**CONTENT ASSIGNMENT 1**

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**Date:**18-05-2020

1. **List and explain the different busses and interfaces that are available on the RPi’s general-purpose in-put/output (GPIO) header.**

**Ans:**

Let start by talking about the interfaces available on the RPi’s general-purpose in-put/output (GPIO) header. There are three different kind of interfaces on Raspberry Pi on GPIO pins. Two of them are Serial Peripheral Interface (SPI) and Inter-Integrated-Circuit bus (I2C) interfaces. While the third one is very common and that is UART serial port. we use this interface for a serial terminal application. The peripheral devices added to the microprocessor are through these interfaces also it includes sensors, EEPROMS and several type of display LCD’s. These interfaces are not enabled by default when you boot up your RPi and need some extra configuration when you want to us these interfaces.

The purpose of I2C bus is to exchange data between microcontrollers and peripheral by using less wiring as possible. The SPI bus also has same application as I2C bus. The serial peripheral interface (SPI) on the raspberry pi allow to connect with up to two attached devices while Inter-Integrated-Circuit bus (I2C) interface allow to connect as much devices as possible by keeping one thing in mind that the connecting addresses of the connected devices not conflict.

If there a case when the GPIO pins on the raspberry pi board are not enough you can turn on your I2C data bus to connect your pi with sensors, motors and other components. As we know, most of the user like to use the GPIO pins but in some cases or projects, GPIO pins not provide the desired function like in some analog input so in this type of situation I2C data bus can be used and it is more efficient. The I2C data bus is very simple and its professional and can be used for large projects as raspberry pi has two corresponding I2C data bus on the board. The I2C bus has feature of master-slave bus that enables the raspberry pi to communicate on the board devices (short distance communication). In I2C bus the transmission of data occurs synchronously between two bidirectional lines. (the serial clock line ‘SCL’ and serial data line ‘SDA’). The I2C bus has different modes of data transmission and the speed of data transmission is vary from mode to mode.

The Raspberry pi has one SPI bus with 2 chip selects that is available on header pins. While The microprocessor chip BCM2835 on the Raspberry Pi has 3 SPI Controllers in which only SPI0 is available on header pins. Like I2C data bus, the SPI bus of the raspberry pi also has different operating modes. i.e. standard mode, bidirectional mode, low speed serial interface board etc. Also, some transfer modes are also available i.e. polled, interrupt, DMA etc. The speed of the SPI clock is set by (CDIV clock divider) field of the CLK register. The SPI bus supports 8-bit per word and 9-bit is supported when you are using low speed serial interface board. Transfer mode in SPI interface supports only interrupt mode.

The system on chip of the raspberry pi has two built-in UART’S. one is PL011 and other is mini UART. These are implements using different hardware blocks so these characteristics are slightly different from each other. As these both UART’s are 3.3V deices so you must care when you are connecting other devices with your raspberry pi using UART interface because same potential is necessary otherwise it will damage the board.so if the devices are on different level of voltages , a voltage converter must be used to make these devices at the same voltages level.

The raspberry pi board has built-in Bluetooth module and Wi-Fi module so the PL011 UART is connected with the Bluetooth module by default while the mini UART is connected with the Linux console. By default, the UART can transmit and receive data by using the GPIO pins 14 & 15 which are pin 8&10 if we see on GPIO pins header.

There are some major differences between these to used UART’s on the raspberry pi board. The mini UART has small FIFOs and it has lack of flow of control, which makes it to lose characters while high baud rate communication. Mini UART is less capable than PL011 due to its baud rate speed with VPU clock speed.