Genuino Uno from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials.

The ATmega328 on the Arduino/Genuino Uno comes preprogrammed with a bootloader that allows you to upload new code to it without the use of an external hardware programmer.

It communicates using the original STK500 protocol (reference, C header files).

You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar; see these instructions for details.

The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available in the Arduino repository. The ATmega16U2/8U2 is loaded with a DFU bootloader, which can be activated by:

- On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then rese ing the 8U2.

- On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.

- You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwriting the DFU bootloader). See this user-contributed tutorial for more information.

Power - The Arduino/Genuino Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector.

The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows ….

- Vin. The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

- 5V.This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.

- 3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

- GND. Ground pins.

- IOREF. This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

Memory - The ATmega328 has 32 KB (with 0.5 KB occupied by the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output - Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.

In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.

- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

- LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

- The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin. There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analog Reference.

- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

4. Description of the components with an introduction to Raspberry Pi-3

Raspberry Pi is an ARM based credit card sized SBC (Single Board Computer). Raspberry Pi runs Debian based GNU/Linux operating system Raspbian. The Broadcom BCM 2837 SoC (System on Chip) is used in it. System on chip

means a chip that holds all of the necessary hardware and electronic circuitry for a complete system. SoC includes on-chip memory (RAM and ROM), the microprocessor, peripheral interfaces, I/O logic control, data converters, and other components that comprise a complete computer system. The Fig. 4.1 represents the hardware configuration of Raspberry Pi 3 and component wise description is explained below [5].
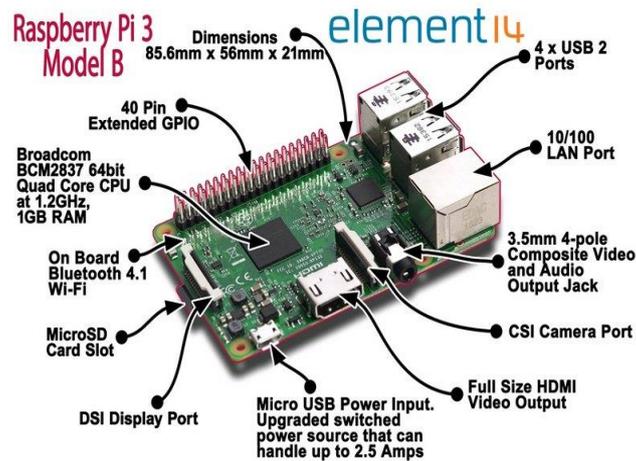

Fig. 4.1 : Raspberry Pi-3 Component Description

RAM

Raspberry Pi 3 has 1GB of RAM which has higher than the previous versions.

GPU:

The Graphical Processing Unit of Raspberry Pi 3 can operate at 250 MHz for video core 4, at 300 MHz for 3D part, 400 MHz for video part.

Networking:

The Raspberry Pi 3 is equipped with 2.4 GHz Wi-Fi 802.11n (150 M bit/s) and also had 10/100 Ethernet port.

Peripherals:

The Raspberry Pi contains 4 USB ports which are used to connect external devices like keyboard, mouse in order to work it as a generic computer. It may also contain USB storage, USB to MIDI converters, and virtually any other device/component with USB capabilities. Other peripherals can be attached through the various pins and connectors on the surface of the Raspberry Pi [6].

CSI Port:

The Raspberry Pi 3 has a Camera Serial Interface which facilitates the connection of a small camera to main board BCM2837 processor. This port provides electrical bus connection between two devices. The video inputs are given through CSI port [7].

HDMI Port:

High Definition Multimedia Interface is a proprietary audio/video interface for transferring uncompressed video data and compressed or uncompressed digital audio data from an HDMI-compliant source device, such as a display controller, to a compatible computer monitor, video projector and digital television. The video outputs are taken through HDMI port. The Fig. 4.2 shows the pin configuration of Raspberry Pi 3 that is used as the front end in the work considered [8].

Fig. 4.2 :   Pin Configuration of Raspberry Pi 3

I²S:

I²S also known as Inter-IC Sound, Integrated Interchip Sound, or IIS, is an electrical serial bus interface standard used for connecting digital audio devices together [9].

PIN CONFIGURATION:

Below shows pin configuration of Raspberry Pi 3. It contains 26 GPIO pins, 4 DC power supply pins out of which 2 are 3.3 V each and remaining 2 are 5 V each, 8 pins for ground and 2 pins for ID_SC. GPIO stands for General Purpose Input Output. These pins are used for purposes other than those specified above [10].

Power Supply:

The entire Raspberry Pi unit is powered via the microUSB connector. By using USB connector one can supply 700mA at +5 V dc.

Internet and Blue Tooth Connection:

The Raspberry Pi 3 contains onboard Wi-Fi and bluetooth module and 10/100 Ethernet port. The internet connection is established through Ethernet/LAN port or by Wi-Fi module.

PI CAMERA:

focus lens that is capable of capturing still images as well as high definition video. Stills are captured at a resolution of 2592 x 1944, while video is supported at 1080p at 30 FPS, 720p at 60 FPS and 640x480 at 60 or 90 FPS. The camera is supported in the latest version of Raspbian, Raspberry Pi's preferred operating system. Raspberry pi camera used is shown in the Fig. 4.3.

Fig. 4.3 : Raspberry pi camera

5. Photograph of the designed system

In the Fig. 5.1 shown, a photographic view of the system developed is being presented which is used for various types of agricultural applications [1]-[10].
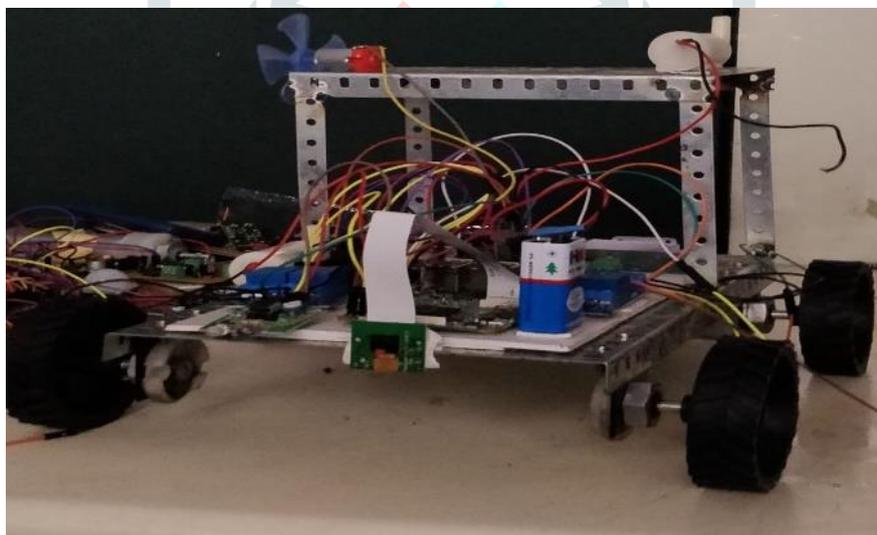

Fig. 5.1 : Photograph of the developed robot

5. Conclusions

The proposed system has been introduced for keep monitoring the plants and sprinkle water to them without any human interference. Since due to laziness and forgetting to sprinkle water, they die. This problem arises mainly in summer, because in summer the chances of plant withering is more. The above consists of camera which monitors and checks the plants condition through its color. If the plant color is not the green, it moves towards to the plant through the help of motors and sprinkle water through water pump. The above system is successfully implemented and tested. Here, only a jist of the work done is being presented in a nut-shell.

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