An approach for Universal Socket for Sensors

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Abstract
Science has always been a key part of the progressing world. Along with the coming changes in today's world many new technologies are flourishing that can be beneficial for the overall growth of the society .The following paper introduces the development and features of a multi-sensing low cost high performance socket interface that can be helpful towards the analysis of various kinds of sensors .
The above mentioned systems presents an intelligent single-chip socket system that can be used for the interfacing of various digital and analog sensors in order to obtain graphs to read and analyze their different characteristics and behavior .

Keywords – UISI;SPI;GPIO; GUI; HyperTerminal; SSH

1 INTRODUCTION

The proposal for a new low-cost system to read a generic transducer or a sensor and with multiple standardized wired interfaces to obtain the output characteristics plotted in a graph is introduced here. The system is called Universal Intelligent Sensor Interface. Specifically, the system can be considered universal only for analog sensors though an approach for it to work the same with others (digital sensors) has been visualized. It provides a flexible analog and/or digital front-end (including conditioning and conversion functions), able to interface different transducer typologies, while providing enhanced processing and storage capabilities and a configurable multi-standard output interface (including plug-and-play interface inspired to IEEE 1451.3 standard). A similar approach based on reconfigurable FPGA (Field Programmable Gate Array) and FPAA (Analog Array), compliant with IEEE 1451.4 standard, have been proposed as well.
Embedded system is a system that is designed for some specific purpose or to perform certain tasks. Some basic examples of embedded systems used in our daily life includes washing machine, wrist watches, chocolate vending machine, remote control etc. Raspberry Pi is compatible with some of the external devices such as mouse, keyboard and works normal on the windows platform. Allowing some key functions, it is quite user-friendly.
Raspberry Pi board being so cost effective performs work of a computer costing hundreds of dollars. For years work was done on Arduino boards but with the launch of the very cheap Raspberry Pi it all changed. The latest Model B+ was announced in July 2014. It works as a solid supplement for computers. The software offered with

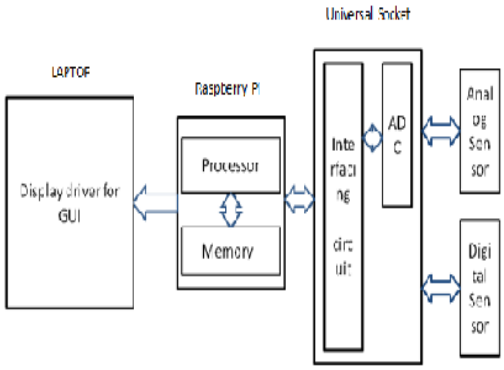


Fig.1 Block Diagram

2.BACKGROUND AND RELATED WORK To continue with our project, research was done on Raspberry Pi, understanding its current problems and identifying their solutions. Research papers on UISI, sensors, Raspberry Pi were studied and helped in finding out the current problems and issues with this device.

Current Problems which we came across included:

- Very Low Power
- No battery backup
- Interfacing issues with LCD and Camera

1. How to format the SD card and burn the latest RASPBIAN image file.
2. How to cross compile with Putty using SSH server and X11 terminal.
3.Installing SPI packages, support packages and running Python based codes in Linux platform.
4.Accessing GPIO as well as SPI pins of the Raspberry Pi.
5. How to interface MCP 3208 (ADC) with Raspberry Pi.
6. Creating GUI based applications having control from the laptop.
7. Creating graph using MATPLOTLIB.
8.Making applications using Python.
9.Creating GUI based applications which will have a control from device as well as laptop.
10. Connecting external hardware to device by enabling the ARM-11 board through kernel(root).
11.Controlling hardware of the device in the form of

various sensors, LED's, Motors, LCD etc.

12.Real time applications such as Concept of Universal Socket for Sensors.

By studying all research papers and current problems, it was understood that it is first necessary to study in detail about the accessing of Raspberry Pi to perform various operations .Though the purpose was also achieved through Matlab as well but we problem is there in accessing the ultrasonic sensor.

3 METHODOLOGY

This section is divided into two subsections: Section 3.1 and Section 3.2. Section 3.1 describes the creation of hardware and Section 3.2 describes the proposed algorithms and software used.

3.1 Creation of Hardware

First of all, creation of hardware was done and then connected to Raspberry Pi. MCP3208 (12-bit ADC) connects with SPI0_MISO, SPI0_MOSI, SPI0_SCLK, SPI0_CE0, GND, +3.3V. Through this ADC we can access various ADC sensors by connecting them through MCP3208 channels.

Digital sensors are accessed by the GPIO pins of the Raspberry Pi. Since, Raspberry Pi works on 3.3V so for the safety purpose register are used as per the requirement of the sensor.

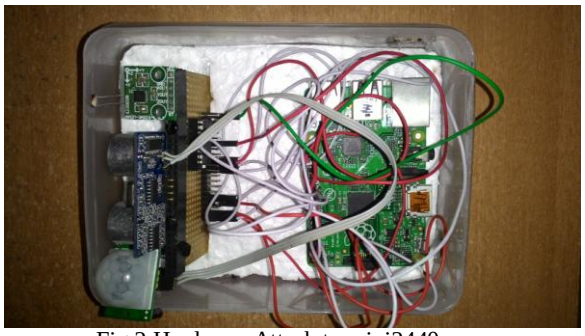


Fig.2 Hardware Attach to mini2440

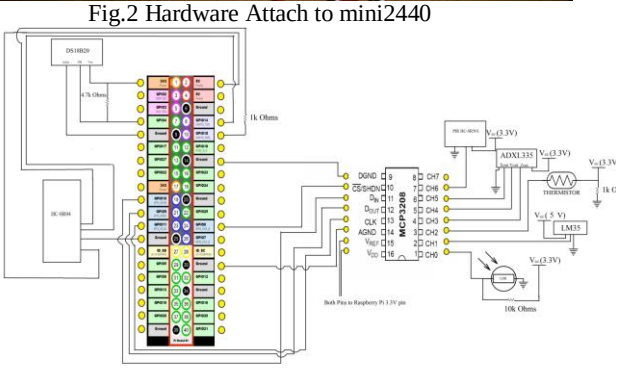


Fig.3 Circuit Diagram

3.2 Algorithms and Software Used

This section depicts the workflow of proposed approach and list all the software and algorithms used.

While working with software first we need to set the IP address to access the Raspberry Pi through the use of Putty. A 32- bit OS Laptop is needed for Raspberry Pi as this device works with 64bit OS only if each and every software is certified and licensed.

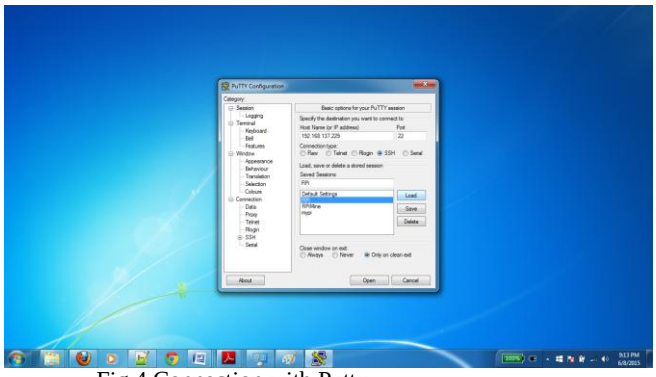


Fig.4 Connection with Putty

We needed:

- SD Formatter
- Win32 disk imager
- Putty
- Xming
- Lx Terminal
- IDLE(Python 2.7)
- Support packages for code execution

After successful deployment of Operating System into Raspberry Pi, these support packages are downloaded by typing these commands in LxTerminal.

After downloading the package we created a python code for each sensor and call each of them in a main script and executed it by tying this command in LxTerminal:

sudo python main.py

we run our application "Universal Socket for Sensor" using LxTerminal and Putty. After successful run of our application file, GUI appears on the device. This application enables users to get real time graph of output characteristics of the sensor in the laptop display as well as the web server.

Common errors during Application Deplyment:

1. Do not forget to enable SPI from the root. If it is lost at one corner then command cannot work in that corner.
2. Expand the memory of the SD card by root.
3. Enable the x11 terminal in Putty.

4 EXPERIMENTATION AND RESULTS

In this section, experimentation and results of this project are being discussed. This section is divided into three subsections: Section 4.1 to Section 4.3 as mentioned below.

4.1 *Installation of Support Package on Raspberry Pi*:

- Basic startup command for start:

sudo apt-get update
sudo apt-get upgrade
sudo reboot

- Python Dev package:
  sudo apt-get install python-dev

- For SPI installation package type these in terminal:

sudonano /etc/modprobe.d/raspi-blacklist.conf

This will open a text editor. You should see a line like this in this file:

spi-bcm2708

Put a # before this line to comment it out and save this.

sudo reboot

--- after reboot ---

lsmod

In the list *lsmod*outputs you should find the entry "*spi_bcm2708*" now.

Also you need the ***SpiDev Python module***. Open a new terminal and execute the following commands:

mkdir python-spi
cd python-spi
wget https://raw.github.com/doceme/py-spidev/master/setup.py
wget https://raw.github.com/doceme/py-spidev/master/spidev_module.c
sudo python setup.py install

Now the SPI will be available.

- The next is for plotting the various graphs. The following codes are to be run.
  - For installation of online graph plotting

sudo apt-get install python-dev
wget https://bitbucket.org/pypa/setuptools/raw/bootstrap/ez_s etup.py
sudo python
sudoeasy_install -U distribute
sudo apt-get install python-pip
sudo pip install rpi.gpio
sudo pip install plotly

  - For installation of offline graph plotting:

sudo apt-get install matplotlib

- Now to run the GUI we require the following packages:

For GUI

Sudo apt-get install tkinter
Sudo apt-get install Tkinter
Sudo apt-get install python-imaging

4.2 GUI Application building and running

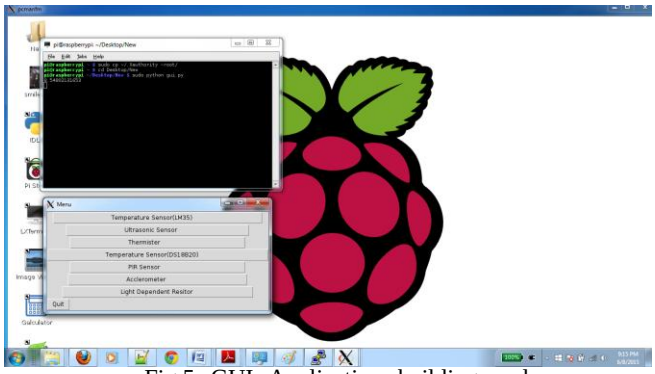
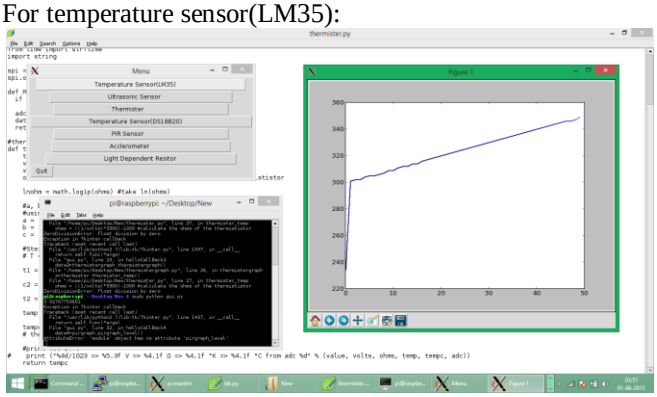


Fig.5 GUI Application building and running

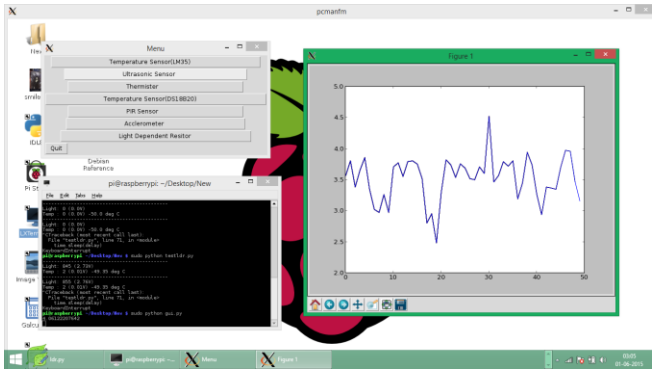
4.3 *Testing GUI Application*

We are getting appropriate graph for the particular as follow:

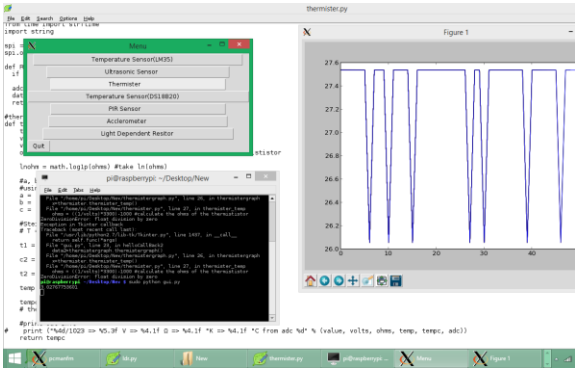
For temperature sensor(LM35):



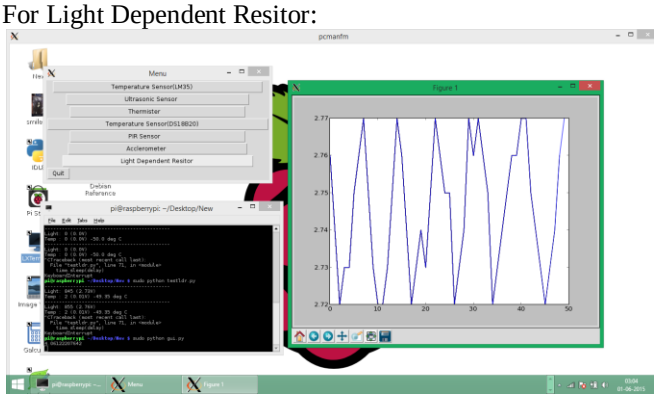
For Ultrasonic sensor:



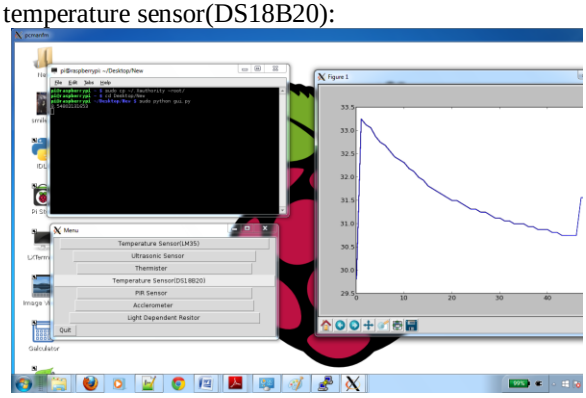
For thermister:



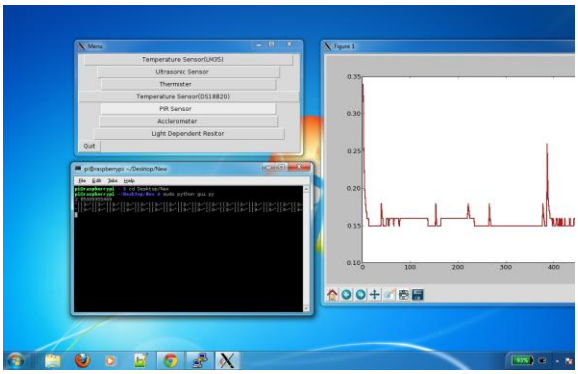
For Light Dependent Resitor:



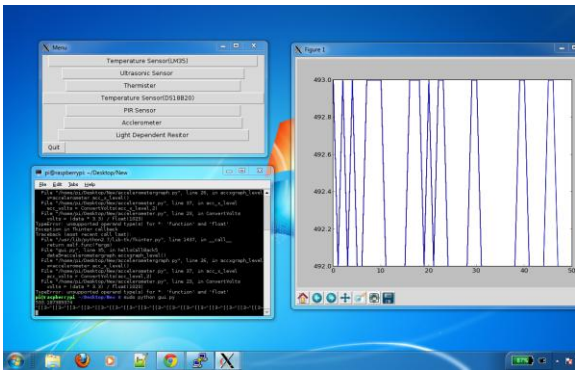
For temperature sensor(DS18B20):



For PIR sensor:



For Accelerometer:



V CONCLUSION

Whilst working on this project we have come across a new field of study as well as realized that the knowledge of sensor technology is not only new but rapidly evolving into a larger global field of study.

Our approach to this particular project was pragmatic hence we have come across a large number of practical errors while dealing with sensors. But on the same level we have totally surpassed the expected outcome of our project and wish to apply more effort into it, in making it an ultimate UNIVERSAL SOCKET FOR SENSORS. With the given time we could not go into further details of other sensors.

On the whole our project was rather very informative and we have given our continual effort till the end to make it a presentable and highly practical.

FUTURE PERSPECTIVE for this work can be as listed:

- While gaining a lot of information in the sensor field we also hope to work in making out project towards a better interface for a larger variety of sensors (analog or digital)

Further work can be done on the implementations of different other digital sensors by their thorough study and analysis.

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